



ANNEXURE – GENERAL CIVIL CONSTRUCTION **TECHNICAL SPECIFICATION**

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GENERAL TECHNICAL SPECIFICATIONS AND MEASUREMENT MODALITIES

A EARTHWORK

1. EXCAVATION AND EARTH WORK

The Contractor shall visit and ascertain the nature of the ground to be excavated and the work to be done and shall accept all responsibility for the cost of the work involved.

1.1. Setting out

The Contractor shall set out the center line of the building or other involved works after clearing the site and get the same approved from Employer/Architects. It shall be the responsibility of the Contractor to install substantial reference marks, bench marks, etc. and maintain them as long as required by the Employer/Architects. The Contractor shall assume full responsibility for proper setting out, alignment, elevation and dimension of each and all parts of the work.

1.2. Ground Level and Site Level

Before starting the excavation the requisite block level of the entire plot shall be taken by the Contractor in consultation with the Employer /Architects and a proper record of these levels kept, which shall be jointly signed by the Contractor and the Employer/Architects. A block level plan showing all ground level of the plot shall be prepared and shall jointly be signed by the Contractor and the Employer/Architects. The levels shall be taken at intervals of 5M or even less as required and directed.

1.3. Excavation and Preparation of Foundation for Concrete.

Excavation shall include removal of all materials of whatever nature at all depths and whether wet or dry necessary for the construction foundation and sub-structure (including mass excavation for underground reservoir where applicable) exactly in accordance with lines, levels, grades and curves shown in the drawings or as directed by the Employer/Architects. The bottoms of excavation shall be leveled both longitudinally and transversely or sloped as directed by the Employer/Architects.

Should the Contractor excavate to a greater depth or width than shown on the drawings or as directed by the Employer/Architects he shall at his own expense fill the extra depth or width in cement concrete in proportion as extra cost.

The Contractor shall report to Employer/Architects when the excavations are ready to receive concrete. No concrete shall be placed in foundations until the Contractor has obtained Employer/Architects' approval. In case, the excavation is done through different strata of soil and if the same is payable as per provision in the Schedule of Quantities the Contractors shall get the dimensions of the strata decided by the Employer/Architects for payment. If no specific provision is made in the Schedule of Quantities it will be presumed that excavation shall be in all type of soil and Contractor's rate shall cover for the same.

After the excavation is passed by the Employer/Architects and before laying the concrete, the Contractor shall get the depth and dimensions of excavation and levels (and nature of strata as applicable as per Schedule of Quantities like hard rock, soft rock etc.) and measurements recorded from the Employer/Architects.

1.4. Shoring

The sides of the excavations should be timbered, sand-bagged and shored in such a way as is necessary to secure them from falling in, and the shoring shall be maintained in position as long as necessary. The

Contractor shall be responsible for the proper design of the shoring to hold the sides of the excavation in position and ensure safety and prevent injury to persons. The shoring shall be removed as directed after the items for which it is required are completed.

1.5. Earth for Leveling of the Area.

Before earth work is started, the area coming under cutting and filling shall be cleared of shrubs, rank vegetation, grass, brush wood and trees and saplings of girth and rubbish removed outside the periphery of the area under clearance and as directed by the Employer/Architects. The roots of trees shall be removed to a minimum depth of 600 mm below ground level or 300 mm below formation level whichever is lower and hollows filled up with approved earth leveled and rammed to the satisfaction of the Employer/Architects at no extra cost.

Under no circumstances shall undermine or under cutting be allowed. The final surfaces shall be neatly dressed and compacted to the required levels. Any extra cutting done, shall be filled back on the approved earth duly consolidated at Contractor's cost. During the execution of the work, the natural drainage of the area shall be maintained by the Contractor.

The approved earth from cutting shall be directly used for filling as directed. The filling shall be done in layer of not more than 300 mm watered and consolidated with roller not less than 10 mt. The earth used for filling shall be free from all roots, rubbish, grass and all lumps and clods shall be broken before filling. The top surface of finally finished area shall be neatly dressed and compacted.

1.6. Protection

If instructed by the Employer/Architects all foundation pits, and similar excavations shall be strong fenced and marked with red lights at night to avoid accidents, adequate protective measure shall be taken to see that the excavation does not effect or damage adjoining structures.

All measures required for the safety of the excavations, the people working in near the foundation trenches, property and the people in the vicinity shall be taken by the Contractor at his own cost, he being entirely responsible for any injury and damage to property caused by his negligence or accident due to his constructional operations.

1.7. Stacking Excavated Materials

All materials excavated will remain the property of the Employer and rate for excavation includes sorting out of useful materials and stacking them on site as directed. Materials suitable and useful for back filling, plinth filling or leveling of the plot or other use shall be stacked in convenient places but not in such a way as to obstruct free movement of men, animals and vehicles or encroach on the area required for constructional purposes.

1.8. Backfilling Foundation and Plinth

All shoring and form work shall be removed after their necessity ceases and trash any sorts shall be cleaned out from the excavation. All space between foundation masonry or concrete and the sides excavation shall be refilled to the original surface with approved excavated materials in layers 150mm in thickness watered and rammed with iron or wooden hammers weighing 7 to 8 kg. When the filling reaches the finished levels, surface should be flooded with water for at least 24 hours, allowed to dry and then rammed and consolidated to avoid settlement at a later stage. The filling shall be done after concrete or masonry is fully set and done in such a way as not to cause undue thrust on any part of the structure, where suitable excavated materials is to be used for refilling it shall be brought from the place where it is temporarily stacked and used in refilling.

No excavation of foundations shall be filled in or covered up until all measurements of excavations, masonry filling or in plinth filling. In case back filling is done without recording measurements of foundation work, the Contractor will have to remove backfilling at his cost for taking measurements otherwise the foundation work will not be measured and will not be paid for.

1.9. Dewatering

Rate for excavation shall include bailing or pumping out water which may accumulate in the excavation during the progress of work either from seepage, springs, rain or any other cause and diverting surface flow if any by bunds or other means. Pumping out water shall be done in such approved manner as to preclude the possibility of any damage to the foundation trench concrete or masonry or any adjacent structure. When water is met in foundation trenches or in tank excavations, pumping out water shall be from auxiliary pit of adequate size dug slightly outside the building excavations. The depth of auxiliary pit shall be more than the working foundation trench levels. The auxiliary pit shall be refilled with approved excavation materials after the dewatering is over.

The excavation shall be kept free from water.

- ☐ during inspection and measurement
- ☐ when concrete and/or masonry are in progress and till they come above the natural water level ☐

Till the Employer/Architects consider that the concrete/mortar is sufficiently set.

1.10. Surplus Excavated Materials

The item of removal of surplus excavated materials shall only be undertaken by the Contractor when specific instruction in this regard has been obtained from the Employer/Architects. The Contractor must also secure the approval of the Employer/Architects regarding the quantity of surplus materials to be removed prior to commencement of this item of work. The Contractor shall dispose of surplus excavated materials anywhere within the site as required and directed. He will spread the same in layers of 300 mm as directed. Contractor will take the decision of Employer/Architects for disposal of surplus excavated material and no extra charge will be paid for double handling of the same. Wherever surplus or unsuitable material is to be disposed off outside the site it shall be dumped and spread at the places to be approved by the employer and as required and directed by the Employer/Architects with any lead and shall be paid as a separate item as stated in the Schedule of Quantities.

2. RATES TO INCLUDE FOR EXCAVATION ITEMS

Apart from other factors mentioned elsewhere in this contract, rates for the item of excavation shall also include for the following:

- Clearing the site of all bushes, grass, roots of trees etc.
- Setting out works, profiles etc. as required
- Providing shorting and shuttering to avoid sliding of soil and to protect adjacent structures and subsequently by removing the same.
- Boiling and pumping out water as required and directed.
- Excavation at all depth (unless otherwise specified in the Schedule of Quantities) and removal of all materials of whatever nature wet or dry and necessary for the construction of foundation underground reservoir etc. preparing bed for laying concrete for roads etc.
- Sorting out useful excavated material and conveying beyond the structure and stacking them neatly on

the site for back filling or reuse as directed.

- Necessary protection including labour, materials and equipments to ensure safety and protection against risk or accident.
- Taking ground levels, keeping proper record duly checked by Employer/Architects.

3. MODE OF MEASUREMENT

- Excavation for foundation of columns, walls and the like shall be measured and paid net as per drawing, dimensions of concrete (bed concrete where so specified) at the lowest level. In regard to length, breadth and depth shall be computed from the concerned excavation levels and ground levels taken before excavation. Any additional excavation required for working space, form work, planking, dewatering and strutting etc. shall not be measured and paid for separately but rates quoted for excavation shall include for all these factors. No increase in bulk after excavation shall be made. Excavation beyond dimensions of mass concrete for foundation as per drawing or below required depth shall not be paid for. Any excavation beyond required level shall fill back the same with concrete 1:4:8 at his cost.
- Measurement for general excavation/filling in roads/areas shall be made on section measurement by taking levels jointly before starting the work and after completion of the work and shall be worked out on average area method. This will give the total quantity of excavation. Levels shall be taken at 5M intervals or closer as required and directed by the Employer/Architects.
- In case of filling by murrum brought from outside, the quantities will be worked by levels as stated above and shall be calculated/checked with lorry measurements after deducting 20% for shrinkage. In case of inadequate information regarding lorry measurement and/or number of lorry trips. Employer's/Architect's decision will be final and binding.
- In case of all fillings, 10% deduction will be made from the total quantities in the running bills, out of which 5% will be deducted permanently and the balance 5% will be paid after expiry of the defects liability period of one year or one monsoon whichever is later and after making good levels, surface etc. as required and directed.
- In case of soft and hard rock measurement will be made on the basis of level or stack measurement after deducting 40% for voids. The material will be stacked on fairly level ground and places as directed. All depressions over the required final levels will be made good by P.C.C 1:4:8 as directed at no extra cost. Stack measurement will be cross checked with level measurements and whichever less shall be paid.
- The quantity of excavated materials disposed off outside the premises will be worked out on the basis of total quantity of excavation less following: a) quantity of excavated materials used for filling (on the basis of levels) b) quantity of rock excavation (stack measurements less 40% level basis). c). quantity of excavated material disposed of within the site (on the basis of levels). The quantity worked out on this basis will be checked with lorry measurements with deduction of 20% for shrinkage. In case of discrepancy Employer/Architects decision will be final and binding.
- Total quantity of excavation and filling will be finalised on the basis of levels only. The total quantity of excavation will be checked by adding quantities of the following items: a) material used for filling wherever required (on level basis) b) Rock excavation (stack measurements with 40% voids/level basis) c) Surplus/unsuitable material disposed within site (on level basis). d). Surplus/unsuitable material disposed outside site (on lorry measurement by deducting 20% shrinkage). In case of any discrepancy the decision of Employer/ Architects shall be final and binding for the subdivision (a), (b), (c), (d), as stated above.
- Wherever the Contractor is instructed to reuse the excavated rock for works such as masonry, soiling,

filling etc. the measurement for such items shall be the same/equivalent as that of rock measured under excavation items earlier. The Contractor will not be paid for double handling of such excavated materials.

- 230 m.m. thick 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 100mm 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. This shall be hammered down to achieve packing and the complete filling of interstices. To achieve the desired level and slopes, pegs at suitable intervals (about 12 meters) 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 vibrator compactor. Filling sand or murrum, watering and rolling shall continue till full compactness is achieved to satisfaction of the PM.
- Measurement shall be in CMT for rubble soling of 230 mm thick and in SQMT for rubble soling of 150 mm thick.

B SOIL TREATMENT FOR TERMITE CONTROL

1. Soil treatment for termite control

It shall conform to the following:

Chemicals

The treatment of the areas shall be carried out by applying the following chemicals at not less than the designated concentration:

<u>Chemicals</u>	<u>Concentration</u>
Chlorpyrifos 20% EC	50 ml mixed in 1 ltr. water

The Contractor shall clearly indicate along with his quotation the chemical he proposed to use. A daily record shall be maintained by the Contractor indicating the amount of work done and the quantity of chemical consumed for the work. This record book shall be property of the Employer.

1.1. Method of Application

- a The following paragraphs specify the manner and sequence of operations, which must be followed. They also indicate the rates of application of chemicals of stated concentration for various operation. It shall be distinctly understood that these represent the minimum rates of application for each operation and that the Contractor shall actually apply chemicals at rates higher than those specified therein to the extent he may consider them necessary for effectiveness during the 10 years guarantee period at no extra cost. In other words the onus or responsibility of applying adequate amounts of chemicals as required to sustain the 10 years guarantee shall be that of the Contractor, but in no case shall actual rates of application be less than these specified herein.
- b After the final depth of the foundation trenches is reached the horizontal and vertical sides shall be soaked with insecticides by high pressure pump at the rate of at least 200 ml of concentration for 1 sq.mt area, along both sides of foundation walls and foundation bottom.
- c After vertical and horizontal sides of the foundation trenches are treated in the manner described above. The floor area in between the walls shall be treated by saturating the soil with insecticides. For this purpose, holes of 2" dia shall be bored in the natural soil surface at suitable space intervals (min.1 mt

c/c) depending upon the type of soil. The chemical used shall be at the rate of at least 200 ml of concentration for 1 sq.mt area.

- d After the walls are constructed and treated as specified above, complete saturation treatment shall be given by digging 1'-6" deep on the outer side and saturating the same with insecticides at the rate of at least 1.5 liters per linear foot of wall.
- e Treatment shall not be made when the soil or fill is excessively wet or immediately after heavy rains, to avoid surface flow of the toxicant for application site. Unless the treated areas are to be immediately covered, precautions shall be taken to prevent disturbances of the treatment by human or animal contact with the treated soil.

1.2. Guarantee 10 years (on requisite stamp paper)

In the unlikely event of any treatment becoming necessary subsequently during the guarantee period, necessary inspection and treatment as required shall be carried out free of cost.

2. The Rate to Include

The contractor should include in his rates given in Schedule of Quantities in sq. meter area all the stages of treatment to bottom of foundation, sides of trenches, underside of the floor, underside/damp proof course, in the outer face of external wall up to window sill level, door and window frames to ground floor area, which comes in contact with the brick wall and finally the treatment all round the buildings as per detailed specification mentioned above. Where the rate of application of the insecticide has not been specified clearly the rates should be governed so that during the guarantee period no trouble may arise. payment will be made on the plinth area measurement and the rate for the same should include all the stages of work as mentioned above and no extra on this account will be entertained.

C CEMENT CONCRETE (PLAIN & REINFORCED) AND ALLIED WORKS

1. SCOPE

This specification covers the general requirements for concrete to be used on jobs using on-site production facilities including requirements in regard to the quality, handling, storage of ingredients, proportioning, batching, mixing and testing of concrete, and also requirements in regard to the quality, storage, bending and fixing of reinforcement. This also covers the transportation of concrete from the mixer to the place of final deposit and the placing, curing, protecting, repairing and finishing of concrete.

2. PLAIN CEMENT CONCRETE 1:4:8 or as specified :

Plain cement concrete shall be in proportion of 1:4:8 or as specified. i.e. in volume by one part of cement, four part of coarse sand and eight parts of black stone aggregate of size 40 m.m. size.

The building materials as stated above shall be mixed in dry condition with power driven concrete mixer. After materials are properly mixed, water shall be added and materials shall again be mixed in concrete mixer. It should be watched that no excessive water is added so that permissible water cement ratio is maintained throughout during the progress of concrete work. . Before the concreting work, necessary centering work if so necessary shall be provided for which payment shall be done separately under respective items. All the materials shall be got tested for every lot from govt. approved Engineering testing laboratories as per I.S. code of practice and test certificates shall be submitted to client/site engineer .

The concrete so prepared shall be stacked in water tight platform .The concrete should not be thrown from height so that segregation may not take place. The concrete so placed shall be properly compacted

with concrete vibrator machine to avoid voids .Moreover concrete shall be compacted in such a way that the surface is become smooth and no honey combing is observed.

After properly setting of concrete, curing shall be done for minimum period of seven days.

3. M-20 Reinforced cement concrete :

The reinforced cement concrete shall be in proportion of R.C.C .(1:1.5:3) i.e. in volume by 1 part of cement,1.5 parts of coarse sand and 3 parts of black stone aggregate of size 20 M.M. size. The stone aggregate shall be of /or Client. The building materials as stated above shall be mixed in dry condition with power driven concrete mixer. After materials are properly mixed, water shall be added and materials shall again be mixed in concrete mixer. It should be watched that no excessive water is added so that permissible water cement ratio is maintained throughout during the progress of concrete work. Before concreting work, necessary centering work and reinforcement as per structural drawing shall be placed for which payment shall be done under respective items. All the materials shall be got tested for every lot from govt. approved Engineering testing laboratories as per I.S. code of practice and test certificates shall be submitted to client/consultant.

The concrete so prepared shall be stacked in water tight platform and concrete shall be poured in respective R.C.C. members. The concrete should not be thrown from height so that segregation of concrete may not take place. The concrete so placed shall be properly compacted with concrete vibrator machine to avoid voids. Moreover concrete shall be compacted in such a way that the surface is become smooth and no honey combing is observed.

After setting of concrete, sufficient curing shall be done for minimum period of seven days. During concrete work , concrete cube of size 150 m.m.x150 m.m.x150 m.m. shall be prepared and these concrete cubes shall be got tested for compressive strength from approved engineering testing laboratories and testing certificate should be submitted to Client/Consultant. The slump test shall also be carried out on site of work during every concrete work on site.

4. TRIMIX M-20 REINFORCED CEMENT FLOOR :

The trimix cement concrete shall be M-20 R.C.C .(1:1.5:3) i.e. in volume by 1 part of cement, 1.5 parts of coarse sand and 3 parts of black stone aggregate of size 20 M.M. size. The building materials as stated above shall be mixed in dry condition with power driven concrete mixer. After materials are properly mixed, water shall be added and materials shall again be mixed in concrete mixer. It should be watched that no excessive water is added so that permissible water cement ratio is maintained throughout during the progress of concrete work. After laying the concrete, Vacuumed Dewatered, surface vibrated, and finished with trimix machine. Grid floor slab Rockite or equivalent metallic floor hardener @ 4.5 kg/Sq.m, formation of construction joints 25MM th @ 3 M c/c by cutting up to 1/4th thickness of concrete slab with mechanized screw and filling the same with semi rigid epoxy based bitumen sealant

4.1. JOINTS

Expansion joints, dummy joints and longitudinal joints shall be provided as per details indicated in the drawing and as directed by Engineer-in-charge.

4.2. SEALING OF JOINTS

After the curing, the temporary seal or other intruded materials of all expansion and contraction joints shall be removed completely and the slots filled with approved joint sealing compound.

The edges of the joints shall thoroughly clean and primed with a thin bituminous paint which shall be allowed to dry before the sealing compound is applied.

The primer shall be applied with a brush. The composition of primer shall be as follows:

Name of Material	Percent by Weight
1) 200-penetration bitumen	66 % blended
2) Light creosote oil	14 % Hot/Cold
3) solvent naphtha	20 %

The bitumen shall be melted and fluxed with oil. When cold, solvent Naphtha shall be added. Bituminous emulsion shall not be used as primers. Care shall be taken to ensure that the sealing compound is not heated above 200 C and the temperature does not exceed 180 C for long periods.

Sealing compound shall be poured into the joint opening in such a manner that the material will not be spilled on the exposed surface of the concrete. When required to prevent pick up under traffic, the exposed surface of the sealing compound shall be dusted with hydrated lime.

5. APPLICABLE CODES AND SPECIFICATIONS

The following specification, standards and codes shall form a part of this specification. All standards, tentative specifications, codes of practice, referred to herein, shall be the latest editions including all applicable official amendments and revisions.

In case of discrepancy, if any, between this specification and those referred to in the following, the latter shall be govern.

Applicable I.S Specifications and Codes of Practices.

I.S. 269 - Specification for ordinary, and low heat portland cement.

I.S. 383 - Specification for coarse and fine aggregate from natural source for concrete.

I.S. 2386 - Method of test for aggregates for Concrete (Part I to VIII)

I.S. 516 - Method of test for strength of concrete

I.S. 1199 - Method of sampling and analysis of concrete

I.S. 3025 - Method of sampling and test (Physical and Chemical) for water and waste water.

I.S 432 - Specification for mild steel and medium tensile steel bars (Part I & II) and hard drawn steel wire for concrete reinforcement.

I.S. 1139 -Specification for hot rolled mild steel and medium tensile steel deformed bars for concrete reinforcement.

I.S. 1566 - Specification for hard drawn steel wire fabric for concrete reinforcement

I.S. 1786 - Specification for cold twisted steel bars for concrete reinforcement.

I.S. 2645 - Specification for integral cement waterproofing compound

I.S. 456 - Code of Practice for plain and reinforced concrete

I.S. 3370 - Code of practice for concrete structures for storage of (part-IV) liquids

I.S. 2502 - Code of practice for bending and fixing of bars for concrete reinforcement.

I.S. 2571 - Code of practice for laying in situ cement concrete flooring

I.S. 3696 - Safety code for scaffolds and ladders (Part I&II)

I.S. 1200 - Method of measurement of building and civil engineering works

D MASONRY WORKS (BRICK AND STONE)

1. BRICKS

- The brick shall be generally conforming to I.S. 1077 first class kiln burnt bricks of regular and uniform size, shape and color, uniformly well burnt throughout but not over burnt. They shall have rectangular faces with parallel sides and sharp, straight and right angled edges. They shall be free from cracks or other flaws. They shall have frog of 10mm depth on one of their flat faces. Where first class bricks are not manufactured locally or nearby areas, best locally available bricks may be used having strength not less than that specified for the job by the Employer/Architects.
- They shall give a clear metallic ringing sound when struck together.
- They shall show a fine grained, uniform homogenous and dense texture on fracture and be free from lumps of lime laminations cracks, air holes, soluble salts causing efflorescence or other defects which may in any way impair their strength, durability, appearance, and usefulness for the purpose intended. They shall not have any part under-burnt. They shall not break when thrown on the ground on their flat face in a sutured condition from a height of 60cm.
- The size of brick shall be 230mm x 115mm x 75mm or near about. Only bricks of one standard size shall be used on one work unless specially permitted by the Employer/Architects. The following tolerance are permitted in the standard conventional size adopted on a particular work:
 - Lengths - Plus or Minus (about 3mm)
 - Breadth - Plus or Minus (about 1.5mm)
 - Depth - Plus or Minus (about 1.5mm)
- After immersion in water, absorption by weight shall not exceed 20 percent of the dry weight of the brick when tested according to I.S. 1077. Unless otherwise specified the load to crush the brick when tested according to I.S. 1977 shall not be less than 75 kg/sq.cm.
- The source, size and brand or the brick to be used for the entire work shall be approved by the Employer/Architects before hand from time to time.

2. MORTAR

Unless otherwise specified, mortar for brick work shall be composed of 1 part of cement to 6 parts of approved coarse sand, for walls of one brick thick (25cm) and over, and 1 part of cement to 4 parts of approved sand for half brick thick and brick on edge walls. Other specification for mortar in brick work shall be as per I.S. 2250. Mixing should be done in a mechanical pan mixer. If hand mixing is allowed, 10% extra cement over and above the proportion as stated above and mortar shall be prepared on a clean and hard water proof platform and water shall be added only after dry mixing of cement and sand. Mixed mortar shall be used within 1/2 an hour of mixing and partly set mortar should be discarded.

3. CONSTRUCTION DETAILS

- 3.1. **Soaking:** All bricks shall be immersed in water for 24 hours before being put into work so that they will be saturated and will not absorb water from the mortar.
- 3.2. **Bats:** No Bats or cut bricks shall be used in the work unless absolutely necessary around irregular openings or for adjusting the dimensions of different course and for closures. In which case full bricks

shall be laid to corners, the bats being placed on the middle of the courses.

- 3.3. Laying:** The bricks shall be laid in mortar to line, level and shapes shown on the plans and drawings slightly pressed and thoroughly bedded in mortar so that they will be completely filled with mortar and no hollows left anywhere. Bricks shall be handled carefully so as not to damage their edges. They should not also be thrown from any height to the ground but shall be put down gently. All courses shall be laid truly horizontal and all vertical joints made truly vertical. Vertical joints on one course and the next below should not come over one another and shall not normally be nearer than quarter of a brick length. For battered faces beading shall be at right angles to the face. Fixtures, plugs, frames etc. if any, shall be built in at place shown in the plans while laying the courses only and not later on by removal for bricks already laid.

Care shall be taken during construction to see that edges of bricks at joints, sills, heads etc. are not damaged. The vertical of the walls and the horizontal of the courses shall be checked very often with plumb bob and spirit level respectively.

The brickwork should have crushing strength not less than 35 kg/sq.cm.

- 3.4. Bond:** Unless otherwise specified, brick work shall be done in Flemish Bond. All walls coming in contact with reinforced concrete columns beams etc. should be properly bonded by inserting reinforcement etc. extra labours for the same shall be included in the rates (reinforcement will be measured and paid separately if not included in the relevant item).
- 3.5. Joints:** Joints shall not exceed 10mm (about 3/8") in thickness and this thickness shall be uniform throughout. The joints shall be raked out not less than 10mm (about 3/8") deep when the mortar is green where pointing is to be done. When the brick surface are to be plastered, the joints shall be raked to a depth of 5mm when the mortar is green, so as to provide good key to plaster.
- 3.6. Uniform Raising:** Brick work shall be carried up regularly in all cases where the nature of work will admit, not leaving any part 60cm lower than another. But where building at different levels is necessary, the bricks shall be stepped so as to give later a uniform level and effectual bond. Horizontal courses should be to line and level and face plumb or as shown on the plans. The laying of masonry per day may be up to a height of 80cm (about 32") if cement mortar is used and 45cm (about 18") if lime mortar is used.

4. SCAFFOLDING

The scaffolding must be strong rigid stiffened with necessary cross bearers and always decked and bearded on the sills with closed board ceilings and swings to prevent injury to persons or materials.

The Contractor shall have to allow other trades to make reasonable use of his scaffolding as directed by the Employer/Architects or requested by Contractors of other trades. If for the interest of work the Contractors have to erect scaffolding in the other properties including local bodies or corporation, the arrangement for the same including the cost of licensing fees etc. shall have to be borne by the Contractor and the Employer should be kept free from any liability on this account.

Put log holes shall be made good by bricks to match the face work when put logs are removed after ensuring that the holes behind are solidly filled in with 1:4:8 cement concrete.

5. CURING

All brick works shall be kept well watered for 14 days after laying, while pozzalana cement is used for mortar the curing shall be extended by one week at Contractors expense. Pozzalana cement will not be normally permitted.

6. HALF BRICK WORK

Half brick thick and brick on edge walls shall be provided with 6 mm dia bars or hoop iron reinforcement. Reinforcement shall be provided in every 4th course and it shall be duly anchored and embedded in main wall and laid in cement mortar (1:4) for 75mm thick wall and concrete 1:2:4 75mm, thick for half brick wall.

7. RATES TO INCLUDE

Apart from other factors mentioned elsewhere in this contract, the rates for items of brick work shall include for the following:

- ☐ All labours, materials, use of tools, equipment and other items incidental to the satisfactory completion of brick masonry at all heights and levels and depths.
- ☐ Erecting and removing of all scaffolding, ladders and plant required for the execution of the work to the height and depths and shapes as shown on the plan or as ordered by the Employer/Architects including extra labours and materials for using cut bricks in the construction of walls of varying thickness other than one brick, one and half bricks, half bricks, and brick on edge walls and different shapes as per drawings.
- ☐ Constructing brick work to lines, levels, batters, pillars, curve projection cutting teething etc. in strict conformity with the drawings and to any position or shape, to any heights or levels or depths including racking out joints and housing frames, fixtures etc.
- ☐ Curing of brick work
- ☐ Extra labour for bonding brick work to R.C.C. works as directed and specified and for doing exposed brick face work where required.
- ☐ Removing of all stains and adhering mortar lumps on the brick work surface.
- ☐ Cost of reinforcement in half brick walls and brick on edge walls where specified in the item alongwith cost of 1:2:4 concrete for half brick.
- ☐ Racking out joints for receiving plaster as specified ☐

Extra labour for exposed brick work.

