

E-Tender on Design, Engineering, Procurement and Construction (EPC) basis for
Proposed Building for BO-I and CAB at Berhampur, Odisha

**TECHNICAL SPECIFICATIONS
FOR CIVIL WORK**

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TECHNICAL SPECIFICATIONS

SECTION I GENERAL REQUIREMENTS

GENERAL

1.1 Information

This section sets out the general requirements for carrying out the Architectural and Finishes works for the project and shall be read in conjunction with all relevant work sections and other documents.

The Specification shall be read in conjunction with the other documents, which together shall form the contract specifications. Notwithstanding the subdivision of the specification under different headings, every part of it shall be deemed supplementary to and complementary to the other part.

All materials and workmanship shall be in accordance with the latest relevant Indian Codes and standards. Except that where the said standards are in conflict with the specifications, the standards take precedence.

The standard specification set out the basic quality of material and workmanship required from the contractor. Any statements pertaining to the sequence and the procedures for the construction of the works herein specified shall be regarded only as a guide to the contractor.

It shall be contractual duty and responsibility of the contractor to have his own done in-depth studies by his consultants for proper details, procedure, mode of execution, use of relevant type, form and size of machineries for the works, form and extent of temporary works requirement and providing the works as specified in or necessarily to be inferred from the documents and drawings forming this contract.

The Contractor shall perform the contract works in proper manner and with due competency for the satisfactory completion of the same.

1.2 Codes, Regulations, Standards and Technical References

A. Regulations

The whole of the Works and materials are to be in accordance with the Building Control Regulations, other regulations as set out by the authorities having jurisdiction over the works, and the relevant bylaws unless otherwise stated. Ensure that the requirements in the Specification are strictly adhered to when carrying out the Works, unless otherwise directed.

B. Standards and Codes of Practices

Unless otherwise agreed by the Employer's Representative, ensure all of the Works comply with the relevant requirements of the Standards and Codes referenced in the body of the Specification. Alternative Standards and Codes may be proposed for approval by the Employer's Representative, provided it can be demonstrated that the alternative Standards and Codes comply with the requirements of the standards specified. All Standards and Codes quoted are the current version, unless specific year references are noted.

C. Technical Reference

Where specified, be guided by the principles and methods as set out in the technical reference when carrying out the works. Alternative methods and principles may be proposed in lieu of the referenced document, subject to acceptance by the Employer's Representative, if it can be demonstrated that the specified quality or performance of the works can be achieved.

1.3 Work Preambles

A. Ambiguity

Before commencing any works, obtain clarification or instructions in relation to any discrepancy or ambiguity, which is discovered within and between the Specification Work sections, and one or other contract documents issued by the various parties.

B. Approved Sub-contractors

All sub-contractors for the works are subject to the acceptance of the Employer's Representative. At the time of tender and before the commencement of work, submit the list of subcontractors intended to be engaged for the works. Submit with the list, details such as the relevant track records of the firms, the qualification of the personnel and details of equipment to be engaged for the works.

C. Licences, Permits and Liaison with the Authorities

Be responsible to initiate the application for all necessary licences, permits, etc and to carry out all necessary liaison with the Government Departments and Statutory Boards, etc whenever necessary, for the satisfactory completion of the Works. Be responsible for ensuring that these licences and permits are obtained in good time

D. Safety Regulations and Temporary Works

Strictly observe all necessary safety requirements and legislation to fully comply with the provisions of the Workplace Safety and Health Regulations and/or any other requirements from the authorities having jurisdiction over the works.

E. Safeguarding Properties Adjacent to Site

Propose and adopt site procedures and methods of working such as to limit to a minimum any disturbance and vibration to the buildings around the Site. Identify and implement protective measures necessary to safeguard the adjacent properties prior to carrying out the works.

Indemnify the Employer in accordance with contract conditions against all claims for loss and/or damage to the adjoining properties by reason of the carrying out of the works or by reason of insufficiency of precautionary measures.

F. Site Supervision

Provide personnel with adequate and relevant experience to Employer's Representative's acceptance, to supervise the Work. Submit the CV of the supervisor(s) to the Employer's Representative where directed.

G. Coordination of Works

Ensure that all units, components or assemblies whether from one or different sources, are available in time for incorporation into the Works.

H. Maintenance Manual

Develop and submit for Employer's Representative's acceptance, a strategy in the form of a maintenance manual and logbook, to ensure that elements that are likely to deteriorate significantly can be replaced or rectified.

PART 2 PERFORMANCE REQUIREMENTS

2.1 General Requirement

Engage methods and resources that will ensure the works achieve the specified quality within the agreed programme and cost.

2.2 Environment

Ensure the carrying out of the works will not cause un-acceptable pollution, noise, erosion and vibrations to the environment as stipulated by the tender and other relevant authorities.

PART 3 MATERIALS

3.1 MATERIALS GENERALLY

Products are to be new unless otherwise specified. All materials are to be supplied clean, undamaged and in good condition ready to be used for the Works. For products with a limited shelf life, ensure no parts or whole are expired. Where a choice of manufacturer or source is allowed for any particular product, supply the whole quantity required as the same type and from the same manufacture and/or source unless otherwise approved. Produce written evidence of sources of supply when requested. Ensure that the whole quantity of each product supplied is of consistent kind, size, quality and overall appearance.

Ancillary products and accessories are to be of a type recommended by the main product manufacturer, unless otherwise specified.

Unless otherwise described, all materials shall be new and in accordance with the latest Indian Standards and the Contractor shall produce all necessary Certificates to substantiate this fact if so required by the Employer's Representative. Unless otherwise described, the description of each item of measured works shall include for supplying and delivering of all materials, unloading, sorting, selecting, storing, carriage and cartage, cutting and all waste on materials, hoisting, all labour setting, fitting and fixing in position, covering up and

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protecting finished work, clearing away all debris and waste, return of packing, carriage paid, use of plant and equipment, supervision, establishment and overhead charges, profit and all other labour and materials necessary for the due and proper execution of each item.

Use of environmentally friendly products and materials that are certified by approved local certification body and are applicable to non-structural and architectural related building components should be adopted where appropriate or required by this Specification.

3.2 ORDERING OF MATERIALS

Unless otherwise directed, do not place orders for materials before the sources and samples of the materials have been approved and the results of any preliminary tests required by the Specification have been accepted.

3.3 CERTIFICATES FOR MATERIALS

All materials and products are to be manufactured and tested in accordance with the appropriate Standard or as specified. All materials and products delivered to the site are to bear the manufacturer's name, brand name or any other data required to verify compliance with the specified requirements. Where appropriate, provide certificates from the supplier or test agencies verifying such compliance. Include, whenever applicable, the location in the Works or the delivery or batch which the certificate represents.

Where certificates of manufacture or tests are not available for materials proposed for use in the Works, carry out independent testing to determine compliance with the specified requirements where directed by the Employer's Representative.

Where applicable or whenever requested by the Employer's Representative, the Contractor shall submit test certificates of materials to be used in the Works certifying that the materials in question comply in all respects with the Specification. The Contractor shall obtain the said certificates either from the materials manufacturers or from an approved testing laboratory. All costs incurred in obtaining the certificates shall be borne by the Contractor.

3.4 Storage of Materials

Store all materials in a manner, which is not detrimental to their use in the Works and in accordance with any specified requirements.

Ensure that the storage facilities and the loadings resulting from the storage will not adversely affect the construction, the building and other buildings/amenities nearby. Engage specialist advise if appropriate.

Do not permit the storage of materials, components or equipment on new or partially completed work without prior approval.

3.5 Rejected Materials

Immediately remove from the site, all materials which are unidentified or do not meet the requirement of the specification.

PART 4 WORKMANSHIP

4.1 WORKMANSHIP GENERALLY

Ensure that all works are carried out:

- i. In accordance with the specified methods and procedures where applicable;
- ii. In accordance with good building practice;
- iii. In accordance with the manufacturers' instructions where applicable
- iv. By suitably qualified and experienced personnel.

4.2 SETTING OUT AND LEVELS

The Contractor shall appoint a licensed land surveyor to check and to confirm the existing levels, location of the existing drains and sewer inverts, existing underground services, alignment and levels of existing roads, etc. before commencing any work. The Contractor shall be deemed to have taken into account the time and cost to carry out the said works in this tender.

4.3 DELIVERY, STORAGE AND HANDLING

Deliver materials and products to the site with labels showing brand name, product name and manufacturers batch number.

Store materials in accordance with the manufacturer's recommendations. Use in order of delivery and before expiration of the shelf life date.

4.4 PROTECTION OF PRODUCTS AND COMPONENTS

Take measures to prevent over-stressing, distortion and other damage to the products. Keep products and components clean and free from contamination. Prevent staining, chipping, scratching or other disfigurement, particularly of products exposed to view in the finished work.

Keep dry to prevent premature setting, moisture movement and similar defects. Where appropriate store off the ground and allow free air movement between stored products

Prevent excessively high or low temperatures and rapid changes of temperature in the products.

Protect adequately from rain, damp, sun and other elements as appropriate. Ensure that products are at a suitable temperature and moisture content at time of use.

Ensure that sheds and covers are of ample size, in good weatherproof condition and well secured.

Keep different types and grades of products separately and adequately identified.

Keep products in their original wrappings, packings or containers until immediately before they are used. Wherever possible, retain protective wrappings after fixing until shortly before handing over to the owners.

Ensure that protective measures are fully compatible with and not prejudicial to the products and materials.

No measurements will be done since it is EPC contract.

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SECTION II MASONRY WORK

AAC Block walls (thickness as required / shown on drawings) shall be used at all places for this project except for locations where block / brick wall is necessary. The AAC Block wall shall be constructed as per the IS Specifications with Block laying adhesive and RCC bands at horizontal levels 1000 mm c/c and vertically at every 3000 mm c/c and / or at ends/ opening sides & top.

A. BRICK WORK

1. INDIAN STANDARDS

Indian Standards to be followed are:

All relevant standards as specified elsewhere in this volume are applicable.

- i. IS 226 Specification for Structural steel standard quality
- ii. IS 1077 Specification for common burnt clay building bricks
- iii. IS 2116 Specification for sand for masonry mortars
- iv. IS 2212 Code of practice for brickwork
- v. IS 2250 Code of practice for preparation and use of masonry mortars.
- vi. IS 8112 Specification for 43 grade OPC
- vii. IS 12269 Specification for 53 grade OPC
- viii. SP 27 Handbook of method of measurement for building works.

Brick work shall be adequately stiffened in the horizontal & vertical directions with concrete bands based on the specific situation of the wall, i.e., external, internal, height, length, thickness, type, lateral supports, mortar mix etc., based on Masonry Design codes & National Building code Part VI Section 4 by the Contractor.

2. MATERIALS

2.1 Bricks

2.1.1.1 Table Moulded Bricks : Bricks shall be sound, hard, well-burnt, uniform in size, shape and colour, homogeneous in texture, giving a metallic ringing sound, free from flaws, cracks, holes, lumps or grit and arises should be square, straight and sharply defined. They shall not break when struck against each other and dropped flat from a height of 1 m to the ground. They shall conform to designation 7.5 or higher of Table-1 of IS 1077 giving classes of common burnt clay bricks.

2.1.1.2 Fly ash Bricks : Bricks shall be sound, hard, well-burnt, uniform in size, shape and colour, homogeneous in texture, giving a metallic ringing sound, free from flaws, cracks, holes, lumps or grit and arises should be square, straight and sharply defined. They shall not break when struck against each other and

dropped flat from a height of 1 m to the ground. They shall conform to designation 7.5 or higher of Table-1 of IS 13757 giving classes of Fly ash Bricks

2.1.2 Bricks shall have to be approved prior to procurement. Bricks shall be obtained from an approved source and shall be of uniform colour, size, and shape. Bricks shall have smooth rectangular faces with sharp straight right angle edges. Maximum absorption shall not be more than 15% of its dry weight on immersion in water for 24 hours. Minimum crushing strength shall be 35 kg/sq cm if not specified in the drawings.

2.1.3 Bricks of approved quality and quantity shall have to be procured by the contractor at the desired time. No delay or extra cost due to non-availability shall be accepted. The contractor is obliged to carry out the work as specified. It shall be the responsibility of the contractor to procure sufficient quantities of bricks and stack them at site or elsewhere to avoid delays.

2.1.4 AAC Blocks: These Blocks shall be machine moulded and prepared in plant by appropriate propositions as manufacturer's specification. The AAC Blocks shall confirm to IS Standards. Visually the blocks shall be sound, uniform size, free from visible cracks, warpage and organic matters. The Blocks shall be solid with / without frogs and shall be confirming to IS specification.

2.2 Mortars

2.2.1 Mortars for masonry shall be prepared in accordance with IS 2250 code of practice for preparation and use of masonry mortars.

2.2.2 Cement

Cement used shall be ordinary Portland cement conforming to IS and shall be of grade 53 or 43. PSC (Portland Slag Cement) and PPC (Portland Pozzolona Cement) may be used in non structural works.

2.2.3 Water

Water used for masonry shall be clean and free from injurious amounts of deleterious materials.

2.2.4 Fine aggregate (sand)

2.2.4.1.1 Natural sand deposited by stream or glacial agencies as a result of disintegration of rock is the best form of fine aggregate. The fine aggregate shall conform to following standards.

- i. For plain and reinforced concrete IS 383 Specification for coarse and fine aggregates from natural sources for concrete.
- ii. Mortar and grout IS 2116 Specification for sand for masonry mortars.

2.2.4.1.2 Sea sand should not be used unless approved by the Employer Representative. If approved, the required treatment shall be done as per the instructions of the LIC of India

2.2.4.2 Sand shall be hard, durable, clean and free from adherent coatings and organic matter and shall not contain any appreciable amount of clay. Sand shall not contain harmful impurities such as iron, pyrites, coal particles, lignite, mica shale or similar laminated material, alkali, and organic impurities in such form or quantities as to affect the strength or durability of concrete or mortar. Also it should not contain any material liable to attack the steel reinforcement.

2.2.4.2.1 When tested as per IS 2386 Part I and Part II, fine aggregate shall not exceed permissible quantities of deleterious materials as given in table 1 of IS 383.

2.2.4.2.2 Fine aggregate shall be thoroughly washed at site with clean fresh water such that the percentage of all deleterious material is within the permissible limits laid down.

2.3 Metal reinforcement

Metal reinforcement used in brick masonry shall conform to the following Indian Standard Specifications.

- IS 226 Specification for steel standard quality
- IS 412 Specification for Expanded metal steel sheets for general purpose
- IS 432 Specification for Mild steel and medium tensile steel bars
- IS 1566 Specification for Steel fabric or hard drawn steel wire

3. MORTAR

3.1 Mortar shall be prepared by mixing fine graded aggregate with cement in the proportion specified for respective items of work as shown in the drawings. Mortar mixes shall generally be 1:6 for 230mm width & above, & 1:4 for 150mm width. Mixing of mortar shall be done by mechanical mixers only. Hand mixing may be permitted in specified cases on the written permission of the LIC OF INDIA

3.2 Mortars shall be specified by proportion. Volumetric mixing shall be based on dry volumes of each ingredient. For convenience, measurement shall correspond to volume of one cement bag i.e. 0.035 cu m. Boxes shall be of size 40 X 35 X 25 cm. These shall be marked as mortar mixing boxes by red paint and shall be used throughout the contract. Hand mixing or mechanical mixing proportions shall be done with the use of these boxes.

3.3 Cement mortar shall be prepared by mixing cement and sand in specified proportions. Proportioning shall be carried out as detailed above. Sand shall be added suitably to allow for bulkage if required. Bulkage shall be determined as specified in IS 2386 Part III. Cement and sand added to mixer shall be thoroughly

mixed and water shall be added to it gradually. After addition of water the mixer shall run for a minimum of 3 minutes. The mortar mixed shall be consumed within 30 minutes of its mixing.

4. WORKMANSHIP

- 4.1 Bricks used for masonry in cement mortar shall be soaked by immersing in water or by hosing of water (so as to prevent bubbling.) at least one hour prior to start of actual laying.
- 4.2 Bricks shall be laid in English bond unless otherwise specified. Half or cut bricks shall be used only for the purpose of bond and at no other place.
- 4.3 Work shall be true to horizontal lines and perfect plumb. Vertical joints shall be truly vertical and those in alternate courses shall be in the same vertical line. Joints of each course shall be within the limit of 6 mm to 10 mm depending upon the size of bricks. Total height of 9 cm brick with 5 courses and 5 mortar joints shall be 50 cm. In no case shall joint thickness of horizontal and vertical be more than stated above. Joints should be filled to full depth and checked each time. Prior to start of work it must be noted and checked that bricks on top are full-size bricks (flat or brick on edge). To achieve this, precautions should be taken from the start of the first layer. Thickness of joints shall be so adjusted so as to have full bricks on top. Also it must be noted and checked that all horizontal joints on, every floor are at the same level, so as to allow proper bonding at junctions. Required datum levels must be established throughout the floor and only then should work start.

It is equally important to take into account levels of windowsills, lintels, etc. While finalizing courses and joint thickness. In normal practice architects do take care of these while finalising levels, but it is difficult to expect the ideal situation at all places. In such situations, the decision of the LIC OF INDIA shall be taken such as providing brick on edge, concrete sills, etc.

In addition, for convenience and speed, gauge boards of exact width shall be fixed at the edges of masonry to correct line and plumb. These boards shall be marked with course levels to achieve exact height of each course and full bricks at the top.

- 4.4 One or half brick thick wall shall have minimum one face in true plumb.
- 4.5 It is imperative to raise the brick work uniformly over complete Work joined together. If this is not possible, raked brickwork shall be done at 45 degrees to the vertical. Toothing shall not be accepted.
- 4.6 All iron fixtures, pipe outlets, hold-fasts for doors and windows shall be fixed when the brick work is in progress. It must be embedded in cement mortar or concrete as specified or as directed by the LIC OF INDIA Required treatment to fixtures shall be carried out prior to embedding.
- 4.7 To achieve better results and proper working, the following tools should be available with masons working at site:

- Spirit level
- Wooden/Aluminium straight edge 3 m long
- metre steel tape
- Right angle 1/2 metre long
- Line and pin strings
- Plumb
- Storey rods

4.8 Joint thicknesses shall be provided as discussed above. Joints shall be filled to full depth before second course is laid. Frogs shall be upward at all times. Joints shall be raked back to a minimum 10 to 15 mm while the mortar is green. Surface of brick work shall be cleaned with coir string, wire brushes, etc. to keep the surface free for the next operation. All dropped and spoiled mortar, brickbats, etc. shall be cleared from the floor before work is closed for the day.

4.9 Protection and curing

Green work shall be protected from rains by suitable covering. Masonry in cement mortar shall be kept constantly moist on all the faces for a minimum period of ten days. The top of masonry shall be left flooded with water at close of the day.

4.10 Scaffolding

Scaffolding independent of brickwork i.e., double scaffolding shall be provided. It should be tied to brick work or structure at suitable intervals in both directions. Two rows of planks shall be provided all around. Planks shall be at least 50 mm thick and well-tied to scaffolding. Railing to the outside face shall be provided. While erecting scaffolding, the following points must be noted and closely followed:

- i. Minimum number of holes in the horizontal direction. Holes shall be formed by omitting header brick.
- ii. No holes in pillars under 1 metre in width.
- iii. No holes near the skew backs of arches.
- iv. Scaffolding must be sound and strong and easy to maintain.
- v. Holes left must be closed while finishing the plaster.

5. TYPES OF BRICK WORK

5.1 Walls 230 mm thick or more

- 5.1.1 Walls of 230 mm thickness or more shall be constructed with approved and selected bricks. Mortar shall be as specified above & in CM 1:6. Points discussed above shall be followed for workmanship.

Brick wall of 230mm thickness shall be constructed from one side and one face shall be true and plumb. Thicker walls shall be constructed with masons on both faces and both the faces shall be true and plumb.

5.2 Half brick work - plain or reinforced

5.2.1 115mm brickwork shall be called as half brick work. It shall be built by laying bricks in stretcher bond. Mortar shall in CM 1:4.

5.2.2 These walls may be used for forming cavities or partition walls inside buildings. Brickwork shall be reinforced with either of following methods:

- i. With 8 mm dia bars, 2 bars at every third layer.
- ii. GI metal lath / GI hoop iron 25 mm X 1.6 mm shall be used at every third layer as detailed by layer as detailed by the manufacturer.
- iii. Bands/ Beams of 100 x 150 mm high in M20 grade concrete shall be casted. Beam shall be reinforced with 2 nos. of 8 mm dia Tor bars and 6mm dia M.S. links at 300mm C/C. Bands/ beams shall be at every 1000 mm interval in height.

Embedding of reinforcement shall be done very carefully. All precautions shall be taken so that edges are not exposed. Lapping of bars and lath shall be proper and staggered.

6. WORKS DEEMED INCLUDED

6.1 The works shall include for all the materials and labour as described in their respective items of work and for all the operations as detailed in the respective specifications for the various items of work. Brick on edge courses, cut brick corners, splays, reveals, cavity walls, shall be included in BRICK WORK.

6.2 The following operations shall be included in the work -:

- a. Raking out joints for plastering or for pointing done as a separate process or for finishing joints flush as work proceeds;
- b. Preparing tops and sides of existing walls and the like for raising;
- c. Rough cutting and waste for forming gables, cores of arches, splays at caves and the likes and all rough cutting in the body of brick- work, unless otherwise stated;
- d. Plumbing to angles and battered surfaces;
- e. Forming reveals to jambs where fair cutting on exposed faces is not involved;
- f. Leaving holes for pipes, etc.;
- g. Building-in holdfasts, air bricks, fixing bricks, etc.;
- h. Building-in ends of beams, joists, slabs, lintels, sills, trusses, etc.;
- i. Forming openings and flues for which no deduction is made;

- j. Bedding wall plates, lintels, sills, roof tiles, corrugated sheets, etc., in or on walls, if not covered in their respective trade.
- k. Leaving chases of section not exceeding 50 cm in girth.

B. BLOCK WORK

1.1 GENERAL & STANDARDS

Concrete blocks (solid) shall completely conform to IS: 2185. Blocks shall be regular in size and shape and shall have a minimum compressive strength of 35Kg/Sqcm. Blocks shall be regular in size and shape and shall be of specified strength. Blocks shall be properly cured before they are brought to site. Half or three quarter size blocks are to be used wherever required to make up length of wall and broken blocks shall not be used. The texture of the blocks shall be such that plaster will adhere to it. They shall be sound, free from cracks, honeycombing, broken edges and other flaws. They shall have plane rectangular faces with parallel sides and sharp straight angled edges. They shall have a fine, compact, uniform texture and thoroughly dried. The contractor shall supply samples for approval. Blocks supplied shall conform to approved Samples.

Block work shall be reinforced with the following methods:

200/ 150mm Block work

- i. Drilling the column & fixing 50x4mm flat, 200mm long bent to shape with anchor bolts at every fifth course.
- ii. Plaster mesh shall be placed & tied in position between masonry & MS flat at every fifth layer as detailed by the manufacturer.

100mm Block work

- i. Drilling the column & fixing 50x4mm flat, 200mm long bent to shape with anchor bolts at every fifth course.
- ii. Plaster mesh shall be placed & tied in position between masonry & MS flat at every fifth layer as detailed by the manufacturer.
- iii. Concrete band 75mm thick with reinforcement longitudinal bars 2 nos 8 Tor & transverse reinforcement 8 Tor @ 200mm c/c at every fifth course.

Embedding of reinforcement shall be done very carefully. All precautions shall be taken so that edges are not exposed. Lapping of bars and lath shall be proper and staggered. Block work shall be adequately stiffened in the horizontal & vertical directions with concrete bands based on the specific situation of the wall, i.e., external, internal, height, length, thickness, type, lateral supports, mortar mix etc., based on Masonry Design codes & National Building code Part VI Section 4 by the Contractor.

1.2 DIMENSIONS

The size of hollow and solid blocks shall be as specified in the drawings. The maximum variation in dimensions shall not be more than +1.5mm in ht. and breadth and +/- 3mm in length. The blocks shall be 400 x 200 x 200mm, 400 x 200 x 150mm or 400 x 200 x 100mm as called for.

1.3 HANDLING AND STORAGE

The contractor is responsible for transporting concrete blocks in such a manner that the units are adequately protected during transportation. The units shall be handled in a manner, which will prevent soiling, chipping or damage of any kind. Broken, chipped or otherwise damaged units will be rejected and shall not be used in the work. The blocks shall be stored in neat piles free from contact with ground, which shall be located to avoid being disturbed or damage by construction activities.

1.4 SAMPLING

At least 3 blocks from a lot manufactured in a day or from 1000 blocks whichever is less, shall be tested for dimension and breaking strength. In case the test result is not up to the standards specified in IS:2185 the entire lot shall be liable for rejection. If solid concrete blocks are used in foundation, plinth or basement wall, the hollows must be filled up with cement concrete 1:3:6. In damp soils, the foundation and basement masonry shall be laid in richer mortar as directed by the engineer-in-charge. In addition, a damp proof course consisting of a 25mm layer of cement mortar 1:2 as an approved type of bituminous course shall be provided.

1.5 MORTAR

Cement mortar used for jointing and laying of blocks for hollow block masonry shall be as specified in the item of work or as directed by the engineer-in-charge.

1.6 PREPARATORY WORK

Wetting of blocks

The blocks need not be wetted before or during laying in the walls. In case the climatic conditions so require, the top and the sides of the blocks may only be slightly moistened so as to prevent absorption of water from the mortar and ensure the required bond with the mortar.

1.7 LAYING CONCRETE BLOCK MASONRY

Each block shall be set with bedding joints and vertical joints filled thoroughly. The wall shall be taken up truly plumb. All courses shall be laid truly horizontal and vertical joints truly vertical. Vertical joints in alternate courses shall come directly over the other. Thickness of the block courses shall be kept uniform.

Necessary tools comprising of wooden straight edge, mason's spirit level, square, foot rule, plumb line and pins etc. shall be frequently and fully used by the masons to ensure that the walls are taken up true to plumb line and levels. Both the faces of walls of thickness greater than 20 cm shall be kept in proper plans. All the connecting block masonry work shall be carried out at nearly one level and no portion of work shall be raised more than 1m above the rest of work. Any dislodged block shall be removed and reset in fresh mortar.

The construction of walls may be started either at the corners first, or started from one end and proceeding in the other direction. If the corners of the walls are built first, they shall be built four or five courses higher than the centre of the walls. As each course is pre-laid at the corner, it shall be checked for alignment, level and for being plumb to ensure truly straight and vertical walls. Each course in building be stepped back by half block and the horizontal spacing of the block shall be checked by placing a mason's level diagonally across the corners of the block, the mason's line shall be stretched from corner to corner for each course and the top outside edge of each block shall be laid to this line. Handling or gripping the block shall be such as to position the block properly with minimum adjustment. Mortar shall not be spread too far ahead of actual laying of the block that it tends to stiffen and lose its plasticity.

1.8 CLOSURE BLOCK

When installing the closure block, all edges of the opening and all four vertical edges of the closure block shall be buttered with mortar the closure block shall be carefully lowered into place. If any of the mortar falls out leaving an open joint the closure block shall be removed, fresh mortar applied and the operation.

1.9 JOINTS

Horizontal (bedding) joints

Mortar shall be spread over the entire top surface of the block including front and rear shall as well as the webs to a uniform layer of 10mm thickness. When filling in the wall between the corners Vertical (cross) joints for vertical joints, mortar shall be applied on the vertical edges of the front and rear shall of the blocks. The mortar shall be applied on the edges of the succeeding unit when it is standing vertically and then placing it horizontally well pressed against the previously laid unit so as to provide well compacted vertical joints. In the case of two cell blocks, depression on either vertical side shall also be filled with mortar.

The thickness of both horizontal and vertical joint shall be not more than 10mm. All face shall be raked to a minimum depth of 10mm by raking tool except in the case of extruded joint construction as is laid when the mortar is still green so as to provide proper key to plaster or pointing to be done. Where pointing or plastering is not required to be done, the joints shall

be struck flush and finish at the time of laying. The face of concrete block masonry shall be kept cleaned and all mortar droppings removed promptly.

Provision for doors and windows frames. A 10cm thick precast concrete sill-block shall be provided under doors and window openings (or as per drawing). The block shall extend for at least 20cm beyond the opening on either side. For jambs of doors and windows, either solid concrete blocks shall be provided or if hollow units are used, the hollows shall be filled with cement concrete 1:2:4.

All block work shall be plumb, square and properly bonded. The joints shall be broken. The thickness of the courses shall be uniform with courses horizontal. All connected work shall be carried out at nearly one level and no portion of the work shall be left more than one course lower than the adjacent work.

Blocks shall be so laid that all joints are well filled with mortar. The thickness of joints shall not be less than 6mm and not more than 8mm. The face joints shall be raked to a minimum depth of 10mm by raking tools daily during the progress of work when the mortar is still green, so as to provide a proper key for the plaster or pointing. When plastering or pointing is not required, the joints shall be struck flush. For pointed masonry or for masonry without plaster, smooth textured concrete blocks shall be used. The face of block work shall be kept clean at all times.

Where blocks are to be used for load bearing walls, the uppermost layer of the blocks supporting slab or other structural members, shall be solid or treated as directed by the Engineer.

Precast concrete screen blocks or 'jali' work may be used for decorative purposes. The contractor shall furnish samples for approval.

AAC Block wall shall be used at all places for this project except for locations where block / brick wall is necessary. The AAC Block wall shall be constructed as per the IS Specifications.

C. STONE MASONRY WORK (IF APPLICABLE)

1. GENERAL

- a) Work included with size stone masonry, pointing, plastering & painting.

2. RELATED WORK

- a) Includes scaffolding, ladders, platforms, staging and other accessories required for the execution of work.
- b) Masonry shall be at any height or depth as the case may be.
- c) Hacking and roughening of concrete or any other surface in contact with masonry for bondage.

CONTRACTOR

CHIEF ENGINEER

- d) Rack out joints to specified depths either for plastering or pointing.
- e) Levelling and preparing the top course of masonry for damp proof course.
- f) Provide holdfasts and other inserts where required.

3. MATERIAL

- a) Size stone shall be of granite basalt or trap stone obtainable from approved quarry.
- b) Size stone shall be of clean and neat sized and to have proper shape and dimension.
- c) Cement used shall be of Portland type
- d) Sand shall be clean river sand.
- e) The height of the course shall not be less than 15cm and all courses shall be of minimum height.

4. EXECUTION

- a) Each course of the stone masonry shall not be less than 15cms.
- b) All courses shall be of uniform depth.
- c) The depth of higher course should not be more than depth of lower portion.
- d) Stones shall be hammer/chiselled dressed from the face to an extent of 75mm and 35 mm towards the bed and side of the stones.
- e) Thickness of mortar joint shall not be more than 20mm.
- f) Stone shall break joints at least half the height of the course.
- g) Faces of stone shall be hammer dressed and bushing not more than 35mm.
- h) Edges of the face stones of exposed faces shall be chiselled in both longitudinal and vertical lines.
- i) All corners of exposed faces shall be two-line dressed 50mm wide.
- j) Bond stones shall be provided at intervals not exceeding two metres in each direction.
- k) Dressing of stones shall be done for super structure and not for masonry below the ground level.
- l) Bond stones shall be to the full width of the walls.
- m) Walls having width upto 60cms. thick shall have through bond stone and shall be in one piece.
- n) Walls over 60cms wide shall have bond stones either in one piece, if available locally or have the headers in series, each header overlapping the adjoining one by not less than 150mm.
- o) The filling of the masonry walls shall be with flat bedded stones laid in mortar.
- p) Use chips, spalls, broken pieces of stones to fill the voids in stone masonry to avoid thick mortar joints.
- q) To avoid voids in stone masonry.

- r) No dry cement mortar shall be left in the masonry.
- s) Wet the stone before using.
- t) Mix the cement and sand by volume.
- u) Clean the masonry of extraneous matter, loose particles, and cement mortar adhering to the sides of the stones.
- v) The mortar mix shall CM 1:6 or as specified in the drawings.

SECTION III

PLASTERING AND POINTING

The primary requirement of plasterwork shall be to provide absolutely water tight enclosure, dense, smooth and hard and devoid of any cracks on the interior and/or exterior. The contractor shall do all that is necessary to ensure that this objective is achieved. All plastering shall be finished to true plane, without any imperfections and shall be square with adjoining work and form proper foundation for finishing materials such as paint etc., Masonry and concrete surfaces which call for applications of plaster shall be clean, free from efflorescence damp and sufficiently rough and keyed to ensure proper bond, subject to the approval of the Engineers / Architects. Wherever directed by the Engineer / Architect, all joints between concrete frames and masonry in filling shall be expressed by a groove cut in the plaster. The said groove shall coincide with the joints beneath as directed. Where grooves are not called for, the joints between concrete members and masonry in filling shall be covered by Plaster mesh strips 200 mm wide on either sides or as called for on drawings/documents, which shall be in position before plastering

1. INDIAN STANDARDS

1.1 Indian Standards to be followed are:

All relevant standards as specified elsewhere in this volume are applicable.

- i. IS 383 Specification for coarse and fine aggregates for natural sources for concrete.
- ii. IS 412 Specifications for expanded metal steel sheets for general purposes
- iii. IS 1542 Specifications for sand for plaster
- iv. IS 1661 Code of practice for application of cement and cement-lime plaster finishes
- v. IS 2402 Code of practice for external rendered finishes
- vi. IS 2645 Specifications for integral cement water proofing compound

2. MATERIALS

2.1 Cement

- 2.1.1 Cement used shall be ordinary Portland cement conforming to IS and shall be of grade 53 or 43. PSC(Portland Slag Cement) and PPC (Portland Pozzolona Cement) may be used in non structural works

2.2 Water

- 2.2.1 Water used for mixing and curing shall be clean, reasonably clear and free from objectionable quantities of silt, oils, alkalis, acids, salts so as not to weaken mortar.

