MUNICIPAL CORPORATION OF GREATER MUMBAI

CITY ENGINEER'S AND CHIEF ENGINEER'S DEPARTMENT (BM)

VOLUME-II

SPECIFICATIONS FOR

COMMON AND BUILDING CONSTRUCTION WORKS

2018

GENERAL NOTES

A. COMMON GENERAL NOTES

1. The schedule of rates will be operative from 01/05/2018
2. The unified schedule of rates includes following department:
   i. Buildings
   ii. Water Supply Projects
   iii. Hydraulic Engineering
   iv. Sewerage Projects
   v. Storm Water Drainage
   vi. Roads
   vii. Bridges
   viii. Traffic and Signals
   ix. Mechanical and Electrical
   x. Garden Works
3. Volume-I contains USR, basic rate list and approved makes and Volume-II contains specification along with drawings wherever necessary and mandatory tests.
4. The specification of the items shall be as per latest Indian Standard Codes unless otherwise specified.
5. The rates of the items in this schedule of rates are worked out assuming average lead for Greater Mumbai area for all sorts of materials.
6. The rates are inclusive of transportation, duties, taxes and charges of all Government, Municipal or any other statutory body, applicable from time to time but exclusive of Works Contract Tax and Labour Cess levied by Government of Maharashtra.
7. The rates also includes Overheads @ 5% and Contractor's Profit @10% which is inclusive of labour supervision charges, tools and plants.
8. Rates of common material and labour is attached in the Annexure-A in Volume-I.

9. The building Schedule of Rates 2018 includes the existing items of FMA, FMB 2009, USOR 2013, Retrofitting works item with deletion of obsolete items, merger of similar items Fair items for HIC and value addition of new items in line with modern technology and trends in accordance with latest rules, regulation, byelaws etc.

10. As per the Government policy the use fly ash is done for framing the items of work in accordance with the latest provisions of IS Codes. Also green building items have been introduced in new schedule to minimize the consumption of energy during construction and occupancy of building and also maintaining ecological balance.

11. From safety, health and environment point of view two legged steel tubular scaffolding shall be used, without making any holes in the outer face of the building or any structure. And no extra payment shall be made for works like scaffolding, centering for any height unless otherwise specified.

12. All materials shall be as per approved list of MCGM or equivalent material having quality standards as per relevant IS codes and shall be of first quality unless otherwise specified.

13. Following basic rates are considered in the USR:

    i. Cement : Rs. 6,000/ MT

    ii. Mild Steel : Rs. 47,400/ MT

    iii. HYSD Steel (Fe415) : Rs. 48,400/ MT

    iv. T.M.T. (Fe500) : Rs. 49,400/ MT

    v. Structural Steel : Rs. 53,400/ MT

14. **Rates given in SOR are for estimation purpose. The rates should be finalized with the items uploaded on SAP System.**

15. Rates of items and specification for excavation, concrete, plaster and brickwork shall be referred from common schedule unless and otherwise not mentioned in concerned department's schedule.

    <u>For Earthwork:</u>

16. Lead will be admissible only within MCGM limits. The distance between centerlines shall be taken as the lead which shall be measured by the shortest route on the plan and not the actual route taken by the Contractor. Here

Centerlines represents the center point (for area/mass excavation) and the center chainage for linear excavation.

17. The Engineer In Charge shall exclusively include these directions in the Tender/Bid document and the Tenders/Bidders shall be insisted to make the declaration of the dumping plot at the time of submission of Bid.

18. The Engineer In Charge shall take the quantity in account for the disposal only upto Municipal Limits for the Shortest Route and payment will be made as per the actual distance within municipal limit. The payment will be restricted to the shortest distance upto the Municipal limit for the plot identified outside the Municipal limit.

<u>For Lift:</u>

19. For the depth beyond 1.5 meter, the excavated quantity shall be worked out with the base rate plus the rate of respective slab of the lift. This is elaborated as below:

If total depth of excavation is 6 meter, wherein for first 4.5 meter soft soil is there and beyond it hard rock is available, then estimate shall be worked out as follows:

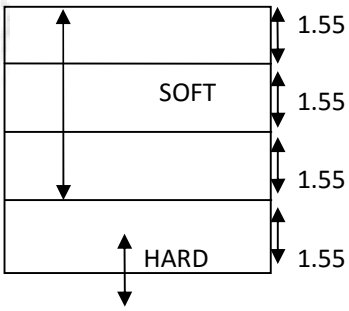
Assumed dimension 1 meter x 1 meter x 6 meter

Upto 4.5 meter depth, amount shall be calculated as:

(1x1x4.5) Cu.M x Rs. 220 (Item no. CS-EW-1) +

(1x1x1.5) Cu.M x Rs. 48 (Item no. CS-EW-2-a) +

(1x1x1.5) Cu.M x Rs. 71 (Item no. CS-EW-2-b)



For next hard strata excavation (4.5 – 6.0 meter), amount shall be calculated as:

(1x1x1.5) Cu.M x Rs. 873 (Item no. CS-EW-4) +

(1x1x1.5) Cu.M x Rs. 220 (Item no CS-EW-7-c)

20. Coding of items:

- The Coding procedure for Basic master material is as follows:
  - Code will start with the common prefix of “MA” which stands for materials

- Followed by Abbreviation code for each schedule of rate for eg H.E. for Building works, SP for Sewerage, WSP for water supply and so on and so forth.
- The first item category in the list will be numbered as “1”
- The last part of the code will be a number starting with “a” to indicate the item number in the master list.
- The alpha numerics will be separated by (dash).
- The code will look like: MA-GN-01

➢ The Coding procedure for SOR is as follows:

- Code will start from abbreviation for Department name “HE” or “WSP” or “SP”
- The USR will be subdivided into chapters according to the item classification; these chapters will be numbered as 1, 2, 3 …..
- The items under the chapter will be numbered from 1
- The sub items will be numbered as a, b, c ….
- The code will look like R2-CS-CW-1-a-1

➢ Abbreviations to be used for Department

Sr. No.	Department	Abbreviation
1	Building works/Common Schedule	CS
2	Roads	RW
3	Traffic and Signaling	RT
4	Bridges	BW
5	Water Supply Projects	WSP
6	Hydraulic Engg.	HE
7	Sewerage Projects	SE
8	Storm Water Drains	SWD
9	Mechanical and electrical	ME
10	Garden Works	GW

B. SALIENT FEATURES OF SOR FOR BUILDING WORKS

1) All the rates are for all heights and levels unless noted otherwise.
2) Chloropyrifos EC 20 has been considered for anti termite treatment.
3) Artificial sand (crushed sand) has been considered for flooring bedding and for concrete work.
4) All the items are excluding fixtures otherwise not specified in respective item. In such case, items of Hardware section shall be used for fixtures.
5) For plastering and mortar work, river sand has been considered.
6) For plastering work all the rates are for all heights and levels and architectural decorative surface.
7) All external plaster items are including waterproofing compound except plastering item for structures like compound wall, masonry pedestals, pillars, etc.
8) Items for ashlar masonry, dewatering, self compacting concrete, vacuum dewatered concrete flooring and TMT steel bars have been introduced.
9) Rates of all the items in roofing work are inclusive of staging or scaffolding for any height.
10) Non-asbestos cement sheet provided in place of asbestos cement sheet roofing.
11) Concreting of pile shall be done with RMC only.
12) Rates of piling are inclusive of Chiseling of intermediate local boulders. No separate payment shall be made for the same
13) While estimating the quantity for Grouting of bentonite slurry in bored precast piles shall be measured as per bore dia. and pile dia. Exact quantity can be measured while execution and shall be paid accordingly
14) Rates considered in concrete items are including pumping of concrete upto placing point.
15) New items like Self compacting concrete, vacuum dewatered concrete flooring and TMT steel bars have been introduced.
16) The dismantling and demolishing chapter covers only removing old items and repair work covers both removing old items and re-fixing the new.
17) For heritage works the rate includes the statutory charges for heritage committee and conservation architect and no extra payment will be made.
18) APP (Atactic poly-propylene) modified polymeric membrane water proofing will be used only for trial basis on approval of City Engineer and/or Chief Engineer (P&D).
19) In plumbing waterless urinals, fly ash bricks, fly ash concrete for green building concept have been introduced.

Star Rating:

In view of ambiguity related to choice of quality or grade of materials and subsequent items of works to be used at Ward level projects, Centralized projects or Special projects of and for smooth functioning during planning stage of a project, the new concept of Star Rating has been introduced for building works depending on the life expectancy of building, degree of occupancy of building and comfort to the end user. The buildings or structures rated are as follows:

i. Two Star **- Ward offices and Central dept. Offices, schools, Small Hospitals, Primary Health Center, Fire Station, Crematorium, Slaughter Houses, Markets, Swimming Pools, Zoos, Chowkies, Libraries, Staff quarters and residential colonies, Public Toilets and Water tanks.

ii. Three Star ***- Super specialty Hospitals, Drama Theatres, MCGM Mayor's and Officer's bungalow, Heritage Structures, Head Office and Engineer's Hub.

The items or work not marked as two star or three star are assumed to be applicable for all the star buildings or structures mentioned above.

For 3 star rating items specific approval of Dir.(ES&P) shall be taken

Annexure – I:

The items under Annexure -1 contains some specialised unique brand items. **Prior approval of AMC (WS) is needed for using these items.**

	MUNICIPAL CORPORATION OF GREATER MUMBAI	VOLUME-II
	City Engineer and Chief Engineer (BM) Department Specifications for Common and Building Construction Works	

Chapter -1

Anti-termite Termite

1. SCOPE

1.1. This specification covers the general requirements for Anti-termite Constructional Measures, chemical treatment of soils for the protection of buildings from attack by subterranean termites, chemicals to be used with their minimum rates of application and procedure to be followed for treatment.

2. APPLICABLE CODES AND SPECIFICATIONS

The following codes, standards and specifications are made a part of this specification. All specifications, standards, codes of practices referred to herein shall be the latest edition including all applicable official amendments and revisions. In case of discrepancy between this specification and those referred to herein, this specification shall govern:

IS:6313 Part I	-	Code of Practice for Anti-termite Measures in Buildings Constructional Measures
IS:6313 Part II	-	Code of Practice for Anti-termite Measures in Buildings Pre-constructional Chemical Treatment Measures
IS:6313 Part III	-	Code of Practice for Anti-termite Measures in Buildings Treatment for Existing Buildings
IS:8944	-	Specification for Chloropyrifos Emusifiable Concentrates.
IS:4015 Part I	-	Guide for Handling cases of Pesticide Poisoning First Aid Measures.
IS:4015 Part II	-	Symptoms, Diagnosis and Treatment.

3. GENERAL

Place of Application

The Anti-termite treatment shall be provided for pre and post construction activities for masonry foundations, pits of column foundations, wall trenches, basements, top surface of plinth filling, junction of wall and floor, soil along external periphery of the building and under apron, expansion joints, soil surrounding pipes and conduits, junction of masonry wall and wooden frames of door and window, junction of wooden beam / joist and masonry wall, etc.

The Pest control services shall be provided for buildings, small size chambers and big size chambers.

3.1. Contractor shall furnish all tools, plants, instruments, qualified supervisory personnel. Labour, materials, any temporary works, consumables, any and everything necessary whether or no such

items are specifically stated herein for completion of the job in accordance with specification requirements.

3.2. All work shall be done in the order of progress required by Owner's construction programme.

3.3. Contractor shall take all necessary precautions to prevent any accident in connection with the performance of the work.

3.4. On final completion of all work, Contractor shall leave the entire premises within the site of his operation clean and free from all rubbish resulting from his operation.

3.5. Owner reserves the right to inspect, check and direct any or all operations at any stage of the work and to require unsatisfactory work to be remedied at Contractor's expense.

3.6. No work shall be carried out under unsuitable weather conditions viz. when raining or when the soil is wet due to rain or sub-soil water.

3.7. Chemicals shall be brought to site of work in sealed original containers. The materials shall be brought in, at a time, in adequate quantity to suffice for the work. The material shall be kept in cool and locked stores. The empties shall not be removed from the work site till the relevant item of work has been completed and permission granted by Owner/ Engineer.

3.8. Chemicals available in concentration forms with concentration indicated on the sealed containers only shall be used. Chemicals shall be diluted with water in required quantity before use, using graduated containers to achieve the desired percentage of concentration:

Examples:

Chloropyrifos 20: 1 Lit. is diluted to 20 Lit. to give 1.0% emulsion.

4. PRECONSTRUCTIONAL CHEMICAL TREATMENT

4.1. GENERAL: The item pertains to providing pre-constructional antitermite treatment to building at different stages of construction by applying different appropriate chemicals as per provision in IS:6313 (Part I-II) 1981. The item also covers the treatment to soil.

4.2. ESSENTIAL REQUIREMENTS

4.2.1. Hand operated pressure pump with graduated containers shall be used to ensure uniform spraying of the chemical. Continuous check shall be kept to ensure that the specified quantity of chemical is used for the required area during the operation.

4.2.2. **Condition of Formation**:

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

4.2.3. **Time of Application:**

Soil treatment shall start when the foundation trenches and pits are ready to receive mass concrete in foundations. Laying of mass concrete shall start when the chemical emulsion has

been absorbed by the soil and the surface is quite dry. Treatment shall not be carried out when it is raining or soil is wet with rain or sub-soil water. The foregoing also applies in the case of treatment to the filled earth surface within the plinth before laying the subgrade for the floor.

4.2.4. **Disturbance:**

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

4.3. MATERIAL

4.3.1. **Chemicals:**

Following chemical shall be used for preparing water emulsion to achieve the percentage concentration specified against each chemical shall be used for anti-termite treatment.

Chemical	**Standard**	**Relevant Indian**	**Concentration by Weight Percent**
a. Chloropyrifos 20 EC	IS: 8944-1978		1% concentrate

Chemicals are available in concentrated form in the market and concentration is indicated on the sealed containers. To achieve the specified percentage of concentration, chemical should be diluted with water in required quantity before it is used.

Graduated containers shall be used for dilution of chemicals with water in the required proportion to achieve the desired percentage of concentration. For example, to dilute chemical of 30% concentration, 69 parts of water shall be added to one part of chemical for achieving 0.5% concentration.

Contractor shall procure the chemical of required concentration in sealed original containers directly from the reputed authorized dealers. The chemical shall be kept in the custody of the contractor or his authorized representatives and issued for use to meet the day's requirements. Empty containers shall be property of contractor.

4.2.2 **Safety Precautions:**

All chemicals used for anti-termite treatment are POISONS. These chemicals can have an adverse effect upon health when absorbed through the skin, inhaled as vapours or spray mists or swallowed.The containers having emulsifiable concentrates shall be clearly labelled and kept secured in closed stores so that children or pet cannot get at them. Storage and mixing of concentrates shall not be done near any fire source or flame. Persons using these chemicals shall be warned that absorption through skin is the most likely source of accidental poisoning. Particular care shall be taken to prevent skin contact with concentrates and prolonged exposure to dilute emulsion shall also be avoided for which safety gloves shall be provided to the work man. After handling the concentrates or dilute emulsion, workers shall wash themselves with soap and water and wear clean clothing, especially before eating and smoking. In the event of

severe contamination, clothing shall be removed at once and the skin washed with soap and water. If chemical has splashed into the eyes they shall be flushed with plenty of soap and water and immediate medical attention shall be sought. The use of plain pair of spectacles or goggles be provided to the workman. Care should be taken in the application of chemicals to see that they are not allowed to contaminate wells or springs, which serve as source of drinking water. The work shall be carried through Sub Agency registered with appropriate authority. The person executing this job should be provided appron, pair of hand gloves, mask, safety specs etc.

4.4. CHEMICAL TREATMENT

4.4.1. Chemical treatment of soils for the protection of buildings from attack of subterranean termites shall be done as per IS: 6313 (Part II)-1981. Treatment shall be got done only from the approved specialized agencies using the chemicals procured from reputed and authorized dealers. Graduated containers shall be used for dilution and spraying of the chemical shall be done using hand operated pressure pumps. Proper check should be kept to ensure that the specified quantity of chemical is used for the required area during the operation.

4.4.2. **Chemical Methods**

(a) Mound Treatment

Termite mounds within the plinth and contingent apron area shall be destroyed by means of insecticides in the form of water suspension or emulsion which shall be poured into the mounds at several places after breaking open the earthen structure and making holes with crow bars. For a mound volume of about one cum., four Lit. of an emulsion in water of 1% Chloropyrifos 20 EC shall be used.

b) Soil Treatment

The following chemical (conforming to Indian Standards) in water emulsion shall be applied uniformly over the area to be treated.

Chemical	**Relevant Indian**	**Concentration by weight percent**
Chloropyrifos	IS: 8944-1978	1% concentrate

4.4.3. **Treatment of Masonry Foundations, Column-pits, Wall-trenches and Basements:**

a) The bottom surface and the sides (up to a height of 300 mm) of the excavations made for masonry foundations and basements shall be treated with the chemical at the rate of 5 litres per square meter surface area.

b) After the masonry foundations and the retaining wall of the basements come up, the backfill in the immediate contact with the foundation structure shall be treated at the rate of 7.5 liters per m^2 of the vertical surface of the substructure for each side. If water is used for ramming, the air fill, the chemical treatment shall be carried out after the ramming iteration is done by rodding the earth at 150mm centres close to the wall surface and spraying the chemical with the above

dosage. The earth is usually returned in layers and the treatment shall be carried out in similar stages of back filling. The chemical emulsion shall be directed towards the concrete or masonry surfaces of the columns and walls so that the earth in contact with these surfaces is well treated with the chemical.

c) In the case of R.C.C. framed structures with columns and plinth beams and R.C.C. basements, with concrete mix 1:2:4 or richer, the treatment shall start at the depth of 500 mm below ground level for columns and plinth beams. From this depth the back-fill around the columns, beams and R.C.C basement walls shall be treated at the rate of 7.5 Lit./sqm of vertical surface. The other details of treatment shall be as laid down in clause (b) above.

4.4.4. **Treatment of Top Surface of Plinth Filling:**

The top surface of the filled earth within the plinth walls shall be treated with chemical emulsion at the rate of 5 liters per m^2 of the surface before the sand/sub-grade is laid. Holes up to 50 to 75 mm deep at 150 mm centres both ways shall be made with crow bars on the surface to facilitate saturation of the soil with chemical emulsion.

4.4.5. **Treatment of Junction of Wall and The Floor:**

To achieve continuity of the vertical chemical barrier on inner wall surfaces from the ground level, a small channel 30 x 30 mm shall be made at all the junctions of walls and columns with the floor (before laying the sub-grade) and rod holes made in the channel up to ground level 150 mm apart and the chemical emulsion poured along the channel @ 7.5 liters per m^2 of the vertical wall or column surface so as to soak the soil right to bottom. The soil shall be tamped back into place after this operation.

4.4.6. **Treatment of Soil Along External Perimeter of Building:**

After the building is complete, 300 mm deep holes shall be provided in the soil with iron rods along the external perimeter of the building at intervals of about 150 mm and these holes shall be filled with chemical emulsion at the rate of 7.5 liters per m^2 of vertical surfaces. If the depth of filling is more than 300 m, the external perimeter treatment shall extend to the full depth of filling up to the ground level so as to ensure continuity of the chemical barrier. In case the earth outside the building is graded on completion of building, this treatment shall be carried out on completion of such grading.

4.4.7. **Treatment of Soil Under Apron Along External Perimeter of Building:**

Top surface of the consolidated earth over which the apron is to be laid shall be treated with chemical emulsion at the rate of 5 litres per square metre of the surface before the apron is laid. If consolidated earth does not allow emulsion to seep through, holes up to 50 to 75 mm deep at 150 mm centres both ways may be made with 12 mm diameter mild steel rod on the surface to facilitate saturation of the soil with the chemical emulsion

4.4.8. **Treatment for Expansion Joints:**

Anti-termite treatment shall be supplemented by treating through the expansion joint after the sub-grade has been laid at the rate of 2 Lit. per linear meter of expansion joint.

4.4.9. **Treatment of Walls Retaining Soil above Floor Level:**

Retaining walls like the basement walls above the floor level retaining soil need to be protected by providing chemical barrier by treatment of retained soil in the immediate vicinity of the walls, so as to prevent entry of termites through the voids in masonry, cracks and crevices, etc. above the floor level. The soil retained by the walls shall be treated at the rate of 7.5 litres per m^2 of the vertical surface so as to effect a continuous outer chemical barrier, in continuation of the one formed under 4.3.3 and 4.3.5.

4.4.10. **Treatment of Soil Surrounding Pipes and Conduits:**

When pipes and conduits enter the soil inside the area of the foundations, the soil surrounding the points of entry shall be loosened around each such pipe water or conduit for a distance of 150 mm and to a depth of 75 mm before treatment is commenced. When they enter the soil external to the foundations, they shall be similarly treated for a distance of over 300 mm unless they stand clear of the walls of the buildings by about 75 mm.

4.5. ITEM TO INCLUDE:

4.5.1. The item includes providing all labour, material, tools & equipments etc. for above anti-termite treatment. Item also includes all precautions while dealing with the poisonous chemicals. The Contractor shall give a ten years service guarantee in writing supplemented by a separate and unilateral guarantee from the specialized agency for the job to keep the building free of termites for the specified period at no extra cost to the MCGM.

4.6. MEASURMENTS

4.6.1. The measurements shall be made in sq.m on the basis of plinth area of the building at ground floor only for all operations described above. Nothing extra shall be measured.

5. ANTI-TERMITE TREATMENT TO THE PERIPHERY OF THE EXISTING BUILDING

5.1. GENERAL: The item pertains to providing anti-termite treatment around the periphery of the existing building as per provision in IS:6313 (Part-Ill).

5.2. MATERIAL:

5.2.1. The same shall be read as per clause 4.3.1 of this specification

5.2.2. **Safety Precautions**: They shall be read as per clause 4.2.2 of this specification

5.3. TREATMENT AROUND THE PERIPHERY OF THE EXISTING BUILDING:

The soil in contact with the external wall of the building shall be treated with chemical emulsion at the rate of 2.25 Lit. per meter length of the sub-structure to a depth of 300 mm. To facilitate this treatment a shallow trench of 20 mm shall be excavated along and close to the wall face. The chemical emulsion shall be directed towards the wall at 1.75 Lit. per running meter of the channel. Rodding with 12 mm diameter mild steel roads a 150 mm apart shall be done in the channel, if necessary, for uniform dispersion of the chemical to 300 mm depth from the ground level. The balance chemical of 0.5 Lit. per running meter shall then be used to treat the backfill earth as it is returned to the channel directing the spray towards the wall surface.

If there is a concrete to masonry apron around the building, approximately 20 mm diameter holes shall be drilled as close as possible to the plinth wall about 300 mm apart, deep enough to reach the so below and the chemical emulsion pumped into these holes to soak the soil below at the rate of 2.25 Lit. per linear meter.

In case of RCC framed structures, the soil (backfill) in contact with the column sides and plinth beams along the external perimeter of the building shall be treated with chemical emulsion at the rate of 7.5 Lit./sqm. of the vertical surface of the structure. To facilitate this treatment, trenches shall be excavated equal to the width of the shovel exposing the sides of the column and plinth beams up to a depth of 300 mm or up to the plinth beams, if this level is less than 300 mm. The chemical emulsion shall be sprayed on the backfill earth as is returned into the trench direction the spray again the concrete surface of the beam as the case may be.

Treatment of Voids in Masonry:

The movement of termites through the masonry wall may be arrested by drilling holes in masonry work at plinth level and squirting chemical emulsions into the holes to soak the masonry. The holes shall be drilled at angle of 45° from the both sides of the plinth wall at 1000 mm intervals and emulsion squirted through the holes to soak the masonry using a hand operated pump. This treatment shall also be extended to internal walls having foundations in the soil. Holes shall also be drilled at wall corners and where door and window frames are embedded in the masonry or floor at ground. Emulsion shall be squirted throughout the holes till saturation or to a maximum of one Lit. per hole. Care shall be taken to seal the holes after the treatment.

5.4. ITEM TO INCLUDE:

The item includes providing all labour, material, tools & equipments etc. for anti-termite treatment around the periphery of the existing building. Item also includes all precautions while dealing with the poisonous chemicals. The two years service guarantee in writing supplemented by a separate and unilateral guarantee from the specialized agency is also covered in the item.

5.5. MEASUREMENT:

All measurements shall be number of holes drilled and treated as per the specifications.

6. ANTI-TERMITE TREATMENT TO SIDES OF THE FLOORING OF THE EXISTING BUILDING

6.1. GENERAL: The item pertains to providing anti-termite treatment to the soils below the flooring as per provisions in IS: 6313 (Part-III).

6.2. MATERIAL:

6.2.1. The same shall be read as per clause 4.3.1 of this specification

6.2.2. **Safety Precautions:** They shall be read as per clause 4.2.2 of this specification

6.3. TREATMENT OF SOIL UNDER FLOORS :

Chemical treatment shall be done by drilling or punching 6 mm holes near the junction of floor and walls along the cracks of the floor if any and at the interval of 30 cm to reach the soil below. Chemical chlordane emulsion shall be squirted into these holes using a hand operated pressure pump to soak the soil below up to a 50 ml per hole. The holes shall then be sealed proper with cement mortar 1:2 (1 cement: 2 coarse sand) finished to match the existing floors. The cement mortar applied shall be cured for at least 10 days per instruction of Engineer-in-Charge.

6.4. ITEM TO INCLUDE:

The item includes providing all labour, material, tools & equipments etc. for anti-termite treatment of soils under the floor. Item also includes all precautions while dealing with the poisonous chemicals. The two years service guarantee in writing supplemented by a separate and unilateral guarantee from the specialized agency is also covered in the item.

6.5. MEASUREMENT:

All measurements shall be perimeter in meter of the building treated as per the specifications.

7. ANTI-TERMITE TREATMENT TO THE WOODEN FRAMES, BEAMS/ JOISTS

7.1. GENERAL:

The item pertains to providing anti-termite treatment to the wooden frames of doors and windows as per provision in IS: 6313 (Part-Ill).

7.2. MATERIAL:

7.2.1. The same shall be read as per clause 4.3.1 of this specification except the base for emulsion shall be kerosene or oil instead of water.

7.2.2. **Safety Precautions:** They shall be read as per clause 4.2.2 of this specification

7.3. TREATMENT WOOD WORK:

Frames of Doors and Windows: All existing wood work in the building which is in contact with the floor or walls and which is infected by termites, shall be treated by injecting at the points of contacts with the adjoining masonry with the chemical emulsion by drilling 3mm holes at a downward angle of about 45° at the junction of wood work and masonry and squirting chemical emulsion into these holes till refusal. The treated holes shall then be sealed.

7.4. ITEM TO INCLUDE:

The item includes providing all labour, material, tools & equipments etc. for anti-termite treatment of wooden frames and junction of beams/joist. Item also includes all precautions while dealing with the poisonous chemicals. The two years service guarantee in writing supplemented by a separate and unilateral guarantee from the specialized agency is also covered in the item.

7.5. MEASUREMENT:

If anti termite treatment provided to the junctions of joists / beams, the unit of measurement shall be in number of joints treated. The contract rate shall be per running meter of frames of doors and windows treated.

8. PEST CONTROL SERVICE TO THE BIG SIZE INSPECTION CHAMBER

8.1. GENERAL:

The item pertains to providing General Pest Control Service to the Buildings.