8. MEASUREMENTS

- ☐ Half brick thick and brick on edge walls shall be measured in sq.mt. Unless otherwise mentioned.
- ☐ One brick thick walls and thicker walls shall be measured in cum. Brick walls up to and including brick in thickness should be measured in multiplies of half bricks which shall be deemed to be inclusive of mortar joints. Widths of more than four bricks in walls will be measured actually and limited to the width specified.
- ☐ No deduction or addition shall be made on any account for ends of dissimilar materials (i.e, joists, beams, lintels, posts, girders, rafters, purlins, trusses, corblesteps(etc.) upto 0.3 sq.mt. in section.
- ☐ For details of measurements not mentioned elsewhere in the contract, the method of measurement should be as per relevant I.S. Code.

9. BRICK FLAT SOLING

For soling the bricks shall be first quality picked jhama of approved, sound, hard, tough durable dense clean, free from soft, spots, decay and other defects. Brick bats shall not be used. All the fillings shall be watered and compacted to get maximum consolidation. All necessary trimming or filling for laying of the soling in line and required grade shall be done. The sub-grade shall be marked by stacks and strings for required depth for laying of soling. The cushioning will also consist of local sand.

The bricks shall be laid on flat (unless otherwise specified) touching each other. Brick shall be laid in parallel rows breaking bond or in herring bone bond pattern as directed and firmly embedded true to line and filled with local sand. Measurement shall be in sq.mt.

10. SURFACE DRAINS

Surface drains are to be as follows and are to be complete in all respects with foundations works and finishing as described.

- ☐ 125mm (5") or 250mm (10") thick brick in cement mortar on wall side or as per drawings.
- ☐ 250mm (10") thick brick in cement mortar on outer side.
- ☐ Bed of one brick flat soling and 100mm (4") cement concrete (1:3:6) with stone aggregate over it.
- ☐ Channel of 250mm (10") finished with overall width laid to proper gradient with a minimum of 75mm (invert at the starting point to be finished with plaster (1:3) finished smooth with angles rounded.

11. WORKMANSHIP

- ☐ The stones shall be hammer dressed as specified in the item before they are laid in position. For masonry to one plastered, bushes shall not exceed 12mm thickness.
- ☐ The masonry shall consist of large stones flat bedded, properly selected for their places and carefully laid, with a suitable proportion of smaller stones and chips to fill up the interstices. The stones shall be wetted before laying in mortar. The whole work shall be hand set and solidly bedded in and surrounded with mortar on every side except the face.
- ☐ Flat stones shall not be less in breadth than in height and its length shall not be less than 1.5 times its height.
- ☐ Through stones or headers shall be laid in every course at a distance not exceeding 1.0 meter apart and shall be staggered. They shall be in one piece for walls up to 600mm width and shall be lap joined in case of greater thickness. The face area of each header shall be less than 0.05 sq.mt. They shall be distinctly marked on their face.
- ☐ Quoins shall have the same height as that of the course. they shall be laid header and stretcher alternatively. Faces of quoins shall be fair dressed. No quoin stone shall be less than 0.03 cum in content. Jambs or doors, windows and openings be formed with quoins. They shall have uniform chisel draft of 40mm at the corner edges.
- ☐ The masonry shall be laid to lines, levels, curves and shape as shown in the plans. The face of all masonry work shall be strictly in plumb. In the case of battered walls, the courses on the battered surface side shall be at right angles to the batter. All joints shall be racked out and unless otherwise stated shall be cement pointed 1:1 in the case of all exposed surface.
- ☐ The fixtures, plugs, frames etc. if any, shall be built in places as shown on plans while laying the masonry and not after by removing the stones already laid.
- ☐ Bad work shall be pulled down as directed by the Architect and shall be rebuilt at the Contractor's cost.
- ☐ All masonry shall be washed down on completion and all stains and mortar removed from the face as Scaffolding is being removed.
- ☐ Holes of the required size and shape shall be preferably left during construction alone for fixing pipes, Service line etc. After the pipes are fixed in position the hollows if any, shall be filled in with 1:3 cement
- ☐ Mortar or 1:3:6 cement concrete. the face shall be neatly finished with matching stones. iron and steel

- ☐ Fixtures shall be embedded in cement mortar 1:5.
- ☐ In wet foundations, work space shall be kept free from water while the masonry is in progress and until the mortar has sufficiently set.
- ☐ Adequate single/double scaffolding required for constructing masonry shall be provided by the Contractor at his expense.

E MISCELLANEOUS STEEL WORKS

1. ANCHOR BOLTS

1.1. MATERIAL

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

1.2. FABRICATION

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

1.3. PLACEMENT

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

1.4. TOLERANCES

Tolerances allowed for anchor bolts positioning shall be:
For sleeved bolts, one tenth of the bolt nominal diameter.
For bolts without sleeves, one twentieth of the bolt nominal diameter.

1.5. PROTECTION

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

2. METAL INSERTS

2.1. PLACEMENT

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

2.2. PAINTING

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

3. CHEQUERED PLATES

**3.1. MATERIAL**

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

3.2. FABRICATION

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

3.3. ERECTION/FIXING

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

3.4. PAINTING

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

4. GRATINGS**4.1. CATEGORIES**

The gratings shall be of two categories:

Category 'A' - Fabricated by the Contractor as per design/drawings/standards.

Category 'B' - Ready made bought out from an approved manufacturer.

4.2. MATERIAL

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

4.3. FABRICATION**CATEGORY 'A' GRATINGS**

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

CATEGORY 'B' GRATINGS

These shall be as per manufacturer's details designed to carry loads as specified on the 6 mm whichever is minimum. The maximum clear size of voids in the grating shall be limited to 30 mm x 55 mm.

Thickness of grating shall be 25 mm. The Contractor shall make necessary notches/opening in the gratings as shown in the drawings. All edges affected by such notches/openings shall be suitably stiffened by welding additional flats of the requisite size. All units shall be given distinct erection marks in accordance with the marking drawings. Before procurement the Contractor shall submit the design calculations, drawings and manufacturer's literature/catalogues and get the same reviewed by the Owner's Representative. The contractor shall submit sample gratings for inspection and approval by Owner's Representative whenever asked for.

4.4. ERECTION/FIXING

Gratings shall be fixed to the bearing members by welding/clamping and bolting as indicated in the drawings. Minimum length and maximum pitch of welds shall be 50 mm and 150 mm respectively where stitch welding is used for fixing along the lines of supports. The edges of two consecutive gratings shall be bolted with minimum two bolts on each side of the grating panel.

4.5. GALVANISING

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

5. TUBULAR HAND RAILING

5.1. MATERIAL

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

5.2. FABRICATION

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

Lower ends of vertical posts shall be cut and splayed (for grouting in pockets in the concrete members). For removable type of hand railing, suitable base plates (with provision for bolting) shall be welded to the lower end of vertical posts. All units shall be given distinct erection marks in accordance with the marking drawing.

5.3. ERECTION/FIXING

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

5.4. PAINTING

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

**6. MILD STEEL RUNGS****6.1. MATERIAL**

All materials shall conform to their respective specifications.

6.2. FABRICATION

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

6.3. FIXING

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

7. LIGHT GAUGE STEEL STRUCTURAL SECTIONS**7.1. MATERIAL**

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

7.2. FABRICATION

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

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

7.3. ERECTION

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

7.4. PAINTING

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

8. EXPANSION FASTENERS**8.1. MATERIAL**

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

8.2. CLASSIFICATION

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

a) MEDIUM DUTY (MILD STEEL/ HIGH TENSILE STEEL)

Ladders and stairs supports.

Cables and cable trays supports.

Electrical panels and fixtures.

Hangers for pipes and cable trays.

Pipe supports.

b) HEAVY DUTY (MILD STEEL / HIGH TENSILE STEEL)

Platform support (beam and columns)

Knee brackets for pipes/multi tiers cable trays/walkways etc.

Note:- Expansion fasteners shall not be used for:

Members supporting equipment and pipes subjected to vibrations.

Cantilever connections designed to cater for effective cantilever spans greater than 1000 mm and 1000 Kgs. Of concentrated load at the free end.

8.3. SELECTION

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

8.4. TESTING

The Contractor shall carry out all the requisite tests (pullout test, torque test etc.) of specimen expansion fasteners (representative of those to be used) from approved laboratory/test house and submit the report to him for approval.

8.5. INSTALLATION

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

8.6. PROTECTION

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

9. ROLLING SHUTTERS

Rolling shutters shall conform to IS: 6248. These shall include necessary locking arrangement and handles etc. These shall be suitable for fixing in the position as specified i.e. outside or inside on or below lintel or between jambs of the opening. The door shall be either push and pull type or operated with mechanical device supplied by the firm. Shutters up to 10 sq. meter shall be of push and pull type and shutters with an area of over 10 sq. meter shall generally be provided with reduction gear operated by mechanical device with chain or handle, if bearings are specified for each of operation, these shall be included in the rate.

**9.1. SHUTTER:**

The shutter shall be built up of interlocking lath section formed from cold' rolled steel strips. The thickness of the sheets from which the lath sections have been rolled shall be not less than 0.90 mm for the shutters up to 3.5 m width and not less than 1.20 mm for shutters above 3.5 m width. Shutters above 9 meters in width should be divided in 2 parts with provision of one middle fixed or movable guide channel or supported from the back side to resist wind pressure. The lath section shall be rolled so as to have interlocking curls at both edges and a deep corrugation at the centre with a bridge depth of not less than 12 mm to provide sufficient curtain of stiffness for resisting manual pressures and normal wind pressure. Each lath section shall be continuous single piece without any welded joint. When interlocked, the lath sections shall have a distance of 75 mm rolling centers. Each alternate lath section shall be fitted with malleable cast iron or mild steel clips securely riveted at either ends, thus locking the lath section at both ends and preventing lateral movement of the individual lath sections. The clips shall be so designed as to fit the contour of the lath sections.

9.2. SPRING:

The spring shall be of coiled type. The spring shall be manufactured from high tensile spring steel wire or strips of adequate strength conforming to IS: 4453-Part I.

9.3. ROLLER AND BRACKETS:

The suspension shaft of the roller shall be made of steel pipe conforming to heavy duty as per IS:1161. For shutter up to 6 meter width and height not exceeding 5 meter, steel pipes of 50 mm nominal bore shall be used. The shaft shall be supported on mild steel brackets of size 375 x 375 x 3.15 mm for shutters up to a clear height of 3.5 meter. The size of mild steel brackets shall be 500 x 500 x 10 mm for shutters of clear height above 3.5 m and up to 6.5 m. The suspension shaft clamped to the brackets shall be fitted with rotatable cast iron pulleys to which the shutter is attached. The pulleys and pipe shaft shall be connected by means of pretension helical springs to counter balance the weight of the shutter and to keep the shutter in equilibrium in any partly open position.

When the width of the opening is greater than 3.5 meter, the cast iron pulleys shall be interconnected with a cage formed out of mild steel flats of at least 32 x 6 mm and mild steel dummy rings made of similar flats to distribute the torque uniformly. Self aligning two row ball bearing with special cast iron casings shall be provided at the extreme pulley and caging rings shall have a minimum spacing of 15 mm and at least 4 number flats running through out length of roller shall be provided.

In case of shutters of large opening with mechanical device for opening the shutter the roller shall be fitted with a pinion wheel at one end which in contact with a worm fitted to the bracket plate, caging and pulley with two ball bearing shall be provided.

9.4. GUIDE CHANNEL:

The width of guide channel shall be 25 mm the minimum depth of guide channels shall be as follows:

Clear width of Shutters	Depth of guide channel
Upto3.5m	65mm
3.5mupto8m	75mm
8 m and above	100 mm

The gap between the two legs of the guide channels shall be sufficient to allow the free movements of the shutter and at the same time close enough to prevent rattling of the shutter due to wind.

Each guide channel shall be provided with a minimum of three fixing cleats or supports for attachment to the walls or column by means of bolts or screws. The spacing of cleats shall not exceed 0.75 m. alternatively, the guide channels may also be provided with suitable dowels, hooks or pins for embedding in the walls.

The guide channels shall be attached to the jambs, plumb and true either in the overlapping fashion or embedded in grooves, depending on the method of fixing.

9.5. COVER:

Top cover shall be of mild steel sheets not less than 0.90 mm thick and stiffened with angle or flat stiffeners at top and bottom edges to retain shape.

Lock plates with sliding bolts, handles and anchoring rods shall be as per IS:6248.

9.6. FIXING:

The arrangement for fixing in different situations in the opening shall be as per IS:6248.

Brackets shall be fixed on the lintel or under the lintel as specified with raw, plugs, and screw bolts, etc. The shaft along with the spring shall then be fixed on the brackets.

The lath portion (shutter) shall be laid on ground and the side guide channels shall be bound with ropes etc. The shutter shall then be placed in position and top fixed with pipe shaft with bolts and nuts. The side guide channels and cover frames shall then be fixed to the walls through the plate welded to the guides. These plates and bracket shall be fixed by means of steel screw bolts, and raw plugs concealed in plaster to make their location invisible. Fixing shall be done accurately in a workman like manner that the operation of the shutter is easy and smooth.

F STRUCTURAL STEEL WORK

1. SCOPE

This part of specification covers the requirements for material, storage, preparation of fabrication drawings, fabrication, assembly, tests/examinations, transportation, erection and painting of all types of bolted welded structural steel works for general construction work. Fabrication of structures shall also include fabricating:

Built up sections/plate girders made out of rolled section and/or plates.

Compound sections made out of rolled sections.

2. REFERENCE

IS CODES

IS:800, 816, 819, 822, 919, 1024, 1261, 1323, 1477,1852, 2074, 7205,7215, 7307, 7310, 7318, 9595 and other relevant BIS Codes.

SP: 6(1)

3. MATERIAL

3.1. GENERAL

All materials shall conform to their respective specifications given in Specification.

3.2. RECEIPT & STORING OF MATERIALS

Each section shall be marked for identification and each lot shall be accompanied by Manufacturer's

quality certificate, chemical analysis and mechanical characteristics.

All material shall be free from surface defects such as pitting, cracks, laminations, twists etc. Defective material shall not be used and all such rejected material shall be immediately removed from the store/site.

Welding wires and electrodes (packed in their original cartons) shall be stored separately by quality and lots inside a dry and enclosed room in compliance with IS:9595. Electrodes shall be kept perfectly dry to ensure satisfactory operation and weld metal soundness.

Each lot of electrodes, bolts, nuts etc. shall be accompanied by manufacturer's quality/test certificates.

All bolts (including nuts & washers) shall be checked, sorted out and arranged diameter-wise by grade and quality in the store.

3.3. MATERIAL TESTS

The Contractor shall submit manufacturer's quality certificates for all the materials supplied by him. However, the Contractor shall get all appropriate tests conducted in approved test houses for such materials, at no extra cost, and submit the same for approval.

4. FABRICATION DRAWINGS

- Fabrication and erection drawings shall be prepared by the contractor on the basis of "Approved for Construction (AFC)" design drawings. These drawings shall be prepared by the contractor or by an agency appointed by the contractor.
- Fabrication and erection drawings shall be thoroughly checked, stamped "approved for construction" and signed by the contractor's own responsible engineer irrespective of the fact that such drawings are prepared by the contractor or his approved agency, to ensure accuracy and correctness of the drawings. Unchecked and unsigned drawings shall not be used for the purpose of proceeding with the work. The contractor shall proceed with the fabrication and erection work only after thoroughly satisfying himself in this regard.
- All fabrication and erection drawings shall be issued for construction by the contractor directly to his work site. Six copies of such drawings shall simultaneously be submitted to OWNER for review.
- However, the Contractor shall not proceed with the fabrication of such structures whose fabrication drawings are required to be reviewed before taking up the fabrication work as noted on "Approved for Construction (AFC)" design drawings issued to the Contractor. The fabrication of such structures shall be done only as per the reviewed fabrication drawings.
- The review of such drawings by Client shall be restricted to the checking of the following only:
 - i. Structural layout, orientation and elevation of structures/members.
 - ii. Sizes of members.
 - iii. Critical joint details.
- Fabrication drawings shall be drawn to scale and shall convey the information clearly and adequately. Following information shall be furnished on such drawings:
 - Reference to design drawing number (along with revision number) based on which fabrication drawing has been prepared.
 - Structural layout, elevations and sections (with distinct erection marking of all members).
 - Framing plans, member sizes, orientation and elevations.
 - Layout and detailing of rain water pipes and gutters showing all necessary levels, connections



and provisions wherever required.

- Detailing of shop/field joints, connections, splices, for required strength and erection.
- Location, type, size and dimensions of welds and bolts.
- Shapes and sizes of edge preparation for welding.
- Details of shop and field joints/welds.
- Bill of materials / D.O.D. lists.
- Quality of structural steel, plates etc., welding electrodes, bolts, nut and washers to be used.
- Erection assemblies identifying all transportable parts and sub-assemblies with special erection instructions, if required.
- Method of erection and special precautions to be taken during erection as required.

The contractor shall additionally ensure accuracy of the following and shall be solely responsible for the same:

- i. Provision for erection and erection clearances.
- ii. Marking of members.
- iii. Cut length of members.
- iv. Matching of joints and holes.
- v. Provision kept in the members for other interconnected members.
- vi. Bill of materials/lists.

- 4.1. Connections, splices and other details where not shown on the design drawings shall be suitably designed and shown on the fabrication drawings based on good engineering practice developing full member strength. Design calculations for such connections/ splices shall be submitted along with the fabrication drawings.
- 4.2. Any substitution or change in section shall be allowed only when prior written approval has been obtained. Fabrication drawings shall be updated incorporating all such substitutions/changes by the contractor at no extra cost to the owner.
- 4.3. In case during execution of the work, the engineer-in-charge on review of drawings considers any modifications/substitutions necessary to meet the design parameters/good engineering practice, these shall be brought to the notice of the contractor who shall incorporate the same in the drawings and works without any extra cost to the owner. The contractor will be totally responsible for the correctness of the detailed fabrication drawings and execution of the work.
- 4.4. Contractor shall incorporate all the revisions made in the design drawings during the course of execution of work in his fabrication drawings, and resubmit the drawings at no extra cost to the owner. All fabrication shall be carried out only as per the latest afc design drawings and corresponding fabrication drawings.
- 4.5. The contractor shall supply two prints each of the final/as-built drawings along with their transparencies for reference and record. The rates quoted shall include for the same.

5. FABRICATION

5.1. GENERAL

Fabrication of structures shall be done strictly as per "Approved for Construction" fabrication drawings

(prepared by the Contractor based on the latest design drawings) and in accordance with IS:800, 9595 and other relevant BIS Codes and BIS Hand Book SP:6(1).

Prior to commencement of structural fabrication undulations in the fabrication yard, if any, shall be removed and area shall be leveled and paved by the Contractor.

Any defective material used in the work shall be replaced by the Contractor at his own expense. Necessary care and precautions shall be taken so as not to cause any damage to the structure during any such removal and replacement.

Any faulty fabrication pointed out at any stage of work, shall be made good or replaced by the Contractor at his own cost.

Tolerances for fabrication of steel structures shall be as per IS: 7215.

5.2. FABRICATION PROCEDURE

a. STRAIGHTENING & BENDING

All materials shall be straight and, if necessary, before being worked shall be straightened and/or flattened (unless required to be of curvilinear form) and shall be free from twists.

Ending of rolled sections and plates shall be done by cold process to shape/s as shown on drawings.

b. CLEARANCES

The erection clearance for cleared ends of members shall be not greater than 2mm at each end. The erection clearance at ends of beams without web cleats and end plates shall be not more than 3mm at each end but where for practical reasons, greater clearance is necessary, suitably designed settings shall be provided.

c. CUTTING

Prior to cutting, all members shall be properly marked showing the requisite cut length/width, connection provisions e.g. location and dimensions of holes, welds, cleats etc. marking for cutting shall be done judiciously so as to avoid wastages or unnecessary joints as far as practicable. Marking shall be done by placing the members on horizontal supports/pads in order to ensure accuracy. Marking accuracy shall be limited to +1 mm.

Cutting may be affected by shearing, cropping or sawing. Gas cutting by mechanically controlled torch shall be permitted for mild steel. Hand flame cutting may be permitted subject to the approval.

Except where the material is subsequently joined by welding, no loads shall be transmitted into metal through a gas cut surface.

Shearing, cropping and gas cutting shall be clean, square, free from any distortion and burrs, and the edges shall be ground afterwards, to make the same straight and uniform at no extra cost to the Owner.

d. HOLING

Holes for bolts shall not be formed by gas cutting process.

Holes through more than one thickness of material of members such as compound stanchions and girder flanges shall, where possible, be drilled after the members are assembled and tightly clamped/bolted together. Punching may be permitted before assembly, provided the thickness of metal is less than 16 mm and the holes are punched 3mm less in diameter than the required size and reamed, after assembly, to the full diameter. Punching shall not be adopted for dynamically loaded structures.

Holes may be drilled in one operation through two or more separable parts and burrs removed from each part after drilling.

Holes in connecting angles and plates, other than splices, also in roof members and light framing, may be punched full size through material not over 12mm thick, except where required for close tolerance bolts or barrel bolts.

All matching holes for black bolts shall register with each other so that a gauge of 2mm less in diameter than the diameter of hole shall pass freely through the assembled members in the direction at right angle to such members. Finished holes shall be not more than 2mm in diameter larger than the diameter of the black bolt passing through them.

Holes for turned and fitted bolts shall be drilled to a diameter equal to the nominal diameter of the shank or barrel subject to H8 tolerance specified in IS:919. Parts to be connected with close tolerance or barrel bolts shall be firmly held together by tacking bolts or clamps and the holes drilled through all the thicknesses in one operation and subsequently reamed to size. Holes not drilled through all the thicknesses in one operation shall be drilled to a smaller size and reamed out after assembly. Where this is not possible, the parts shall be drilled and reamed separately.

To facilitate grouting, holes shall be provided in column bases or seating plates exceeding 300mm in width for the escape of air.

To avoid accumulation of water in gusseted column bases of laced, battened or box type stanchions, suitable reverse U-type holes shall be provided at the junction of base plate and column section in the vertical gussets for draining out of any water.

e. ASSEMBLY

The component parts shall be assembled and aligned in such a manner that they are neither twisted nor otherwise damaged, and shall be so prepared that the required camber, if any, is provided. Proper clamps, clips, jigs and other fasteners (bolts and welds) shall be placed in a balanced pattern to avoid any distortion in the members and to ensure their correct positioning (i.e. angles, axes, nodes etc.). Any force fitting, pulling/stretching of members to join them shall be avoided. Proper care shall be taken for welding shrinkage and distortion so as to attain the finished dimensions of the structure shown on the drawings.

6. WELDING

6.1. GENERAL

All joints shall be welded unless noted otherwise on the design drawings.

Welding shall be in accordance with IS:816, IS:819, IS:1024, IS:1261, IS:1323 and IS:9595 as appropriate. It shall be the responsibility of the Contractor to ensure that all welding is carried out in accordance with the terms of this specification and relevant BIS codes. The Contractor shall provide all the supervision to fulfil this requirement.

The Contractor shall make necessary arrangement for providing sufficient number of welding sets of the required capacity, all consumables, cutting and grinding equipment with requisite accessories/auxiliaries, equipment and materials required for carrying out various tests such as dye penetration, magnetic particle, ultrasonic etc.

Adequate protection against rain, dust, snow and strong winds shall be provided to the welding personnel and the structural members during welding operation. In the absence of such a protection no welding shall be carried out.

6.2. PREPARATION OF MEMBER FOR WELDING

a. EDGE PREPARATION

Edge preparation/bevelling of fusion faces for welding shall be done strictly as per the dimensions

shown in the drawings. In case, the same are not indicated, edges shall be prepared (depending on the type of weld indicated in the drawing) as per the details given in IS:9595. Beveling of fusion faces shall be got checked and approved. The tolerances on limits of gap, root face and included angle shall be as stipulated in IS: 9595.

b. CLEANING

Welding edges and the adjacent areas of the members (extending upto 20mm) shall be thoroughly cleaned of all oil, grease, scale and rust and made completely dry. Gaps between the members to be welded shall be kept free from all foreign matter.

c. PREHEATING

Preheating of members, shall be carried out as per IS:9595 when the base metal temperature is below the requisite temperature for the welding process being used. Preheating shall be done in such a manner that the parts on which the weld metal is being deposited, are above the specified minimum temperature for a distance of not less than 75mm on each side of the weld line. The temperature shall be measured on the face opposite to that being heated. However, when there is access to only one face, the heat source shall be removed to allow for temperature equalization (1 minute for each 25mm plate thickness) before measuring the temperature.

d. GRINDING

Column splices and butt joints of struts and compression members (depending on contact for load transmission) shall be accurately ground and close-butt over the whole section with a tolerance not exceeding 0.2mm locally at any place. In column caps and bases, the ends of shafts together with the attached gussets, angles, channels etc., shall be accurately ground so that the parts connected butt over minimum 90% surface of contact. In case of connecting angles or channels, care shall be taken so that these are fixed with such accuracy that they are not reduced in thickness by grinding by more than 2mm.

Ends of all bearing stiffeners shall be ground to fit tightly at both top and bottom. Similarly, bottom of the knife edge supports along with the top surface of column brackets shall be accurately ground to provide effective bearing with a tolerance not exceeding 0.2mm locally at any place.

Slab bases and caps shall be accurately ground over the bearing surfaces and shall have effective contact with the ends of stanchions. Bearing faces which are to be grouted direct to foundations need not be ground if such faces are true and parallel to the upper faces.

e. WELDING PROCESSES

Welding of various materials under this specification shall be carried out using one or more of the following processes.

Manual Metal Arc Welding Process (MMAW)

Submerge Arc Welding Process (SAW)

Gas Metal Arc Welding Process (GMAW)

Flux Cored Arc Welding Process (FCAW)

The welding procedure adopted and consumables used shall be specifically approved. A combination of different welding processes or a combination of electrodes of different classes/makes may be employed for a particular joint only after qualifying the welding procedures to be adopted.

f. APPROVAL & TESTING OF WELDERS

The Contractor shall satisfy that the welders are suitable for the work upon which they will be employed. For this purpose the welders shall have satisfied the relevant requirements of IS:7318. If the welders will

be working to approved welding procedures, they shall have satisfied the relevant requirements of IS:7310.

Adequate means of identification shall be provided to enable each weld to be traced to the welder by whom it was made.

g. APPROVAL & TESTING OF WELDING PROCEDURES

The Contractor shall carry out procedure tests in accordance with IS:7307 to demonstrate by means of a specimen weld of adequate length on steel representative of that to be used. The test weld shall include weld details from the actual construction and it shall be welded in a manner simulating the most unfavorable instances of fit-up, electrode condition etc., which are anticipated to occur on the particular fabrication. Where material analyses are available, the welding procedure shall be carried out on material with the highest carbon equivalent value.

After welding, but before the relevant tests given in IS:7307 are carried out, the test weld shall be held as long as possible at room temperature, but in any case not less than 72 hours, and shall then be examined for cracking. The examination procedure shall be sufficiently rigorous to be capable of revealing significant defects in both parent metal and weld metal.

After establishing the welding method, the Contractor shall finally submit the welding procedure specification in standard format given in IS:9595 before starting the fabrication.

h. SEQUENCES OF WELDING

As far as practicable, all welds shall be made in a sequence that will balance the applied heat of welding while the welding progresses.

The direction of the general progression in welding on a member shall be from points where the parts are relatively fixed in position with respect to each other towards points where they have a greater relative freedom of movement.