2.2.2 Water tested shall be in accordance with IS 3025. Maximum permissible limits of deleterious materials in water as given in IS 456 are reproduced for ready reference in table 6 of Annexure.

2.3 Coloured cement may be either ready-mixed material or may be obtained by mixing pigments and cement at site. The pigments to be mixed with cement shall conform to Appendix "A" of IS 2114 code of practice for laying in-situ Terrazzo Floor Finish.

2.4 Sand shall conform to IS 1542 specification for sand for plaster. For white or coloured renderings, only quartz or silica sand shall be used. For textured finishes produced by treatment of freshly applied final or finishing coat with a tool coarser, particles used shall be screened through 3.35 mm IS sieve or 2.36 mm IS sieve. For torn texture a slightly larger portion of material coarser than 4.75 mm IS sieve shall be use

2.5 Aggregate shall conform to IS 383.

2.6 Marble dust obtained from crushing of hard marble stone shall not contain more than 8% of silt determined by field test. Fineness modulus shall be greater than 1.0.

2.7 Integral water proofing compound shall conform to IS 2645 (specification for integral water proofing compound).

2.8 Fibrous materials

Certain natural fibres, such as flax, sisal, manila, jute hemp, and coconut fibres may be used for incorporation in the mortar. They shall be clean, dry and free from oil.

2.9 Expanded metal

Expanded metal used as background for rendering shall comply with requirements of IS 412.

2.10 Plaster Mesh

Plaster mesh of shall be used over junctions of concrete and masonry or two dissimilar materials about 200 mm wide fixed with GI wire nails etc. as directed by the LIC of India.

2.11 Lime for Rendering

This wall be prepared out of best quality fat lime slaked at site with fresh water not less than one week or more than two weeks before use. All impurities, ashes, improperly burnt stuff shall be screened and picked out before slackening. Slaked lime shall be screened through

to remove all un-slaked materials, stones etc., so that only a fine creamy paste is available for rendering. Slaking lime is diluted with just sufficient water to give a thick consistent liquid suitable for effective covering of base surface. Before the base coat sets the lime, rendering is applied and finished smooth and the entire plastered surface is truly plane.

3. MORTARS

3.1.1 General

Mortars shall be prepared by mixing fine graded aggregate with cement, the lime or a combination of these in the proportion specified for respective items of work as detailed below & in the drawings. Mixing of mortars shall be done by mechanical mixers only. Hand mixing may be permitted in specified cases on the written permission of the LIC OF INDIA

Mortars shall be specified by proportion only and not by strength. Volumetric mixing shall be based on dry volumes of each ingredient. For convenience, measurement shall correspond to volume of one cement bag i.e. 0.035 cu m. Boxes shall be of size 40 X 35 X25 cm. These shall be marked as mortar mixing boxes by red paint and shall be used throughout the contract. Hand mixing or mechanical mixing proportions shall be done with the use of these boxes.

3.2 Cement mortar

3.2.1 Cement mortar shall be prepared by mixing cement and sand in specified proportions. Proportioning shall be carried out as detailed above. Sand shall be added suitably to allow for bulkage if required. Bulkage shall be determined as specified in IS 2386 Part III. Cement and sand added to mixer shall be thoroughly mixed and water shall be added to it gradually. After addition of water the mixer shall run for a minimum of 3 minutes. The mortar mixed shall be consumed within 30 minutes of its mixing.

3.2.2 If ready mix mortar is used the mortar is to be prepared as per the manufacturers specifications .

4. WORKMANSHIP

4.1 Preparation of mortar mix

4.1.1 The material used in preparation of plastering mixes shall be measured by volume using gauge-boxes or by weight.

4.1.2 When cement is measured by weight, 1440 kg of material shall be taken equivalent to one cubic meter.

4.2 Mixing

- 4.2.1 Mixing shall be done mechanically. Each mortar batch shall be used within half an hour. Hand mixing if permitted as special case shall be carried out on a clean, watertight platform. The mixing operation shall be continued with addition of necessary quantity of water until a uniform appearance and consistency of mortar is obtained.
- 4.2.2 Cement and sand shall be mixed dry in required proportion to obtain a uniform colour and water shall then be added to get the required consistency for the plaster.
- 4.3 Method of plastering:
- 4.3.1 Surfaces to be plastered must be clean and free from dust, loose material, oil, grease, mortar droppings, sticking of foreign matter, traces of algae, etc. It is very important to ensure that there should not be any chance of the plaster getting debonded due to presence of materials harmful for bonding.
- 4.3.2 Raking out of joints is expected to be carried out along with masonry but it should be checked thoroughly so as to receive good key.
- 4.3.3 Walls should be sufficiently damp prior to plastering. Water from plastering mortar must not be absorbed by masonry under any condition.
- 4.3.4 Any unavoidable projections in masonry and concrete surfaces shall be chiseled back. Care shall be taken that surrounding surfaces are not damaged and reinforcement is not exposed.
- 4.3.5 Thickness of one coat should not be more than 15mm and less than 8 mm for single coat finished plaster.
- 4.3.6 In case of multi coat plaster, sufficient time shall be allowed for the undercoat to harden (cured, dried and shrunk properly) before subsequent coats are applied.
- 4.3.7 Undercoats shall be scratched or roughened before they are fully hardened to form a mechanical key.
- 4.3.8 The method of application is also important and hence it is recommended that the mix be thrown on the surface rather than stuck with trowel. This increases the adhesion.
- 4.3.9 Scaffolding should be rigid, allowing free and safe movement on the platform and it should be at sufficient distance or height from the working areas. Scaffolding with railing gives more confidence to workers and improves the quality of work.
- 4.3.10 Actual plastering shall be undertaken only on the approval of the LIC OF INDIA Plasterwork should only follow the steps mentioned below:
- a. Surface must be thoroughly cleaned.
 - b. Plaster area must be provided with level dabs or spots allowing working and checking with 2-3 m straight edge. Depth of plaster must not be less than 8 mm at any point.
 - c. Required concealing services must be completed and tested.
 - d. No further cutting of masonry must be required.
 - e. Repairs carried out to masonry or concealing work must be cured and dry.
 - f. Surface must be sufficiently damp.

- g. Plaster dabs are checked for plumb and level by the LIC OF INDIA or his representative.
- h. Joints, concealing and repairing areas must be covered with 20 gauge GI chicken mesh as per the LIC OF INDIA's instruction.
- 4.3.11 Corners, external or internal, shall be finished along with final coat. It is advisable to have rounded corners.
- 4.3.12 Plaster shall be cured for 14 days by wet curing except in near finish plaster. During this period plaster shall be protected from exposure to extremes of temperature and weather.
- 4.3.13 Plaster shall be leveled and lined by aluminium hollow section, 2-3 m long. (This will give even and levelled surface). There shall not be more than 2 mm difference in level when checked with 3 m straight edge. It is important that enough pressing and beating is done to achieve compact filling of joints and that the area is fully compacted.
- 4.3.14 Finishing of plaster may be carried out with wooden float (randhas) or trowelled smooth with sheet metal trowels as specified. Care shall be taken to avoid excessive trowelling and overworking of the wooden float.
- 4.3.15 All corners, internal or external, shall be truly vertical or horizontal. These shall be finished with a proper template to achieve best workmanship for rounding and chamfering as specified or directed.
- 4.3.16 Plaster shall be cut to correct horizontal or vertical line at the end of the day or if work requires to be suspended for any reason

It is advisable to limit the area of plaster to 15 sq m to avoid cracks due to thermal movements of dissimilar material in contact, it is advisable to provide joints treated with groove or any other detail as suggested by the Architect. These joints if not specified shall be treated with 200 mm wide reinforcing Plaster mesh (approved by the LIC OF INDIA) fixed over joints by GI nails and the area plastered.

5. TYPE OF PLASTER

5.1 Internal cement sand lime rendered plaster

Single coat cement-sand plaster with cement-sand mix in proportion of 1:6 shall be carried out over the entire area as detailed above with Plaster mesh of approved equivalent make at all concrete & masonry interfaces of width 200mm. Columns shall have corner beads of size 55x55mm of approved equivalent make all fixed as per manufacturer's instructions. The plaster shall be finished just with wooden float to give the best smooth surface possible duly lime rendered as indicated Clause above after hydrating the lime for 24 hours before commencing the work. Thickness may be from 15 to 20 mm maximum or as specified in the drawings. The Edges to be protected with the PVC Corner Guard at the time of Plastering

5.2 Ceiling cement sand lime rendered plaster

Single coat cement-sand plaster with cement-sand mix in proportion of 1:4 shall be carried out over the entire area as detailed above with Plaster mesh of approved make at all concrete & masonry interfaces of width 200mm. The plaster shall be finished just with wooden float to give the best smooth surface possible duly lime rendered as indicated Clause above after hydrating the lime for 24 hours before commencing the work. Thickness may be from 12 to 15mm maximum or as specified in the drawings.

5.3 Rough cement sand plaster

Single coat cement-sand plaster with cement-sand mix in proportion of 1:6 shall be carried out over the entire area as detailed above. The plaster shall be finished just with wooden float to give a rough surface as backing for tiling work. Thickness may be from 10 to 20mm as specified in the drawings.

5.4 Stone Crete Plaster

Decorative, long lasting, maintenance-free outside facade shall be obtained. Undercoat as detailed in clauses above of this section shall be prepared and applied. Finishing coat 12 mm thick shall be applied over the keyed undercoat. Mix shall be in ratio of 1:1:2 proportion (i.e. 1 white cement or grey cement, 1 marble powder and 2 marble chips). Finished coat shall be firmly applied and worked over to get a fine, smooth surface. Top grade masons shall only be employed. The surface should be perfectly true in line and level. There shall be no difference in level when checked with a 3 m long straight edge. Finished surface shall be cured for 2 days thoroughly with water. Then neat and pleasing designs as approved or directed by the Architect shall be chiselled out and further curing shall be done.

5.5 External Water proof Plaster

20mm two coat cement and sand mortar in proportion of 1:4 shall be applied to external surfaces. The first or the scratch coat shall be approximately 14mm thick and shall be carried out continuously without break to the full lengths of walls or natural breaking points, such as doors, windows and the like. The scratch coat shall be applied to prepared surfaces with heavy pressure to produce a true and even surface and then lightly roughened by cross scratch lines to provide a bond for the finishing coat. The scratch coat shall be cured for at least 7 (seven) days and then allowed to dry. The second coat shall be 6 mm thick and shall not be applied until at least 10 (ten) days after the application of the scratch coat. Before the application of the second coat the scratch coat shall be uniformly dampened. This coat shall be applied from top to bottom in one operation and without joints and the finish shall be straight, true and even. Only approved white sand shall be used for the second coat and for finishing work. Sand for finish shall be of even coarse size and shall be dashed on the surface and sponged. Water proofing compound shall be added as per manufacturers specifications in the plaster mix. Where 32mm thick plaster or render is specified for the purpose of providing beading, bands and the like work shall be carried out in either two or three coats as directed by the LIC of India or his representative. For pebble face finished plaster or render pebbles of approved size and quality shall be dashed against the final surface to obtain a uniform pattern to the satisfaction of the LIC of India or his representative.

5.6 External Plaster or Render

18mm two coat cement and sand mortar in proportion of 1:4 shall be applied to external surfaces as specified. The first coat shall be 12mm thick and the second coat 6mm thick. The first layer shall be dashed against prepared surfaces with a trowel to obtain an even surface. The second layer shall then be applied and finished leaving a trowel finished even and uniform surface.

5.7 Rough Cast Plaster

The specification for sand faced plaster shall also apply to rough cast plaster, subject to the following:

Base coat

The first coat of plaster shall be of cement mortar 1:4 mixed and applied according to the relevant provisions of IS 1661. The finished thickness shall be 12mm for brick masonry and concrete surfaces and 15mm for stone masonry. The plaster shall be laid by throwing the mortar by using a strong whipping action and pressing to form a good bond. The surface shall be roughened.

Second coat

The second coat shall be the roughcast mixture consisting of aggregate, which may vary in size from 5mm to 8mm and may consist of specially graded mixture mixed with fine sand and cement. The proportion of cement to sand to aggregate shall be 1:1:3. It shall be flung upon the first coat with large trowels to form an over protective coat. The second coat must be applied while the first coat is still soft and plastic. The work shall generally conform to requirements IS 1661. The thickness of the coat shall be about 12mm

5.8 Grit Finish Plaster

Select aggregates, 12mm below, granite chips.

Remove all dirt, foreign material and stone dust.

Clean the aggregates with water thoroughly.

Mix the aggregates in proportion of one cement to two parts of aggregate thoroughly to a well and consistent paste.

Apply on a rough plastered surface prepared to receive the grit plaster.

Water the plastered surface to an extent such that the grit plaster can be applied.

After initial setting of grit plaster use a wet sponge to clean the surface.

Use hose water to clean the grit surface effectively so that the grit particles are seen neat and clean and the surface is cleaned of any of the cemented particles.

5.9 Metal Lath Plaster

Work to include backing and reinforcement to plaster.

Fix metal lath over areas which have to be covered with plaster.

Fix metal lath over surface where two different materials meet which have to be covered with plaster.

Lathing material shall be expanded galvanized mesh weighing not less than 1.8 kg/sq.m.

Tying wire shall be black annealed steel 18 G wire.

Provide reinforcement as shown in drawings and tied to the main structural member.

Fix metal lath from the centre outwards so that it is taut.

Extend lathing to a minimum of 150 mm on to adjacent concrete or masonry surface which are to be plastered.

Provide temporary support at one end of the lath and plaster work, and plaster with cement mortar 1:3, one part of cement and three parts of sand.

Finish the lath and plaster work with smooth/sand faced plastering as per instructions by architect.

5.10 Waterproof Finishes

Where specified or directed by the LIC of India or his representative the Contractor shall incorporate approved waterproofing admixtures obtained from reputed manufacturers into the mortar for plasterwork and render. Quantities to be used and the method of incorporation shall be strictly in accordance with the manufacturer's instructions subject to the satisfaction of the LIC of India or his representative. Admixtures shall not contain calcium chloride unless specifically approved by the LIC of India or his representative and shall conform to IS 2645.

5.11 POP PUNNING

General Plaster of Paris punning (Plaster) is generally applied on already cement plastered surface to give it a smooth and even surface.

Preparation of Surface: Projecting burrs of mortar existing on cement plaster shall be removed. The surface shall be scrubbed clean with wire brushes. In addition the plastered surface shall be pock marked with pointed tool, at spacing of not more than 4 cms c/c and depth of pock to be approx. 3 mm. This is to ensure a proper key for the plaster. The surface shall be cleaned of all grease marks etc

6. GYPSUM LIGHTWEIGHT PLASTER

6.1 Scaffolding shall be double scaffolding independent of the work having two sets of vertical supports shall be provided. The supports shall be sound and strong, tied together with horizontal pieces over which scaffolding planks shall be fixed.

6.2 Preparation of surface: The joints shall be raked out properly. Dust and loose mortar shall be brushed out. Efflorescence if any shall be removed by brushing and scrapping. The surface shall then be thoroughly washed with water, cleaned and kept wet before plastering is commenced.

In case of concrete surface if a chemical retarder has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting dust and loose particles cleaned off and care shall be taken that none of the retarders is left on the surface.

Projecting burrs of mortar formed due to the gaps at joints in shuttering shall be removed. The surface shall be scrubbed clean with wire brushes. In addition concrete surfaces to be plastered shall be pock marked with a pointed tool, at spacing's of not more than 5 cm. Centers, the pock being made not less than 3 mm deep. This is to ensure a proper key for the plaster. The mortar shall be washed off and surface, cleaned off all oil, grease etc. and well wetted before the plaster is applied.

6.3 Materials

6.3.1 Premixed light weight plasters essentially consist of retarded hemihydrates gypsum plaster and light weight aggregate which are characterized by low density, high thermal insulation and sound absorption properties. Other additions may be incorporated to impart desired properties. The physical and chemical requirements shall conform to IS 2547(Pt.II).

The minimum recommended water-premixed plaster ratio is 1:2 as per standard practice or as recommended by the manufacturers.

6.3.2 Application of Plaster

Ceiling plaster shall be completed before commencement of wall plaster.

Plastering shall be started from the top and worked down towards the floor. All putlog holes shall be properly filled in advance of the plastering as the scaffolding is being taken down. To ensure even thickness and a true surface, plaster about 15 × 15 cm shall be first applied, horizontally and vertically, at not more than 2 metres intervals over the entire surface to serve as gauges. The surfaces of these gauged areas shall be truly in the plane of the finished plaster surface. The mortar shall then be laid on the wall, between the gauges with trowel. The mortar shall be applied in a uniform surface slightly more than the specified thickness. This shall be brought to a true surface, by working 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 trowel or wooden float according as a smooth or a sandy granular texture is required. Excessive trowelling or over working the float shall be avoided. All corners, arises, angles and junctions shall be truly vertical or horizontal as the case may be and shall be carefully finished. Rounding or chamfering corners, arises, provision of grooves at junctions etc. where required shall be done without any extra payment. Such rounding, chamfering or grooving shall be carried out with proper templates or battens to the sizes required

6.3.3 Thickness

Where the thickness required, as per description of the item is 12 mm, the average thickness of the plaster shall not be less than 12 mm whether wall treated is of brick/block/RCC work.

6.3.4 Finish

The plaster shall be finished to a true and plumb surface and to the proper degree of smoothness as required. The work shall be tested frequently as the work proceeds with a true straight edge not less than 2.5m long and with plumb bobs. All horizontal lines and surfaces shall be tested with a level and all jambs and corners with a plumb bob as the work proceeds.

7. WORKS DEEMED INCLUDED

- 7.1 Description of item in the drawings, unless otherwise stated, includes, wherever necessary, conveyance and delivery handling, unloading, storing, fabrication, hoisting, all labour for finishing to required shape and size, setting, fitting and fixing in position, straight cutting and waste, return of packings and other incidental charges.
- 7.2 Levels and heights shall be as indicated in the drawings.
- 7.3 Preparation of surface shall be as approved by the LIC of India
- 7.4 Trimming off the projections on masonry shall be included in the price.
- 7.5 Scaffolding and working platform shall be included in the price.
- 7.6 Materials as detailed and as required to complete item as specified shall be included in the price.
- 7.7 Curing of plaster shall be included in the price.
- 7.8 Cleaning of adjacent areas, windows, door frames, etc. including masonry surface in exposed masonry work, shall be included in the price.
- 7.9 Forming grooves for joints between beams/columns and masonry etc. shall be deemed included including any special treatment if detailed.
- 7.10 Providing and fixing Plaster mesh at junction of R.C.C., brick work, edges, corners, chiselled and repaired brick work prior to plaster over concealed conduit, etc. shall be as directed by the LIC of India It shall be considered as part of the work.

8. POINTING

- 8.1 Pointing shall be done as soon as possible to achieve a good bond in the raked joint.

8.1.1 Mortar

Mortar shall be prepared in proportion as specified in drawings. Mixing shall be done mechanically or manually if approved by the LIC of India Cement and sand shall be mixed dry in required proportion to obtain a uniform colour and water shall then be added to get the required consistency.

- 8.1.2 Surfaces for which pointing is to be done must be clean and free from dust, loose material, oil, grease, sticking of foreign matter, traces of algae etc. Raking out of joints should be checked thoroughly so as to receive good key. Minimum depth of mortar in joint shall be 10 mm. Mortar shall be set in or pressed into the raked joint with a pointing trowel. Care shall be taken not to spread the corner edges or surface of masonry. It shall be further finished with a pointing tool. Pointing shall be cured for 7 days by hosing water.

8.2 Types of pointing

8.2.1 Flush pointing

The mortar shall be pressed into the joints and shall be finished, flush and levelled. The edges shall be neatly trimmed with a trowel and straightened.

8.2.2 Ruled pointing

The joint shall be finished as detailed in clause 8.2.1. of this section. Then while the mortar is green, grooves in horizontal and vertical direction shall be formed with a specially formed tool. Point lines shall be uniform in width, truly horizontal, vertical, and parallel to the floor and ceiling.

8.2.3 Cut or weather struck pointing

The mortar shall first be pressed into joints. The top or horizontal shall be pressed back 3 mm with the pointing tool so that the joint is sloping from top to bottom. The vertical joint shall be ruled pointed. Vertical and horizontal joint lines shall be at true right angles.

8.2.4 Raised and cut pointing

Joints shall be uniformly raised about 6 mm high, 10 mm wide or more and with edges cut parallel. The pointing should be smooth finished and surface of masonry shall be cleaned.

9. WORKS DEEMED INCLUDED

9.1 Description of item in the drawings, unless otherwise stated, includes, wherever necessary, conveyance and delivery, handling, unloading, storing, fabrication, hoisting, all labour for finishing to required shape and size, setting, fitting and fixing in position, straight cutting and waste, return of packings and other incidental charges.

9.2 Levels and heights shall be as indicated in the drawings.

9.3 Preparation of surface shall be as approved by the LIC of India

9.4 Trimming off the projections on masonry shall be included in the price.

9.5 Scaffolding and working platform shall be included in the price.

9.6 Materials as detailed and as required to complete item as specified shall be included in the price.

9.7 Curing of pointing shall be included in the price.

9.8 Cleaning of adjacent areas, windows, doorframes, etc. including masonry surface in exposed masonry work.

SECTION IV FLOOR FINISHES

1.1 Scope

This Specification describes the general requirements for flooring finishes and rendering on projects.

Contractor shall be responsible for clean up & Housekeeping & shall take every precaution necessary to ensure the protection of the completed works till hand over to Owners representative.

1.2 Applicable Codes

- i. IS 269 Specification for ordinary and Low Heat Portland Cement
- ii. IS 383 Specifications for Coarse and Fine Aggregates
- iii. IS 777 Specifications for Glazed Earthenware Tiles
- iv. IS 1237 Specification for Cement Concrete Flooring Tiles
- v. IS 1443 Code of Practice for Laying and Finishing of Cement Concrete Flooring Tiles
- vi. IS 2571 Code of Practice for Laying In-situ Cement Concrete Flooring
- vii. IS 457 Specifications for Ceramic Unglazed Vitreous Acid-Resisting Tiles

1.3 General Materials

Cement shall be ordinary Portland cement conforming to IS 269 for all purposes. Lime shall conform to IS 712. Other than Structural work , PSC(Portland Slag Cement) and PPC (Portland Pozzolona Cement) may be used.

For lime mortar lime from burnt stone shall be used and shall be free from ash and other impurities and be in lump form and not powder when brought to Site. Lime deteriorated due to rain, soaking, moisture or air slaking will be rejected.

Sand shall conform to IS 1542. For white and/or coloured render only quartz or silica sand shall be used.

For textured finishes and final or finishing coats sand used shall be screened through 3.35mm and 22.36mm IS sieves respectively. For torn texture a slightly larger proportion of sand screened through a 4.75mm IS sieve shall be used.

Water used for mixing and curing shall be clean, clear and free from silt, oil, alkalis, acids, salts and the like.

Coloured cement shall be either ready mixed material or may be obtained by mixing pigments and cement on Site. Pigments mixed with cement shall conform to IS 2114.

Integral waterproofing compound shall conform to IS 2645.

1.4 Mosaic, Terrazzo and Plain Cement Tiling Work

The type, quality, size, thickness and colour of tiles for flooring, skirting and dados shall be of the best quality as described and approved by the Employers Representative or his representative. The Contractor shall provide the Employers Representative or his representative with samples for approval and only approved tiles, skirting and dados shall be brought on to the Site.

Before laying tiles sub-surfaces shall be thoroughly cleaned and washed of all loose materials, dirt, laitance and the like and then well wetted without forming water pools on the surface.

Tiles shall be laid on cement mortar bedding approximately 20 to 30mm thick in the proportions of one part of cement and six parts sand. Mortar shall be evenly spread over sub-surfaces and covered with a bed of cement at the rate of 5kg per square metre.

Tiles shall be laid on cement bed one after another, each tile being gently tapped with a wooden mallet until properly bedded and level with adjoining tiles. Joints shall be perfectly straight and uniform in thickness. Tiles shall be laid perfectly level unless otherwise specified or directed by the Employers Representative or his representative. After laying joints of tiles shall be finished with white cement or cement of approved colour as described.

Floor tiles laid adjoining walls shall project at least 12mm under plaster or render, skirting or dados. Half tiles and cut pieces shall be avoided as far as possible. After laying flooring shall be allowed to cure undisturbed for 7 (seven) days. Design traffic shall not be allowed on the floor for at least 14 (fourteen) days after laying tiles. Following curing each and every tile shall be lightly tapped with a small wooden mallet. Should this give a hollow sound such tiles, together with any cracked or broken tiles, shall be removed and replaced with new tiles to proper lines and levels.

The work shall include admixtures & grouts such as LATAPOXY SP-100 (Epoxy Grout) all as manufacturer's specifications & drawings.

The above procedure shall be followed again after tiles are polished. To ensure that such replaced tiles match those laid earlier laid the Contractor shall order sufficient extra tiles to meet this requirement.

Tiles shall finally be cleaned and polished using oxalic acid or any other method recommended by the tile manufacturer and approved by the Employers Representative or his representative.

After joints have developed sufficient strength floors shall be machine polished to the desired finish to the satisfaction of the Employers Representative or his representative. Sufficient quantities of water shall always be used during polishing to prevent scratching.

For skirting and dado vertical surfaces shall be thoroughly cleaned and wetted and evenly and uniformly covered with approximately a 12mm thick coat of cement mortar (1:2). Tiles for skirting and dados shall be provided fully polished. Backs of tiles shall be covered with a thin layer of neat cement paste and tiles gently tapped against the wall with a wooden mallet. Work shall be done from the bottom of the surface proceeding upwards. Joints shall be as close as possible and the work shall be truly vertical and flush. At the tops of dado work coloured tile borders, if specified, shall be provided.

Once work has set skirting and dados shall be hand polished with Carborundum stone to produce a high glossy finish. Corners and junctions shall be finished true.

The work for flooring, skirting and dado work shall be inclusive of forming angles, corner pieces and approved borders.

1.5 In-Situ Terrazzo and Mosaic Flooring

Marble chips shall be of approved size, colour and shade. Cement shall be white coloured cement or cement mixed with colouring pigments as directed by the Employers Representative or his representative. The proportion of marble chips to cement shall be as directed by the Employers Representative or his representative but shall not be less than 2.5:1.

Samples of terrazzo and mosaic work shall be prepared for the approval of the Employers Representative or his representative. Work shall conform strictly to the approved samples and only approved materials shall be brought on to the Site. In-situ terrazzo and mosaic work on stair treads, floors at building entrances and the like shall have chequered non-slippery finish at no extra cost.

Terrazzo chips shall be laid on 15mm thick bases of lime mortar spread and levelled as described in Section above. Chips shall be thoroughly mixed dry and then white cement or cement of approved colour added in the specified proportions. Chips and cement shall be thoroughly mixed and evenly spread on bases and not heaped. Water shall then be added to obtain a plastic mix of suitable consistency as directed by the Employers Representative or his representative.

Terrazzo layers shall be placed as soon as screed coats have set sufficiently but no sooner than the day after. Thicknesses of terrazzo topping shall not be less than 10mm. Surfaces shall be rammed to obtain consolidation and levels. Additional chips shall be sprinkled on surfaces and rammed until all surplus cement is worked out and chips forced together to ensure that finished floors have not less than 70% visible aggregate. Final surfaces shall be lightly trowelled.

Finished surfaces shall be kept moist for a period of not less than 6 (six) days and then machine polished to leave the work in first class condition. Voids shall be filled with neat grout of the same kind and colour as the base and allowed to remain for at least 72 (seventy two) hours before being removed for final cleaning.

While under beds are still plastic dividing strips of brass or aluminium, 35mm wide x 1.25mm thick, shall be inserted in accordance with the floor design, care being taken to ensure that no section exceeds 1.5 square metres. Tops of strips shall project 10mm above surfaces of under beds and shall be flush with finished floor levels.

The work for flooring, skirting and dado work shall be inclusive of forming angles, corner pieces and approved colour borders.

1.6 Glazed, Ceramic & Vitrified Tile Work

The type, quality, size, thickness and colour of tiles for flooring, skirting and dados shall be of the best quality as described and approved by the Employers Representative or his representative. The Contractor shall provide the Employers Representative or his representative with samples for approval and only approved tiles, skirting and dados shall be brought on to the Site.

Before laying tiles sub-surfaces shall be thoroughly cleaned and washed of all loose materials, dirt, laitance and the like and then well wetted without forming water pools on the surface.

Tiles shall be laid on cement mortar bedding 20mm thick in the proportions of one part of cement, four parts sand.

Tiles shall be laid on mortar beds one after another, each tile being gently tapped with a wooden mallet until properly bedded and level with adjoining tiles. Joints shall be perfectly straight and uniform in thickness. Tiles shall be laid perfectly level unless otherwise specified or directed by the Employers Representative or his representative. After laying joints of tiles shall be finished with white cement or cement of approved colour as described.

Floor tiles laid adjoining walls shall project at least 12mm under plaster or render, skirting or dados. Half tiles and cut pieces shall be avoided as far as possible. After laying flooring shall be allowed to cure undisturbed for 7 (seven) days. Design traffic shall not be allowed on the floor for at least 14 (fourteen) days after laying tiles. Following curing each and every tile shall be lightly tapped with a small wooden mallet. Should this give a hollow sound such tiles, together with any cracked or broken tiles, shall be removed and replaced with new tiles to proper lines and levels.

The work shall include admixtures & grouts such as Laticrete / Bal Endura (Cementitious Polymer Grout) & LATICRETE 290 (Adhesive) or equivalent from Bal Endura all as manufacturers specifications & drawings.

Corner Beadings

External round/ convex and internal concave PVC corner beads to match the colour of the tiles. PVC Inner Corner Tile Beading and External Round edge Tile Beading of nominal thickness 1.2mm of Colours matching the tile colours & depths of, 9.5 and 10.5mm made out of PVCU and PVC co-extrusion equivalent to BS 5750 as protector for tiles inner corners

and external edges, for all vertical and horizontal edges. The size shall be minimum length 2.5mts. Joints are not permitted. Tile Spacers 3mm spacers made of PVC as per manufacturers specifications with size of 30 x 30 x 3mm. where directed 2mm spacer may be provided instead of 3mm spacers.

For skirting and dado vertical surfaces shall be thoroughly cleaned and wetted and evenly and uniformly covered with a 12mm thick coat of cement mortar (1:4). Backs of tiles for skirting and dados shall be covered with a thin layer of neat cement paste and tiles gently tapped against the wall with a wooden mallet. Work shall be done from the bottom of the surface proceeding upwards. Joints shall be as close as possible and the work shall be truly vertical and flush. Corners and junctions shall be finished true. At the tops of dado work glazed tile borders, if specified, shall be provided.

The work for flooring, skirting and dado work shall be inclusive of forming angles, corner pieces and approved borders.

1.7 Shahabad, Tandur, and Kota Stone Flooring, Dado, Coping & Skirting

Stones as described shall be of approved quality, free of defects hard, sound, durable and uniform thickness and approved by the Employers Representative or his representative. Edges shall be chisel dressed and the top surface shall be machine polished with joints running true and parallel from side to side. The Contractor shall provide the Employers Representative or his representative with samples for approval and only approved stones shall be brought on to the Site.

The slabs shall be machine polished, Flamed or honed as mentioned in the drawings at the factory prior to being brought to the Site. All edges shall be machine cut to have the slabs to required correct sizes and the edges shall be ground smooth and even to full depth. A straight edge laid along the side of the slab shall be in full contact with it. All angles and edges of the slabs shall be true and square and free from chipping. Bull nosing, grooves & chamfering of edges for staircases & skirting, etc., shall be as indicated in the detailed drawings.

Before laying slabs sub-surfaces shall be thoroughly cleaned and washed of all loose materials, dirt, laitance and the like and then well wetted without forming water pools on the surface.

Thoroughly wetted stones shall be laid on cement mortar bedding not less than 20mm and not more than 25mm thick in the proportions of one part of cement and six parts sand.

Mortar shall be evenly spread over sub surfaces and covered with a bed of cement at the rate of 5kg per square metre over areas that can be covered with stones within half an hour.

Stones shall be laid on cement beds one after another, each stone being gently tapped with a wooden mallet until properly bedded and level with adjoining stones. Joints shall be

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perfectly straight and uniform in thickness. Stones shall be laid perfectly level unless otherwise specified or directed by the Employers Representative or his representative. After laying joints of stones shall be struck smooth.

Floor stones laid adjoining walls shall project at least 12mm under plaster or render, skirting or dados. Cut pieces shall be avoided as far as possible. After laying flooring shall be covered with a layer of damp sand and allowed to cure undisturbed for 7 (seven) days. Design traffic shall not be allowed on the floor for at least 14 (fourteen) days after laying stones. Following curing each and every stone shall be lightly tapped with a small wooden mallet. Should this give a hollow sound such stones, together with any cracked or broken stones, shall be removed and replaced with new stones to proper lines and levels. To ensure that such replaced stones match those laid earlier laid the Contractor shall order sufficient extra stones to meet this requirement.

The work shall include admixtures & grouts such as 511 IMPREGNATOR (Sealer) & LATICRETE 111 & 4237 all as manufacturers specifications & drawings.

For skirting and dado vertical surfaces shall be thoroughly cleaned and wetted and evenly and uniformly covered with approximately a 20mm thick coat of cement mortar (1:4).

Backs of stones for skirting and dados shall be covered with a thin layer of neat cement paste and tiles gently tapped against walls with a wooden mallet. Work shall be done from the bottom of the surface proceeding upwards. Joints shall be as close as possible and the work shall be truly vertical and flush. The work for flooring, skirting and dado work shall be inclusive of forming angles and corner pieces

Pre-polished counters for wash basins

The Slabs shall be fixed on RCC slab/ MS framework true to line and level all as per detail drawing including Skirting, Fascia band & verticals wherever required, and making openings in the slab counter for seating washbasins etc. and pillar cock, including edge polishing and rounding of edges as approved. Shop drawings for seating arrangement shall be prepared by the vendor & approved by the Architect.