8.2. PEST CONTROL SERVICES:

Pest control Services are provided by some recognized companies such as Pest Control of India. Other local companies of experience and proven records may be selected for the Pest control work.

The Pest control of the any type of buildings is covered under this item. The company may use the chemicals and the concentration according to their standards and experience. The pest control shall be expected to be effective for one year period. The contractor is expected to check up the effectiveness of the pest control by periodical inspection of inspection chamber at least once in a month. If found necessary during check up, the corrective measures shall be immediately taken up. If nuisance of cockroaches and other insects persists and called by MCGM for the pest control services, the Agency / contractor shall have to reapply the pest control chemicals etc. The persons preparing solution and spraying the same shall be provided with apron, gloves, specs, mask etc.

8.3. ITEM TO INCLUDE:

The same shall be read as per clause 7.4 of this specification.

8.4. MEASUREMENT:

The measurements shall be in number of big size inspection chambers treated as per the specifications. The period of services shall be one year.

9. PEST CONTROL SERVICE TO THE SMALL SIZE INSPECTION CHAMBER

9.1. GENERAL:

The item pertains to providing General Pest Control Service to small size inspection chamber.

9.2. PEST CONTROL SERVICES:

Pest control Services are provided by some recognized companies such as Pest Control of India. Other local companies of experience and proven records may be selected for the Pest control work.

The Pest control of the big size inspection chambers less than 1 cum of volume are covered under this item. The company may use the chemicals and the concentration according to their standards and experience. The pest control shall be expected to be effective for one year period. The contractor is expected to check up the effectiveness of the pest control by periodical inspection of inspection chamber at least once in a month. If found necessary during check up, the corrective measures shall be immediately taken up. If nuisance of cockroaches and other insects persists and called by MCGM for the pest control services, the Agency / contractor shall have to reapply the pest control chemicals etc. The workman preparing solution and spraying shall be provided with apron, mask, specs, gloves etc.

9.3. ITEM TO INCLUDE:

The item includes providing all labour, material, tools & equipments etc. for pest control treatment of small size inspection chamber, including all precautions while dealing with the poisonous chemicals. The period of services for 1 year are covered under this item. All safety precautions shall be scrupulously followed.

9.4. MEASUREMENT: The measurements shall be in number of small size inspection chambers treated as per the specifications. The period of services shall be one year.

END.

Chapter -2

Earth Work

1. SCOPE

1.1. This specification covers the general requirements of earthwork in excavation in different materials, site grading, filling in areas as shown in drawing, filling back around foundations and in plinths, pipe / cable lines etc., conveyance and disposal of surplus soils or stacking them properly as directed by the Engineer-in-charge and all operations covered within the intent and purpose of this specification.

2. GENERAL

2.1. The following Indian Standard Codes, unless otherwise specified herein, shall be applicable. In all cases, the latest revision of the codes shall be referred to.

IS 783	-	Code of practice for laying of concrete pipes.
IS 1200	-	Method of measurement of building and civil Engineering works.
(Part 1)		Part 1 Earthwork
(Part 27)		Part 27 Earthwork done by mechanical appliances.
IS 3764	-	Excavation work-code of safety.
IS 4081	-	Safety code for Blasting and related drilling operation.
IS 2720	-	Methods of test for soils:
(Part 1)	-	Preparation of dry soil samples for various tests.
(Part 2)	-	Determination of water content.
(Part 4)	-	Grain size analysis.
(Part 5)	-	Determination of liquid and plastic limit.
(Part 7)	-	Determination of water content-dry density relation using light compaction.
Part (9)	-	Determination of dry density - moisture content relation by constant weight of soil method.
(Part 14)	-	Determination of density index (relative density) of cohesionless soils.

(Part 28) - Determination of dry density of soils in place, by the sand replacement method.

(Part 33) - Determination of the density in place by the ring and water replacement method.

(Part 34) - Determination of density of soil in place by rubber balloon method.

(Part 38) - Compaction control test (Hilf Method).

2.2. **General:** The Contractor shall furnish all tools, plants, instruments, qualified supervisory personnel, labour, materials, any temporary works, consumables, any and everything necessary, whether or not such items are specifically stated herein for completion of the job in accordance with the specification requirements.

2.3. The Contractor shall carry out the survey of the site before excavation and set out properly all lines and establish levels for various works such as earthwork in excavation for grading, basement, foundations, plinth filling, roads, drains, cable trenches, pipelines etc. Such survey shall be carried out by taking accurate cross sections of the area perpendicular to established reference/ grid lines at 5 m. intervals or nearer as directed by the Engineer based on ground profile. These shall be checked by the Engineer and thereafter properly recorded.

2.4. The excavation shall be done to correct lines and levels. This shall also include, where required, proper shoring to maintain excavations and also the furnishing, erecting and maintaining of substantial barricades around excavated areas and warning lamps at night for ensuring safety.

2.5. The rates quoted shall also include for dumping of excavated materials in regular heaps, bunds, riprap with regular slopes as directed by the Engineer-in-charge, within the lead specified and levelling the same so as to provide natural drainage. Rock/ soil excavated shall be stacked properly as directed by the Engineer-in-charge. As a rule, all softer material shall be laid along the centre of heaps, the harder and more weather resisting materials forming the casing on the sides and the top. Rock shall be stacked separately.

3. DEFINITIONS

3.1. **Deadmen or Tell Tales:** Mounds of earth left undisturbed in pits dug out for borrowing earth.

3.2. **Burjis:** Short pillars of brick/ stone having top surface finished with cement plaster for marking etc.

3.3. **Formation or Profile:** Final shape of the ground after excavation or filling up.

3.4. **Foul condition:** Filthy and unhygienic conditions where physical movements are hampered such as soil mixed with sewage or night soil.

3.5. **Lead:** Lead for deposition / disposal of excavated material, shall be as directed by the Engineer-in-charge. For the purpose of measurement of lead, the area to be excavated or filled or area on which excavated material is to be deposited/ disposed off shall be divided into suitable blocks as approved by Engineer-in-charge and for each of the blocks, the distance between centrelines shall be taken as the lead which shall be measured by the shortest route on the plan and not the actual route taken by the Contractor. No extra compensation is admissible on the grounds that the lead including that for borrowed material had to be transported over marshy or 'kacha' land / route.
Carriage by manual labor shall be reckoned in units of 50 meters or part thereof.
Carriage by animal and mechanical transport shall be reckoned in one km. unit. Distances of 0.5 km. or more shall be taken as 1 km. and distance of less than 0.5 km. shall be ignored.
However, when the total lead is less than 0.5 km., it will not be ignored but paid for separately in successive stages of 150 meters subject to the condition that the rate worked on this basis does not exceed the rate for initial lead of 1 km. by mechanical/animal transport.

3.6. **Lift:** The vertical distance for removal with reference to the ground level. The excavation up to 1.5 meters depth below the ground level and depositing the excavated materials upto 1.5 meters above the ground level are included in the rate of earth work. Lifts inherent in the lead due to ground slope shall not be paid for.

3.7. **Safety rules:** Safety rules as laid down by the statutory authority and as provided in National Building Code (NBC) shall be followed.

4. CLASSIFICATION OF SOILS

4.1. The earthwork shall be classified under the following categories and measured separately for each category:

4.1.1. **All kind of soils:** Generally any strata, such as sand, gravel, loam, clay, mud, black cotton, murum, shingle, river or nallah bed boulders, siding of roads, paths etc. and hard core, macadam surface of any description (water bound, grouted tarmac etc.), lime concrete and their mixtures which for excavation yields to application of picks, shovels, jumper, sanctifiers, ripper and other manual digging implements.

4.1.2. **Ordinary rock:** Generally any rock which can be excavated by splitting with crow bars or picks and does not require blasting, wedging or similar means for excavation such as lime stone, sand stone, hard laterite, hard conglomerate and un-reinforced cement concrete below ground level. If required light blasting may be resorted to for

loosening the materials but this will not in any way entitle the material to be classified as 'Hard rock'.

4.1.3. Hard rock: Generally any rock or boulder for the excavation of which blasting is required such as quartzite, granite, basalt, reinforced cement concrete (reinforcement to be cut through but not separated from concrete) below ground level .

4.1.4. **Hard rock (blasting prohibited):** Hard rock requiring blasting as described under (c) but where the blasting is prohibited for any reason and excavation has to be carried out by chiseling, wedging, use of rock hammers and cutters or any other agreed method.

4.2. **Authority for Classification:**
The classification of excavation shall be decided by the Engineer-in-charge and his decision shall be final and binding on the contractor. Merely the use of explosive in excavation will not be considered as a reason for higher classification unless blasting / chiseling is clearly necessary in the opinion of the Engineer-in-charge. All the excavated material shall be the property of the Municipal Corporation of Greater Mumbai.

5. PRECIOUS OBJECTS, RELICS, OBJECTS OF ANTIQUITY, ETC.

5.1. All gold, silver, oil, minerals, archaeological and other findings of importance, trees cut or other materials of any description and all precious stones, coins, treasures, relics, antiquities and other similar things which may be found in or upon the site shall be the property of the Municipal Corporation of Greater Mumbai or government as per the statutory provisions and the Contractor shall duly preserve the same to the satisfaction of the Engineer-in-charge and from time to time deliver the same to such person or persons as the Owner may from time to time authorise or appoint to receive the same.

6. PROTECTIONS

6.1. Excavation where directed by the Engineer-in-Charge shall be securely barricaded and provided with proper caution signs, conspicuously displayed during the day and properly illuminated with red lights and/or written using fluorescent reflective paint as directed by engineer in charge during the night to avoid accident.
The contractors shall take all precautions to keep all the blinkers working throughout the night for the guidance of the traffic in the following manner. No extra payment will be made for such protection works. The contractors should take this in account while quoting for the tender.

- All blinkers shall be red in colour.
- At least two blinkers shall be provided across the direction of the traffic.

6.2. The Contractor shall take adequate protective measures to see that the excavation operations do not damage the adjoining structures or dislocate the services. Water supply pipes, sluice valve chambers, sewerage pipes, manholes, drainage pipes and chambers, communication cables, power supply cables etc. met within the course of excavation shall be properly supported and adequately protected, so that these services remain functional. However, if any service is damaged during excavation shall be restored in reasonable time without extra cost.

6.3. Excavation shall not be carried out below the foundation level of the adjacent buildings until underpinning, shoring etc. is done as per the directions of the Engineer-in-Charge for which payment shall be made separately.

6.4. Any damages done by the contractor to any existing work shall be made good at his own cost. Existing drains pipes, culverts, over head wires, water supply lines and similar services encountered during the course of execution shall be protected against damage by the contractor and shall not be paid for it. The contractor shall not store material or otherwise occupy any part of the site in manner likely to hinder the operations of such services.

6.5. The noise level shall be maintained within the permissible limit in Silence zone area during the construction activities by the Contractors, as per the notification dated 14.02.2000, issued by the Ministry of Environment & Forests.

7. SITE CLEARANCE

7.1. Before the earth work is started, the area coming under cutting and filling shall be cleared of shrubs, rank vegetation, grass, brushwood, trees and saplings of girth up to 30cm measured at a height of one meter above ground level and rubbish removed up to a distance of 50 meters outside the periphery of the area under clearance. The roots of trees and saplings shall be removed to a depth of 60cm below ground level or 30 cm below formation level or 15 cm below sub grade level, whichever is lower, and the holes or hollows filled up with the earth, rammed and leveled.

7.2. The trees of girth above 30 cm measured at a height of one meter above ground shall be cut only after permission of the Engineer-in-Charge is obtained in writing. The roots of trees shall also be removed as specified in 7.1, payment for cutting such trees and removing the roots shall be made separately.

7.3. Existing structures and services such as old buildings, culverts, fencing, water supply pipe lines, sewers, power cables, communication cables, drainage pipes etc. within or adjacent to the area if required to be diverted/ removed, shall be diverted/ dismantled as per directions of the Engineer-in-Charge and payment for such diversion/ dismantling works shall be made separately.

7.4. In case of archaeological monuments within or adjacent to the area, the contractor shall provide Necessary fencing all around such monuments as per the directions of the Engineer-in-Charge and protect the same properly during execution of works. Payment for providing fencing shall be made separately.

7.5. Lead of 150 m mentioned in the ‘Schedule of Quantities’ is the average lead for the disposal of excavated earth within the site of work. The actual lead for the disposal of earth may be more or less than the 150 m for which no cost adjustment shall be made in the rates.

7.6. Disposal of Earth shall be disposed off at the specified location or as decided by the Engineer-in-Charge. The contractor has to take written permission about place of disposal of earth before the earth is disposed off, from Engineer-in-Charge. The contractors shall

have to submit the receipts from the receiving dumping ground, acknowledging actual receipt of the material. However no payment will be made for dumping the construction debris in the dumping ground in limits of Municipal Coporation of Greater Mumbai.

8. BLASTING

Where hard rock is met with and blasting operations are considered necessary, the contractor shall obtain the approval of the Engineer-in-Charge in writing for resorting to blasting operation.

In ordinary rock blasting operations shall not be generally adopted. However, the contractor may resort to blasting with the permission of the Engineer-in-charge, without extra cost for such blasting operations. The contractor shall obtain license from the relevant authority for undertaking blasting work as well as for obtaining and storing the explosive as per the Explosive Act, 1884 as amended up to date and the Explosive Rules, 1983. The contractor shall purchase the explosives fuses, detonators, etc. only from a licensed dealer. The contractor shall be responsible for the safe transportation, storage and custody as per explosive rules and proper accounting of the explosive materials.

The magazine for the storage of explosive shall be built to the designs and specifications of the Explosives Department and locked at the approved location. No unauthorised person shall be admitted into the magazine and when not in use shall be kept securely locked. No matches or inflammable material shall be allowed in the magazine. The magazine shall have an effective lighting conductor. The following shall be hung in the lobby of the magazine:

a) A copy of rules both in English and in the language with which the workers concerned are familiar.
b) A statement of up to date stock in the magazine.
c) A certificate showing the last date of testing of the lighting conductor.
d) A notice that smoking is strictly prohibited.

A careful and day-to-day account of the explosives shall be maintained by the contractor in approved register and in an approved manner. Fuses and detonators shall be stored separately and away from the explosives. The Engineer-in-Charge or his authorized representative shall have the right to check the contractor's store and account of explosives. The contractor shall provide necessary facilities for this. Surprise visit may also be paid by the Engineer-In-Charge to the storage and in case of any unaccountable shortage or unsatisfactory accounting, the contractor shall be liable to be penalised by forfeiture of part or whole of his security deposit or by cancellation of tender in which case he shall not be entitled for any compensation. The contractor shall be responsible for any damage arising out of accident to workmen, public or property due to storage, transportation and use of explosive during blasting operation.

8.1. Blasting operations shall be carried out under the supervision of a responsible authorized agent of the contractor (referred subsequently as agent), during specified hours as approved in writing by the Engineer-in-Charge. The agent shall be conversant with the rules of blasting. In case of blasting with dynamite or any other high explosive, the position of all the bore holes to be drilled shall be marked in circles with white paint. These shall be inspected by the contractor's agent. Bore holes shall be of a size that the cartridge can easily pass down. After the drilling operation, the agent shall inspect the holes to ensure that drilling has been done only at the marked locations and no extra hole has been drilled. The agent shall then prepare the necessary charge separately for each bore hole. The bore holes shall be thoroughly cleaned before a cartridge is inserted. Only cylindrical wooden tamping rods shall be used for tamping. Metal rods or rods having pointed ends shall never be used for tamping. One cartridge shall be placed in the bore hole and gently pressed but not rammed down. Other cartridges shall then be added as may be required

to make up the necessary charge for the bore hole. The top most cartridge shall be connected to the detonator which shall in turn be connected to the safety fuses of required length. All fuses shall be cut to the length required before being inserted into the holes. Joints in fuses shall be avoided. Where joints are unavoidable a semi-circular nitch shall be cut in one piece of fuse about 2 cm deep from the end and the end of other piece inserted into the nitch. The two pieces shall then be wrapped together with string. All joints exposed to dampness shall be wrapped with rubber tape.

The maximum of eight bore holes shall be loaded and fired at one occasion. The charges shall be fired successively and not simultaneously. Immediately before firing, warning shall be given and the agent shall see that all persons have moved to a safe place. The safety fuses of the charged holes shall be ignited in the presence of the agent, who shall see that all the fuses are properly ignited. Careful count shall be kept by the agent and others of each blast as it explodes. In case all the charged bore holes have exploded, the agent shall inspect the site soon after the blast but in case of misfire the agent shall inspect the site after half an hour and mark red crosses (X) over the holes which have not exploded. During this interval of half an hour, nobody shall approach the misfired holes. No driller shall work near such bore until either of the following operations have been done by the agent for the misfired boreholes.

(a) The contractor's agent shall very carefully (when the tamping is of damp clay) extract the tamping with a wooden scraper and withdraw the fuse, primer and detonator. After this a fresh detonator, primer and fuse shall be placed in the misfired holes and fired, or

(b) The holes shall be cleaned for 30 cm of tamping and its direction ascertained by placing a stick in the hole. Another hole shall then be drilled 15 cm away and parallel to it. This hole shall be charged and fired. The misfired holes shall also explode along with the new one.

Before leaving the site of work, the agent of one shift shall inform another agent relieving him for the next shift, of any case of misfire and each such location shall be jointly inspected and the action to be taken in the matter shall be explained to the relieving agent.

The Engineer-in-Charge shall also be informed by the agent of all cases of misfires, their causes and steps taken in that connection.

8.2. **General Precautions**

For the safety of persons red flags shall be prominently displayed around the area where blasting operations are to be carried out. All the workers at site, except those who actually ignite the fuse, shall withdraw to a safe distance of at least 200 meters from the blasting site. Audio warning by blowing whistle shall be given before igniting the fuse. Blasting work shall be done under careful supervision and trained personnel shall be employed. Blasting shall not be done within 200 meters of an existing structure, unless specifically permitted by the Engineer-in-Charge in writing.

All procedures and safety precautions for the use of explosives, drilling and loading of explosives before and after shot firing and disposal of explosives shall be taken by the contractor as detailed in IS 4081, safety code for blasting and related drilling operation.

8.3. **Precautions against Misfire**

In case of a misfire the following procedure shall be observed.

a) Sufficient time shall be allowed to account for the delayed blast.

b) The man in charge shall inspect all the charges and determine the missed charge.

c) If it is blasting powder charge it shall be completely flooded with water.
d) A new hole shall be drilled at about 45 cm. (about 18") from the old hole and fired. This should also blast the old charge. The procedure shall be repeated till the old charge is blasted.
e) In case of charges of gelignite, dynamite etc., the man-in-charge shall gently remove the tamping and the primer with the detonator. A fresh detonator and primer shall then be used to blast the charge. Alternatively the hole may be cleared of one foot of tamping and the direction then ascertained by placing a stick in the hole.
f) Another hole may then be drilled 15 cm. (about 6") away and parallel to it. This hole shall then be charged and fired when the misfired hole should explode at the same time.
g) The man in charge shall report to the office at once all cases of misfire, the cause of the same and what steps were taken in connection therewith.
h) The safety fuse shall be cut in an oblique direction with a knife. All saw dust shall be cleared from inside of the detonator. This can be done by blowing down the detonator and tapping the open end. No tools shall be inserted into the detonator for this purpose.
i) If there is water present or if the bore hole is damp, the junction of the fuse and detonator shall be made water tight by means of tough grease or any other suitable material. The detonator shall be inserted into the cartridge so that about one third of the copper tube is left exposed outside the explosive. The safety fuse just above the detonator shall be securely tied in position in the cartridge. Water proof fuse only shall be used in the damp bore hole or when water is present in the bore hole.
j) If a misfire has been found to be due to defective fuse, detonator or dynamite, the entire consignment from which the fuse detonator or dynamite was taken shall be got inspected by the Engineer-in-Charge or his authorized representative before resuming the blasting or returning the consignment.

9. EXCAVATION IN ALL KINDS OF SOILS

9.1. All excavation operations manually or by mechanical means shall include excavation and 'getting out' the excavated materials. In case of excavation for trenches, basements, water tanks etc. 'getting out' shall include throwing the excavated materials at a distance of at least one meter or half the depth of excavation, whichever is more, clear off the edge of excavation. In all other cases 'getting out' shall include depositing the excavated materials as specified. The subsequent disposal of the excavated material shall be either stated as a separate item or included with the items of excavation stating lead.

9.2. During the excavation the natural drainage of the area shall be maintained. Excavation shall be done from top to bottom. Undermining or undercutting shall not be done.

9.3. In firm soils, the sides of the trenches shall be kept vertical upto a depth of 2 meters from the bottom. For greater depths, the excavation profiles shall be widened by allowing steps of 50 cms. on either side after every 2 meters from the bottom. Alternatively, the excavation can be done so as to give slope of 1:4 (1 horizontal : 4 vertical). Where the soil is soft, loose or slushy, the width of steps shall be suitably increased or sides sloped or the soil shored up as directed by the Engineer-in-Charge. It shall be the responsibility of the contractor to take complete instructions in writing from the Engineer-in-Charge regarding the stepping, sloping or shoring to be done for excavation deeper than 2 meters.

9.4. All excavation shall be measured net. Dimensions for purpose of payment shall be reckoned on the horizontal area of the excavation at the base (PCC Dimensions) for

foundations of the walls, columns, footings, tanks, rafts or other foundations/ structures to be built, multiplied by the mean depth from the surface of the ground in accordance with the drawings. Excavation in side slopes will not be paid for. The Contractor may make such allowance in his rates to provide for excavation in side slopes keeping in mind the nature of the soil and safety or excavation. The additional allowances for working space in excavation shall be measured and recorded for payment as shown on the drawings or as specified in clause 18.3 or as directed by the Engineer-in-Charge.

Unless otherwise specified, the unit rates quoted for excavation in different types of material shall also account for a basic lead of 150 meters for disposal as specified or directed. Only leads beyond the basic lead of 150 meters will be considered as extra lead and paid for at the rates quoted in the schedules.

Backfilling, as per specification the sides of foundations of columns, footings, structures, walls, tanks, rafts, trenches etc. with excavated material will not be paid for separately. It shall be clearly understood that the rate quoted for excavation including backfilling shall include stacking of excavated material as directed, excavation/ packing of selected stacked material, conveying it to the place of final backfill, compaction etc. as specified. As a rule material to be backfield shall be stacked temporarily within the basic lead of 150 metres unless otherwise directed by the Engineer.

For fill inside trenches, plinth or similar filling with selected excavated material will be made for only compaction as specified/ directed. Cost of all operations shall be deemed to have been covered in the rate quoted for excavation.

Backfilling, plinth filling etc. with borrowed earth will be paid for at rates quoted. The quoted rate shall include all operations such as clearing the site excavation, transport, fill, compaction etc. as specified. Actual quantity of consolidated filling or actual quantity of excavation in the borrow pits (less such top soil which has been excavated and not used for filling) whichever is less shall be measured and paid for in cubic meters. The lead, lift etc. shall be as indicated in the schedule of quantities. Actual quantity of consolidated sand filling shall be measured and paid in cubic meters.

9.5. In case of excavation for foundation in trenches or over areas, the bed of excavation shall be to the correct level or slope and consolidated by watering and ramming. If the excavation for foundation is done to a depth greater than that shown in the drawings or as required by the Engineer-in-Charge, the excess depth shall be made good by the contractor at his own cost with the concrete of the mix used for leveling/ bed concrete for foundations. Soft/ defective spots at the bed of the foundations shall be dug out and filled with concrete (to be paid separately) as directed by the Engineer-in-Charge.

9.6. While carrying out the excavation for drain work care shall be taken to cut the side and bottom to the required shape, slope and gradient. The surface shall then be properly dressed. If the excavation is done to a depth greater than that shown on the drawing or as required by the Engineer-in-Charge, the excess depth shall be made good by the contractor at his own cost with stiff clay puddle at places where the drains are required to be pitched and with ordinary earth, properly watered and rammed, where the drains are not required to be pitched. In case the drain is required is to be pitched, the back filling with clay puddle, if required, shall be done simultaneously as the pitching work proceeds. The brick pitched storm water drains should be avoided as far as possible in filled-up areas and loose soils.

9.7. In all other cases where the excavation is taken deeper by the contractor, it shall be brought to the required level by the contractor at his own cost by filling in with earth duly watered, consolidated and rammed.

9.8. In case the excavation is done wider than that shown on the drawings or as required by the Engineer-in-charge, additional filling wherever required on the account shall be done by the contractor at his own cost.

9.9. The excavation shall be done manually or by mechanical means as directed by Engineer-in-charge considering feasibility, urgency of work, availability of labour /mechanical equipments and other factors involved. Contractor shall ensure every safety measures for the workers. Neither any deduction nor any extra payment will be made on this account.

10. EXCAVATION IN ORDINARY/HARD ROCK

10.1. All the excavation operations shall generally be as per clause 9.

10.2. Where hard rock is met with and blasting operations are considered necessary, the contractor shall obtain the approval of the Engineer-in-Charge in writing for resorting to the blasting operations. Blasting operations shall be done as specified in clause 8 and chiseling shall be done to obtain correct levels, slopes, shape and pattern of excavation as per the drawings or as required by the Engineer-in-Charge and no extra cost shall be payable for chiseling.

10.3. Where blasting operations are prohibited or are not practicable, excavation in hard rock shall be done by chiseling.

10.4. In ordinary rock excavation shall be carried out by crowbars, pick axes or pneumatic drills and blasting operation shall not be generally adopted. Where blasting operations are not prohibited and it is practicable to resort to blasting for excavation in ordinary rock, contractor may do so with the permission of the Engineer-in-Charge in writing no extra cost shall be paid for this blasting. Blasting shall be done as specified in clause 8.

11. EXCAVATION IN WATER MUD OR FOUL POSITION

11.1. All water that may accumulate in excavations during the progress of the work from springs, tidal or river seepage, broken water mains or drains and seepage from subsoil aquifer shall be bailed, pumped out or otherwise removed. The contractor shall take adequate measures for bailing and/or pumping out water from excavations and/or pumping out water from excavations and construct diversion channels, bunds, sumps, coffer dams etc. as may be required. Pumping shall be done directly from the foundation trenches or from a sump outside the excavation in such a manner as to preclude the possibility of movement of water through any fresh concrete or masonry and washing away parts of concrete or mortar. During laying of concrete or masonry and for a period of at least 24 hours thereafter, pumping shall be done from a suitable sump separated from concrete or masonry by effective means. Capacity and number of pumps, location at which the pumps are to be installed, pumping hours etc. shall be decided from time to time in consultation with the Engineer-in-Charge. Pumping shall be done in such a way as not to cause damage to the work or adjoining property by subsidence etc. Disposal of water

shall not cause inconvenience or nuisance in the area or cause damage to the property and structure nearby.

To prevent slipping of sides, planking and strutting may also be done with the approval of the Engineer-in-Charge. During power failure, DG standby arrangement should have been done by the contractor for dewatering. While quoting for the rate all these points shall be included. No extra payment will be made for any reason there off.

11.2. Bailing or pumping out water, accumulated in excavation, due to rains is included under respective items of earthwork and is not to be paid separately.

12. EARTHWORK FOR MAJOR WORKS

12.1. Excavation shall be undertaken to the width of the Basement/Retaining wall footing including necessary margins for construction operation as per drawing or directed otherwise. Where the nature of soil or the depth of the trench and season of the year, do not permit vertical sides, the contractor at his own expense shall put up the necessary shoring, strutting and planking or cut slopes with or without steps, to a safer angle or both with due regard to the safety of personnel and works and to the satisfaction of the Engineer. Measurement of plan area of excavation for payment shall be permitted only.