All splices in each component part of a cover-plated beam or built up member shall be made before the component part is welded to other component parts of the member.

Joints expected to have significant shrinkage shall be welded before joints expected to have lesser shrinkage.

Welding shall be carried continuously to completion with correct number of runs.

The welding in steel work shall be done of size 50M.M.X50M.M. and at every 150 M.M. run intervals or as directed on site of work by engineer in charge. The entire welding work for canopy and for trench cover should be done as per instruction and as per direction of engineer in charge.

The Contractor shall choose the welding sequence after carefully studying each case such as to minimize distortion and shrinkage.

i. WELDING TECHNIQUE

After the fusion faces are carefully aligned and set with proper gaps, the root pass of butt joints shall be executed properly so as to achieve full penetration with complete fusion of the root edges.

On completion of each run, all slag and spatters shall be removed and the weld and the adjacent base metal shall be cleaned by wire brushing and light chipping. Visible defects such as cracks, cavities and other deposition faults, if any, shall be removed to sound metal before depositing subsequent run of weld.

All full penetration butt welds shall be completed by chipping/gouging to sound metal and then depositing a sealing run of weld metal on the back of the joints. Where butt welding is practicable from

one side only, suitable backing steel strip shall be used and joint shall be arranged in such a way as to ensure that complete fusion of all the parts is readily obtained.

While welding is in progress care shall be taken to avoid any kind of movement of the components, shocks, vibrations to prevent occurrence of weld cracks.

j. INSPECTION & TESTING OF WELDS

The method of inspection shall be according to IS:822 and extent of inspection and testing shall be in accordance with the relevant applicable standard. Welds shall not be painted or otherwise obscured until they have been inspected, approved and accepted.

The Engineer-In-Charge shall have access to the Contractor's work at all reasonable times and the Contractor shall provide him with all facilities necessary for inspection during all stages of fabrication and erection with, but not limited to, the following objectives.

- ☐ To check the conformity with the relevant standards and suitability of various welding equipments and their performance.
- ☐ To witness/approve the welding procedure qualification.
- ☐ To witness/approve the welders performance qualification.
- ☐ To check whether shop/field welding being executed is in conformity with the relevant specifications and codes of practice.

Inspection and testing of all fabricated structures shall be carried out by the Contractor by any, or, a combination of all the following methods and no separate payment shall be made, unless otherwise mentioned, for inspection and testing of welds/fabricated structures:

A VISUAL INSPECTION

All finished welds (i.e. 100 percent) shall be visually inspected for identification of the following types of weld defects and faults.

- ☐ Weld defects occurring at the surface such as blow holes, exposed porosity, unfused welds, etc. ☐

Surface cracks in the weld metal or in the parent metal adjacent to it.

- ☐ Damages to the parent metal such as undercuts, burning, overheating, etc.
- ☐ Profile defects such as excessive convexity or concavity, overlapping, unequal leg lengths, excessive reinforcement, incompletely filled grooves, excessive penetration beads, root grooves etc.
- ☐ Distortion due to welding i.e., local shrinkage, camber, bowing, twisting, rotation, wariness etc. ☐

Linear eccentric, angular and rotational misalignment of parts.

- ☐ Dimensional errors.

B MECHANICAL TESTS

The mechanical testing (such as tensile load tests, bend tests, impact tests etc.) shall be done in accordance with the relevant standards.

C MAGNETIC PARTICLE/DYE PENETRATION/ULTRASONIC EXAMINATION

The examination shall be done at random. Whenever such tests are directed, the tests shall be carried out on joints chosen by him. The tests shall be carried out by employing approved testing procedure in accordance with IS: 822.

D RADIOGRAPHIC EXAMINATION

Radiographic examination shall be carried out only in special cases for random joints. The Contractor shall be paid extra for such examination except for penalty radiographic tests for which the cost shall be borne by him. The Contractor shall make necessary arrangement at his own expense for providing the radiographic equipment, films and all other necessary materials required for carrying out the examination. The tests shall be carried in the presence of the Engineer-In-Charge by employing approved testing procedure in accordance with IS: 822. The Contractor shall fulfil all the statutory safety requirements while handling X-ray and Gamma-ray equipment and provide all the necessary facilities at site such as dark room, film viewer etc., to enable him to examine the radiographs.

E REPAIR OF FAULTY WELDS

No repair of defective welds shall be carried out without proper permission.

Welds not complying with the acceptance requirements (as specified by BIS Codes), as revealed during inspection and testing of welds or erection or in-situ condition, shall be corrected either by removing and replacing or as follows:

- | | |
|---|---|
| a. Excessive convexity | - Reduced to size by removal of excess weld metal. |
| b. Shrinkage cracks, cracks in parent plates and craters | - Defective portions removed down to sound metal and re welded. |
| c. Under cutting | - Additional weld metal deposited. |
| d. Improperly fitted I misaligned edges | - Welding cut & edges suitably prepared and parts |
| e. Members distorted the | - Member straightened by mechanical means or careful |
| by heat of welding application of limited amount of heat, temperature of such area not to exceed 650 degree Centigrade dull red heat. | |

In removing defective parts of a weld, gouging, chipping, oxygen cutting or grinding shall not extend into the parent metal to any substantial amount beyond the depth of weld penetration, unless cracks or other defects exist in the parent metal. The weld or parent metal shall not be undercut in chipping, grinding, gouging or oxygen cutting.

Any fabricated structure or its component is defective and/or beyond any corrective action shall be removed- forth with from the site without any extra claim. The Owner reserves the right to recover any compensation due to any loss arising out of such rejections.

7. BOLTING

All bolts shall be provided such that no part of the threaded portion of the bolts is within the thickness of the parts bolted together. Washers of suitable thickness shall be used under the nuts to avoid any threaded portion of the bolt being within the thickness of parts bolted together.

The threaded portion of each bolt shall project through the nut at least one thread.

Flat washers shall be circular and of suitable thickness. However, where bolt heads/nuts bear upon the beveled surfaces, they shall be provided with square tapered washers of suitable thickness to afford a seating square with the axis of the bolt.

8. SPLICING

Splicing of built up/compound/latticed sections shall be done in such a fashion that each component of the section is joined in a staggered manner.

Where no butt weld is used for splicing, the meeting ends of two pieces of joist/channel/ built up section shall be ground flush for bearing on each other and suitable flange and web splice plates shall be

designed and provided for the full strength of the flange/web of the section and welds designed accordingly.

Where full strength butt weld is used for splicing (after proper edge preparation of the web and flange plates) of members fabricated out of joist/channel/angles/built up section, additional flange and web plates shall be provided, over and above the full strength butt welds, to have 40% strength of the flange and web.

Where a cover plate is used over a joist/channel section the splicing of the cover plate and channel/joist sections shall be staggered by minimum 500mm. Extra splice plate shall be used for the cover plate and joint/channel section as per clause 5.2.8.2 or 5.2.8.3.

Prior approval shall be obtained by the Contractor for locations of splices where not shown on design drawings. Only a single splice at approved location shall be allowed for members' up to a length of 6 to 7m. Maximum two numbers of splices shall be allowed for members exceeding this length.

9. MACHINING AND GRINDING

All slab bases and slab caps shall be accurately machined over the bearing surfaces and shall be in effective contact with the ends of column sections (shafts).

For slab bases and slab caps, ends of column shafts shall be accurately machined. However, for gusseted bases and caps, the column shafts shall be ground flush for effective contact with parts connected together.

Gusseted bases and caps shall be ground flush for effective contact with ends of column sections.

End of all bearing stiffeners shall be machined or ground to fit tightly at top and bottom without any air gap.

While machining or grinding care shall be taken so that the length or thickness of any part does not get reduced by more than 2.0mm.

For all machining or grinding works for gasketed base and cap plates, the clearance between the parts joined shall not exceed 0.2mm at any location.

MARKING FOR IDENTIFICATION

Each component shall be distinctly marked (with paint) before delivery in accordance with the marking diagrams and shall bear such other marks as will facilitate erection.

For small members which are delivered in bundles or crates, the required marking shall be done on small metal tags securely tied to the bundle.

SHOP ERECTION

The steel work shall be temporarily shop erected complete, so that the accuracy of fit may be checked before dispatch.

10. INSPECTION AND TESTING OF STRUCTURES

Should any structure or part of a structure be found not to comply with any of the provisions of this specification (or relevant bis codes as referred to), it shall be liable to rejection. No structure or part of the structure, once rejected shall be resubmitted for inspection. Defects which may appear during/after fabrication/ erection shall be made good.

11. SHOP PAINTING

All components and members of steel work shall be given one shop coat of red oxide zinc chromate primer (conforming to is:2074) or any other primer as specified, in the tender, immediately after the

surfaces have been properly prepared (i.e. Degreased, derusted, descaled and cleaned) in accordance with is:1477. The primer coat shall be applied over completely dry surfaces (using brushes of good quality) in a manner so as to ensure a continuous and uniform film without "holidaying". Special care shall be taken to cover all the crevices, corners, edges etc. However, in areas which are difficult to reach by brushing, daubers/mops shall be used by dipping the same in paint and then pulling/pushing them through the narrow spaces. The primer coat shall be air dried and shall have minimum film thickness of 25 microns.

Surfaces which are inaccessible after shop assembly, shall receive the full specified protective treatment before assembly (this shall not apply to the interior of sealed hollow sections).

Steel surfaces shall not be painted within a suitable distance of any edges to be welded if the paint specified would be harmful to welders or impair the quality of the welds.

Welds and adjacent parent metal shall not be painted prior to deslagging and inspection.

Parts to be encased in concrete shall have only one coat of primer and shall not be painted after erection.

12. PACKING

All items shall be suitably packed in case these are to be dispatched from the fabrication shop to the actual site of erection so as to protect them from any damage/distortion or falling during transit. Where necessary, slender projecting parts shall be temporarily braced to avoid warping during transportation.

Small parts such as gussets, cleats etc., shall be securely wired onto their respective main members.

Bolts, nuts washers etc. Shall be packed in crates.

13. TRANSPORTATION

Loading and transportation shall be done in compliance with transportation rules

14. SITE (FIELD) ERECTION

14.1. PLANT & EQUIPMENT

The suitability and capacity of all plant and equipment used shall be to the complete satisfaction of the Engineer-In-Charge.

14.2. STORING & HANDLING

All steel work shall be so stored and handled at site so that the members are not subjected to excessive stresses and any damage.

14.3. SETTING OUT

Prior to setting out of the steel work, the Contractor shall get himself satisfied about the correctness of levels, alignment, location of existing concrete pedestals/columns/brackets and holding down bolts/pockets provided therein. Any minor modification in the same including chipping, cutting and making good, adjusting the anchor bolts etc., if necessary, shall be carried out by the Contractor at his own expense. The positioning and leveling of all steel work including plumbing of columns and placing of every part of the structure with accuracy shall be in accordance with the drawings.

14.4. TOLERANCES

Tolerances for erection of steel structures shall be as per table mentioned in the end.

14.5. SAFETY AND SECURITY DURING ERECTION

The contractor shall comply with is:7205 for necessary safety and adhere to safe erection practices and guard against hazardous as well as unsafe working conditions during all stages of erection.

During erection, the steel work shall be securely bolted or otherwise fastened and when necessary, temporarily braced/guyed to provide for all loads to be carried by the structure during erection till the completion, including those due to the wind, erection equipment and its operation etc. At no extra cost to the owner. For the purpose of guying, the contractor shall not use other structure in the vicinity. No permanent bolting or welding shall be done until proper alignment has been achieved.

Proper access, platform and safety arrangement shall be provided for working and inspection, (at no extra cost to the owner) whenever required.

14.6. FIELD CONNECTIONS**FIELD BOLTING**

Field bolting shall be carried out with the same care as required for shop bolting.

FIELD WELDING

All field assembly and welding shall be executed in accordance with the requirements for shop assembly and welding. A hole for all erection bolts where removed after final erection shall be plugged by welding. Alternatively erection bolts may be left and secured.

14.7. GROUTING

Prior to positioning of structural columns/girders/trusses over the concrete pedestals/ columns/brackets, all laitance and loose material shall be removed by wire brushing and chipping. The bearing concrete surfaces shall be sufficiently leveled, hacked with flat chisels to make them rough, cleaned (using compressed air) and made thoroughly wet. All pockets for anchor bolts shall also be similarly cleaned any any excess water removed. Thereafter, the structural member shall be erected, aligned and plumbed maintaining the base plates/shoe plates at the levels shown in the drawings, with necessary shims/pack plates/wedges.

After final alignment and plumbing of the structure, the forms shall be constructed all round and joints made tight to prevent leakage. Grouting (under the base plates/shoe plates including grouting of sleeves and pockets) shall be done with non-shrink grout having compressive strength (28 days) not less than 40N/sq.mm non shrink grout shall be of free flow premix type and of approved quality and make. It shall be mixed with water in proportion as specified by the manufacturer. Ordinary 1:2 cement/sand mortar grout shall be used only for small, isolated structures e.g. Operating platforms not supporting any equipment, pipe supports, crossovers, stairs and ladders. The thickness of grout shall be as shown on the drawings but not less than 25 mm nor more than 40 mm in any case.

The grout mixture shall be poured continuously (without any interruption till completion) by grouting pumps from one side of the base plate and spread uniformly with flexible steel strips and rammed with rods, till the space is filled solidly and the grout mixture carried to the other side of the base plate.

The grout mixture shall be allowed to harden for a period as decided by the engineer-in-charge. At the end of this period, the shims/wedges/pack plates may be removed and anchor bolts tightened uniformly. The alignment of the structure shall now be rechecked and if found correct, the voids left by the removal of shims/wedges/pack plates (if removed) must be filled upto with a similar mixture of grout. In case after checking, serious misalignment is indicated, the grout shall be removed completely and fresh grouting done after making appropriate correction of alignment.

14.8. SCHEME AND SEQUENCE OF ERECTION

The Contractor shall furnish the detailed scheme and sequence of erection to match with the project schedule.

14.9. PAINTING AFTER ERECTION

GENERAL

The Contractor shall obtain written instruction in this regard sufficiently prior to taking up any procurement of paint and execution of painting work after erection of steel structures.

The Contractor shall carry out the painting work in all respects with the best quality of approved materials (conforming to relevant BIS Codes) and workmanship in accordance with the best engineering practice. The Contractor shall furnish characteristics of paints (to be used) indicating the suitability for the required service conditions. The paint manufacturer's instructions, if any, shall be followed at all times. Particular attention shall be paid to the following:

Proper storage to avoid exposure and extremes of temperature.

Surface preparation prior to painting.

Mixing and thinning.

Applicable of paint and the recommended limit on time intervals between consecutive coats.

Painting shall not be done in frost of foggy weather, or when humidity is such as to cause condensation on the surfaces to be painted.

Surface which shall be inaccessible after site assembly shall receive the full specified protective treatment before assembly.

Primers and finish coat paints shall be from the same manufacturer in order to ensure compatibility. Painting colour code shall be as per table mentioned in the end.

RUB DOWN AND PRIMER APPLICATION

The shop coated surfaces shall be rubbed down thoroughly with emery/abrasive paper to remove dust, rust, other foreign matters and degreased, if required, in accordance with IS:1477, as applicable, cleaned with warm fresh water and air dried. The portions, from where the shop coat has peeled off, shall be touched up and allowed to dry.

Primer coat of red oxide zinc chromate primer (conforming to IS:2074) or any other primer, as specified, shall be applied by brushing/spraying over the shop coat in a manner so as to ensure a continuous and uniform film throughout. Special care shall be taken to cover all the crevices, corners, edges etc. The final primer coat shall be air dried and shall have a minimum film thickness of 25 microns or as per specifications (tolerance $\pm 10\%$) after drying, as applicable.

In case a different cleaning procedure and primer specifications are specified in the drawing/Tender, the same shall be adopted.

FINAL PAINT APPLICATION

After the primer is hard dry, the surfaces shall be dusted off and one coat of synthetic enamel paint of approved color and shade (conforming to IS:2932) or any other paint as per specification shall be applied by brushing/spraying so that a film free from "holidaying" is obtained. The colour and shade of first coat of paint shall be slightly lighter than the second coat in order to identify the application of each coat. The second coat of paint shall be applied after the first coat is hard dry. The minimum thickness of each film shall be 20 microns ($\pm 10\%$ tolerance) after drying.

In case a different type of paint and painting procedure are specified in the drawing/tender, the same shall be adopted.

INSPECTION AND TESTING OF PAINTING WORKS

All painting materials including primers and thinners brought to site by the Contractor for application

shall be procured directly from reputed and approved manufacturers and shall be accompanied by manufacturer's test certificates. Paint formulations without certificates shall not be accepted.

The Engineer-In-Charge, at his discretion may call for additional tests for paint formulations. The Contractor shall arrange to have such tests performance including batch wise test of wet paints for physical and chemical analysis. All costs shall be borne by the Contractor.

The painting work shall be subject to inspection by the Engineer-In-Charge at all times. In particular, the stage inspection will be performed, and Contractor shall offer the work for inspection and approval at every stage before proceeding with the next stage. The record of inspection shall be maintained. Stages of inspection are as follows:

- a) Surface preparations
- b) Primer applications
- c) Each coat of paint

Any defect noticed during the various stages of inspection shall be rectified by the Contractor before proceeding further. Irrespective of the inspection, repair and approval at intermediate stages of work the Contractor shall be responsible for making good any defects found during final inspection/guarantee period/defect liability period, as defined in General Conditions of contract. Dry film thickness (DFT) shall be checked and recorded after application of each coat. The Contractor shall provide standard thickness measuring instrument such as elcometer (with appropriate range for measuring dry film thickness of each coat) free of cost whenever asked for.

MAXIMUM PERMISSIBLE ERECTION TOLERANCES

A. Columns

1. Deviation of column axes at foundation top level with respect to true axes.

In longitudinal direction	± 5 mm
In lateral direction	± 5 mm
2. Deviation in the level of bearing surface of columns at foundation top with respect to true level ± 5 mm
3. Out of plumb (Verticality) of column axis from true vertical axis, as measured at top:

Up to and including 30 m height	± H/1000 or ± 25 mm
	Whichever is less.
Over 30 m height	± H/1000 or ± 35 mm
	Whichever is less.
4. Deviation in straightness in longitudinal & transverse planes of column at any point along the height. ± H/1000 or ± 10 mm
Whichever is less.
5. Difference in the erected positions of adjacent pairs of Columns along length or across width of building prior to connecting trusses/beams with respect to true distance. ± 5 mm
6. Deviation in any bearing or seating lvl with respect to true lvl. ± 5 mm
7. Deviation in difference in bearing levels of a member ± 5 mm

on adjacent pair of columns both across and along the building

B. Trusses

1. Shift at the centre of span of top chord member with centre $\pm 1/250$ of height of truss in mm at respect to the vertical plane passing through the centre of span or of bottom chord. ± 15 mm whichever is less.
2. Lateral shift of top chord of truss at the centre of span 10 mm $\pm 1/1500$ of span of truss in mm or $\pm$ 10 mm From the vertical plane passing through the centre of supports of the truss. whichever is less.
3. Lateral shift in location of truss from its true position ± 10 mm
4. Lateral shift in location of purlin from true position ± 5 mm
5. Deviation in difference of bearing levels of truss from the true level. $\pm 1/1200$ of span of truss in mm or 20 mm whichever is less.

G FLOORING AND PAVING WORK

1. CERAMIC/GRANAMITE TILES IN FLOORS, DADO & SKIRTING

1.1. Materials

Standard color glazed ceramic tiles shall be of first quality approved make 6mm to 8mm in thickness. They shall be sound, hard, well and evenly glazed with fine and sharp arises and free from twist. The rear face shall be grooved and recessed in parts to provide the necessary key for mortar. They shall generally conform to I.S. 777. The tiles shall be 300mm x 300mm, 300mm x 400mm or as specified.

1.2. Workmanship

The tiles to be used for floor and dado shall be of the same manufacture and first quality as per approved sample.

Tiles shall be immersed in water for at least 6 hours prior to their use.

An average 12mm, thick cement and sand mortar 1:4 for skirting/dado and lime mortar 1:2 bedding for flooring average 20mm thick over the approved sub-base and finished to proper levels and falls. After the surface has hardened sufficiently it shall be roughened, cleaned and well set to receive a thin cement slurry. Tiles with their under side also smeared with cement slurry shall then be laid over the bedding and tamped into position properly to have the top surface in a true plane and level or to falls as directed.

For dado, the surface shall be plastered with 1:4 cement mortars to make the surface even and in plumb. The surface of the plaster shall be sacrilege with wire brush for getting a good bond between the tile and bedding. After soaking the tiles, the back of the tile shall be battered with plastic cement paste and pressed on the plastered surface and tapped back in position. Joints shall be thin, uniform, even and straight. The joints shall be cleaned off gray cement and pointed with white cement paste with pigment. If required, to match the shade of the tiles. The work to be cured for 7 days. After curing, the surface shall be washed and finished clean with oxalic acid. The finished floor shall not sound hollow when tapped with a wooden mallet.

1.3. Mode of Measurement

All flooring work will be measured on sq.mt basis and shall be measured between unplastered wall surfaces. Skirting and dado will be measured in sq.mt. And the height will be above flooring.

2. GRANITE SLAB WORK

The slab must be of uniform thickness as specified with the variation in the thickness not exceeding 1.2mm and must be from the source. They shall be of uniform texture and color, free of any veins and streaks. All the edges shall be chiseled true to line, square and shape. The brushes in the joints are not more than specified thickness. The surface should be rough dressed/one line dressed/two lines dressed/three lines dressed palmane finish/mirror polish as specified.

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 chiseling so that the variations are not more than 4mm. Work includes rough dressing also.

Two Lines Dressing

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

Three Lines Dressing

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

Palmane Dressing

After the three line dressing is over the surface is smoothened by using a special palmane tool to further even out the three line dressed surface so that the maximum variation in surface evenness is not more than 1.0mm. Work includes rough, one line, two lines and three lines dressing also unless otherwise stated.

Polishing

The surfaces will be polished by grinding using manual or mechanical process to give a smooth, even, perfect plane surface or as may be directed. The polished surface should reflect light like a mirror and must be free from searches and depressions.

3. POLISHED KOTA STONE FLOORING :

The polished kota stone shall be of 18 m.m. thick. The kota stone shall be supplied with all four edges machine cut and both faces polished. The size of kota stone shall be cut as directed by engineer incharge or as per architectural drawings issued by consultant. Kota stone shall be immersed in water for at least 6 hours prior to their use so that water from mortar may not be absorbed. The kota stone shall be laid on 20 m.m. thick bed of cement mortar (1:3) i.e. one part of cement and three parts of screened river sand. The materials in proportion as stated above shall be properly mixed in concrete mixer in dry condition. After the mortar is properly mixed, the cleaned water shall be added as per requirement and mortar shall be again mixed in concrete mixer. It should be seen that no excessive water is added in mortar so that cement from mortar is washed out. Mixed mortar shall be used within half an hour of mixing. During laying of kota stone, necessary slope if necessary shall be maintained as per instruction by engineer in charge. The joints of kota stone shall be filled up with cement. After the joints are properly set, sufficient

curing with water shall be done. Necessary testing of kota stone shall be carried out as per I.S. code. 4.

4. I.P.S. (Indian patent stone) FLOORING :

I.P.S. shall be in proportion of 1:2:4 i.e. by volume 1 part of cement, 2 part of coarse sand and 4 parts of black stone aggregates of size 10 M.M.

The building materials as stated above shall be mixed in dry condition with power driven concrete mixer. After materials are properly mixed with each other, water shall be added and materials shall again be mixed in concrete mixer. It should be watched that no excessive water is added and see that permissible water cement ratio is maintained throughout during the progress of I.P.S. flooring. All the materials shall be got tested for every lot from govt. approved engineering testing laboratories as per I.S. code of practice and test certificates shall be submitted to client/consultant.

The concrete so prepared shall be stacked in water tight platform and I.P.S. flooring shall not be deposited from height to avoid segregation of concrete. Moreover concrete shall be compacted in such a way that the surface is become smooth and no honey combing is observed. The thickness of I.P.S. flooring shall be 50 M.M. or as specified. After necessary thickness of I.P.S., cement slurry layer be done and surface shall be made smooth by using G.I. gutka and geometrical square design or as directed by using string shall be done as per instruction of engineer-in-charge.

After I.P.S., flooring work is completed; curing shall be done for minimum period of seven days. 5.

5. PAVER BLOCKS FLOORING :

The paver blocks of 75 to 80 M.M. thick from approved manufacturer shall be obtained and a sample be got approved from client/consultant before using. The minimum compressive strength should be of 400 kg/sq cm. and Paver blocks should be got tested from approved engineering testing laboratories and testing certificate should be submitted to client/consultant. It should be seen that throughout the progress of work same lot as per approved sample is used on site.

The paver blocks shall be laid over bed of 50 M.M. thick river sand and joints to be filled with screened river sand and compaction shall be done by Mechanical Compactor. The river sand to be used in bedding shall be screened with proper sieve and gravels or other foreign materials shall be removed. The river sand bed should be well watered and properly compacted before laying of paver blocks.

H PLASTERING AND POINTING

1. MATERIALS

- ☐ Cement, sand and water constituting the materials for the work shall conform to the specifications laid down for the concrete work. Finer sand shall be used as per I.S. Code.
- ☐ Line required for neeru finish shall be of approved variety fat lime.
- ☐ Mortar shall be in proportion as specified in the Bills of Quantities.

2. WORKMANSHIP

2.1. GENERAL

- ☐ Adequate scaffolding shall be provided by the contractor at his expense. For external plaster and wherever required by Architect double scaffolding having 2 sets of vertical supports so that the scaffolding is independent of the walls, is to be provided by the contractor.
- ☐ Dewatering the foundation if required, shall be done by the Contractor at his own cost.
- ☐ The surfaces to be plastered shall be first cleaned and watered well in advance. All put log holes in brick work and junction between concrete and brick work shall be properly filled in advance. All joints shall

be raked out to a depth of 10mm to make a key for the plaster. All cement surfaces to be hacked to receive plaster. All the surfaces to be thoroughly wetted before plastering.

- ☐ Smooth surfaces of concrete old plaster etc. Shall be suitably roughened or removed to provide necessary bond for the plaster. All dirt, soot, oil paint etc. Which prevents proper bond with plaster shall be removed.
- ☐ Patches of plaster 150 x 150mm shall be put on about 3 meter apart as gauges to ensure even plastering in one plane.
- ☐ All plaster work will be done in line level and plumb to the satisfaction of Employer/Architect.
- ☐ For walls, column, beams thickness will be average 12mm thick while for ceiling it shall be average 8mm. unless otherwise stated cement mortar shall be in 1:4 proportion.

2.2. Specification of Sand faced cement plaster:

Sand faced cement plaster shall be of 20 M.M. thick in two coats as under:

The first coat shall be of 12 M.M. in C.M.(1:4) i.e. one part of cement and four part of screened sand. The second coat shall be in C.M. (1:2) i.e. one part of cement and two parts of screened sand. The materials in proportion as stated above shall be properly mixed in concrete mixer in dry condition. After the mortar is properly mixed, the cleaned water shall be added as per requirement and mortar be again mixed in concrete mixer. It should be seen that no excessive water is added in mortar so that cement from mortar is washed out. Mixed mortar shall be used within half an hour of mixing.