1.8 Marble and Granite Flooring, Dado, Coping & Skirting

The type, quality and thickness of marble and granite slabs for flooring, skirting and dados shall be of the best quality as described and approved by the Employers Representative or his representative and shall be hard, dense, uniform, homogenous in texture, have even crystallising grains and be free from cracks and other defects. The Contractor shall provide the Employers Representative or his representative with samples for approval and only approved slabs shall be brought on to the Site. The slabs shall be machine polished, Flamed or honed as mentioned in the drawings at the factory prior to being brought to the Site .All edges shall be machine cut to have the slabs to required correct sizes and the edges shall be ground smooth and even to full depth. A straight edge laid along the side of the slab shall be in full contact with it. All angles and edges of the slabs shall be true and square and free

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from chipping. Bull nosing, grooves & chamfering of edges for staircases & skirting, etc., shall be as indicated in the detailed drawings.

Flaming on polished granite to achieve the required undulated flame finish shall be done using the thermal torch. The ignited torch shall be held at 45 degrees to the granite slab plane with required temperature using combination of Oxygen and LPG gasses in presence of continuous water jet for immediate cooling. The pressure of the gasses required, depends on the level, intensity and pattern of flaming as approved by the Architect.

Honed Finish of granite shall be prepared where necessary to have a smooth surface without reflection. Pathways and walkways shall be provided with Honed granites.

Granite Slabs for Lift flooring shall have suitable Epoxy underlays & adhesives as per the detailed drawings & manufacturers specifications.

Rough Dressing

The stone surface to be chisel dressed to one plane by removing all bushings so that the maximum depression is not more than 6mm.

One Line Dressing

This is done after the rough dressing is completed by point chiselling so that the variations are not more than 4mm. Work includes rough dressing also.

Two Line Dressing

This is done after one-line dressing is done by chiselling so that variations are not more than 2.5mm. Work includes rough and one line dressing also.

Three Line Dressing

This is done after two lines dressing is over by chiselling so that the variations are not more than 1.5mm. Work includes rough, one line & two lines dressing also.

Before laying sub-surfaces shall be thoroughly cleaned and washed of all loose materials, dirt, laitance and the like and then well wetted without forming water pools on the surface.

Slabs shall be laid in cement slurry over a cement mortar bed approximately 18mm thick (one part of cement, and six parts sand) evenly spread over sub-surfaces.

Slabs shall be gently tapped with a wooden mallet until properly bedded and level with adjoining slabs. Joints not exceeding 1mm wide shall be perfectly straight and uniform in thickness. Slabs shall be laid perfectly level unless otherwise specified or directed by the Employers Representative or his representative. After laying joints shall be finished with white cement.

The work shall include admixtures & grouts such as 511 IMPREGNATOR (Sealer) & LATICRETE 111 & 4237 all as manufacturers specifications & drawings.

Slabs laid adjoining walls shall project at least 12mm under plaster or render, skirting or dados.

After laying flooring shall be allowed to cure undisturbed for 10 (ten) days. Design traffic shall not be allowed on the floor for at least 14 (fourteen) days after laying slabs. Following curing slabs shall be lightly tapped with a small wooden mallet. Should this give a hollow sound such slabs, together with any cracked or broken slabs, shall be removed and replaced with new slabs to proper lines and levels.

The above procedure shall be followed again after slabs are polished. To ensure that such replaced slabs match those laid earlier the Contractor shall order sufficient extra slabs to meet this requirement.

After joints have developed sufficient strength floors shall be machine polished to the desired finish to the satisfaction of the Employers Representative or his representative. Sufficient quantities of water shall always be used during polishing to prevent scratching. For skirting and dado vertical surfaces shall be thoroughly cleaned and wetted and evenly and uniformly covered with approximately a 12mm thick coat of cement mortar (1:4). Backs of cut slabs for skirting and dados shall be covered with a thin layer of neat cement paste and tiles gently tapped against the wall with a wooden mallet. Joints shall be as close as possible and the work shall be truly vertical and flush. At the top of dado work borders, if specified, shall be provided.

Once work has set skirting and dados shall be hand polished with Carborundum stone to produce a high glossy finish. Corners and junctions shall be finished true.

The work for flooring, skirting and dado work shall be inclusive of forming angles, corner pieces and approved borders.

Urinal Partitions

The Urinal Partitions shall be 25mm thick. double side polished Granite slabs of size (450 +365) x 1050mm between Urinals. Top, side and all visible surfaces shall be polished & rounded off and fixed In CM 1:4 to walls with necessary MS clip sections as per detail drawings& approved by Architects.

Pre-polished Marble counters for washbasins

The Slabs shall be fixed on MS framework/ RCC slab true to line and level all as per detail drawing including

Skirting, Fascia band & verticals wherever required, and making openings in the Granite counter for seating washbasins etc. and pillar cock, including edge polishing and rounding of edges as approved. Shop drawings for seating arrangement shall be prepared by the vendor & approved by the Architect.

1.9 Integral Cement Finish on Concrete Floors

Where integral cement finish is specified to concrete floors surfaces of concrete shall be screed to proper levels and tamped with tamper with conical projections to ensure that aggregate is forced below the surface.

Surfaces shall be finished with a wooden float and a trowel applying sufficient pressure to provide a smooth finish. Treatment shall be continued until the concrete reaches its initial set. No cement or cement mortar finish is to be used on finished surfaces. Where specified, floor hardeners, approved by the Employers Representative or his representative, shall be supplied and incorporated into surface finishes in accordance with the manufacturer's recommendations.

1.10 IPS Flooring

General

The flooring shall be of specified thickness and shall consist of 1:2:4 concrete base/ M15 concrete as specified in the finishing schedule and 12mm thick wearing coat. The granolithic flooring shall be laid in alternate panels. The size of panels shall be as decided by the Employers Representatives.

Laying of 1:2:4/ M15 Concrete Base

The 1:2:4/ M15 concrete base shall be of graded coarse aggregate of 20mm and down size, 10mm course sand & cement. The ingredients shall be thoroughly mixed with sufficient water to obtain the required plasticity. The floor shall be completed with 1:1 cement sand mortar 12mm thick and cement slurry 2.2kg/sqm including Glass divider strips 45/50x4mm thick set in the flooring including necessary levelling, setting, etc.

The free water on the surface of the base shall be removed and a coat of cement slurry of the consistency of thick cream shall be brushed on the surface.

The prepared 1:2:4/ M15 concrete shall be laid immediately after mixing on the fresh grouted base. The concrete shall be spread evenly and levelled carefully. Low places shall be filled, humps removed and the whole surface again leveled. The layer shall be compacted by ramming and troweled and allowed to set.

Mixing and Laying Of Wearing Coat

One part of cement in dry state shall be mixed with 1.5 parts by volume of well graded/crushed granite chips of 6mm maximum size. The ingredients shall be then mixed with sufficient water as for ordinary concrete. The wearing coat shall be laid 12mm thick over 1:2:4 cement concrete base immediately after it has set compacted and levelled with a steel trowel. Just sufficient trowelling shall be made to give a level surface. The surface should not be over trowelled, as excessive trowelling will bring the cement to the surface, which shall be

strictly avoided. When the initial set takes place further compaction by steel trowelling shall be done and final brushing shall be made before the topping becomes too hard.

Floor hardeners

Where specified in the drawings, floor hardeners, approved by the Employers Representative or his representative, shall be supplied and incorporated into surface finishes in accordance with the manufacturer's recommendations.

Curing

As soon as the surface is hard enough, it shall be covered with sacking or sand and kept continuously wet for a period of at-least one week.

1.11 Screed Flooring

General

The flooring shall be of specified thickness and shall consist of 1:2:4 concrete base as specified and 12mm thick wearing coat. The screed flooring shall be laid in alternate panels. The size of panels shall be as decided by the Employers Representatives.

Laying of 1:2:4 Concrete Base

The 1:2:4 concrete base shall be of graded course aggregate of 20mm and down size, 10mm course sand & cement. The ingredients shall be thoroughly mixed with sufficient water to obtain the required plasticity.

The free water on the surface of the base shall be removed and a coat of cement slurry of the consistency of thick cream shall be brushed on the surface.

The prepared 1:2:4 concrete shall be laid immediately after mixing on the fresh grouted base. The concrete shall be spread evenly and levelled carefully. Low places shall be filled, humps removed and the whole surface again levelled. The layer shall be compacted by ramming and trowelled and allowed to set.

MS Mesh at joints

MS mesh shall be laid at all panel joints with mesh of size 40mmx80mm-10 SWG

Mixing and Laying Of Wearing Coat

One part of cement in dry state shall be mixed with 1.5 parts by volume of well graded/crushed granite chips of 6mm maximum size. The ingredients shall be then mixed with sufficient water as for ordinary concrete. The wearing coat shall be laid 12mm thick over 1:2:4 cement concrete base immediately after it has set compacted and levelled with a steel trowel. Just sufficient trowelling shall be made to give a level surface. The surface should not be over trowelled, as excessive trowelling will bring the cement to the surface, which shall be

strictly avoided. When the initial set takes place further compaction by steel trowelling shall be done and final brushing shall be made before the topping becomes too hard.

Floor hardeners

Where specified in the drawings, floor hardeners, approved by the Employers Representative or his representative, shall be supplied and incorporated into surface finishes in accordance with the manufacturer's recommendations.

Curing

As soon as the surface is hard enough, it shall be covered with sacking or sand and kept continuously wet for a period of at-least one week.

1.12 Vacuum Dewatered Concreting & Flooring

1.12.1 Preparation

The surface to receive flooring shall be clean, free from dirt and free from foreign material.

Any undulations or mortar remaining on the floor shall be trimmed.

Base course shall be trimmed.

The base shall be cleaned and watered before laying the floor.

Work includes at all depths and heights.

The finished surface shall be kept wet for a maximum period of one week.

1.12.2 Concreting (General)

Concreting shall have a concrete base of M20 of specified thickness.

Flooring shall have hardtop on the concrete base.

Flooring shall be laid in strips, the size of which is mentioned on the drawings.

1.12.3 Materials

Cement – Cement used shall be ordinary Portland cement conforming to IS and shall be of grade 53 or 43. PSC(Portland Slag Cement) and PPC (Portland Pozzolona Cement) may be used in non structural works

Sand - River sand

Aggregate - Max.size 10 to 20mm

Water - Potable

Nito hardener (Optional) - @ 3kg/sqm

Poly Sulphide sealant - At all control joints of size 10mmx6mm at every 200 sqm area

1.12.4 Execution

Mix cement, sand and aggregates in proportion 1:1.5:3 thoroughly with water to get an appropriate consistency.

Prepared concrete shall be laid immediately after mixing.

The base shall be free from water and other foreign materials, dust and dirt.

A coat of cement slurry of the consistency of thick cream shall be brushed on the surface of the base course.

The concrete shall then be spread over this base evenly and levelled carefully.

Low areas shall be filled with concrete and humps removed. De-vaccumisation shall be done for removing the voids.

The whole concrete surface shall be levelled, compacted by ramming and trowelling.

Prepared surface shall be allowed to set.

Hardener screed:

Hard top to be prepared as per the specifications with Nito hardener and one part of dry cement.

The heard top shall be provided over concrete base immediately after it is set, compacted and levelled with a steel trowel.

The surface shall be trowelled to bring the hardener coat to a levelled surface.

Excessive trowelling shall be avoided.

After the initial set, further compaction shall be done by steel trowelling.

Final brushing where required (to achieve desired surface finish) shall be made before the floor top becomes too hard.

1.12.5 Curing

1.12.5.1 Curing shall commence as soon as the surface is hard enough to receive the water. The surface shall be covered with sacks or sand and shall be kept continuously wet for a period of at least one week.

1.13 Wooden Laminate floor

Wooden Laminate flooring shall be of PERGO or approved equivalent make comprising of a substrate of High density fibre board over a backing resin film, underlay boards & foam, all topped by a decorative laminate film of approved pattern & design topped by an transparent overlay as an anti abrasive protector all as per manufacturers specifications. The rate shall include for necessary Skirting boards, beadings, finishing profiles etc., complete all as per directions of Architect/Engineer in charge.

1.14 Engineered Wooden Floor

Engineered wood flooring shall be of TRY SQUARE make and Kayu Kuku wood species of Length of 300mm ~ 1500mm, with 121mm wide slats and 12.5mm thick. A layer of 2mm roofing felt/ PU foam shall be laid on bare levelled slab. 6mm thick marine ply wood shall be laid out on the roofing felt / PU foam including providing 12mm space along the walls. Slats shall be laid on top of ply wood with locking by Tongue and groove on all four sides. Slats shall be laid with maximum 1mm micro bevel 'V Groove' along all the joints. Pre finished Slats shall be coated with Aluminium Oxide with ceramic coating as per manufacturers specifications & Architects instructions

1.15 Solid wood floor

Providing and laying Exterior grade Solid wood flooring of TRYSQUARE make wood species IPE Species from Brazil of Length of 900mm ~ 1800mm as per approved drawings, with 120mm wide slats and 21mm thick. Slats shall be locked by nailed from the top on a hardwood runner base as per manufacturers specifications & Architects instructions. Slats shall be laid with minimum gap of 3 to 4mm. Slats shall be oiled at the site.

1.16 Wooden Cladding

Providing and fixing panelling on wall. Framing shall consist of Aluminium Section 50 mm x40 mm (Wall Thickness 2 mm) @ 2'0" C/C. Both ways horizontally and vertically on the wall. This framing would be covered by 1/4" thk. Ply & Road wood veneer finished with melamine polished. Wooden moulding, lipping etc. as directed by Architect shall be provided wherever required

1.17 Dholpur Stone Cladding

- a. Stone shall be all hard, sound durable and tough, free from cracks, decay and weathering and defects like cavities, cracks, flaws, sand holes, veins, patches of soft or loose materials uniform shade.
- b. The stone shall be cut into slabs of required thickness along the flames parallel to the natural bed of stones.
- c. The stone shall be wetted before laying. They shall then be fixed with mortar in position without the use of chips, or underpinning of any sort.
- d. Where so desired, the adjoining stones shall be secured to each other by means of stainless steel pins 40mm long and 6mm diameter or as specified in the item of schedule.

- e. The stones shall be secured to the backing by means of stainless steel angle or cramps of design/size given in the drawing or as per site condition.

Stainless steel cramps can also be of 25x6mm flat 30cm or 16.5cm long required according to thickness of wall or as per site conditions unless specified otherwise they may be provided as directed by the Engineer-in-Charge. The cramps shall be spaced not more than 60 cms apart or as shown on the drawing and fixed with approved fasteners in RCC or with concrete blocks in brick work.

- f. Cramps may be attached to its sides or top and bottom and or sides top and bottom. The minimum number of cramps required for fixing to the wall shall be as per requirements of design to carry the loads.
- g. When cramps are used to hold the unit in position only, the facings shall be provided with a continuous support in which the stones rest at the ground level and other storey levels, the support being in the form of projection from or recesses into the concrete floor slab, or a beam between the columns or stainless steel angle attached to the floor slab or beams.
- h. The pins, cramps and dowels shall be laid in non shrink grout and their samples got approved by the Engineer-in-Charge.
- i. Stainless steel angle cramps/bracket shall be held in position with the help of expansion hold fasteners (Wedge expansion type) approved make.

1.18 ALUMINIUM COMPOSITE PANEL METAL CLADDING

Scope of Work

The contractor shall design, supply, fabricate, deliver and install and guarantee all construction necessary to provide a complete aluminium composite panel cladding, complete with all necessary anchors, hardware and fittings to provide a total installation, fully in conformity with the requirements and intent of the drawing and specification as per item description. The scope of work shall be read in conjunction with those in the specification of curtain walling.

Design Concept

- a. The proposed cladding shall be based on a water-tight system.
- b. A 20mm wide joint shall be provided between cladding elements to cater for individual panel installation and shall be sealed off with extruded EPDM gasket or silicon sealant.

Aluminium Composite Panel Cladding

Providing, designing, cutting, bending and fixing 4mm thick aluminium composite cladding of approved make on external façade of size as shown with Water tight system either curved or straight in plan. Skin material 0.5mm thick aluminium sheet (3005 H6) core material natural polyethylene, aluminium cladding panel to be of approved colour/shade fixed with extruded aluminium basic frame, angle cleats, weather sealants, rivets, GI brackets all as approved, using suitable chemical/anchor bolts on structural steel work including necessary accessories complete in all respects. Where level difference is shown dummy structural steel backup frame shall be provided. Protective Film: The finished surface shall be protected with 80 microns self adhesive Peel Off film with two layers of white and black tested to withstand at least 6 months exposure to local weather condition, without losing the original peel off characteristic or causing stains or other damages.

Technical Data

- A. Composition: Skin material 0.5mm thick aluminium sheet (3005 H6) core material natural polyethylene.
- B. Dimensions: Panel thickness: 4mm
Panel size: Width 1000/1250/1500mm, Length between 1500 and 5000mm
Tolerance
Width + 2.0mm ,
Length + 4.0mm
Thickness + 0.02mm
- C. Principal Properties: Panel weight: 5.5 kg/sqm

Thermal expansion: 1mm/M/60 deg.C.

D. Acoustic Properties: Average airborne sound transmission loss 26 db.

E. Mechanical Properties: Tensile Strength $R_M > 160$ MPa.

0.2% Proof stress $R_P > 130$ MPa.

Modulus of Elasticity $E 70,000$ Mpa.

Elongation A-50 – 5-7%

F. Aluminium Extrusions: Extrusions shall be of aluminium alloy 6063 T conforming to BS 1470 – 1475: 1972 in mill finish.

1.19 ALUMINIUM INSULATED WALL PANEL

Scope of Work

The contractor shall design, supply, fabricate, deliver and install and guarantee all construction necessary to provide a complete aluminium insulated wall Panelling, complete with all necessary anchors, hardware and fittings to provide a total installation, fully in conformity with the requirements and intent of the drawing and specification as per item description.

The scope of work shall be read in conjunction with those in the specification of curtain system and interior fit outs.

Design Concept

- a. The wall system shall be based on a water-tight system.
- b. Seamless joint shall be provided between elements with clip lock system and shall be sealed off with extruded EPDM gasket or silicon sealant.

SECTION V

RAILINGS

1. MS Railing, Grill, Canopy Steel Ladder (General)

These shall be made from MS sections consisting of M.S. Pipes, flats, square / round bars, channels, Tees, angles, plates, etc. as per the detailed drawings. The work includes fixing with screws or necessary anchor bolts and flats to fix the railing rigid in position. The members shall be welded together and all the welded joints shall be filed to make smooth joints. The work includes Synthetic enamel/ powder coating/ Autocoat paint to all steel members as per manufacturers specifications after phosphating and appropriate primer coat, etc. complete. of required shade as per the finishing schedule& drawings.

2 GI Pipe Railing

Providing GI pipe railing as per detailed drawings above flooring with 'A' class GI pipes as per design including all specials, bends, elbows, Tees and with holdfasts or clamps. If the pipe railing is to be fixed in ground or brick work it shall be with 300 x 300 x 450mm (1:2:4 PCC) and if it is to be fixed in RCC work with necessary anchor bolts and plates to fix the railing rigidly in position.

3 MS Staircase Railing

Providing MS Staircase Railing with Top hand rail of 50mm dia Hollow MS pipe of 16 gauge to be welded as railing to the verticals made of 40mm dia MS tubes with 25mm dia MS Rod Mid Rails 3 Nos. welded to 40mm dia MS Tube Vertical Pipe. Verticals should be fixed to the concrete slabs with 200mm x 150mm, 10 gauge MS plate anchored with 4 Nos. of 10mm dia 75mm long Expansion bolts. All exposed MS sections to be painted with 2 coats of Synthetic Enamel paint over a coat of primer, etc., complete. all as per Architectural drawings and instructions. Horizontal bars of 10mm dia MS rod of nos. as called for in the drawings to be fixed to the verticals.

4 MS Staircase Hand Rail

Providing Staircase hand rail of 65mm dia hollow MS pipe of 16 gauge, fixed to 12mm dia MS rod bent to profile and welded to insert plates of 200mm x 125mm size and 6mm thick, anchored in the wall with 4 nos. of 10mm dia, 75mm long expansion bolts, etc., complete, as per architectural drawings. Rate to include painting all MS sections with 2 coats of Synthetic Enamel over a coat of primer.

5 MS Handrail with Wooden Handle

Providing Staircase hand rail of 65mm dia Wooden anchored in the wall with 4 nos. of 10mm dia, 75mm long expansion bolts, etc., complete, as per architectural drawings. Rate to include painting all MS sections with 2 coats of Synthetic Enamel over a coat of primer.

6 Stainless Steel Handrail with Glass

The hand rail shall be 900mm high & made from 38mm diameter Brush finished stainless steel in position of D-line make with intermediate vertical balusters in stainless steel flats of size 52 x 12mm thick as recommended by the manufacturer adhering to the detail drawings. The 10mm thick edge polished toughened glass shall be rigidly held in position with vertical balusters with necessary interim and end adjustable brackets as per the manufacturer's specifications. The balusters shall be rigidly held in granite floor with necessary anchor fasteners, sleeves and finally covered with brush finished stainless steel coupling as per the detail drawings. The fixing of anchor fasteners shall be carried in close co-ordination with Civil Contractor and should be completed before finishing the Granite flooring as instructed by the Architects. The 75% of glass shall be fixed with 3M film for frosted/ etched effect to the pattern as indicated in the detail drawings. The Contractor to submit the shop drawing of the same including the fabrication details, calculations and stability report. The work to start only on written approval of the same by the Architects.

7 Stainless Steel Handrail without Glass

Fabricating, Supplying and Fixing in position SS Staircase Handrail with Top hand rail of 50 mm dia Hollow SS pipe of to be welded as railing connected to the verticals through 8mm connecter plate with 2mm SS flat base plate below the hand rail. The Verticals shall be made of frame work of 2 Nos. 50X6 mm SS flat with 8mm spacer plate and rounded edges finish placed at 1000mm c/c as balusters as per the detail architectural drawing. Mid rails shall be 3 Nos 20mm dia SS rods connecting the verticals. Balusters should be fixed to the concrete slabs with 150mm x 100mm, 6mm SS plate anchored with 4 Nos. of 10mm dia 75mm long Expansion bolts as per the detail drawings. All SS sections will be finish as per Architects / Site in charge instructions. All sections to be of grade 304. The Contractor to submit the shop drawing of the same including the fabrication details, calculations and stability report. The work to start only on written approval of the same by the Architects.

8 Stainless Steel Ramp Handrail

Fabricating, Supplying and Fixing in position SS Ramp Handrail with Top hand rail of 50mm dia Hollow SS pipe of to be welded as railing connected to the verticals through 30mm wide SS flat. The Verticals shall be made of frame work of 2 Nos. 50X6 mm SS flat and rounded edges finish placed at 1300mm c/c as balusters as per the detail architectural drawing. Mid rails shall be 2 Nos 30mm X 30mm SS flat connecting the verticals. Balusters should be fixed to the concrete slabs with 150mm x 100mm, 6mm SS plate anchored with 4 Nos. of 10mm dia 75mm long Expansion bolts as per the detail drawings. All SS sections will be finish as per Architects / Site in charge instructions. All sections to be of grade 304. The Contractor to submit the shop drawing of the same including the fabrication details, calculations and stability report. The work to start only on written approval of the same by the Architects.

9 Stainless Steel Wheel chair Access Railing

Fabricating, Supplying and Fixing in position Wheel chair Access Railing with Top hand rail of 50mm dia Hollow SS pipe of 16 gauge to be welded as railing to the verticals made of 2 no's 50 x 6mm SS flat section placed back to back 1200mm c/c is connected with railing by 30mm wide SS flat sections as per the detail Architectural drawing and 100mm dia SS pipes

3 no's placed equally as mid rails as per the detail architectural drawing. The verticals fixed to the concrete slabs with 100mm x 150mm, 6mm MS plate anchored with 4 Nos. of 10mm dia 75mm long Expansion bolts as per the detail drawings. All SS & MS sections will be finished as per Architects / Site in charge instructions. All SS sections will be finish as per Architects / Site in charge instructions. All sections to be of grade 304. The Contractor to submit the shop drawing of the same including the fabrication details, calculations and stability report. The work to start only on written approval of the same by the Architects.

10 Glazier's Work

All glass for Railings etc. shall be as specified in the drawings and free from air bubbles, specks and scratches of other defects. All glass shall be cut to fit the sashes or other members as required. All glass shall be properly bedded, securely fixed and finished as indicated on the drawings. Beading finished as specified shall be provided for fixing the glass. No glazing shall be complete until all the stains and marks have been removed from the surface of glass.

11 Tolerances

Tolerance on nominal width and height shall be +3mm or -0mm and that on thickness shall be +/- 1.2mm. The thickness of the members shall be uniform throughout with a variation not exceeding +/- 0.8mm when measured at two end points.

SECTION- VII

EARTH WORK

1.0 GENERAL

1.1 Standards

Work shall be carried out to Indian Standards and Code of Practices. In absence, International Standards shall be followed. These shall be latest issue. List given hereunder is not to be considered as conclusive and is for reference and guidance only. Any discrepancies/conflict noticed shall be directed to the Engineer-in-Charge for his direction/approval. However as a general rule more stringent specification shall take precedence.

- 1) IS 1498 Classification and identification of soils for general engineering purpose
- 2) IS 2720 Method of test of soil
- 3) IS 3764 Safety code for excavation work
- 4) IS 4081 Safety code for blasting and related drilling operation
- 5) IS 6313 Part 1 Code of practice for antitermite measures in buildings: constructional measures
- 6) Part 2 Code of practice for anti termite measures in buildings: Pre constructional chemical treatment measure
- 7) Explosive Rules 1940

2.0 SITE CLEARANCE

- 2.1 Prior to the start of any activity of earth-work, the area under construction shall be cleared of shrubs, vegetation, grass, brushwood, trees and saplings of girth upto 30 cm measured at a height of 1 metre above ground level. All rubbish must be removed and stacked at a distance of 50 m outside the periphery of the area under clearance or location as decided by the Engineer-in-Charge.
- 2.2 The rate of such clearance is to be included in the rate of other earthwork items and no separate rate shall be paid.

3.0 SETTING OUT

- 3.1 The contractor shall prepare detailed setting out drawings based on the layout of Architectural drawings and those shall be submitted to the Engineer-in-Charge prior to commencement of work. Bench Marks and Reference Lines shall be established, by the contractor with approval of the Engineer-in-Charge.
- 3.2 The contractor shall do the setting out with the use of theodolite and like instruments at site, based on details given to him. He shall erect timber profiles, masonry pillars, burjis, etc. for his use. All markings on these shall be painted with red colour and they shall be maintained for the entire duration of the project. Setting out shall be approved by the Engineer-in-Charge before the commencement of any work.
- 3.3 The rate for the earth-work items shall include expenses for all such work including labour, material and equipment/instruments, etc. No additional payment shall be eligible on this account.

4.0 EXCAVATION IN SOILS

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4.1 Excavation over area

Excavation exceeding 1 m in width as well as 10 sq m in plan and 30 cm in depth shall be considered as excavation over area.

4.2 Surface dressing

Trimming of natural ground, excavated surfaces, and filled up areas to remove vegetation and/or small inequalities not exceeding 15 cm in depth shall be described as surface dressing.

4.3 Rough excavation

Excavation not requiring dressing of sides and bottom and reduction to exact levels, such as winning earth from borrow pits, hill side cuttings, etc. shall be described as rough excavation.

4.4 Surface excavation

Excavation exceeding 1 m in width as well as 10 sq m on plan but not exceeding 30 cm in depth shall be considered as surface excavation.

4.5 Trenches for pipes/cables

It shall be detailed with nominal dia of pipe/cable. Required bottom width, allowance for concrete foundation for laying pipes, working area, grip required for socketed pipe, return fill, ramming and removal of surplus soil shall be part of this item unless otherwise specified. It shall generally be measured in cubic metres unless specified specifically as running meter in the BOQ.

4.6 Post holes

Independent post holes (or similar holes) each not exceeding 0.5 cu m shall generally be enumerated. Rate shall include return fill, ramming and removal of surplus soil. However this shall be in cubic meters as part of excavation items.

4.7 General

4.7.1 The excavated earth shall be thrown or disposed off beyond 50 m periphery of the building. Earth suitable for backfilling shall be stacked separately.

Subsequent disposal of the surplus and unsuitable material shall be as per the respective items. Foundations, trenches shall be dug out to the exact dimensions as shown in the drawings or as directed by the Engineer-in-Charge.

4.7.2 In firm soil, the sides of the trench shall be kept vertical upto a depth of 2 m. If the trench is to be deeper, it shall be in the form of steps of 50 cm, at every 2 m depth. This shall be suitably increased or decreased as per site conditions and type

of soil met with. This shall be to the approval of the Engineer-in-Charge. Sloping of sides also may be adopted.

- 4.7.3 The bed of trenches shall be firmly consolidated and leveled by watering and ramming of the soft soil. Defective spots shall be dug out and filled with concrete of the same mix as of PCC or as directed by the Engineer-in-Charge. Cost of digging and filling with concrete shall be paid extra if excavation and PCC is measured separately.

If excavation is done to a depth greater than that required, excess depth shall be back filled with the same mix as of PCC or as directed. Cost of such concrete shall be to the contractor's account.

- 4.7.4 Excavated trenches shall have to be approved by the Engineer-in-Charge prior to laying of PCC or any other Permanent Work.

- 4.7.5 Excavation for drains shall be carried out with extra care to cut the sides and bottom exactly to the required shape, slope and gradient. Filling for excess deeper excavation shall be done at the contractor's cost in consultation with the Engineer-in-Charge.

- 4.7.6 Excavated materials shall not be placed within 1 m of the edge of the trench or half the depth of the trench, whichever is more.

- 4.7.7 Excavations for column footings shall be carried to depths indicated in the drawings. Safe bearing capacity at such depth shall be verified to comply design requirements. If ordered by the Engineer-in-Charge, appropriate tests shall be carried out by the contractor.

4.8 Protection

- 4.8.1 Fencing and/or other suitable measures for protection against risk of accidents due to open excavation shall be provided by the contractor at his cost.

- 4.8.2 Where excavation is to be carried out below the foundation level of an adjacent structure, and to avoid underpinning, precautions such as shoring and strutting, etc. must be taken. No excavation should start till such measures are taken to the satisfaction of the Engineer-in-Charge. Payments for such work shall not be made separately unless specified otherwise.

5.0 EXCAVATION IN SOFT ROCK

- 5.1 This shall be carried out by crowbars, pickaxes or pneumatic drills or any other suitable means. Blasting may be permitted if the contractor so desires but no extra money shall be paid for blasting.

- 5.2 Other general details same as clause 4.7 and its sub clauses.

6.0 EXCAVATION IN HARD ROCK

- 6.1 General

- 6.1.1 On meeting hard rock that requires blasting, the contractor shall inform the Engineer-in-Charge. On approval in writing, blasting operation shall start if the contractor feels it necessary and so desires.
- 6.1.2 The contractor shall obtain the necessary license from the District Authorities for undertaking blasting work and explosive storing as per Explosives Rules 1940, and as updated. Explosives shall only be procured from an authorised dealer. He shall be responsible for the safe custody and proper accounting of explosives. The Engineer-in-Charge shall have access to the store.
- 6.1.3 The contractor shall be responsible for any accident to those working on the site, to the public or to property due to blasting operations.

6.2 Precautions

- 6.2.1 Safety measures to be adhered to shall be as detailed in IS 4081, Safety Code of Blasting (as amended from time to time, and to related drilling operations). Also digest No.37 of C.R.R.I and I.R.C.A. Road tariff No.18 shall be adhered to.
- 6.2.2 Blasting operation shall be carried out under the supervision of a responsible authorised agent of the contractor. Timings shall be as approved by the Engineer-in-Charge in writing. Lunch break will be preferred. The authorised agent of the contractor should be well conversant with the rules and regulations of blasting operations. Further the contractor shall employ licensed blasters for actual operation.
- 6.2.3 All proper precautions for safety shall be taken. All persons shall be moved away to a distance not less than 200 m. All entries shall be sealed and red flags displayed at prominent places.
- 6.2.4 Blasting shall be done only with gunpowder. Dynamite, gelignite, or any other high explosive shall be used only with written permission of the Engineer-in-Charge.]
- 6.2.5 The number of charges to be fired and the actual number of shots heard shall be counted and the contractor's agent shall satisfy himself by examining that all charges have exploded. Only then shall workmen be allowed to start work. Unexploded charges shall be flooded with water, a new hole drilled and exploded again.
- 6.2.6 The ER shall be informed about all misfires, their causes and the remedial steps taken.

7.0 CLASSIFICATION

7.1 All soils comprising any of the following:

- a) Vegetable or organic soil, turf, sand, silt, loam, clay, mud, peat, black cotton soil, soft shale or loose murrum.
- b) Any mixture of soils in (a).
- c) Mud concrete below ground level.
- d) Generally any material which yields to the ordinary application of a pickax and shovel or to phawra, rake or other ordinary digging implement and not affording resistance to digging greater than mentioned in (a) to (c).
- e) Stiff heavy clay, hard shale, or compacted murrum requiring close application of a grafting tool or pick or both and shovel.
- f) Gravel and cobblestone (cobblestone is a rock fragment), usually rounded, having maximum dia in one direction of 75-300 mm.

7.2 Soft rock comprising any of the following

- a) Soling of roads, paths, etc. and hard core.
- b) Macadam surfaces of any description (water bound, grouted, tarmac, etc.)
- c) Lime concrete, stone masonry, in lime mortar and brick work in lime or cement mortar, below ground level.