12.2. All the major excavation shall be carried out by mechanical excavator. No extra payment shall be made for that.

12.3. The contractor shall make at his own cost all necessary arrangements for maintaining water level, in the area where works are under execution low enough so as not to cause any harm to the work shall be considered as inclusive of pumping out or bailing out water, if required, for which no extra payment shall be made. This will include water coming from any source, such as rains, accumulated rain water, floods, leakages from sewer and water mains, subsoil water table being high or due to any other cause whatsoever. The contractor shall make necessary provision of pumping, dredging bailing out water coming from all above sources and excavation and other works shall be kept free of water by providing suitable system approved by the Engineer-in-charge.

Sub-soil water table at work site is reported to be about approx. 6.5 m. below the general ground level as observed in the month of April. The water level is likely to rise up to 1 to 2 m. during rainy season. In order to avoid possibility of basement floor of main building being getting uplifted / damaged due to water pressure, the contractor shall lower the ground water table below the proposed foundation level by boring tube wells all around the proposed building using well point sinking method or any suitable method as approved by Engineer-in-charge. Sub soil water table shall be maintained at least 50 cm. below the P.C.C. level during laying of P.C.C. water proofing treatment, laying of basement raft and beams including filling of earth/sand under the basement floor. The water table shall not be allowed to rise above base of raft level until completion of outer retaining walls including water proofing of vertical surface of walls and back filling along the walls upto ground level and until the structure attains such height to counter balance the uplift pressure. However, the contractor should inspect the site and make his own assessment about sub-soil water level likely to be encountered at the time of execution and quote his rates accordingly. Rate of all items are inclusive of pumping out or bailing out water, if

required. Nothing extra on this account whatsoever shall be paid to him. The sequence of construction shall be got approved by the Engineer-in-charge.

12.4. The contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades including signs, markings, flags, lights and flagman, as necessary at either end of the excavation/embankment and at such intermediate points as directed by the Engineer-in-charge for the proper identification of construction area. He shall be responsible for all damages and accidents caused due to negligence on his part.

12.5. The contractor shall provide suitable barricading with suitably painted single row of G.I. Sheets about 3'- 0" wide (90 cms.) nailed or bolted with wooden poles spaced 2 to 3 meter apart and each pole 1.6 m to 2 m long 8 cm. to 10 cm. dia. The poles will be embedded in mobile iron pedestal rings suitably framed for giving stable support as per direction of the Engineer-in-charge. All management (including watch and ward) of barricades shall be the full responsibility of the contractor. The barricades shall be removed only after completion of the work or part of the work. The contractor's rate shall include all above items of work and no extra shall be paid to the contractor over and above his quoted rates.

13. CLASSIFICATION OF EXCAVATION

The excavation shall be classified as described below.

a) Excavation in trenches for foundations and drains: This shall comprise excavation not exceeding 2.0m in width or 10 sq.mt in plan.

b) Excavation over area: This shall comprise the excavation exceeding 2.0 m in width and 10 sq.mt. in plan.

14. EARTHWORK BY MECHANICAL MEANS

Earth work by mechanical means involves careful planning keeping in view site conditions i.e. type of soil, nature of excavation, distances through which excavated soil is to be transported and working space available for employing these machines. The earth moving equipments should be selected accordingly.

Scrapers, dozers, graders, dumpers, trucks, trolleys etc. may be used for mechanised works. Three wheeled 8 to 10 ton power roller or vibratory roller or sheep foot roller may be used for compaction. In case of non availability of power / vibratory roller, the Municipal Corporation of Greater Mumbai may procure the same on hire basis in which case, the hire charges paid plus 15% extra or department's over heads will be recovered from the contractor's bills. Mechanically driven tanker may be used for watering. The contractor will have to ensure that the watering is done profusely. In case he fails to use adequate quantum of water (Adequacy will be decided by the Engineer-in-charge whose decision in this regard shall be final). The Engineer-In-Charge will have the right to make arrangements for procuring additional water at contractor's cost by giving 24 hours notice in writing. The departmental expenditure incurred plus 15% overhead shall be recovered through the contractor's bills.

15. FILLING AND BACKFILLING

15.1. General

All fill material will be subject to the Engineer's approval. If any material is rejected by the Engineer-in-charge, the contractor shall remove the same forthwith from the site at no extra cost to the owner. Surplus fill material shall be deposited/ disposed off as directed by the Engineer-in-charge after the fill work is completed.

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

15.2. Material

To the extent available, selected surplus soils from excavated materials shall be used as backfill. Fill material shall be free from clods, salts, sulphates, and organic or other foreign material. All clods of earth shall be broken or removed. Where excavated earth is mostly rock, the boulders shall be broken into pieces not larger than 150mm size, mixed with properly graded fine materials consisting of murum or earth to fill up the voids and mixtures used for filling.

15.3. Fills shall normally be made up of Cohesive Non Swelling (CNS) material and Murum or river sand/gravel, as specified; capable of being compacted up to 95% modified proctor density.

If any selected fill material is required to be borrowed from outside, the contractor shall make arrangements for bringing such material from borrow pits. The material and source shall be subject to prior approval of the engineer-in-charge. The approved borrow pit area shall be cleared of all bushes, roots of trees, plants, rubbish etc. Top soil containing salts/ sulphate and other foreign material shall be removed. The materials so removed shall be burnt or disposed off as directed by the engineer. The contractor shall make necessary access roads to borrow areas and maintain the same, if such access road does not exist, at his cost.

15.4. Filling in pits and trenches around foundations of structures, walls etc.

As soon as the work in foundations has been accepted and measured, the spaces around the foundations, structures, pits, trenches etc. shall be cleared of all debris, and filled with earth in layers not exceeding 15 cm., each layer being watered, rammed and properly consolidated, before the succeeding one is laid. Each layer shall be consolidated to the satisfaction of the Engineer. Earth shall be rammed with approved mechanical compaction machines. Usually no manual compaction shall be allowed unless the Engineer-in-charge is satisfied that in some cases manual compaction by tampers cannot be avoided. The final backfill surface shall be trimmed and leveled to proper profile as directed by the Engineer-in-charge or indicated on the drawings.

15.5. Plinth filling

Plinth filling shall be carried out with approved material as described herein before in layers not exceeding 15 cm, watered and compacted with mechanical compaction machines. The Engineer may however permit manual compaction by hand tampers in case he is satisfied that mechanical compaction is not possible. When filling reaches the finished level, profused watering shall be done, unless otherwise directed, and allowed to dry and then the surface shall be compacted again as specified above to avoid settlements at a later stage. The finished level of the filling shall be trimmed to the level/ slope specified.

15.5.1. Compaction of the plinth fill shall be carried out by means of 10 tonne rollers smooth wheeled, sheep-foot or wobbly wheeled rollers. In case of compaction of granular material such as sands and gravel, vibratory rollers shall be used. A smaller weight roller may be used only if permitted by the Engineer-in-charge. As rolling proceeds water sprinkling shall be done to assist consolidation. Water shall not be sprinkled in case of sandy fill.

The thickness of each unconsolidated fill layer can in this case be upto a maximum of 300 mm. The Engineer-in-charge will determine the thickness of the layers in which fill has to be consolidated depending on the fill material and equipment used. Rolling shall commence from the outer edge and progress towards the centre and continue until compaction is to the satisfaction of the Engineer-in-charge, but in no case less than 10 passes of the roller will be accepted for each layer.

The compacted surface shall be properly shaped, trimmed and consolidated to an even and uniform gradient. All soft spots shall be excavated and filled and consolidated.

At some locations/ areas it may not be possible to use rollers because of space restrictions etc. The Contractor shall then be permitted to use pneumatic tampers, rammers, etc. and ensure proper compaction.

15.6. Sand filling in plinth and other places

At places backfilling shall be carried out with sand if directed by the Engineer-in-charge. The sand used shall be clean, medium grained and free from impurities. The filled-in-sand shall be kept flooded with water for 24 hours to ensure maximum consolidation. Any temporary work required to contain sand under flooded condition shall be to the Contractor's account. The surface of the consolidated sand shall be dressed to required level or slope. Construction of floors or other structures on sand fill shall not be started until the Engineer has inspected and approved the fill.

15.7. Filling in trenches

Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipes and drains have been tested and passed. The backfilling material shall be properly consolidated by watering and ramming, taking due care that no damage is caused to the pipes.

Where the trenches are excavated in soil, the filling from the bottom of the trench to the level of the centre line of the pipe shall be done by hand compaction with selected approved earth in layers not exceeding 10 cm; backfilling above the level of the centre line of the pipe shall be done with selected earth by hand compaction or other approved means in layers not exceeding 15 cm.

In case of excavation of trenches in rock, the filling upto a level of 30cm above the top of pipe shall be done with fill materials, such as earth, murum etc. The filling up of the level of the centerline of the pipe shall be done by hand compaction in layers not exceeding 10cm. Whereas the filling above the centerline of the pipe shall be done by hand compaction or approved means in layers not exceeding 15cm. The filling from a level of 30cm above the top of the pipe to the top of the trench shall be done by hand or other approved mechanical methods with broken rock filling of size not exceeding 15cm mixed with fine material as available to fill up the voids.

Filling of the trenches shall be carried simultaneously on both sides of the pipe to avoid unequal pressure on the pipe.

16. SITE GRADING

16.1. Site grading shall be carried out as indicated in the drawings and as directed by the Engineer-in-charge. Excavation shall be carried out as specified in the specification.

16.2. To the extent available, selected surplus soils from excavated materials shall be used as fill. Fill material shall be free from clods, salts, sulphates, and organic or other foreign material. All clods of earth shall be broken or removed. Where excavated material is mostly rock, the boulders shall be broken into pieces not larger than 150mm size, mixed with properly graded fine material consisting of murum, earth to fill up voids and the mixture used for filling.

16.3. Fills shall normally be made up of cohesive non swelling (CNS) capable of being compacted up to 95% modified proctor density. In case earth has to be borrowed from outside the boundary, contractor shall arrange the same with no cost to owner. The contractor shall make necessary access roads to borrow areas and maintain the same, if such access road does not exist, at his cost.

16.4. The fill material shall be tested for its optimum moisture content and maximum dry density as per is: 2720 part –vii & part-viii. Moisture content shall be checked at the source of supply in accordance with is: 2720 part -ii and if found less than that required for proper compaction, the same shall be made good either at the source or after spreading the soil in loose thickness for compaction. In the latter case, water shall be sprinkled directly from the hose line or from the truck mounted water tank making due allowance for evaporation losses and the fill material be thoroughly mixed by means of harrows, rotary mixers or by any other suitable approved method until the layer is uniformly wet. Flooding shall not be permitted for watering purpose under any circumstances. If the material delivered is too wet, it shall then be dried by aeration and exposure to the sun till the moisture content is suitable for compaction. Should circumstances arise, owing to wet weather where the moisture content cannot be reduced to the required amount by the above procedure, the work on compaction shall be suspended. Clods or hard lumps of earth shall be broken to have a maximum size of 150 mm when being placed in the layers before compaction.

16.5. All fill material will be subject to the Engineer's approval. If any material is rejected by the Engineer-in-charge, the contractor shall remove the same forthwith from the site at no extra cost to the owner. Surplus fill material shall be deposited/ disposed off as directed by the Engineer-in-charge after the fill work is completed. No earth fill shall commence until surface water discharges and streams have been properly intercepted or otherwise dealt with as directed by the Engineer-in-charge.

16.6. Before commencement of filling, the contractor shall submit proposal for the methodology to be adopted for compaction. The compaction equipments as approved by the Engineer-in-charge shall only be employed to compact the different type materials encountered during construction. If directed by the Engineer-in-charge, the contractor shall demonstrate the efficiency of the plant, to be used by carrying out compaction near optimum moisture content during compaction. The methodology shall also specify the frequency of various tests to be conducted on compacted soil to ensure that compaction is carried out at near optimum moisture content.

16.7. After clearing site as per clause 7.0, the original ground shall be compacted by rolling subject to a minimum 6 passes of 8 to 10 tonne roller. Approved fill material shall be spread in layers not exceeding 225mm in layer thickness and compacted to 150mm with approved compaction equipment. Each layer shall be watered and thoroughly compacted with proper moisture content and such equipments as may be required to obtain a minimum of 95% of its maximum dry density as determined by Standard Proctor's Test per IS:2720, part-VII. Addition quantity of water if required shall be added by means of sprinklers.

16.8. All compaction shall be done under controlled condition. The degree of compaction requires shall be as per the stipulation laid down in is: 4701. Frequencies of sampling and testing including the method for conducting the tests are to be submitted to the owner/ Engineer for approval. Moisture content of the fill material shall be controlled near optimum moisture content during compaction. All tests for determination and checking of the specified density shall be carried out by a qualified Engineer in the presence of Engineer-in-charge. All tests shall be carried out in accordance with relevant is code. Records of all tests shall be forwarded to the owner before proceeding the next layer of filling.

16.9. To ensure that the fill has been compacted as specified, field and laboratory tests shall be carried out by the contractor at his cost.

16.10. Field compaction test shall be carried out at different stages of filling and also after the fill to the entire height has been completed. This shall hold good for embankments as well.

16.11. Contractor shall submit all the test results to the Engineer-in-charge immediately after completion of the tests. A sample shall be deemed to have passed the test when the dry density of the compacted fill is equal to or more than 95% of its maximum dry density. When field density measurements reveal any soft areas in the fills, further compaction shall be carried out as directed by the Engineer.

16.12. The contractor shall protect the earthfill from being washed away by rain or damaged in any other way. Should any slip occur, the contractor shall remove the affected material and make good the slip at his cost.

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

16.14. If so specified, the rock as obtained from excavation may be used for filling and levelling to the indicated grades without further breaking. In such an event, filling shall be done in layers not exceeding 50 cms approximately. After rock filling to the approximate level, indicated above has been carried out, the void in the rocks shall be filled with finer materials such as earth, broken stone, etc. And the area flooded so that the finer materials fill up the voids. Care shall be taken to ensure that the finer fill material does not get washed out. Over the layer so filled, a 100 mm thick mixed layer of broken material and earth shall be laid and consolidation carried out by a 10 tonne roller. No less than twelve passes of the roller shall be accepted before subsequent similar operations are taken up.

17. FILL DENSITY

17.1. The compaction, only where so called for, in the schedule of quantities/ items shall comply with the specified (standard proctor/ modified proctor) density at moisture content differing not more than 5 percent from the density at optimum moisture content. The contractor shall demonstrate adequately at his cost, by field and laboratory tests that the specified density has been obtained

18. MEASUREMENTS

18.1. The length and breadth of excavation or filling shall be considered from respective construction drawings. If needed, measurement at site shall be taken with a steel tape correct to the nearest cm. The depth of cutting or height of filling shall be measured, correct to 5 mm, by recording levels before the start of the work and after the completion of the work. The cubical contents shall be worked out to the nearest two places of decimal in cubic meters.

All excavation shall be measured net. Dimensions for purpose of payment shall be reckoned on the horizontal area of the excavation at the base (PCC Dimensions as per drawing) for foundations of the walls, columns, footings, tanks, rafts or other foundations/ structures to be built, multiplied by the mean depth from the surface of the ground in accordance with the drawings. Excavation in side slopes will not be paid for. The Contractor may make allowance for working space/ side slopes in his rates keeping in mind the nature of the soil and safety or excavation. The allowances for working space in excavation shall be measured and recorded for payment if shown on the drawings or as specified in clause 18.3 or as directed by the Engineer-in-Charge.

18.2. In case the ground is fairly uniform and where the site is not required to be levelled, the Engineer-in-Charge may permit the measurements of depth of cutting or height of filling with steel tape, correct to the nearest cm. In case of borrow pits, diagonal ridges, cross ridges or dead-men, the position of which shall be fixed by the Engineer-in-Charge, shall be left by the contractor to permit accurate measurements being taken with steel tape on the completion of the work. Deduction of such ridges and dead men shall be made from the measurements unless the same are required to be removed later on and the earth so removed is utilized in the work. In the latter case nothing extra will be paid for their removal as subsequent operation.

18.3. **Width of Trench and size of manhole/ chamber for Excavation.**

(a) The width of excavation for a built up drain or sewer unless otherwise stated will be calculated to 250 mm. on either side of the extreme edge of the foundations and the depth upto the bottom of foundation. In case of pipes of different diameters and manholes the width of the trenches will, unless otherwise directed, by the Engineer in writing, be paid for as mentioned in the table below. This width shall include the extra width required for shoring in one or more stages and working space required for constructing brick masonry or plastering the same, for laying and jointing of the pipes or any other purpose in connection with the execution of the work.

(b) Where hard rock is met with, unless otherwise determined by the Engineer, the width of the trench below the point at which hard rock is met shall be calculated as shown in the accompanying table, irrespective of the depth of the trench. In case of built up drains this shall be calculated to 75 mm. on either side of the extreme edge of the footings.

(c) **(I) Statement showing widths to be given for excavation for either 1.22M x 0.91 M or 0.91 M x 0.61 M size rectangular inspection chambers**

Chamber Size	Size of Excavation
0.91 M x 0.61 M	2.25 M x 1.95 M
0.61 M x 0.45 M	1.95 M x 1.33 M

Pipe dia	Manhole upto 5.0 m depth	Manhole more than 5.0 m depth
230 mm	3.50 m x 3.5 m	3.80 m x 3.8 m
300 mm	3.65 m x 3.5 m	3.95 m x 3.8 m
400 mm	3.85 m x 3.5 m	4.15 m x 3.8 m
450 mm	3.9 m x 3.5 m	4.2 m x 3.8 m

(the size will be reduced at hard rock level)

Note :-1) The size of bed cc for Manholes will be increased according to the diameter of drop

2) The thickness of bed cc of rectangular chamber is 15 cm.

(d) **Statement showing widths to be given for excavation for either 1.21 M or 1.52 M (inside) circular or 1.52M X 1.52 M Square Manholes in Sewerage works.**

Depth of Manholes Upto invert level	Size of Excavation			Remarks
(1) For 1.21 M Dia M.H. upto 2.30 M.	2.50 M Square			Without drop arrangement
(2) For 1.52 M. dia M.H. upto 2.30 M	3.0 M Square			Without drop arrangement
(3) For 1.52 M. dia M.H. For 2.30 M to 5M.	3.5 M X 3.00 M.			With drop arrangement on both sides.
(4) For 1.52 M. dia M.H. above 5M	**A – Without drop arrangement**			
	I – in ordinary Soil:			
	3.4 M. Square			1st stage upto 5.0 M
	3.0 M. Square			2nd stage below 5.0 M
	II- in trenches where rock is met with			
	3.4 M. Square			Upto the point where rock is met with
	3.0 M. Square			Below the point where rock is met with.
	B – With drop arrangement on both sides			
	I – in ordinary Soil:			
	Across		Along	
	3.8 M	x	3.4 M	1st stage upto 5.0 M
	3.5 M	x	3.0 M	2nd stage below 5.0 M
	II- in trenches where rock is met with			

Depth of Manholes Upto invert level	Size of Excavation			Remarks
	3.8 M	x	3.4 M	Upto the point where rock is met with
	3.5 M	x	3.0 M	Below the point where rock is met with.
(5) For 1.83 M. dia M.H.	**A – Without drop arrangement**			
	I – in ordinary Soil:			
	3.7 M. Square			1st stage upto 5.0 M
	3.4 M. Square			2nd stage below 5.0 M
	II- in trenches where rock is met with			
	3.7 M. Square			Upto the point where rock is met with
	3.4 M. Square			Below the point where rock is met with.
	B – With drop arrangement on both			
	I – in ordinary Soil:			
	Across		Along	
	4.1 M	x	3.7 M	1st stage upto 5.0 M
	3.8 M	x	3.4 M	2nd stage below 5.0 M
	II- in trenches where rock is met with			
	4.1 M	x	3.7 M	Upto the point where rock is met with
	3.8 M	x	3.4 M	Below the point where rock is met with.
(6) For 1.83 x1.83 M scrapper type manhole	**A – Without drop arrangement**			
	I – in ordinary Soil:			
	3.7 M. Square			1st stage upto 5.0 M
	3.4 M. Square			2nd stage below 5.0 M
	II- in trenches where rock is met with			
	3.7 M. Square			Upto the point where rock is met with
	3.4 M. Square			Below the point where rock is met with.
	B – With drop arrangement on both sides			
	I – in ordinary Soil:			
	Across		Along	
	4.3 M	x	3.7 M	1st stage upto 5.0 M
	4.0 M	x	3.4 M	2nd stage below 5.0 M
	II- in trenches where rock is met with			
	4.3 M	x	3.7 M	Upto the point where rock is met with
	4.0 M	x	3.4 M	Below the point where rock is met with.
	C – With drop arrangement on one side			
	I – in ordinary Soil:			
	Across		Along	
	4.1 M	x	3.7 M	1st stage upto 5.0 M
	3.8 M	x	3.4 M	2nd stage below 5.0 M
	II- in trenches where rock is met with			
	4.1 M	x	3.7 M	Upto the point where rock is met with
	3.8 M	x	3.4 M	Below the point where rock is met with.

Depth of Manholes Upto invert level	Size of Excavation			Remarks
(7) For 1.52 x2.40 M scrapper type manhole	**A – Without drop arrangement**			
	I – in ordinary Soil:			
	3.7 M.	x	4.3M	1st stage upto 5.0 M
	3.4 M.	x	4.0M	2nd stage below 5.0 M
	II- in trenches where rock is met with			
	3.7 M.	x	4.3M	Upto the point where rock is met with
	3.4 M.	x	4.0M	Below the point where rock is met with
	B – With drop arrangement on both sides			
	I – in ordinary Soil:			
	Across		Along	
	3.7 M.	x	4.9M	1st stage upto 5.0 M
	3.4 M.	x	4.6M	2nd stage below 5.0 M
	II- in trenches where rock is met with			
	3.7 M.	x	4.9M	Upto the point where rock is met with
	3.4 M.	x	4.6M	Below the point where rock is met with.
	C – With drop arrangement on one side			
	I – in ordinary Soil:			
	Across		Along	
	3.7 M.	x	4.7M	1st stage upto 5.0 M
	3.4 M.	x	4.4M	2nd stage below 5.0 M
	II- in trenches where rock is met with			
	3.7 M.	x	4.7M	Upto the point where rock is met with
	3.4 M.	x	4.4M	Below the point where rock is met with.

Size of pipe	Excavation in ordinary soil			Excavation in rock wherever it is met with	
Diameter	Shoring In one stage upto 2 M depth	Above 2 M & upto 5 M depth.	Shoring In two Stages more than 5 m. depth	Shoring In one stage upto 5 m depth	Shoring In two stages more than 5 m depth.
1	2a	2b	2c	3a	3b
150 mm S.W.	0.80 M	0.90 M	-	-	-
230 mm S.W.	0.90 M	1.00 M	1.4 M up to 5 M 1 M below 5 M	0.90 M	1.00M
300 mm S.W.	0.90 M	1.00 M	1.4 M up to 5 M 1 M below 5 M	0.90 M	1.00M
350 mm R.C. Pipe	1.30 M	1.50 M	1.8 M up to 5 M 1.5 M below 5 M	1.30 M	1.50 M
400mm R.C. Pipe	1.40 M	1.60 M	1.90 M up to 5 M 1.60 below 5 M	1.40 M	1.60 M
450mm R.C. Pipe	1.50 M	1.70 M	2 M up to 5 M 1.70 M below 5 M	1.50 M	1.70 M

Size of pipe	Excavation in ordinary soil			Excavation in rock wherever it is met with	
Diameter	Shoring In one stage upto 2 M depth	Above 2 M & upto 5 M depth.	Shoring In two Stages more than 5 m. depth	Shoring In one stage upto 5 m depth	Shoring In two stages more than 5 m depth.
1	2a	2b	2c	3a	3b
500mm R.C. Pipe	1.50 M	1.70 M	2 M up to 5 M 1.70 M below 5 M	1.50 M	1.70 M
600mm R.C. Pipe	1.60 M	1.80 M	2.10 M up to 5 M 1.80 M below 5 M	1.60 M	1.80 M
700mm R.C. Pipe	1.70 M	1.90 M	2.20 M up to 5 M 1.90 M below 5 M	1.70 M	1.90 M
800mm R.C. Pipe	2.00 M	2.30 M	2.60 M up to 5 M 2.30 M below 5 M	2.00 M	2.30 M
900mm R.C. Pipe	2.10 M	2.40 M	2.70 M up to 5 M 2.40 M below 5 M	2.10 M	2.40 M
1000mm R.C. Pipe	2.20 M	2.50 M	2.80 M up to 5 M 2.50 M below 5 M	2.20 M	2.50 M
1100mm R.C. Pipe	2.30 M	2.60 M	2.90 M up to 5 M 2.60 M below 5 M	2.30 M	2.60 M
1200mm R.C. Pipe	2.40 M	2.70 M	3.00 M up to 5 M 2.70 M below 5 M	2.40 M	2.70 M
1400mm R.C. Pipe	2.70 M	3.00 M	3.50 M up to 5 M 3.00 M below 5 M	2.70 M	3.00 M
1600mm R.C. Pipe	2.90 M	3.20 M	3.50 M up to 5 M 3.20 M below 5 M	2.90 M	3.20 M
1800mm R.C. Pipe	3.10 M	3.40 M	3.70 M up to 5 M 3.40 M below 5 M	3.10 M	3.40 M

18.4. **Recording Measurements for Earth Levelling / Grading Work**

18.4.1. **Level Books:** In case of levelling operations and earthwork, measurements are required to be recorded in level books in addition to Measurement Books. The Level Books should be numbered, accounted for and handled like Measurement Books.

18.4.2. **Preparatory Works*:*** Before starting the earth work, following steps should be taken:

(a) Original ground levels should be recorded by MCGM's representative in the Level Book in the presence of the contractor or his authorized representative, and should be signed by him and the Department Officer who records the levels. All the local mounds and depressions should be indicated clearly in the drawing and the field Level Book and should be checked by the **Assistant Engineer/ Executive Engineer** before the levelling work is started.

(b) While recording the levels, it should be ensured that the circuit is closed by taking final levels of the starting point or any other point, the R.L. of which was previously determined.

(c) Plans showing initial levels, location of bench marks and reduced levels, should be prepared and signed by both the parties and attached to the agreement before commencement of the work.

18.4.3. **Large Scale Leveling Work**

(a) In case of large scale levelling work involving both cutting and filling, an accurate site plan should be prepared before the work is commenced. The portions requiring cutting and filling shall then be divided into squares and corresponding squares into filling, which are complementary to the squares in cutting given the same number.

(b) A table may be written upon the plan showing leads involved between the various complementary squares. This would form a lead chart for the work to be done.

(c) Before the work of levelling is commenced, the lead chart shall be checked by the Assistant Engineer in the presence of the contractor or his authorized representative, and his signatures shall be obtained on the same. This should form an integral part of the contract and should be duly signed by both the integral parties before commencement of the work.

(d) The quantity payable for earthwork shall be lower of the quantity derived from cutting or filling. The payment for lead shall be based on lead chart prepared in the aforesaid manner.