Before plastering work, the surface to be plastered, be cleaned properly and all loose materials stuck on masonry/R.C.C. surface should be removed and surface be cleaned to receive even plaster and vertical /horizontal joints of masonry shall be raked to about 10mm. to have proper key for mortar and proper bond is maintained. Then after, the surface be well watered so that water from cement mortar is not absorbed. Before plastering is started, patches of plaster 150 M.M. x 150 M.M. of 12 M.M. thick shall be applied on wall surface about 3 meters apart to ensure even plastering in one plane. . During plastering on chhaja of doors/windows and other openings and wherever required, Tapak of size 25 M.M. wide x 10 M.M. thick in C.M.(1:2) shall be done as per direction of engineer in charge. The surface of first coat shall be made rough with wire or brush for proper bond between first and second coat. After first coat is completed, the surface be cured with water for seven days and then after second coat of 8 mm. shall be applied. After the second coat of plaster is completed, the entire plastered surface should be again cured with water for minimum seven days. The scaffolding required for plastering work shall be provided by contractor at his own cost for which rate is inclusive of all above operations and nothing extra shall be paid.

2.3. Specification of 12 M.M. or 6 M.M. thick smooth cement plaster:

Smooth cement plaster shall be done in 12 M.M. or 6 M.M. thick or as specified and shall be done as under.

The plaster shall be done in C.M. (1:4) i.e. one part of cement and four part of screened sand. The materials in proportion as stated above shall be properly mixed in concrete mixer in dry condition. After the mortar is properly mixed, the cleaned water shall be added as per requirement and mortar be again mixed in concrete mixer. It should be seen that no excessive water is added in mortar so that cement from mortar is not washed out. Mixed mortar shall be used within half an hour of mixing.

Before plastering work, the surface to be plastered shall be cleaned properly and all loose materials stuck on masonry/R.C.C. surface should be removed and surface be cleaned to receive even plaster and vertical /horizontal joints of masonry shall be raked to about 10mm. to have proper key for mortar and for proper bond. Then after the surface be well watered so that water from cement mortar may not

be absorbed. Before plastering is started, patches of plaster of size 150 M.M. x 150 M.M. of 6 M.M. thick shall be applied on wall / R.C.C. surface about 3 meters apart to ensure even plastering in one plane. During plastering on chhaja of doors/windows and other openings and wherever required, Tapak of size 25 M.M. wide x 10 M.M. thick in C.M. (1:2) shall be done as per direction of engineer in charge. After the plaster is set properly, the surface be cured at least for seven days. The scaffolding required for plastering work shall be provided by contractor at his own cost for which rate is inclusive of all above operations and nothing extra shall be paid.

2.4. Waterproof Cement Plaster

This shall be as specified herein before for cement plaster work except for the following:

- ☐ No neeru finish shall be applied over the rendered surface but the rendered surface itself shall be finished smooth by steel trawling.
- ☐ In the preparation of cement and sand mortar, cement shall be mixed with an approved waterproofing compound such as pudlo cico No.1 water lock, impermo, composed etc. As per the manufacturer's instructions and as directed by the Architects.

2.5. CEMENT VATA:

Providing cement vata (10 cm x 10 cm size) quarter round in cement mortar 1:1 including neat cement finishing, watering etc. complete.

The cement vata shall be provided at junction of terrace slab and parapet wall or as specified by engineer incharge. The cement vata shall be in proportion of cement mortar (1:1) i.e. one part of cement and one part of screened river sand by volume. The natural river sand brought on site shall be screened with proper sieve and all impurities and other foreign materials shall be removed during screening. The materials in proportion as stated above shall be properly mixed in concrete mixer in dry condition. After the mortar is properly mixed, the cleaned water shall be added as per requirement and mortar be again mixed in concrete mixer. It should be seen that no excessive water is added in mortar so that cement from mortar is washed out. Mixed mortar shall be used within half an hour of mixing. The surface on which vata is to be done, shall be properly cleaned and old mortar or other materials set on surface shall be removed. On this clean surface, cement neeru shall be applied and then cement mortar as prepared above shall be done in size as 100m.m. x 100m.m. of horizontal and vertical surface. After the vata is properly set, curing with water shall be done for a period of minimum seven days.

2.6. Groove in cement plaster:

Groove in cement plaster shall be applied after entire plaster on wall is completed.

The size of groove shall be of size 12 M.M. X 12 M.M. and in line, level and in plumb.

The payment of groove shall be done in running meter.

2.7. Rate to Include

Apart from other factors mentioned elsewhere in the contract, rates for plastering shall also include following:

- ☐ All materials, labors, use of tanks/implements for satisfactory completion of the work.
- ☐ Supply, erection, dismantling and removing single/double scaffolding.
- ☐ Preparing all the surfaces to secure plaster.

- ☐ Providing cement plaster of any type of specified average thickness and proportion at all heights and depths and to any shape as directed.
- ☐ Curing for 7 days
- ☐ Chicken mesh of approved gauge shall be provided at all the junction of concrete, masonry, timber and grouting of chases made for electrical/ plumbing or other purpose as directed at no extra cost.
- ☐ Any molding, bend, arises grooves/drip mould, rounding/ wattas, chamfering, soffits or arches and making good plaster after all the Sub-Contractor or nominated Sub-Contractor have done their work

2.8. Mode of Measurement

All plastering will be measured in square meters unless otherwise described as per relevant I.S. code.

Walls: the measurement of wall plastering shall be taken between the walls or partitions for the length and from top of floor or skirting up to the ceiling bottom for the height. The dimensions before plastering shall be taken.

Ceiling: Ceiling shall be measured between walls or partitions and the dimensions before plastering shall be taken. Ceilings with projected beams shall be measured over beam and the plastered side of the beam shall be measured and added to plastering on ceiling.

For jambs, soffits, sills, etc. For openings not exceeding 0.5 sq.mt each in area ends of joists beams posts girders steps etc. Not exceeding 0.5 sq. mt. Each in area and openings not exceeding 3 sq.mt. Each deductions and additions shall be made in the following manner:

- ☐ No deduction shall be made for ends of joists, beams, posts, etc. And openings not exceeding 0.6 sq.mt. Each and no addition shall be made for reveals, jambs, soffits, sills etc. Of these openings not for finishing the plaster around ends of joists, beams, posts etc.
- ☐ Deductions for opening exceeding 0.5 sq.mt. But not exceeding 3sq.mt. Each shall be made as follows and no addition shall be made for reveals, jambs, soffits, sills, etc. of these openings. When both faces of wall are plastered with the same plaster, deduction shall be made for one face only. When two faces of wall are plastered with different plasters or if one face is registered and the other pointed, deduction shall be made from the plaster or pointing on the side of frames for doors, windows on which the width of reveals less than that on the other wise but no deduction shall be made on the other side.
- ☐ In case of openings of area above 3 sq.mt. Deductions shall be made for the openings, but the jambs, soffits and sills shall be measured.

I WOOD WORK, GLAZING AND PAINT

1. MATERIALS

- ☐ The materials shall be of the best approved quality obtainable and they shall comply with the respective Indian Standard Specification.
- ☐ If directed, materials shall be tested in any approved Testing Laboratory and the test certificates in original shall be submitted to the Architect and the entire charges connected with testing including charges for repeated tests, if ordered shall be borne by the Contractor.
- ☐ It shall be obligatory for the Contractor to furnish certificate, if demanded by the Architect, from manufacturer or the material supplier that the work has been carried out by using their material and as per their recommendations.
- ☐ All materials supplied by the employer/any other specialist firms shall be properly stores and the Contractor shall be responsible for its safe custody until they are required on the works and till the

completion of work.

- ☐ Unless otherwise shown on the Drawings or mentioned in the "Schedule of Quantities" or Special Specifications, the quality of materials, workmanship, dimensions etc., shall be as specified herein under.
- ☐ All equipment and facilities for carrying out field-tests on materials shall be provided by the Contractor without any extra cost.

2. TIMBER:

Timber generally is to be the best of its kind, well and properly seasoned, of mature growth, free from worm holes large loose or dead knots or other defects and sawn square and will not suffer warping, splitting or other defects through improper handling.

The hardwood is to be teak weighing not less than 45 lbs. per cubic foot, with moisture content not exceeding 12% to 14%. The moisture content of timber shall be determined according to method described in paragraph 4 of IS:287 for "Maximum permissible moisture content of Timber used for different purposes in different climatic zones".

In measuring cross-sectional dimensions of the frame pieces tolerance upto 1.5mm shall be allowed for each planned surface.

Unless otherwise specified, all timber for frames and shutters for doors, windows, ventilators, cupboards etc. Shall be first class or good quality as specified, sound, well seasoned, C.P. or other equivalent and approved teak and shall be free from knots, shakes, fissures, flaws, sub-cracks and other defects. The planned surface shall be smooth and free from blemishes and discolorations.

All timber for carpentry and joinery in touch with masonry or concrete shall be provided with 2 coats of creosote or solignum before fixing.

All fully fabricated timber shall be air seasoned at site of work for a period of not less than two months to allow for any shrinkage that may take place. The preparation of timber for joinery is to commence simultaneously with the beginning of the project work generally and should proceed continuously until all the wood work is prepared and fixed/stacked on or near the site as the case may be.

Timber shall be considered as well seasoned, if its moisture contents (M.C.) does not exceed the following limits.

Timber for frames - 14%

Timber for planking and shutters etc - 12%

The M.C. of timber shall be determined according to method described in para 4 of I.S. 287 for maximum permissible moisture contents of timber used for different purpose in different climatic conditions.

Timber is to be cut to the required sizes and lengths as soon as practicable after the works are begun and stored under cover so that the air will circulate freely around it. Joinery is to be prepared, immediately after the placing of the contract, framed up (but not bonded) and stored until required for fixing in position that warp or develop shakes or other defects are to be replaced before wedging up. the whole of the work is to be framed and finished in a proper and workman like manner, in accordance with the detailed drawings, and fitted with all necessary motets straps belts screws etc. Running bonded joints are to be cross tongued with teak and where over 1-1/2 % thick double cross tongued. Joiner's work generally is to be finished with the fine class prepared surfaces unless otherwise specified.

Templates boxes and moulds shall be accurately set out and rigidly constructed so as to remain accurate

during the time they are in use.

Grounds are to be clean sawn, free from large knots, splayed as required, plugged and fixed to walls etc. at 1'6" centers.

Wood plugs are to be cut on the twist. Patent wall plugs or plastic filling may be used in lieu of wood plugs with the approval of the architect.

All unexposed surfaces of timber e.g. false ceilings, backings, fillets backs of doors frames, cupboard framing, ground etc. are to be treated with two coats of approved timber preservatives like solignum, kirticite, termiseal or castrol or vacuum pressure impregnated with and approved water soluble timber preservative before fixing or bedding.

□ **Superior Quality Indian Teak Wood:**

Superior quality Indian teak wood means Dandeli, Balarshah and Malabar Burma teak. It shall be of good quality and well seasoned. It shall have uniform colour, reasonably straight grains and shall be free from large, loose, dead knots, cracks, shakes, warp, twists, bends, borer, holes sapwood or defects of any kind. No individual hard and sound knot shall be more than 1 cm. in diameter and aggregate area of all knots shall not exceed 1/2% of the area of the piece. It shall be close grained and there shall not be less than 6 growth rings per 2.5 cm width.

□ **First Class Indian Teak Wood:**

1st class teak wood means C.P. and Bular teak of good quality and well seasoned. It shall have uniform colour reasonably straight grains and shall be free from large, loose, dead knots, cracks, shakes, warp, twists, bends, sapwood or defects of any kind. No individual hard and sound knot shall be more than 2.5 cm in diameter and aggregate area of all knots shall not exceed 1% of the area of the piece. There shall not be less than 4 growth rings per 2.5 cm width.

□ **Second Class Indian Teak Wood:**

Shall be similar to 1st Class Indian Teak Wood except that knot upto 4 cm diameter and aggregate area of all knots upto 11/2% of the area of the piece shall be allowed. There shall not be less than 4 growth rings per 2.5 cm width.

HOLDFASTS

Three holdfasts shall be fixed to each post of the door frame. The M.S. holdfasts shall be of the size 37.5cm X 40mm X 6mm or as required at site and shall be fixed to the frames by means of screws and not nails. The other end of the holdfast shall be fixed into jambs with 1:2:4 P.C.C. of dimensions as directed. Ends of holdfast will be fish tailed. Corner straps of M.S. sheet shall be provided and fixed on corners with screws.

Whenever asked for metal fastener or bolts as directed shall be used for rough grounds, framing, langers etc.

The rates quoted for wood work and joinery shall include the cost for all types of holdfasts or Rawl plugs or other approved fasteners directed (Horns for frames shall be cut and shall not be used as holdfasts), cement grouting and fixing to frame work with screws etc., All materials, wastages, labour, T & P hoisting & fixing in position at all heights and depths, providing two coats of creosote/ solignum, air seasoning of wood.

WORKMANSHIP AND CONSTRUCTIONS

- The workmanship shall be first class and to the approval of the Employer/ Architects Scantlings and boardings shall be accurately sawn and shall be of required width and thickness. All carpenter's work shall be wrought except where otherwise described. The workmanship and joinery shall be accurately set

out in strict conformity with the drawings and shall be framed together and securely fixed in approved manner and with properly made joints. All work is to be properly tennoned, shouldered, wedged, pinned braded etc. And properly glued with approved quality glue to the satisfaction of the Employer/Architects. All mortice and tennon joints shall fit in fully and accurately without wedging or filling. The joints shall be pinned with hard wood or bamboo pins of 10 to 12mm dia or rust resisting star-shaped metal pins of 8mm dia after the frames are put together and pressed in position by means of a press.

- ❑ Screws: All screws to be used in wood work and joinery shall be G.I.
- ❑ Tolerance: 1.5mm (1/16") will be allowed for each wrought face of sizes specified except where described
As finished in which case they shall hold to the full dimensions.
- ❑ Protection: All edges of timber frames etc. Shall be protected from being damaged during construction by providing rough timber casing securely fixed and other adequate protective measures. All portions of timber abutting against or embedded in masonry or concrete shall be treated against termites by giving a coat of approved wood preservative.
- ❑ If it is decided by the Employer to provide antitermite treatment, the buildings Contractor shall co-ordinate his work suitably as directed by the Employer/Architects or otherwise treat all wooden members with anti-termite treatment as instructed within the rate quoted for doing anti-termite work.
- ❑ Door/windows frames shall have cut rebate. Planted rebates shall not be permitted.

3. JOINTS:

3.1. Carpentry and Joinery:

- ❑ The carpenter and joiner shall include the finishing of all labour, materials, equipment, and appliances required to complete the work including the installation of hardware as per the drawing.
- ❑ The timber shall be of the quality as described on the drawings or in the bills of quantities, shall be seasoned and uniform in texture, free from fungal growths, knots, wanes, open shake borer holes, rot, decay, discoloration, soft or spongy spots, hollow pockets, patch or box heart and all other defects.
- ❑ The entire carpenter's work shall be carried out by skilled workmen, using proper tools. All joints shall be securely nailed without splitting the wood. Wherever it is necessary the members shall be lapped or jointed by G.I. Straps or extra wood blocks. All joining and nailing shall be done in neatness, and shall be approved by the Architects. All assembly shall be exactly at right angles.
- ❑ Finished wood work and joinery including doors shall be surfaced with straight without any warp or bow and shall have smooth, well planed faces at right angles to each other. The frame members shall be planed on the three sides exposed at right angles to each other.
- ❑ All joinery work shall be securely mortised and tenoned with synthetic resin conforming to I.S.851-1957. Heads, posts, transoms, mullions of door and window frames shall be made out of single pieces of timber only. The heads and posts shall be through-tenoned into the mortises of the jamb posts to the full width of latter and thickness of the tenon shall be not less than 1/2". Solid wood panels of not less than 5" and not more than 8" in width shall be used and jointed together with tongue and groove joint.
- ❑ All interior wood finish doors, cabinet work shall be smoothly treated and sanded after erection, until all the defects are entirely removed. Assembled door frame without sills shall be fitted with temporary stretchers. All exposed wood and plywood shall be straight grained, matched grain and colour and shall be approved by the Architects.
- ❑ Interior wood finish doors, cabinets, and other fixed wooden equipment shall be properly installed, level plumb and true. But joints shall be avoided wherever possible; if unavoidable the joint shall be leveled. All exterior angles shall be mitered. Adjoining interior wood work shall match and harmonise. All wood

work in contact with masonry shall be painted with bitumen paint or red oxide paint.

4. GLASS AND GLAZING:

- All glass shall be float glass of the best quality, free from specks, bubbles, smokes, veins, air holes, blisters and other defects. The kind of glass to be used shall be as mentioned in the item or specification or in the special provisions or as shown in detailed drawings Thickness of glass panel shall be uniform. All glass to be approved manufacture complying with IS: 3548-1966 or as per approved quality and sample.
- The contractor shall furnish all labors, materials, and equipment required for the installation of glass and glazing items.
- The glass shall be of the type, quality and substance specified in the bills of quantities.
- In case of the glass being supplied by the owners, the contractor shall take the delivery of the glass at site and shall be responsible for proper handling and stacking. We shall insure glass against theft, fire etc.
- The Contractor shall replace at his own expense all broken, damaged or disfigured glass caused in the execution of the work or faulty installation, before the virtual completion of the work.
- Patterned or translucent glass shall be 4mm. in thickness and shall be approved by the Architects. Sheet glass shall be in 5mm. in thickness. Wired glass shall be 6mm. in thickness.
- The putty used for glazing metal door, window or ventilator shall conform to I.S.420:1953.
- Before installation of the glass, the Contractor shall ensure against the following:
 - i) All glazing rebates shall be square, plumb, true in plane, clear, dry and free of dust.
 - ii) The frames shall be adjusted before glazing. The weight of the glass in a side hung casement causes it to drop slightly on its hinges. Before glazing the frame shall be set in slightly high position in its frame.
 - iii) Glass edges shall be clean and cut to the exact size, chipped or damaged edges shall be rejected. iv) Sashes shall be glazing in the closed position and shall not be opened till the putty is set.
 - v) The glass shall be set in teak wood beading or metal glazing chips and so installed to achieve proper water tightness.
- The platter glass shall be bedded on strips of leather or felt turned over the two sides of the glass to form a packing between the glass and the metal casing. The ground glass shall be set with smooth surface outside.
- Glazing large panes of glass, or when heavy wind pressure is experienced, glazing bead may be used instead of front putty. In this case putty shall be applied to the face of the bead which is in contact with glass. Putty would also be necessary, at the back.
- Beads shall be of timber, rust-proof steel or aluminum and shall have mitred corners. The position and size of the bead may depend on the thickness of glass used. The beads shall be fixed with screws 8" apart. The doors or windows shall be drilled during manufacture with holes accordingly.
- On completion of the job, all glass shall be thoroughly cleaned. All paint or other marks to be removed.

4.1. Glazing (I.S. 1765)

Unless otherwise mentioned the whole of the Glass shall be of 7.4 kg/ sq.mt. Thick sheet glass and free from speck, waves, bubbles and other imperfections. The thickness of the glass depends on the unsupported span and area. The thickness, type and quality should be specified by the Employer/

Architects. Thickness should be generally 2.9mm, up to 0.60 X 0.60 meter size and 4mm for sizes larger than this. The glazing shall be fixed with beads or bedded, backed and puttied with putty suitable for use in tropical countries. Putty for glazing to wood work shall be best oil putty or polysulfide sealant as specified. In case of metal windows it shall be special gold size putty. The glass should be obtained from approved manufacturers like Hindustan Pilkington Glass Works Ltd., Triveni, modigaurd sheet glass or similar other approved manufacturer. Prior to placement of order the sample for all glasses to be used will have to be approved by the Employer/ Architects as regards their quality and tint etc. And same should be kept in the office of the Employer/ Architects will be at liberty to reject the same for which no claim shall be entertained. On completion of the works the general building Contractor shall clean and wash all the glass and leave the same perfectly clean and in tidy conditions.

4.2. Measurement

Measurement shall be in square meter of the net actual area.

5. MELAMINE FACED PARTICLE BOARD:

It should be three layered wood based particle board, such as Nova pan melamine faced pre-laminated on both sides. Particle board should be ISI 3087 FPTH (type II, 1965) marked on edges and should also confirm to German Din standard Viz. DIN 66761. It should impart good bending strength and screw holding strength. Melamine faced surface should has resistant to crack at 100 c and should pass cigarette burn test.

6. PLYWOOD

Plywood for general purpose shall confirm I.S. 303-1975 It shall be of B.W.R. grade the specified thickness for commercial type B.W.R. grade plywood formed with 0.8mm. th. commercial face veneers and 1.5mm th. Intermediate veneers in two opposite grain direction shall be 1:1. The moisture content shall not be more than 12.5% by mass. It shall either be of Mafatlal, Kitply make or other equivalent approved make. Where B.W.P. grade is specified it should be boiling water proof confirming to I.S. standards.

7. LAMINATES:

All the laminate to be used shall be of 1.5mm thickness in approved the color and shade as proved and specified by the architect. It shall be matt finish manufactured by Formica India ltd. or its equivalent as per sample shown by the consultant unless otherwise specified. It shall satisfy all the I.S.I. standards for melamine coated laminated fiber boards before the use of such fiber board laminated, The contractor shall have to take approval of the department for each sheet of the laminates.

8. VENEERS:

The best quality natural wood veneers of the specified wood and of the specified thickness shall be used. It shall be in matching group and of uniform shade and as per the selection and approval. the contractor shall have to obtained the approval of the prior to pressing of veneers. The contractor shall have to use the brand of veneers as approved by the architect.

9. RUBBER:

Natural latex rubber (MM foam or its equivalent) of specified density and the thickness shall be used for all the cushions and padding for upholstered furniture. Loose cushions of all furniture should have solid foam walling to keep up proper shape.

10. UPHOLSTERY:

This will be of first class standard workmanship with webbing, padding and filling as specified on drawings. Covering fabrics will be shown tufted and corded as shown on the drawing. Brass or aluminum 'cushion vents' should be installed at the back or underside of seat cushions (specially those

covered in leather venial plastic or very tightly woven fabric) to allow air escape and to prevent torn seams.

11. BLOCK BOARD

For block board, battens of good quality well seasoned and treated wood having straight grain and uniform width of about 2.5cm properly glued and machine pressed together. With grains of each piece reversed from that of adjoining one, shall be used. For particle board or medium density fibre board (MDF), the core shall be of solid particle board or MDF, as the case may be of approved make with the edges lipped internally with first class teak wood/other approved hardwood battens of 4cm(1 ½") minimum depth, glued and machine pressed along with the core. The particle or block board shall have veneer -the first one called cross band with its grain at right angle to that of core and the next one with the grains parallel to these of the core, the face veneer being 1mm of first class teak, well matched. For cheaper variety, one or both faces can have commercial hardwood veneer. Thermoset synthetic resin of phenol for maldchide, type (to I.S 303) shall be used for all doors except otherwise mentioned. Wherever specified, in addition to veneers, the top surface may be provided with synthetic lamination. When this is called a prelaminated slump, the type and colour of the lamination being of approved type.

11.1. Panelled Shutters

The type, pattern and material - solid wood (teak, sal, and hardwood), particle board or MDF shall be as shown in the drawings of Bill of Quantities or as directed by the Employer/ Architects, Solid wood panels shall be in one piece whenever possible. Where 2 or more pieces are permitted they shall be of equal width. Panels, shall be framed into grooves made in styles and rails to the full depth width. Panels, shall be framed into grooves made in styles and rails to the full depth of groove and faces shall be closely filled to sides or groove. If block board, particle board or MDF is to be used it should be solid core with teak internal lipping or other hand edging as specified in drawing or Bill of Quantities.

11.2. Partly or Fully Glazed Shutters

The general specifications for partly paneled fully glazed shutter shall be similar to that for paneled shutter described in the drawings or relevant item. The styles and rails in the glazed shutters shall be rebated. 5/8" X 0.5" (16mm X 12mm) to receive the glass unless otherwise specified or shown in drawings. Sash bars shall be of full thickness of the shutter and of width as shown in the drawings. These shall be moulded and rebated mitred on side to receive the glass as per drawing unless otherwise specified, glass panels shall be fixed by means of moulded teak beads and suitable G.I. screws. Finished thickness of the shutter shall be as mentioned in the schedule of Quantities. The rate shall be for the completed work in all respects fitted and fixed in position at all heights and depths and locations.

Approved samples should be kept in the office of the Employer/ Architects or at the site for reference. The glass shall conform to specifications as described under head glazing. The thickness of glass shall be mentioned in the Schedule of Quantities.

12. HARDWARE FITTING

All hardware fittings for doors shall be oxidised from/brass/anodised aluminum as otherwise specified in the Schedule of Quantities. The samples for the fittings for door shutters shall not be paid as separate item. The rate for hardware fittings shall include for supplying and fixing the fittings with necessary screws, washers, bolts, nuts etc. as required. All locks shall be provided with keys in duplicate and rate shall include for the same. All screws shall be of the same metals as specified. Approved samples of hardware fittings shall be deposited with the Employer/Architects for reference. However if locks and slide bars are included as a separate item in the schedule of Quantities, these shall be measured, counted and paid for separately.

RATES TO INCLUDE

Apart from other factors mentioned elsewhere in this contract, the rate for item of wood work and joinery shall include for the followings:

A) Items of Scantling

All labour, materials and equipment for fixing framework as per drawing including the cost of holdfasts. Rawl plug. Or other fasteners etc.

B) Items of Shutters

- All labour, materials and equipments for carrying out the work as per drawing, hoisting and fixing in position including all wastages etc.
- Labour for fixing the shutters in position (including the cost of fittings) as per drawings. Only net area within the rebates viz. Actual area of shutters shall be measured:

MODE OF MEASUREMENTS

- ☐ All measurements shall be as per I.S. 1200 (part XXI).
- ☐ Scantling shall be measured in Cum. The sectional area shall be the area of the least square or rectangles from which the scantling may be cut. The length shall be actual length of timber required for the purpose including the extra portion required for joining.
- ☐ Shuttering shall be measured in square meter for closed door shutters net area i.e. Rebate to rebate without extra measurement and/or to splayed meeting style of door. Nothing extra shall be paid for wastages etc.

13. ALUMINIUM DOORS AND WINDOWS

All aluminum doors, windows etc. Shall be procured from an approved manufacturer. Aluminum section shall be extruded tubular hollow sections conforming to latest I.S. specifications including I.S. 1948 and I.S. 773. All sections shall be approved by the Employer/Architects before placing the order. All extruded sections shall have minimum 1.8mm wall thickness. The aluminum sections shall be anodized in natural matt finish and the anodic film shall be 20 microns with tolerance + 2 microns.

Operable windows shall be double weather-stripped. One weather strip shall be provided in the outer frame and other weather-strip in the shutter frame. The weather-strip shall be extruded neoprene and of a size to make the windows completely weather tight. The weather-strip shall be extruded in the window sections. The hinges of open able windows shall be strong. Pin of the hinges shall be of stainless steel with nylon/PVC washers. In case the windows are projected type, these shall be provided with brass pivots sliding on stainless steel guides. Concealed type friction stays shall be provided to keep the windows open in any desired position. The window shall be provided with the handle for two-point locking or single point locking as required and directed. The glass used shall be 4mm thick or 5mm sheet glass of first quality and approved make, free from scratches, waviness, bubbles, etc. All as shown in drawing or as specified and directed. Sliding windows wherever used should have the sliding tracks, rollers, pins and the locking clamps as directed by the Employer/Architects. General fabrication and mode of measurement shall be as earlier given for steel windows and doors.

14. General for all Metal Doors, Windows and Ventilators

Fabricated frames shall be handled with care and stacked on edge on level bearers and supported evenly so that no erecting, the surfaces of frames coming in contact with concrete, plaster or dissimilar materials shall be coated with an approved zinc chromate primer (yellow variety) applied after proper surface preparation. Anodized surface should be protected with a thick layer of clear lacquer based on methacrylate or cellulose butyrate to protect it from wet cement during installation. At the time of handing over the aluminum work/_anodized metal shall be washed with a mild solution of non-alkali

detergent and water.

15. P V C DOORS AND WINDOWS, OTHER PROPRIETARY TYPE POWDER COATED METAL DOORS / WINDOW FRAMES

These should be manufactured and installed as per respective Indian Standards/Codes of Practices, suitably augmented by manufacturers' instructions and the direction of Employer/Architects specifically laid down.