- d) Soft conglomerate, where the stones may be detached from the matrix with picks, crow bars, wedges, etc.
- e) Limestone, sandstone, laterite, hard conglomerate or other soft or disintegrated rock which may be quarried or split with a crowbar.
- f) Unreinforced cement concrete which may be broken up with crowbars or pickaxes and stone masonry in cement mortar, below ground level.
- g) Boulders not requiring blasting, rock fragments usually rounded by weathering, disintegration and exfoliation or abrasion by water or ice, having maximum dia length in any direction of 500 mm, found loose, embedded, etc.
- h) Other varieties of rock which would normally be removed with pick, crowbars, wedges and hammer with only a little difficulty.

7.3 Hard rock comprising any of the following

- a) Any rock or cement concrete in excavation for which the use of mechanical equipment or blasting is required.
- b) Reinforced cement concrete.
- c) Boulders bigger than 1/2 cubic meter requiring blasting.

Hard rock as in (a) to (c) requiring blasting but prohibited from doing so for any reason and excavation has to be carried out by chiseling, wedging or any other agreed method.

8.0 FILLING

8.1 Filling shall be done where required with approved quality of earth. It may be from excavation and, where possible, cutting and filling shall be done simultaneously to avoid double handling.

8.2 Filling shall be done in layers not exceeding 20 cm in depth. Earth used shall be free from roots, grass and rubbish and all lumps and clods exceeding 8 cm in any direction shall be broken down. Each layer shall be watered with optimum moisture content to achieve 95% Procter density. Consolidation shall be done by mechanical roller of minimum 12 tons weight. The roller shall pass a minimum of 10 runs evenly to achieve dense consolidation. All undulation made up and final layer re-rolled.

8.3 Sand filling

The sand shall be free from any organic and deleterious materials as detailed in IS. It should be suitable for compaction. Filling shall be in layers of 15 to 20 cm watered with optimum moisture content and mechanical rammers.

8.4 Rubble soling

Good quality 150 mm to 230 mm thick rubble soling shall be carried out depending upon the grade of soil. Rubble used shall be at least 100 mm for 150 mm thick soling and 150 mm for 230 mm thick soling. Stone shall be hand packed as close as possible and bedded firmly with the broadest face downwards and the greatest length across, voids filled with chips and small stones. These shall be hammered down to achieve packing and the complete filling of interstices. To achieve the desired levels and slopes, pegs at suitable intervals (about 12 m) shall be fixed. Soling shall be watered and again packed with sand

or murrum to fill interstices created by watering. Then it shall be rolled with 10 ton roller or vibratory compactor. Filling sand or murrum, watering and rolling shall continue till full compactness is achieved to satisfaction of the Engineer-in-Charge.

8.5 Metal packing

Coarse aggregate used for metal packing shall be crushed or broken stone, hard, durable and free from excess of flat, elongated, soft and disintegrated particles, dirt and other objectionable matter.

Prepared sub-base surface shall be uniformly spread with well graded metal. Templates shall be used for leveling. Leveling shall be true and checked with 3 m straight edge. Any raised areas or depressions of more than 12.5 mm shall be corrected. This shall be rolled with power wheel roller of 6 to 10 tons as required or as asked by the Engineer-in-Charge for the intended purpose. Rolling shall continue till aggregate is thoroughly keyed and the creeping of the aggregate ahead of the roller is no longer visible. The rolled surface shall be checked and all irregularities corrected by loosening the surface, adding or removing necessary amounts of aggregate and rerolling until the complete area conforms to the required datum. After the coarse aggregate has been thoroughly keyed and set by rolling, screening shall be carried out to fill the interstices. This shall be done in 3 to 4 layers. Material shall be dry and no sprinkling of water shall be allowed.

9.0 PLANKING AND STRUTTING

In case of deep trenches where the soil is soft and not capable of being retained without the help of support, planking and strutting as required shall be carried out. It shall be the responsibility of the contractor to take steps to prevent slide/collapse. Method of planking/strutting will be largely influenced by the type of soil encountered and as approved by the Engineer-in-Charge.

10.0 DISPOSAL OF SURPLUS EARTH

10.1 Surplus earth shall be used to the maximum extent in the compound. Earth useful for filling shall be separately stacked as directed by the Engineer-in-Charge from time to time. Approved quality earth shall be used in the filling. It shall be consolidated as detailed and approved by the Engineer-in-Charge.]

10.2 Rate for excavation shall include sorting out of useful materials.

10.3 All surplus and unusable earth shall be disposed off outside the plot but at a location approved by local authority and conforming to their specification. The contractor shall quote his rate for disposing off or carting away the items considering requirements and standards of the local authority with whose permission surplus and unusable earth shall have to be disposed off.

11.0 DEWATERING

11.1 The works covered by this section of the specifications consist of furnishing all plant, labour, equipment appliances and materials and in performing all operations in connection with earthworks of all underground supplies and services and for all structural units, stock piling of suitable excavated materials, disposal of unsuitable and surplus excavated material, in accordance with this

section of specifications and applicable drawings and subject to terms and conditions of the contract.

- 11.2 The Contractor shall acquaint himself of the nature of the ground, existing structures, foundations and subsoil which might be encountered during excavation of earthworks. The Employer does not guarantee or warrant in any way that the material to be found in the excavation will be similar in nature to that of any samples which may have been exhibited or indicated in the Report, Drawings or in any other Contract Documents or to material obtained from boring or trial pits. The Contractor shall be deemed to have made local and independent inquiries towards the nature of the ground, subsoil conditions or material to be excavated or penetrated. The Contractor shall not be entitled to receive any extra or additional payment on account of any variations.
- 11.3 All excavations, cuttings, and fills shall be carried out to the lines, levels and gradients specified with necessary allowance for consolidation, settlement and drainage. Any approval from Consultant shall not relieve the Contractor of any of his duties under the Contract.
- 11.4 The dewatering system shall consist of the basic dewatering system, a standby dewatering system, standby power system, monitoring devices, ditches, sumps, pumps and all associated equipment as specified herein. The basic dewatering system shall be the minimum dewatering system required to achieve the specified result.
- 11.5 The standby dewatering system shall be that system, which may be required to achieve the specified results, should part or all of the basic dewatering system becomes ineffective for maintenance or any reasons, other than a failure of power supply.
- 11.6 The standby power system shall be that independent generating system which may be required to keep the dewatering system fully operational in the event of a power failure.

11.7 DESIGN OF DEWATERING SYSTEM

- 11.7.1 The Contractor shall arrange to have the entire dewatering system designed in detail, installed, maintained and operated by qualified and experienced personnel throughout the course of the work. If the Contractor wishes to appoint some properly qualified dewatering sub-contractor, then his name, qualifications, record of previous jobs of a similar nature, personnel to be employed on the work, and other pertinent information shall be submitted to the Project Engineer for approval. Two weeks prior to commencement of installation of the dewatering system, Contractor shall submit to the Project Engineer for his technical approval, complete final plans, details and description of the dewatering system. Approval of the dewatering system by the Consultant shall in no way relieve the Contractor from his responsibility of satisfying the entire dewatering requirements as specified herein.

11.8 DEWATERING THE EXCAVATIONS

- 11.8.1 The Contractor shall install, maintain and operate a system of wells, trenches and pumps as required performing the excavations for the areas and subsequent construction of the structures and placement of backfill, in dry condition. Dewatering of the excavation shall be accomplished in a manner that will prevent seepage, boils, loss of fines, corrosion, softening of the strata, and that will maintain the stability of the bottom and slopes of excavation. In case any damage is caused to the work, in the opinion of the Project Engineer, due to inadequacy or failure of the dewatering

system, in part or in whole, then the supply of all labour, materials and plant, and the performance of all work necessary to carry out additional or remedial work resulting from such damage shall be undertaken by the Contractor at his own cost. The cost of any damage caused to the structures or other equipment due to the failure of the dewatering system shall be borne by the Contractor and shall be covered by proper insurance to be provided by the Contractor, in accordance with insurance clauses of the "General Conditions of Contract".

- 11.8.2 The dewatering system shall be designed to operate on a continuous basis in such a manner that during excavation, the water level as observed in all piezometers installed near the periphery of the excavation with their tips located below the prevailing excavation level, is at least one meter below the prevailing excavation level. If the water level observed in any or all of the piezometers is higher than that specified, the excavation shall be halted until remedial measures to the dewatering system have been effected and the specified water levels in the piezometers attained or until the Contractor demonstrates to the satisfaction of the Project Engineer that it is safe to proceed with the excavation. Piezometers tips shall be installed near the bottom of the hole drilled for that purpose.
- 11.8.3 During construction of structures and subsequent backfill placement and associated work operations, the dewatering system shall operate on a continuous basis in such a manner that the water level, as observed in the piezometers located below the level of construction and backfill placement is at least one meter below the lowest point of construction and backfill placement and the water level in the piezometers is maintained at such level till the concrete if any, has sufficiently hardened and until in the opinion of the Project Engineer, it is safe to allow the water level to rise up to a predetermined level.
- 11.8.4 The Dewatering System shall be maintained in operating condition so as to achieve the specified results until the construction of the structures and the backfill placement at all points, and installation of machinery and other associated equipment and embedded parts has reached a stage when, in the opinion of the Project Engineer Dewatering system can be cut off in stages as directed by the Project Engineer.
- 11.8.5 The Contractor shall not permit the accumulation of surface water within the confines of the excavation areas. The Contractor shall control, remove and divert surface water run-off, and water discharging from the dewatering system away from the excavations, to a point outside the working area as required by the Project Engineer.
- 11.8.6 The Contractor shall perform all work including, but not limited to, the construction and maintenance of ditches and sumps and provide, install, maintain and operate pumps and pipelines of adequate capacity as are necessary for the effective control of surface run-off and ground water not required to be intercepted by the dewatering system.
- 11.8.7 The Contractor shall supply, install, maintain and operate as required, the generators for power supply which shall be of sufficient capacity to maintain all pumps and equipment for both the Basic and Standby systems, operating on a continuous basis.
- 11.8.8 The Contractor shall supply, install and maintain an alarm system that will alert responsible personnel at the time of power failure and at the same time will automatically activate the standby units
- 11.8.9 The dewatering system shall be designed in such a manner that all or parts of the standby system may be directly connected to the basic system.
- 11.8.10 The standby dewatering systems shall be operated for a period of at least 3 hours duration each week to demonstrate its complete effectiveness. For such demonstrations, the Contractor shall not be entitled to any payment/ compensation.

11.9 OBSERVATIONS

- 11.9.1 Contractor's dewatering system shall include the supply, installation, data recording and maintenance of piezometers as may be required to demonstrate the satisfactory performance of the dewatering system.
- 11.9.2 In order to ascertain the continuous effectiveness of the dewatering system, Contractor shall supply all equipment and perform all work necessary to obtain and correlate records of the water elevation in each of the piezometric observation wells and records of the discharges from the dewatering system. These data shall be obtained on a continuous basis and shall be properly compiled and copies of the compiled data shall be submitted to the Project Engineer daily, or as required. The Contractor shall also keep the Project Engineer advised on a daily or as required basis on the equipment being utilized to effect the required results during the entire period when the dewatering system is in operation.
- 11.10 If at any time the Project Engineer is dissatisfied with the performance of dewatering system installed and operated by the Contractor, and if in his opinion it is necessary to make substantial changes in the dewatering system to achieve the desired results, the Contractor shall be entitled to do the same without any extra cost.

12.0 Soil Erosion Measures

12.1.1 Timing of Construction

Construction work and erosion control applications shall be scheduled and sequenced during dry weather periods when the potential for erosion is the lowest. Slope construction techniques to control erosion shall be used when construction during wet season is unavoidable. Sedimentation collection systems, drainage systems, and runoff diversion devices shall be installed before construction activity. The Landscape Architect/Architect/Engineer-in-charge shall monitor the site conditions and progress of work and schedule appropriate timing and sequencing of construction.

12.1.2 Preservation of Existing Vegetation

Protection of existing vegetation (including trees, shrubs, grasses and other plants) where possible, by preventing disturbance or damage to specified areas during construction is recommended. This practice minimizes the amount of bare soil exposed to erosive forces. All existing vegetation shall be marked on a site survey plan. A tree survey in prescribed format shall be carried out as indicated in Table below. The landscape plan should indicate trees, which have been preserved, and also those, which had to be transplanted or removed clearly differentiating between these three categories.

Plant Material Schedule for Tree Survey

Tree No	Botanical Name	Girth	Height	Spread	Condition

12.1.2.2 Trees retained on the project site shall be protected during the construction period by following measures:

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- a) Damage to roots shall be prevented during trenching, placing backfill, driving or parking heavy equipment, dumping of trash, oil, paint and other materials detrimental to plant health by restricting these activities to outside the area of canopy of trees.
- b) Trees will not be used for support; their trunks shall not be damaged by cutting and carving or by nailing posters, advertisements or other material.
- c) Lighting of fires or carrying out heat or gas emitting construction activity within the ground, covered by canopy of the tree shall not be permitted.
- d) Young trees or saplings identified for preservation (height less than 2.00 m, 0.10 m trunk girth at 1.00 m height from finish ground, 2.00 m crown diameter) within the construction site have to be protected using tree guards of approved specification.
- e) Existing drainage patterns through or into any preservation area shall not be modified unless specifically directed by the Landscape Architect/Architect/Engineer-in-charge.
- f) Existing grades shall be maintained around existing vegetation and lowering or raising the levels around the vegetation is not allowed unless specifically directed by the Landscape Architect/Architect/Engineer-in-charge.
- g) Maintenance activities shall be performed as needed to ensure that the vegetation remains healthy
- h) The preserved vegetated area shall be inspected by the Landscape Architect/Architect /Engineer-in-charge at regular intervals so that they remain undisturbed. The date of inspection, type of maintenance or restorative action followed shall be recorded in the logbook.

12.1.3 Staging Areas

Measures shall be followed collecting runoff from construction areas and material storage sites; diverting water flow away from such polluted areas, so that pollutants do not mix with storm water runoff undisturbed areas.

Temporary drainage channels, perimeter dike/swale, etc shall be constructed to carry the pollutant-laden water directly to treatment device or facility. The plan shall indicate how the above is accomplished on site, well in advance of the commencing of the construction activity.

12.1.4 Prevention of Topsoil

Topsoil removal and preservation shall be mandatory for development projects larger than 1.00 Hector. Topsoil shall be stripped to a depth of 200 mm from areas proposed to be occupied by buildings, roads, paved areas and external services. Topsoil is rich in organic content and is essential to establish new vegetation. It shall be stockpiled to a height of 400 mm in designated areas and shall be reapplied to site during plantation of the proposed vegetation. Topsoil shall be separated from subsoil debris and stones larger than 50 mm diameter. The stored topsoil may be used as finished grade for planting areas.

12.1.5 Spill Prevention and Control

Spill prevention and control plans shall be made, clearly stating measures to stop the source of the spill, to contain the spill, to dispose the contaminated material and hazardous wastes, and stating designation of personnel trained to prevent and control spills. Hazardous wastes include pesticides, paints, cleaners, petroleum products, fertilizers and solvents.

13.0 ANTI-TERMITE TREATMENT

13.1 Indian Standards

Indian Standards to be followed are

- 1) IS 4015 (Part-I & II) - Guide for handling cases of pesticide poisoning.
- 2) IS 6313 (Part-I) - Code of practice for Anti- termite measures in buildings constructional measures
- 3) IS 6313 (Part - II) - Code of practice for anti-termite measures in Building (pre constructional chemical treatment)
- 4) IS 8944 - Specification for Chloropyrifos Emulsified concentrates.

13.2 Materials

One of the following chemicals in water emulsion shall be used

13.2.1 For mound treatment

	Chemical	Relevant Indian Standard	Concentration By Volume
a	Cholopyrifos emulsifiable concentrate	IS : 8944	1.0%
b	Lindane	IS : 632	1.0%

13.2.2 For soil treatment

	Chemical	Relevant Indian Standard	Concentration By Volume
a	Cholopyrifos emulsifiable concentrate	IS : 8944	1.0%
b	Lindane	IS : 632	1.0%

13.3 Workmanship

13.3.1 Conditions of formation

Barrier shall be complete and continuous under the whole of the structure to be protected. All foundation shall be fully surrounded by and in close contact with the barrier of treated soil. Each part of the area treated shall receive the prescribed dosage of chemical.

13.3.2 Time of application

Soil treatment should start when foundation trenches and pits are ready to take mass concrete in foundations. Laying of mass concrete should start when the chemical emulsion has been absorbed by the soil and the surface is quite dry. Treatment should not be carried out when it is raining or when the soil is wet with rain or sub-soil water. The foregoing applies also in the case of treatment to the filled earth surface within the plinth area before laying the sub-grade for the floor.

13.3.3 Disturbance

Once formed, treated soil barriers shall not be disturbed. If, by chance, treated soil barriers are disturbed, immediate steps shall be taken to restore the continuity and completeness of the barriers- system.

13.4 Termite mound treatment

If termite mounds are found within the plinth area, these shall be destroyed by pouring into the mounds at several places, after breaking open the earthen structure, and making holes with crow- bars, at the rate of approximately 4 litres of emulsion per cubic meter of mound.

13.5 Soil Treatment

13.5.1 Treatment of column pits foundation, trenches and basement excavations:

The bottom surface and the sides (upto a height of 300 mm above concrete foundation level) of the excavations made for column pits, wall trenches and basements shall be treated with the chemical at the rate of 5 litres per sqm of surface area. After the column foundation and retaining walls of the basement come up, the back fill in immediate contact with the foundation structure shall be treated at the rate of 15 litres per sqm. of the vertical surface of the sub-structure for each side. If water is used for ramming the earth fill the chemical treatment shall be carried out after ramming operation is done by rodding the earth at 150 mm centers close to wall surface and spraying the chemical with the above dose. As earth is filled in layers the treatment shall be carried out in similar stages. The chemical emulsion shall be directed towards the concrete or masonry surfaces of the columns and walls so that earth in contact with these surfaces is well treated with the chemicals. In the case of RCC framed structure with columns and plinth beams and RCC basements, the treatment shall start at the depth of 500 mm below ground level. From this depth the back fill around the columns beams and RCC basement wall shall be treated at the rate of 15 liters per sq m. of vertical surface. The other details of treatment shall be as described below:

13.5.2 Treatment to top surface of plinth filling:

After the earth filling is completed in the plinth area and before the rubble packing or subgrade is laid, the entire surface of the filled earth shall be treated with the chemical emulsion at the rate of 5 litres per sq m. Light rodding may be carried out in the soil surface to facilitate absorption saturation of the soil with chemical emulsion.

b) For buildings where construction has advanced already for facility of construction, the treatment could also be done effectively, over the base concrete (lean mix) under the floor taking care that the emulsion, at the rate of 5 litres per sq m. soak fully into

the concrete. The above application effectively prevents entry of termites through the floor structure.

13.5.3 Treatment of soil along external perimeter:

Finally the earth around the external perimeter of the building upto a depth of 30 cm shall be treated at the rate of 5.0 litres per running meter of the external wall. To facilitate this treatment solid MS rods should be driven into the soil as close possible to the plinth wall at intervals of 15 cm, and upto a depth of 30 cm, and the rods moved backwards and forwards in a direction parallel to the wall to break up the earth so that the emulsion mixes intimately with the soil.

13.5.4 Treatment of soil surrounding pipes, wastes and conduits:

When pipes, wastes and conduits enter the soil inside the area of the foundation, the soil surrounding the points of entry shall be loosened around each such pipe, waste or conduits for a distance of 15 cm, and upto a depth of 7.5 cm before the treatment is commenced. When they enter the soil external to the foundations, they shall be similarly treated unless they stand clear of the walls of the building by about 7.5 cm for a distance over 30 cm.

13.5.5 Treatment for expansion joints

Expansion joints at ground floor level are one of the biggest hazards for termite infestation. The soil beneath these joints should receive special attention when the treatment under para 13.5.4 is carried out. This treatment should be supplemented by treating through the expansion joint after the sub-grade has been laid at the rate of 2 litres per linear meter

13.6 Spraying Equipment

A pressure pump shall be used to carry out spraying operations to facilitate uniform spraying and penetration of chemical into the earth. The chemicals, concentration and dosage for horizontal and vertical surfaces are based on the IS code of practice for Anti- termite measures in Buildings. IS 6313 (Part-II).

13.7 Safety

Work shall be carried out as per safety measures instructions of manufacturer of approved pesticide & direction of Engineer-in-Charge. Also IS 4015 part I and II shall be followed.

13.8 Free Service Guarantee

The contractor shall note that termite proofing work is subject to a free service guarantee from the date of completion of the treatment. The contractor shall give an undertaking in writing to the effect that during the guarantee period any infestation of subterranean termites will be eradicated and necessary treatment carried out to prevent re-infestation, free of cost to the employer. The guarantee shall allow a minimum period of- 5 (Five) years for pre-constructional treatment.

Tenders must ensure that the work will be done through the professional Pest Control operator. They should be members of National Pest Control Association of USA, or Indian Pest Control Association or any other recognized professional body. They should furnish a list of Termite Control jobs carried out by them successfully for Government Department, Statutory bodies or large private organizations to prove that they are capable of handling anti termite work.

Technical specifications – SHEET PILING

Sheet piling shall be designed by the contractor to resist all dead and live loadings (earth pressures, hydrostatic pressures, traffic loads, point loads, line loads and surcharge loads) that the sheet piles may experience during the service life of the structure. In the design for sheet pile wall, account shall be taken of the following types of loads and forces:-

- i. Active and passive earth pressure,
- ii. Lateral earth pressure due to surcharge loads,
- iii. Differential water pressure and seepage pressure,
- iv. Earthquake force, and
- v. Stresses due to handling and driving.

Sheet piling material may be of RCC piles, timber, reinforced concrete, pre-stressed concrete or steel. Depending upon the materials adopted by looking at various parameters, the conformance shall be as per the specifications given for the timber, reinforced concrete, prestressed concrete and steel sheet pile sheet pile in accordance with IS: 2911 (Part II)-1980, IS: 456-1978, IS: 1343-1980 and IS: 2314-1963 respectively.

The contractor shall submit design calculations, including soil design parameters used, methods of construction, and detailed drawings for all the design cases. He shall be responsible for the external stability of all temporary sheet piles. Differential and absolute settlements of sheet piles shall be limited to ensure minimal detrimental effects.

When a satisfactory bearing stratum is not encountered at a reasonable depth below the surface in front of the earth to be retained, then a sheet-pile wall may be provided. If the height of the wall and the pressure on the sheet-piles are such that an excessively thick pile is required, the provision of a tie at the level of the capping beam reduces the maximum bending moment. The tie can be provided at one level or at many levels. The ties are not only at top level but also intermediate levels also. The ties numbers can be either being reduced or increased depending upon the availability of anchorage n economy of design.

SECTION VIII CONCRETE WORK

1.0 GENERAL

1.1 Standard

Work shall be carried out to Indian Standards and Code of Practices. In absence International Standards shall be followed. These shall be latest issue. List given hereunder is not to be considered as conclusive and is for reference and guidance only. Any discrepancies /conflict noticed shall be directed to the Engineer-in-Charge for his direction/approval. However as a general rule more stringent specification shall take precedence.

- 1) IS 269 Specification for Ordinary and low heat, Portland cement
- 2) IS 8112 Specification for 43 grade ordinary Portland cement
- 3) IS 12269 Specification for 53 grade ordinary Portland cement
- 4) IS 383 Specification for Coarse and fine aggregates from natural sources for concrete
- 5) IS 456 Code of practice for plain and reinforced concrete
- 6) IS 460 Specification for test sieves (Part I,II & III)
 - i. Wire cloth test sieve
 - ii. Perforated plate test sieve
 - iii. Method of examination of test sieves
- 7) IS 515 Specification for natural and manufactured aggregates from natural sources for concrete.
- 8) IS 516 Method of test for strength of concrete
- 9) IS 875 Design loads for building structure. (Part I,II,III)
- 10) IS 1199 Method of Sampling and analysis of concrete
- 11) IS 1791 Batch type concrete mixers
- 12) IS 1893 Earthquake resistant design.
- 13) IS 2386 Method of test for aggregate for concrete (Part I,II & III)
 - i. Particle size and shape
 - ii. Estimation of deleterious materials and organic impurities
 - iii. Specific gravity, density, voids, absorption and bulking.
- 14) IS 2505 General requirements for concrete vibrators
- 15) IS 2645 Specification for Integral cement water proofing compound
- 16) IS 3025 Methods of Sampling and test (Physical and Chemical for water)
- 17) IS 4326 Code of practice for earthquake resistant design and construction of building.
- 18) IS 4926 Specification for ready mixed concrete
- 19) IS 7861 Code of practice for extreme weather concreting
 - i. Recommended practice for hot weather concreting
 - ii. Recommended practice for cold weather concreting
- 20) IS 9103 Specifications for admixture for concrete
- 21) IS 12118 (Part I) Specification for two parts polysulphide based sealant : general requirements
- 22) SP 16 Handbook
- 23) SP 23 Handbook on concrete mix
- 24) SP 24 Explanatory handbook on Indian Standards code for plain and reinforced concrete (IS 456)

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1.2 Quality Assurance

- 1.2.1 Concrete used on site shall comply to relevant parts of Standards, Codes of practices, technical specification given in particular or approved, designed mixes as prepared, approved and adopted for works to give designed strength, serviceability, long term durability etc.
- 1.2.2 Provide and monitor quality control over materials received from suppliers / manufacturers to ensure that materials comply with standard specified and are as approved.
- 1.2.3 Provide experienced supervision and work force to ensure that workmanship is of specified quality.
- 1.2.4 Work shall not be subjected to harmful, dangerous, damaging or deleterious exposures while it is in progress or on completion during contract period.
- 1.2.5 Contractor to under take quality assurance by documenting.
 - Test report for material used in producing concrete.
 - Mix design details with laboratory test report, actual site trial mix test and accepted modified design if any
 - Pour cards with approval of the Engineer-in-Charge prior to placement
 - Control charts
 - Non conformance reports, changes, orders etc.

1.3 Submittals

- 1.3.1 Submit samples of all materials such as cement, sand, aggregate, admixtures, water etc to be incorporated into concrete along with test certificates from Govt .Engineering colleges like VGIT, IIT etc or Govt approved laboratories for the Engineer-in-Charge's approval.

1.3.2 Samples

During construction, the materials shall be sampled and tested as often as directed by the Engineer-in-Charge to the contractor. Samples shall be taken and tested in accordance with latest revisions of Indian standard specifications and the cost thereof shall be borne by the Contractor.

1.3.3 Shop Drawings

Contractor shall prepare and submit method made of casting of slabs, beams with details of construction and expansion joint for approval of the Engineer-in-Charge.

1.4 Examination of conditions

Contractor shall inspect and examine sub stratas and confirm prior to start that.

- Substrate is acceptable and approved by Engineer-in-Charge.
- Conditions are satisfactory
- Setting out/Layout is verified

- Corrective measures needed if any are within reach and contractor proceeds with full responsibility for work.

2.0 MATERIALS

2.1 Cement

Cement shall be ordinary Portland cement conforming to IS and shall be of grade 53/43 for structural use .

It shall be received in bags of 50 kg or loose in tankers and each batch shall be accompanied with a test certificate of the factory. Also it shall be tested before use to ascertain its strength, setting time, etc. In case cement has been stored for over 3 months or for any reasons the stored cement shows signs of deterioration or contamination, it shall be tested as per the direction of the Engineer-in-Charge prior to use in the works.

2.2 Coarse aggregate

- 2.2.1 Coarse aggregate shall be obtained from natural sources such as stone, gravel, etc., crushed or uncrushed or a combination thereof from approved quarries. Aggregate shall be hard, strong, dense, durable, clean and free from veins and adherent coatings. It shall be free from soft, feeble, thin, elongated or laminated pieces and shall be roughly cubical in shape. It shall consist of coarse material, most of which is retained on 4.75 mm IS sieve.
- 2.2.2 Coarse aggregate shall not contain any harmful material such as iron, pyrites, coal, mica, shale or similar laminated material; neither shall it contain clay, alkali, soft fragments, sea shells, organic impurities, etc. in such quantities that adversely affects the strength and durability of the concrete. In addition to the above, in reinforced concrete the aggregate shall not contain any material which might attack the reinforcement. The maximum quantities of deleterious materials in the coarse aggregate, when determined in accordance with IS 2386 Part I and Part II "Method of test for aggregates for concrete" shall not exceed the limits laid down in table 1 of IS 383.
- 2.2.3 Aggregate crushing value, impact value, abrasion value and soundness of aggregate shall respectively be in accordance with para 3.3, 3.4, 3.5 and 3.6 of IS 383.
- 2.2.4 Grading of coarse aggregate shall be in conformity with the requirements laid down in IS-383. See table 2 and table 3.

The grading of coarse aggregate shall be such that not more than 5% shall be larger than the maximum size and not more than 10% shall be smaller than the smallest size. Between these sizes the coarse aggregates shall be well graded.

For heavily reinforced concrete the aggregate shall be subjected to tests in accordance with IS 2386 or as directed by the Engineer-in-Charge.

The maximum size of coarse aggregate should not be greater than one fourth of the minimum thickness of the member and it should be restricted to 5 mm less than the

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minimum clear distance between the main bars or 5 mm less than the minimum cover to the reinforcement.

2.2.5 Source of aggregate shall be from an approved Government location. It shall be tested prior to the approval of the Engineer-in-Charge from an approved testing laboratory. In case available aggregates do not meet certain requirements of IS 383 or any other specification, required processing shall be carried out by the contractor. It shall be the duty of the contractor to make sure that aggregate material received by him is from Government approved quarries and with fully paid royalties, taxes, duties, etc. as may be in force from time to time for respective locations.

2.2.6 Coarse aggregate shall have a minimum specific gravity of 2.6. (Saturated surface dry basis). Aggregate below this specific gravity shall not be used without the special permission of the Engineer-in-Charge.

2.2.7 Once a specific source of supply of coarse aggregate is approved, the source shall not be changed without the prior approval of the Engineer-in-Charge.

2.3 Fine aggregate

2.3.1 Natural sand deposited by stream or glacial agencies as a result of disintegration of rock shall be used as fine aggregate. Fine aggregate shall pass through 4.75mm sieve in total. Crushed sand may be added to natural sand in approved proportions to achieve required grading. The fine aggregate shall conform to following standards.

- i. For plain and reinforced concrete IS 383 Specification for coarse and fine aggregates from natural sources for concrete.
- ii. Mortar and grout IS 2116 Specification for sand for masonry mortars.

2.3.2 Sea sand shall not be used unless special approval by the Engineer-in-Charge in writing is given. If approved, the required treatment shall be done at the contractor's cost.

2.3.3 Sand shall be hard, durable, clean and free from adherent coatings and organic matter and shall not contain any appreciable amount of clay. Sand shall not contain harmful impurities such as iron, pyrites, coal particles, lignite, mica shale or similar laminated material, alkali, and organic impurities in such form or quantities as to affect the strength or durability of concrete or mortar. Also it should not contain any material liable to attack the steel reinforcement.

2.3.4 When tested as per IS 2386 Part I and Part II, fine aggregate shall not exceed permissible quantities of deleterious materials as given in table 1 of IS 383.

2.3.5 Fine aggregate shall be thoroughly washed at site with clean fresh water such that the percentage of all deleterious material is within the permissible limits laid down.

2.3.6 Grading of fine aggregate shall conform to IS and shall fall within limits of one of the four zones given in table 4 of IS 383.

- 2.3.7 Due allowance for bulking due to damp and moist sand shall be made while preparing the mixes based on volume measurements. It shall be determined as per IS 2386 Part III Appendix A.

2.4 Water

- 2.4.1 Water used for mixing and curing shall be clean, reasonably clear and free from objectionable quantities of silt, oils, alkalies, acids, salts so as not to weaken mortar or concrete or cause efflorescence or attack the steel in RCC while curing it shall be free of elements, which significantly affects the hydration reaction or otherwise interferes with hardening of concrete during curing or those elements which produce objectionable stains or deposits. Potable water is generally satisfactory but it shall be tested prior to use in the works.
- 2.4.2 Water tested shall be in accordance with IS 3025. Maximum permissible limits of deleterious materials in water as given in IS 456.
- 2.4.3 Suitability of water shall be ascertained by the compressive strength and initial setting time test as specified under :
- Average 28 days compressive strength of atleast three 15 cm concrete cubes prepared with water proposed to be used shall not be less than 90% of the average strength of three similar concrete cubes prepared with distilled water. Preparation and testing to be in accordance with IS 516.
 - The initial setting time of test blocks made with proposed cement and water to be used shall not be less than 30 minutes and shall not differ by + 30 minutes from the initial setting time of control test block prepared with the same cement and distilled water. Preparation and testing of block shall be in accordance with IS 4031.
- 2.4.4 The PH value of water shall not be less than 6 and more than 9.
- 2.4.5 Water shall be tested and approved in writing by the Engineer-in-Charge prior to use in the works.

2.4.6 Sea water

Sea water in concrete shall not be permitted unless specifically approved in writing by the Engineer-in-Charge for purpose stated. The Engineer-in-Charge, under unavoidable circumstances, may allow mixing or curing by sea water in concrete construction which are permanently under sea water.

2.5 Admixture

- 2.5.1 These are substances other than cement, aggregate and water and shall be permitted to be used to modify the properties of concrete for single, or a combination of purposes. This shall be used only on the written approval for specific purpose and at the cost of the contractor. Good concrete shall be achieved without the aid of any admixtures.
- 2.5.2 Admixtures shall be free from chlorides and sulphates which might affect concrete or any other material which may cause problems to the concrete in the due course of time. Also it shall have no effect on the reinforcement in case of Reinforced Cement Concrete.
- 2.5.3 Admixtures generally in use are classified as under:
- Accelerators
 - Retarders
 - Workability agents

- d. Water repelling agents
- e. Air-entraining agents
- f. Gas-forming agents
- g. Corrosion inhibitor additive

These are manufactured and sold by various companies under brand names. The contractor proposing to use any one of them shall submit to the ER technical literature with its chemical composition, purpose of use and method recommended by the manufacturer and what he proposes to follow at site for strict control.