18.4.4. **Import of Earth:** In case of earth to be imported, the area from where the earth is to be imported, should be pre-determined wherever possible before the start of the work, and wherever feasible, the average lead should be worked out and stipulated in the tender. After this is determined, initial levels of the area to be filled should be recorded. The levels should be properly checked during the progress of work and on completion.

19. RATES

Rates for Earthwork shall include the following:

(a) Excavation and depositing excavated material as specified.
(b) Handing of antiquities and useful material as specified in clause 5.
(c) Protection as specified in clause 6.
(d) Site clearance as specified in clause 7.
(e) Setting out and making profiles as specified in clause 2.
(f) Forming (or leaving) deadmen or 'Tell Tales' in borrow pits and their removal after measurements.
(g) Bailing out or pumping of rain water from excavations.
(h) Initial lead of 150 m and lift of 1.5 m.
(i) Handling, supporting the existing utilities, pipes, cables.

(j) Blasting operations for hard rock as specified in clause 8.

END.

Chapter -3
Concrete Work

CONCRETE WORKS

1.0 SCOPE

1.1 This specification covers the general requirements for concrete using on-site production facilities including requirements in regard to the quality, handling, storage of ingredients, proportioning, batching, mixing, transporting, placing, curing, protecting, repairing, finishing and testing of concrete; formwork; requirements in regard to the quality, storage, bending and fixing of reinforcement; as well as mode of measurement and payment for completed works

1.2 It shall be very clearly understood that the specifications given herein are brief and do not cover minute details. However, all works shall have to be carried out in accordance with IS: 456 and other relevant standards and codes of practices or in their absence in accordance with the best accepted current engineering practices or as directed by ENGINEER from time to time. The decision of ENGINEER as regards the specification to be adopted and their interpretation and the mode of execution of work shall be final and binding on CONTRACTOR and no claim whatsoever will be entertained on this account.

2.0 APPLICABLE CODES AND SPECIFICATIONS

2.1 The following specifications, standards and codes, including all official amendments/revisions and other specifications & codes referred to therein, should be considered a part of this specification. In all cases the latest issue/edition/revision shall apply. In case of discrepancy between this specification and those referred to herein below or other specifications forming a part of this bid document, this specification shall govern.

2.2 Materials

IS:383 Specification for coarse and fine aggregates from natural sources for concrete.

IS:455 Specification for portland slag cement

IS:1489 Specification for portland pozzolona cement

IS:1566 Specification for Hard drawn Steel wire fabric for concrete reinforcement

IS:1786 Specification for high strength deformed steel bars and wires for concrete reinforcement.

IS:2062 Hot Rolled Low, Medium & High Tensile Structural Steel.

IS:2645 Specification for integral cement water- proofing compounds.

IS:4990 Specification for plywood for concrete shuttering work.

IS: 8112 Specification for 43 grade ordinary portland cement.

IS:9103 Specification for admixtures for concrete

IS: 12269 Specification for 53 grade ordinary portland cement.

2.3 MATERIAL TESTING

IS:4031 (Parts 1 to 15) Methods of physical tests for hydraulic cement.

IS:4032 Method chemical analysis of hydraulic cement.

IS:650 Specification for standard sand for testing of cement.

IS:2430 Methods for sampling of aggregates for concrete.

IS.2386 (Parts 1 to 8) Methods of test for aggregates for concrete.

IS:3025 Methods of sampling and test (physical and chemical) water used in industry.

IS:6925 Methods of test for determination of water soluble chlorides in concrete admixtures.

2.4 MATERIAL STORAGE

IS:4082 Recommendations on stacking and storing of construction materials at site.

2.5 CONCRETE MIX DESIGN

IS:10262 Recommended guidelines for concrete mix design.

SP:23 (S&T) Handbook on Concrete Mixes.

IS:4926 Ready Mixed Concrete-Code of Practice

2.6 CONCRETE TESTING

IS:516 Method of test for strength of concrete.

IS.1199 Method of sampling and analysis of concrete.

IS:2770 Methods of testing bond in reinforced concrete.

IS:8142 Method of test for determining setting time of concrete by penetration resistance

IS:9013 Method of making, curing and determining compressive strength of accelerated cured concrete test specimens.

IS:9284 Method of test for abrasion resistance of concrete.

2.7 EQUIPMENT

IS:1791 Specification for batch type concrete mixers.

IS:2505 General Requirements for concrete vibrators: Immersion type.

IS:2506 General Requirements for screed board concrete vibrators.

IS:2722 Specification for portable swing weigh batchers for concrete (single and double bucket type).

IS:2750 Specification for steel scaffoldings

IS:4925 Specification for concrete batching and mixing plant.

IS:5892 Specification for concrete transit mixers and agitator.

IS:7242 Specification for concrete spreaders.

2.8 CODES OF PRACTICE

IS:456 Code of practice for plain and reinforced concrete.

IS:2502 Code of practice for bending and fixing of bars for concrete reinforcement.

IS:2571 Code of practice for laying insitu cement concrete flooring.

IS:2751 Code of practice for welding of mild steel plain and deformed bars used for reinforced concrete construction.

IS:3370 (Parts 1 to 4) Code of practice for concrete structures for storage of liquids.

IS:3414 Code of practice for design and installation of joints in buildings.

IS:3558 Code of practice for use of immersion vibrators for consolidating concrete.

IS:4014 (Parts 1 & 2) Code of practice for steel tubular, scaffolding.

IS:4326 Code of practice for earthquake resistant design and construction of building.

IS:5525 Recommendation for detailing of reinforcement in reinforced concrete works.

IS:7861 Code of practice for extreme weather concreting.

Part 1 Recommended practice for hot weather concreting.

Part 2 Recommended practice for cold weather concreting

IS:9417 Specification for welding cold worked bars for reinforced concrete construction.

2.9 CONSTRUCTION SAFETY

IS.3696 (Parts 1& 2) Safety code for scaffolds and ladders.

IS:7969 Safety code for handling and storage of building materials.

IS:8989 Safety code for erection of concrete framed structures.

2.10 MEASUREMENT

IS:1200 – Method of measurement of building and engineering works.

3.0 GENERAL

3.1 ENGINEER

shall have the right at all times to inspect all operations including the sources of materials, procurement, layout and storage of materials, the concrete batching and mixing equipment, and the quality control system. Such an inspection shall be arranged and ENGINEER's approval obtained, prior to starting of concrete work. This shall, however, not relieve CONTRACTOR of any of his responsibilities. All materials, which do not conform to this specification, shall be rejected.

3.2 3Materials

should be selected so that they can satisfy the design requirements of strength, serviceability, safety, durability and finish with due regards to the functional requirements and the environmental conditions to which the structure will be subjected. Materials complying with codes/standards shall generally be used. Other materials may be used after approval of the ENGINEER and after establishing their performance suitability based on previous data, experience or tests.

4.0 MATERIALS

4.1 Cement

4.1.1 Cement shall be 43 grade / 53 grade ordinary portland cement conforming to IS:8112/ IS:12269 or portland slag cement conforming to IS:455 or portland pozzolona cement conforming to IS:1489. Type of cement to be used for specific work is covered in item description in section 'C2' of the document.

4.1.2 Only one type of cement shall be used in any one mix. The source of supply type or brand of cement within the same structure or portion thereof shall not be changed without approval from ENGINEER.

4.1.3 Cement, which is not used within 90 days from its date of manufacture, shall be tested at a laboratory approved by ENGINEER and until the results of such tests are found satisfactory, it shall not be used in any work.

4.2 AGGREGATES

4.2.1 Aggregates shall consist of naturally occurring stones (crushed or uncrushed), gravel and sand. They shall be chemically inert, strong, hard, clean, durable against weathering, of limited porosity, free from dust/silt/ organic impurities/deleterious materials and conform to IS:383. Aggregates such as slag, crushed over burnt bricks, bloated clay ash, sintered fly ash and tiles shall not be used.

4.2.2 Aggregates shall be washed and screened before use where necessary or if directed by the ENGINEER.

5.0 COARSE AGGREGATE

Coarse aggregate for concrete, except as noted above and for other than lightweight concrete shall conform to IS 383. This shall consist of natural or crushed stone and gravel, and shall be clean, and free from elongated, flaky or laminated pieces, adhering coatings, clay lumps, coal residue, clinkers, slag, alkali, mica, organic matter or other deleterious matter.

5.1 Screening and Washing

Natural gravel and crushed rock shall be screened and/ or washed for the removal of dirt or dust coating, if so demanded by the Engineer.

5.2 Grading

Coarse aggregate shall be either in single size or graded. In both cases, the grading shall be within the limits.

The pieces shall be conical in shape and shall have granular or crystalline surfaces. Friable, flaky and laminated pieces, mica and shale, if present, shall be only in such quantities that will not, in the opinion of the Engineer, affect adversely the strength

and/or durability of concrete. The maximum size of coarse aggregate shall be 40 mm for M15 to M30 concrete and 20 mm for M35 and M40 concrete, or as directed by the Engineer or specified otherwise. The maximum size of coarse aggregate shall be the maximum size specified above, but in no case greater then 1/4 of the minimum thickness of the member, provided that the concrete can be placed without difficulty so as to surround all reinforcement thoroughly and fill the corners of the form. Plums above 160 mm and up to any reasonable size can be used in plain mass concrete work of large dimensions up to a maximum limit of 20% by volume of concrete when specifically approved by the Engineer. For heavily reinforced concrete members, the nominal maximum size of the aggregate shall be 5 mm less than the minimum clear distance between the reinforcing main bars or 5 mm less than the minimum cover to the reinforcement whichever is smaller. The amount of fine particles occurring in the free state or as loose adherent shall not exceed 1% when determined by laboratory sedimentation tests as per IS 2386. After 24 hours' immersion in water, a previously dried sample shall not have gained more than 10% of its oven dry weight in air, as determined by IS 2386.

5.3 Foreign Material Limitations

The percentage of deleterious substances in the aggregate delivered to the mixer shall not exceed the following:

Table 1 –

Sr.No.	Foreign Material	Percent by weight	
		Uncrushed	Crushed
i)	Material finer than 75 micron IS sieve	3.00	3.00
ii)	Coal and lignite	1.00	1.00
iii)	Clay lumps	1.00	1.00
iv)	Soft Fragments	3.00	-
v)	Total of all above substances	5.00	5.00

The fineness modulus of sand shall neither be less than 2.2 nor more than 3.2.s

5.4 Fine Aggregate

Fine aggregate except as noted above, and for other than lightweight concrete shall consist of natural or crushed sand conforming to IS 383. The Sand shall be clean, sharp, hard, strong and durable and shall be free from dust, vegetable substances, adherent coating, clay, alkali, organic matter, mica, salt or other deleterious substances, which can be injurious to the setting qualities/strength/durability of concrete.

5.5 Machine-made Sand

Machine-made sand will be acceptable, provided the constituent rock-gravel composition shall be sound, hard, dense, non-organic, uncoated and durable against weathering.

5.6 Screening and Washing

Sand shall be prepared for use by such screening or washing, or both, as necessary, to remove all objectionable foreign matter while separating the sand grains to the required size fractions.

5.7 Grading

Unless otherwise directed or approved, the grading of sand shall be within the limits indicated hereunder:

Table 1 – B

PERCENTAGE PASSING FOR

IS Sieve Designation	Grading Zone I	Grading Zone II	Grading Zone III	Grading Zone IV
10 mm	100	100	100	100
4.75 mm	90-100	90-100	90-100	95-100
2.36 mm	60-95	75-100	85-100	95-100
1.18 mm	30-70	55-90	75-100	90-100
600 microns	15-34	35-59	60-79	80-100
300 microns	5-20	8-30	12-40	15-50

Where the grading falls outside the limits of any particular grading zone of sieves, other than 600 micron IS sieve, by total amount not exceeding 5 percent, it shall be regarded as falling within that grading zone. This tolerance shall not be applied to percentage passing the 600 micron IS sieve or to percentage passing any other sieve size on the coarser limit of Grading Zone I or the finer limit of Grading Zone IV. Fine aggregates conforming to Grading Zone IV shall be used unless mix designs and preliminary tests have shown its unsuitability for producing concrete of specified strength and workability.

5.8 Fineness Modulus

The sand shall have a fineness modulus of not less than 2.2 or more than 4.2. The fineness modulus is determined by adding the cumulative percentages retained on

the following IS sieve sizes (4.75 mm, 2.36 mm, 1.18 mm, 600 micron, 300 micron and 150 micron) and dividing the sum by 100.

The maximum size of coarse aggregate shall be as stated on the drawings but in no case greater than 1/4 of the minimum thickness of the member.

6.0 WATER

Water used for both mixing and curing shall conform to IS:456. Potable waters are generally satisfactory. Water containing any excess of acid, alkali, sugar or salt shall not be used.

6.1 REINFORCEMENT

Reinforcement bars shall conform to IS:2062 or IS:1786 and welded wire fabric to IS:1566 as shown or specified on the drawing.

All reinforcement shall be clean, free from pitting, oil, grease, paint, loose mill scales, rust, dirty, dust, or any other substance that will destroy or reduce bond.

If permitted by ENGINEER, welding of reinforcement shall be done in accordance with IS:2751 or IS:9417 as applicable at no extra cost to the Owner.

6.1.1 ADMIXTURES

Accelerating, retarding, water-reducing and air entraining admixtures shall conform to IS:9103 and integral water proofing admixtures to IS:2645.

Admixtures may be used in concrete as per manufacturer's instructions only with the approval of ENGINEER based upon the condition that desired slump and strength is obtained with optimum cement content without affecting the durability with the passage of time. An admixture's suitability and effectiveness shall be verified by trial mixes with the other materials used in the works. If two or more admixtures are to be used simultaneously in the same concrete mix, their interaction shall be checked and trial mixes done to ensure their compatibility. There should also be no increase in risk of corrosion of the reinforcement or other embedments.

Calcium chloride shall not be used for accelerating set of the cement for any concrete containing reinforcement or embedded steel parts.

7.0 SAMPLES AND TESTS

All materials such as cement, aggregates (coarse & fine), reinforcement and admixtures etc. used for the works shall be tested as per relevant IS codes before use.

Manufacturer's test certificate shall be furnished, for each batch of cement and samples shall also be got tested by the CONTRACTOR in a laboratory approved by

ENGINEER at no extra cost to OWNER. Sampling and Testing shall be as per relevant IS codes.

Manufacturer's test certificate shall be furnished, for each batch of steel and samples shall also be got tested by the CONTRACTOR in a laboratory approved by ENGINEER at no extra cost to OWNER. Sampling and Testing shall be as per relevant IS codes.

Sampling and testing shall be as per IS:2386 under the supervision of ENGINEER. The cost of all tests, sampling etc. shall be borne by CONTRACTOR.

Water to be used shall be tested to comply with requirements of IS:456.

CONTRACTOR shall furnish manufacturer's test certificates and technical literature for the admixture proposed to be used. If directed by Engineer, the admixture shall be got tested at an approved laboratory at no extra cost.

8.0 STORAGE OF MATERIALS

All material shall be stored in a manner so as to prevent its deterioration and contamination, which would preclude its use in the works. Requirements of IS:4082 shall be complied with.

CONTRACTOR will have to make his own arrangements for the storage of adequate quantity of cement. If such cement is not stored properly and has deteriorated, the material shall be rejected. Cement bags shall be stored in dry weatherproof shed with a raised floor, well away from the outer walls and insulated from the floor to avoid moisture from ground. Not more than 15 bags shall be stacked in any tier. Storage under tarpaulins shall not be permitted. Each consignment of cement shall be stored separately and consumed in its order of receipt.

Each size of coarse and fine aggregates shall be stacked separately and shall be protected from leaves and contamination with foreign material. The stacks shall be on hard, clean, free draining bases, draining away from the concrete mixing area.

CONTRACTOR shall make his own arrangements for storing water at site in tanks to prevent contamination.

The reinforcement shall be stacked on top of timber sleepers to avoid contact with ground/water. Each type and size shall be stacked separately.

9.0 CONCRETE

9.1 GENERAL

Concrete grade shall be as designated on drawings. In concrete grade M20, M25 etc. the number represents the specified characteristics compressive strength of 150 mm cube at 28 days, expressed in N/sq.mm as per IS:456. Concrete in the works shall be "DESIGN MIX CONCRETE" or "NOMINAL MIX CONCRETE". All concrete

works of grade M7.5, M10, M15 and M20 shall be NOMINAL MIX CONCRETE and M10, M15 and above, shall be DESIGN MIX CONCRETE.

9.1.1 DESIGN MIX CONCRETE

9.1.2 Mix Design & Testing

For Design Mix Concrete, the mix shall be designed according to IS:10262 and SP:23 to provide the grade of concrete having the required workability and characteristic strength not less than appropriate values given in IS:456. The design mix shall in addition to such that it is cohesive and does not segregate and should result in a dense and durable concrete and also capable of giving the finish as specified. For liquid retaining structures, the mix shall also result in water tight concrete. The CONTRACTOR shall exercise great care while designing the concrete mix and executing the works to achieve the desired result.

The minimum cement content and maximum free water-cement ratio for Design Mix Concrete shall be as per table – 5 of IS 456 for “Severe” category of exposure, unless noted otherwise in the specification document.

The minimum cement content stipulated in IS 456 shall be adopted irrespective of whether the CONTRACTOR achieves the desired strength with less quantity of cement. The CONTRACTOR's quoted rates for concrete shall provide for the above eventuality and nothing extra shall become payable to the CONTRACTOR on this account. Even in the case where the quantity of cement required is higher than that specified above to achieve desired strength based on an approved mix design, nothing extra shall become payable to the CONTRACTOR.

It shall be CONTRACTOR's sole responsibility to carry out the mix designs at his own cost. He shall furnish to ENGINEER at least 30 days before concreting operations, a statement of proportions proposed to be used for the various concrete mixes and the strength results obtained. The strength requirements of the concrete mixes ascertained on 150 mm cubes as per IS:516 shall comply with the requirements of IS:456. The mix design shall be approved by the Engineer before starting the concrete work.

Range of slumps which shall generally be used for various types of constructions shall be as per clause 7.1 of IS:456 unless instructed otherwise by ENGINEER.

Batching & Mixing of Concrete

Proportions of aggregates and cement, as decided by the concrete mix design, shall be by weight. These proportions shall be maintained during subsequent concrete batching by means of weigh batchers capable of controlling the weights within one percent of the desired value.

Amount of water added shall be such as to produce dense concrete of required consistency, specified strength and satisfactory workability and shall be so adjusted to account for moisture content in the aggregates. Water- cement ratio specified for

use by ENGINEER shall be maintained. Each time the work stops, the mixer shall be cleaned out, and while recommencing, the first batch shall have 10% additional cement to allow for sticking in the drum.

Arrangement should be made by CONTRACTOR to have the cubes tested in an approved laboratory or in field at his own expense, with prior consent of ENGINEER. Sampling and testing of strength and workability of concrete shall be as per IS:1199, IS:516 and IS:456.

Batching Plant where used shall conform to IS 4925.

Ready-Mixed Concrete

Ready-mixed concrete to be used, subject to approval. It shall be produced at an approved plant. The concrete shall conform with IS:4926 and with this specification.

All the constituents for each mix shall be added at the manufacturer's plant. No extra water or other material shall be added after the concrete has left the plant.

All delivery notes shall be retained by the CONTRACTOR and made available for inspection throughout the duration of the contract.

Samples of concrete shall be taken in accordance with the requirements of the specification at the point and time of delivery. The sampled concrete shall be tested in accordance with the specification. The test results shall be certified by Owner/Engineer.

If at any time the ENGINEER is not satisfied that the ready-mixed concrete complies with the specification, ENGINEER may alter the frequency of the sampling.

10.0 NOMINAL MIX CONCRETE

10.1 Mix Design & Testing

Mix design and preliminary tests are not necessary for Nominal Mix Concrete. However, works tests shall be carried out as per IS:456. Proportions for Nominal Mix Concrete and w/c ratio may be adopted as per IS:456. However, it will be CONTRACTOR's sole responsibility to adopt appropriate nominal mix proportions to yield the specified strength.

Batching & Mixing of Concrete

Based on the adopted nominal mixes, aggregates shall be measured by volume. However, cement shall be by weight only.

Fly ash Blended Cements conforming to IS 1489 (Part I) may be used in RCC structures as per guidelines given below

IS 456- 2000 Code of Practice for Plain and Reinforced Concrete (as amended up to date) shall be followed in regard to Concrete Mix Proportion and its production as under

The concrete mix design shall be done as “Design Mix Concrete” as prescribed in clause-9 of IS 456 mentioned above.

Concrete shall be manufactured in accordance with clause 10 of above mentioned IS 456 covering quality assurance measures both technical and organizational, which shall also necessarily require a qualified Concrete Technologist to be available during manufacture of concrete for certification of quality of concrete.

(ii)Minimum M -25 grade of concrete shall be used in all structural elements made with RCC both inload bearing and framed structure. If design demands higher grade shall also used.

(iii)The mechanical properties such as modulus of elasticity, tensile strength, creep and shrinkage of fly ash mixed concrete or concrete using fly ash blended cements (PPCs) are not likely to be significantly different and their values are to be taken same as those used for concrete made with OPC.

(iv)To control higher rate of carbonation in early ages of concrete in PPC based concrete; water/binder ratio shall be kept as low as possible, which shall be closely monitored during concrete manufacture.

If necessitated due to low water/binder ratio, required workability shall be achieved by use of chloride free chemical admixtures conforming to IS 9103. The compatibility of chemical admixtures and super plasticizers with each set OPC, fly ash and /or PPC received from different sources shall be ensured by trials.

(v)In environment subjected to aggressive chloride or sulphate attach in particular, use of fly ash admixed or PPC based concrete is recommended. In cases, where structural concrete is exposed to excessive magnesium sulphate, flyash substitution/content shall be limited to 18% by weight. Special type of cement with low C3A content may also be alternatively used. Durability criteria like minimum binder content and maximum water /binder ratio also need to be given due consideration in such environment.

(vi) Wet curing period shall be enhanced to a minimum of 10 days or its equivalent. In hot & arid regions, the minimum curing period shall be 14 days or its equivalent.

10.2 Use of Fly Ash Blended Cements in Cement Concrete (PPCC) in RCC Structures

Subject to General Guidelines detailed out as above, PPC manufactured conforming to IS 1489(Part-I) shall be treated at par with OPC for manufacture of Design Mix concrete for structural use in RCC.

(ii)Till the time, BIS makes it mandatory to print the %age of fly ash on each bag of cement, the certificate from the PPC manufacture indicating the same shall be insisted upon before allowing use of such cements in works.

(iii)While using PPC for structural concrete work, no further admixing of fly ash shall be permitted.

11.0 FORMWORK

Formwork shall be all inclusive and shall consist of but not limited to shores, bracings, sides of footings, walls, beams and columns, bottom of slabs etc. including ties, anchors, hangers, inserts, falsework, wedges etc.

The design and engineering of the formwork as well as its construction shall be the responsibility of CONTRACTOR. However, if so desired by ENGINEER the drawings and calculations for the design of the formwork shall be submitted to ENGINEER for approval.

Formwork shall be designed to fulfil the following requirements in addition to normal requirements:

Sufficiently rigid and tight to prevent loss of grout or mortar from the concrete at all stages and appropriate to the methods of placing and compacting.

Made of suitable materials.

Capable of providing concrete of the correct shape and surface finish within the specified tolerance limit as per IS 456.

Capable of withstanding without deflection the worst combination of selfweight, reinforcement and concrete weight, all loads and dynamic effects arising from construction and compacting activities, wind and weather forces.

Capable of easily striking without shock, disturbance or damage to the concrete.

Soffit forms capable of imparting a camber if required.

Soffit forms and supports capable of being left in position if required.

Capable of being cleaned and/or coated if necessary immediately prior to casting the concrete; design temporary openings where necessary for these purposes and to facilitate the preparation of construction joints.

The formwork may be of timber, plywood, steel, plastic or concrete depending upon the type of finish specified. Sliding forms and slip form may be used with the approval of ENGINEER. Timber for formwork shall be well seasoned, free from sap, shakes, loose knots, worm holes, warps and other surface defects. Joints between formwork and formwork and structures shall be sufficiently tight to prevent loss of slurry from concrete, using seals if necessary.

The faces of formwork coming in contact with concrete shall be cleaned and two coats of approved mould oil applied before fixing reinforcement. All rubbish, particularly chippings, shavings, sawdust, wire pieces dust etc. shall be removed from the interior of the forms before the concrete is placed. Where directed, cleaning of forms shall be done by blasting with a jet of compressed air at no extra cost.

Forms intended for reuse shall be treated with care. Forms that have deteriorated shall not be used. Before reuse, all forms shall be thoroughly scraped, cleaned, nails removed, holes suitably plugged, joints repaired and warped lumber replaced to the satisfaction of ENGINEER. CONTRACTOR shall equip himself with enough shuttering to allow for wastage so as to complete the job in time.

Permanent formwork shall be checked for its durability and compatibility with adjoining concrete before it is used in the structure. It shall be properly anchored to the concrete.

Wire ties passing through beams, columns and walls shall not be allowed. In their place bolts passing through sleeves shall be used. Formwork spacers left in situ shall not impair the desired appearance or durability of the structure by causing spalling, rust staining or allowing the passage of moisture.

For liquid retaining structures sleeves shall not be provided for through bolts nor shall through bolts be removed if provided. The bolts, in the latter case, shall be cut at 25 mm depth from the surface and the hole made good by cement mortar of the same proportion as the concrete just after striking the formwork.

Where specified or shown on drawings all corners and angles exposed in the finished structure shall have chamfers or fillets of 20 mm x 20 mm size.

CONTRACTOR shall provide adequate props carried down to a firm bearing without overloading any of the structures.

The shuttering for beams and slabs shall be so erected that the side shuttering of beams can be removed without disturbing the bottom shuttering. If the shuttering for a column is erected for the full height of the column, one side shall be built up in sections as placing of concrete proceeds or windows left for placing concrete from the side to limit the drop of concrete to 1.0m or as directed by ENGINEER. CONTRACTOR shall temporarily and securely fix items to be cast in (embedments/ inserts) in a manner that will not hinder the striking of forms or permit loss of grout.

Formwork showing excessive distortion during any stage of construction shall be repositioned and strengthened. Placed concrete affected by faulty formwork, shall be entirely removed and formwork corrected prior to placement of new concrete at CONTRACTOR's cost.

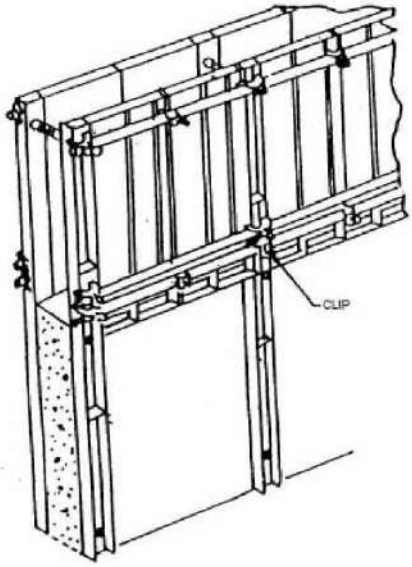
If ENGINEER rejects any improper formwork after inspection, at any stage of construction, it is responsibility of the CONTRACTOR to get corrected before concreting at no extra cost to the OWNER.

Under normal circumstances forms may be struck after expiry of the time period given in IS:456 unless otherwise directed by Engineer. It is the CONTRACTOR'S responsibility to ensure that forms are not struck until the concrete has developed sufficient strength to support itself, does not undergo excessive deformation and resist surface damage and any stresses arising during the construction period.