16. ROLLING SHUTTERS, COLLAPSIBLE STEEL GATES

These shall be of approved manufacturer suitable for fixing in the position ordered, that is, outside, inside, on or below lintel or between jambs. Shutters up to 12 sq.mt. (130 sq.ft.) In area shall be manually operated or "push-up" type while bigger sizes shall be of reduction gear type mechanically operated by chain or handles.

These shall consist of 8 gauge sheet or as specified with 75mm (3") m.s. Laths of the best quality mild steel strip machine rolled and straightened with an effective bridge depth of 16mm (5/8") and shall have convex corrugation. These shall be interlocked together throughout their entire length with end locks. These shall be mounted on specially designed pipe shaft.

The springs shall be approved make piled type. These shall be manufactured from tested high tensile spring steel wire or strip of adequate strength to balance the shutters in position. The spring pipe shaft etc. Shall be supported on strong m.s. Or malleable cast iron brackets. Both the side guides and bottom rail shall be jointless and of single piece of presses steel. Top cover of shaft, spring etc. Shall with wicket-gate night latch shall be provided free of cost.

The shutter and cover etc. shall be painted with one coat of anti-corrosive paint and two coats of synthetic enamel paint of approved quality and shade.

16.1. Collapsible Steel Gate.

It shall consist of vertical double channel at 10cms centres. The sizes of channels T-section for top and bottom shall be approved by the Architects. The gate shall be provided with necessary bolts, nuts, lacing arrangements, stoppers and brass handles on both sides. The gate shall be painted with one coat of anticorrosive paint before erection and two coats of synthetic enamel paint of approved quality and shade.

17. ALUMINIUM COMPOSITE PANNEL CLADDING :

Aluminium composite panel shall be supplied from approved supplier. The A.C.P. shall be as per relative I.S. code. A.C.P. shall be of Flexibond or other approved make. Before A.C.P. fixing, necessary framing and scaffolding work as per requirement shall be done. The rate is inclusive of framing work A.C.P. fixing over framing shall be done as per drawing and as per directions of engineer - in-charge. The joints of A.C.P. shall be filled up with sealant like silicon or approved by consultant.

J WATERPROOFING

- ☐ Respective trade preambles wherever applicable shall apply to this section also. All waterproofing work shall be got executed from approved firms as per their specifications under the overall supervision of the main contractor. Rates quoted by the main contractor shall include for the waterproofing treatments by approved waterproofing agency with all overheads and profits.
- ☐ Main building contractor shall obtain a guarantee for a period of 10 years for all the water proofing treatments from approved waterproofing contractor and shall be jointly responsible for any defects noticed in the work during the above period. Rate quoted shall include for the same.

- All waterproofing work shall be guaranteed for ten years in approved proforma acceptable to the employer, on a stamp payer of required denomination. This guarantee will be given by approved waterproofing contractor directly to the employer counter signed by the main contractor and furnished to employer as soon as the work is virtually completed and before the final bill is settled.
- Although the waterproofing work is guaranteed by the approved waterproofing contractor for ten years, the main building contractor shall be responsible if at any time during the defects liability period, the surfaces treated for waterproofing show leaks, wet patches, dampness or the waterproofing gives way to the above influence either due to the inadequacy of the work carried out or used or for any other reason whatever relating to materials, workmanship etc. And shall be liable, without any extra cost and inconvenience to the employer or the occupants, to carry out the necessary remedial measures as and required during defects liability period.

1. CHEMICAL BASE WATERPROOFING TREATMENT

- The chemical waterproofing treatment to floors of toilet block and terrace shall begin with cleaning the surface with wire brush and water, so that the surface is absolutely free from dust and loose materials. The surface should be without any lump or extraneous material. The cracks, if any, in the floor should be chiseled and fill with polysulphate sealant. Two coats of acrylic polymer and betonic base chemical waterproofing treatment shall be applied. Each coat should be allowed to dry for atleast 6 hours before another coat is applied.
- The sunk depression should have some 20mm dia. Heavy pvc pipes embedded in the walls to drain away moisture, if any.
- Graded BBCC with 50mm minimum thickness in CM 1:4 should be hand placed and leveled with minimum slope of 50mm and finished with 50mm thickness average waterproofing cement plaster with wired key to receive final finish cover.
- The plaster surface is to be treated with two additional coats of chemical waterproofing treatment after plaster has been properly cured.
- The treatment shall be carried out upto the height of dado/vata of 30cm. This treatment is carried out in toilet area only after the required plumbing and sanitary works are completed to the satisfaction of the architect/bank.
- The chemical waterproofing treatment shall cover maximum of 25 SFT areas per liter of mixed and ready to apply chemical.

2. MODE OF MEASUREMENT

- The treatment carried out in the toilet area/terrace area shall be measured in SQMT.
- The area of treatment to the walls shall be measured separately by calculating the parameter of the unfinished walls of the toilet/terrace and multiplying the same to the height of the waterproof treatment above the finished level of the treatment.

K PAINTING WORKS

General - All paints, distemper, lime wash shall conform to material standards as per relevant Indian Standards, along with surface preparation and Application Technique and methods, wherever such Code of Practice exists.

1. WHITE WASHING, COLOUR WASHING & DISTEMPERING

1.1. White Washing

- **Materials**

White wash shall be prepared from 5 parts of stone lime and 1 part of lime. The lime shall be dissolved in a tub with sufficient quantity of water (about 4/5 litres/kg of lime) and the whole thoroughly mixed and stirred until it attains the consistency of thin cream. The wash shall be taken out in small quantities and strained through a clean coarse cloth. Clean gum dissolved hot water shall then be added in suitable proportion of 2 kg of gum arabic per cum of lime to prevent the white wash coming off easily when rubbed Indigo as necessary shall be mixed as per standard practice.

☐ **Scaffolding**

This shall be double or single according to requirements and as directed ladders are used, pieces of old gunny bags or cloth rags shall be tied on their tops to avoid damage or scratches to the plastered surfaces, etc., Proper stage scaffolding shall be erected when white washing the ceiling.

☐ **Preparation of Surfaces**

The surface shall be prepared by removing all mortar droppings and foreign matter and thoroughly cleaned with hair or fiber brush or other means as may be ordered by the Employer/Architects to produce an approved clean and even surface. All loose pieces and scales shall be scrapped off and holes, cracks etc. Stopped with mortar to match with the surrounding finish. The mortar should be cured sufficiently. In case where the surface have been previously white washed or color washed, the old white or color wash shall be entirely removed and surface broomed down before the new white wash is applied. In case the old white wash cannot be removed by brooming, the surfaces shall be cleaned by scrapping.

☐ **Application of White Wash**

On the surface so prepared the white wash shall be laid on with a brush. The first stroke of the brush shall be from top downwards, another from bottom upwards over the first stroke, and similarly one stroke from the right and another from the left over the first brush before it dries. This will form one coat, each coat must be allowed to dry and shall be subject to inspection and approval before the next coat is applied when dry, the surface shall show no signs of cracking. It shall present a smooth and uniform finish free from brush marks and it should not come off easily when rubbed with a finger. Minimum 3 coats of white wash shall be applied.

No portions in the surface shall be left out initially to be patched up later on.

For new work, the white washed surface shall present a smooth and uniform finish.

For old work, patches and repairs shall be white washed first. Thereafter, the whole surface shall be white washed with the required number of coats.

Doors windows floors and other articles of furniture etc. Shall be protected from being splashed upon. Splashing and droppings, if any shall be removed and the surfaces cleaned to the satisfaction of Engineer in Charge / Architects.

☐ **Rates to Include**

Apart from other factors mentioned elsewhere in this contract, the rates for white wash shall include for the following:

- All labor, materials equipment required, for white washing at all heights depths and locations.
- Scaffolding including erection and removal
- Providing and preparing the white wash.
- Preparing the surface for white wash including the scaffolding.
- Applying the white wash in three coats minimum. If a proper even surface is not obtained to the

satisfaction of the Employer/Architects in 3 coats Contractor shall carry out additional coats of white wash to approval at Contractor's expense.

☐ **F) Mode of Measurement**

The measurement shall be in square meter. The mode of measurement shall be as applicable to that for plaster.

1.2. Color Wash

Materials: This shall be prepared by adding approved coloring matter the white wash (prepared as for white washing) according to tint required. In all other respects the same conditions and specifications as applicable to white wash shall be applicable to color wash.

1.3. Distempering

Providing Dry Distemper

- ☐ Material: The powder dry, distemper shall be of approved make and shade.
- ☐ Scaffolding. This shall be double or single as required and directed.
- ☐ Preparing the surface: The surface which is to be distempered shall be cleaned and all cracks holes and surface defects shall be filled/rectified with gypsum and allowed to set hard. All irregularities shall be sand papered smooth and wiped clean. The surface so prepared must be completely dry and free from dust before distempering is commenced. In the case of walls newly plastered special care shall be taken to see that it is completely dry before any treatment is attempted.

For the old surface which had earlier been distempered, the surface shall be cleaned of grease, dust, etc. The flakings of previous coating, if any, shall be taken off. All cracks holes and surface defects shall be repaired with gypsum and allowed to set hard and then sand papered and wiped clean. But in case the surface are colored or white washed the wash must be removed thoroughly first.

☐ **Priming Coat**

The priming coat shall be applied over the complete dry surface in the manner recommended by the makers in the case of patent distemper. When no priming coat is specified by the manufacturer, a finely powdered chalk mixed with a solution of glue shall be applied to prepare a good hard background, the coating when dry being sand papered as close and smooth as possible.

☐ **E) Application of Distemper**

The instruction of the makers shall be followed regarding the preparation of the surface and application of priming and finishing coats. Distemper shall not be mixed in a larger quantity than is actually required for a days' work. Hot water should be used to prepare the mixture. Distemper shall be applied in dry weather with broad stiff brush in long parallel strokes. The treated surface shall be allowed to dry and harden. Second or succeeding coats shall not be applied until the preceding coat has been passed by the Employer/Architects. Two more coats of distemper shall be given in exactly the same manner as the first one but only after the earlier coat laid has thoroughly dried.

☐ **Rates to Include**

The rates shall include all labors, materials, equipment and tools for carrying out the following operations.

- Providing the primer and distemper and mixing the distemper at all heights, depths etc.
- Scaffolding
- Preparing the surface to receive the priming and finishing coats.

- Applying the priming coat.
- Applying the distemper in 3 coats minimum, if a proper even surface is not obtained to the satisfaction of the Employer/Architects in 3 coats. Contractor shall carry out additional coats of distemper to approval at Contractor's expense.
- **Mode of Measurement**

Similar to that for white washing.

1.4. Oil Bound Distempers

The specifications and conditions for this shall; be the same as that applicable for dry distemper above except, that oil bound distemper of approved make, shade and colour shall be used after applying priming coat of petrifying liquid or primer as may be recommended by the manufacturers of distemper or as directed.

2. PLASTIC EMULSION PAINT

2.1. Materials

The emulsion paint and primers in general shall be of approved quality colour and shade as manufactured by reputed and approved manufacturers.

2.2. Scaffolding

This shall be double or single as required and directed. If ladders are used, piece of gunny bags or cloth bags shall be tied on their tops to avoid damage of scratches to the plastered surfaces etc. Proper stage scaffolding shall be erected when painting the ceiling.

2.3. Preparation of the Surface

☐ New Surface

The surface to be painted shall be cleaned and all cracks, holes and surface defects shall be repaired with plaster of Paris for spot fillings and with filler prepared with whitening, water and a little quantity of paint for filling and leveling the wider areas.

☐ Old Surfaces

- The surfaces, which have been previously painted with emulsion paint, shall be lightly rubbed down and washed with clean water.
- The surfaces, which had been painted with oil bound distemper or oil paint, shall be cleaned, washed and sand papered.
- The surface, finished with lime/color wash, powder distemper shall be completely scrapped off to the bare surface.
- In case, after scrapping any cracks, holes or other surface defects are noted the same shall be repaired before applying priming coat with plaster of Paris for spot filling, and with filler prepared with whitening, water and a little quantity of paint for filling and leveling the wider areas.

2.4. Priming Coat

The priming coat of the approved shade shall be applied over the completely dry surface in the manner as recommended by the paint manufacturer. The emulsion paint, in the priming coat may be thinned down with 20% or as recommended by the paint manufacturers. Turpentine or any other solvent shall not be used for thinning the paint.

2.5. Application of Emulsion Paint

The recommendation of approved paint manufacturer, whose product is used, shall be followed regarding the preparation of the surface and the application of the priming and finishing coats. The Contractor shall arrange for technical assistance and supervision from the paint manufacturer, during the execution of painting work. After the priming coat has been applied and perfectly dried, all holes, scratches if any shall be repaired as mentioned in "preparation of surface" and then the second coat of approved shade and manufacture shall be evenly applied and allowed to dry. The third coat shall be carefully applied to achieve smooth and even surface after the previous coat has dried up. Minimum 3 coats of paint shall be applied inclusive of primer coat. If a proper and even surface is not obtained to the satisfaction of the Employer/Architects in 3 coats Contractor shall carry out additional coats of painting to approval, at Contractor's expenses. Care shall be taken that dust or other foreign materials do not settle or disfigure the various coats.

2.6. Rate to Include

Apart from other factors mentioned elsewhere in this Contract the rates for the item of plastic emulsion Paint shall include for the following:

- All labors, materials and equipment necessary to carry out the work at all heights and depths.
- Supplying the approved emulsion paint for priming and finishing coats.
- Preparing the surface for receiving the primer and finishing coats.
- Scaffolding including its erection, and dismantling.
- Application of one primer coat and minimum two coats of finishing. If a proper and even surface is not obtained to the satisfaction of Employer /Architects in 3 coats the Contractor shall carry out addition coats of painting to approval at Contractor's expense.
- Protection to painted surface till dried and handed over.
- Expense, if any, for supervision and technical assistance supplied by the approved paint Manufacturers.

2.7. Mode of Measurement

The measurement shall be in sq.mt. The mode of measurement shall be as applicable to that for white washing.

3. OIL PAINTING, FRENCH POLISHING, WAX POLISHING

3.1. Painting

A Material

Ready mixed oil paints and primers, in general, shall be of approved quality, color and of approved manufacturer. These materials shall be in sealed tins and shall be opened in the presence of the Employer/Architects at site.

B Preparation of Surface

☐ **Iron and Steel Works**

Surface to be painted shall be thoroughly cleaned, sand papered and/or rubbed with emery cloth, if necessary, to remove, mortar or any other foreign materials. In case of rusted surface, it shall be first cleaned with wire brushes till the corroded rust is removed. A rust removing chemical may be used for the purpose, if required and advised. The prepared surface shall be shiny and free from brush marks, patches, blisters and other irregularities. The surface thus finished shall be got approved for painting.

☐ **Wood Work**

All surfaces to be painted shall be thoroughly cleaned sand papered and removed of all foreign materials. In case of surfaces having knot and nails holes, this shall be filled with knotting and stopping materials. Knotting materials shall consist of pure shellac dissolved in methylated spirit. Stopping materials shall consist of putty. The surface thus treated shall be allowed to dry and then sand papered smooth.

C Application

After preparing the surface, a primer coat shall be applied. The primer coat shall be ready mixed of approved make filled in with putty and paint of approved shade and manufacture shall be evenly applied and allowed to dry. The third coat shall be carefully applied to achieve smooth and even surface after the previous coat has dried up. Minimum 3 coats of paint shall be applied inclusive of a primer coat. If a proper and even surface is not obtained to the satisfaction of the Employer/Architects in 3 coats. Contractor shall carry out additional coats of painting to approval at Contractor's expenses. Care shall be taken that dust or other foreign materials do not settle or otherwise disfigure the various coats.

D Rates to Include Apart from other factors mentioned elsewhere in this contract, the rate for the item of painting shall include for the following:

- ☐ All labors, materials and equipment necessary to carry out the work. ☐

Supplying the approved paint for painting the finishing coats.

- ☐ Preparing the surface including knotting and stopping for receiving the painting and finishing coats. ☐

Scaffolding, including its erection and dismantling.

- ☐ Application of one primer coat and two coats of finishing minimum. If a proper and even surface is not obtained to the satisfaction of the Employer/Architects in 3 coats, contractor shall carry out additional coats of painting to approval at Contractor's expense.

- ☐ Protection to painted surface till dried and handed over.

E Mode of Measurement Normally painting to woodwork and steel shall be included in the concerned items of work and shall be measured separately, as per I.S. 1200 (part XV) if not included in that item.

3.2. French polishing

French polish to be used shall comply with I.S. 348 in requirements of quality and method of test.

Before French polish is applied, the surface of wood work shall be prepared in the same manner as for painting. The wood to be polished should be first painted with a filler composed of 1 part of whiting mixed with 0.53 part of methylated spirit. After drying, it should be finely sand papered.

On the wood work thus treated a thin coat of French polish shall be applied and allowed to dry. After drying, the surface shall be lightly rubbed with a fine sand paper prior to the second and third coats. The surface shall show an even polished surface and be approved by the Employer/Architects.

Rates to Include

Similar to that of painting.

Mode of Measurement

Similar to that of painting

3.3. Wax Polishing

- The polish shall be of approved manufacture (e.g. Mansion Brand) or shall be prepared as under:
 - A mixture of Bee's wax dissolved in boiled oil and turpentine in proportion of 2:1 by weight shall be used. The wax is melted in linseed oil and added to the turpentine, mixed well and allowed to cool.
- The surface of wood work shall be prepared as for oil painting before waxing. The wood work shall be smeared with the mixture and allowed to remain overnight so that the mixture may soak into the pores of the wood. In the morning the superfluous wax flannel to a fine polishes. Final rubbing is done with sand paper which is slightly moistened with linseed oil. Gloss of the polish depends on the quality, intensity and uniformity of the rubbing.

Rates to Include

Similar to that of painting

Mode of Measurement

Similar to that of

painting

4. POWDERCOATING

Material

Powder and pre-coating treatment shall be of approved quality, color and or approved manufacturer. □

Preparation of Surface to be painted shall be thoroughly cleaned, rubbed with emery cloth to remove any rust or foreign materials. Three tank dip-in procedures as specified by manufacturer for De-greasing, De-rusting and phosphate shall be done.

- Application After cleaning and wiping the surface, passivation is to be applied. The surface shall be preheated and powder shall be applied by electrostatic spray gun in recycling booth. The powder shall be of specified make. The powder coating is to be baked for 15 minutes in Oven at temperature of 180° to 200° C. The application and preparation of surface shall be such that a smooth and uniform finish is achieved.
- Rates to Include Apart from other factors mentioned elsewhere in this contract, the rate for the item of powder coating shall include for the following:
 - All labors, materials and equipment necessary to carry out the work of powder coating.
 - Providing and preparing the powder coating.
 - Preparing the surface for powder coating.

- Mode of Measurement

Measurements are to be in Sq. Mts. and as per I.S.

**L WATER SUPPLY & SANITARY WORKS****1. GI pipes and fittings****1.1. Materials**

The pipes shall be galvanized mild steel welded pipes and seamless, screwed and socketed tubes conforming to the requirement to I.S. 1239 for heavy grade. They shall be of the diameter (Nominal bore) specified in the description of the item. The sockets shall be designated by the representative nominal bores of the pipes for which they are intended. The pipes and sockets shall be cleanly finished well galvanized in and out and free from cracks, surface flaws, laminations and other defects. All screw threads shall be clean and well cut. the ends shall be cut clean and square with the axis of the tube. Unless otherwise specified the pipes below ground level or concealed in walls or floors and those supported on walls shall be of "C" class only.

The weights of GI pipes for various classes and diameter are reproduced below:

Weights in Kg per meter of common GI pipe of various diameters (plain ends).

Dia.	(Light) "A" Class	(Medium) "B" Class	(Heavy) "C" Class
15	0.952	1.22	1.45
20	1.41	1.58	1.90
25	2.01	2.44	2.97
32	2.58	3.14	3.84
40	3.25	3.61	4.43
50	4.11	5.10	6.17
65	5.80	6.51	7.90

1.2. Pipe Fittings

The fittings shall be of malleable cast iron or mild steel tubes complying with all the appropriate requirements given in para 1:1 or as specified. The fittings shall be designated by the respective nominal bores of the pipes for which they are intended.

1.3. Cutting, Laying and Jointing

The pipes and fitting shall be inspected at site before use to ascertain that they conform to the specification given in para 1:1 above. The defective pipes shall be rejected. Where the pipes have to be cut or rethreaded, the ends shall be carefully filled out so that no obstruction to bore is offered. The end of the pipes shall then be threaded with pipe dies and taps carefully in such a manner as will not result in slackness of joints when two pieces are screwed together. the taps and dies shall be used only for straightening screw threads which have become bend or damaged and shall not be used for turning of the threads so as to make them slack, as the later procedure may not result in a water tight joint. The screw threads of pipes and fittings shall be protected from damage until they are fitted.

The pipes shall be cleaned and cleared of all foreign matter before being laid. In jointing the pipes, the inside of the socked and screwed end of the pipes shall be oiled and rubbed over with white lead and a few turns of Teflon tape wrapped round the screwed end of the pipe. The end shall then be screwed in the socket, tee etc. with the pipe wrench. Care should be taken that all pipes and fittings are properly jointed so as to make the joints completely water tight and pipes are kept at all times free from dust and dirt during the fixing. Burr from the joint shall be removed after screwing. After laying, the open ends of

the pipes shall be temporarily plugged to prevent access of water, soil or any other foreign matter.

Any threads exposed after jointing shall be painted or in the case of underground piping thickly coated with approved anti-corrosive paint to prevent corrosion.

1.4. Internal Work

For internal work the galvanized iron pipes and fittings shall run on the surface of the walls or ceiling (not in chase) unless otherwise specified. The fixing shall be done by means of standard pattern holder-bat clamps, keeping the pipes about 1.5cm clear of the wall. When it is found necessary to conceal the pipes chasing may be adopted or pipes fixed in the ducts or recesses etc. provided there is sufficient space to work on the pipes with the usual tools. The pipes shall not ordinarily be buried in walls or solid floors. Where unavoidable, pipes shall not ordinarily be buried for short distances provided adequate protection is given against damage and where tube sleeve shall be fixed at a place a pipe is passing through a wall or floor for reception of the pipe and to allow freedom for expansion and contraction and other movements. In case the pipe is embedded in walls or floors it should be painted with anti-corrosive bitumastic paint of approved quality and the pipe shall be wrapped in burlap or heisian cloth impregnated with bitumen. The wrapping shall be made to fit tightly over the pipe and where wrapping with a new piece it shall overlap the old one and the joint shall be tied with M.S. wire or nylon thread. Where pipes are encased within chases made in the wall they shall be fixed to the wall with M.S. clamps so as to prevent movement before filling in and making good the chase. The pipe should not come in contact with lime mortar or lime concrete as the pipe is corroded by lime. Under the floors the pipes shall be laid in a layer of sand filling done under concrete floors.

Insulation for Hot Water Pipes

Pipes carrying hot water from storage heater or from central heating system shall be insulated for preventing loss of heat. The materials used for insulation shall be hair felt, asbestos fibre, mineral wool, glass wool or glass wool felt of sufficient thickness as directed which shall be wrapped around the pipe tightly and tied in position by wire loops at certain intervals.

Surface pipes shall be covered by hesian cloth wrapping as detailed above for cold water pipes.

All pipes and fittings shall be fixed truly vertical and horizontal unless unavoidable. the pipes shall be fixed to walls with standard pattern holder bat clamps of required shape and size so as to fit tightly on the pipes when tightened with screwed bolts. the bats shall be of teakwood painted with coal tar.

These clamps shall be embedded in brick work in cement mortar 1:4(1 cement:4 coarse sand) and shall be spaced at regular intervals in straight lengths.

The clamps shall be fixed at shorter length near the fittings or as directed by the Employer/Architects.

For G.I. pipes 15mm to 25mm diameter the holes in the walls and floors shall be made by drilling with chisel or jumper and not by dismantling the brick work or concrete. However, for bigger dimension pipes the holes shall be carefully made of the smallest size as directed by the Employer/Architects. After fixing the pipes the holes shall be made good with cement mortar 1:4 (1 cement : 4 coarse sand) and properly finished to match the adjacent surface.

1.5. External Work

The galvanized iron pipes and fittings shall be laid in trenches excavated to true lines and levels. The gradient should be set out by means boning rods and any excess excavation refilled at contractor's expense as directed. The widths and depths of the trenches for different diameters of the pipes shall be given as in the table below and shall be deep enough to have a clear cover of at least 400 mm above the top of pipes.

Diameter of Pipe	Width of Trench	Depth of Trench
15mm to	50mm	30cm 60cm
65mm to	100 mm	40cm 75cm

At joints the trench width shall be widened where necessary. The work of excavation and refilling be done true to line and gradient with sand and soft materials (murrum earth) at the bed and on sites water, well rammed and consolidated.

The pipes shall be painted with two coats of anti corrosive bitumastic paint of approved quality. The pipes shall be surrounded with sand, earth or murrum before the trenches are back filled with excavated earth.

When excavation is done in rock, the bottom shall be cut deep enough to permit the pipes to be laid on a cushion of sand minimum 7.5cm deep. In case of bigger diameter pipes where the pressure is very high thrust blocks of cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate of 20mm nominal size shall be constructed on all bends to transmit the hydraulic thrust without impairing the ground and spreading it over a sufficient area, as directed by the engineer.

1.6. Testing the Joints

After laying and jointing, the pipes and fittings shall be filled up with water and inspected under working conditions of pressure and flow. Any joint found leaking shall be redone and all leaking pipes removed and replaced without extra cost. Leakage rate should not be more than that specified in I.S. 3114.

The pipes and fittings after they are laid shall be tested to a hydraulic pressure of 6kg/cm (60 meter or double the design working pressure whichever is more. The pipes shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock or water hammer. The draw off takes and stop cocks shall the be closed and specified hydraulic pressure shall be applied gradually. Pressure gauge must be accurate and preferably should have bee recalibrated before the test. the test pump having been stopped the test pressure should maintain without any loss for at least half an hour. The pipes and fittings shall be tested in sections as the work of laying proceeds, keeping the joints exposed for inspection during the testing.

1.7. Measurement

The lengths shall be measured in running meter correct to a centimeter for the finished work, which shall include G.I. pipe and G.I. fittings such as bends, tees, elbows, reducers, crosses, plugs, sockets, nipples and nuts unless otherwise specified, but exclude brass or gun metal taps (cocks), valves, lead connection pipes and shower rose. The measurements shall be taken separately for internal and external work. For this the internal and external work shall have meaning as given in 1:4 and 1.5. the length shall be taken along the central line of the pipe fittings. All pipes and fittings shall be classified according to their diameters, method of jointing and fixing substance, quality and finish. The diameter shall be the nominal diameter of the internal bore. The pipe shall be including all cuttings and wastage in case of fittings of equal bore, the largest bore shall be measured. Digging and refilling of trenches is clubbed with main item. If digging and refilling is clubbed with the item, the maximum depth of trench shall be as specified.

Internal work

The rate for internal work shall include the cost of labour and material involved in all the operations described above except in para 1.5. the rate shall include the cost of cutting holes in walls and floors and

making good the same, insulation of pipes for hot water supply will be paid separately as extra.

External Work

The rate for external work shall include the cost of labour and materials involved in all the operations described above except in para 1.4. the rate shall include excavation of trenches, paintings of pipes and re-filling all round the pipes.

2. MAKING CONNECTION OF G.I. DISTRIBUTION BRANCH WITH G.I. MAIN

2.1. Materials

Pipes and Fittings Para 1.1 and 1.2 shall apply

2.2. Preliminary Work

A pit of suitable dimensions shall be dug at the point where the connection is to be made with the main and earth removal upto 15cm below the main. The flow of water in the water main shall also be disconnected by closing the slum or wheel valves on the mains.