2.5.4 The contractor's proposal shall accompany the followings with his request to use admixture.

- a. The trade name of the admixture, its source and the manufacturer's recommended method of use.
- b. Typical dosage rates and the possible detrimental effects of under and over dosage.
- c. Whether the admixture contains chloride in any free form or any other chemical present as an active ingredient which is a likely cause of corrosion of reinforcement or deterioration of concrete.
- d. The average expected air content of freshly mixed concrete containing an admixture which causes air to be entrained when used at the manufacturer's recommended rate of dosage.

2.6 Miscellaneous

2.6.1 Integral cement water proofing compound specified for specific use shall conform to IS-2645.

2.6.2 Bituminous felts for water proofing and damp proofing course shall conform to IS 1322.

2.6.3 Bituminous compounds for water proofing purposes shall conform to IS 1580.

2.6.4 Expansion joint filler

Bituminous impregnated premoulded preformed expansion joint filler board conforming to IS 1838 part (I) specification for preformed filler boards shall be of approved quality and thickness at designated locations.

2.6.5 2.6.5 Poly sulphide sealants

- i. Expansion, construction or other joints shall be sealed with approved quality polysulphide sealants.
- ii. One part gun grade polysulphide-based joint sealants shall conform to IS 11433(Part I). It shall be used with the approval of the Engineer-in-Charge and as per the manufacturer's instructions. Correct primer shall be used at the specified location.
- iii. Two part polysulphide based sealant gun grade or pouring grade shall conform to IS 12118 (part I). Pouring grade shall be used in horizontal joints. Gun grade shall be used in vertical, inclined and horizontal joints. Specified primer shall be applied prior to the use of sealant. Use of sealant shall be as per instructions of the approved manufacturer.
- iv. Sealant shall be cured at ambient temperature and humidity when applied as per the approved manufacturer's instruction and received in suitable packs. Each package shall indicate
 - Manufacturer's name and trade mark
 - Weight of the components

- Instructions for storage
- Type and grade of sealants
- Date of manufacture and expiry
- Instructions for use

2.6.6 Water bar

PVC or rubber water bar of type, quality and width shall be used as approved by the Engineer-in-Charge. Water bar shall be continuous and fixed at the indicated locations. Water bar should be welded or joined with the approved method. All angles and corners shall be purpose-made and shall be joined with the approved method.

2.7 Delivery and Storage

2.7.1 It shall be received in bags of 50 kgs and each batch shall be accompanied with a test certificate of the factory. Reject damp or torn bags. Cement shall be stored in dry and water proof shed so as to prevent deterioration due to moisture, dampness. Bags shall be stacked on rigid water-proof platforms about 15 to 20 cm clear above the floors and 25 to 35 cm clear or away from the surrounding walls. A maximum high stack of 10 bags permitted. Stacks shall be so arranged that the first batches are used first, (FIFO) and that they permit easy access for inspection and handling. Loose cement received shall be stored in silo's. Silo's shall be equipped to receive cement by pump and manually. Silo's shall be water tight and damp proof to keep cement fresh.

2.7.2 Coarse Aggregates and Fine Aggregates

Aggregate shall be stored in such a way that it does not get mixed with mud, grass, vegetables and other foreign matter. The best way is to have a hard surface platform made out of concrete, bricks or planks. It should be to the approval of the ER.

2.7.3 Water

Water storage tanks shall be such as to prevent any deleterious materials getting mixed with it.

2.7.4 Covered storages

Considering the atmospheric/ weather conditions at site storages, covering shall be arranged to take care of temperature controls at site.

3.0 CONCRETE

Concrete is prepared by mixing graded aggregate of stone or along with cement, in a specified proportion. Mixing shall be done by batching plant for better quality control. For PCC / Mass foundations mechanical mixers can be used with permission of Engineer-in-Charge. Manual hand mixing shall be permitted in specific cases with the written permission of the Engineer-in-Charge on account of small quantity or location or any other reason acceptable to the Engineer-in-Charge.

3.1 Cement concrete

This shall be classified as plain cement concrete or reinforced cement concrete. Plain cement concrete shall be in leveling course under foundations, floors, copings, etc. and shall include form work as part of the work.

Reinforced cement concrete shall be at all locations and comprises form work, reinforcement and concrete. Payment of reinforced cement concrete may be composite or item wise as specified in the BOQ. In PCC, payment for form work shall not be made.

3.1.1 Concrete shall be classified by its compressive strength at the 28th day. The concrete grades shall be as designated in table 2 of IS 456 "Grade of concrete".

3.1.2 Design mix

Various types of concrete aimed are to be used in works. It shall be the responsibility of the contractor to carry out design mixes and approval of the same shall be obtained from the Engineer-in-Charge at least 35 days in advance from the actual pouring of concrete at site in the permanent works.

- i. Mix design of concrete shall be done as per IS 10262 & SP 23, 24. Following basic points shall be finalised.
 - Characteristic compressive strength and targeted compressive strength required at design stage.
 - Standard deviation factor based on site actual execution conditions.
 - Minimum cement specified in BOQ or as per IS for strength and durability for location where concrete is to be used.
 - Water cement ratio permitted by IS.
 - Workability to be achieved for better workmanship and good quality concrete
 - Admixtures to be used if any
 - Aggregates being used are tested to IS383. Include for Alkali reactivity, chloride and sulphate contents independently and combination of cement and water.
 - Water being used is tested.

Further the contractor shall ensure that designed mix meet minimum cement contents as specified in BOQ/drawings and proposed revision to IS 456 along with maximum water cement ratio, to different exposure condition from durability point of view. In addition contractor shall ensure

a) Alkali - reactivity

Aggregates containing material susceptible to attack by alkali's (Na_2O and K_2O) originating from cement or other sources and producing expansive reaction shall not be used.

The aggregates source shall be initially tested for alkali reactivity prior to being used in design mix.

b) Sulphate and chlorides in concrete.

Harmful salts coming from the concrete materials such as cement, aggregate, water and admixture, as well as by diffusion from environments shall be limited to following weight of cement.

- Total chlorides (as Cl) - 0.15 %

- Total soluble sulphate (as SO₃) - 4 %

3.1.3 Compressive strength

For expected strength of cubes tested on the 28th day, the design mix at preliminary test and work site shall be as per IS 456 2000.

Water cement ratio

The water-cement ratio shall be between 0.42 to 0.55. Additional water may be permitted only at the discretion of the Structural Engineer. The slump shall depend upon the location and type of work. Higher slump with use of plasticizers shall be permitted.

3.1.4 Trial mixes

3.1.4.1 The contractor shall submit, at least 5 weeks in advance, to the Engineer-in-Charge the mix design that he proposes to use at site. The mix design in addition to points in 3.1.2 shall also give basic details (when tested according to IS 1199 and IS 2386-Part III 1963), as per followings

- a) Slump/Workability
- b) Bleeding
- c) Compacting factor
- d) Vee-Bee time
- e) Cement required for one cubic meter of concrete
- f) Wet and dry density
- g) Air contents if applicable

3.1.4.2 On receipt of this, the Engineer-in-Charge may immediately order to carry out work site test before the final approval. This shall be done with mixer and materials actually being used at site. This shall give the contractor additional chance to check for himself actual workability and make sure that the mix proposed by him will be fully satisfactory with regards to slump, segregation, bleeding, water-cement ratio and workability. 6 cubes shall be taken from each of the 3 batches to test the mix. Cubes shall be cast, stored, cured, transported and tested to IS 516. The test may be carried out at site or laboratory as approved by the Engineer-in-Charge. Trial mixes shall be approved provided that average strength of 3 consecutive cubes is not less than that specified and that one out of three may give a value less than specified but limited to a maximum of 90% of the specified strength.

3.1.4.3 In case the trial mix falls below the above criterion, the Engineer-in-Charge shall order fresh trial mixes to be made as before, until the desired strength is arrived at.

3.1.4.4 This design mix and trial mix hold good so long as the materials continue to be of the same quality and from the same sources. For any change, the Engineer-in-Charge may order fresh design mix and trial mixes to be carried out before the same is used at site.

3.1.5 Mixing of concrete

3.1.5.1 Machinery and equipments.

- a) Batching

Batching shall be done by weigh batchers conforming to IS 2722. A platform scale of capacity 300kg with fraction upto 100gms shall be at site. For water supply to mixture through metering system shall be organised. Design mix converted to volumetric may be permitted by Engineer-in-Charge.

Accordingly suitable size of boxes equivalent to 1 bag of 50kg cement shall be prepared by the contractor.

b) Mixer

Mixers used shall conform to IS. Type Capacity shall be as per size, extent and nature of work.

c) Transportation

Wheel borrows, cranes, mini dumpers, truck, agitators, belt conveyors, pumps with piping etc. as per requirement depending upon location, size extent and nature of work shall be deployed by the contractor with prior approval of the Engineer-in-Charge.

d) Vibrators

Internal and external vibrators working on electricity, Pneumatic or petrol shall be approved by the Engineer-in-Charge. Vibrators shall conform to IS.

e) All machineries and equipments shall be maintained regularly. Periodic calibration of all machines shall be done and records maintained in a register. As and when requested by the Engineer-in-Charge same shall be forwarded for his inspection.

3.1.5.2 At the start of mixing mixer shall be rinsed/coated by loading with cement, sand, water of the same proportion of batch to be used. Loading the mixer/charging the mixer shall be done mechanically and care to be taken that all material is fully loaded. The mixer shall be run for a minimum period of 2 minutes after all materials are loaded in full quantity. The concrete produced shall be uniform in colour and consistency. Unless agreed by Engineer-in-Charge the first batch of concrete from mixer shall contain two-third of normal quantity of coarse aggregate.

3.1.5.3 Transportation

Concrete shall be transported to place of pour as far as possible in most efficiently, conveniently and without loss of concrete characteristic. Method of transportation shall depend upon the location, size and nature of work. Concrete should be placed within ½ hour of production i.e. prior to initial set.

Use of admixtures such as air entraining agent, retarders etc. shall be adopted and incorporated into design mix stage.

Concrete shall be kept in agitating state when ambient temperatures are high. This shall increase placing time to 1 ½ hrs after water is added.

Points to be taken care are

- Method adopted do not permit segregation
- Containers used are leak proof
- Containers are well covered during rains, heavy winds
- Concrete does not get contaminated by oil, dirt etc.

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3.1.5.4 Placing

The placing temperature of concrete shall not be more than 34° C. If it is more, the ER may order addition of ice or chilled water to the concrete. Also the contractor shall take the following precautions:

- a) Mixers and weigh batchers shall be painted with white colour
- b) Aggregate storing bins shall not be exposed to the Sun
- c) Water shall be sprinkled on aggregates well before concreting to keep the temperature low.
- d) Use chilled water for mixing or add flake ice as a proportion of the mixing water.
- e) Place concrete at night.

3.1.5.5 Ready mix concrete (RMC)

- a) Concrete
Ready mix concrete as approved only shall be used. It shall comply all requirements of concrete. Batching plant, mixture, truck mixture, pump etc shall conform to relevant Indian standard. Daily returns shall be provided showing total volume of each class of concrete received.

- b) Pumping of concrete

Stationery or mobile pumps as per requirements shall be deployed. Concrete shall be continuous to avoid any blockage within pump. Concrete mix shall be with slump as desired by pump manufacturer and most desirable at site to pump operator / supervisor. Required piping, bends, clamps, chutes etc. shall be well organised and placed in position prior to start so continuous concrete with minor changes will keep concrete flowing at predetermined location in approved manner.

Mix design adopted shall be approved by Engineer-in-Charge and shall conform all tests as detailed in specification.

Pump concrete shall flow quite fast and is placed with larger impact on formwork. Hence special precautions at design stage of formwork shall be taken and staging/scaffolds should be well restrained in all directions to withstand thrust.

Pumping shall be done with due care and safety. Recommendation of pump suppliers shall be followed strictly.

3.1.6 Shrinkage cracks

Concreting shall be avoided in very warm weather. If necessary, it shall be covered with damped hessian within 2 hours of placing of concrete. To achieve good results the concrete shall be immediately covered with a plastic sheet and not allowed any direct wind contact. This shall eliminate shrinkage cracks

3.1.7 Laying of concrete

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- a) Concreting shall commence only after formwork is approved, reinforcement is recorded and permission to proceed with concreting has been approved in writing from the Engineer-in-Charge.
- b) Formwork should be clean, free from sawdust, pieces of wood or any other foreign material. It should have been treated by form releasing agent prior to the laying of reinforcement and concrete. Prior to placing concrete against old concrete, masonry, rock all loose materials shall be removed and surfaces washed down. Concrete shall be worked around ties and bond and in open joints.
- c) Concrete shall be as gently deposited as is practically possible, in its final position to avoid rehandling and shall be so deposited that segregation of aggregates does not occur. In case of deep trenches and footings, it may be done with the help of a chute. Columns and walls shall be so adjusted in form work so that maximum depth is 1.5 metre unless consented to by the ER. Concrete from wheel barrows shall not be dumped away from the face of concrete already in place. It shall be dumped into the face of concrete already in place. In excavations prevent contamination of earth and concrete without disturbing unsupported sides of excavation. Concrete shall not be placed in water except where specified.
- d) Concrete onto a sloping surface shall be discharged by providing a chute with a baffle and a drop at its end so that the concrete remains on the slope.
- e) Columns and walls shall be concreted in one operation to their full height to avoid any horizontal construction joint as far as possible.
- f) All slabs, beams, wooden planks, and cat-walks shall be provided clear of reinforcement.
- g) Concrete shall be placed in position within 30 minutes from the time it is produced. Concrete shall be laid during normal working hours. Concreting at night or on holidays shall be permitted only on the written approval of the Engineer-in-Charge.
- h) Placing in each section shall be a continuous between construction joints. The contractor shall make provision for standby equipment. In case of delay or break down stop ends are to be provided or concrete placed to be removed as per direction of the Engineer-in-Charge.
- i) Placing shall not take in open during storms or rains, strong winds. Contractor to organise and provide required protection.

3.1.8 Compaction of concrete

Concrete shall be thoroughly compacted as depositing shall proceed by means of suitable vibrators. The vibrators shall maintain the entire concrete under treatment in an adequate state of agitation and shall continue during the whole period occupied by placing of concrete. Care shall be taken not to over-vibrate the concrete. While withdrawing needles no holes should be visible in concreting. Compaction shall be completed before the initial setting time. Concrete already set shall not be disturbed by successive vibrations.

It shall be ensured that the needle vibrators are not applied on reinforcement which may destroy the bond between concrete and reinforcement.

When electric vibrators are in use, the standby petrol vibrator must always be available at the concreting point.

3.1.9 Construction joints

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In large pours, it is practically not possible to carry on concreting continuously. Hence construction joints shall be provided. Location of construction joint shall be submitted by the contractor for approval of the Engineer-in-Charge. Such joints shall be kept to a minimum. The joints shall be at places where shear force is nil or minimum and these shall be straight and at right angles to the direction of the main reinforcement.

Stop ends provided shall be with necessary slots for reinforcement bars to pass freely without bending or any other obstruction. Also a trapezoidal fillet nailed on stop board shall be provided to form a regular keyed joint. Joints shall be straight and truly vertical or horizontal.

Before commencement of concrete, adjacent concrete stopper and surfaces shall be chipped and roughened to expose aggregate, then wire brushed and cleaned. The concrete surface shall be sprayed with water for 24 hours before casting and kept wet until casting.

True horizontal joints shall also be provided with a keyed joint by inserting planed greased timber.

Prepared joint shall be treated as above prior to the start of fresh concreting.

For vertical joints neat cement slurry shall be applied on the surface just before concreting. For horizontal joints, the surface shall be covered with a layer of mortar about 10 to 15 mm thick composed of cement and sand in the same ratio as the cement and sand in the concrete mix. This layer of cement slurry shall be freshly mixed and applied just before concreting.

3.1.10 Expansion joints

Expansion joints shall be formed and located as detailed in the drawing. Insert sealant to completely fill the joint and finish neat and smooth.

3.1.11 Curing

Curing of concrete is most important. There shall be no compromise on this activity and it is for the contractor to arrange for everything necessary to make sure that the concrete is cured to the complete satisfaction of the Engineer-in-Charge. As said above in clause 3.1.8, after concrete has begun to harden i.e. about 1 to 2 hours after laying, it shall be protected from quick drying with moist or damped hessian cloth or any other material approved by the Engineer-in-Charge. After 24 hours of laying of the concrete, the surface shall be cured by flooding with water or covering with damp hessian cloth for a period of 7 days to keep it moist.

For the next 7 days the surface shall be kept wet all the time by sprinkling water continuously.

For membrane curing, details as listed in 12.5 of SP 24 shall be followed.

3.1.12 Finishing

Concrete shall be finished keeping in mind the next operation to be carried out over the surface. For guidance the following points shall be noted but the Engineer-in-Charge shall be consulted prior to start of concreting and his decision in this regard shall be final.

- a) Roof slab shall be troweled even and smooth with a wooden float.
- b) The surface that will receive plaster shall be roughened immediately.
- c) Surfaces that will be in contact with any masonry work shall be roughened immediately.
- d) The surface that will receive mosaic floor or IPS or any other type of tiled work shall be roughened while it is green. Every care shall be taken not to disturb the freshly laid concrete.
- e) For dust proof (or hardened) finish, clean the concrete surface of oil and contamination and apply approved dust proof hardener as per manufacturer's instructions.

3.1.13 Inspection and corrective measures

3.1.13.1 On removal of form work, the surface shall be examined by the Engineer-in-Charge. Till such time, no remedial measures shall be carried out by the contractor. All patching, rectification or chipping shall be done only on the Engineer-in-Charge's instructions. In case of any violation of this rule, the concrete poured stands rejected. The decision of the Engineer-in-Charge in this regard shall be final and binding on all parties. Sagged, bulged, patched, honeycombed work shall stand to be rejected for surfaces that are exposed, or require fairface finish or decorative textured finish. The ER may permit any work found structurally safe and areas of unexposed faces, for repairing. As directed by the Engineer-in-Charge these works shall be retained and the cost of repair shall be at the contractor's account.

3.1.13.2 Cracks observed shall be brought to the notice of the Engineer-in-Charge who shall examine them. It shall be kept under observation and a record shall be maintained for a period of 45 days. It shall be shown to the Structural Engineer and the following procedure shall be followed:-

- a) Cracks not developing further and in the opinion of Structural Engineer not detrimental to the strength of the construction shall be grouted with non-shrinking cement slurry or as directed by the Engineer-in-Charge.
- b) Cracks developing further and, in the opinion of the Structural Engineer, detrimental to the strength of construction, shall be tested as per the relevant Indian standard.
- c) Based on results of the test, the Engineer-in-Charge in consultation with the Structural Engineer shall order remedial measures or order the contractor to dismantle construction, cart away the debris, replace the construction and carry out all the consequential works thereto.
- d) Cost of the above shall be borne by the contractor if the failure was on his part. In case it is due to design faults, it shall be borne by the employer.
- e) The decision of the Engineer-in-Charge in this matter shall be final and binding on all parties. This decision shall not be open for arbitration.

3.1.14 Testing

3.1.14.1 Quantum of cubes and testing

The minimum frequency of cube casting shall be as follows. Each sample shall consist of 6 cubes.

Concrete quantity Number of Samples.

Upto 5 Cum in a day	: 1
5 Cum to 15 Cum	: 2
15 Cum to 30 Cum	: 3
30 Cum to 50 Cum	: 4
More than 50 Cum	: 4 + one additional per each 50 Cum or part thereof

Three cubes shall be tested on the 7th day and other three cubes on the 28th day.

3.1.14.2 Field Tests

It is the responsibility of the contractor to prepare and get the cubes tested and to provide all the material, labour, moulds, equipment, casting and curing facility, charges for testing, etc.

Further, the contractor shall have to provide and maintain all the equipment and staff at the site throughout to carry out the following tests in a small laboratory or get these tests from approved laboratories without extra cost to the contract.

- a) Grading of coarse and fine aggregates
- b) Silt content of sand
- c) Moisture content of coarse and fine aggregates
- d) Slump test of concrete
- e) Concrete cube test

3.1.14.3 The contractor shall maintain full records of all above tests in a register. The format of records shall be prepared in consultation with the Engineer-in-Charge and either he or his representative shall have full access to the contractor's laboratory. The contractor shall include charges for the above work in his rates and no extra whatsoever shall be admissible on this account of designing, testing, maintaining laboratory, etc.

3.2 Concreting under special conditions

3.2.1 Work in extreme weather conditions

During hot or cold weather the concreting should be done as per the procedure set out in IS 7861 Part I or IS 7861 Part II or as directed by the Engineer-in-Charge.

3.2.2 Underwater concreting

The procedure set out under 13.2 of IS 456 shall be followed or as directed by the Engineer-in-Charge.

3.2.3 Concreting in sea water

The procedure set out under 13.3 of IS 456 shall be followed or as directed by the Engineer-in-Charge.

3.2.4 Concreting in aggressive soils and water

Guidelines laid down in 13.4 of IS 456 shall be followed together with the instructions of the Engineer-in-Charge.

3.3 Precast concrete

3.3.1 Precast concrete can be plain or reinforced. It shall meet all requirements and specifications of concrete as stated hereof. Precast concrete shall be done for cellular roof units, drainage or specially designed for specific use taking into consideration achievements in flexibility, speed and economy in construction.

3.3.2 Precast concrete units shall be cast in a suitable mould so as to make sure that they are,

- a) Easy to lift
- b) Easy to transport
- c) Excellently finished
- d) Handy to erect and join at site

Units shall be sound and free from cracks or any other defects that would interfere with the proper placing of units or the strength or performance of units or the structure.

3.3.3 Precast units shall be lifted and handled with proper tools from points designated to avoid any cracking or developing of any undue stresses. If required, necessary tools and tackles shall be fabricated by the contractor. Precast units shall be removed from mould within 24 hours or the time allowed by the designer or as approved by the Engineer-in-Charge.

All units that are, in the opinion of the Engineer-in-Charge, cracked and unsafe, shall be stacked in the pre-casting yard in a proper manner. The date of casting shall be noted therein and wet curing for 15 days shall be done without fail. The yard shall have a duly dressed ground and sufficient supports at the required intervals to receive precast units.

Units shall be erected only after 28 days of casting and after the cubes of those days have given the strength specified.

Tolerances in units shall not be more than +3 mm as approved by the Engineer-in-Charge taking into consideration the purpose and location of use.

3.4 Plum Concrete

Stone plums shall be used only when specified. Size of stone plums may be from 150 to 300mm.

Plums shall be hard, double clean and free from soft or loose pieces or deleterious material and should not have sharp corners.

Generally first layer of concrete of specified mix shall be of thickness 2.5 time thickness of maximum size of plums to be used. Plums shall be laid when concrete becomes stiff but top portion is still green. No plums shall be used for concrete laid under water. The thickness of next and successive layers shall be 2 times that of largest plums.

SECTION – IX REINFORCEMENT WORK

1 GENERAL

1.1 Standards

Work shall be carried out to Indian Standards and Code of Practices. In absence International Standards shall be followed. These shall be latest issue. List given hereunder is not to be considered as conclusive and is for reference and guidance only. Any discrepancies /conflict noticed shall be directed to the Engineer-in-Charge for his direction/approval. However as a general rule more stringent specification shall take precedence.

- i. IS 226 Specification for steel standard quality
- ii. IS 228 Methods for chemical analysis of steels
- iii. IS 280 Specification for mild steel wire for general engineering purpose.
- iv. IS 432 Specification for mild steel and medium tensile steel burn and hard drawn steel wires for concrete requirement.
 - Part 1 Mild steel and Medium tensile steel bars.
 - Part 2 Hard drawn steel wire.
- v. 5. IS 456 Code of practice for construction and design of reinforced concrete.
- vi. 6. IS 816 Code of practice for use of metal arc welding for general construction in mild steel
- vii. 7. IS 961 Specification for structural steel : high tensile steel bars
- viii. 8. IS 1566 Hard drawn steel wire fabric for concrete reinforcement.
- ix. 9. IS 1599 Method of Bend test
- x. 10. IS 1642 General requirements for fire protection.
- xi. 11. IS 1785 Cold drawn stress relieved wire (part I)
- xii. 12. IS 1786 Specification for high strength deformed steel bars and wires for concrete reinforcement.
- xiii. 13. IS 2751 Code of practice for welding of MS bars.
- xiv. 14. IS 2502 Code of practice for bending and fixing of bars for concrete reinforcement.
- xv. 15. IS 2751 Code of practice for welding of Bars
- xvi. 16. IS 3696 Safety Code of scaffolds and ladders :
 - Part 1 Scaffolds
 - Part 2 Ladders
- xvii. 17. IS 4014 Code of practice for steel (Part 1 & 2) tubular scaffolding
- xviii. 18. IS 4082 Recommendation on stacking and storage of construction materials at site
- xix. 19. IS 5525 Recommendation for detailing of reinforcement in RCC work.
- xx. 20. IS 9417 Recommendation for welding cold worked steel bars for reinforced concrete construction
- xxi. 21. IS 10790 Method of sampling of steel for prestressed and reinforced concrete

1.2 Quality Assurance

- 1.2.1 The Contractor shall procure and provide reinforcing steel bars conforming to IS specified and shall comply with all physical, chemical and mechanical test. Each type shall be from same manufacturer.
- 1.2.2 Steel manufacturers shall conform steel produced conforms IS requirements for reinforced cement concrete works. Steel shall not react chemically with ingredient of reinforced cement concrete which are harmful to strength, durability of reinforced cement concrete.
- 1.2.3 Unit weights and diameter of rolled steel bars shall conform to IS.
- 1.2.4 Provide supervision and work force with minimum 5 (five) years experience to ensure workmanship of specified quality.
- 1.2.5 Contractor to undertake documenting of
- Test reports for steel brought at site for each lot
 - a) Chemical composition from factory
 - b) Mechanical
 - c) Physical
 - Bar bending schedule for cutting and bending
 - Record of laps and anchors / development length
- 1.2.6 Work shall not be subjected to harmful, dangerous and damaging exposures.

1.3 Submittals

- 1.3.1 Submit for approval of the Engineer-in-Charge all details of Material / Product which conforms the specification laid down in documents.
- 1.3.2 Submittals shall include
- Product data sheet
 - Manufacturers certificates
 - Test report of laboratories
 - Alternative product if any with tabulation for conformation that alternatives proposed meets / exceeds specification.
- 1.3.3 Samples

Samples of type of materials to be used. Further during construction samples shall be taken and tested by the Contractor as per specification and as directed / instructed by the ER. The cost of samples and test shall be borne by the Contractor within quoted prices.

1.3.4 Shop drawings

Contractor shall prepare and submit bar bending schedule based on structural detailed drawing prior to fabrication for approval of the Engineer-in-Charge.

1.4 Examination of Conditions

Contractor shall inspect and examine sub stratas and confirm prior to start that.

- Substrate is acceptable and approved by Engineer-in-Charge
- Conditions are satisfactory

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- Setting out/Layout is verified
- Corrective measures needed if any are within reach and contractor proceeds with full responsibility for work.

2.0 MATERIAL

2.1 Reinforcing Bars

2.1.1 Reinforcement bars used in construction shall be mild steel or medium tensile steel round bars and high strength deformed bars. Steel shall be fresh and new. It shall be free of defects and free of rust, oil, paints, grease, loose mill scale or any other deleterious material undesirable for RCC or prevent adhesion of concrete with reinforcement. Steel should be from the original iron ore producers (like SAIL, TATA). If other steel is to be used then billets should be approved from SAIL, TATA. Other steel can be used only after prior approval of the Engineer-in-Charge.

2.1.2 M S Plain

Rolled mild steel and medium tensile steel plain round bars used in concrete shall conform to IS 432 Part I. Steel received shall conform to the following IS with regard to manufacturing and chemical composition.

- M.S. bar Grade I Steel designation Fe 410-S of IS 226
- M.S. bar Grade II Steel designation Fe 410-O of IS 1977
- Medium Tensile Steel designation Fe 540 Steel bars W-HT IS 961

2.1.3 Nominal sizes and tolerances shall be as specified in IS 432 Part I. Physical requirements shall be determined in accordance with IS 1608, read in conjunction with IS 226. For reference of minimum requirements, properties are tabulated in IS 432 Table 1 "Mechanical properties of bars mild steel & tensile steel bars".

2.1.4 Tor Steel

High-strength deformed bars for use as reinforcement in concrete shall be of grade Fe 415, Fe 500 and Fe 550 conforming to IS 1786.

2.1.5 Chemical composition shall conform to IS 1786 when made as a relevant part of IS 228.

2.1.6 Welding of cold work steel bars in reinforcement shall be permitted as per IS 2751 and 9417. (Recommendation for welding cold worked steel bars for RCC).

2.1.7 Nominal sizes, cross sectional areas and their mass shall be as specified in IS 1786, allowing due consideration for tolerances specified therein.

2.1.8 Physical properties

- It shall satisfy IS 1599 test for bend and rebend test in conjunction with IS 226.
- Bond requirements shall be deemed to have been satisfied if it meets clause 4.0 of IS 1786.
- Tensile, proof stress and percent elongation shall be as per table 3 of IS 1786.

2.1.9 Material received at site shall have ISI certification mark. Each bundle or coil containing the bars shall be suitably marked with ISI certification mark. Also bars shall be marked to identify categories. This shall be done as per IS 1387. In case bars are without ISI certification mark, the manufacturer shall give a certificate stating

process of manufacture, chemical composition and mechanical properties. Each certificate shall indicate the number or identification mark of the batch production/cast to which it applies. Corresponding number or identification mark should be found on the material.

- 2.1.10 All reinforcement material shall be free from loose mill scale, excessive rust, loose rust, pitting, oil, grease, paint, mud or any foreign deleterious material present on the surface. Cleaning shall be done to the satisfaction of the Engineer-in-Charge.
- 2.1.11 Each batch brought at site shall be tested prior to use for respective specification /physical properties. Cost of all such tests shall be borne by the contractor. Material acceptable as per IS shall be allowed into the works. All rejected material shall be removed from site by the contractor within 3 days of rejection. If the same is not done, the ER shall impose a penalty of Rs.500/- per metric ton per day. This will be without any appeal and shall not be subjected to arbitration.

2.2 Cover block

Cover blocks shall be of non-corrosive material such as plastic but not wooden or broken bricks or stone. Designed purpose made PVC cover spacers shall be used in the Works. Concrete cover spacers may be permitted by the Engineer-in-Charge. Such concrete spacers shall be cast from concrete and not cement-mortar. Strength of these blocks shall be equal to the strength of concrete in use. These should be fully cured prior to use in works.

2.3 Binding Wire

Binding wire shall be 16 or 18 gauge annealed wire conforming to IS 280. It shall be free from rust, oil, paint, grease, loose mill scale or any other deleterious material undesirable for the reinforcement and concrete or which may prevent adhesion of concrete with reinforcement

2.4 Mechanical Splices

Mechanical Splices fabricated out of steel pipes, sheets etc. capable of withstanding bending and compression stress equal to 1.25 times of those specified for reinforcing bars shall be used. Supplier of splices should submit details about quality of materials, mechanical test results and method of splicing. The Contractor shall arrange required hydraulic press and clipping equipment's. Samples pieces shall be prepared at site and shall be tested for torsion. Sample pieces results should give value of about 1.5 times than required for reinforcing bars.

2.5 Delivery and Storage

Reinforcing steel bars each batch should accompany manufacturers certificate. Reinforcement bars received at site shall be loaded and unloaded at site and stored with care such that it does not get bent or damaged. Steel received shall be as far as possible in straight length of 12 M. Steel shall be weighed in presence of representative of the contractor prior to delivery being received by him. Empty and loaded truck loads shall indicate correct quantity.

Reinforcement bars received at site shall be stored on hard concrete platform and clear of the ground with the use of timber sleeper, concrete sleeper or any other means. Reinforcement material shall be kept covered by tarpaulins or plastic to avoid excessive corrosion and other contamination. Each dia of bars shall be stacked separately. Bars without "ISI" / Tor marking shall not be brought to site.

3.0 SCOPE OF WORK

The contractor shall be responsible for

3.1 Material Procurement

- a) The contractor will submit the Schedule of Procurement of steel in consultation with Engineer-in-Charge as specified and conforming to specifications detailed in drawings and bills of quantities.
The steel shall be delivered to site as per approved indent of the contractor to agreed schedule.
- b) Purchase steel and stack with covering on firm platform free of contamination.
- c) Collect samples of each type for every batch received and test as per IS for
 - Unit weight per running meter
 - Cross section area
 - Bend / Rebend Test
 - Ultimate tensile strength
 - Yield stress
 - Elongation
- d) Procure binding wire, cover blocks splices etc.

3.2 Prepare bar bending / cutting schedule detailing schedule covering as under and obtain approval of Engineer-in-Charge.

- Cutting lengths
- Laps
- Rings for various locations and items
- Chairs

3.3 Transport, cut, bend and shift to site reinforcing bars.

3.4 Place in position and tie as detailed in drawing reinforcement with specified cover.

3.5 Provide attendance to keep reinforcement in position during concreting.

3.6 Disposal of surplus reinforcement steel as per approval of the Engineer-in-Charge.

3.7 Provide anticorrosive treatment to reinforcement bars including required handling, application, and touch up and maintenance till concreting.

- a) CECRI System : Cement polymer composite coating system
- b) Fusion bonded epoxy coating.