TYPICAL SET UP OF STEEL WALL FORM WORK

Sub Head : R.C.C. (Form Work)

Single Sided Wall Form (Adjustable)

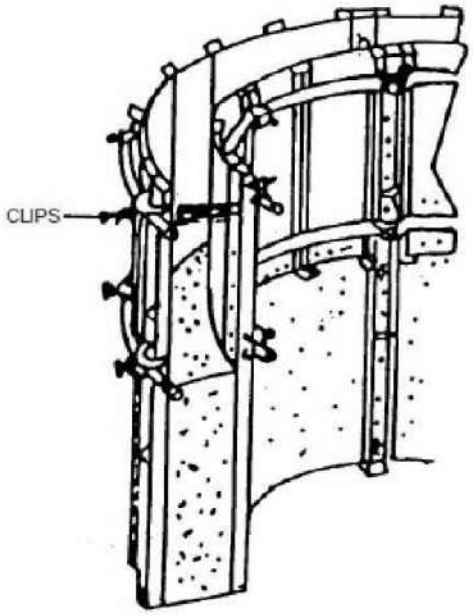


Double Sided Wall Form

All Members are of Steel

Typical Set Up of Steel Wall Form Work

WALL FORM



All Members are of Steel

Adjustable Curved Wall Form (Double Sided)

TYPICAL FIXING DETAILS OF WALL TIES

Sub Head : R.C.C. (Form Work)

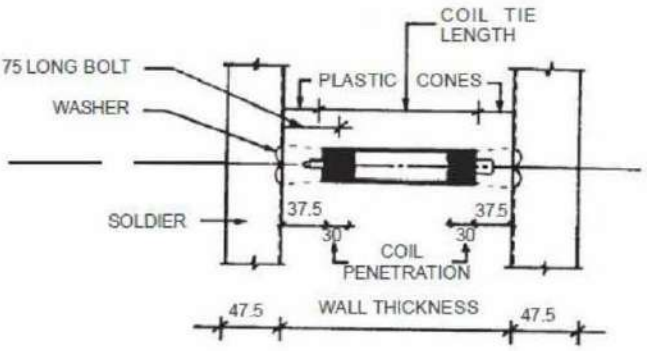


Fig. : Wall Tie for Two Sided Shuttering

All Members are of Steel

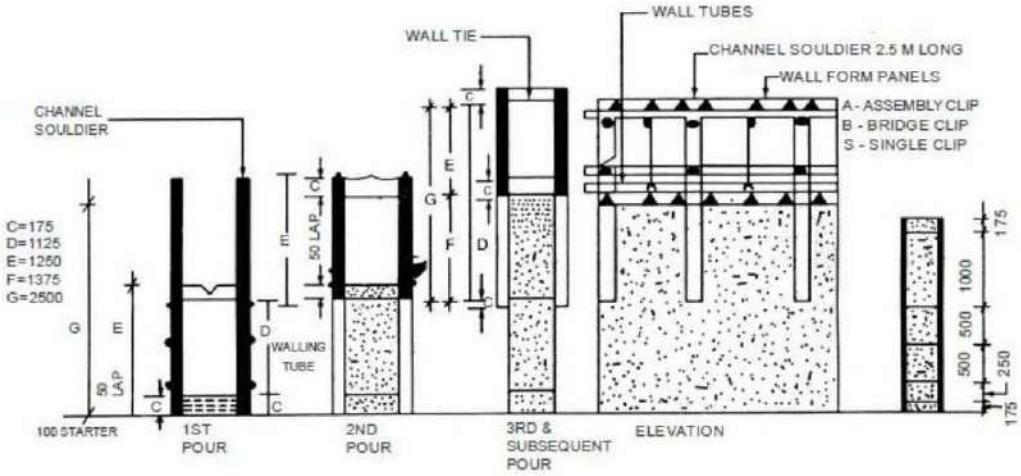


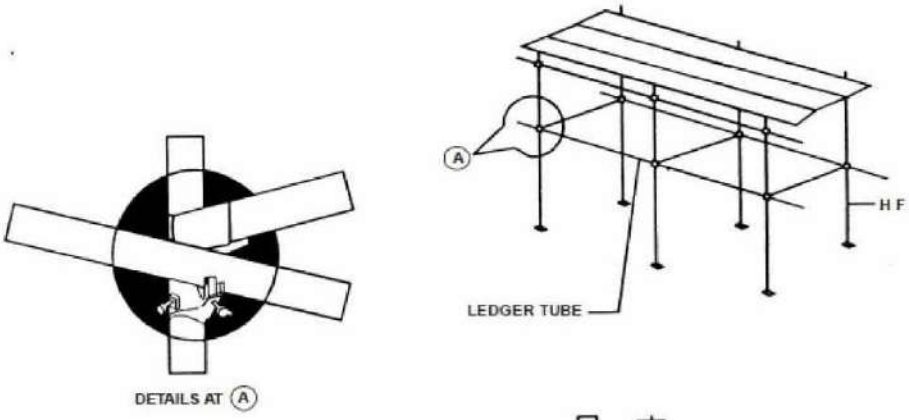
Fig. : Position of Wall Ties & Walling Tubes
(Shuttering for 1st Pour should be properly Strutted by Rakers)

Drawing not to scale
All dimensions are in MM

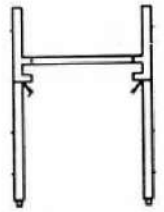
Typical Fixing Details of Wall Ties

TYPICAL STANDARD UNITS OF FORM WORK
(CENTRING & SHUTTERING)

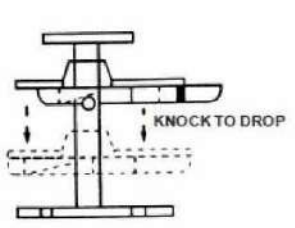
Sub Head : R.C.C. (Form Work)



DETAILS AT (A)

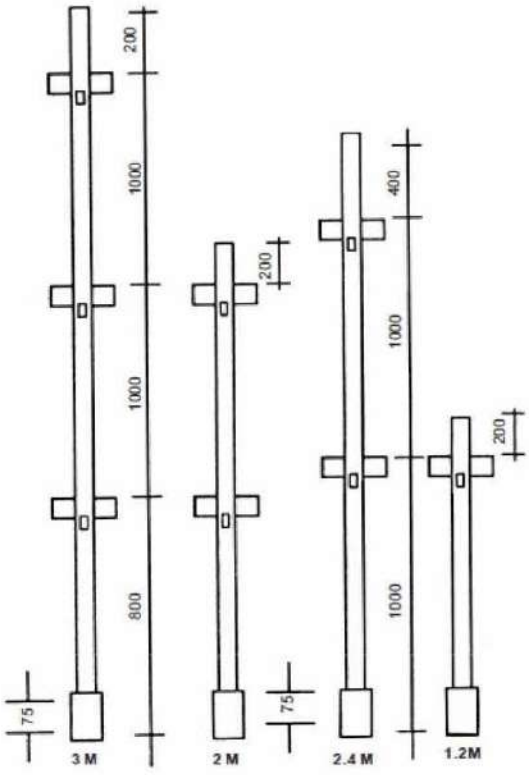


DETAILS OF H FRAME UNIT
(B)



DROP HEAD
C

ADJ. STIRRUP HEAD
D



E - VERTICALS (IN DIFFERENT HEIGHTS)

All Members are of Steel
All dimensions are in MM
Drawing not to scale

Typical Standard Units of Form Work

TYPICAL COMPONENTS OF FORM WORK

Sub Head : R.C.C. (Form Work)

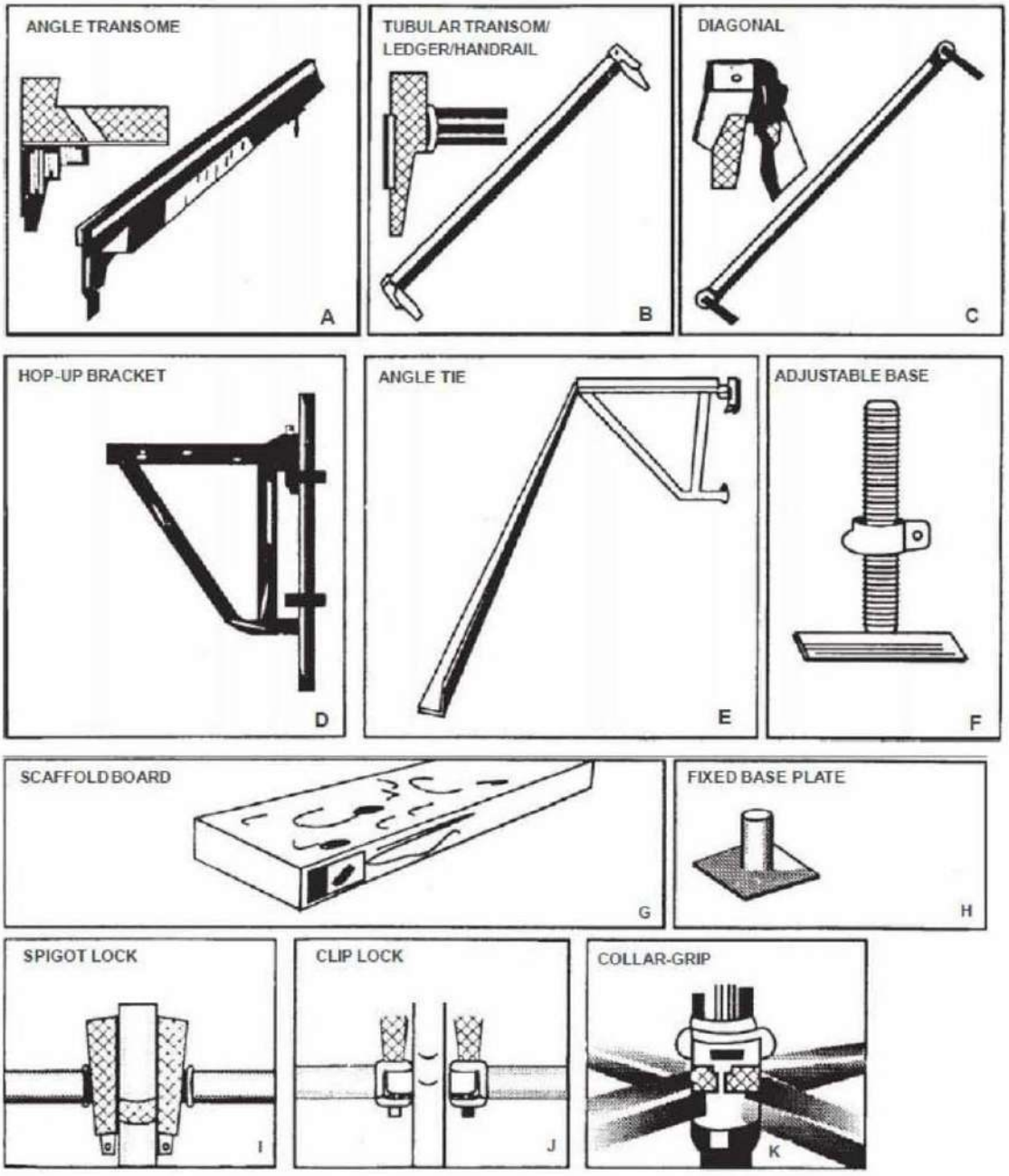


Fig. : Typical Components of Form Work

TYPICAL ARRANGEMENT OF COLUMN FORM WORK

Sub Head : R.C.C. (Form Work)

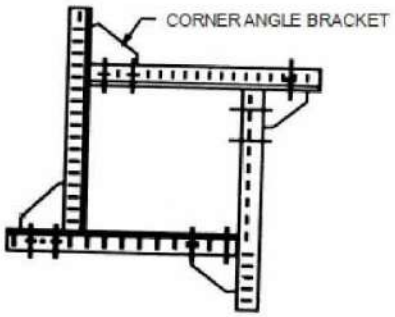


Fig. : Four Sides Adjustable Column Form

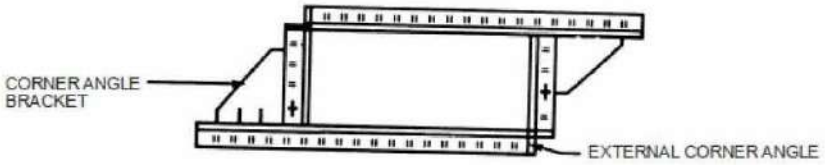


Fig. : Two Sides Adjustable Column Form

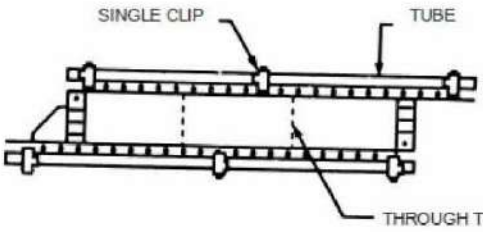


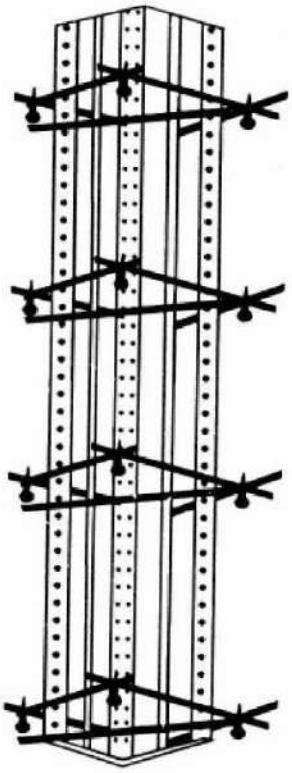
Fig. : Column Form with Adjustable Shuttering Wall Form Type Panels

All Members are of Steel

Fig. : Typical Arrangement of Column Form Work

TYPICAL COLUMN SHUTTERING

Sub Head : R.C.C. (Form Work)



All Members are of Steel

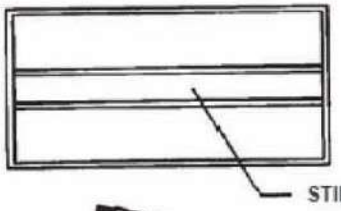
Typical Column Shuttering

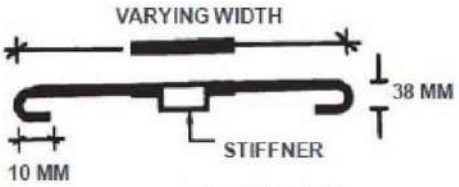
TYPICAL DETAIL OF BEAM HEAD AND STIFFNER

BEAM HEAD (A)

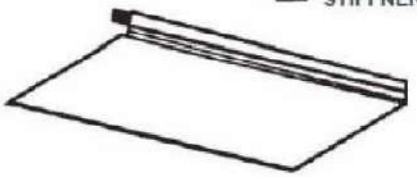
BEAM HEAD (C)

ASSEMBLY OF BEAM
HEAD OVER PROP
(B)





FLOOR FORMS
(OUT OF 14 GAUGE M.S. SHEET) (ADJUSTER
FLOOR FORMS AVAILABLE IN VARIOUS SIZES
(E)



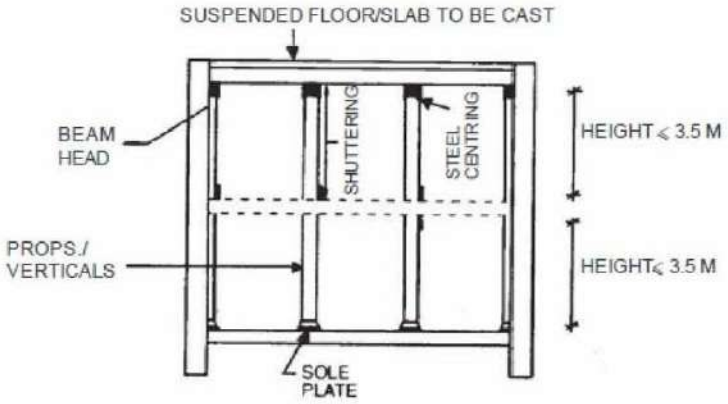
PLAN OF FLOOR (SLAB) FORMS
(D)

All Members are of Steel

Typical Detail of Beam Head and Stiffner

TYPICAL DETAILS OF MULTI STAGE SHUTTERING

Sub Head : R.C.C. (Form Work)



All Members are of Steel

Fig. : Suspended Floor – Multi Stage Shuttering (Vertical Section)

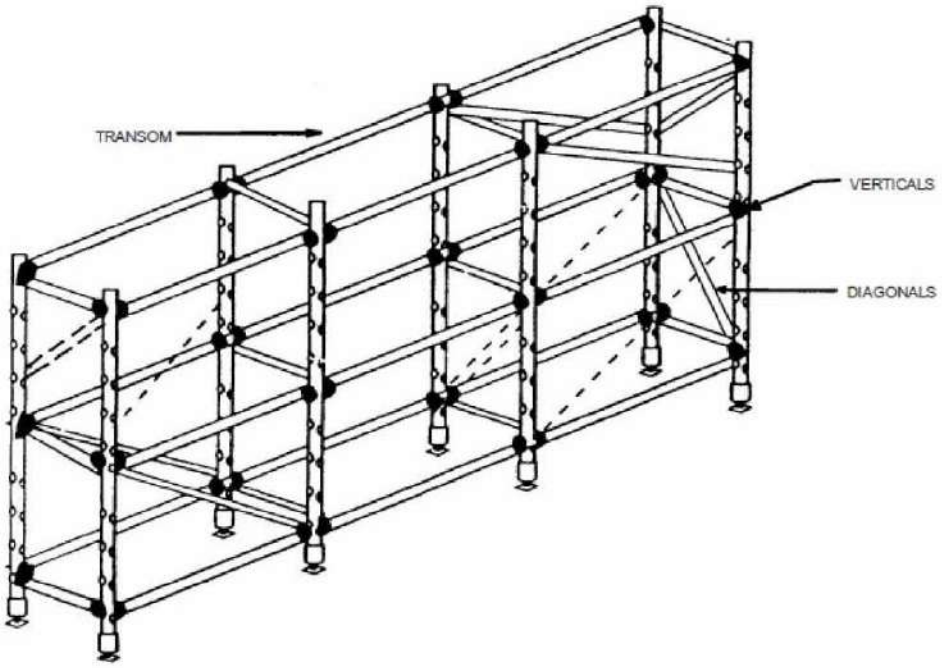


Fig. : Typical Details of Multi-State Shuttering

11.1.1 FORMWORK FOR EXPOSED ARCHITECTURAL CONCRETE

The specifications as given in CPWD shall generally be followed.

However, the Contractor to note the following:

1. Since the exposed concrete is intended to make a visual statement the Contractor to ensure that the concrete on deshuttering presents a clean and even surface. No surface treatment (apart from application of hydrophobic sealant) is envisaged and therefore no repair/patchwork will be permitted.

2. Form exposed corners of beams and columns to produce square, smooth, solid, unbroken lines, except as otherwise shown.

3. The Contractor to furnish the shutter boards in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.

4. All formed joints on concrete surfaces to be exposed shall be taped and shall align so joints will not be apparent on the concrete surfaces.

5. The location of all exposed features such as through tie bolts, joints to be planned in such a way that no bolt hole/joint line etc. Seems to be arbitrary and/or out of place.

6. The shuttering should be of superior construction so as to avoid slurry leakage and consequent honeycombing etc.

7. The pattern of formwork for exposed concrete works shall be approved by the EIC prior to execution.

11.1.2 Mock-up

The Contractor shall prepare a mock-up of the formwork for typical members and carry out trial castings to establish the suitability of formwork, of mould oil proposed to be used on formwork as a releasing agent to prevent surface blemishes etc.

12.0 REINFORCEMENT WORKMANSHIP

Reinforcing bars supplied bent or in coils shall be straightened cold without damage at no extra cost. No bending shall be done when ambient temperature is below 5 Deg.C.

All bars shall be accurately bent gradually and according to the sizes and shapes shown on the drawings/ schedules or as directed by ENGINEER.

Re-bending or straightening incorrectly bent bars shall not be done without approval of ENGINEER.

Reinforcement shall be accurately fixed and maintained firmly in the correct position by the use of blocks, spacers, chairs, binding wire etc. to prevent displacement during placing and compaction of concrete. The tied inplace reinforcement shall be approved by ENGINEER prior to concrete placement. Spacers shall be of such materials and designs as will be durable, not lead to corrosion of the reinforcement and not cause spalling of the concrete cover.

Binding wire shall be 16 gauge soft annealed wire. Ends of the binding wire shall be bent away from the concrete surface and in no case encroach into the concrete cover.

Substitution of reinforcement, laps/splices not shown on drawing shall be subject to ENGINEER's approval.

Tolerances on placing of reinforcement and Tolerance for cover shall be as per IS 456.

13.0 TOLERANCES

Tolerance for formed and concrete dimensions shall be as per IS:456 unless specified otherwise.

Tolerances specified for horizontal or vertical building lines or footings shall not be construed to permit encroachment beyond the legal boundaries.

14.0 PREPARATION PRIOR TO CONCRETE PLACEMENT

Before concrete is actually placed in position, the inside of the formwork shall be cleaned and mould oil applied, necessary inserts/embedments/pipe sleeves and reinforcement shall be correctly positioned and securely held, necessary openings, pockets, etc. provided.

All arrangements-formwork, equipment and proposed procedure, shall be approved by ENGINEER. CONTRACTOR shall maintain separate Pour Card for each pour as per the format enclosed.

15.0 TRANSPORTING, PLACING AND COMPACTING CONCRETE

Concrete shall be transported from the mixing plant to the formwork with minimum time lapse by methods that shall maintain the required workability and will prevent segregation, loss of any ingredients or ingress of foreign matter or water.

In all cases concrete shall be deposited as nearly as practicable directly in its final position. To avoid segregation, concrete shall not be rehandled or caused to flow. For locations where direct placement is not possible and in narrow forms CONTRACTOR shall provide suitable drops and "Elephant Trunks". Minimum diameter of Elephant Trunks shall be 200mm. Concrete shall not be dropped from a height of more than 1.5m.

Concrete shall not be placed in flowing water. Under water, concrete shall be placed in position by tremies or by pipeline from the mixer and shall never be allowed to fall freely through the water.

While placing concrete the CONTRACTOR shall proceed as specified below and also ensure the following :

a) Continuously between construction joints and predetermined abutments.

b) Without disturbance to forms or reinforcement.

c) Without disturbance to pipes, ducts, fixtures and the like to be cast in; ensure that such items are securely fixed. Ensure that concrete cannot enter open ends of pipes and conduits etc.

d) Without dropping in a manner that could cause segregation or shock.

e) In deep pours only when the concrete and formwork designed for this purpose and by using suitable chutes or pipes.

f) Do not place if the workability is such that full compaction cannot be achieved.

g) Without disturbing the unsupported sides of excavations; prevent contamination of concrete with earth. Provide sheeting if necessary. In supported excavations, withdraw the linings progressively as concrete is placed.

h) If placed directly onto hard core or any other porous material, dampen the surface to reduce loss of water from the concrete.

i) Ensure that there is no damage or displacement to sheet membranes.

j) Record the time and location of placing structural concrete.

Concrete shall normally be compacted in its final position within thirty minutes of leaving the mixer. Concrete shall be compacted during placing with approved vibrating equipment without causing segregation until it forms a solid mass free from voids thoroughly worked around reinforcement and embedded fixtures and into all corners of the formwork. Immersion vibrators shall be inserted vertically at points not more than 450 mm apart and withdrawn slowly till air bubbles cease to come to the surface, leaving no voids. When placing concrete in layers advancing horizontally, care shall be taken to ensure adequate vibration, blending and melding of the concrete between successive layers. Vibrators shall not be allowed to come in contact with reinforcement, formwork and finished surfaces after start of initial set. Over-vibration shall be avoided.

Concrete may be conveyed and placed by mechanically operated equipment after getting the complete procedure approved by ENGINEER. The slump shall be held to the minimum necessary for conveying concrete by this method. When concrete is to be pumped, the concrete mix shall be specially designed to suit pumping. Care shall be taken to avoid stoppages in work once pumping has started.

Except when placing with slip forms, each placement of concrete in multiple lift work, shall be allowed to set for at least 24 hours after the final set of concrete before the start of subsequent placement. Placing shall stop when concrete reaches the top of the opening in walls or bottom surface of slab, in slab and beam construction, and it shall be resumed before concrete takes initial set but not until it has had time to

settle as determined by ENGINEER. Concrete shall be protected against damage until final acceptance.

All necessary equipment required for concrete works shall be maintained in clean and good working condition by the CONTRACTOR. In case ENGINEER feels that the equipment is not maintained properly, it will rejected and CONTRACTOR shall replace with new equipment at no extra cost to the OWNER.

16.0 MASS CONCRETE WORKS

Sequence of pouring for mass concrete works shall be as approved by ENGINEER. CONTRACTOR shall exercise great care to prevent shrinkage cracks and shall monitor the temperature of the placed concrete.

17.0 CURING

Curing shall start immediately after the compaction of the concrete to protect it from

a) Premature drying out, particularly by solar radiation and wind;

b) leaching out by rain and flowing water;

c) rapid cooling during the first few days after placing;

d) high internal thermal gradients;

e) low temperature or frost;

f) vibration and impact which may disrupt the concrete and interfere with its bond to the reinforcement.

All concrete, unless directed otherwise by ENGINEER, shall be cured by use of continuous sprays or ponded water or continuously saturated coverings of sacking, canvas, hessain or other absorbent material for the period of complete hydration with a minimum of 7 days. The quality of curing water shall be the same as that used for mixing.

Where a curing membrane is directed to be used by the ENGINEER, the same shall be of a non-wax base and shall not impair the concrete finish in any manner. Curing shall be carried out generally as per ACI:307. Curing compound shall comply with ASTM C 309. The curing compound to be used shall be got approved from the ENGINEER before use and shall be applied with spraying equipment capable of a smooth, even textured coat, generally in conformity with recommendations of the manufacturer.

Curing may also be done by covering the surface with an impermeable material such as polyethylene, which shall be well sealed and fastened.

Extra precautions shall be exercised in curing concrete during cold and hot weather.

18.0 CONSTRUCTION JOINTS AND KEYS

Construction joints will be as shown on the drawing or as approved by ENGINEER. Concrete shall be placed without interruption until completion of work between construction joints. If stopping of concreting becomes unavoidable anywhere, a properly formed construction joint shall be made with the approval of ENGINEER.

Dowels for concrete work, not likely to be taken up in the near future, shall be coated with cement slurry and encased in lean concrete as indicated on the drawings or as directed by ENGINEER.

Before resuming concreting on a surface which has hardened, all laitance and loose stone shall be thoroughly removed by wire brushing/hacking and surface washed with high pressure water jet and treated with thin layer of cement slurry for vertical joints and a 15mm thick layer of cement sand mortar for horizontal layers, the ratio of cement and sand being the same as in the concrete mix.

When concreting is to be resumed on a surface which has not fully hardened, all laitance shall be removed by wire brushing, the surface wetted, free water removed and a coat of cement slurry applied. On this a layer of concrete not exceeding 150 mm thickness shall be placed and well rammed against the old work. Thereafter work shall proceed in the normal way.