2.3. Making Connection

For cutting and jointing para 1.3 shall apply. The G.I. main shall first be cut. Water, if any, collected in the pit shall be bailed out and ends of the G.I. pipe threaded. the connection of distribution pipe shall then be made by fixing malleable G.I. tee of the required size and fittings such as Jump Nut. G.I. socket, connecting piece etc.

2.4. Testing of Joints

Para 1.6 shall apply.

The portion of the pipe in the pit shall be painted with bitumastic paint and encased with sand 15 cm around. the pit shall be filled with earth in level with the original ground surface watered, rammed and the area dressed.

2.5. Measurements

The work of making connections should be counted in numbers if paid separately.

2.6. Rate

The rate shall include the cost of labor and materials involved in all the operations described above.

3. FIXING WATER METER AND STOP COCK IN G.I. PIPE LINE

3.1. Material

Pipe and fittings-Para 1.1 and 1.2 shall apply

3.2. Cutting G.I. Pipe Line

The G.I. line shall be cut to the required length at the position where the meter and stop cock are required to be fixed. the ends of the pipe shall then be threaded. For cutting and threading the pipe, para 1.3 shall apply.

3.3. Fixing Meter and Stop Cock

The meter and stop cock shall be fixed in position by means of connecting pipes, G.I. jam nut and socket etc. The stop cock shall be fixed near the inlet of the water meter. The paper disc inserted in the ripples of the meter shall be removed and the meter installed exactly horizontal on critical in the flow line in the direction shown by the arrow cast on the body of the meter. Care shall be taken at the factory seal of the meter is not disturbed. Wherever the meter shall be fixed to a newly fitted pipe line, the pipe line shall have to be completely washed before fitting the meter. For this purpose piece of pipe equal to the length

of the meter shall be fitted in the proposed position of the meter in the new pipe line. the water shall be allowed to flow completely to wash the pipe line and then the meter installed as described above by replacing the connecting piece.

3.4. Testing of Joints

Testing of joints shall be done as described in Para 1.6

3.5. Measurements

The work of fixing meters and stop cocks shall be counted in numbers according to the diameters.

3.6. Rate

The rate shall include the cost of labor and materials involved in all the operations described above excluding the cost of stop cock and water meter.

4. FITTINGS

4.1. General

The bars or gun metal fittings shall be heavy quality and of approved manufacture and pattern with screwed or flanged ends as specified. The fittings shall in all respects comply with Indian Standard Specifications No.I.S.778 and I.S. 781. the standard size of brass or gun metal fittings shall be designated by the nominal bore of the pipe outlet to which the fittings are attached. A sample of each kind of fittings shall be got approved from the Employer/Architects and all supplies made according to the approved samples.

All cast fittings shall be sound and free from laps, blow laps, blow holes and pitting. Both internal and shall not be permissible. The bodies, bonnets, spindles and other parts shall be truly machined so that when assembled the parts shall be axial, parallel and cylindrical with surfaces smoothly finished. The area of the water way of the fittings shall not be less than the area of the nominal bore.

The fittings shall be fully ... mined and cleared of all foreign matter before being fixed. The fittings shall be fitted in the line in a workman like manner. The joints between fittings and pipes shall be made leak-proof. The joints and fittings shall be leak proof when tested to a pressure of 6kg/sq.cm. or as specified as described in para 1.6 and the defective fittings and joints shall be replaced or redone without any extra cost.

4.2. Brass Bib Cock and Stop Cock

A bib cock (bib tap) is a draw off tap with a horizontal inlet and free outlet and a stop cock (stop tap) is a valve with a suitable mean of connections for insertion in a pipe line for controlling and stopping the flow. they shall be of specified size and shall be of screw down type. The closing device should work by means of a disc carrying a renewable non-metallic washer which shuts against water pressure on a seating at right angles to the axis of the threaded spindle which operates it. The handle shall be either crutch or butterfly type securely fixed to the spindle. valve shall be of the loose leather seated pattern. the cocks (taps) shall open in anti-clockwise direction.

The bib cock and stop cock shall be polished bright. The minimum finished weights of bib tap (cock) and stop tap (cock) as give in the I.S. specifications are reproduced below.

Size	Minimum finished weight	
	Bib Tap	Stop Tap
MM	Kg	Kg
8	0.25	0.25

10	0.30	0.35
15	0.40	0.40
20	0.75	0.75

When the bib cocks or stop cocks are required to be chromium plated, the chromium plating shall be of grade B type conforming to I.S. 1068. the chromium shall never be deposited on brass unless a heavy coating of nickel is interposed. In case there are required to be nickel plated, the plating shall be of the first quality with a good thick deposit of silvery whiteness capable of taking high polish which will not easily tarnish or scale.

In finish and appearance, the plated articles, when inspected shall be free from plating defect such as blisters, pits roughness and unplated areas and shall not be stained or discolored. Before a plate is plated, the washer plate shall be removed from the fittings. the gland packing shall be protected from the plating solution.

5. BALL VALVE

The ball valve shall be of high pressure or low pressure class and shall be of sizes as specified and directed.

The nominal size of a ball valve shall be that corresponding to the size of the pipe to which it is fixed. The ball valve shall be of gun metal as specified with standard polyurethane float. the flat shall be spherical in shape. The joining of the float shall be made by efficiently burnished, lapped and soldered seam or by brazing. Polyurethane floats shall be used as specified.

The ball valve shall generally conform to I.S. specification No.1.3. The weight of ball cock and the size of ball as per table given below:

Both low pressure and high pressure ball valves are designed for use on mains having pressures of 17.5 kg/cm and above.

Dia	Total Weight H.P.	Total Weight L.P
15	524 gms	481 gms
20	986 gms	867 gms
25	1549 gms	1411 gms
32	2120 gms	1873 gms
40	2646 gms	2303 gms
50	4454 gms	3959 gms

6. H.D.P.E. OR P.V.C. PIPES AND FITTINGS FOR WATER SUPPLY AND SANITATION

These should conform to respective Indian Standards relevant in the case wherever used and Employer/Architects shall stipulate clear instructions in the specification for the subject job alongwith the Bill of Quantities.

M SANITARY AND DRAINAGE WORKS 1.

1. STONEWARE PIPES

All pipes with spigot and socket ends shall conform to I.S. 651 and shall be of grade -A-as specified. These shall be sound, free from visible defects such as fire cracks or hair cracks. The glaze of the pipes shall be free from crazing. The pipes shall give a sharp clear note when struck with a light hammer. There shall be no broken blisters or chipping on the spigot or socket. The approximate thickness of 60cm long pipes shall be as given in the table below:

Internal Diameter MM	Thickness of the Socket MM	Barrel and Weight of Each Pipe Per M Kg
100	12	14
150	16	22
200	17	33
230	19	44
250	20	52
300	25	79

The length of pipes shall be about 60cm exclusive of the internal depth of the socket.

The pipes shall be handled with sufficient care to avoid damage to them.

1.1. Laying of Stoneware Pipes

All pipes shall be laid on a bed of 15cm cement concrete as specified, projecting on each side of the pipe to the width of the trench specified. The pipes with their crown level at 1.20m depth and less from ground shall be covered with 15cm thick concrete above the crown of the pipe and sloped off to meet the outer edges of the concrete to give a minimum thickness of 15cm all round the pipe. Pipes laid at a depth greater than 1.20m at crown shall be concreted at the sides' up to the level of the center of the pipe and sloped off from the edge to meet the pipe tangentially.

The pipes shall be carefully laid to the alignments, levels and gradients shown on the plans and sections. Great care shall be taken to prevent sand etc. from entering the pipes. The pipes between two manholes shall be laid with socket up the gradient. The body of the pipe shall for its entire length rest on an even bed of concrete and places shall be excavated in the concrete to receive the socket of the pipe.

Where pipes are not bedded on concrete but on the duly approved well consolidated fine materials the trench floor shall be left slightly high and carefully bottomed up as pipe laying proceeds, so that the pipe barrels rest on firm and undisturbed ground. If the excavation has been carried to low, the desired levels shall be made up with concrete 1:5:10 (1 cement: 5 fine sand: 10 graded stone aggregate 40mm nominal size) for which no extra payment shall be made.

If the floor of the trench consists of rock or very hard ground that cannot easily be excavated to a smooth surface the pipes shall be laid on a leveling course of concrete as desired.

1.2. Joining

Tarred gasket of hemp yarn soaked in thick cement slurry shall first be placed round the spigot of each pipe and the spigot shall then be slipped home well into the socket of the pipe previously laid. The pipe shall then be adjusted and fixed in the correct position and the gasket caulked tightly home so as to fill not more than ¼th of the total depth of the socket.

The remainder of the socket shall then be filled with stiff mixture of cement mortar in the proportion of 1:1 (1 cement: 1 fine sand). When the socket is filled, a fillet shall be formed round the joint with a trowel forming an angle of 45° with the barrel of the pipe. The joints shall be tested hydraulically as per

Para 1.3 and no concreting for encasement shall be done unless pipes are tested and at least 24 hours elapsed after the pipes are jointed. After a day's work any extraneous material shall be removed from the inside of the pipe. The newly made joints shall be cured.

1.3. Testing of Joints: Hydraulic Test

Stoneware pipe used for sewers shall be subjected to a test pressure of 1.5m or required head of water at the highest point of the section under test. The test shall be carried out by suitable plugging the low end of the drain and the ends of the connection if any and filling the system with water. A knuckle bend shall be temporarily joined in at the top end and a sufficient in a funnel which could be raised or lowered till the required head is obtained and fixed suitably to observation.

During the test the required head is maintained for 30 minutes by adding water from a measuring vessel at 10 minutes interval and the average quantity added shall not exceed 1 liter per hour per 100m length per 10mm dia. of pipe.

Where leakage will be visible the defective part of the work shall be removed and made good, at no extra cost.

1.4. Refilling of Trenches

6.6 under water supply shall apply.

In case where pipes are not bedded on concrete, special care shall be taken in refilling trenches to prevent the displacement and subsequent settlement at the surface resulting in uneven surfaces and dangers to foundations etc. The backfilling materials shall be packed by hand under and around the pipe and rammed with a shovel and light temper. This method of filling will be continued up to the top of pipe. The refilling shall rise evenly on both sides of the pipe up to 60cm above the top of pipe so as not to disturb the pipe. No tamping should be done within 15cm of the top of pipe. The reminder of the backfill shall not be done until 7 days have elapsed for brick sewers and 14 days of concrete sewers, unless local conditions or materials are suitable for the either placing of a load on the pipes. The tamping shall become progressively earlier as the depth of the backfill increases.

1.5. Measurements

The lengths of pipes shall be measured in running meters nearest to a centimeter as laid or fixed from inside of one manhole to the inside of the other manhole. The length shall be taken along the center line of the pipes over all fittings such bends, junctions, etc. which shall not be measured separately.

Excavation, shoring, timbering backfilling in trenches and cement concreting wherever required and is clubbed with the item. Excavation in hard rock will be paid separately on stack measurement basis after deducting voids.

1.6. Rates

The rate shall include the cost of materials and labors involved in all the operations described above.

2. S.W. GULLY TRAP

Gully traps shall conform to I.S. 651. These shall be sand free from visible defects such as fire cracks or hair cracks. The glaze of the trap shall be free from crazing. They shall given a sharp clear note when struck with light hammer. There shall be no broken blisters.

The size of the gully trap shall be as specified and all dimensions will be as per drawing.

Each gully trap shall have one C.I. grating of square size corresponding to the dimensions of inlet of gully trap. It will also have water tight C.I. cover with frame inside dimensions 300 X 300mm the cover weighing not less than 2.72 kg. The cover and frame shall be of sound and good casting and shall have truly square machined seating faces.

2.1. Excavation

The excavation for fully traps shall be done true to dimensions and levels indicated on plans as directed by the Employer/Architects.

2.2. Fixing

The gully trap shall be fixed on cement concrete foundation 600 X 600cm square and not less than 10cm thick. The mix for the concrete will be 1:5:10 (1 cement : 5 fine sand : 10 graded stone aggregate 10mm nominal size). The joining of gully outlet to the branch drain shall be done similar to jointing of S.W.

pipe as directed in 2.

2.3. Brick Masonry Chamber

After fixing and testing gully and branch drain, a brick masonry chamber 300 X 200mm (inside) in second class bricks in cement mortar 1:6 (1 cement : 6 fine sand) shall be built with a 10cm thick brick work round the gully trap from the top of the bed concrete upto ground level. The space between the chamber walls and the trap shall be filled in with cement concrete 1:5:10 (1 cement: 5 fine sand : 10 graded stones aggregate 400mm nominal size). The upper portion of the chamber i.e. above the top level of the trap shall be plastered inside with cement mortar 1:4 (1 cement : 4 coarse sand), finished with a floating coat of neat cement. The corners and bottom of the chambers shall be rounded off as to slope forwards the grating and form a hopper.

C.I. cover with frame 300 X 300mm (inside) shall then be fixed on the top of the brick masonry with cement concrete 1:2:4 (1 cement : 2 coarse and : 4 graded stone aggregate 20mm nominal size) and rendered smooth. The finished top of cover shall be left about 4cm above the adjoining ground level so as to exclude the surface water from entering the gully trap.

2.4. Measurements

The work shall be enumerated including excavation.

2.5. Rate

The rate shall include the cost of materials and labor involved in all the operations described above.

3. CEMENT CONCRETE PIPES

The pipes shall be with or without reinforcement as required and of the class as specified. These shall conform to I.S. 458. The reinforced cement concrete pipes shall be manufactured by centrifugal (or spun) process. All pipes shall be true to shape, straight, perfectly sound and free from cracks and flaws. The pipes shall be free from defects resulting from imperfect grading of the aggregate mixing or moulding. The pipes shall be R.C.C. light duty, NP2 type.

3.1. Trenches for Concrete Pipe

Para 1.1 shall apply. Where the pipe shall be bedded directly on soil, the bed shall be suitably rounded to fit the lower part of the pipe, the cost for this operation being included in the rate for laying the pipe itself.

3.2. Laying of Pipes

Loading, transporting and unloading of concrete pipes shall be done with care. Handling shall be such as to avoid impact. Gradual unloading by inclined plans or by chain block is recommended. All pipe sections and connections shall be inspected carefully before being laid. Broken or defective pipes or connections shall not be used. Pipes shall be lowered into the trenches carefully. Mechanical appliances may be used. Pipes shall be laid true to line and grade as specified. Laying pipe shall proceed upgrade of a slope.

If the pipes have spigot and socket joints, the socket end shall face upstream. In the case of pipe with

joints to be made with loose collars, the collars shall be slipped on before the next pipe is laid. Adequate and proper expansion joints shall be provided where directed.

In case where the natural foundation is inadequate the pipes shall be laid either in concrete cradle supported on proper rendition or on any other suitably designed structure as specified. If a concrete cradle bedding is used the depth of concrete below the bottom of the pipe shall be least $\frac{1}{4}$ th of the internal dia. and shall extend up the sides of the pipe at least to a distance of $\frac{1}{4}$ th of the outside diameter for pipes 300mm and over in dia. The pipe shall be laid in this concrete bedding before the concrete has set. Pipes laid in trenches in earth shall be bedded evenly and firmly and as far up the haunches of the pipe as to safely transmit the load expected from back-fill through the pipe to the bed. This shall be done either by excavating the bottom of the trench to fit the curve of the pipe or by compacting the earth under around the curve of the pipe to form an even bed. Necessary provision shall be made for joints wherever required.

When the pipe is laid in a trench in rock hard clay, shale or other hard material the space below the pipe shall be excavated and replaced with an equalizing bed of concrete, sand or compact earth. In no place shall pipe be laid directly on such hard material.

When the pipes are laid completely above the ground the foundations shall be made even and sufficiently compacted to support the pipe line without any material settlement. Alternatively the pipe line shall be supported on P.C.C. sandal blocks. Similar arrangement shall be made to retain the pipe line in the proper alignment, such as by shaping the top of the supports to fit the lower part of the pipe. The distance between the supports shall in no case exceed the length of the pipe. The pipe shall be supported as far as possible close to the joints. In no case shall the joint come in center of the span. Care shall be taken to see that superimposed load greater than the total load equivalent to the weight of the pipe when running full shall not be permitted.

3.3. Joining of Pipes

Joints are generally of rigid type.

- a. Spigot and socket joint (rigid) : The spigot of each pipe shall be slipped home well into the socket of the pipe previously laid and adjusted in the correct position. The opening of the joint shall be filled with stiff mixture of cement mortar in the proportion of 1:2 (1 cement: 2 fine sand) which shall be rammed with caulking tool.

After a day's work any extraneous material shall be removed from the inside of the pipes and the newly made joint shall be cured.

- b. Collar Joint (Rigid) : The two adjoining pipe be butted against each other and adjusted in correct position. The collar shall then be slipped over the joint, covering both the pipes equally. The annular space shall be filled with stiff mixture of cement mortar 1:2 (1 cement: 2 fine sand) which shall be rammed with caulking tool.

After a day's work any extraneous material shall be removed from the inside of the pipes and the newly made joint shall be cured.

3.4. Testing of Joints, Refilling of Trenches, Measurements and Rate.

Paras 1.3 to 1.6 for stoneware and concrete sewers shall apply.

4. MANHOLES, INSPECTION CHAMBERS, STORM WATER GULLIES ETC.

4.1. Inspection Chambers

Where depth of sewer is less than 1.5m rectangular chambers shall be used having size as specified. Usual sizes are 450 X 900 or 600 X 900. These shall be constructed in the sewer line at such places and

levels and dimensions as indicated on the drawing. Sizes specified shall be clear internal dimensions of the chamber.

4.2. Manhole

Where depth of sewer exceeds 1.5m circular conical manholes shall be provided. Various types and sizes of manholes are specified for different depths. This should be clearly mentioned in the Bill of Quantities. Typical drawing of various types of manholes shall be supplied to the Contractors. In the absence of such drawings the standard drawings of the BMC sewerage department or local body if available shall be followed.

Manholes and inspection chambers which are provided on roads or where heavy vehicular traffic is expected are provided with "heavy duty" C.I. airtight frame and cover. For those built on footpaths carriage drives and cycle tracks "medium duty" covers are provided. For locations within domestic premises or areas not subjected to wheel traffic loads they shall be provided with "light duty" covers.

4.3. Construction of Manholes and Inspection Chambers

- Excavation: This shall be done to dimensions and levels on the drawing.
- Bed Concrete: Base of the manhole shall be constructed in P.C.C. 1:3:6 or 1:2:4 of thickness as specified and shown on drawing or as directed.
- Brick Work: Brickwork shall be in C.M. 1:6 constructed with second class bricks. Brick masonry in arches and arching over the pipe shall be in C.M. 1:3 Walls shall be generally built in 230mm thickness for inspection chambers and manholes upto a depth of 2.1m and 350mm for depth over 2.1m. However the exact thickness shall be specified by the Employer/Architects.
- Plastering: Walls of manholes shall be plastered inside with 12mm thick cement plaster 1:4 and finished smooth. here ground water table is high external surface of manholes shall also be plastered in C.M. 1:4
- Vata: 75mm filler shall be made with C.M. 1:3 all round the external joint between the bed concrete and brick masonry wall of manhole.
- Benching: Channels and benching inside the manhole or Inspection Chamber shall be done in C.C. 1:2:4 and rendered smooth with cement. Depth of channel and benching shall be as per the table given below :

Size of Drain in mm.	Top of Channel at Center in cm above Concrete.	Depth of Benching at Side Walls in Bed cm above Bed Concrete
100	15	29
150	20	30
200	25	35
250	30	40
300	35	45

- P.C.C. Cap: P.C.C. M 150 cap of 150mm thickness shall be provided on top of manholes for fixing the manholes frame.
- Footrest: Footrests shall be C.I. rings weighing 5.41 kg made up of 20mm dia. M.S. square or round bars as specified. These shall be embedded in 1:3:6 concrete and properly secured. Footrests shall be placed 300mm apart vertically and 375mm horizontally in staggered fashion. First footrests shall be 450mm below top. Footrests shall be painted with coal tar or bituminous paint and the portion embedded shall be

painted with thick cement slurry before fixing.

- i. Manhole frames and Covers: Approximate weights for various dimensions of frames and covers of various duties shall be as specified in the respective items.
- j. Covers shall have raised Chequered design on the top surface to provide adequate non slip grip. The cover shall be capable of easy opening and closing and it shall be fitted in the frame in a workmanlike manner. Covers shall be of specified weight, gas and water-tight. Size of the cover shall be the clear internal dimensions of frame. 2.5% variation in weight shall be permissible. Covers and frames shall be coated with black anticorrosive paint of bituminous composition. The coating shall be smooth and tenacious. The covers shall be so fixed as to be flushed with ground surface. After completion the manhole covers shall be sealed by means of grease.
- k. Testing: Manhole after it is raised above highest expected subsoil water level in monsoon shall be tested for water tightness. The mouths of all pipes entering the manhole shall be suitably plugged with brick masonry or wooden or any other type of plug. Manhole under test shall then be filled with water upto general subsoil water level and the level observed for one hour. If the level does not drop of more than 50mm in one hour, it shall be deemed as water tight. During testing the pit around shall be kept free of water and Contractor shall observe the places where leakage takes place and take steps to correct the same.

4.4. Measurements

Manholes, Inspection Chambers, Gullies etc. shall be enumerated under relevant items in the Schedule of Quantities. Depth shall be measured from top of C.I. cover to the invert level of channel. Depth shall be measured to correct centimeter. The extra depth shall be measured as an extra over the depth specified under enumerated item and paid per running meter under separate item following the main item.

4.5. Rate

The rate shall include the cost of materials and labor involved in all operations from 4.3 (b) to (i) upto specified depth in the item. Payment for extra depths shall be paid separately under relevant item. Excavation and refilling is clubbed with the item of manhole. If the duty of the cover in the item is changed during execution by the Employer/ Architects amount due to difference in weight of the cover shall be paid extra or deducted as the case may be.

4.6. Drop Connection

In cases where branch pipe sewer enters the manhole of main pipe sewer at level higher than the main sewer by more than 600mm a drop connection should be provided. A typical drawing for drop connection shall be supplied to the contractor.

For 150 and 250mm main line, the difference in level between the water line (peak flow-level) and the invert level of branch line is less than 60cm, a drop connection may be provided within the manhole by giving ramp. If the difference in level is more than 60cm, the drop should be provided externally.

- a Excavation: The excavation shall be done for the drop connection at the place where the branch line meets the manhole. The excavation shall be carried upto the bed concrete of the manhole and to the full width of the branch line.
- b Laying: At the end of branch sewer line stoneware shall be fixed to the line which shall be extended through the wall of the manhole by a horizontal piece of S.W. pipe to form an inspection on cleaning eye. The open end shall be provided with chain and lid. The stoneware drop pipe shall be connected to the tee at the top and to the S.W. bend at the bottom. The end shall be extended through the wall of the manhole by a piece of C.I. pipe which shall discharge into the channel. Necessary channel shall be made with cement concrete 1:2:4 (a cement: 2 coarse sand 4 graded stone aggregate 20mm

nominal size). Finished smooth to connect the main channel. The joint between S.W. tee and S.W. branch line shall be made with cement mortar 1:1 (1 cement: 1 fine sand) as per Para 1.2 for S.W. pipes. The exposed portion of the drop connection shall be encased all round with a single brickwork in C.M. 1:4 and pointed. The holes made in the walls of the manholes shall be made good with brick work in cement mortar 1:6 (1 cement : 6 fine sand) and plastered with cement mortar 1:4 (1 cement : 4 coarse sand) on the inside of the manhole wall. The excavated earth shall be backfilled in the trench in level with the original ground level.

4.7 Measurements

Drop connections shall be enumerated. The depth beyond 60cm shall be measured in running meters correct to a centimeter under relevant items.

4.8 Rates

The rates shall include the cost of labor and materials involved in all the operations described above but excluding the cost of excavation and refilling.

5. SOIL, WASTE, RAIN-WATER VENT AND ANTI-SIPHONAGE PIPES AND FITTING

- All soil, waste and anti-siphon age pipes and fittings used within sunken floor areas or within plumbing shafts vertical run, shall be sand-cast iron socket and spigot type pipes (HCI) conforming to I.S. 1729 or its subsequent revision. In exposed vertical and horizontal locations, PVC and HDPE and coated G.I. pipes can be also used in addition to HCI pipes. These should conform to relevant I.S. Standard and instruction of Employer/Architects in Bill of Quantities etc. All cast iron pipes and fittings shall be of the best approved Indian make of soil variety and free from flaws, air bubbles, cracks, and sand holes and other defects truly cylindrical and uniform in thickness. They shall not be brittle but shall allow for heavy cutting, chipping and drilling and shall not be less than the diameter, mentioned in the Schedule of Quantities and shall be of the largest length available and shall be fixed against the wall on special "U" clamps - 25mm wide. 3mm thick and hot dip galvanized by means of round headed flat nail on brick wall.
- Joining shall be carried out unless otherwise specified with molten lead. The spigot of the pipe must be forced well home into its socket and must be entered. So that the joint may be of even thickness all round. At least, one complete lap of clean white hemp spun shall be drawn into the socket without being forced through the joint. As many laps as may be needed to leave the space of not less than 25mm for the lead shall then be poured into the joint and caulked tight. The joint shall then be run with molten lead in sufficient quantity so that after being caulked solid, the lead may project 1/8" beyond the face of the socket against the outside of the spigot but must be flushed with the outside edge of the socket.
- The joints if specified in the respective items shall be done in cement mortar in place of lead. In case of cement joint, the joints shall be done as specified in 5.2 but after the hemp soaked in thick cement slurry is forced into the socket for one complete lap, a stiff mixture of cement mortar in proportion 1:1 (1 part of cement to 1 part of clean fine sand) is filled in the remainder of the socket. when the socket is filled a fillet shall be formed round the joint with a trowel and finished smooth and well cured.
- Clean outs at the head of C.I./S.S. horizontal pipes running under the floor shall be of Cast Brass screwed in type. Floor and wall clean outs shall be of cast brass screwed type. The connecting pipes shall be G.I. threaded coupling to suit the clean out with lead caulked joint.
- Inspection Chambers, gully traps etc. within the building shall be approved make cast iron chambers with bolts, nuts to close the cover, all to be fabricated as per actual requirement.
- Supports, pedestals and base for inspection chambers, gully traps and pipes shall be in 1:2:4 cement concrete mix.

- Pipe sleeves and inserts, etc. through R.C.C. wall either external or internal shall be of C.I. or M.S. provided with water bar flange.
- During installation open ends of pipes shall be plugged with wood cut into required shape of gunny bags and to be maintained free from dirt.
- G.I. waste pipes and fitting shall be "C" class I.T.C. or equivalent with G.I. unions, tail piece reducers and connections to be provided between joints to either lead or C.I. pipes.
- The sizes of branch waste pipes for different fittings shall be as follows:

Lavatory Basin	32mm dia.
Urinal	40mm dia.
Sink	40mm dia.
Nahani Trap	75mm dia.
- W.C. pan Connectors shall be to suit the requirements as per drawing with 40 dia. vent born for connection to the anti-siphon age pipe with pen connector of C.I. of lead.
- Connections to the sewage or storm water collection sumps to be perfectly water tight as specified in the drawing.
- Rain water flashing shall be with C.I. dome shape grating and extension piece as specified in the item.
- All rainwater pipes and fittings shall be soil type variety conforming to I.S. 1729 or equivalent. This shall apply to pipe outside buildings or within the building or separate shafts.
- The floor traps for toilet blocks shall be cast iron with C.I. brass grating, bolted down design. The traps shall be provided with minimum water seals of 1½ to 2".
- Where toilet slabs are sunk, the floor trap shall be of 100 X 75 heavy type C.I. "P" trap with C.P. brass grating, bolted down design.
- Bathroom C.P. grating shall be of bolted down design out of heavy cast brass with the chromium plating of the best approved standard.
- Cast iron grating shall be flat with perfect edge of the best quality procurable of the specified width and thickness and in the available lengths.
- Spigotted and socketed 75mm, 100mm and 150mm C.I. pipes shall be of heavy pattern for the portion below the floor and embedded and laid over 150mm cement concrete 1:2:4 with width of the concrete being:

75mm dia	320mm wide
100mm dia.	400mm wide
150mm dia.	450mm wide
200mm dia.	600mm wide

The pipes shall be laid to a slop of minimum 1 in 100 and preferably in 1 in 50. and connected to the drain. On no account should lime concrete be in direct contact.