3.8 Providing required tools, plants, equipments such a

- Material cutting and bending tools
- Bending platform Bar cutting machine

- Bar bending machine
 - Hydraulic clipping machines
- 3.9 Unit weights payable per metre shall be as follows-

- i. 8 mm : 0.395 kg/Rm
- ii. 10 mm : 0.617 kg/Rm
- iii. 12 mm : 0.888 kg/Rm
- iv. 16 mm : 1.580 kg/Rm
- v. 20 mm : 2.469 kg/Rm
- vi. 25 mm : 3.858 kg/Rm
- vii. 32 mm : 6.320 kg/Rm

4.0 WORKMANSHIP

4.1 Fabrication of reinforcement

Reinforcement shall be fabricated as per the drawing and approved bar bending schedule. Bending shall be done mechanically or with hand but to the correct radius, with proper tools and platform and shall conform to IS 2502. Bending of material shall be cold bending only. Material shall be inspected for visible defects such as cracks, brittle, excessive rust, loose mill scale, etc. Cracked ends of bars shall not be used in Works. Also the bars should be free from any deleterious material and hence the best practice shall be to hose down reinforcement just prior to concreting.

It is important that bending, straightening, cutting, etc. shall be carried out in a manner not injurious to the material and the safety of the persons working should be ensured.

4.2 Anchoring

Anchoring of bars and stirrup shall be provided exactly as detailed in the structural drawing or as directed by the Engineer-in-Charge.

4.3 Lapping of bar

Laps shall be strictly as per the drawing or as directed by the Engineer-in-Charge. For general guidance, the following principles shall be followed as given in IS 456.

- a) Splices shall be provided as far as possible away from sections of maximum stress and be staggered.
- b) Not more than half of the total bars shall be spliced at a section.
- c) Where more than one half of the bars are spliced at a section or where splices are made at points of maximum stress, special precautions shall be taken, such as increasing the length of lap and/or using spirals or closely spaced stirrups around the length of the splice.
- d) Lap splices shall not be used for bars larger than 36 mm diameter: For larger diameters, bars may be welded. In cases where welding is not practical, lapping of bars larger than 36 mm diameter may be permitted and additional spirals should be provided around the lapped bars.

- e) Lap length including anchorage value of hooks in flexural tension shall be L_d (as defined in 25.2.1 of IS 456) or 50 dia whichever is greater.
- f) When splicing of welded wire fabric is to be carried out, lap splices of wires shall be made so that the overlap measured between the extreme cross wires shall be not less than the spacing of cross wires plus 10 cm.

4.4 Spacing of bars

Bars shall be placed in position as shown in the drawing. Following guidelines as given in IS 456 shall be followed in case of difficulties or shall be carried out as directed by the Engineer-in-Charge.

- a) Horizontal distance between two parallel main reinforcing bars shall usually not be less than the greatest of the following:
 - i. The diameter of the bar, if the diameters are equal.
 - ii. The diameter of larger bar, if the diameters are unequal, and
 - iii. 5 mm more than the nominal maximum size of coarse aggregate (By using reduced size of aggregate in congested reinforced area, conditions given hereof should be overcome).
- b) Greater horizontal distance should be provided. But when needle vibrators are used, distance between bars of a group may be reduced to two-thirds of the nominal maximum size of the coarse aggregate, provided sufficient space is left between groups of bars to enable the vibrator to be immersed.
- c) Where there are two or more rows of bars, the bars shall be vertically in line and the minimum vertical distance between the bars shall be 15 mm, two-thirds the nominal maximum size of the aggregate or the maximum size of bar, whichever is more.

4.5 Cover to reinforcement

Reinforcement shall have concrete cover and the thickness of such cover (exclusive of plaster or other decorative finish) shall be as specified in drawing or as directed by the ER. The following guidelines are to be observed in the absence of the above.

- a) At each end of the reinforcing bar, not less than 25 mm, nor less than twice the diameter of such bar;
- b) For a longitudinal bar in a column, not less than 40 mm, nor less than the diameter of such bar. In the case of columns of minimum dimension of 200mm or under, whose reinforcing bars do not exceed 12 mm, a cover of 25 mm.
- c) For longitudinal reinforcing bar in beam, not less than 20 mm, nor less than the diameter of such bar.
- d) For tensile, compressive, shear or other reinforcement in slab, not less than 15 mm, nor less than the diameter of such bar; and
- e) For any other reinforcement, not less than 15 mm, nor less than the diameter of such bar.
- f) Increased thickness shall be provided in case the concrete members are in the surrounding of harmful chemicals, saline atmosphere, etc. and the cover shall be 50 mm or more as directed by the Engineer-in-Charge.
- g) For concrete members totally immersed in sea water, the cover shall be 40 mm more than specified above (a) to (f).

This shall be 50 mm more for periodical immersion in sea water.

- h) Concrete cover should not exceed 75 mm in any case. Cover to reinforcement shall be as specified in the drawing or as directed by the Engineer-in-Charge. Details given in sub para (a) to (h) are for guidance and shall be followed in absence of any specific direction.

4.6 Welded joints or mechanical connections

- a) Welded joints or mechanical connections in reinforcement may be used but in all cases of important connections, tests shall be made to prove that the joints are of the full strength of the connected bars. Welding of reinforcement shall be done in accordance with IS recommendation. Welded joints shall preferably be located at points where steel will not be subject to more than 75 percent of the maximum permissible stresses and welds so staggered that, at any one section, not more than 33 percent of the rods are welded.
- b) Welding rods used shall conform to IS 814: covered electrodes for metal arc welding of structural steel. Work shall be carried out by a competent welder. Samples from work site shall be taken at regular intervals and tested. Frequency and number of samples shall be as directed by the Engineer-in-Charge.

4.7 Fixing in position

- 4.7.1 Correctly cut and bent bars shall be accurately placed in position as detailed in the drawing. Unless otherwise specified by the Engineer-in-Charge, reinforcement shall be positioned within the tolerance as under :

- a) for effective depth 200 mm or less, + 10 mm
b) for effective depth more than 200 mm, + 15 mm

- 4.7.2 But in no case shall the cover be reduced by more than 5 mm of that specified. There shall be no compromise on cover for foundation work.

- 4.7.3 Reinforcing bars shall be held in position during the placing of concrete by use of PVC or concrete cover blocks (made of equal strength of well-cured concrete in use), steel chair spacers, steel hangers, supporting wires, etc. and secured by tying with an annealed binding wire of 16 to 18 gauge as approved by the Engineer-in-Charge.

- 4.7.4 Layer of bars shall be separated by precast concrete spacer blocks or spacer bars. Reinforcement shall be in correct position prior to start of concreting. No reinforcing bar shall be placed on freshly laid concrete for adjusting bar spacing. Care shall be taken

to maintain reinforcement in position and keep it clean, throughout the period till it is embedded in the concrete. For maintaining cover, pieces of broken stone or brick or wooden blocks shall not be used at any stage.

- 4.7.5 Where reinforcement bars are bent aside at construction joints and afterwards bent back into their original position, care should be taken to ensure that at no time is the radius of the bend less than 4 bar diameters in case of plain mild steel or 6 bar diameters for deformed bars. Care shall be taken when bending back bars to ensure that the concrete around is not damaged/disturbed.

SECTION – X

FORM WORK

1 GENERAL

1.1 Standards

Work shall be carried out to Indian Standards and Code of Practices. In absence International Standards shall be followed. These shall be latest issue. List given hereunder is not to be considered as conclusive and is for reference and guidance only.

Any discrepancies/conflict noticed shall be directed to the Engineer-in-Charge for his direction/ approval. However as a general rule more stringent specification shall take precedence.

- i. IS 303 Specification for plywood for general purpose.
- ii. IS 456 Code of practice for construction and design of reinforced concrete.
- iii. IS 2751 Code of practice for welding of M.S bars used for RCC
- iv. IS 3696 Safety Code of scaffolds and ladders :
 - Part 1 Scaffolds
 - Part 2 Ladders
- v. IS 4014 Code of practice for steel (part 1 & 2) tubular scaffolding
- vi. IS 4082 Recommendation on stacking and storage of construction materials
- vii. IS 8989 Safety code of erection of concrete formed structures

1.2 Quality assurance

Contractor shall assume and take upon himself to

- a) Design, construct, erect, maintain and struck form work proprietary or custom made
- b) Form work shall provide required
 - Shape, size and finish
 - Rigidity and durability during placing(live levels)
 - Rigidity and durability for receiving fresh concrete
 - Leak proof water tight joints/junctions
 - Easy removal without disturbing concrete
 - Provide easy access for handling and placing
- c) Form work shall provide safety and shall have adequate access for concreting
- d) Workers shall work with required safety measures such as safety belts, helmet etc.

1.3 Experience

The contractor shall provide

CONTRACTOR

CHIEF ENGINEER

- a) Site supervisors and foremen qualified and experienced atleast 5(five) years on similar nature of form work.
- b) Semi skilled/skilled labour shall be of minimum experience of 5(five) years in doing similar nature of form work

1.4 Examination of strata

The contractor shall examine, and convince himself prior to start of work that strata is firm, rigid and safe to erect scaffold. In absence, same shall be prepared by him and then work shall proceed. If it is not possible due site condition, method of erection support etc. shall be detailed and got approved from Engineer-in-Charge prior to start. In any case responsibility of formwork shall be that of the contractor.

2 MATERIAL

2.1 Material

Material used in form work shall be combination of timber, plywoods, steel props, steel plates, or specially designed and manufactured moulds out of plastic or reinforced fibre glass or steel or aluminium alloy or combination. Use of timber shall be limited to beam bottoms, runners, but not for soffit of slab, wall faces etc. Use shall depend upon its location, type of finish specified and subject to acceptability by the ER. Recommendations are as under:

- i. Steel Props - Heavy duty, drop head and adjustable type or as per system to be adopted.
- ii. Steel Plates - MS angles 45 x 45 x 4 mm thick frame work with minimum 16 gauge thick sheet.
- iii. Ply wood - Marine ply: Plastic coated preferred.
 - a. 12 mm thick with timber framing for sides of beam.
 - b. 18 mm thick with timber framing for beam bottom and wall panels.
 - c. 12/18 mm thick for slab depending upon thickness and supporting system.
- iv. Bracing - 40 mm dia MS steel tubes with clamps.

Formwork designed with proposed material in use should be able to retain its shape, lines, and dimensions shown in the drawings. It should safely carry the full load of concrete together with any live and impact load likely to occur during concreting. Specially when concrete pumps and large buckets with crane are deployed.

Material used shall conform to IS. It is the contractor's responsibility to entirely achieve the standard expected to the satisfaction of the Engineer-in-Charge.

Standard rolled steel sections shall be used with due fabrication of standard special moulds, unitised form work scaffolds, staging etc.

2.2 Timber

- a) Jungle wood timber in form of planks, battens (runners), ballies, strong durable without cracks, able to sustain warping, twisting and distortion shall be allowed in work for type of requirements.
- b) Teakwood /good quality jungle wood shall be used for special decorative moulds. Moulds may be smooth planed or finished with laminate

2.3 System

Patented proprietary designed metal (Steel, aluminium or fiber glass) form work best suited for type of work under taken and its requirements shall be used.

2.4 Wire nails confirming to IS and mating needs shall be used.

2.5 Bolts / Nuts /Clamps

MS bolts, nuts, clamps standard or purpose made shall be used. Use of these shall not be harmful to concrete and shall be easily removable or if left in concrete shall be inert to concrete in all respect.

2.6 Form release Agents

Emulsion and oil or chemical agent being used shall not react with reinforce concrete at any stage. No chemical reaction shall take place which may be harmful to reinforcement concrete for its durability strength. These shall not produce any stain and shall not stick to concrete surfaces which will reduce further bonding strength of masonry mortar, painting etc.

3.0 SCOPE OF WORK

3.1 Designing

The contractor shall design, draw, prepare and submit method of statement backed by designed calculations, taking into account the points noted in clause 1.2 here above atleast six weeks prior to the starting of activity. Required drawing and sketches shall be enclosed along with statement for the proposed area to be taken up for working. The statement shall give

- Loadings considered
- Materials proposed
- Repetitions expected
- Staging/supporting arrangement
- Deployment of proprietary metal form work system.
- Method of handling

It shall be responsibility of the contractor to get the design approved from Engineer-in-Charge atleast four weeks prior to start of formwork.

3.2 Equipments

The contractor shall provide required tools, plants, equipments including its proper maintenance during construction at site.

3.3 Proprietary metal formwork

The contractor shall arrange to provide proprietary system metal formwork applicable/adoptable to various areas of works. He shall be responsible to deploy with required mechanism for handling, shifting, transporting placing in position.

3.4 Supervision

The contractor shall be responsible to provide experienced foremen (atleast Five years) in supporting/executing similar nature and magnitude of work. He shall be able to read drawings and should be capable of guiding and getting work executed to quality.

3.5 Labour

The contractor shall provide experienced skilled carpenters to carryout work with system of formwork deployed and necessary plants and equipment shall be made available at site.

4.0 WORKMANSHIP

4.1 Form work shall be classified namely as follows :

- a) Textured or decorative finish
- b) Fair-faced finish
- c) Rough finish

In BOQ, the contractor shall account for all material and labour etc. to achieve the above finishes to the satisfaction of the Engineer-in-Charge in his quoted price.

4.2

- i. Erection of form work may be from pre-moulded, pre-fabricated, pre-assembled plates or forms reasonable enough to transport and erect at site to correct line and level as set out at site. Supports shall be firm and maintained in position by nails, cross bracings, tie rods, locking bolts and nuts. It shall be rigid and stiff so as to retain its shape during and after concreting. The tie rods shall be terminated atleast 40mm inside the finished surface.
- ii. Joints shall be water-tight and no cement slurry shall be allowed to slip through. In joints foamed tapes shall be used.
- iii. Pre-fabricated or site forms shall be assembled, so as to deshutter without any jerk to the green concrete. For this double wedges shall be used. Wedges shall be nailed, the heads reasonably left out, allowing easy removal while deshuttering.
- iv. Pre-fabricated or on site fabricated forms shall be of sufficient thickness and with the required supporting runners in either direction. Supporting runners shall be standardized in size for easy replacement and universal use at site.
- v. Props shall be of steel only. Teak ballies may be permitted with written permission of the Engineer-in-Charge for specific use. Size and verticality shall be approved by the Engineer-in-Charge. Its spacing shall be as per design. It shall be vertical and plumbed. Base shall be a proper steel plate or timber plank, for equal distribution of load.
- vi. In repeated use, panels shall be clearly marked for using at defined locations.
- vii. Successive lift shall be tightened with previous lift by fixing foamed strips at joints to avoid grout leakage.

- viii. In fill pieces and panels shall be well dressed, leveled and jointed with main formwork so as to achieve smooth, even natural finish.
- ix. Props, Soldiers, wallings, Shores, bearers, Clamps, wall & ties etc. shall be at required spacings.
- x. Props, shores shall be securedly braced with firm bearing.
- xi. Provide and fix or fix only inserts pockets, to correct line and level and with sufficient rigidity to keep in position while concrete placing is in progress along with vibration.
- xii. Sloping, brackets, chajjas etc shall be well secured and firmly restrained.
- xiii. Adequate access and working platform shall be arranged with required safety to avoid reinforcement displacement, damage to shuttering and easy movement of concrete gang.
- xiv. Props and scaffolds are to be erected to correct plumb, line, level and with required tie. Load carrying capacity of props shall be as per table of manufacturer.
- xv. Props and scaffolds shall not be loaded more than allowed by manufacturer of Props /scaffolds.
- xvi. Heavy, medium and light duty props shall not be mixed up.
- xvii. Beams and slabs shall have camber of 4 mm per metre or as directed by the Engineer-in-Charge.
- xviii. All angles and corners shall be sharp and well defined. In places where concrete edges are permanently exposed and require no further treatment, they shall be chamfered in a tringle of 25x25mm
- xix. Props of steel or timber (if approved in writing) shall be provided with adequate horizontal and cross - bracing. Steel props shall use steel pipes and steel couplers. If use of timber is permitted, planks of 100 x 25 mm shall be used and shall be secured by nailing them to timber props. No other material shall be permitted.
- xx. At the design and erection stage, the following additional points shall be considered and incorporated into the shutters.
 - a. Openings for cleaning prior to start of concreting.
 - b. Pouring points shall avoid high drops and provide easy access to vibrator needles.
- xxi. 21 Surfaces shall be treated with mould releasing oil or emulsion as approved by the Engineerin-Charge prior to reinforcement laying.
- xxii. The following point shall be observed very carefully:
 - a. Joints of moulds shall be water-tight. It is easy to check from bottom and make sure that no light is visible.
 - b. Props shall be on solid base, plumbed, in one straight line, and braced horizontally and cross.
 - c. Tie bars in beams, walls and columns shall be at the correct place and fully tight.
 - d. Wedges shall be fully secured and nailed with head left out for easy removal.
 - e. All saw dust, dirt, shaving and any other unwanted materials shall be cleaned and hosed out.
 - f. Provision shall be made for watching form work while concreting and any other platform needed for movement of workers without any disturbance to reinforcement.
- xxiii. Opening/inserts

All required openings and pockets shall be provided as detailed in the drawing. The contractor shall provide for the required material, labour for fixing and supporting during concreting, in his quoted price. It is imperative that all openings and pockets shall be deshuttered with care and all corners of openings shall be preserved. All openings/pockets shall be in a correct line and level. After concreting, the openings shall be secured by proper covering against any accident and guard rail and warning notice, if any will be incorporated.
- xxiv. In case of multistory building, any upper floor shall be suitably supported on atleast one floor below the same or as approved by the Engineer-in-Charge. The concreting of upper floor shall be done only after lower floors have attained the strength.

- xxv. In case of shear walls, lift walls, internal walls, the form work shall be done by removable type tie rods within PVC sleeves.

4.3 Checking prior to concreting.

All props and struts are plumbed at right spacing properly tightened up and locked.

- i. Formwork is correctly aligned and leveled.
- ii. Stop ends are properly secured and sealed.
- iii. All ties are properly tightened.
- iv. All inserts, pockets etc are at desired level and secured.
- v. Joints are sealed and no possibility of leakage of grouts.
- vi. Reinforcement has proper covers and required spacers.
- vii. All forms are cleaned, free from rubbish, tie wires etc.
- viii. Proper access for concreting and compaction available.
- ix. Required guard rails, toe boards are provided

4.4 Tolerances

- 4.4.1 Tolerance is a specified permissible variation from lines, grade or dimension given in drawings. No tolerances specified for horizontal or vertical building lines or footings shall be considered to permit encroachment beyond the legal boundaries. Unless otherwise specified, the following tolerances will be permitted.

4.4.2 Tolerances for RCC buildings

- i. Variation from the plumb :
 - a. In the lines and surfaces of columns, piers, walls and in arises 3 mm per 2.5 m but not more than 10 mm.
 - b. For exposed corner columns and other conspicuous lines,
 - In any bay upto 5 m maximum : 5 mm
 - In 10 m or more : 10 mm
- ii. Variation from the level or from the grades indicated on the drawings,
 - a. In soffits of slab, ceilings, beam and in arises
 - In 2.5 m 5 mm
 - In any bay upto 5 m maximum 8 mm
 - In 10 m or more 10 mm
 - b. For exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines,
 - In any bay upto 5 m maximum 5 mm
 - In 10 m or more 8 mm
- iii. Variation of the linear building lines from established position in plan and related position of columns, wall and partitions.
 - In any bay upto 5 m maximum 5mm
 - In 10 m or more 10 mm
- iv. Variation in the sizes and location of sleeves, openings in walls and floors 5mm (except in the case of and for anchor bolts).
- v. Variation in cross-sectional dimensions of columns and beams and in the thickness of

- slabs and walls - 5 mm + 10 mm
- vi. Footings
- Variation in dimension in plan - 5 mm + 50 mm
 - Misplacement or eccentricity
 - 2% of footing width in the direction of misplacement but not more than 50 mm
 - Reduction in thickness
 - 5% of specified thickness subject to a maximum of 50mm
- vii. Variation in steps
- | | Riser | Tread |
|-------------------------|--------|-------|
| • In a flight of stairs | 3 mm | 5 mm |
| • Consecutive steps | 1.5 mm | 3 mm |

4.4.3 Tolerances in other concrete structures.

- i.
- Variation of the constructed linear outline from established position in plan
 - In 5 m : 5 mm
 - In 10 m or more : 10 mm
 - Variations of dimensions to individual structure features from established positions
 - In 20 m or more : 25 mm
 - In buried construction : 50 mm
 - Variation from plumb, from specified batter or from curved surfaces of all structures
 - Upto 2.5 m : 3 mm
 - 2.5 m to 5 m : 8 mm
 - 5 m to 10 m or more : 12 mm
 - In buried construction : Twice the above
 - Variation in cross sectional dimensions of columns, beams, buttresses, piers and similar members
 - (-) 5 mm (+) 10 mm
 - Variation in the thickness of slabs, walls, arch sections, and similar members.
 - (-) 5 mm (+) 10 mm
- ii. Footings for columns, piers, walls, buttresses and similar members.
- Variation of dimensions in plan
 - (-) 10 mm (+) 50 mm
 - Misplacement or eccentricity
 - 2% of footing width in the direction of misplacement but not more than 50 mm
 - Reduction in thickness
 - 5% of specified thickness subject to a maximum of 50mm

4.5 Removal of form work

- 4.5.1 .Forms shall not be struck until the concrete has reached a strength at least twice the stress to which the concrete may be subjected at the time of removal of form work. Under normal circumstances and where 53/43 grade O.P.Cement is used, forms shall be removed after expiry of the following periods:
- Walls, columns and vertical faces 24 to 48 hrs
 - Slabs (props left under) 3 days
 - Beam soffits (props left under) 7 days
 - Removal of props under slabs
 - Spanning upto 4.5 m 7 days
 - Spanning over 4.5 m 14 days
 - Removal of props under beams and arches
 - Spanning upto 6 m 14 days

ii. Spanning over 6 m 21 days

For other cements, the stripping time shall be suitably modified in consultation with the Engineer-in-Charge.

4.5.2 Where the shape of elements is such that the formwork has re-entrant angles, the formwork shall be removed as soon as possible after the concrete has set, to avoid shrinkage or cracking that might occur due to the restraint imposed.

4.5.3 For precast moulds, the stripping time shall be 24 hours. The mould may be lifted and stored in the yard within 24 hours to 48 hours as approved by the Engineer-in-Charge.

4.6 Maintenance

It shall be responsibility of the contractor to protect, maintain and handover to next contractor / Employer in finished condition. Providing and fixing inserts is part of this

- a. On completion of concreting inserts shall be cleaned and required treatment such as oiling, greasing, covering with plastic/plywood boxes, painting etc. shall be carried out by the contractor to approval of the Engineer-in-Charge. Inserts and pockets shall be protected from weathering/or damage in course of construction.
- b. Opening and pockets shall be deshuttered with due care not to damage edges, falling of debries within pockets etc. Further all opening and pockets shall be preserved, secured against accident by covering, putting up guard rails, warning notice etc. as approved by the Engineer-in-Charge. Guarding and protecting pockets shall be responsibility of the contractor.

4.7 .Cleaning / stacking

All formwork deshuttered shall be cleaned with a stiff wire brush to remove dust, grout, concrete etc. and if required maintained/repared prior to being reused. Steel plates, props, frames, proprietary formwork system shall be oiled, greased to protect against rusting, weathering etc.

Plywood and timber form shall also be applied with preservative agent if to be kept for long time without use. It shall be protected against heat, rains etc.

4.8 Opening/inserts

All required openings and pockets shall be provided as detailed in the drawing. The contractor shall provide for the required material, labour, for fixing and supporting during concreting, in his quoted price. It is imperative that all openings and pockets shall be deshuttered with care and all corners of openings shall be preserved. All openings/pockets shall be in a correct line and level. After concreting, the openings shall be secured against any accident by proper covering and guard rail and warning notice, if any.

The contractor shall clean and grout the pocket at a later date with a non-shrinking compound added to the grout mix or non-shrinking cement shall be used. It shall be well-cured and protected to correct line and level till handing over.

- 4.9 Inserts are material such as timber, steel, plastic, dowels, bolts, locks, brackets, pipes, etc. left in concrete partly or fully embedded to receive connection with foreign member at a later date. These may be fabricated by the contractor or provided by the owner as received from specialist, manufacturer, etc. These shall be protected from weathering and damage in course of the construction. The cleaning required after concreting and any treatment such as oiling, greasing or covering with paint etc. shall be carried out by the contractor at his cost.
- 4.10 It is very important that the providing and fixing shall be carried out with the "utmost precision" and to the entire satisfaction of the Engineer-in-Charge. Any deviation from that as shown in the drawings or instructions shall be rectified by the contractor at his own cost and responsibility.
- 4.11 Nos. of repetition of form work shall be as per approval of Engineer-in-Charge..

SECTION XI

STRUCTURAL STEEL WORK

1 GENERAL

1.1 Description

This section covers the requirements for providing fabrication, erection and placing of structural steel work for building construction including temporary supports and all other work as required for structural steel construction.

1.2 Applicable Codes and Standards

The codes and standard generally applicable to the work of this section is listed hereinafter.

- i. IS 210 Grey iron castings
- ii. IS 226 Structural steel (Standard quality)
- iii. IS 451 Technical supply conditions for wood screws
- iv. IS 800 Code of Practice for use of structural steel in general building construction.
- v. IS 801 Code of practice for use of cold formed light gauge steel structural members in general building construction.
- vi. IS 803 Code of practice for design, fabrication and erection to vertical mild steel cylindrical welded storage tanks.
- vii. IS 806 Code of Practice for use of steel tubes in general building construction.
- viii. IS 808 Dimension for hot rolled steel sections.
- ix. IS 813 Scheme of symbols for welding.
- x. IS 814 Covered electrodes for metal arc welding of (Part I & II) structural steel.
- xi. IS 816 Code of practice for use of metal arc welding and general construction in mild steel.
- xii. IS 822 Code of Practice for inspection of welds.
- xiii. IS 961 Structural steel (high tensile)
- xiv. IS 1024 Code of practice for use of welding in bridges and structures subject to dynamic loads.
- xv. IS 1030 Carbon Steel casting for general engineering purpose.
- xvi. IS 1120 Coach Screws.
- xvii. IS 1149 Specification for light tensile steel rivet, bars for structural purposes.
- xviii. IS 1161 Steel tubes for structural purposes.
- xix. IS 1182 Recommended practice for Radiograph examination of fusion welded butt joints in steel plates.
- xx. IS 1200 Method of measurement in Building Civil Engineering work.
- xxi. IS 1239 Mild steel tubes, tubulars and other wrought steel fittings
 - Part I - Mild Steel
 - Part II - Mild steel tubulars and other wrought sheet pipe fittings.
- xxii. IS 1363 Black hexagonal bolts, nut and black hexagon screws product of Grade C (size range M25 to M64) (Part 1 to 3).
- xxiii. IS 1365 Slotted counter sunk screws.
- xxiv. IS 1367 Technical supply conditions for threaded fasteners.
- xxv. IS 1477 Code of practice for painting of (Part I and II) ferrous metal in buildings.

- xxvi. IS 1852 Rolling and cutting tolerances for hot rolled steel products.
- xxvii. IS 1915 Code of Practice for steel bridges.
- xxviii. IS 1977 Structural steel (ordinary quality)
- xxix. IS 2016 Plain washer.
- xxx. IS 2062 Structural steel (fusion welding quality)
- xxxi. IS 2079 Ready mix paint, air drying, red oxide zinc chrome and priming.
- xxxii. IS 2595 Code of practice for Radiographic testing.
- xxxiii. IS 3063 Single coiled rectangular section spring warms for bolts, nut and screws.
- xxxiv. IS 3443 Crane rail sections.
- xxxv. IS 3600 Code of practice for testing of fusion welded (Part-I) joints and weld metal in steel
- xxxvi. IS 3658 Code of practice for liquid penetrant
- xxxvii. IS 3757 Specification for High Tensile Friction grip bolts
- xxxviii. IS 4000 High strength bolts in steel structures Code of practice.
- xxxix. IS 4923 Hollow steel sections for structural use.
 - xl. IS 5334 Code of practice for magnetic particle flaw detection of welds.
 - xli. IS 5369 General requirements for plain washer and lock washers.
 - xl.ii. IS 5372 Taper washers for channels.
 - xl.iii. IS 5374 Taper washers for I beam
 - xliv. IS 5624 Specification for foundation bolts.
 - xl. v. IS 6227 Code of practice for use of metal arc welding in tubular structure.
 - xl. vi. IS 6610 Heavy washers for steel structures.
 - xl. vii. IS 7215 Tolerances for fabrication of steel structures.
 - xl. viii. IS 8500 Structural steel- Micro alloyed (medium and high strength qualities)
 - xl. ix. IS 9595 Recommendations for metal arc welding of carbon and carbon manganese steel.

2 SUBMITTALS

2.1 Material Report

Prior to start of delivery of structural steel required for contractor shall submit the following to the Engineer-in-Charge for review.

- a. Certified copies of mill test reports including chemical analysis and physical properties as required by the applicable Indian Standards for each consignment of steel.
- b. Where such mill certificates are not available or if the Engineer-in-Charge feels it necessary to substantiate conformance of the mill test reports, the contractor shall employ an approved testing laboratory to perform the required tests and chemical analysis at his own cost.

2.2 Shop/Fabrication Drawings

Before commencement of any structural steel fabrication work, the contractor shall submit the following to the Engineer-in-Charge for his approval:

- a. Fabrication drawings including details of connections.
- b. Assembly, erection and installation drawings and manuals indicating the sequence of work, welding and bolting procedure to be used. Cambers for trusses and large span girders shall be shown.

- c. For composite construction the details and calculation of details and calculation of false work and forms supporting the concrete work in steel structure shall be submitted.
- d. The drawings prepared by the contractor and all subsequent revisions etc. shall be at the cost of contractor for which no separate payment will be made.

3 MATERIALS

3.1 Structural Steel

3.1.1 Structural Steel (Primary Structural)

All structural steel used shall be confirmed to IS 2062. As per table 2 of IS 2062:2011 steel grade E450 is used in design calculation of all members sizes with following properties.

Unit mass = 7850 kg/m³

E = 200000 N/mm²

Ultimate tensile strength = 570 N/mm²

Yield stress = 450 N/mm² for thickness less than 20 mm

430 N/mm² for thickness between 20 to 40 mm

Percentage Elongation = 15% (minimum)

Charpy V- notch energy = E>27J at -20 degree Celsius

3.1.2 Structural steel used in the works other than steel in reinforced concrete, rails and fastenings shall be either of the following type :

- a. Mild steel conforming to IS : 226 - "Structural Steel (Standard quality)" or IS : 2062 - "Structural Steel (fusion welding quality)" whichever is approved.
- b. Whenever high tensile steel is specified it shall be conforming to IS : 961 - "Structural steel (High Tensile)".
- c. All steel tubes shall be hot finished seamless steel tubes (HFS) of the specified strength and as approved by the Engineer-in-Charge and shall conform to IS : 1161. Tubes made by other processes and which have been subjected to cold working, shall be regarded as hot finished if they have been subsequently been heat treated and are supplied in the normalised condition,

3.2 Threaded Fasteners

3.2.1 Bolts (HSFG)

All high strength bolts being used in frames resisting seismic force should be high strength friction grip bolt with adequate pre-tensioning and should conform to relevant grade

3.2.2 All bolts exposed outside the building must have at least 60 micro meter zinc coating

3.2.3 A third party Contractor must be hired which will check 5% of the complete bolts in the structure are taut enough as per the manufacturers and structural engineers standards. The selection of third party shall be done in presence of client and after getting approval from the client, the team shall be selected.

3.2.4 All bolts and nuts shall comply with IS : 1367.

3.2.5 Black bolts, nuts and screws shall be In accordance with IS : 1363.

- 3.2.6 Wherever counter sunk screws are specified, they shall be precision grade,bslotted, counter sunk head, machine screws conforming to type 'R' of IS : 1364.
- 3.2.7 Wherever high tensile special quality bolts and nuts are specified, they shall comply with provision of IS : 800.
- 3.2.8 Coach screws shall be in accordance with IS : 1120 and wood screws shall conform IS : 451.
- 3.2.9 All plain washers shall conform to requirements of IS : 2016. Wherever spring washers for bolts, nuts and screws are specified, they shall be in accordance with the provision of IS: 3003.

3.3 Cast Iron

Cast iron shall be conforming to IS : 210. All cast iron goods shall be of best quality and make and as approved by Engineer-in-Charge.

- 3.4 Cast steel shall be conforming to IS : 1030. Unless specified otherwise, the steel shall be grade 2 and shall cater or all tests specified in the said standard.

- 3.5 Rails for the cranes shall comply with the requirements of IRST-12-64 or IS : 3443 if so instructed by the Engineer-in-Charge. They shall be obtained form an approved manufacturer.

3.6 Electrodes

Electrodes used for metal arc welding of mild steel shall be heavy coated type electrodes conforming to IS : 814 (Part I& II and shall be of best quality approved by the Engineer-in-Charge.

- 3.6.1 All welds must be maximum 1.5 mm less than the connecting member thickness.
- 3.6.2 20 % of field welds and 10% of yard welds must be tested by dye penetration tests
- 3.6.3 All weld strength must have ultimate tensile strength higher than ultimate tensile strength of the structural members connecting it.

4.0 HANDLING & STORAGE

- 4.1 Structural steel shall be stored out of mud and dirt and proper drainage of the storage area shall be provided. Protect from damage or spoiling by adjacent construction operations.
- 4.2 Fabricated steel shall not be handled until the paint has thoroughly dried. Care shall be taken to avoid paint abrasions and other damager. Steel work shall be transported in the largest practical lengths and in such a way as not to overstress the fabricated sections. All pieces bent or otherwise damaged shall be replaced by the Contractor at his own cost.
- 4.3 Storage of fabricated steel at the job site shall be the responsibility of the Contractor. Material shall be stored at the Job site in a manner which does not overload the existing or newly constructed structures. Materials shall be protected against excessive deflection, corrosion or deterioration.
- 4.4 As far as practicable, stacking of fabricated steel shall be done in sequence of erection. But heavy members shall not be stacked on top of the light ones.