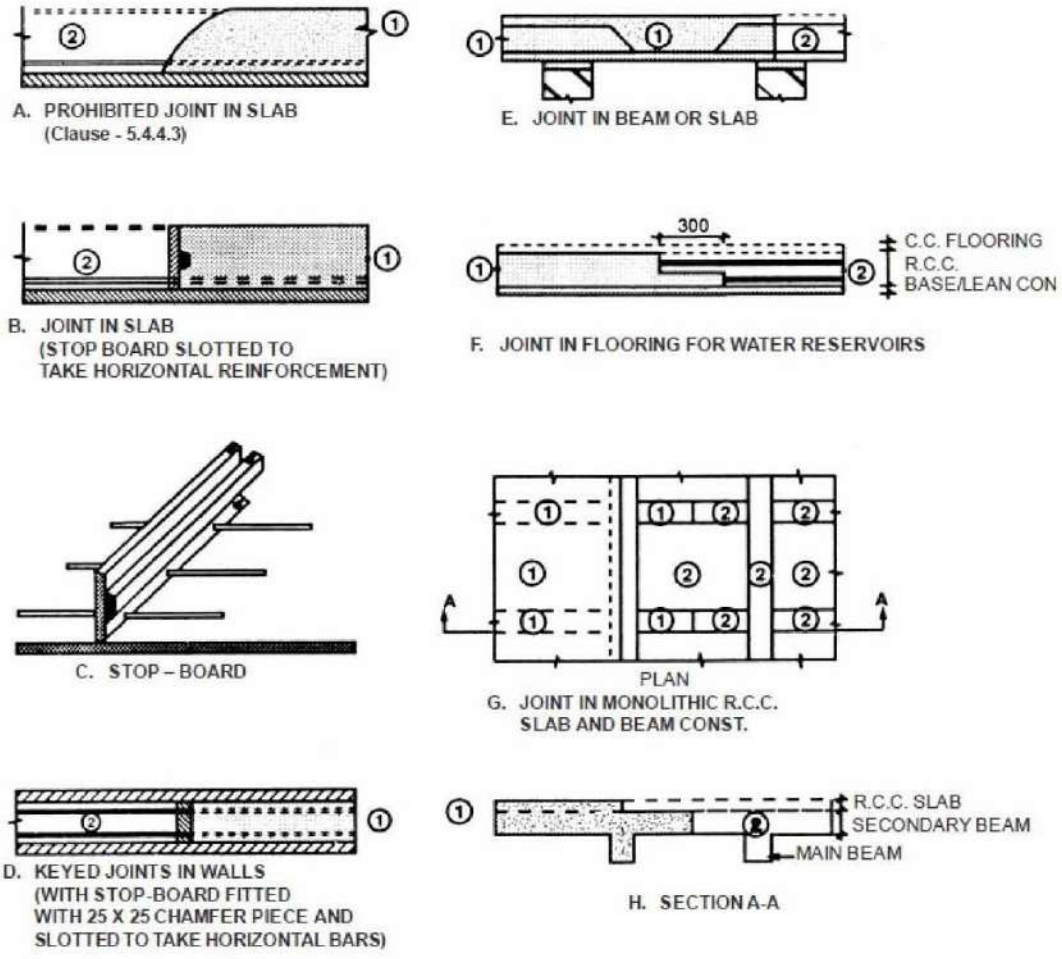


Fig. : Construction Joints

19.0 FOUNDATION BEDDING

All earth surfaces upon which or against which concrete is to be placed, shall be well compacted and free from standing water, mud or debris. Soft or spongy area shall be cleaned out and back filled with either soil-cement mixture, lean concrete or clean sand compacted as directed by ENGINEER. The surfaces of absorptive soils shall be moistened.

Concrete shall not be deposited on large sloping rock surfaces. The rock shall be cut to form rough steps or benches by picking, barring or wedging. The rock surface shall be kept wet for 2 to 4 hours before concreting.

20.0 FINISHES

20.1 GENERAL

The formwork for concrete works shall be such as to give the finish as specified. The CONTRACTOR shall make good any unavoidable defects as directed consistent with the type of concrete and finish specified; defects due to bad workmanship (e.g. damaged or misaligned forms, defective or poorly compacted concrete) will not be accepted. CONTRACTOR shall construct the formwork using the correct materials and to meet the requirements of the design and to produce finished concrete to required dimensions, plumbs, planes and finishes.

20.1.1 Surface Finish Type F1

This type of finish shall be for non-exposed concrete surfaces against which back fill or concrete is to be placed. The main requirement is that of dense, well compacted concrete. No treatment is required except repair of defective areas, filling all form tie holes and cleaning up of loose or adhering debris. For surfaces below grade which will receive waterproofing treatment the concrete shall be free of surface irregularities which would interfere with proper and effective application of waterproofing material specified for use.

20.1.2 Surface Finish Type F2

This type of finish shall be for all concrete work which will be exposed to view upon completion of the job. The appearance shall be that of a smooth dense, well-compacted concrete showing the slight marks of well fitted shuttering joints. The CONTRACTOR shall make good any blemishes.

20.1.3 Surface Finish Type F3

This type of finish shall be for concrete work which will be exposed to view but to give an appearance of smooth, dense, well-compacted concrete with no shutter marks, stain free and with no discolouration, blemishes, arrises, airholes etc. Only lined or coated plywood with very tight joints shall be used to achieve this finish. The panel size shall be uniform and as large as practicable. Any minor blemishes that might occur shall be made good by CONTRACTOR.

20.1.4 INTEGRAL CEMENT FINISH ON CONCRETE FLOOR

In all cases where integral cement finish on a concrete floor has been specified, the top layer of concrete shall be screeded off to proper level and tamped with tamper having conical projections so that the aggregate shall be forced below the surface. The surface shall be finished with a wooden float and a trowel with pressure. The finish shall be continued till the concrete reaches its initial set. No cement or cement mortar finish shall be provided on the surface. Where specified, a floor hardener as approved by the ENGINEER shall be supplied and used as recommended by the manufacturer.

21.0 REPAIR AND REPLACEMENT OF UNSATISFACTORY CONCRETE

Immediately after the shuttering is removed, all the defective areas such as honey-combed surfaces, rough patches, holes left by form bolts etc. shall be brought to the notice of ENGINEER who may permit patching of the defective areas or reject the concrete work.

All through holes for shuttering shall be filled for full depth and neatly plugged flush with surface.

Rejected concrete shall be removed and replaced by CONTRACTOR at no additional cost to OWNER.

For patching of defective areas all loose materials shall be removed and the surface shall be prepared as directed by the ENGINEER.

Bonding between hardened and fresh concrete shall be done either by placing cement mortar or by applying epoxy. The decision of the ENGINEER as to the method of repairs to be adopted shall be final and binding on the CONTRACTOR and no extra claim shall be entertained on this account. The surface shall be saturated with water for 24 hours before patching is done with 1:5 cement sand mortar. The use of epoxy for bonding fresh concrete shall be carried out as directed by ENGINEER.

22.0 VACUUM DEWATERING OF SLABS

Where specified floor slabs, either grade or suspended, shall be finished by vacuum dewatering including all operations such as poker vibration, surface vibration, vacuum processing, floating and trowelling as per equipment manufacturers recommendation. The equipment to be used shall be subject to ENGINEER's approval.

22.1 HOT WEATHER REQUIREMENTS

Concreting during hot weather shall be carried out as per IS:7861 (Part I).

22.1.1 COLD WEATHER REQUIREMENTS

Concreting during cold weather shall be carried out as per IS:7861 (Part 2)

The ambient temperature during placement and upto final set shall not fall below 5 Deg C. Approved anti- freeze/accelerating additives shall be used where directed.

For major and large scale concreting works the temperature of concrete at times of mixing and placing, the thermal conductivity of the formwork and its insulation and stripping period shall be closely monitored.

22.1.2 WATER RETAINING STRUCTURES

The CONTRACTOR shall take special care for concrete for underground structures such power house basement, reservoirs etc., and those others specifically called for to guarantee the finish and water tightness. Construction of water retaining structures shall generally follow the requirements of IS:3370.

The minimum level of surface finish for liquid retaining structures shall be Type F2. All such structures shall be hydro-tested.

The CONTRACTOR shall include in his price, hydrotesting of structures including all arrangements for testing such as temporary bulkheads, pressure gauges, pumps, pipelines etc.

All temporary arrangements that may have to be made to ensure stability of structures during testing shall also be considered while quoting rates.

Any leakage that may occur in the structures shall be effectively stopped either by cement/epoxy pressure grouting, guniting or such other methods as may be approved by the ENGINEER. All such rectification shall be done by the CONTRACTOR to the entire satisfaction of the EMPLOYER/ENGINEER at no extra cost to the EMPLOYER.

22.1.3 TESTING CONCRETE STRUCTURES FOR LEAKAGE

Hydro-static test for water tightness shall be done at full storage level or soffit of cover slabs, as may be directed by ENGINEER, as describe below.

In case of structures whose external faces are exposed, such as elevated tanks, the requirements of the test shall be deemed to be satisfied if the external faces show no sign of leakage or sweating and remain completely dry during the period of observation of seven days after allowing a seven day period for absorption after filling with water.

In the case of structures whose external faces are submerged and are not accessible for inspection, such as underground tanks, the structures shall be filled with water and after the expiry of seven days after the filling, the level of surface of water shall be recorded. The level of water shall be recorded again at subsequent intervals of 24 hrs. Over a period of seven days. Backfilling shall be withheld till the tanks are tested. The total drop in surface level over a period of seven days shall be taken as an indication of the watertightness of the structure. The engineer shall decide on the actual permissible nature of this drop in the surface level, taking into account whether the structures are open or closed and the corresponding effect it has on evaporation losses. Unless specified otherwise, a structure whose top is covered shall be deemed to be watertight if the total drop in the surface level over a period of seven days does not exceed 40mm

Each compartment/segment of the structure shall be tested individually and then together.

For structures such as pipes, tunnels etc. The hydrostatic test shall be carried out by filling with water after curing as specified and subjecting to the specified test pressure for specified period. If during this period the loss of water does not exceed the equivalent of the specified rate, the structure shall be considered to have successfully passed the test.

23.0 OPTIONAL TESTS

If the ENGINEER feels that the materials i.e. cement, sand, coarse aggregates, reinforcement and water are not in accordance with the specifications or if specified concrete strengths are not obtained, he may order tests to be carried out on these materials in laboratory, to be approved by the ENGINEER, as per relevant IS Codes. OWNER shall pay only for the testing of material supplied by the OWNER, otherwise CONTRACTOR shall have to pay for the tests. Transporting of all material to the laboratory shall however be done by the CONTRACTOR at no extra cost to OWNER.

In the event of any work being suspected of faulty material or workmanship requiring its removal or if the works cubes do not give the stipulated strengths, ENGINEER reserves the right to order the CONTRACTOR to take out cores and conduct tests on them or do ultrasonic testing or load testing of structure, etc. All these tests shall be carried out by CONTRACTOR at no extra cost to the OWNER. Alternately ENGINEER also reserves the right to ask the CONTRACTOR to dismantle and re-do such unacceptable work at the cost of CONTRACTOR.

If the structure is certified by ENGINEER as having failed, the cost of the test and subsequent dismantling/ reconstruction shall be borne by CONTRACTOR.

23.1 INSPECTION

All materials, workmanship and finished construction shall be subject to continuous inspection and approval of ENGINEER. Materials rejected by ENGINEER shall be expressly removed from site and shall be replaced by CONTRACTOR immediately at no extra cost to OWNER.

23.2 CLEAN-UP

Upon the completion of concrete work, all forms, equipment, construction tools, protective coverings and any debris, scraps of wood, etc. Resulting from the work shall be removed and the premises left clean.

23.3 CHECKING VERTICALITY, ECCENTRICITY AND LEVELS OF THE STRUCTURES

During the progress of the construction, the CONTRACTOR shall check the levels of the floors, the verticality and eccentricity of all the vertical structural members. Such checking shall be carried out with appropriate survey equipment by an independent registered land surveyor for all floors of the building structures, one floor at a time and as soon as the structural works for each floor are completed.

The CONTRACTOR shall submit two sets of the surveyor's report and field readings compiled in an approved format to the ENGINEER as and when they are completed. Such report shall indicate the levels, verticality, eccentricity and deviation, if any, of the building structures.

The checking of the levels, verticality and eccentricity of the building structures and the submission of such reports to the ENGINEER shall not relieve the CONTRACTOR of any of his duties or responsibilities under the contract.

23.4 SAMPLING AND STRENGTH OF DESIGNED CONCRETE MIX

Samples from fresh concrete shall be taken as per IS 1199 and cubes shall be made, cured and tested at 28 days in accordance with IS 516.

Frequency of sampling, Test specimen and Test results of sample shall be as per IS 456.

Any other tests such as for workability, durability,etc, required at field shall be done as per IS 456.

23.5 ACCEPTANCE CRITERIA

Any concrete work shall satisfy the requirements given below individually and collectively for it to be acceptable.

a) properties of constituent materials;

b) characteristic compressive strength;

c) specified mix proportions;

d) minimum cement content;

e) maximum free-water/cement ratio;

f) workability;

g) temperature of fresh concrete;

h) density of fully compacted concrete;

i) cover to embedded steel;

j) curing;

k) tolerances in dimensions;

l) tolerances in levels;

m) durability;

n) surface finishes;

p) special requirements such as;

i) water tightness;

ii) resistance to aggressive chemicals

iii) resistance to freezing and thawing

iv) very high strength

v) improved fire resistance

vi) wear resistance

vii) resistance to early thermal cracking

The ENGINEER's decision as to the acceptability or otherwise of any concrete work shall be final and binding on the CONTRACTOR.

For work not accepted, the ENGINEER may review and decide whether remedial measures are feasible so as to render the work acceptable. The ENGINEER shall in that case direct the CONTRACTOR to undertake and execute the remedial measures. These shall be expeditiously and effectively implemented by the CONTRACTOR. Nothing extra shall become payable to the CONTRACTOR by the OWNER for executing the remedial measures.

24.0 SELF COMPACTING CEMENT CONCRETE(SCC)

The Self Compacting Concrete (referred hereinafter as SCC) shall conform to the requirements of IS 456: 2000 reaffirmed 2005 (Fourth Revision).

In addition to the provisions of the IS code the SCC shall meet the following requirements as per EN standards:

$T_{50\ cm}$ slump flow	2-5 sec
J Ring	0 -10 mm
V funnel	8-12 sec
V Funnel $T_{50\ min}$	+ 3 sec
L Box	H_2 / H_1 = 0,8-1,0
U Box	$H_2 - H_1$= 30

	mm max
Fill Box	90-100 %
Screen Stability	0-15 %
Orimet test	0-5 sec

The mineral admixture in the SCC shall be Flyash with a minimum content of 30% of the total weight of the cementitious material.

The formwork shall be suitably designed for achieving the desired form finish of the exposed concrete.

24.1 Hydrophilic water sealing materials of assorted profiles at construction joints at different locations during the construction of Basement Raft RCC and peripheral RCC Retaining wall

24.2 Scope

Providing and fixing hydrophilic water sealing materials at construction joints at different locations during the construction of Basement Raft RCC and peripheral RCC Retaining wall and also construction joints at other water retaining structures including creating necessary nominal trapezoidal key shape in the formwork finish or by mason's finish, including applying suitable adhesives and sealants as recommended and supplied by the approved manufacturer for proper and highly secure bonding with substrate, rough / smooth and wet / dry, proper splicing and jointing at corners, T, L and X junctions using suitable glue, at all such locations as directed by Engineer in-charge.

24.3 Material

It shall be hydro-swelling water bar, ready for installation in construction joint to render the joints leak proof. It is based on the specially designed polymer composite that acts as undergoing reversible swelling on exposure to water to form an effective seal.

Hydro swelling water bar has water molecules held by molecular attraction not by vacuum. It should not generate gas or foam with water and prevents water ingress even when joint width varies. It should have elastomeric properties which keeps swelling and reverting to original volume on drying throughout the life of structure.

Construction joints at the retaining wall shall be installed with hydro-swelling water bar based on advance vinyl acrylate polymers. The water bar shall be formulated to

exhibit low pre-mature swelling (less than 50% within 12 hours) and shall not be based on super absorbents. The water bar shall have low swelling pressure; not exceeding 0.25 mpa at full swelling capacity. The water bar shall be installed with special adhesive as per approved manufacturer's instructions.

24.4 Workmanship

The concrete substrate to which the water bar is to be fixed must be smooth and sound

Cut the water bar to the required length.

Fix the water bar to the concrete substrate using approved adhesive. Apply light tension to the water bar as it is being fixed. Allow the adhesive on the verticals to dry at least over night before concreting.

Protect the fixed water bar from mould release oil and dirt. Do not saturate the water bar before concreting as this may cause it to swell.

For additional work methodology refer Clause 22.4 of CPWD specification Vol. 2, 2009

24.5 Mode Of Measurements

The length shall be measured as per Clause 22.4 of CPWD specification Vol. 2, 2009

25mm thick alkali resistance, closed cell polymer based expansion joint filler board of approved make, having minimum density of 28 Kg/ Cu.m & compression strength of 0.21 Kg/sqm; using double sided adhesive tape as per the manufacturer's specifications etc.

24.6 Scope

Providing and fixing polymer based Expansion joint filler board of approved make and as approved by Engineer in-charge.

24.7 Material

It shall be alkali resistant, closed cell polymer based expansion joint filler material for RCC Columns, Beams, Walls, and Slabs.

It does not react with acids & alkalis.

It should withstand joint movements.

It shall be non-impregnated, non-staining, non-bleeding and negligible water absorption properties.

Technical details

A)	Water absorption (%)	:	0.02%
B)	Density (Kg/cum)	:	28 (min.)
C)	Compression strength (Kg/sqm)	:	0.21 (min.)
D)	Tensile strength (Kg/sqm)	:	1.8 (min.)
E)	Elongation (%)	:	60 (min.)
F)	Bitumen content	:	NIL

24.8 Workmanship

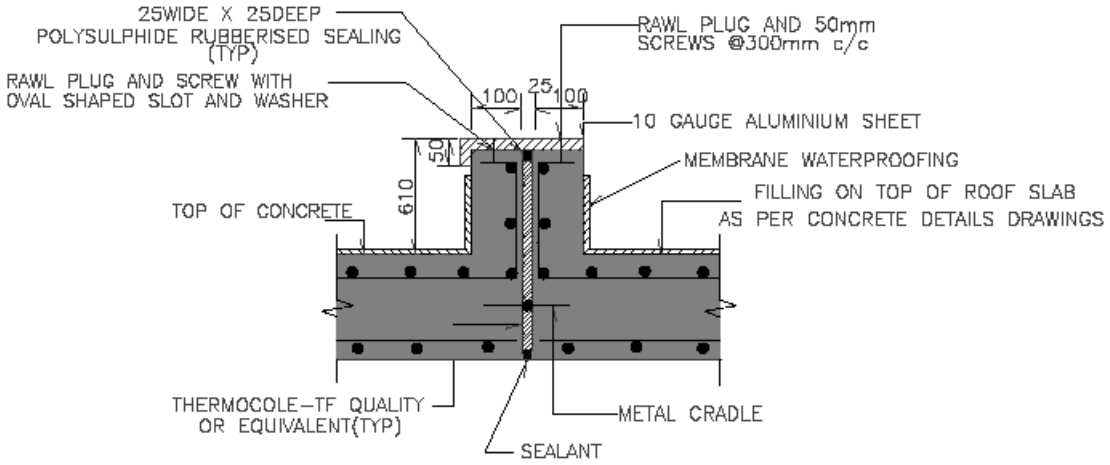
24.8.1 Surface preparation

While creating expansion joint, the filler board will become one side of shuttering.

In an expansion / movement joint filler board is to be fixed in position to substrate using double sided adhesive tape of approved manufacturer or synthetic rubber adhesive.

24.9 Mode Of Measurements

It shall be measured in Sqm including required accessories.



EXPANSION JOINT DETAIL
ROOF SLAB SECTION

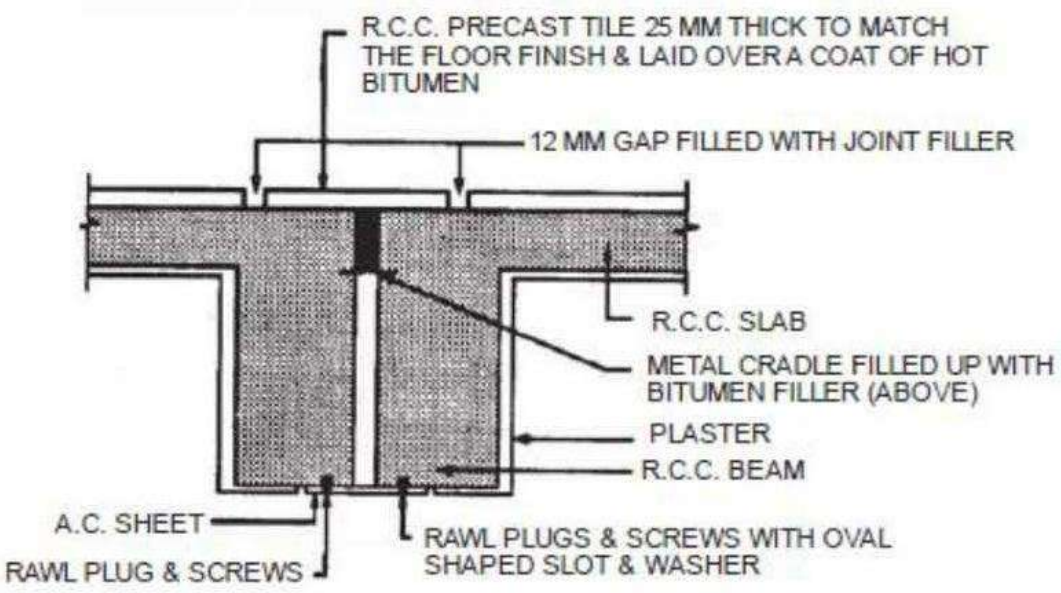


Fig. : Typical Details of Expansion Joint at Floor

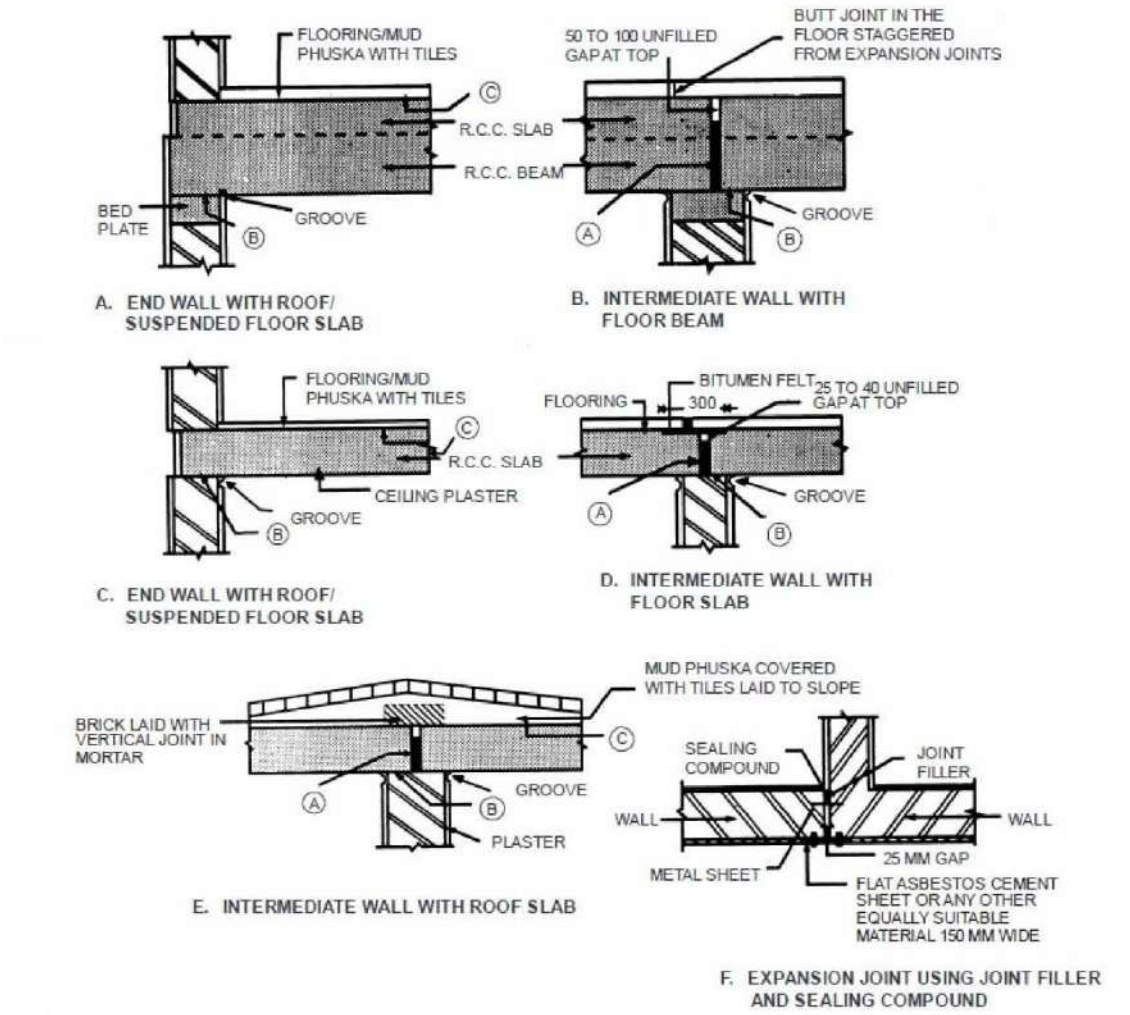


Fig. : Expansion Joint (Contd.)

Hydrophobic Silane-Siloxane coating of approved make to exposed concrete surfaces in two coats wet-on-wet or as recommended by approved manufacturer including preparation of surfaces etc.

24.9.1 GENERAL

24.9.2 SCOPE

Specification for Concrete Protection by colourless, hydrophobic liquid impregnator.

24.9.3 APPLICATION

The application should be carried in accordance with the technical datasheet and the application guideline of the material manufacturer.

24.9.4 MATERIALS

Single component, free flowing, Colourless, solvent free liquid, based on monomeric Alkylalkoxysilane system.

24.9.5 PERFORMANCE REQUIREMENTS

The material shall be a single component, Free flowing, Solvent free liquid based on Monomeric Alkylalkoxysilane system of protection. The free flowing liquid shall effectively work as a hydrophobic / water repellent impregnator when applied on concrete substrates.

24.9.6 DELIVERY, STORAGE & HANDLING

Comply with manufacturer's ordering and lead time requirement to avoid construction delays.

The material should be clearly labeled with manufacturer's identification, date of expiry, Identifiable batch code. Store materials in unopened containers in dry area.

24.10 MODE OF MEASUREMENT AND PAYMENT

The unit rate for concrete work under various categories shall be all inclusive and no claims for extra payment on account of such items as leaving holes, embedding inserts, etc. Shall be entertained unless separately provided for in the schedule of quantities. No extra claim shall also be entertained due to change in the number, position and/or dimensions of holes, slots or openings, sleeves, inserts or on account of any increased lift, lead of scaffolding etc. While quoting the unit rates. Unless provided for in the schedule of quantities the rates shall also include fixing inserts in all concrete work, wherever required. All the quantities are to be worked out from approved construction drawings and not based on actual measurement.