□ **Measurements**

All pipes shall be measured along linear lengths, including length over the fitting. The lengths over

fitting shall be paid as extra over under relevant item. Alternatively straight pipes shall be laid along linear lengths along center line excluding length over fitting and fitting shall be enumerated and paid per number. Whatever method of measurement is followed the item in the schedule shall be worded accordingly. Trap clean outs shall be enumerated.

6. LEAD PIPES

- ☐ Lead pipes shall be of solid drawn lead. the size mentioned being their internal diameter and shall conform to the requirements of Indian Standard Specification.
- ☐ The weight for the various bores shall be as follows:

100 dia.	-11.4 kg per m	
75 dia.	-8.5 kg per m	for soil waste,
65 dia.	-7.2 kg per m	anti-siphonage
50 dia.	-6 kg per m	and vent
40 dia.	-4.47 kg per m	
40 dia.	-6 kg per m	for
32 dia.	-4.47 kg per m	flushing &
15 dia.	-1.5 kg per m	washing pipes
25 dia.	-6.2 kg per m	supply and
20 dia.	-4.47 kg per m	distribution
15 dia	-3 kg per m	pipes

- ☐ The joints between the lead pipes and other fitting shall be made with brass thimbles and tail pipes and jointing shall be with wiped solder joints.

7. CUTTING, PATCHING, REPAIRING AND MAKING GOOD

- ☐ Cutting, patching and repairing required for the proper installation and completion of the work, specified in each division, including chasing plastering masonry work, concrete work, etc. and making good shall be carried out by the contractor wherever required. Holes which are cut over size shall be refilled, so that a tight fit is obtained around the pipe or other passing through.
- ☐ Any damages to water proofed location should not be patched up. without rectification by the water proofing agency (specialist Contractor) to ensure his guarantee.

8. EQUIPMENT PROTECTION

- ☐ Keep all pipe and conduit openings closed by means of plugs or caps to prevent the entrance of foreign matter. Protect all piping conduit, fixtures, equipment or apparatus. Any such items damaged prior to final completion of work shall be restored to its original conditions or replaced at no expense to the Owner.

8.1. Accessibility

The installation of valves, thermometers, clean out fitting and other indicating equipment or specialties requiring frequent reading, adjustment, inspection, repairs, removal or replacement, shall be conveniently and accessibly located with reference to the finished buildings. Thermometers and gauges

shall be installed so as to be easily read from the floor. Minimum distance of 600mm shall be available from any wall for clean out.

8.2. Inserts & Sleeves

General: Layout work in advance of placing of concrete slabs or construction of walls. Furnish and set inserts and sleeves necessary to complete the work. Cost of cutting or patching made necessary as a result of this operation shall be at no expense to the Owner. Openings shall be as per structural Consultants approval.

9. EQUIPMENT, MATERIAL & WORKMANSHIP

- ☐ Determine that each piece of equipment meets that detailed requirements of the contract documents and that it is suitable for the installation shown. Notify the Architect of any short comings found during the tendering period. Each piece of equipment furnished shall meet all detailed requirements of the contract documents. Equipments not meeting all requirements will not be acceptable, even though specified by name along with other manufacturers.
- ☐ Where two or more units of the same class of equipment are furnished use product of the same manufacture, component parts of entire system need not be product of the same manufacture but conform to I.S.I. standard. Furnish all materials and equipment, new and free from defects and of size, make type and quality herein specified or approved by the Employer/Architects. All shall be installed in a neat and workman like manner.

10. CLEANING, OPERATION & TESTS

- ☐ Plumbing equipment fixtures piping etc. shall be free from stampings, marking (except those required by codes) iron cutting and other foreign materials.
- ☐ Hot, cold and drinking water systems shall be cleaned thoroughly filled and flushed with water.
- ☐ The entire mechanical apparatus shall operate at full capacity without objectionable noise or vibrations.
- ☐ Test all plumbing system in the presence of the Employer's site Engineer/Architects as herein specified. Provide all equipment materials and labour necessary for inspection and tests and repair all work, not passing the test. After repairs are made repeat test until units system is found satisfactory and to the approval of above authorities. Carry out tests prior to concealing. Insulating or back filling over any piping. No exceptions will be made.
- ☐ Test entire system of soil waste and vent piping by water after the roughing in is completed and before the fixtures are set. After setting the fixtures provide smoke test after sealing all traps.
- ☐ Water Test entire system or section of system by closing all openings in piping except the highest opening and filling system with water to the point of overflow. If the system is tested in sections. plug each opening except the highest opening of the section filled with water. Keep the water in system or in portion under test for at least 45 minutes before inspection starts with test pressure/head lasting for two hours. The system must be tight at all joints.
- ☐ Final Test : After fixtures are set, test the system with smoke test as follows :
- ☐ Test all down spouts or rain headers and their branches within the building by water as described for the above soil, waste and vent system.
- ☐ All water piping: Hydro-static test 10kg/cm² or twice the working pressure hours without drop in pressure as required.
- ☐ All systems are tested in sections as required to expedite the work or other trades and meet construction

schedules and final test on completion.

- ☐ On completion of the works, the following tests shall be performed to the satisfaction of the consultants/ Employers / Architects representative before issue of Virtual Completion Certificate. If so required.
 - a) Smoke test
 - b) Hydraulic test
 - c) Self inducted test for fixtures
 - d) Tests for anti-siphon age system
 - e) Pump rating and output
 - f) Inspection of all units and fixtures

The Contractor shall arrange on his own initiative for similar tests during the progress of works to ensure that there are no defects in material/workmanship in portions of work to be concealed or embedded under the floor or walls or in ceiling.

Any pipe, fitting or fixtures found damaged or stolen during the progress of the work and before handing over of the building, the same shall be replaced by the Contractor including patching of the surfaces etc. as directed at no extra cost.

11. SANITARY FIXTURES AND FITTINGS:

- ☐ Unless otherwise specified, the sanitary fixtures shall be of the following specifications :
- ☐ Water Closets (European Type) shall be of vitreous china of approved pattern, quality capacity and colour. The closet shall be fixed with C.P. brass screws in floor for floor mounted type and shall be provided with solid plastic seat and cover with chrome-plated pillar brass hangers as specified.
- ☐ Water closet (Indian pattern) shall be of similar quality and specified capacity as specified above. The pan shall be 675/575mm in length with "S" or "P" trap of the same material of the pan. The W.C. with the trap shall be fitted and fixed in position and built round solid with brick and cement to required level after all connections are made. The finished floor of the water closet shall be of 25mm below the level of the room or passage in front of it.
- ☐ Both types of closets should conform to the requirements of I.S. 771 for glazed vitreous china sanitary appliances.
- ☐ The flushing cisterns shall conform to the requirements of I.S. 774 high level cisterns shall be of cast iron unless otherwise specified. Low level cisterns shall be of the same material as the water closet. The cisterns shall be mosquito proof and shall fulfill the requirements of the local Authority Capacities should be clearly mentioned in Bill of Quantities.
- ☐ The flush pipe shall be 32mm dia. lead if concealed and if exposed brass/C.I. as specified.
- ☐ Where flush valves are specified, this shall be of the best approved quality procurable with C.P. control valve and C.P. flush pipe.

12. MODE OF MEASUREMENT:

- ☐ All drain pipes shall be measured in linear lengths along the center line of the drainage line laid. Deductions shall be made for chambers and fitting lengths etc. The rate include all work as specified in the respective items.
- ☐ Stoneware or cast iron gully traps, bends, junctions, sewer traps etc. shall be measured in numbers as in above.

- All cast iron spigot and socked or flanged pipes for water supply, shall be measured in linear lengths along the center line completed. Deductions shall be made for lengths of specials and fitting. The rate shall include lead caulking or nut and bolt, rubber gasket, joints etc. complete as specified in the respective items.
 - Same rate shall be applicable for pipes of same size and material laid in building at any level or floor.
- Cast iron fitting such as spigot and socket fitting, fitting like tees, bends, tapers, cross etc., shall be measured in numbers and paid for separately.
- The rock cutting shall be measured in cu.mt. of the stacks of excavated rock. The deduction for voids being 50% of the stack measurement only the rock which is removed by chiselling or blasting etc., shall be measured for this item of work. Boulders shall not be considered as a rock. The excavated rock will become the owners property.
- All cast iron pipes, such as soil, waste, vent and rainwater shall be measured in linear lengths along the center line, to nearest centimeter as completed including length over fittings. The rates shall include all joints and clamps etc. as specified in the respective items.
- Length over case iron or any other material fittings, like specials, (T.Y short/long bend) for soil, waste vent or rain water pipes like single or double ways of various degrees bends cowls etc., shall be measured in meters, as extra over in the item for 12.6 above. These are paid separately whenever any separate item for specials is provided in the Schedule of Quantity.
- Plain cement concrete for supports and for encasement or bedding etc. shall be measured as specified in the respective items in the Schedule of Quantities.
- Lead pipes shall be measured in linear length and shall be of weights as per specifications of the respective item in installation work. The rates shall include making of necessary offsets and bends, etc.
- All sanitary fittings and fixtures shall be measured in numbers and the rate shall include all the work specified and described under item in the Schedule of Quantities.
- All G.I. pipes shall be measured in linear lengths along the center line of the pipe, including G.I. fittings. The rate for pipe line upto and including 50mm dia. shall be inclusive of all G.I. fittings in the case of pipeline of dia above 50mm. G.I. fittings will be measured in Nos. pipe length will be measured after deducting the lengths over fittings from linear measurements. The rate in all cases will be inclusive of all work as specified in the respective items. G.I. fittings of 75mm and over shall be measured in numbers (Lengths over valves shall be excluded) and paid separately.
- All peet valves, ball valves, non-return valves, sluice valves, pressure reducing valves etc. shall be measured in numbers after excluding them from linear measurement.
- The diameters of pipes and fittings mentioned in the specifications are the inside nominal diameters in all cases unless otherwise stated H.D.P.E pipes shall be specified as outside diameter and class.
- In case fittings of C.I./G.I. or stoneware of unequal bore, the largest bore shall be measured if paid separately.

N ROAD WORK

1. GENERAL

This specification covers the material construction details for earthwork in filling for embankments,

filling with sand/murum, WBM sub-base, WBM base course and shoulders for roads and flexible pavements.

2. REFERENCE CODES AND STANDARDS

B.I.S. SPECIFICATIONS.

IS : 2720- methods of Test of Soil.

INDIAN ROAD CONGRESS STANDARDS.

IRC:19-Standards Specification and Code of Practice for Water Bound Macadam.

3. EARTH WORK FILLING

MATERIALS

Only material considered suitable by the Owner's Representative shall be employed for the construction and that considered unsuitable shall be disposed off as directed by Owner's Representative at his own cost and no claim for compensation will be entertained. The Contractor shall give the samples of earth, he proposes to use for filling along with the following characteristics of the sample to Owner's Representative prior to collection and use, for approval.

Mechanical analysis or grain size analysis as per IS:2720 Part IV.

Liquid limit as per IS: 2720 Part V

Plastic limit as per IS: 2720 Part V.

Moisture density relationship as per IS: 2720 Part VIII.

- ❑ The material (soil) used for filling shall be free from boulders, lumps, tree roots, rubbish or any organic deleterious matter.
- ❑ Material (soil) having plasticity index less than 20 shall be used for filling purposes. Soil having laboratory maximum dry density of less than 1.5 gm/cc shall not be used.
- ❑ Care shall be taken to see that unsuitable waste material is disposed off in such a manner that there is no likelihood of its getting mixed with the materials proposed to be used for filling.
- ❑ The work shall be so planned and executed such that the best available material (soil) is reserved for the top portion of embankment.
- ❑ Filling for Embankments and Shoulders The area where filling is to be placed must be cleared of all loose material and virgin soil must be exposed. Such exposed surface must be consolidated properly to obtain 90% of maximum laboratory dry density of the soil. All soft patches must be worked out to remove the soft soil and selected approved earth must be filled back and compacted.
- ❑ Payment for the removal of loose top soil as described in clause 3.2.1 above shall be included in the item for earthwork in filling. No separate payment for consolidation of exposed ground surface will be made. The rate quoted for the earthfill shall be inclusive of the cost of clearing and stripping, consolidation, including watering, testing etc. of the exposed ground.
- ❑ Approved fill material shall be spread in uniform layers not exceeding 20 cms in loose depth for embankment filling. Shoulder construction shall be so organised as to keep pace with the construction of different layers of the pavement, which may require earth fill thickness less than 20 cm. All clods, lumps etc. shall be broken before compaction.
- ❑ In general the soil shall be spread uniformly over the entire width of embankment or shoulder as the case may be. For large embankments, the spreading of soil shall be as directed by Engineer-in Charge.
- ❑ Successive layers of filling shall not be placed until the layer under construction has been thoroughly

compacted to satisfy the requirements laid down in this specification.

- Prior to rolling, the moisture content of material shall be brought to within plus or minus 2% of the optimum moisture content as described in IS: 2720- Part-VIII. The moisture content shall preferably be on the wet side for potentially expensive soils.
- After adjusting the moisture content as described in Clause 3.2.6, the layers shall be thoroughly compacted by means of rollers till 90% of maximum laboratory dry density is obtained as per IS:2720 Part VIII.
- Each layer shall be tested in field for density and accepted by Owner's Representative subjected to achieving the required density before laying the next layer. A minimum of one test per 500 M2 area for each layer shall be conducted.
- All type of rollers that should be employed for compaction shall be as per direction of Owner's Representative.
- If the layer fails to meet the required density, it shall be reworked or the material shall be replaced and method of construction altered as directed by Owner's Representative to obtain the required density.
- The filling shall be finished in conformity with alignment, levels, cross sections and dimensions as shown in the drawings.
- Extra material shall be removed and disposed off as directed by Owner's Representative.
- Tolerance
- Embankment and shoulders for roads, units etc. shall be carried to within a tolerance of cm. From final lines but shall be to required grades and slopes.

4. FILLING WITH SAND/ MURRUM

Sand for filling shall preferably be locally available sand clean and free from any chemical or other impurities. Murrum for filling shall be clean and well graded. Sand/ Murrum shall not contain any vegetation, organic, clayey or other material and shall be obtained from a source approved by Owner's Representative.

Murrum/ Sand shall be spread in layers not exceeding 15 cm in loose thickness over the areas. Each layer shall be uniform in density, quality of material and moisture content before compaction. The moisture content shall be within two percent of the optimum moisture content as per IS: 2720 Part VIII.

In case of pure sand, flooding with water is permissible.

Compaction of each layer shall be by mechanical means as per directions of Owner's Representative. Only in accessible reaches shall be worked manually. Each layer shall be uniformly compacted to obtain 90% of maximum laboratory dry density of the material. If the material fails to achieve the required density, the layer shall be reworked with necessary alteration in compaction, so that the required compaction is obtained. A minimum of one test per M2 area for each layer shall be conducted.

Subsequent layers shall be placed only after the layer already laid has been compacted to the required density and approved by Owner's Representative.

The finish surface must be dressed to required grade and slope. Excess material must be removed from compaction site, as directed by Owner's Representative.

5. WATER BOUND MACADAM SUB BASE/ BASE COURSE

The sub-base course shall consist of one or more layers, each of 100 mm compacted thickness.
The base course shall consist of one or more layers, each of 75 mm compacted thickness.

Stone Aggregate for WBM

The coarse aggregates shall be hard, crushed or broken stone metal from quarries approved by Owner's Representative, it shall be hard durable and free from flat elongated, soft and disintegrated particles. It shall not have excess of dirt and other objectionable matter. The quality, size and grading of the coarse aggregate shall be conforming to IRC 19 : Std Spec and code of practice for WBM.

Size Range	Sieve Designation (IS : 460)	% by weight passing the sieve
90mm to 45 mm Grade-I	125 mm	100
	90 mm	90-100
	63 mm	25-60
	45 mm	0-15
	22.4 mm	0-5

a) The grading of the coarse aggregate for the base course shall be as below:

Size Range	Sieve Designation (IS : 460)	% by weight passing the sieve
63 mm to 45 mm Grade-2	90 mm	100
	63 mm	90-100
	53mm	25-75
	45mm	0-15
	22.4 mm	0-5

c) Physical requirement of coarse aggregates for sub-base course shall be below:

- i) Los Angles Abrasion Value 60% (Maximum) or
- ii) Aggregate Impact Value 50% (Maximum)

d) Physical requirement of coarse aggregates for base course shall be as below:

- i) Los Angles Abrasion Value 50% (Maximum) or
- ii) Aggregate Impact value 40% (Maximum)
- iii) Flakiness index value 15% (Maximum)

Samples of test shall be representative of the material to be used and collected as per IS : 2430.

The aggregates shall be stacked at the road side on firm, well drained ground in regular stacks, as directed by Owner's Representative. The various grade shall be stacked separately and contamination by earth and other extraneous matter shall be prevented effectively.

Binding Material Murrum

The binding material shall be clean, dry murrum free from leaves, organic matter and any deleterious material.

It shall be obtained from quarries approved by Owner's Representative.

Spreading Coarse Aggregates

The sub grade or sub-base to receive WBM coarse shall be prepared to the required grade and camber. Before starting with WBM construction, side shoulders shall be constructed in advance to a thickness corresponding to the compacted layer of the WBM coarse for lateral confinement of aggregate. After shoulders are ready, there inside edge shall be trimmed vertical to receive the aggregate. The practice of constructing WBM in a trench section excavated on the embankment/ formation must be avoided.

The coarse aggregate shall be spread uniformly and evenly on the prepared base in required quantities from the stacks. The aggregate shall be spread to proper profiles by using templates across the road about 6m apart.

The surface of the aggregate spread shall be carefully, trued up and all high or low spots remedied by removing or adding aggregate as may be required. The surface shall be checked from time to time, during the spreading and rolling of the coarse aggregate to ensure a finished surface without variation greater than 12 mm, when a 3 meter long straight edge is laid parallel to centre line of the road.

The WBM layer shall be tested by depth blocks. No segregation on large or fine particle shall be allowed and the coarse aggregate as spread shall be of uniform gradation with no pocket of fine materials.

The coarse aggregate shall not be spread in lengths more than 3 days average work in advance of the rolling, spreading murrum and bonding of the preceding section.

Rolling Road Metal

Immediately following the spreading of the coarse aggregates, it shall be compacted to full width by rolling with either three wheeled power roller of 8 to 10 tone weight or equivalent vibratory roller true to the line and camber as shown in the drawing. The course shall not be rolled when the sub-grade is soft or yielding or the rolling causes a wave like motion in the base course or sub-grade. When rolling develops irregularities that exceed 12mm when tested with a 3 meter straight edge, the irregular surface shall be loosened and then aggregate added to or removed from it as required and the area rolled until it gives uniform surface conforming to the desired cross-section and grade. The surface shall also be checked transversely by template and any irregularities corrected as above. The use of murrum to make up depression shall not be permitted.

The rolling shall begin from edges with roller running forward and backward until the edges have been firmly compacted. The rolling shall then progress gradually from edges to the centre parallel to the centre line of the road lapping uniformly each preceding rear wheel track by one half width and shall continue until the entire area of the course has been rolled by the rear wheel. On the super elevated portions of road, the rolling shall commence from the lower edge and progress gradually towards the upper edge of the road.

Rolling shall be discontinued when aggregate are thoroughly keyed and creating of stone wheel of roller is no longer visible partially compacted with sufficient void space in them to permit application of screenings. Slight sprinkling of water may be done if required.

Screenings Material

Screenings to fill the voids in the coarse aggregates shall, as far as possible be the same material as the coarse aggregates. Where it is decided by the Owner's Representative to use other materials, the same

shall be predominantly non plastic materials such as Kankar nodules, gravel (other than river-borne rounded aggregate) or murrum, provided that the liquid limit and plasticity indeed of such material is below .20 and 6 respectively, and the fraction passing 75 micron sieve does not exceed 10 per cent.

Grading requirements of screenings

Size Range Sieve % by weight

Designation (IS: 460) passing the sieve

13.2 mm	13.2 mm	100
11.2 mm	95-100	5.6 mm
15-35	180 micron	0-10

This grading, however, shall not be mandatory, in case either murrum or gravel is used as screenings.

Application of Screenings

After the coarse aggregate has been rolled as described in Clause 5.3, screenings shall be applied uniformly and gradually over the surface to completely fill the interstices. Dry rolling shall be continued while the screenings are being spread so that the jarring effect of the roll will cause them to settle into the voids of the coarse aggregates.

The screenings shall not be dumped in piles on coarse aggregate but shall be spread uniformly in successive thin layers either by the spreading motion of hand shovels or by mechanic spreaders.

The screenings shall be applied at a uniform and slow rate (in three or more applications so as to ensure filling of all voids. Rolling and brooming shall continue with the spreading of the screenings. Either mechanical brooms or hand brooms or both may be used. In no case shall the screenings be applied so fast and thick as to form cakes or ridges on the surface making the filling of voids difficult or preventing the direct bearings of the roller on the coarse aggregates. The spreading, rolling and brooming of screenings shall be performed on sections which can be completed within one day's operation and shall continue until no more screenings can be forced into the voids of the coarse aggregates. Damp and wet screening shall not be used under any circumstances.

The quantity of screenings used shall be such as to fill all voids in the water bound macadam courses.

Sprinkling and Grouting

After spreading the screenings, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet screenings into voids and to distribute them evenly. The sprinkling, sweeping and rolling shall be continued and additional screenings applied where necessary until the coarse aggregates are well compacted and grout of screenings and water form a wave ahead of wheels of the roller. Care shall be taken to see that the base of sub-grade does not get damaged due to the addition of the excessive quantity of water during the construction.

Binding Material

Binding material, to prevent reveling of WBM, shall consist of fine grained material possessing P.I.Value up to 6.

Application of binding material shall not be necessary where murrum or gravel is used as screenings.

Binding material shall be obtained from quarries/ sources approved by the Owner's Representative.

Application of Binding Material

After the application of screenings as described above, the binding material shall be applied at a uniform and slow rate (in two or more successive thin layers) so as to ensure filling of all voids.

After each application of binding material, the surface shall be copiously sprinkled with water and the resulting slurry swept in with hand brooms/ mechanical brooms or both so as to fill the voids properly. This shall be followed by rolling with a 6-10 tone roller during which water shall be applied to the wheels to wash down the binding material that may get stuck to them. The spreading , rolling and brooming of binding material shall be performed on sections which can be completed within one day's operation and shall continue until no more binding material can be forced into the voids of the coarse aggregates and until the slurry of binding material and water forms a wave ahead of the wheels of moving roller. Damp and wet binding material shall not be used under any circumstances.

The quantity of binding material used shall be such as to fill all voids in the water bound macadam.
Subsequent Layers of WBM

Before laying the subsequent layers of WBM, the surface shall be scarified and reshaped to the required camber and profile, and all ruts, depressions, pot holes etc. made good. The second layer shall be laid after the surface preparation is approved by Owner's Representative. The specification and mode of measurement for subsequent layers of WBM will be similar to that described before.

6. CONSTRUCTION OF SHOULDERS OR BERMS

After the WBM course is laid and compacted, the existing surface at side berms or shoulders of the roadway must be scarified. Fresh quantity of approved earth must be spread in layers for building up of berms upto the required level and scope.

The earth must be consolidated by at least three passes of an 8-10 tonne road roller.

The edges must be well consolidated by suitable means to prevent edge slips and the work properly trimmed and dressed.

Bitumen premix carpet

This part of specification establishes the material and construction requirements for the flexible pavement with Bitumen-Premix Carpet.

□ Material

□ Coarse aggregate

The aggregate shall consist of crushed stone of clean, hard, tough, durable rock of uniform quality and shall be clean, free from excess of dust, flat or elongated pieces, soft or disintegrated stone, clay or other deleterious matter. The size of aggregate shall be as mentioned in the schedule of quantities.

□ SAND

The sand shall consist of clean hard, durable, uncoated, coarse dry particles and shall be free from injurious amounts of dust, soft or flaky particles, organic matter or other deleterious substances.

□ BINDER

The binder shall be bitumen or penetration 80/100 conforming to IS:73. The bitumen shall be collected on road side drums. Any drum leaking or damaged shall not be accepted.

Quantities of material (premix carpet)

For Premix Carpet 20 mm thick

	Material	Per 100 m2	Per 100 m2
	1	2	3
1)	Coarse Aggregate 12 mm and down size	2.75 m3	--



2)	Bitumen 80/100	150 Kg	68.3 Kg
3)	Coarse sand as sealing aggregate	--	0.6 m3
For Premix Carpet 25 mm thick			
	Material	For Premix Carpet Per 100 m2	For Seal Coat Per 100 m2
	1	2	3
1)	Coarse Aggregate 12 mm and down size	3.5 m3	--
2)	Bitumen 80/100	185 Kg	68.3 Kg
3)	Coarse sand as sealing compound	--	0.6 m3
6.1. For Premix Carpet 50 mm thick			
	Material	For Premix Carpet Per 100 m2	For Seal Coat Per 100 m2
	1	2	3
i)	Coarse Aggregate 25mm and down Size (For 35 mm thick Carpet 1 Layer)	5.5 m3	--
ii)	Coarse Aggregate 12 mm and down size (For 15 mm thick Carpet Layer)	2.0 m3	--
iii)	Bitumen 80/100	150 Kg	68.3 Kg
	a) For 35 mm thick Carpet (1 Layer)	269 Kg.	68.3 Kg
	b) For 15 mm thick Carpet (II Layer)		--
iv)	Coarse sand as sealing aggregate	--	0.6 m3
For Premix Carpet 75 mm thick			
	Material	For Premix Carpet Per 100 m2	For Seal Coat Per 100 m2
	1	2	3
i)	Coarse Aggregate 25 mm and down size (For 50 mm thick Carpet 1 Layer)	8.5 m3	--
ii)	Coarse Aggregate 25 mm and down size (For 15 mm thick Carpet II Layer)	3.5 m3	--
iii)	Bitumen 80/100		
	a) For 50 mm thick I Layer	375 Kg.	68.3 Kg
	b) For 25 mm thick II Layer	185 Kg	--
iv)	Coarse sand as sealing aggregate	--	0.6 m3

□ **LAYING**

○ Preparation of Road Surface

The existing surface shall be thoroughly cleaned of dust, loose materials, caked mud and other foreign matter with the help of wire brush, chisel, picks etc. before laying the tack course. The cleaning shall be carried out in such a manner as to expose the stone metal to a depth of 1 to 2 mm without dislodging the interlocking of the metal. All dust and other material thus removed shall be

carried away and dumped at suitable places as directed by the Owner's Representative.

If pot holes or ruts are found on the existing road surface, these irregularities must be filled in with premix chippings and well rammed about a week before the carpet is laid.

☐ Tack Coat

The bitumen shall be heated in asphalt boilers to 177° - 188° C and shall be spread uniformly at the rate of 1 kg / m² by means of sprayers. The applied binder shall be evenly brushed.

The tack coat shall be applied just ahead, keeping pace with laying of premix carpet.

☐ Preparation of Premix

Mechanical mixers shall be generally used for preparation of premix. Improvised hand mixing drums may be used if permitted by the Owner's Representative.