5.0 FABRICATION

5.1 Shop Drawings

- 5.1.1 The Contractor shall prepare required detailed shop drawings giving complete information necessary for the fabrication of the structure. All information should be clearly given and the drawings shall be in conformity with the best modern practice. A marking diagram allotting distinct identification marks to each separate piece of steel work shall be prepared in sufficient detail to ensure convenient assembly and erection. Symbol's used for welding in the drawings shall be in accordance with IS: 813.
- 5.1.2 The Contractors shall prepare comprehensive details of material sheets for each shop drawings giving therein all the items shown on the drawings together with their weights, marks, numbers, cutting lengths etc. Three copies of all working drawing and bill of material sheets shall be submitted to the Engineer-in-Charge for approval. Fabrication shall not commence until the approval of the relevant drawings has been obtained from the Engineer-in-Charge. While the shop drawings prepared by the Contractor and approved by the Engineer-in-Charge are deemed to represent the correct interpretation of the work to be done, the Contractor is not relieved of the responsibility for accuracy of detailed dimensions shown thereon.

5.2 Templates

All fabrication shall be in accordance with IS : 800 and IS: 1915. Extensive use of templates shall be made. The templates shall be steel bushed where considered necessary by the Engineer-in- Charge.

- 5.2.1 In case actual members are used as templates for similar pieces, it will be at discretion of the Engineer-in-Charge to decide whether such pieces are fit to be incorporated in the finished structure. The Contractor shall arrange for corresponding part of each unit manufactured from the same drawings to be interchangeable as far as economic manufacturing conditions permit, and shall advice the Engineer-in-Charge of the precise arrangement made in this respect, but prior approval of the Engineer-in-Charge in writing should be taken.

5.3 Straightening

All materials shall be straight unless required to be of curvilinear form and shall be free from twists. If necessary the materials shall be straightened and/or flattened by pressure. Heating of rolled sections and plates for purpose of straightening will not be permitted. Limited straightening may however be effected by local application of heat with a gas torch, but prior approval of the Engineer-in-Charge, in writing, should be taken.

5.4 Cutting

5.4.1 Gas Cutting shall normally be permitted for mild steel only. Gas cutting of high tensile steel may be permitted provided special care is taken to leave sufficient metal to be removed by matching so that nil metal that liar, boon hardened by flame is removed. Gas cutting shall preferably be done by machine, Hand flame cutting; may only be permitted subject to the approval of the Engineer-in-Charge. Gas cut edges shall be free of gouge. Any gouges that remain after cutting shall be removed by grinding.

5.4.2 Rolled sections shall be sawed or flame cut to length. Small plate pieces the gussets may be sheathed or chopped to size. Sawing, shearing and chopping shall be clean and free from any distortion. If necessary the edges shall be ground afterwards.

For tubular construction cutting of the pipe and preparation of joint surface shall be done in a neat manner for a good fit up. The ends of the tubes may be flattened or otherwise framed for connections provided that the methods adopted for such flattening do not injure the material. The change of section shall be gradual.

5.5 Holing

- 5.5.1 Holes shall preferable be done by drilling. Punching shall not be resorted to unless previously approved by the Engineer-in-Charge. In any case, punching of holes in materials having a thickness in excess of the connector diameter or in the materials thicker than 16mm shall not be permitted. Where punching is permitted the holes shall be punched 3 mm less in diameter than the required size and reamed after assembly to the full size.
- 5.5.2 Holes shall be drilled or punched at right angles to surface of the member, not more than 1.5 mm/2.0 mm (as the case may be depending upon whether the connector diameter is less than or more than 25 mm) larger than the connector diameter. Holes shall not be formed or enlarged by burning or gas cutting. Holes shall be clean-cut without torn or ragged edges. Outside burrs resulting from drilling operations shall be removed.
- 5.5.3 Holes through more than one thickness of material of members such as compound stanchions and girder flanges shall be drilled after the members are assembled and tightly clamped or bolted together. They shall then be separated and burrs removed if so directed by the Engineer-in-Charge.
- 5.5.4 Steel members adjustment shall be provided with slotted holes as shown on the drawings. Suitable templates shall be used for proper location of the holes.

5.6 Fabrication Tolerances

Unless otherwise shown on the drawings, the fabricating tolerances shall generally be as follows:

- Compression members shall not deviate from straightness by more than 1/1000 of the axial length between points which are to be laterally supported.
- A variation of 1 mm is permissible in the overall length of members with both ends finished for contact bearing,

Members without ends finished for contact boarding which are to be framed together in parts of the structure, may have a variation from the detailed length not greater than 2mm for members 10 metres or less in length and not greater than 3 mm for members over 10 metres in length.

6.0 ASSEMBLY

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6.1 All connections shall be either bolted or welded as shown on the drawings. Contractor shall not redesign or alter any connection without prior approval ERs.

The component parts shall be assembled in such a manner that they are neither twisted nor otherwise damaged and shall be prepared so that the specified camber if any is provided. Drafting done during assembly shall not distort the metal or enlarge the holes. Poor matching of holes shall be cause of rejection. However if permitted by the Engineer-in-Charge, holes that must be enlarged due to mismatching shall be reamed.

6.2 Bolting

6.2.1 All steel work which bolted together shall be in close contact over the whole surface. Where two bolted surfaces are to be in permanent contact after assembly, each shall be thoroughly scrapped free of loose scales, dirt and burrs and a heavy coat of red oxide, zinc chrome or other approved paint applied after cleaning and drying.

All bolts shall be provided with washers under the nut tapered on the inside of the flanges of R.S. Joists and channels. Bolts and studs shall project not less than one full thread through the nut after tightening. Unless otherwise specified, the ends of the bolts shall be burred after erection to prevent the removal of nuts.

6.2.2 High strength bolts shall be used in bearing or friction as shown on the drawings. High strength bolted joints shall be made without the use- of erection bolts. Bolts shall be of a strength that will extend not less than 6 mm beyond the nuts. Bolts shall be entered into holes without damaging the thread-members shall be brought tightly together with sufficient high-strength fitting up bolts which shall be retightened as all the bolts are finally tightened. Bolts heads shall be protected from damage during placing. Bolts that have been completely tightened shall be marked for identification. Bolted parts shall fit solidly together and shall not be separated by interposed compressible materials. The contact surface in high strength bolted connections shall be free of oil, paints, lacquer, loose scale or other coatings. The facing surfaces shall be machined flat. Final tightening of high strength bolts shall be by turn-of-out method. Retightening shall not be permitted. Whenever the Contractor intends to use other means of tightening he shall obtain prior approval of the Engineer-in-Charge.

6.2.3 Anchor bolts shall be set by use of templates secured firmly in place to permit true positioning of the bearing plates and assemblies. When in drawings anchor bolts are shown to be installed in sleeves, the sleeves shall be completely filled with grout.

6.3 Welding shall be done in accordance with IS : 816.

6.3.1 Welding procedures shall be based on the specific analysis of any given heat of steel (based on the certified mill test reports) and shall be subject to the review of the Engineer-in-Charge.

These procedures shall call for one or all of the following

- a. Proper bead shape
- b. Minimized penetration to prevent dilution of the weld metal with the alloy elements.
- c. Preheating, controlled interpass temperature and controlled heat input.

6.3.2 Welding shall be performed only by qualified and tested welders specifically trained and experienced for the type of job required to execute the welding work to the

- complete satisfaction of the Engineer-in-Charge. However periodical testing of welders shall be done as per IS 817, IS 7310 (Part I) and IS 738 (Part I).
- 6.3.3 Use of standard weld symbols as adopted by IS : 813 is mandatory. Pre-qualified joints which are detailed, prepared and welded in accordance with the requirement of IS : 816 shall be invariably used.
- 6.3.4 Structural welding shall not commence until joint elements are bolted or tacked in intimate contact and adjusted to dimensions shown with allowance for any weld shrinkage that is expected. Welding sequence shall be planned and controlled to minimise undue stress increase or undue distortions in restrained members. Heavy sections and those having a high degree of restraint shall be welded with low hydrogen type electrodes.
- 6.3.5 If copper wire spacers are used between two surfaces to be welded to reduce transverse stresses in the weld, care shall be taken that it does not mix with the weld metal.
- 6.3.6 Concave bead shape shall be avoided. Ratio of weld width to weld depth shall preferably vary from a minimum of 1 to 1, to a maximum of 1.4 to 1.

width-of-weld

————— = 1 to 1.4

depth of fusion

- 6.3.7 Field welding shall not be permitted unless shown on the drawings.
- 6.3.8 Subsequent to fabrication, the overlapping or contacting surfaces, or other closed sections (such as tubular, box section) which are inaccessible to painting shall be seal welded. When the end of the tube is not automatically sealed by virtue of its connection by welding to another member the end shall be properly and completely sealed. Before sealing, the inside of the tube shall be made dry and free from loose scale.
- 6.3.9 Order of assembly of the tubular sections shall consist of welding the tensile member to the main member first. Compression members shall be cut back to overlap the tensile member and then welded to both of these members.
- 6.3.10 No welding shall be done when the surface of the member is wet nor during periods of high wind. No welding shall be done on base metal at a temperature below -50°C . Base metal shall be preheated to the temperature as per relevant IS codes.
- 6.3.11 Each layer of multiple layer weld except root and surfaces runs may be moderately peened with light blows from blunt tool. Due care should be taken to prevent scaling or flaking of weld and base metal from over peening.
- 6.3.12 Electrodes other than low-hydrogen electrodes shall not be permitted for thicknesses of 32 mm and above.

6.4 Inspection of welds

All welds shall be inspected for flaws by any of the methods given in clause 7. The choice of method shall be determined by Engineer-in-Charge.

6.5 Tolerances

The dimensional and weight tolerances for rolled shapes shall be in accordance with IS 1852 for indigenous steel and equivalent applicable codes for imported steel. The tolerance for fabrication of structural steel shall be as per IS 7215.

6.6 End milling

Where compression joints are specified to be designed for bearing, the bearing surfaces shall be milled true and square to ensure proper bearing and alignment.

7.0 INSPECTION

- 7.1 The contractor shall give due notice to the Engineer-in-Charge in advance of the work getting ready for inspection. All rejected material shall be promptly removed from the site.
- 7.2 No materials shall be painted or erected or despatched to site without inspection and approval by the Engineer-in-Charge.
- 7.3 The Contractor shall provide all the testing and inspection services and facilities for shop works except where otherwise specified.
- 7.4 For fabrication work carried out at site, the same standard of supervision and quality control shall be maintained and inspection and testing shall be conducted in a manner satisfactory to Engineer-in-Charge.

7.5 Testing of welds

7.5.1 Magnetic particle test

Welds are to be tested in accordance with relevant IS codes. If heat treatment is performed, the completed weld shall be examined after heat treatment. All defects shall be repaired and retested. Magnetic particle test shall be carried out using alternating current. Direct current may be used with the permission of Engineer-in-Charge.

7.5.2 Liquid penetrate inspection

These tests shall be carried out as per IS codes. All defects shown shall be repaired and rechecked.

7.5.3 Radiographic Inspection

All full strength butt weld shall be radiographed in accordance with the recommended practice from radiographic testing as per relevant IS codes.

7.6 Test failure

In event of failure of any member to satisfy inspection or test requirement, the contractor shall notify the same to Engineer-in-Charge. Before repairing, contractor shall obtain permission from Engineer-in-Charge. The quality control procedures to be followed to ensure satisfactory repairs is subject to approval of Engineer-in-Charge.

- 7.7 The contractor shall maintain records in all inspection and testing which shall be made available to the Engineer-in-Charge as and when required.

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8.0 SHOP ERECTION

8.1 Steel work shall be temporarily shop erected completely or partially as directed by the ERs so that the accuracy of fit may be checked before dispatch. Due notice shall be given to the ERs so that the accuracy of fit may be checked before dispatch. Due notice shall be given to the ERs when the work is ready for inspection and the assembly shall not be dismantled until it has been inspected and approval obtained.

8.2 The parts shall be assembled with a sufficient number of parallel drifts to bring and keep the components in place. In the case of parts drilled or punched through steel jigs resulting in similar parts being interchangeable for portion of the steel work, trial assembly shall be carried out to the extent required by IS : 1915.

8.3 All erection marks shall be die-stamped and also distinctly stenciled in paints. The marking shall be as per the marking diagram approved by the Engineer-in- Charge.

9.0 ERECTION

9.1 As far as possible, the Contractor shall deliver the fabricated steel work to the site in the same sequence as that which he wishes to follow for the erection. Dispatch should be scheduled to avoid cluttering up of the site. The bolts required for erection shall be bagged according to size prior to dispatch.

9.2 All structural work shall be erected in accordance with IS : 800/IS : 806 and IS : 1915 and as per the approved erection drawings. The Contractor shall be responsible for setting out the works. The suitability any capacity of all plant and equipment used for erection shall be to the Satisfaction ERs. These shall be regularly serviced and maintained. Occupational safety practices shall be strictly adhered to and shall be to the satisfaction of the Engineer-in-Charge.

9.3 Individual pieces shall plumbed, leveled and aligned. Drift pins may be used only to bring together the several parts. They shall not be used in such manner as to distort damage the metal. Temporary bracing, guy line and staging shall be provided to ensure proper alignment and to adequately protect all persons property and to withstand all loadings to which the structure may be subjected during erection. Attachment of such temporary steel work to the permanent steel work shall only be done with the approval of the ERs. Temporary steel work shall remain in position until the structure is stable and self-supporting and until the structure is stable and self-supporting and permanently bolted or welded to the satisfaction of the ERs. After removal of temporary steel work, the permanent structure shall be made good to the complete satisfaction of the Engineer-in-Charge .No permanent bolting or welding shall be done until proper alignment has been obtained. Erection of the parts with any moderate amount of reaming, chipping or cutting shall be immediate reported to the Engineer-in-Charge. The steel work shall be rejected unless corrective action is approved by the Engineer-in-Charge.

9.4 No erection shall be permitted more than 2 story above a complete bolted and/or welded floor or above a decked surface.

9.5 Placement of joists shall not start until the supporting work is secured. Temporary bridging, connections and anchors shall be provided to assure lateral stability during erection. Bridging to steel joists shall be installed immediately after joist erection,

before any construction loads are applied. Horizontal or vertical bridging shall be provided in accordance with the type of span of the joists. Ends of the bridging lines shall be anchored at top mid bottom chords whom terminating to walls or beams.

9.6 Erection Tolerances

The Contractor shall control the erection of steel structures in such a way that in level no components are more than 10mm out of their correct position nor shall the lines of the structure depart from straightness and plumb by more than a 3mm in metres. The error shall be measured from the designed position of level given by the dimensions and co-ordinates on the drawings.

In structures where movements due to temperature change considerable the deviations listed above will apply at the morning position of the member being checked.

10.0 FILLED MODIFICATION

Correction to accommodate minor misfits in steel structure by moderate use of drift pins and reaming will be permitted. Errors that cannot be corrected by these measures, but require modifications must be reported immediately to the Engineer-in-Charge along with Contractors proposed solution.

11.0 GROUTING UNDER BASE PLATES

Grouting under base plates shall be done after erection of the structural steel unless otherwise approved by the ERs. All bearing plates, bearing assemblies and masonry plates shall be steel level and to the elevations shown on plans. These shall be shimmed with approved means and grouted to assure full bearings on the supporting substrata regardless of the tolerances otherwise permitted.

- 11.1 The grout to be used in superstructure stanchion bases shall be cement mortar 1 :2 (1 cement : 2 coarse sand) and shall have a 28 days compressive strength of atleast 300 kg/sqm. The surface which are to receive the grout shall be thoroughly cleaned immediately prior to the grouting operation. The grout shall be carefully worked under the base plates and shall completely fill the space under the base plates. Air pockets in the grout packing shall be avoided.
- 11.2 After the grout has had its initial set, the grout shall be cut back flush with the base plate and the surplus grout shall, be removed. Before leaving the site the Contractor shall retighten the nuts of all anchor bolts.

12.0 CLEANING & PAINT TOUCHING

After erection, exposed surfaces of filed connections, unpainted areas adjacent to tie connections and damaged area in the shop coat shall be cleaned to the same standards required or the shop cost. These shall then be painted with the same used in the shop coat.

13.0 INSERTS & EMBEDMENTS

Various steel inserts and embedment are required under the Contract to be fabricated, positioned and secured firmly into place inside the formwork prior to concrete being poured. There are also requirements of jointing, threading, bolting and welding inserts and embedment of different concrete and structural steel elements in order to establish structural continuity and connection. Great care

shall be exercised by the Contractor in executing all aspects of the work related to inserts and embedment - including tolerances so that the final assembly of the concrete elements can meet satisfactorily the continuity and contiguity requirements intended in the structure. The payment for the inserts and embedment shall be based on the weight of the fabricated puce at the same rate as that applicable to structural steel. The said rate shall be deemed to include supply of materials (Including rounds/bars), labour and all works related to steel inserts and embedments indicated in this specification.

SECTION XI PLUMBING TECHNICAL SPECIFICATIONS

SECTION – a SANITARY FIXTURES

1. SCOPE OF WORK

- 1.1 The work in general shall be carried out as per the latest CPWD Specifications.
- 1.2 The rules and regulations of Local Authority Having Jurisdiction, and as per the statutory regulations applicable.
- 1.3 Work under this section shall consist of furnishing all Material and labor as necessary and required to completely install all Sanitary Fixtures , brass and chromium plated fittings and accessories as required by the drawings and specified hereinafter or given in the Drawings. Indicative list for Fittings and fixtures is as given below:

Sanitary fixtures	Location	Chrome plated brass fittings	Location
Wall hung EWC	All toilets	15 mm CP brass auto close pillar tap	One for each wash basin
Wash basin	All toilets	15 mm CP brass Bib cock	One for each EWC
Stainless steel sink with washboard	Kitchen	CP brass Heath faucet with 1 m long hose	One for each EWC
Other Fixtures	Location	Concealed CP brass Stop cock and angle valve	As per requirement
Geyser water heater 15/25 ltr	In any one toilets	CP brass Coat hook	In each EWC stall
Mirror	All toilets	CP brass towel rail of minimum length 450 mm long	Near wash basin
		Soap dish	All toilets

1.4 Without restricting to the generally of the foregoing the Sanitary Fixtures shall include all Sanitary Fixtures, C.P. fittings and Accessories etc. necessary and required for the Building.

1.5 Whether specifically mentioned or not all Fixtures and appliances shall be provided with all fixing devices, nuts, bolts, screws, hangers as required.

2. GENERAL REQUIREMENTS

2.1 All Fixtures and fittings shall be provided with all such accessories as are required to complete the item in working condition whether specifically mentioned or not in the specification & Drawings.

2.2 The flow rate and type of Fixtures will be as per IGBC gold rating Building requirements.

2.3 All Fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per Architectural/ Interior designer's requirements. Wherever necessary the fittings shall be centered to dimensions and pattern desired.

2.4 Fixing screws shall be half round head Chromium Plated brass with C.P. washers wherever required as per directions of Engineer-in-Charge / LIC OF INDIA .

2.5 All Fittings and Fixtures shall be fixed in a neat workmanlike manner true to Levels and Heights shows on the drawings and in accordance with the manufacturer's recommendations. Care shall be taken to fix all Inlet and Outlet Pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, tiling or terrace shall be made good at Contractors cost.

2.6 When directed, Contractor shall install Fixtures and accessories in a mock-up room for the approval of the Engineer-in-Charge/LIC OF INDIA. Sample room Fixtures may be reused on the works if undamaged, but no additional payment for fixing or dismantling shall be admissible.

3. EUROPEAN W.C.

3.1 European W.C. shall be wash down, single or double siphonic type, wall mounted set, flushed by means of exposed or concealed type flushing cistern, as specified in drawings. Flush pipe/bend shall be connected to the W.C. by means of suitable rubber adapter. Wall hung W.C. shall be supported by C.I. floor mounted chair/bolts as per approval.

3.2 Each W.C. seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C.

4. WASH BASIN

4.1 Wash Basins shall be white glazed vitreous chinaware of size not less than 470x420 mm, shape and type as specified in the drawings.

4.2 Each Basin shall be provided with R.S. or C.I. brackets duly painted. The clips and the basin securely fixed to wall and have accessories as mentioned in the drawings.

5. SINKS

5.1 Sinks shall be of precast Terrazzo marble or White Glazed fire clay or vitreous china or stainless steel or any other material as specified in the drawings.

5.2 Kitchen Sinks and Process Sinks shall be of stainless steel

5.3 Each sink shall be provided with R.S. or C.I. brackets and clips and securely fixed. Counter top sinks shall be fixed with suitable angle iron clips or brackets as recommended by the manufacturer. Each sink shall be provided with 40 mm dia C.P. waste with chain and plug or P.V.C. waste. Fixing shall be done as directed by Engineer-in-Charge / LIC OF INDIA.

5.4 Supply fittings for sinks shall be mixing fittings as specified in the Drawings.

6. URINALS

6.1 Urinals shall be white glazed Vitreous China flat back half stall or lip type as specified in drawings.

6.2 Half stall Urinals shall be provided with sensor based flushing system , 32 mm dia C.P. domical waste and C.P. cast brass bottle trap with pipe and wall flange, and shall be fixed to wall by one C.I. bracket and two C.I. wall clips as recommended by manufacturers complete and as directed by Engineer-in-Charge/LIC OF INDIA.

6.3 Half stall urinals shall be fixed with C.P. Brass screws and shall be provided with 32 mm dia Domical Waste leading to Urinal trap.

6.4 Urinals shall be flushed by means of automatically sensor operated flushing system as specified in drawings.

6.5 Waste pipes for urinals shall be of the following:

a) G.I. / UPVC Pipes

Waste pipes may be exposed on wall or concealed in chase as directed by the Engineer-in -Charge / LIC OF INDIA. Specifications for waste pipes shall be same as given in Sub Section

7. URINAL PARTITIONS

- 7.1 Urinal partitions shall be white glazed vitreous china or 25mm thick marble of size specified in the Drawings.
- 7.2 Porcelain partitions shall be fixed at proper heights with C.P. brass bolts, anchor fasteners and M.S. clips as recommended by the manufacturer and directed by Engineer-in-Charge / LIC OF INDIA.

8. HAND DRYERS

- 8.1 The hand drier shall be no touch operating type with solid state time delay to allow user to keep hand in any position.
- 8.2 The hand drier shall be fully hygienic, rated for continuous repeat use (CRU).
- 8.3 The rating of hand drier shall be such that time required to dry a pair of hands up to wrists is approximately 30 seconds.
- 8.4 The hand drier shall be of wall mounting type suitable for 230V, single phase, 50Hz, AC power supply.

9. TOILETS FOR DISABLED

- 9.1 Where specified in washroom facilities designed to accommodate physically handicapped, accessories should be provided as directed by Engineer-in-Charge.
- 9.2 Stainless steel grab bars of required size suitable for concealed or exposed mounting and non-slip gripping surface shall be provided in all washrooms to be used by physically handicapped as directed by Engineer-in-Charge.

10. ACCESSORIES

- 10.1 Contractor shall install all Chromium Plated and porcelain accessories as shown on the drawings or directed by Engineer-in-Charge / LIC OF INDIA, and given in the Drawings.
- 10.2 All C.P. Accessories shall be fixed with C.P. brass half round head screws and cup washers in wall with raw plugs or nylon sleeves and shall include cutting and making good as required or directed by Engineer-in-Charge/LIC OF INDIA.
- 10.3 Porcelain accessories shall be fixed in walls and set in cement mortar 1:2 (1 cement: 2 coarse sand) and fixed in relation to the tiling work.

11. PAN CONNECTOR

The WC pan connector shall be Flexible, soft and shall be made of single body construction with integral fins. The pan connector must be supplied with factory fitted spring loaded seal guard.

While fixing of the pan connector with the Soil pipe, the pipe must be reasonably clean and smooth on the inner surface; in case the soil piping is in C.I. then supplier supplied bush / adaptor shall be used. The connector socket is pushed fully home onto the pan spigot, thereafter the WC is placed in position gently pushing the fitment

to ensure that the connector end fits into the Spigot of the pipe. The pan connector must be pushed in such a easy as to ensure that the seals and fins turn inward to ensure proper sealing.

12. MEASUREMENT

Rates for fixing of Sanitary Fixtures Accessories, urinal partitions shall include all items and operations stated in the respective specifications and Drawings and nothing extra is payable.

Rates for all items under specifications above shall be inclusive of cutting holes and chases and making good the same, C.P. screws, nuts, bolts and any fixing arrangements required and recommended by Manufacturers, Testing and Commissioning.

SECTION – b SOIL, WASTE & VENT PIPES

1. SCOPE OF WORK

1.1 Work under this section shall consist of furnishing all labor, materials, equipments and appliances necessary and required to completely install all soil, waste, vent and rainwater pipes as required by the drawings and specifications.

1.2 Without restricting to the generally of the foregoing, the soil, waste, vent and rainwater pipes system shall include the followings:

- a) Vertical and horizontal Soil, Waste and Vent Pipes, Rainwater Pipes and Fittings, Joints Clamps and connections to Fixtures.
- b) Connection of pipes to Gully Traps & Manholes etc.

2. GENERAL REQUIREMENTS

2.1 All materials shall be new of the best quality conforming to specifications and subject to the approval of Engineer-in-Charge / LIC OF INDIA.

2.2 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

2.3 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

2.4 Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals required.

2.5 Access doors for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.

2.6 All works shall be executed as directed by Engineer-in-Charge / LIC OF INDIA.

3. UPVC PIPES (I.S. 4985)

- a) 4/6/10 kg/cm² Class selection shall be as per drawings.
All fittings for uPVC pipes up to 200 mm O.D. size shall be injections moulded as per manufacturer, confirming to IS: 4985 and as specified in the drawings.
- b) For Fittings of sizes which are not injection molded but fabricated (Locally/Imported) sample of the same shall be submitted for approval.

4. CLAMPS

4.1 G.I. clamps shall be of standard design and fabricated from M.S. flat 40x3mm thick with required Galvanization.

4.2 Where G.I. clamps are to be fixed on RCC columns or slotted angles, walls or beam they shall be fixed with 40x3mm flat iron "U" type clamps with anchor fasteners of approved design or 6mm nuts and bolts.

4.3 Structural clamps shall be fabricated from G.I. (Galvanized) Structural members e.g. rods, angles, channels flats as per detailed drawing or as directed.

Contractor shall provide all nuts, bolts, welding material and paint the clamps with one coat of red oxide and two or more coats of black Enamel paint. Wooden saddles, where required shall be provided free of cost.

4.4 Slotted angle/channel supports on walls shall be provided wherever shown on drawings. Angles/channels shall be of sizes shown on drawings or specified in Drawings, angles/channels shall be fixed to brick walls with bolts embedded in cement concrete blocks and to RCC walls with suitable anchor fasteners. The spacing of support bolts horizontally shall not exceed 1 m.

4.5 Wherever G.I. clamps are required to be anchored directly to brick walls, concrete slabs, beams or columns, nothing extra shall be payable for clamping arrangement and making good with cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 mm stone aggregate 20mm nominal size) as directed by the Engineer-in-Charge / LIC OF INDIA.

5 TRAPS

5.1 C.I. Hubless deep seal trap

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Floor traps shall be either Cast Iron, deep seal with an effective seal of 50 mm. The trap and waste pipes shall be set in cement concrete blocks firmly supported on the structural floor. The blocks shall be in 1:2:4 mix (1 cement: 2 coarse sand:4 stone aggregate 20 mm nominal size) and extended to 40 mm below finished floor level. Contractor shall provide all necessary shuttering and centering for the blocks. Size of the block shall be 30x30 cm of the required depth. Where traps are suspended below ceilings, they shall be provided with proper structural supporting arrangements.

5.2 Urinal Traps

Urinal traps shall be Cast Iron deep seal traps with or without Vent and set in cement concrete block specified in Para above without extra charge.

5.3 Floor Trap Inlet

Bath room traps and connections shall ensure free and silent flow of discharging water. Where specified, Contractor shall provide a special type G.I. inlet hopper without or with one, two or three inlet sockets to receive the waste pipe. Hopper shall be connected to trap with at least 50 mm seal (Hopper and traps shall be paid for separately.)

5.4 C.P./Stainless Steel Gratings

Floor and Urinal Traps shall be provided with 100-150 mm square or round C.P./Stainless steel grating, with rim of approved design and shape. Minimum thickness shall be 4-5 mm or as specified in the Drawings.

6 CLEANOUT PLUGS

Contractor shall provide brass cleanout plugs as required. Cleanout plugs shall be threaded and provided with key holes for opening. Cleanout plugs shall be fixed to the pipe by a male threaded adaptor.

7. WASTE PIPE FROM APPLIANCES

7.1 Waste pipe from appliances e.g. wash basins, sinks, urinals, bathtubs, water coolers shall be of galvanized steel/uPVC as given in the Drawings or as shown on the drawings.

7.2 All pipes shall be fixed in gradient towards the outfalls of drains. Pipes inside a toilet room shall be in chase unless otherwise shown on drawings. Where required pipes may be run at ceiling level in suitable gradient and supported on structural clamps. Spacing for clamps for such pipes shall be as follows:-

	Vertical	Horizontal
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GI pipes	300 Cm	240 Cm
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7.3 Galvanized Iron Pipes

Pipes shall be galvanized iron tubes conforming to IS: 1239-1979 (medium class) and quality certificates shall be furnished. Pipes shall be provided with all required fittings e.g. Tees, Couplings, Bends, Elbows, Unions, Reducers, Nipples, Plugs. All G.I. waste pipes shall be terminated at the point of connection with the appliance with an outlet of suitable diameter.

8 CEMENT CONCRETE

Cast Iron Soil and Waste pipes under floors in sunken slabs and in wall chases (When cut specially for the pipe) shall be encased in cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 12 mm size) 75 mm in bed and all-round. When pipes are running well above the structural slab, the encased pipes shall be supported with suitable cement concrete pillars of required height and size at intervals as directed by Engineer-in-Charge/LIC OF INDIA.

9 CUTTING AND MAKING GOOD

Pipes shall be fixed and tested as buildings proceeds. Contractor shall provide all necessary holes cutouts and chases in structural members as building work proceeds. Wherever holes are cut or left originally, they shall be made good with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) or cement mortar 1:2 (1 cement: 2 coarse sand) and the surface restored as in original condition.

10 INSPECTION & TESTING

10.1 Inspection

Work should be inspected during installation and tests applied on completion, care being taken that, all work which is to be encased for concealed is tested before it is finally enclosed.

Inspection should be carried out to ensure the following:

- Work accords with the drawing and specifications.
- All pipe brackets, clips etc. are securely fixed.
- Fixtures are correctly spaced.
- Pipe is protected where necessary by Thermal Insulation.
- Embedded pipe work is properly protected before sealing-in

- f) All access covers, caps or plugs.
- Are accessible
 - Are so made that the internal faces truly complete in internal bore.
 - Cause no obstruction in the pipe bore
 - Are well joined.

11 Testing

The soil, waste piping system and rain water should be tested after installation as follows:

a) Water Test

The pipes shall be tested after installation & before the appliances are connected, preferably in sections so as to limit the static head of 4.5m. The pipe shall be filled with water for at least 10 minutes. After filling, pipes shall be struck with a hammer and inspected for blow holes and cracks. Then it will be necessary to seal all openings and leaks at joints immediately as observed during the test and all defective pipes shall be rejected and removed from the site. Pipes with minor sweating shall be accepted at the discretion of the Engineer-in-Charge/LIC OF INDIA.

b) Smoke Test

Alternatively, the Contractor may test all Soil, Waste and Rainwater stacks by smoke testing machine. The smoke test shall be carried out as under: Smoke shall be pumped into the stack after plugging all inlets and connections at the lowest points from a smoke testing machine which consists of a bellow & burner. The material usually burnt is greasy cotton waste which gives out a clear pungent smoke which is easily detected by sight as well as by smell, if there is leak at any points of the pipe. The top end shall however be left open. The stack shall then be observed for leakiness and all defective pipes and fittings removed or repaired as directed by the Engineer-in-Charge / LIC OF INDIA.

- c) A test register shall be maintained and all entries shall be signed and dated by Contractors and Engineer-in-Charge/LIC OF INDIA.

12 General

12.1 General

- a) Rates for all items quoted shall be inclusive of all work and items given in the above mentioned specifications and Drawings and applicable for the work under floor, in shafts or at ceiling level at all heights and depths.
- b) All rates are inclusive of cutting holes and chases in RCC and masonry work and making good the same.
- c) All rates are inclusive of pre testing and on site testing of the installations, materials and commissioning.

SECTION – C

WATER SUPPLY SYSTEM

1. SCOPE OF WORK

1.1 Work under this section consists of furnishing all labor, materials equipment and appliances necessary and required to completely install the water supply system as required by the drawings.

1.2 Without restricting to the generality of the foregoing, the water supply system shall include the following:-

- a) All water lines to different parts of building and making connection from source etc. including risers, terrace lines, down take and distribution system.
- b) Pipe protection and painting.
- c) Providing Hot water supply lines and with insulation of hot water pipe lines.
- d) Control valves, masonry chambers and other appurtenances.
- e) Connections to all toilets, kitchen equipments, storage tanks and appliances.
- f) Excavation and refilling of pipe trenches, wherever required.
- g) Trenches for taking pipe lines for these services.

2. GENERAL REQUIREMENTS

2.1 All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Engineer-in-Charge / LIC OF INDIA.

2.2 Pipes and Fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

2.3 Short or Long bends shall be used on all main pipe lines as far as possible. Use of Elbows shall be restricted for short connections. As far as possible all Bends shall be formed by means of a hydraulic pipe bending machine for pipes up to 65mm dia.

2.4 Pipes shall be fixed in a manner so as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

2.5 Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.

2.6 Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.

3. uPVC PIPES

3.1 Definition

uPVC pipe means unplasticized Polyvinyl Chloride pipe, confirming to IS: 4985. It has density of Approx. 1.43 g / Cm³ as such it is less than 1/6th the weight of C.I. and steel pipes, therefore easier to handle during installation and transportation.

3.2 The uPVC Pipes to be used for Portable water to be odorless and hygienic, and should have inside surface mirror smooth.