Payments for concrete will be made on the basis of unit rates quoted for the respective items in the schedule of quantities. No deduction in the concrete quantity will be made for reinforcement, inserts etc. and opening less than 0.100 sq.m in areas where concrete is measured in sq.m and 0.010 cu.m where concrete is measured in cu.metres. Where no such deduction for concrete is made, payment for shuttering work provided for such holes, pockets, etc. will not be made. Similarly the unit rates for concrete work shall be inclusive or exclusive of shuttering as provided for in the schedule of quantities.

Payment for beams will be made for the quantity based on the depth being reckoned from the underside of the slabs and length measured as the clear distance between supports. Payment for columns shall be made for the quantity based on height reckoned upto the underside of slabs/beams.

The unit rate for precast concrete members shall include formwork, mouldings, finishing, hoisting and setting in position including setting mortar, provision of lifting arrangement etc. complete. Reinforcement and inserts shall be measured and paid for separately under respective item rates.

Only the actual quantity of steel embedded in concrete including laps shown on drawings or as approved by ENGINEER shall be measured and paid for, irrespective of the level or height at which the work is done. The unit rate for reinforcement shall include all wastages, binding wires, chairs, spacer bars etc. for which no separate payment shall be made.

For purpose of measurement unit weight of reinforcement bars and structural steel will be considered as per IS hand book and not based on actual weight.

25.0 CONCRETE POUR CARD

CLIENT: DATE: POUR NO

PROJECT: STRUCTURE:

CONTRACTOR: MAX AGGREGATE SIZE/SLUMP: MM/ MM

DRG. NO.: START/COMPLETION TIME: /

CONCRETE GRADE/QUANTITY: M / m^3 MIXING TIME:

SL. NO.		ITEM	CONTRACTOR'S REP. SIGNATURE	ENGINEER'S SIGNATURE	REMARKS
1	BEFORE CONCRETING	CENTERLINES & LEVELS WITH RESPECT TO DATUM LEVEL CHECKED			
		a) TRIAL MIXED DESIGN TEST VERIFIED			
		b) RECOMMENDED SLUMP AS PER MIX DESIGN / ACTUAL SLUMP			
2		FORMWORK AND STAGING CHECKED FOR ACCURACY, STRENGTH & FINISH			
3		REINFORCEMENT CHECKED			

4		COVER TO REINFORCEMENT CHECKED				
5		VERIFIED TEST CERTIFICATE FOR CEMENT/STEEL		YES/NO	YES/NO	
6		ADEQUACY OF MATERIALS/EQUIPMENT FOR POUR		YES/NO	YES./NO	
7		EMBEDDED PARTS CHECKED (LOCATION AND PLUMB)	CIVIL			
			MECHANICAL			
			ELECTRICAL			

POUR AUTHORISED SITE ENGINEER

	SOFFIT(S) AND POUR TOP(T) LEVELS CHECKED BEFORE(B) AND AFTER(A) FORM REMOVAL (ONLY OF OVER 10M SPAN AND IMPORTANT STRUCTURES LIKE T.G. ETC.)		S(B) T(B) S(A) T(A)		
	CONSTRUCTION JOINT LOCATION AND TIME (IF NOT AS PER DRAWING)				
	CEMENT CONSUMPTION IN KGS				
	NUMBER OF CUBES AND IDENTIFICATION BANKS				
	TEST CUBE RESULTS (7 DAYS / 28 DAYS)		/		
		CONCRETE CONDITION ON FORM REMOVAL	V. GOOD / GOOD / FAIR		

SITE-IN-CHARGE

NOTES:

1. EACH ITEM TO BE CHECKED & SIGNED BY THE RESPECTIVE ENGINEER/SITE-IN-CHARGE.

2. ITEMS 8 TO 13 (BOTH INCLUSIVE) TO BE FILLED BY ONLY TCE. ENGINEER.

3. EACH POUR TO HAVE SEPARATE CARDS, IN TRIPLICATE ONE EACH FOR CLIENT, TCE & SITE OFFICE.

UNDER REMARKS INDICATE DEVIATIONS FROM DWGS. & SPECIFICATIONS, CONGESTION IN REINFORCEMENT.

IF ANY, UNUSUAL OCCURENCES, SUCH AS FAILURE OF EQUIPMENTS, SINKING OF SUPPORTS/PROPS. HEAVY RAINS AFFECTING CONCRETING, POOR COMPACTION, IMPROPER CURING, OTHER DEFFICIENCES, OBSERVATIONS ETC.

26.0 GUNITING WORKS

I. Air pressure shall be about 60 lbs/in^2. The operating air pressure shall be uniform and proper nozzle velocity shall be obtained. The water pressure shall be 70 to 75 lbs/in and shall be uniform. Water shall be free from Chemical Compound and other impurities.

II. All surface where gunite is to be applied shall be clean and free of loose materials, cleaning of concrete surface and corroded steel shall be done by sand-blasting only.

III. The water content shall be regulated so as to obtain a mix that will be plastic enough to give good compaction and a low percentage of rebound but stiff enough not to sag.

IV. The nozzle shall be hold at the proper distance normally within 2 to 3 feet and as nearly normal to the surface to be gunited as possible.

V. All sand pockets behind reinforcement shall be cut away and removed.

VI. All rebound from the surface shall be removed.

VII. The gunite shall be brought to finished lines in near and workmanlike manner.

VIII. All surfaces before receiving gunite shall be thoroughly cleaned. Adequate and safe scaffolding shall be provided so that the nozzle man can hold nozzle at the correct angle and distance from the surface of all parts, for uninterrupted working and proper finishing.

IX. Augment control: Adequate ground wires shall be installed to establish the thickness and surface planes of the gunite built up. Both horizontal and vertical ground wires shall be installed at and offsets not clearly established by from work.

X. Guniting thickness: Each layer of gunite shall be built by making several passes of the nozzle over the working area. The gunite material shall emerge from the nozzle in a steady stream. When the flow become intermittent the nozzle man shall direct the flow away from the surface, except when guniting through reinforcing bars the nozzle shall be hold closer and at a slight angle to permit better encasement and removal of rebound. Special care shall be taken that no loose material is left behind reinforcing bar.

XI. Nozzle Velocity: The gunite tends to become substandard due to improper nozzle velocity is attained when rebound is reasonable and slight stream appears on the surface due to tamping effect of the steam.

At higher velocities the strength decrease. The decrease is due to the interference of nozzle material particles with rebound material causing porous mass in place.

Under size compressor, long nose, large diameter tips cause low velocity. The compaction is poor and the rebound is more.

XII. Rebound: The amount of rebound depends upto many factors such as hydration efficiency, water cement ratio fine aggregate convent, nozzle velocity and grading angle of nozzle flow, distance of impact, application thickness and skill of nozzle man.

The quantity of rebound for well executed gunite work would range from 15 to 25% for vertical walls and 30 to 40% for overhead wall. During the initial stages the percentage of rebound is excessive but it soon diminishes after a plastic cement sand cushion has been formed on the surface of application permitting the sand particles to become embedded in freshly laid gunite. The percentage of rebound is also effected by the distance of the nozzle from the application surface. The amount of rebound be generally held than acceptable minimum if the distance between the nozzle and application surface is about 3 feet and the nozzle is as nearly perpendicular to the application surface as possible. Grading of rebound is usually much coarser than the original mix itself since only the larger particles tend to all tank. Refuse of rebound is not permissible.

In case the rebound materials is to be reused the same shall be thoroughly washed and dried and screened.

XIII. Construction joints :- These shall be tapered to a thin edge over a width of 1 foot. The entire joint shall be thoroughly cleaned and wetted prior to the application of additional gunite.

XIV. Preparation of succeeding layers: - Where a layer of gunite is to be covered by succeeding layer, it shall be first allowed to take its initial set. Then all loose laitance and loose material shall be removed by booming. Sand blasting or water jetting. In addition the surface shall be thoroughly sounded by a hammer for hollow areas resulting from rebound pockets or lack of bound which shall be cut out and replaced during the next layer. Surface to be

shot shall be damp. Guniting shall be laid to a total thickness of 40 to 60 mm in one operation as specified.

XV. Curing:- Curing shall be done for at least 7 days . Membranes curing is permissible.

XVI. It is highly important that all unsound material be removed before applying gunite. Improper preparatory work is responsible for many failures. The final prepared surface shall be critically examined to see that it is sound.

New reinforcement shall be anchored into the beam and the gunite finished with a hamper at the junction of slab with beams as directed. No extra payment shall be made for making the necessary groove in beam and for chamber etc.

26.1 EPOXY RESIN:

A coat of epoxy resin is to be applied to the old concrete surface after the same has been thoroughly cleaned of all dust, rust loose particles etc. The epoxy resin is used to bounding the gunite to the old concrete and is to be used in accordance with the manufacturer's specification. The resin is to be applied to the prepared concrete surface or steel and the fresh concrete or gunite applied as soon as possible but always during the open time of the adhesive.

a) Preparation of surface: To obtain good adhesion it is necessary to have a clean and sound surface. Dust and loose particle resulting from pre treatment shall be removed by vacume cleaning or all free air blast.

b) Mixing: The resin and hardener shall be thoroughly mixed before in the dry filler. The mixed ready to use adhesive shall not contain lumps of up wetter filler and should be of a uniform co lour. For a total weight of 1 kg. or less hand mixing shall be sufficient. For quantities in excess of 1 the use of mechanical mixer is recommended.

c) Plot life and open time: The plot life is the period during which the ready to used 'Araldite' based formulation must be applied after this period the mix can no longer be worked and will have begun to set in container:

Table – I	
Mix temperature	Pot life in minutes
25^0 c	90
30^0 c	60
35^0 c	45

(The figure above are for batches less than 1 kg)

The "Open time" is the maximum period of time allowable between application of adhesive and purring the fresh concrete of gunite. Exceeding the 'open time' would result in considerably reduced adhesion. The adhesive should be applied to the

perforated surface as soon as the components have been mixed and fresh gunite shot immediately.

Accurate knowledge of 'open time' is essential in case the work is interrupted. Any delay between mixing application will reduce the 'open time' fresh gunite must be shot before the adhesive begins to gel.

Method of application – May be applied by hand using brushes broom, squeegees or any other suitable applicator.

Suitability of the fresh concrete:_ Best results are obtained when the water/cement of the new concrete/cement mortar is as low as practicable.

Coverage- 1 kg. of the mixed 'Araldite' adhesive including hardeners and fillers covers an area of 2-3 sq.mtrs. when applied with a stiff nylon bristle brush. However, the coverage is very much dependent, on the finish of the concrete.

Not withstanding the source, the sand shall be washed using sand washing machine before use.

26.2 Special directions to tenderers for Guniting works

1. The Tenderers are requested to inspect the site personally and observe the scope of work.

2. Cement used on guniting work shall be got tested as per relevant I.S.Specifications as directed.

3. After completing the guniting job, contractor will have to remove all debris and leave the work site clean of all dust, stains etc. Nothing extra will be paid for removing such debris.

4. Wherever necessary and directed the corroded reinforcement of slabs, beams and columns, shall be replaced by additional reinforcement, paid as per F.M.B. Items of the schedule at the time of the execution of the work.

5. Wherever required guniting work will be done in two layers especially for columns.

6. The tenderer will have to make good without any extra payment, any damage or loss to the Municipal property while executing the work. Surfaces which do not receive guniting shall be protected with waterproof paper or other adequate means, adjacent structures or ground which would be damaged by guniting by dust or rebound shall also be protected.

7. The electrical work as dismantling the existing electrical wiring and installation etc. shall be carried out through approved registered electrical contractors of appropriate category.

8. The tenderer will have to make adequate shielding arrangement by putting necessary hoarding, screens etc. so as to not to effect the normal working of the activities without any extra payment.

ENCASING ROLLED STEEL SECTION

Sub Head : R.C.C.

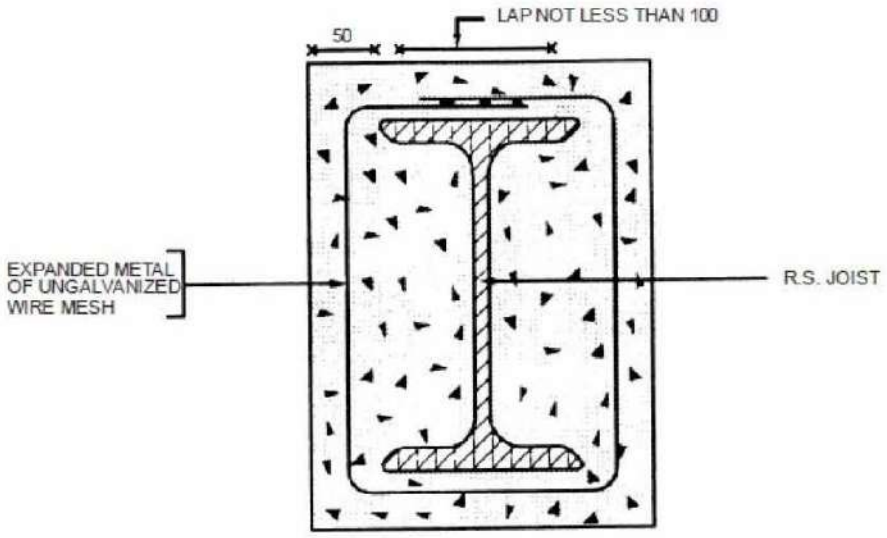


Fig. : Steel Column

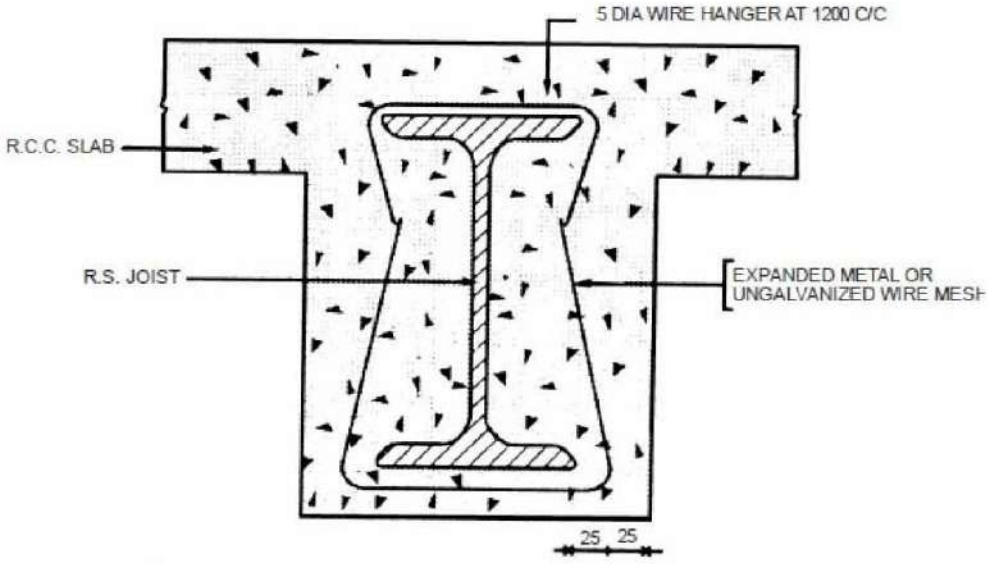


Fig. : Steel Beam with Slab

Normally Cement Concrete 1 : 2 : 4 (1 Cement : 2 Coarse Sand : 4 Graded Stone Aggregate 12.5 Nominal Size) shall be used.

Drawing not to scale
All dimensions are in mm

Chapter -4

Masonry Work

MASONRY WORKS

1.0 SCOPE

This specification covers the general requirements for masonry works comprising brick, random rubble masonry, uncoursed rubble masonry, block masonry, and such other related works forming a part of this job, which may be required to be carried out though not specifically mentioned above. The work under this specification shall consist of furnishing of all tools, plants, labour, materials, and everything necessary for carrying out the work.

2.0 APPLICABLE CODES AND SPECIFICATIONS

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

In case of discrepancy between this specification and those referred to herein, this specification shall govern.

IS:269/1989	-	Specification for 33 grade ordinary portland cement.
IS:1077/1992	-	Specification for common burnt clay building bricks.
IS:1124/1974	-	Method of test for determination of water absorption, apparent specific gravity and porosity of natural building stones.
IS:1397/1990	-	Specification for Kraft paper.
IS:1597/1992	-	Code of practice for construction of stone masonry: Part 1 Rubble stone masonry.
IS:2116/1980	-	Specification for sand for masonry mortars.
IS:2185/1967	-	Specification for concrete masonry units (Parts 1,2 & 3).
IS:2212/1991	-	Code of practice for brickwork.
IS:2250/1981	-	Code of practice for preparation and use of masonry mortars.
IS:2572/1963	-	Code of practice for construction of hollow concrete block masonry.
IS:2691/1988	-	Specification for burnt clay facing bricks.
IS:2750/1964	-	Specification for steel scaffoldings.

IS:3068/1986	-	Specification for broken brick (burnt clay) coarse aggregates for use in lime concrete.
IS:3495/1992	-	Method of test for burnt clay building bricks: Part 1 to 4.
IS:3696/1987	-	Safety code of scaffolds and ladders (Part 1).
IS:3696/1991	-	-DO- (Part 2).
IS:4832/1969	-	Specification for chemical resistant mortars (Part 2).
IS:4860/1968	-	Specification for acid resistant bricks.
IS:6041/1985	-	Code of practice for construction of autoclaved cellular concrete block masonry.
IS:6042/1969	-	Code of practice for construction of light weight concrete block masonry.
IS:8042/1989	-	Specification for white Portland cement.

3.0 BRICKWORK

3.1 MATERIALS

Bricks used in the works shall conform to the requirements laid down in IS:1077. The class of the bricks shall be as specifically indicated in the respective items of work.

The nominal size of the modular brick shall be 200mm x 100mm x 100mm with the permissible tolerances over the actual size of 190mm x 90mm x 90mm as per IS: 1077. The nominal thickness of one brick and half brick walls using modular bricks shall be considered as 200 mm and 100 mm respectively. In the event of use of traditional bricks of nominal size 230mm x 115mm x 75mm with tolerance up to +3 mm in each dimension, one brick and half brick walls shall be considered as 230 mm and 115 mm respectively.

3.1.1 Classification

Bricks/Brick tiles shall be classified on the basis of their minimum compressive strength as given below :

Class designation	Average compressive strength not less than	Average compressive strength less than

Class designation	Average compressive strength not less than	Average compressive strength less than
12.5	12.5	15
10	10	12.5
7	7	10
5	5	7
3.5	3.5	5

The bricks shall have smooth rectangular faces with sharp corner and shall be uniform in colour and emit clear ringing sound when struck.

Bricks/Brick tiles shall be classified on the basis of material used and size as given below :

3.1.2 Common Burnt Clay Bricks:

Common Burnt Clay Bricks shall conform to IS:1077 and shall be hand moulded or machine moulded. They shall be free from nodules of free lime, visible cracks, flaws warpage and organic matter, have a frog 100 mm in length 40 mm in width and 10 mm to 20 mm deep on one of its flat sides. Bricks made by extrusion process and brick tiles may not be provided with frogs. Each brick shall be marked (in the frog where provided) with the manufacturer's identification mark or initials.

3.1.3 Clay Fly Ash Bricks:

The clay fly ash bricks shall conform to IS 13757. The bricks shall be sound, compact and uniform in shape and colour. Bricks shall have smooth rectangular faces with sharp and square corners. The bricks shall be free from visible cracks, flaws, warpage, nodules of free lime and organic matter, the bricks shall be hand or machine moulded. The bricks shall have frog of 100 mm in length 40 mm width and 10 to 20 mm deep on one of its flat sides. If made by extrusion process may not be provided with frogs. Fly Ash shall conform to grade I or grade II of IS 3812.

3.1.4 Tile Brick:

The bricks of 4 cm height shall be moulded without frogs. Where modular tiles are not freely available in the market, the tile bricks of F.P.S. thickness 44 mm (1-3/4") shall be used unless otherwise specified.

3.1.5 Brick Bats:

Brick bats shall be obtained from well burnt bricks.

3.1.6 Refractory brick:

These bricks should conform to IS:6 and should have size tolerance of variation from specified dimensions, covering both warpage and shrinkage shall be allowed to the extent of ±2% or ±2 mm, whichever is greater.

The average water absorption shall not be more than 20 percent by weight up to class 12.5 and 15 percent by weight for higher classes. Bricks which do not conform to this requirement shall be rejected. Over or under burnt bricks are not acceptable for use in the works.

Sample bricks shall be submitted to the ENGINEER for approval and bricks supplied shall conform to approved samples. If demanded by ENGINEER, brick samples shall be got tested as per IS: 3495 by CONTRACTOR at no extra cost to OWNER. Bricks rejected by ENGINEER shall be removed from the site of works within 24 hours.

Mortar for brick masonry shall consist of cement and sand and shall be prepared as per IS: 2250. Mix shall be in the proportion of 1:6 for brickwork of thickness one brick or above and 1:4 for brickwork of thickness half brick or below, unless otherwise specified in the respective items of work. Sand for masonry mortar shall conform to IS: 2116. The sand shall be free from clay, shale, loam, alkali and organic matter and shall be of sound, hard, clean and durable particles. Sand shall be approved by ENGINEER. If so directed by the ENGINEER, sand shall be screened and washed till it satisfies the limits of deleterious materials.

For preparing cement mortar, the ingredients shall first be mixed thoroughly in dry condition. Water shall then be added and mixing continued to give a uniform mix of required consistency. Mixing shall be done thoroughly in a mechanical mixer, unless hand mixing is specifically permitted by the ENGINEER. The mortar thus mixed shall be used as soon as possible, preferably within 30 minutes from the time water is added to cement. In case, the mortar has stiffened due to evaporation of water, this may be re-tempered by adding water as required to restore consistency, but this will be permitted only up to 30 minutes from the time of initial mixing of water to cement. Any mortar which is partially set shall be rejected and shall be removed forthwith from the site. Droppings of mortar shall not be re-used under any circumstances.

The CONTRACTOR shall arrange for test on mortar samples if so directed by the ENGINEER.

3.2 WORKMANSHIP

Workmanship of brick work shall conform to IS: 2212. All bricks shall be thoroughly soaked in clean water for at least one hour immediately before being laid. The cement mortar for brick masonry work shall be as specified in the respective item of work. Brick work 200mm/230mm thick and over shall be laid in English Bond unless otherwise specified. 100mm/115mm thick brickwork shall be laid with stretchers. For laying bricks, a layer of mortar shall be spread over the full width of suitable length of the lower course. Each brick shall be slightly pressed into the mortar and shoved

into final position so as to embed the brick fully in mortar. Only full size bricks shall be used for the works and cut bricks utilised only to make up required wall length or for bonding. Bricks shall be laid with frogs uppermost.

All brickwork shall be plumb, square and true to dimensions shown. Vertical joints in alternate courses shall come directly one over the other and be in line. Horizontal courses shall be levelled. The thickness of brick courses shall be kept uniform. In case of one brick thick or half brick thick wall, atleast one face should be kept smooth and plane, even if the other is slightly rough due to variation in size of bricks. For walls of thickness greater than one brick both faces shall be kept smooth and plane. All interconnected brickwork shall be carried out at nearly one level so that there is uniform distribution of pressure on the supporting structure and no portion of the work shall be left more than one course lower than the adjacent work. Where this is not possible, the work shall be raked back according to bond (and not saw toothed) at an angle not exceeding 45^0. But in no case the level difference between adjoining walls shall exceed one metre. Brick-work shall not be raised more than one metre per day.

Bricks shall be so laid that all joints are well filled with mortar. The thickness of joints shall not less than 6 mm and not more than 10 mm. The face joints shall be raked to a minimum depth of 10mm/15mm by raking tools during the progress of work when the mortar is still green, so as to provide a proper key for the plastering/pointing respectively to be done later. When plastering or pointing is not required to be done, the joints shall be uniform in thickness and be struck flush and finished at the time of laying. The face of brickwork shall be cleaned daily and all mortar droppings removed. The surface of each course shall be thoroughly cleaned of all dirt before another course is laid on top.

During inclement weather conditions, newly built brick masonry works shall be protected by tarpaulin or other suitable covering to prevent mortar being washed away by rain.

Brickwork shall be kept constantly moist on all the faces for at least seven days. The arrangement for curing shall be got approved from the ENGINEER.

Double scaffolding having two sets of vertical supports shall be provided to facilitate execution of the masonry works. The scaffolding shall be designed adequately considering all the dead, live and possible impact loads to ensure safety of the workmen, in accordance with the requirements stipulated in IS:2750 and IS:3696 (Part 1). Scaffolding shall be properly maintained during the entire period of construction. Single scaffolding shall not be used on important works and will be permitted only in certain cases as decided by the ENGINEER. Where single scaffolding is adopted, only minimum number of holes, by omitting a header shall be left in the masonry for supporting horizontal scaffolding poles. All holes in the masonry shall be carefully made good before plastering/painting.

In the event of usage of traditional bricks of size 230 mmx115mmx75mm, the courses at the top of the plinth and sills as well as at the top of the wall just below the roof/floor or slabs and at the top of the parapet shall be laid with bricks on edge.

All brickwork shall be built tightly against columns, floor slabs or other structural members.

To overcome the possibility of development of cracks in the brick masonry following measures shall be adopted.

For resting RCC slabs, the bearing surface of masonry wall shall be finished on top with 12 mm thick cement mortar 1:3 and provided with 2 layers of Kraft paper Grade 1 as per IS:1397 or 2 layers of 50 micron thick polyethylene sheets.

RCC/steel beams resting on masonry wall shall be provided with plain or reinforced concrete bed blocks of dimensions as indicated in the drawings duly finished on top with 2 layers of Kraft paper Grade 1 as per IS:1397 or 2 layers of 50 micron thick polyethylene sheets.

Steel wire fabric shall be provided at the junction of brick masonry and concrete as specified elsewhere before taking up plastering work.

The above items shall be measured and paid for separately under the respective items of work.

Bricks for partition walls shall be stacked adjacent to the structural member to pre-deflect the structural member before the wall is taken up for execution. Further, the top most course of half or full brick walls abutting against either a de-shuttered slab or beam shall be built only after any proposed masonry wall above the structural member is executed to cater for the deflection of the structural element.

Reinforced cement concrete transoms and mullions of dimensions as indicated in the construction drawings are generally required to be provided in half brick partition walls. Reinforced concrete for transoms and mullions shall be measured and paid for separately under the respective items of work.

Where drawings indicate that structural steel sections are to be encased in brickwork, the brick masonry shall be built closely against the steel section, ensuring a minimum of 20mm thick cement-sand 1:4 over all the steel surfaces. Steel sections partly embedded in brickwork shall be provided with bituminous protective coating to the surfaces at the point of entry into the brick masonry.

CONTRACTOR shall note that the unit rates quoted for the masonry work shall be deemed to include for the installation of miscellaneous inserts such as pipe sleeves, bolts, steel sections with anchors etc. and providing pockets, leaving openings, cutting chases etc. in accordance with the construction drawings. Miscellaneous inserts shall he either supplied FREE by the OWNER or to he furnished by the CONTRACTOR. Any of the miscellaneous inserts which are required to be fabricated and supplied by the CONTRACTOR and cement concrete to be provided

in the pockets for the hold fasts of door/window frames etc. shall however, be measured and paid separately under the respective items of work. .