Stone chippings of specified size shall be thoroughly mixed dry in the mixer at the rate indicated above. Binder heated at temperature suitable for the grade of bitumen is added to the mixer drum at the specified rate per 100 m³ of surface and thoroughly mixed till the stone chips are completely coated with the binder.

The premix shall be emptied on to wheel barrows or stretchers and carried to work site.

☐ Spreading of Premix

Immediately after applying the tack coat, the premix shall be spread with rakes to the required thickness and distributed evenly by means of a drag spreader. The camber shall be checked by means of camber board and the unevenness shall be rectified.

☐ Rolling

When the premix has been laid for a length of 15-20 meters, rolling shall be commenced with tandem rollers (8 to 10 tonnes). Rolling should commence from edges and proceed towards centre longitudinally.

The wheels of roller shall be continuously moistened to prevent the premix, adhering to the wheels and being picked up.

After the preliminary rolling and honey combing, high spot or depressions shall be rectified by adding or removing the premix as per requirements and the surface shall be rolled again to compaction. Camber shall be checked at every stage and any defects found shall be rectified. Excessive rolling shall be avoided.

☐ Seal Coat (For low rainfall areas - under 150 cm/yr)

A premix seal coat, mix preferably in a mechanical mixer after heating the sand should be applied immediately after laying the carpet and rolled. Materials required for this seal coat are as per clause 3.

7. SEAL COAT (FOR HIGH RAINFALL AREAS - OVER 150 CM/YR)

The material requirement for seal coat in high rainfall areas is as under:-

Binder 80/100 = 98 kg / 100 m² of road surface

Coarse aggregates 6.3 mm

Passing IS 10 mm Square mesh

Retained on IS sieve 2.36 mm = 0.9 m³/100 m² of road surface.

A liquid seal coat, preferably with chippings as above (through coarse sand can also be used) should be applied after laying the carpet. The binder, heated to permitted temperature, should be applied to the cleaned surface, bladed with chippings and rolled.

Traffic may be allowed on the road preferably 24 hours after providing the seal coat removal of surplus earth.

O GRANULAR SUB-BASE

1. SCOPE

This work shall consist of laying and compacting well-graded material on prepared subgrade in accordance with the requirements of these Specifications.

The material shall be laid in one or more layers as sub-base or lower sub-base and upper sub-base (termed as sub-base hereinafter) as necessary according to lines, grades and cross -sections shown on the drawings or as directed by the Engineer.

2. MATERIALS

The material to be used for the work shall be natural sand, murrum, gravel, crushed stone, or combination thereof depending upon the grading required. Materials like crushed slag crushed concrete, brick metal and kankar may be allowed only with the specific approval of the Engineer. The material shall be free from organic or other deleterious constituents and conform to one of the three gradings given in Table -1,

While the gradings in Table -1 are in respect of close-graded granular sub-base materials, one each for maximum particle size of 75 mm, 53 mm and 26.5 mm, the corresponding gradings for the coarse graded materials for each of the three maximum particle sizes are given at Table -2. The grading to be adopted for a project shall be as specified in the Contract.

2.1. Physical requirements:

The material shall have a 10 per cent fines value of 50 kN or more (for sample in soaked condition) when tested in compliance with BS: 812 (Part 111). The water absorption value of the coarse aggregate shall be determined as per IS: 2386 (Part 3); if this value is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS: 383.

For Grading II and III materials, the CBR shall be determined at the density and moisture content likely to be developed in equilibrium conditions which shall be taken as being the density relating to a uniform air voids content of 5 per cent.

TABLE -1. GRADING FOR CLOSE-GRADED GRANULAR SUB-BASE MATERIALS

IS Sieve Designation	Per cent by weight passing the IS sieve		
	Grading I	Grading II	Grading III
75.0 mm	100	—	—
53.0 mm	80-100	100	—
26.5 mm	55-90	70-100	100-
9.50 mm	35-65	50-80	65-95
4.75 mm	25-55	40-65	50-80
2.36 mm	20-40	30-50	40-65
0.425 mm	10-25	15-25	20-35
0.075 mm	3-10	3-10	3-10
CBR Value (Minimum)	30	25	20

TABLE -2. GRADING FOR COARSE GRADED GRANULAR SUB -BASK MATERIALS

IS Sieve Designation	Per cent by weight passing the IS Sieve		
	Grading I	Grading II	Grading III
75.0 mm	100	—	—
53.0 mm		100	
26.5 mm	55-75	50-80	100
9.50 mm			
4.75 mm	10-30	15-35	25-45
2.36 mm			
0.425 mm			
0.075 mm	<10	<10	<10

CBR Value (Minimum) 30 25 20

Note: The material passing 425 micron (0.425 mm) sieve for all the three grading! When tested according to IS: 2720 (Part 5) shall have liquid limit and plasticity index not more than 25 and 6 per cent respectively.

3. STRENGTH OF SUB BASE

It shall be ensured prior to actual execution that the material to be used in the sub-base satisfies the requirements of CBR and other physical requirements when compacted and finished.

When directed by the Engineer, this shall be verified by performing CBR tests in the laboratory as required on specimens remoulded at field dry density and moisture content and any other tests for the "quality" of materials, as may be necessary.

4. CONSTRUCTION OPERATIONS

4.1. Preparation of sub grade:

Immediately prior to the laying of sub-base, the subgrade already finished to Clause 301 or 305 of MORTH Specifications as applicable shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water if necessary and rolled with two passes of 80 -100 kN smooth wheeled roller.

4.2. Spreading and compacting:

The sub-base material of grading specified in the Contract shall be spread on the prepared subgrade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation or other means as approved by the Engineer.

When the sub-base material consists of combination of materials mentioned in Clause 401.2.1, mixing shall be done mechanically by the mix-in-place method.

Manual mixing shall be permitted only where the width of laying is not adequate for mechanical operations, as in small-sized jobs. The equipment used for mix-in -place construction shall be a rotavator or similar approved equipment capable of mixing the material to the desired degree. If so desired by the Engineer, trial runs with the equipment shall be carried out to establish its suitability for the work.

Moisture content of the loose material shall be checked in accordance with IS:2720 (Part 2) and suitably adjusted by sprinkling additional water from a truck mounted or trailer mounted water tank and suitable for applying water uniformly and at controlled quantities to variable widths of surface or other means approved by the Engineer so that, at the time of compaction, it is from 1 per cent above to 2 per cent below the optimum moisture content corresponding to IS:2720 (Part 8). While adding water, due allowance shall be made for evaporation losses. After water has been added, the material shall be processed by mechanical or other approved means like disc harrows, rotavators until the layer is uniformly wet.

Immediately thereafter, rolling shall start. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer upto 225 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight with plain drum or pad foot drum or heavy pneumatic tyred roller of minimum 200 to 300 kN weight having a minimum tyre pressure of 0.7 MN/m² or equivalent capacity roller capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional crossfall and super-elevation and shall commence at the edges and progress towards the centre for portions having crossfall on both sides.

Each pass of the roller shall uniformly overlap not less than onethird of the track made in the preceding pass. During rolling, the grade and crossfall (camber) shall be checked and any high spots or depressions, which become apparent, corrected by removing or adding fresh material.

The speed of the roller shall not exceed 5 km per hour. Rolling shall be continued all the density achieved is at least 98 per cent of the maximum dry density for the material determined as per IS:2720 (Part 8). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

5. SURFACE FINISH AND QUALITY OF WORK

The surface finish of construction shall conform to the requirements of Clause 902 of MORTH Specifications.

Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900 of MORTH Specifications.

6. ARRANGEMENTS OF TRAFFIC

During the period of construction, arrangement of traffic shall be maintained in accordance with Clause 112 of MORTH Specifications.

7. MEASUREMENTS OF PAYMENT

Granular sub-base shall be measured as finished work in position in cubic metres.

The protection of edges of granular sub-base extended over the full formation as shown in the drawing shall be considered incidental to the work of providing granular sub-base and as such no extra payment shall be made for the same.

8. RATE

The Contract unit rate for granular sub-base shall be payment in full for carrying out the required operations including full compensation for :

- i. Making arrangements for traffic to Clause 112 except for initial treatment to verges, shoulders and construction of diversions;
- ii. Furnishing all materials to be incorporated in the work including all royalties, fees, rents where necessary and all leads and lifts;
- iii. All labour, tools, equipment and incidentals to complete the work to the Specifications; iv. Carrying out the work in pan widths of road where directed; and
- v. Carrying out the required tests for quality control.

P BARBED WIRE FENCING WITH ANGLE IRON POSTS**1. MATERIALS**

Barbed wire shall be as per IS 278 and the angle shall be of size 40 × 40 × 6 mm unless otherwise specified or as directed by the Engineer-in-Charge for the dimensions of the area to be fenced.

2. SPACING OF POSTS AND STRUTS

The spacing of posts shall be 3.00 m centre to centre, unless otherwise specified or as directed by the Engineer-in-Charge to suit the dimensions of the area to be fenced. Every 15th, last end posts and corner post shall be strutted on both sides and end post on one side only. Posts to be painted with two coats 50 micron DFT for Each Coat of synthetic enamel paint over a coat of 50 micron DFT for Zinc chromate primer.

3. FIXING OF POSTS AND STRUTS

The post to be fixed in the ground with 0.45 M x 0.45.M x 0.6 M. block in M-20 (1:1.5:3) unless otherwise specified or as directed by the Engineer-in-Charge. In addition, angle iron post at bottom shall be split and banded at right angle in opposite direction for at least 10 cm length for get proper grip.

4. FIXING BARBED WIRE

The barbed wire shall be stretched and fixed in specified number of rows and two diagonals. The barbed wires shall have max spacing of 2.5 cm centre to centre unless otherwise specified. The diagonal shall be stretched between adjacent posts from the top wire of one post to the bottom wire of 2nd post. The diagonal wire will be inter woven with horizontal wires by fixing the odd rows of wires first, then the diagonal cross wires and lastly even rows of wires. The barbed wire shall be held by tearing the holes of 10 mm dia in the post and tied with G.I. staples, turn buckles and straining bolts shall be used at the end post, if so specified.

5. RATES

Rate shall include labour and material involved in all the operations described above also including excavation, backfilling, compaction, pcc, rcc, shuttering, steel work, fabrication work & painting etc. complete, as directed by Engineer In charge. Weight of washers, nuts, GI staples & bolts shall not be paid extra. No extra payment shall be made for making holes in angle and nothing shall be deducted on account of holes.

Q CORRUGATED ROOFING SHEET**1. CORRUGATED SHEETS**

Sheets shall be of the thickness specified in the description of the item and shall conform to IS 277 & IS 513. The sheets shall be free from cracks, pitting, blisters, split edges, twists, laminations, scales and other surface defects they shall be clean, bright and smooth. The coating shall be clean, bright, smooth and free from un-galvanized spots and other defects. The sheets shall not show signs of rust or white powdery deposits on the surface. The corrugations shall be uniform in depth and pitch and parallel with the side. Weathering surface finished with coat of specified colour over primer, rear side having neutral back coating and minimum Yield Strength 550 MPa. The sheet shall be fixed by means of anti-corrosive approved make (Epoxy Polymer) coated self-drilling, self-tapping fasteners with EPDM seals through crest for roofing.

**2. STORAGE OF MATERIALS**

Sheets shall be stacked to a height of not more than one meter on firm and level ground, with timber or other packing beneath them. All galvanized materials shall be protected from damage while stored on site preferably in sheltered store. If they are to be placed in an exposed position, they shall be protected from damage by wind and rain by providing a suitable cover. Contractor shall exercise great care in handling the sheets and Accessories. Damaged materials shall not be stacked with sound materials. All damaged or rejected materials shall be removed from site immediately.

3. LAYING AND FIXING

The sheets shall be laid on the purlins/ other roof members, wall cladding and side girths as indicated on the drawings or as instructed by Engineer. Before the actual laying of sheets is started, the purlin spacing and the length of the sheets shall be checked to ensure proper laps and the specified overhang at the eaves. The end lap of the sheets shall always fall over a purlin/ side girt. The bearing surfaces of all purlins/other roof members and side/girths shall be in one plane so that the sheets being fixed shall not be required to be forced down to rest on the purlins/side girths. The finished roof shall present a uniform slope and the lines of profile shall be straight and true and the completed work shall present a neat and uniform appearance and be leak proof. The sheets shall be cut to suit the dimensions or shape of the roof, either along their length or their width or in a slant across their lines of profile at crests and valleys. They shall be cut carefully with a straight edge and chiselled to give a smooth and straight finish. Where slopes of roofs are less than 22 degrees, sheets shall be joined together at the side laps by approved fasteners. The seam bolts shall be placed zig zag over the two overlapping profile at a spacing not exceeding 600 mm along each of the staggered rows.

Sheets shall be secured to the purlins and other roof members by means of approved self-driven screws or required size & dia. approved make PVC coated galvanized iron J or L hook bolts and nuts with bitumen and G.I. limpet washer or with a G.I. limpet washer filled with white lead, as directed by Engineer-in-charge. The grip of the hook bolt on the side of the purlin shall not be less than 25 mm. Each hook bolt shall have a neoprene washer and a galvanized iron washer placed over the sheet before the nut is screwed down from above. There shall be a minimum of three hook bolts placed at the crest/valley of profile in each sheet on every purlin and spacing shall not exceed 300 mm. Washer 35 mm in dia. and 1.5 mm thick shall be of approved manufacture. Each nut shall be screwed lightly at first. After 10 or more sheets are laid, the nuts shall be tightened to ensure a leak proof roof. The bolts shall be sufficiently long so that after fixing they project at least 12 mm above the top of their nuts. Holes for hook bolts etc. shall be drilled and not punched in the crest/valley of the profile in the exact positions to suit the purlins while the sheets are on the ground. The diameter of holes shall be 1.5 mm more than the diameter of the fixing bolts, while the holes in the washers shall be of the exact diameter of the hook bolts or the seam bolts. No hole shall be nearer than 40 mm to any edge of a sheet or an accessory. Sheets with holes drilled wrongly shall be rejected.

4. MEASUREMENTS

The length and breadth shall be measured correct to a cm. Area shall be worked out in sqm correct to two places of decimal. The superficial area of roof covering shall be measured on the flat without allowance for laps and corrugations. Portion of roof covering overlapping the ridge or hip etc. shall be included in the measurements of the roof. Cutting across corrugation shall be measured on the flat and not girthed. No additions shall be made for laps cut through.

5. RATES

The rate shall include the cost of all the materials and labour involved in all the operations described above. This includes the cost of roof sheets, self-driven/Self tapping screws, galvanised iron J or L hooks, bolts and nuts, galvanised iron seam bolts and nuts, bituminous and galvanised iron limpet washers etc. all complete.



R FALSE CEILING WITH GYPSUM BOARD AND G.I. FRAMEWORK

The work envisaged under these specifications refer to supplying and fixing in position false ceiling at any floor, any location and at any height. Providing and fixing suspended G.I. frame work. Providing and fixing one layer of 12.5 mm gypboard over this frame work. Making necessary cut out for light fitting, A.C. grills diffusers and other necessities. The work shall include horizontal, vertical and inclined surfaces depending upon the various requirements.

1. GYPSUM BOARD

Gypsum Board of plain series 12.5 mm shall be used. The Gyp board shall conforms to IS 2095. The longitudinal edge of the Gyp board shall be of tapered / square edges, so as to have flush joints while fixing. Handling and transporting of Gyp board shall be done carefully and as recommended by the manufactures. The board should always be kept in a dry and covered place sheltered from rain and to avoid dampness from flow. The material shall be stacked in piles of smaller heights and should not be stacked on edges. Gyp board which have deformed due to poor stacking should not be used.

2. G.I. FRAME WORK

The system consists of G.I. frame work suspended form the soffit of the RCC ceiling. The following G.I. components shall be used for grid work (or) as specified in the drawing.

1. Ceiling section of 80X26X0.5 mm
2. Perimeter channel of 20X27X0.5mm
3. Intermediate channels of 15X45X0.9mm
4. Soffit cleat 27X37mm
5. Anchor fasteners 6 mm

All the G.I. components shall be of standard approved make.

The G.I. grid work system shall be suspended from the soffit of RCC ceiling using anchor fasteners of 6mm (or as specified) of approved type and make and connected to soffit cleats and ceiling angle by means of necessary nuts, bolts and washers etc.

3. INSULATION

Perimeter channels are leveled at the required position of the finished ceiling line and fixed to the wall with the screws and nylon plugs. The remaining G.I. grid component are installed to form a regular grid suspended from the soffit of RCC slab using soffit cleats ceiling angle and anchor fasteners as specified. Extra frame for various cut outs of different shapes, light fittings, AC grills, diffusers, smoke detectors and other necessities have to be provided frame work has to be made with perimeter channel of specified size and shall be suitably supported. The line and level of the grid work has to be checked for perfection and prior clearance of the grid work has to be checked for perfection and prior clearance of the grid work has to be obtained from the Engineer-in-charge before the placement of Gyp board.

Necessary door openings of suitable sizes has to be provided with a suitable frame work for access above false ceiling / AC duct boxing at no extra cost. Joints at horizontal, vertical and inclined surfaces shall be suitably strengthened with additional G.I. frame work as required.



4. MEASUREMENTS

Measurements will be made on flat plan area basis in Sq.m. Length and breadth shall be measured corrected to a cm. No deduction shall be made for cut outs made for A.C. grills, diffusers, electrical fittings, smoke detectors etc.

5. RATE

The rate shall include providing all materials, erecting, suspending, G.I. grid work, jointing the boards, providing required cut outs and open able doors and painting including providing necessary fittings and fixtures etc. complete as per the specifications and all other activities related to the completion of the above job.

S ACP CLADDING WORK

1. GENERAL

All composite aluminum panels shall have a thickness of 4.00mm. All fixing and joint details shall be designed to provide for the expected thermal expansion and contraction. The fixing of these panels shall accommodate the expected structural movements in the building/Canopy. The installed composite panel surface shall not have irregularities such as oil canning, waves, buckles, and other irregularities. All fasteners, anchors, brackets and similar attachments used for the fixing and erection of these panels shall be of aluminum, non-magnetic stainless steel, or hot dip galvanized steel.

2. MATERIALS

Aluminium Composite Panel (ACP) cladding of approved shade made of Aluminium Composite Material (ACM) made out of 4 mm thick aluminium composite panel consisting of 0.5mm TH. AL Foil both side. The ACPs are used for the external cladding surface like canopy facia, column, wall, jambs, sills, projected area, ceiling, decorative cladding on any surface to any profile and shape at horizontally / vertically / sloped / curved / circular etc. (linear as well as curvilinear shape).

The ACP top face (exposed surface) coil should have PVDF coating of approved colour and shade of 30 microns to ensure corrosion resistance and weather proof and thus shall confirm to relevant ASTM or DIN or EN or BS code. The back face (rear side) of the cladding panel surface facing to the wall shall have polyester based wash (service) coating of 7 microns preferably grey in colour to protect against possible corrosion problems. The finished surface (Top face) shall be protected with a self-adhesive peel off film with two layers of white & black tested to with stand local weather conditions without losing the original peel off characteristic or causing stains or other damages.

The ACP shall confirm to ASTM E84-08 or EN13501-1 or DIN4102 resulting in fire resistant properties.

The complete system shall be designed to with stand the design wind pressure as per relevant IS code or international code. Necessary pull out test of anchor fastener shall be carried out on the masonry wall /RCC structure to check the load carrying capacity of the bolt designed under suction pressure for designing the supporting and anchoring system.

3. MOVEMENT

System shall be designed to accommodate movement due to any force including the movement resulting from the exterior skin temperature ranging from 15°C to 85°C and also to accommodate the horizontal building movement of 10 mm per panel & vertical movement of 20 mm between floors on the aluminium framing system with support brackets, glass, gaskets and fastening devices. System shall be designed to accommodate the size and shape of the laminated sandwiched composite panel as per the approved drawings including approved modifications as may be required during execution as well

as all other incidental forces and stresses likely to be experienced under service conditions, i.e. Lateral force, Dead weight and Thermal expansion due to building/canopy movement both vertical and horizontal etc. Grooves shall be designed in such a way to accommodate weather silicon sealant approved make.

4. PERFORMANCE CERTIFICATE

Contractor shall furnish material quality warranty certificate for 10 years period from ACP manufacturer on the name of Gujarat Gas Limited for any manufacturing defects.

5. INSTALLATION

The ACP is first fixed on the substructure i.e. of steel members/RCC structures/brick walls with the help of base aluminium member frame work using necessary clamps, brackets, anchor fasteners, stainless screws, nuts and bolts, weather silicon sealant backer rods etc. as per approved design & drawing at all height and elevation which include all labours, materials, equipment's, handling, transportation, workmanship, design & preparation of working drawings, staging, scaffolding etc. all complete as per specification, drawings and instructions of the Engineer-in-Charge.

5.1 FRAMES

Aluminium member shall be fixed into masonry wall / RCC member / steel structures with brackets / clamps and it shall be of chromicised finish aluminium. All fastening straps, nuts & bolts, rivets, washers/other fastening materials shall be of nonmagnetic stainless steel and aluminium brackets shall be considered for ACP cladding with standard dimension and after the site survey if any undulation is observed intern that doesn't allow to fix the aluminium bracket only in these areas the additional support with locally fabricated hot dip galvanized bracket can be considered. Aluminium brackets / clamps shall be fixed with chemical injection technique threaded anchor rods of approved make to the base structure in the case of masonry wall / RCC members and SS anchor bolts in the case of steel structure. Extruded member shall be designed to accommodate laminated sandwiched composite panel as per the approved shop drawings and extruded aluminium member shall be conforming to BS 1467 or IS 8147.

5.2 SEALING

After fixing the ACP on the sub structure, then a suitable sealing materials i.e. Non-structural weather silicon sealant/Non staining sealant filled to the joints of panel with baker rod of approved make to ensure water tightness to the panel. Sealing shall be carried out with Non-structural (weather) sealant / Non staining sealant with PE baker rods, wherever the system is interfacing with glazing, cladding groove and any other groove.

5.3 GENERAL GUIDELINE

System design in total, including Aluminium extruded member, type & thickness of Aluminium composite panel, Aluminium sleeves at connections, inserts, Sealant, Supporting system/bracket including fastening and anchoring system & materials specified in the schedule and the system details as shown in the tender drawing are only tentative and is meant to set out a general outline of the proprietary system. Since the cladding system in terms of design, materials, all fixing details, methodology of execution are proprietary in nature, the onus of the design and performance requirements, shop drawing, execution etc. satisfying the design intent, particular specification and site conditions lies solely with the Contractor.

5.4 PRECAUTIONS

- Do unpacking and repacking of ACP sheet work in a clean place.
- Remove dust and chips from ACP sheet and the packing paper.
- ACP sheets should always be handled by two people with external face upward to avoid possible rubbing of the ACP surface during handling.
- Ensure that cutting chips generated from saws, routers and drills are completely removed from the interface between ACP sheet and tools.
- Do not use adhesive tapes made of PVC (Polyvinyl Chloride) on the surface of protective film or any time during storage, fabrication or installation.



6. MEASUREMENT

For the purpose of payment, only the actual area on the external face of the curtain wall with Aluminum Composite Panel cladding (including width of groove) shall be measured in square meters.

7. RATE

The rate includes the cost of all materials, labour, equipment's, design, fabricating, installation and fixing in position the Aluminum composite panels cladding for all height and all level etc. in all the operation described above and any other stipulations in the particular specification and agreement. Also, includes the cost of scaffolding, infrastructure facility and all other consumables to execute the work as specified above. The cost of testing charges, cost of all sample of the individual components for testing in an approved laboratories, field test on the assembled aluminum composite panels claddings, cleaning and protection of the aluminum composite panel claddings till the handing over of the site. Rate for base aluminum members frame work for ACP cladding shall not be paid extra.

T BORED CAST IN SITU R.C.C PILES

This specification covers construction of load bearing concrete bored cast-in situ piles of appropriate diameter which can transmit the load of the structure to the soil by both resistance developed at the tip by end bearing and along the surface of the pile shaft by friction.

1. EQUIPMENT & ACCESSORIES

The equipment and accessories shall depend on the type of bored cast-in-situ piles chosen for the job and shall be selected giving due consideration to the sub-soil strata, ground water conditions, type of founding materials and the required penetration, manner of operation etc. For Bored cast-in-situ piles percussion boring by suitable drilling rigs using direct mud circulation or reverse mud circulation methods to bail out the cuttings or as specified. The size of cutting tool shall be as per [IS 2911 (Part I Section 2)] and not less than the diameter of pile by more than 75 mm.

2. GENERAL CONSIDERATIONS

The construction of pile foundation shall be in such a way that the load from the structure it supports, can be transmitted to the soil without causing any soil failure & without causing such settlement, differential or total under permanent transient loading as may result in structural damage and/or functional distress to the structure. When working near the existing structures, any damage to such structures shall be made good at no extra cost to the GGL. The contractor shall, therefore, take adequate care to avoid any damage to the existing structures.

Concrete to be used for the pile shaft shall be as specified in BOQ/contract. Concrete mix shall be so designed as to have a homogeneous mix having a flow able character consistent with the method of concreting of pile. The slump of concrete shall range between 150 to 180 mm depending on the method/manner of concreting. Minimum cement content shall be 400 kg per cubic metre.

3. WORKMANSHIP

Piles shall be installed as accurately as possible as per the designs and drawings. The piles shall be installed vertically with tolerance as stipulated by IS: 2911 (Part-1/Section-2) (Latest revision). Piles shall not deviate by more than 75 mm or D/6 whichever is less in case of piles having diameter less than 600 mm, 75 mm or D/10 whichever is more in the case of piles having diameters more than 600 mm from their designed positions at the working level. In the case of a single pile in a column, positional tolerance should not be more than 50 mm or D/6 whichever is less (100 mm in case of piles having diameter more than 600 mm). In case of piles deviating beyond these limits, contractor shall carry out necessary remedial measures duly approved by the GGL/consultant at no extra cost. Piles that are deviated to such an extent that the resulting eccentricity cannot be taken care of by a redesign of the pile cap or plinth beams, the piles should be re-placed or supplemented by one or more additional



piles at no extra cost. In under-reamed compaction piles, suitable device should be used for guiding the movement of drop weight and specified core assembly for its vertical driving for operating the drop weights of adequate capacity, suitable winch with hoisting attachment should be used. In order to achieve proper under-reamed bulb, the depth of bore hole should be checked before starting under reaming. It should also be checked during under-reaming and any extra soil at the bottom of bore hole; removed by auger before reinserting the under reaming tool. In double or multi under-reamed piles, boring is first completed to the depth to the first (top) under-ream only and after completing the under-reaming boring is extended further for the second under-ream and the process is repeated.

Concreting shall be done as soon as possible after completing the pile bore. The bore hole full of drilling mud should not be left un-concreted for more than 12 to 24 hours depending upon the stability of the bore hole. For placing concrete in pile bores, a funnel should be used and method of concreting should be such the entire volume of the pile is filled up without formation of voids and/or mixing of soil and drilling fluid in concrete. In empty bore holes for under-reamed piles a small quantity of concrete is poured to give about 100 mm layer of concrete at bottom. Reinforcement is lowered next and positioned correctly. Then concrete is poured to fill the bore hole. Care should be taken that soil is not scrapped from side if rodding is done for compaction. Vibrators shall not generally be used unless specified specifically.

When concreting is carried out under water, a temporary casing should be installed to the full depth of the bore hole or 2 to 3 M into the top stratum, so that fragments of ground cannot drop from the sides of the hole into the concrete as it is placed.

4. MODE OF MEASUREMENT OF PILES

The piles shall be measured in running metres from the pile cut-off level to the founding level or as specified in BOQ/contract. The rates quoted for piling work shall include the cost of concrete, hire charges of tools and plants, bailing out of water, breaking of pile heads to required level and shape, breaking, cutting through and removing the boulders or any other obstructions, if met with before reaching the required founding level etc. complete and as specified.