3.3 The Pipes should have high corrosion resistance and should be immune to chemical electrolytic and galvanic action.

3.4 These Pipes should be longer lasting because of corrosion resistance property.

3.5 Handling Guidelines

Pipes should be kept on an even surface while storing. They should be properly supported and should not be stacked for heights more than 1.5 meters for longer duration.

3.6 Jointing Instruction

The uPVC Pipes are of two types i.e. Selfit and Ringfit. The following procedure may be adopted while jointing the Pipes: -

a) Selfit Pipes

- Cut the Pipes as square as possible and ensure fitment of Pipes with socket of fitting is correct. Total length of insertion of sockets to be marked from the Pipe.
- The Pipe and the socket should be clean and dry. Dust, Oil, water, grease etc. should be wiped out with dry cloth or cleaner from the surfaces to be coated with Solvent Cement.
- Roughen the outside of Pipe and inside of Socket using sand Paper up to the entry mark. Stir adhesive i.e. Solvent Cement thoroughly.
- Apply thick coat of Solvent Cement using a flat clean brush evenly on the inside of the socket mouth for full length of insertion and then outside of the Pipe end up to the marked line.
- After application of Solvent Cement, insert the Pipe within one minute in to the Socket. Hold the Joint for few seconds and ensure that the Pipe does not come out of the fittings. Wipe off extra cement and allow it to dry for at least 24 Hours. The PVC Pipe with joint is ready for use.

b) Ring-fit Pipes

- Clean the inside of Socket. Remove all traces of mud, dirt, grease, gravel and also clean sealing ring.
- Form the EPDM ring into heart shape by pinching a portion of ring inside. Insert it into the socket and release to seat in to the groove.
- Mark the insertion depth on spigot portion of the pipe. Clean and apply lubricant to insertion depth before pushing in to the Socket. Ensure that no sand or dirt adheres to the lubricated surface of the Pipe.
- Push the Spigot into the Socket until it reaches the depth of entry mark, taking care not to over insert. This can be done manually. Make sure that the insertion of Spigot end inside the socket should be at correct angle. The Pipe and Joint are ready for use.

- In case of large diameter Pipes if crow bar does not give sufficient leverage, use of jointing jack may be helpful.

Precautions

- a) uPVC Pipes and Fittings should not be cleaned by Solvent Cement.
- b) For large diameter and Higher class Pipes (6 kgf/cm² & above), use heavy duty Solvent cement.
- c) uPVC pipes and fittings to be used of same Brand and Manufacturer.

4. CPVC PIPES AND FITTINGS

4.1 Description

CPVC piping shall be Fire Proof, Corrosion resistance with smooth, friction free interior surfaces and with anti - bacterial growth properties.

4.2 JOINING TUBING & FITTINGS

a) Cutting

CPVC tubing shall be cut with a wheel-type plastic tubing cutter, a hack saw or other fine toothed hand or power saws. Use of ratchet cutters shall be permitted, provided blades are sharpened regularly. A miter box should be used to ensure a square cut when using a saw.

b) Deburring/Beveling

Burrs and fillings can prevent proper contact between tube and fitting during assembly, and should be removed from the outside and inside of the tubing. A chamfering tool shall be used for this purpose. A slight bevel on the end of the tubing shall be provided to enable entry of the tubing into the fitting socket and minimize the chances of pushing solvent cement to the bottom of the joint.

c) Fitting Preparation

The surfaces shall be wiped clean of dirt and moisture from the fitting sockets and tubing end. Check the dry fit of the tubing and fitting. The tubing should make contact with the socket wall 1/3 to 2/3 of the way into the fitting socket.

d) Solvent Cement Application

Only approved type Solvent Cement shall used for jointing the CPVC pipes, which shall be procured as per the manufacturer recommendations. Apply an even coat of Cement Solvent on the Pipe end after cleaning of whole pipe and also inside the fittings socket. Old or deteriorated or thickened or Lumpy Solvent Cement shall not be used.

e) Assembly

Immediately insert the pipe into fitting socket, rotate the pipe $\frac{1}{4}$ to $\frac{1}{2}$ turn while inserting. This motion ensures an even distribution of cement within the joint. Properly align the fitting. Hold the assembly for approximately 10 seconds, allowing the joint to set-up. An even bead of cement should be evident around the socket edge, it may indicate that sufficient cement was applied. In this case, remake the joint to avoid potential leaks. Wipe excess cement from the tubing and fitting surfaces for an attractive, professional appearance.

5. G.I. PIPES & FITTINGS

- 5.1 All pipes inside the buildings and where specified, outside the building shall be galvanized steel tubes heavy duty conforming to I.S. 1239/3589 of class specified.
- 5.2 Fittings shall be malleable iron galvanized fittings, of approved make. All fittings shall have manufacturer's trade mark stamped on it. Fittings for G.I. pipes shall include Couplings, Bends, Tees, Reducers, Nipples, Unions, Bushes, Fittings shall be of I.S:1879 - (part I to X) 1975.
- 5.3 Pipes and fittings shall be jointed with screwed fittings. Care shall be taken to remove burr from the end of the pipe after cutting by a round file. Genuine red lead with grummet and a few strands of fine hemp shall be applied. All pipes shall be fixed in accordance with layout and alignment shown on the drawings. Care shall be taken to avoid air pockets. G.I. pipes inside toilets shall be fixed inwall chases well above the floor. No pipes shall be run inside a sunken floor as far as possible. Pipes may be run under the ceiling or floors and other as shown on drawings.

6. CLAMPS

G.I. pipes in shafts and other locations shall be supported by M.S. clamps of design approved by Engineer-in-Charge / LIC OF INDIA. Pipe in wall chases shall be anchored by iron hooks. Pipes at ceiling level shall be supported on structural clamps fabricated from M.S. structural as described in the sub section. Pipes in typical shafts shall be supported on Slotted Angles/Channels as specified elsewhere.

7. UNIONS

Contractor shall provide adequate number of unions on all pipes to enable dismantling later. Unions shall be provided near each Gunmetal Valve, Stop Cocks, or Check Valves and on straight runs as necessary at appropriate locations as required and/or directed by Engineer-in-Charge / LIC OF INDIA.

8. FLANGES

Flanged connections shall be provided on pipes where shown on the drawings, all equipment connections as necessary and required or as directed by Engineer-in-Charge / LIC OF INDIA. Connections shall be made by the correct number and size of the bolts and made with 3 mm thick insertion rubber washer. Where hot water or steam connections are made insertion gasket shall be of suitable high temperature grade and quality approved by Engineer-in-Charge / LIC OF INDIA. Bolt hole dia for flanges shall conform to match the specification for C.I. Sluice Valve to I.S. 780.

9. TRENCHES

The galvanized iron pipes and fittings shall be laid in trenches. The width and depth of the trenches for the different diameters of the pipes shall be as follows:

Dia of pipe	Width of trench	Depth of trench
15mm to 50 mm	30 cms	60cms
65 mm to 100 mm	45 cms	75 cms

At joints the trench width shall be widened where necessary. The work of excavation and refilling shall be done true to line and gradient in accordance with general specifications for earthwork in trenches.

When excavation is done in rock, it shall be cut deep enough to permit the pipes to be laid on a cushion of sand minimum 7.5 cm deep.

10. PAINTING

- 10.1** All surfaces shall be thoroughly cleaned before painting.
- 10.2** All pipes above ground shall be painted with one coat of Red Lead and two coats of Synthetic Enamel paint of approved shade and quality. Pipes shall be painted to standard color code specified by Engineer-in-Charge/LIC OF INDIA.
- 10.3** All pipes in chases and below floor shall be provided Anti-corrosive treatment.

11. PIPE PROTECTION

Where specified in the Drawings all pipes below ground shall be protected against corrosion by wrapping 100mm wide and 4mm thick layer of material of approved make over the pipe.

12. GUNMETAL VALVES

- 12.1** Valves 65mm dia and below shall be heavy Gunmetal Fullway Valves or Globe Valves or Ball valves conforming to I.S. 778-1971 of 20-25 Kg/cm² class. Valves shall be tested at manufacturer's works and the same stamped on it.
- 12.2** All Valves shall be approved by the Engineer-in-Charge / LIC OF INDIA before they are allowed to be used on work.

13. BALL VALVES

Ball Valves have body material as Forged Brass Chrome plated with Spindle Brass Nickel Plating & Lever handle Steel Chrome plated with green plastic cover. The valve is suitable for water maximum working pressure up to 25 bar (PN 25). The valve is operated by turning. The rotation from open to close is a quarter turn (90°) which closes in a clock-wise direction.

14. BUTTERFLY VALVES

- a) Butterfly valves of approved quality for pressure rating of 230 P.S.I. with locking arrangement and gearbox with handle operated or gearbox with lid shall be provided or as given in the Drawings.
- b) Butterfly valves shall be of specified quality conforming to IS: 13095 or BS: 5155.
- c) Joints for butterfly valves shall be made with suitable tail /socket pieces on the pipe line and flanged joints made with 3mm thick insertion rubber gasket with appropriate number of bolts, nuts and washers.
- d) Butterfly valves shall be provided on all branches as shown in the drawings or as specified.

15. SLUICE VALVES

15.1 All valves 80mm dia and above shall be C.I. Double Flanged Sluice Valves. Sluice valves shall be Cast Iron double flanged, with rising spindle. Each sluice valve shall be provided with wheel for valves in exposed positions and Cap Top for underground valves. Contractor shall provide suitable operating keys for Sluice Valves with Cap Tops.

15.2 Sluice valves shall be of best quality conforming to I.S: 780-1969 of class

15.3 Sluice valves shall be socketed type or double flanged type conforming to I.S:780.

- a) Joints for socketed valves shall be lead-caulked joints as specified above.
- b) Joints for double flanged sluice valves shall be made with suitable tail/socket pieces on the pipeline and flanges joints made with 3 mm thick insertion rubber gasket with appropriate number of bolts, nuts and washers.
- c) Sluice valves shall be installed at all branches and as shown on the drawings.

16. SCOUR VALVES

Scour valves shall be C.I. sluice valves as specified above. They shall be installed at the lowest level or tail end of the system as shown on drawings and directed by Engineer-in-Charge / LIC OF INDIA.

17. AIR RELEASE VALVES

- a) Air release valves shall be single acting type air valves with cast iron body and bronze/gunmetal internal parts and plastic float.
- b) Each air release valve shall be provided with a cast iron isolating sluice valve of specification given above.

18. CAST IRON PIPES

18.1 Pipes for water supply mains where specified shall be cast iron pipes, centrifugally cast spun iron pipes, class LA conforming to I.S. 1536. Quality certificates shall be furnished.

18.2 Fittings and Inspection Chambers

Fittings and chambers shall be provided as required.

18.3 Anchor Block

Suitable anchor blocks shall be provided at all bends and tees to encounter the excessive thrust developed due to water hammer.

18.4 Rubber Joints

Joints between two pipes shall be made by premoulded rubber joints with suitable tackles in a manner recommended & approved by the manufacturer. No joints shall be covered until the lines are Hydraulically tested.

19. VALVE CHAMBERS

19.1 Contractor shall construct chambers for all full way valves, butterfly valves and other type of valves as specified in the Drawings. These shall be made, in brick masonry in cement mortar 1:4 (1 cement: 4 coarse sand) on cement concrete foundations 150mm thick 1:5:10 mix (1 cement: 5 coarse sand: 10 graded stone aggregate 40mm nominal size) 12 mm thick cement plaster 1:3(1 cement : 3 coarse sand) inside finished with a floating coat of neat cement with 8mm thick M.S surface box with hinged cover and locking arrangement, 150 mm thick reinforcement cement concrete top slab of 1:2:4 (1 cement : 2 coarse sand: 4 graded stone aggregate 20mm nominal size), as specified and shown in drawings, including excavation, back filling rammed complete or as specified in Drawings.

19.2 Valve chambers shall be constructed as specified in drawings but generally shall be of following sizes:

	Length (MM)	Width (mm)	Depth (mm)
For pipes dia upto 80 mm	600	600	1000
For pipes dia 80mm and above	750	750	1000

20. TESTING

20.1 All pipes, fittings and valves shall be tested by hydrostatic pressure of min. 1.5 times, the working pressure and subject to minimum of 7 kg/cm² in any case and with the consent of Engineer-in-Charge / LIC OF INDIA.

20.2 Pressure shall be maintained for a period of at least two hours without appreciable drop in the pressure after fixing at site. (+10 %). A test register shall be maintained and all entries shall be signed and dated by Contractor(s) and Engineer.

20.3 In addition to the sectional testing carried out during the construction, Contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains. He shall rectify all leakages, and shall replace all defective materials in the system. Any damage done due to carelessness, open or burst pipes or failure of fittings, to the building, furniture and Fixtures shall be made good during the defects liability period without any extra cost.

20.4 After completion of the water supply system, Contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves which do not effectively operate shall be replaced by new ones at no extra cost and the same shall be tested as above.

21. DISINFECTION

21.1 After completion of the work Contractor shall flush clean the entire system with the city's filtered water after connection has been made.

21.2 After the first flushing, commercial bleaching powder is to be added to achieve a dosage of 2 to 3 mg/l of water in the system added and flushed. This operation should be performed twice to ensure that the system is fully disinfected and usable.

22. PRE COMMISSIONING

- 22.1 Ensure that all pipes are free from debris and obstructions.
- 22.2 Check all valves and fire hydrant for effective opening and closing action. Defects should be rectified or valves replaced.
- 22.3 Ensure that all Connections to Branches has been made.
- 22.4 Ensure that mains have been connected to the respective pumps, underground and overhead tanks.
- 22.5 Water supply should be available at main Underground tank.
- 22.6 All main line Valves should be closed.

23. COMMISSIONING

- 23.1 Fill Underground tank with water. Add 1kg fresh bleaching powder after making a solution to be added near inlet.
- 23.2 Start Water Supply Pump and allow water to fill main Underground tank. Water will first fill the fire tank and then overflow to the Raw Water tanks.
- 23.3 After filling Overhead Reservoir drain the same to its one forth capacity through tank scour valve. (This is to ensure removal of all mud, debris etc. from the tank).
- 23.4 Fill Overhead tank to full. Release water in the main lines by opening Valves in each circuit. Drain out
- 23.5 water in the system through scour valves or fire hydrant in lower regions. Ensure clean water is now coming out of the system.
- 23.6 Open valves for individual clusters. Observe for leakages or malfunctions, check pressure & flow at end of line by opening Hydrants etc. Remove and rectify defects noticed.
- 23.7 Check all outlet points for proper operation by opening each valve and allowing water to flow for a few minutes. Also check for effective closure of valve.
- 23.8 The entire water supply system should be disinfected with bleaching powder and system flush cleaned.
- 23.9 Send four samples of water drawn from four extreme locations for testing for bacteriological test in sterilized bottles obtained from the concerned laboratory. (Laboratory personal may collect the samples themselves).

24. . RESPONSIBILITY

Responsibility for various activities in pre-commissioning and commissioning procedures will rest with the Contractor.

SECTION – D

SEWERAGE / DRAINAGE SYSTEM

1. SCOPE OF WORK

Work under this section shall consist of furnishing all Labor, Materials, Equipments and Appliances necessary and required to completely finish Sewerage/Drainage system as required by the drawings and specified hereinafter or given in the Drawings.

2. GENERAL REQUIREMENTS

- 2.1 All materials shall be new of the best quality conforming to specifications and subject to the approval of the Engineer-in-Charge / LIC OF INDIA.
- 2.2 Drainage lines shall be laid to the required gradients and profiles.
- 2.3 All drainage work shall be done in accordance with the local Municipal byelaws.
- 2.4 Location of all manholes, catch basins etc., shall be got confirmed by the Contractor from the Engineer-in-Charge / LIC OF INDIA before the actual execution of work at site.
- 2.5 All works shall be executed as directed by Engineer-in-Charge / LIC OF INDIA.

3. ALIGNMENT AND GRADE

The sewer pipes shall be laid to alignment and gradient shown on the drawings but subject to such modifications as shall be ordered by the Engineer-in-Charge / LIC OF INDIA from time to time to meet the requirements of the works. No deviations from the lines, depths of cutting or gradients of sewers shown on the plans and sections shall be permitted except by the express direction in writing of the Engineer-in-Charge / LIC OF INDIA.

4. SALT GLAZED STONEWARE PIPES

- 4.1 Pipes and Fittings shall be new and of the best quality, grade and shall confirm to IS: 651. The Glaze shall be free from crazing, fire cracks or hair cracks. There shall be no broken blisters. There shall be sharp clear tone when struck lightly. Pipes shall be with spigot and socket ends.

4.2 Laying and Jointing of Stoneware Salt Glazed Pipes

- a) Pipes are liable to be damaged in transit and notwithstanding tests that may have been made before dispatch each pipe shall be examined carefully on arrival at site. Each pipe shall be rung with a wooden hammer or mallet and those that do not ring true and clear shall be rejected. Sound pipes shall be carefully stacked to prevent damage. All defective pipes should be segregated, marked in a conspicuous manner and their use in the works prevented.
- b) The pipes shall be laid with sockets leading uphill and should rest on solid and even foundations for the full length of the barrel. Socket holes shall be formed in the foundation sufficiently deep to allow the pipe jointer room to work right round the pipe and as short as practicable to admit the socket and allow the joint to be made.
- c) Where pipes are not bedded on concrete the trench bottom shall be left slightly high and carefully bottomed up as pipe laying proceeds so that the pipe barrels rest on firm ground. If excavation has been carried too low it shall be made up with cement concrete 1:5:10 mix at the Contractor's cost and charges.
- d) If the bottom of the trench consists of rock or very hard ground that cannot be easily excavated to a smooth surface, the pipes shall be laid on cement concrete bed of 1:5:10 mix to ensure even bearing.

4.3 Jointing of Pipes

- a) Tarred gaskin shall first be wrapped round the spigot of each pipe and the spigot shall then be placed into the socket of the pipe previously laid, the pipe shall then be adjusted and fixed in its correct position and the gaskin caulked tightly home so as to fill not more than one quarter of the total length of the socket.
- b)
- c) The remainder of the socket shall be filled with stiff mix of cement mortar (1 cement: 1 clear sharp washed sand). When the socket is filled, a fillet should be formed round the joint with a trowel forming an angle of 45 degrees with the barrel of the pipe. The mortar shall be beaten up and used after it has begun to set.
- d) After the joint has been made any extraneous materials shall be removed from inside of the joint with a suitable scraper or "Badger". The newly made joints shall be protected until set from the sun, drying winds, rain or dust. Sacking or other materials, which can be kept damp, shall be used. The joints shall be exposed and space left all rounds the pipes for inspection by the Engineer-in-Charge / LIC OF INDIA. The inside of the sewer must be left absolutely clear in bore and free from cement mortar or other obstructions throughout its entire length, and shall efficiently drain and discharge.

5. HDPE PIPES

5.1 HDPE pipes used for external sewerage / drainage purpose shall conform to IS:14333 & to the grade as specified in the drawings.

5.2 All the HDPE pipes shall be jointed with Butt welding method complete as per manufacturer's specifications including testing of joints etc.

6. ECO DRAIN PIPES

- 6.1 Pipes and Fittings shall be new and of the best quality, grade and shall confirm to IS: 16098 and European international standards for "Structured wall pipes and fittings" for U.G. Drainage and Sewerage. These are solid wall pipes which have a unique wall structure i.e. with a number of holes across, the pipe wall thickness in longitudinal direction. ECO Drain pipes are of long lengths and hence reducing the number of joints and potential for flow disturbances.
- 6.2 The joints are stable, water tight and can accommodate angular deflection and axial displacement. Joints are designed to resist loads from horizontal and vertical forces. These joints can accommodate 3° angular deflection in any direction and hence offer good flexibility against lateral or vertical displacements.

Dimension and Stiffness class of Eco drain pipes as per IS: 16098

7. GULLY TRAPS

- 7.1 Gully traps shall be of the same quality as described for stoneware pipes in Clause 4.
- 7.2 Gully traps shall be fixed in cement concrete 1:5:10 mix (1 cement: 5 coarse sand: 10 stone aggregate 40mm nominal size) and a brick masonry chamber 30x30 cms inside in cement mortar 1:3 with 10 x 10 cms grating inside and 30x30 cms C.I. sealed cover and frame weighting not less than 7.2 kg to be constructed as per standard drawing. Where necessary, sealed cover shall be replaced with C.I. grating of the same size.

8. GREASE TRAP

Grease Trap shall be provided on Kitchen waste lines before discharging the waste into the main sewer line. Grease Trap shall be built in brick masonry and shall be similar in construction to manholes. The grease trap shall be construction to size as shown at the location on drawings. The grease trap shall be provided with drop inlet, drop outlet, galvanised wrought iron sediment pan and a baffle wall. Grease trap shall be provided with 2 Nos, double seal manhole cover and frame which shall be identified with lettering "Grease trap".

9. REINFORCED CEMENT CONCRETE PIPES

- 9.1 All underground storm water drainage pipes and sewer lines where specified (other than those specified cast iron) shall be centrifugally spun RCC pipes of specified class. Pipes shall be true and straight with uniform bore. Throughout cracked, warped pipes shall not be used on the work. All pipes shall be tested by the manufacturer and the Contractor shall produce, when directed a certificate to that effect from the manufacturer.

9.2 Laying

R.C.C. spun pipes shall be laid on cement concrete bed or cradles as specified and shown on the detailed drawings the cradles may be precast and sufficiently cured to prevent cracks and breakage in handling. The invert of the cradles shall be left 12mm below the invert level of the pipe properly placed on the soil to prevent any disturbance. The pipe shall then be placed on the bed concrete or cradles and set for the line and gradient by means of sight rails and bonding rods etc. cradles or concrete bed may be omitted, if directed by the Engineer-in- Charge / LIC OF INDIA.

9.3 Jointing

After setting out the pipes the collars shall be centered over the joint and filled in with tarred gaskin, so that sufficient space is left on either side of the collar to receive the mortar. The space shall then be filled with cement mortar 1:2 (1 cement: 2 fine sand) and caulked by means of proper tools all joints shall be finished at an angle of 45 degree to the longitudinal axis of the pipe on both side of the collars neatly.

10. CAST IRON PIPES FOR DRAINAGE

10.1 All drainage lines passing under building, floors and roads with heavy traffic, in exposed position above ground e.g. service floor and basement ceiling shall be cast iron pipes. Position of such pipes shall generally be shown on the drawings.

10.2 Cast iron pipes shall be centrifugally spun iron pipes conforming to I.S: 1536. Quality certificates shall be furnished.

10.3 Fittings and Inspection Chambers

- a) Fittings used for C.I. drainage pipe shall conform to I.S: 1538. Wherever possible junction from branch pipes shall be made by a 'Y tee'.
- b) Cleanout plugs shall be provided on head of each drain and at location indicated on plans or directed by Engineer-in-Charge / LIC OF INDIA. Cleanout plugs shall be of size matching the full bore of the pipe. Plugs shall be made out with G.I. coupling caulked into the socket of the pipe or fittings. The end shall be provided with a brass screwed plug with suitable key for opening.

10.4 Laying

- a) All cast iron pipes and fittings shall be jointed with best quality soft Pig Lead (conforming to IS: 782) which shall be free from impurities. In wet trenches joints shall be made from Lead Wool. Nothing extra will be paid for Lead Wool joints. Depth of pig lead and weight for joints shall be as given in I.S. code.
- b) The spigot of pipe or fittings shall be centered in the adjoining socket by caulking. Sufficient turns of tarred gaskin to leave unfilled the required depth of socket for depth of 45mm when the gaskin has been caulked tightly home. Jointing ring shall be placed round the barrel and against the face of the socket. Molten Pig Lead shall then be poured to fill the remainder of the socket. This shall then be done in one pouring. The lead shall then be solidly caulked with suitable tools and hammers weighting not less than 2 kg.
- c) For lead wool joints the socket shall be caulked with tarred gaskin, as explained above. The lead wool shall be inserted into the sockets and tightly caulked home by Gaskin with suitable tools and hammers of not less than 2 kg weight until joint is filled.

10.5 Testing

- a) All lengths of the sewer and drain shall be fully tested for water tightness by means of water pressure maintained for not less than 30 minutes. Testing shall be carried out from manhole. All pipes shall be subjected to a test pressure of at least 1.5 meter head of water. The test pressure shall, however, not exceed 1.5 meter head at any point. The pipes shall be plugged preferably with standard design rubber plugs on both ends. The upper end shall, however, be connected to a pipe for filling with water and getting the required head. The tolerance figure of two liters per centimeter of dia per kilometer may be allowed during a period of ten minutes. Subsidence of the test water may be due to one or more of the following causes:

- Absorption by pipes and joints
- Sweating of pipe or joints
- Leakage at joints or from defective pipes

b) Trapped Air

Allowance shall be made for (i) by adding water until absorption has ceased after which the test proper should commence. Any leakage will be visible and the defective part of the work should be cut out and made good. A slight amount of sweating which is uniform may be overlooked, but excessive sweating from a particular pipe or joint shall be watched for and taken as indicating a defect to be made good.

- c) Sewer and Drain Pipelines shall be tested for straightness by:
- Inserting a smooth ball 12mm less than the internal diameter of the pipe. In the absence of obstructions such as yarn or mortar projecting at the joints the ball should roll down the invent of the pipe and emerge at the lower end.
 - Means of a mirror at one end and a lamp at the other end. If the pipe line is straight the full circle of light will be seen otherwise obstruction of deviation will be apparent.
- d) The Contractor shall give a smoke test to the drains and sewer at his own expense and charges, if directed by the Engineer-in-Charge / LIC OF INDIA.
- e) (A test register shall be maintained which shall be signed and dated by Contractor, Engineer-in-Charge / LIC OF INDIA and representative of Architects/ LIC OF INDIA/consultants

11. CEMENT CONCRETE AND MASONRY WORKS FOR MANHOLES AND CHAMBERS ETC.

11.1 11.1 Materials

a) Water

Acidity , Alkalinity and percentage of Solids shall be in accordance with IS: 3025. The Ph value shall generally be not less than 6. In general potable water is considered satisfactory for use. Sea water shall not be used. Testing shall be done individually for different source points before the start of the work and there after once in every three months.

b) Aggregate for Concrete

It shall be strong, durable and free from adherent coatings, sea shell, organic impurities, disintegrated pieces If dirty, shall be washed with water before actual use. Flaky and elongated pieces shall be avoided. It shall confirm to IS: 383 and IS: 2386.

c) Sand

It shall be hard, durable, chemically inert, clean and free from adherent coatings, organic matter etc. and shall not contain any appreciable amount of clay balls of pellets and harmful impurities and shall confirm IS: 2386. It shall not contain more than 8 % of silt as per the field test. Grading for masonry, plaster and concrete shall be as per IS: 2116, IS: 1542, IS: 383 respectively, Sea sand shall not be used. Testing for bulking to be done and allowance be made at the time of use.

d) Cement

The cement used for all the constructional purposes shall be Portland pozzolana cement conforming to I.S. 1489 OR rapid hardening, Portland cement conforming to I.S. 269. Different types of Cement shall not be mixed together, shall be stacked and stored separately. Cement Bags shall be stacked in a manner to facilitate their removal and use in the order in which they are received. The site where it is stored shall be dry, leak proof and as far as possible moisture proof. Necessary precautions to be taken to avoid dampness through floor and walls. Stacking shall not be more than 10 bags high.]

e) Mild Steel Reinforcement

The mild steel for the reinforcement bars shall be in the form of round/ twisted/deformed bars conforming to all requirements of I.S. 432 (Grade I).

f) Bricks

Brick shall have uniform color, thoroughly burnt, smooth rectangular faces, with parallel slab, sharp and right angled edges, but not over-burnt. When struck should give clear ringing sound. The maximum permissible area of perceptible deposit of efflorescence shall be 50% of the surface area of the Bricks. The affected bricks should not be more than 80% of the lot. There shall be no powdering or flaking of the surface. The average water absorption shall not exceed 22% by weight after 24 hours immersion in water. The average minimum compressive strength for bricks of class designation 75 shall not be less than 75 kg / cm².

g) Other Materials

Other materials not fully specified in these specifications and which may be required in the work shall conform to the latest I.S. All such materials shall be approved by the Engineer-in-Charge / LIC OF INDIA before use.

11.2 Cement Concrete (Plain or Reinforced)

a) Cement concrete pipes bedding, cradles, foundations and RCC slabs for all works shall be mixed by a Mechanical mixer where quantities of the concrete poured at one time permit. Hand mixing on properly constructed platforms may be allowed for small quantities by the Engineer-in-Charge / LIC OF INDIA. Rate for cement concrete shall be inclusive of all shuttering and centering at all depth and heights.

b) Concrete work shall be of such thickness and mix as given in the Drawings.

- c) All concrete work shall be cured for a period of at least 7 days. Such work shall be kept moist by means of gunny Bags at all times. All pipe trenches and foundations shall be kept dry during the curing period.

11.3 Masonry Work

Masonry work for manholes, chambers, brick masonry pipe trench and such other works as required shall be constructed from 1st class bricks as specified in the Drawings in cement mortar 1:4 mix (1 cement: 4 coarse sand). All joints shall be properly raked to receive plaster.

11.4 Cement Concrete for Pipe Support

- a) Wherever specified or shown on the drawings, all pipes shall be supported in concrete bed all round or in haunches. The thickness and mix of the concrete shall be given in the Drawings. Type of the bedding is as described as follows:
- b) Unless otherwise directed by the Engineer-in-Charge / LIC OF INDIA cement concrete for bed, all round or in haunches shall be laid as follows:-

Description	Upto 3 M depth
Pipes in open ground (No sub soil water)	All round (1:4:8)
Pipes (all) in sub soil water condition	All round (1:3:6)
Pipes under the building or at road crossing or under public places	All round (1:2:4)

- c) R.C.C. pipes or C.I. pipes, may be supported on brick masonry or precast R.C.C or Cast insitu cradles. Cradles shall be as shown on the drawings.
- d) Pipes in loose soil or above ground shall be supported on brick or RCC anchor blocks as shown on the drawings.

12. MANHOLES AND CHAMBERS

12.1 All manholes, chambers and other such works as specified shall be constructed in brick masonry in cement mortar 1:4 (1 cement: 4 coarse sand) or as specified in the Drawings.

12.2 All Manholes, Chambers, etc., shall be supported on base of cement concrete of such thickness and mix be constructed as follows:-
(All dimensions internal clear in mm)

Size of Manhole Type(in mm)	900x800 Rect.	900X1200 Rect.	910 dia Circular	1220 dia Circular	1520 dia Circular
Maximum depth	Up to 900	Up to 2450	Up to 1620	From 1620 to 2290	From 2300 to 9000
Average thickness of R.C.C slab	150	150	-	-	-
Size of cover and frame (Internal dia)	610x455	560 dia	560 dia	560 dia	560 dia
Weight of cover and frame not	38 Kg. or as specified	116 Kg. or 170 Kg. or 208 Kg. or	116 Kg. or 170 Kg. or 208 Kg. or	116 Kg. or 170 Kg. or 208 Kg. or	116 Kg. or 170 Kg. or 208 Kg. or

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less than	in drawing	as specified in drawing	as specified in drawing	as specified in drawing	as specified in drawing
Type of Cover & Frame	C.I. or SFRC as specified in drawing	C.I. or SFRC as specified in drawing	C.I. or SFRC as specified in drawing	C.I. or SFRC as specified in drawing	C.I. or SFRC as specified in drawing

- 12.3 All manholes shall be provided with cement concrete benching in 1:2:4 mix (1cement: 2 coarse sand: 4 stone aggregate 20mm nominal size). The benching shall have a slope of 10cm towards the channel. The depth of the channel shall be full diameter of the pipe. Benching shall be finished with a floating coat of neat cement.
- 12.4 All manholes shall be plastered with 12/15mm thick cement mortar 1:3 (1 cement: 3 coarse sand) and finished with a floating coat of neat cement inside. Manhole shall be plastered outside as above but with rough plaster.
- 12.5 All manholes with depths greater than 1 M. shall be provided with plastic encapsulated 20mm square or 25mm round rods foot rungs set in cement concrete blocks 25 x 10 x 10cms in 1:2:4 mix 30cms vertically and staggered. Foot rests shall be coated with coal tar before embedding.
- 12.6 All manholes shall be provided with cast iron covers and frames and embedded in reinforced cement concrete slab or SFRC precast concrete covers as per instructions of the Engineer-in-Charge / LIC OF INDIA. Weight of cover, frame and thickness of slab shall be as specified in the Drawings or as given above.
- 12.7 All catch basins shall be having C.I. grating or SFRC precast Gully Grating as per instructions of Engineer-in-Charge / LIC OF INDIA. The grating along with frame shall be of approved design and quality as per instruction of Engineer-in-Charge/ LIC OF INDIA.

13. MAKING CONNECTIONS

Contractor shall connect the new sewer line to the existing manhole by cutting the walls, benching and restoring them to the original condition. A new channel shall be cut in the benching of the existing manhole for the new connection. Contractor shall remove all sewage and water if encountered in making the connection without additional cost.

14. RAIN WATER HARVESTING SYSTEM

Rain water harvesting system to be provided as per local site conditions.

15. COMMISSIONING

- 15.1 After successful testing of the different sewerage and drainage pipes in parts, the Contractor shall provide all facilities including necessary pipings, labours, tools and equipments etc. for carrying out testing and commissioning of the entire external sewerage and drainage system complete as per requirement in the presence of Client representative/LIC OF INDIA/consultant, whenever and as may be required. Generally, the following test/inspection has to be carried out:-
- a) For any Leakages/seepages in the external sewerage and drainage pipes.

- b) For checking the functioning of the entire external sewerage and drainage system including rainwater harvesting system and to ensure that the waste water is continuously flowing towards outfall without any intermediate stagnation.
- c) For the functioning of the valves and accessories etc. by putting ON/OFF the controlling valves of the various diversions in the sewerage and drainage and rain water harvesting system.

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