Facing bricks of the type specified conforming to IS:2691 shall be laid in the positions indicated on the drawings and all facing brickwork shall be well bonded to the backing bricks/RCC surfaces. The level of execution of the facing brick work shall at any time be lower by at least 600 mm below the level of the backing brickwork.

Facing bricks shall be laid over 10 mm thick backing of cement mortar. The mortar mix, thickness of joint and the type of painting to be carried out shall be as specified in the item of work. The pattern of laying the bricks shall be as specifically indicated in the drawings.

For facing brickwork, double scaffolding shall be used.

Faced works shall be kept clean and free from damage, discoloration etc., at all times.

3.2.1 Soaking of Bricks

Bricks shall be soaked in water before use for a period for the water to just penetrate the whole depth of the bricks. Alternatively bricks may be adequately soaked in stacks by profusely spraying with clean water at regular intervals for a period not less than six hours. The bricks required for masonry work using mud mortar shall not be soaked. When the bricks are soaked they shall be removed from the tank sufficiently early so that at the time of laying they are skin-dry. Such soaked bricks shall be stacked on a clean place where they are not again spoiled by dirt earth etc.

Note I: The period of soaking may be easily found at site by a field test in which the bricks are soaked in water for different periods and then broken to find the extent of water penetration. The least period that corresponds to complete soaking will be the one to be allowed for in construction work.

Note II : If the bricks are soaked for the required time in water that is frequently changed the soluble salt in the bricks will be leached out, and subsequently efflorescence will be reduced.

3.2.2 Laying

Bricks shall be laid in English Bond unless otherwise specified. For brick work in half brick wall, bricks shall be laid in stretcher bond. Half or cut bricks shall not be used except as closer where necessary to complete the bond. Closers in such cases, shall be cut to the required size and used near the ends of the wall. Header bond shall be used preferably in all courses in curved plan for ensuring better alignment.

Note: Header bond shall also be used in foundation footings unless thickness of walls (width of footing) makes the use of headers impracticable. Where thickness of

footing is uniform for a number of courses, the top course of footing shall be headers.

All loose materials, dirt and set lumps of mortar which may be lying over the surface on which brick work is to be freshly started, shall be removed with a wire brush and surface wetted. Bricks shall be laid on a full bed of mortar, when laying, each brick shall, be properly bedded and set in position by gently pressing with the handle of a trowel. Its inside face shall be buttered with mortar before the next brick is laid and pressed against it. Joints shall be fully filled and packed with mortar such that no hollow space are left inside the joints.

The walls shall be taken up truly in plumb or true to the required batter where specified. All courses shall be laid truly horizontal and all vertical joints shall be truly vertical. Vertical joints in the alternate course shall come directly one over the other. Quoin, Jambs and other angles shall be properly plumbed as the work proceeds. Care shall be taken to keep the perpends properly aligned within following maximum permissible tolerances :

(a) Deviation from vertical within a storey shall not exceed 6 mm per 3 m height.

(b) Deviation in verticality in total height of any wall of building more than one storey in height shall not exceed 12.5 mm.

(c) Deviation from position shown on plan of any brick work shall not exceed 12.5 mm.

(d) Relative displacement between load bearing wall in adjacent storeys intended to be vertical alignments shall not exceed 6 mm.

(e) A set of tools comprising of wooden straight edge, masonic spirit levels, square, 1 metre rule line and plumb shall be kept on the site of work for every 3 masons for proper check during the progress of work.

All quoins shall be accurately constructed and the height of brick courses shall be kept uniform. This will be checked using graduated wooden straight edge or storey rod indicating height of each course including thickness of joints. The position of damp proof course, window sills, bottom of lintels, top of the wall etc. along the height of the wall shall be marked on the graduated straight edge or storey rod. Acute and obtuse quoins shall be bonded, where practicable in the same way as square quoins. Obtuse quoins shall be formed with squint showing three quarters brick on one face and quarter brick on the other.

The brick work shall be built in uniform layers.

No part of the wall during its construction shall rise more than one metre above the general construction level. Parts of wall left at different levels shall be raked back at an angle of 45 degrees or less with the horizontal. Toothing shall not be permitted as an alternative to raking back. For half brick partition to be keyed into main walls, indents shall be left in the main walls.

All pipe fittings and specials, spouts, hold fasts and other fixtures which are required to be built into the walls shall be embedded, as specified, in their correct position as the work proceeds unless otherwise directed by the Engineer-in-Charge.

Top courses of all plinths, parapets, steps and top of walls below floor and roof slabs shall be laid with brick on edge, unless specified otherwise. Brick on edge laid in the top courses at corner of walls shall be properly radiated and keyed into position to form cut (maru) corners. Where bricks cannot be cut to the required shape to form cut (maru) corners, cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) equal to thickness of course shall be provided in lieu of cut bricks.

Bricks shall be laid with frog (where provided) up. However, when top course is exposed, bricks shall be laid with frog down. For the bricks to be laid with frog down, the frog shall be filled with mortar before placing the brick in position.

In case of walls one brick thick and under, one face shall be kept even and in proper plane, while the other face may be slightly rough. In case of walls more than one brick thick, both the faces shall be kept even and in proper plane.

To facilitate taking service lines later without excessive cutting of completed work, sleeves (to be paid separately) shall be provided, where specified, while raising the brick work. Such sleeves in external walls shall be sloped down outward so as to avoid passage of water inside.

Top of the brickwork in coping and sills in external walls shall be slightly tilted. Where brick coping and sills are projecting beyond the face of the wall, drip course/throating (to be paid separately) shall be provided where indicated.

Care shall be taken during construction that edges of jambs, sills and projections are not damaged in case of rain. New built work shall be covered with gunny bags or tarpoulin so as to prevent the mortar from being washed away. Damage, if any, shall be made good to the satisfaction of the Engineer-in-Charge.

Vertical reinforcement in the form of bars (MS or high strength deformed bars or thermomechanically treated bars as per direction of Engineer-in-Charge)), considered necessary at the corners and junction of walls and jamb opening doors, windows etc. shall be encased with cement mortar not leaner than 1:4 (1 cement : 4 coarse sand), or cement concrete mix as specified. The reinforcement shall be suitably tied, properly embedded in the foundation and at roof level. The dia. of bars shall not be less than 8 mm and concrete grade shall be minimum 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size).

In retaining walls and the like, where water is likely to accumulate, weep holes, 50 to 75 mm square shall be provided at 2 m vertically and horizontally unless otherwise specified. The lowest weep hole shall be at about 30 cm above the ground level. All weep holes shall be surrounded by loose stones and shall have sufficient fall to drain out the water quickly.

Work of cutting chases, wherever required to be made in the walls for housing G.I. pipe, CI pipe or any other fixtures shall be carried out in various locations as per guidelines given below :

(a) Cutting of chases in one brick thick and above load bearing walls.

(i) As far as possible services should be planned with the help of vertical chases. Horizontal chases should be avoided.

(ii) The depths of vertical chases and horizontal chases shall not exceed one-third and one-sixth of the thickness of the masonry respectively.

(iii) When narrow stretches of masonry (or short length of walls) such as between doors and windows, cannot be avoided they should not be pierced with openings for soil pipes or waste pipes or timber joints, etc. Where there is a possibility of load concentration such narrow lengths of walls shall be checked for stresses and high strength bricks in mortar or concrete walls provided, if required.

(iv) Horizontal chases when unavoidable should be located in the upper or lower one-third of height of storey and not more than three chases should be permitted in any stretch of a wall. No continuous horizontal chase shall exceed one metre in length. Where unavoidable, stresses in the affected area should be checked and kept within the permissible limits.

(v) Vertical chases should not be closer than 2 m in any stretch of a wall. These shall be kept away from bearings of beams and lintels. If unavoidable, stresses in the affected area should be checked and kept within permissible limits.

(vi) Masonry directly above a recess, if wider than 30 cm horizontal dimension) should be supported on lintel. Holes in masonry may be provided upto 30 cm width and 30 cm height without any lintel. In the case of circular holes in the masonry, no lintel need be provided for holes upto 40 cm in diameter.

(b) Cutting of chases in half brick load bearing walls.

No chase shall be permitted in half brick load bearing walls and as such no reccessed conduits and concealed pipes shall be provided with half brick thick load bearing walls.

(c) Cutting of chases in half brick non-load bearing wall :

Services should be planned with the help of vertical chases. Horizontal chase should be provided only when unavoidable.

3.2.3 Joints

The thickness of all types of joints including brick wall joints and cross joints shall be such that four course and three joints taken consecutively shall measure as follows:

(i) In case of modular bricks conforming to IS 1077 specification for common burnt clay buildings bricks, equal to 39 cm.

(ii) In case of non-modular bricks, it shall be equal to 31 cm.

Note : Specified thickness of joints shall be of 1 cm. Deviation from the specified thickness of all joints shall not exceed one-fifth of specified thickness.

3.2.4 Finishing of Joints:

The face of brick work may be finished flush or by pointing. In flush finishing either the face joints of the mortar shall be worked out while still green to give a finished surface flush with the face of the brick work or the joints shall be squarely raked out to a depth of 1 cm while the mortar is still green for subsequently plastering. The faces of brick work shall be cleaned with wire brush so as to remove any splashes of mortar during the course of raising the brick work. In pointing, the joints shall be squarely raked out to a depth of 1.5 cm while the mortar is still green and raked joints shall be brushed to remove dust and loose particles and well wetted, and shall be later refilled with mortar to give ruled finish. Some such finishes are 'flush', 'weathered', ruled, etc.

3.2.5 Curing

The brick work shall be constantly kept moist on all faces for a minimum period of seven days. Brick work done during the day shall be suitably marked indicating the date on which the work is done so as to keep a watch on the curing period.

3.2.6 Scaffolding

Scaffolding shall be strong to withstand all dead, live and impact loads which are likely to come on them. Scaffolding shall be provided to allow easy approach to every part of the work.

3.2.7 Single Scaffolding:

Where plastering, pointing or any other finishing has been indicated for brick work, single scaffolding may be provided, unless otherwise specified. In single scaffolding, one end of the put-logs/pole shall rest in the hole provided in the header course of brick masonry. Not more than one header for each put-log/pole shall be left out. Such holes shall not be allowed in the case of pillars, brick work less than one metre in length between the openings or near the skew backs of arches or immediately under or near the structural member supported by the walls. The holes for putlogs/poles shall be made good with brick work and wall finishing as specified.

3.2.8 Double Scaffolding:

Where the brick work or tile work is to be exposed and not to be finished with plastering etc. double scaffolding having two independent supports, clear of the work, shall be provided.

3.3 MEASUREMENT

Brick work shall be measured in cubic metres unless otherwise specified. Any extra work over the specified dimensions shall be ignored. Dimensions shall be measured correct to the nearest 0.01 m i.e. 1 cm. Areas shall be calculated to the nearest 0.01 sq mtrs and the cubic contents shall be worked out to the nearest 0.01 cubic metres.

Brick work shall be measured separately in the following stages:

(a) From foundation to floor one level (Plinth level)

(b) Plinth (floor one) level to floor two level

(c) Between two specified floor levels above floor two level

Note : (i) Brick work in parapet walls, mumty, lift machine room and water tanks constructed on the roof upto 1.2 m height above roof shall be measured together with the corresponding work of the floor next below.

No deductions or additions shall be done and no extra payment made for the following :

Note : Where minimum area is defined for deduction of an opening, void or both, such areas shall refer only to opening or void within the space measured.

(a) Ends of dissimilar materials (that is, joists, beams, lintels, posts, girders, rafters, purlins, trusses, corbels, steps, etc.); up to 0.1 m2 in section;

(b) Opening up to 0.1 m2 in area (see Note);

(c) Wall plates, bed plates, and bearing of slabs, chajjas and the like, where thickness does not exceed 10 cm and bearing does not extend over the full thickness of wall;

(d) Cement concrete blocks as for hold fasts and holding down bolts;

(e) Iron fixtures, such as wall ties, pipes upto 300 mm diameter and hold fasts for doors and windows; and

(f) Chases of section not exceeding 50 cm in girth.

(g) Bearing portion of drip course, bearing of moulding and cornice.

Note : In calculating area of an opening, any separate lintel or sills shall be included with the size of the opening but end portions of lintel shall be excluded. Extra width of rebated reveals, if any, shall also be excluded.

Walls half brick thick and less shall each be measured separately in square metres stating thickness.

Walls beyond half brick thickness shall be measured in multiples of half brick which shall be deemed to be inclusive of mortar joints. For the modular and non-modular, half brick thickness shall mean 100 mm for modular and 115 mm for non-modular bricks.

Where fractions of half brick occur due to architectural or other reasons, measurement shall be as follows :

(a) upto 1/4th brick-actual measurements and

(b) exceeding 1/4 brick-full half bricks.

String courses, projecting pilasters, aprons, sills and other projections shall be fully described and measured separately in running metres stating dimensions of each projection.

Square or rectangular pillars shall be measured separately in cubic metres in multiple of half brick.

Circular pillars shall be measured separately in cubic metres as per actual dimensions.

Brick work curved on plan shall be measured like the brick work in straight walls and shall include all cutting and wastage of bricks, tapered vertical joints and use of extra mortar, if any. Brick work curved on plan to a mean radius not exceeding six metres shall be measured separately and extra shall be payable over the rates for brick work in straight walls. Nothing extra shall be payable if the mean radius of the brick work curved in plan exceeds six metres.

Tapered walls shall be measured net as walls and extra payment shall be allowed for making tapered surface for brick work in walls.

Brick work with brick tiles shall be measured and paid for separately.

3.3.1 Rate

The rate **shall** include the cost of materials and labour required for all the operations described above except the vertical reinforcement and its encasement in cement mortar or cement concrete. The rate shall also include the following :

(a) Raking out joints or finishing joints flush as the work proceeds;

(b) **Preparing** tops of existing walls and the like for raising further new brick work.

(c) Rough cutting and waste for forming gables, splays at eaves and the like.

(d) **Leaving** holes for pipes upto 150 mm dia. and encasing hold fasts etc.

(e) **Rough** cutting and waste for brick work curved in plan and for backing to stone or other types of facing.

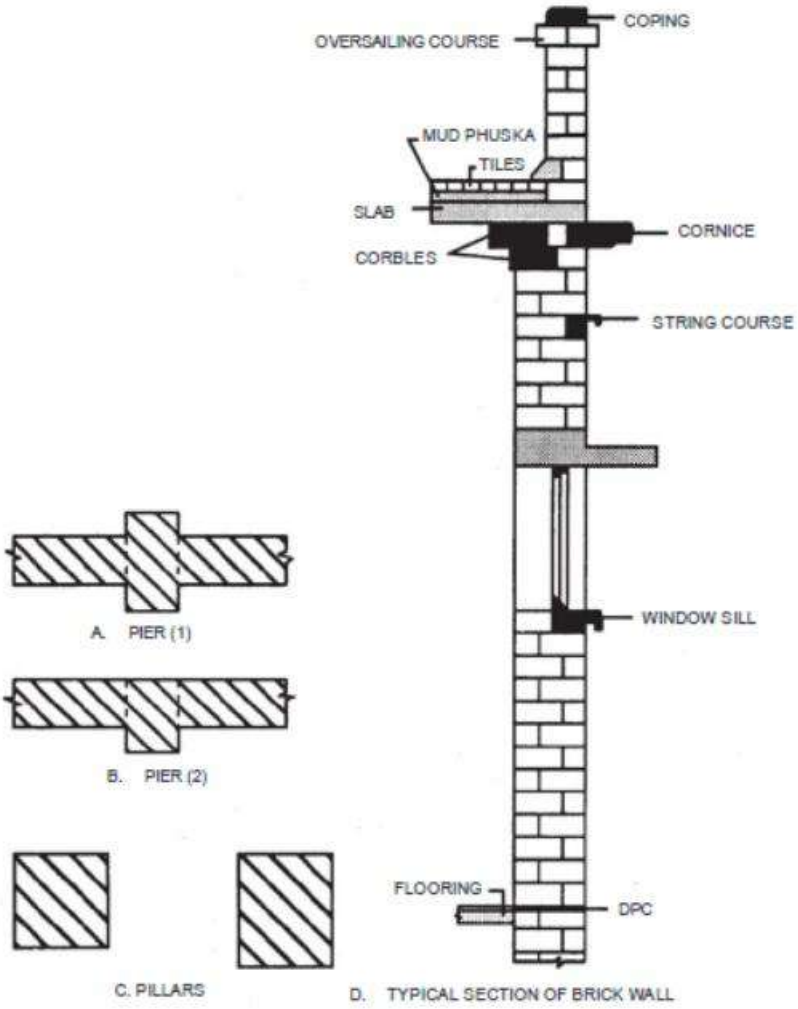
(f) **Embedding** in ends of beams, joists, slabs, lintels, sills, trusses etc.

(g) **Bedding** wall plates, lintels, sills, roof tiles, corrugated sheets, etc. in or on walls if not covered in respective items and

(h) Leaving chases of section not exceeding 50 cm in girth or 350 sq cm in cross-section.

(i) Brick on edge courses, cut brick corners, splays reveals, cavity walls, brick works curved on plan to a mean radius exceeding six metres.

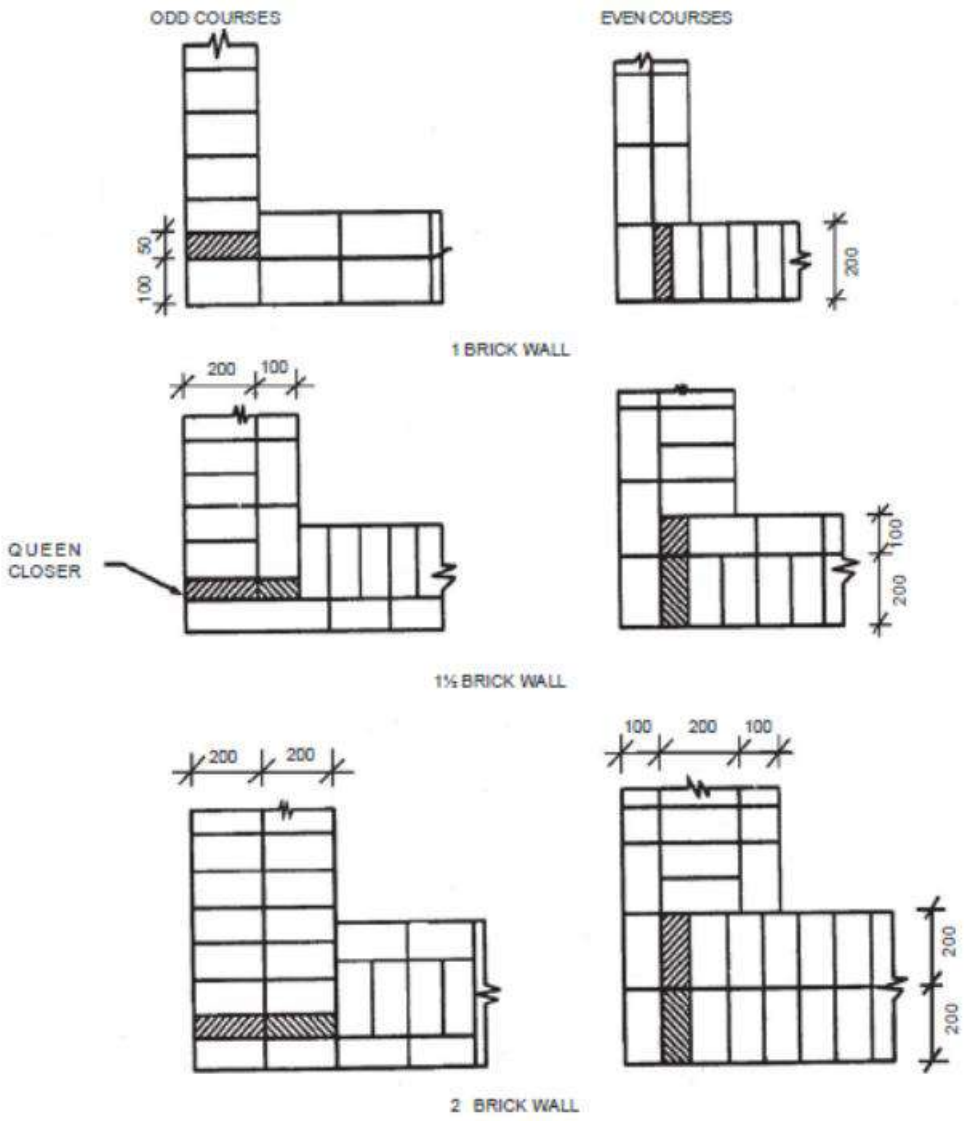
All concrete works shall be measured and paid for separately under the respective items of work.



THE BREADTH SHALL NOT EXCEED THREE TIMES THE THICKNESS AND THICKNESS ITSELF SHALL NOT EXCEED MORE THAN THREE BRICKS

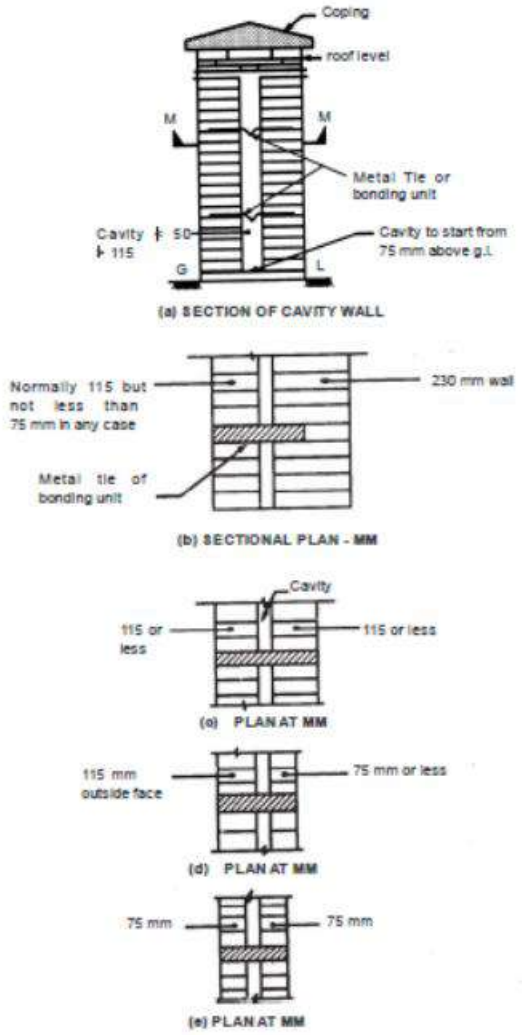
Drawing not to scale

Fig.: Brick Work



Drawing not to scale
All dimensions are in mm

Fig. : English Bond



Note :
(1) Only one of the alternative a, b, c, d or e shall be applicable in each case.
(2) Ties shall be placed sloping towards exterior side.

Drawing not to Scale
All dimensions are in mm

Fig: Brick Work in Cavity Walls

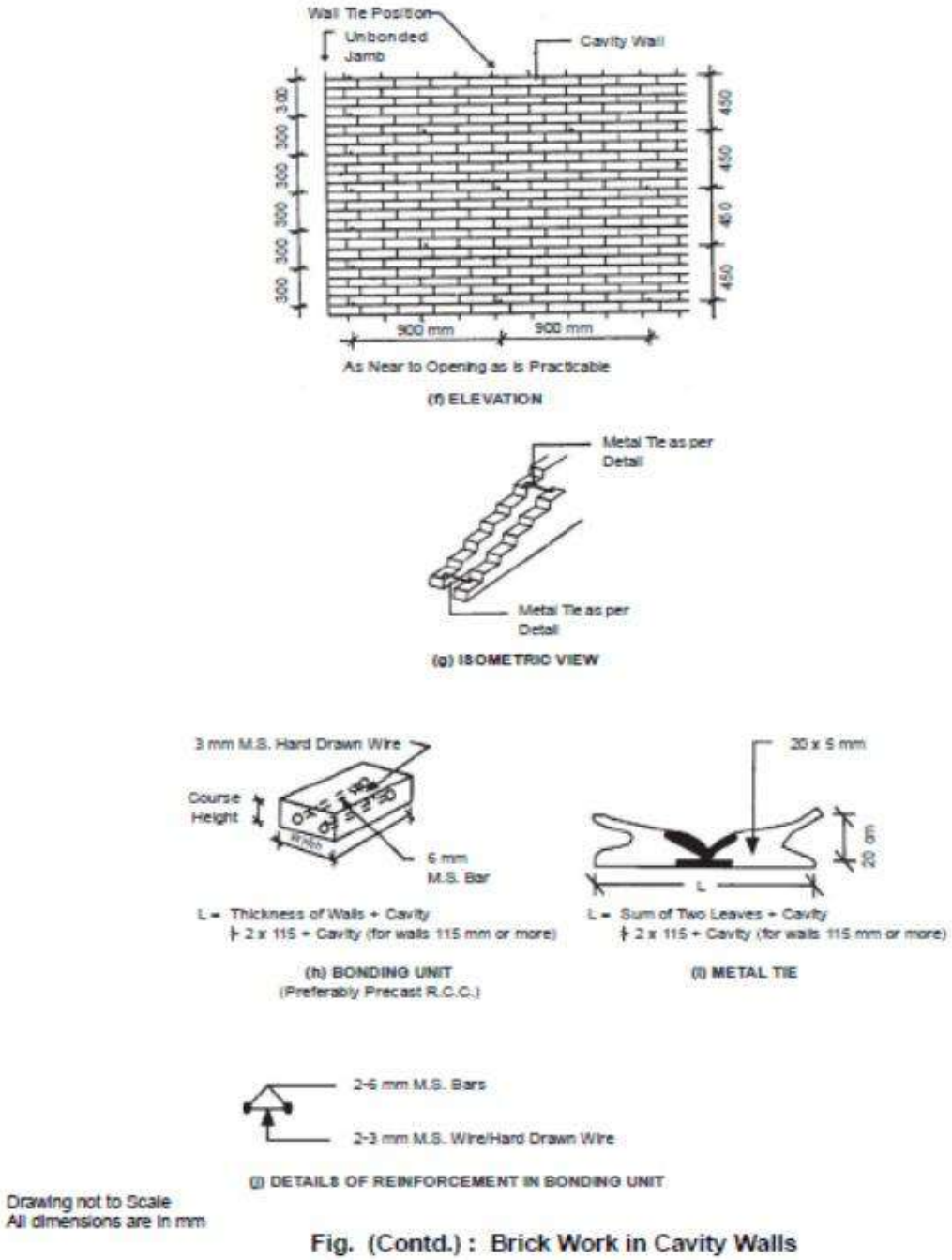


Fig. (Contd.) : Brick Work in Cavity Walls

3.3.2 Burnt Clay Perforated Building Bricks

3.3.3 General Quality:

The bricks shall be made of suitable clay and shall be thoroughly burnt at the maturing temperature of clay. They shall be free from cracks, flaws and nodules of

free lime. They shall have rectangular face with sharp straight edge at right angle. They shall be of uniform colour and texture. These bricks generally should conform to IS 2222.

3.3.4 Dimensions and Tolerances:

The standard size of burnt clay perforated bricks shall be as follows:

	Length (L) mm	Width (W) mm	Height (H) mm
Modular	190	90	90
Non Modular	230	110	70

The permissible tolerances on the dimensions shall be as follows:

Dimension mm	Tolerance mm
70, 90	+ 4
110, 190	+ 7
230	+ 10

Note: The tolerances specified above shall apply to measurements on individual bricks.

3.3.5 Perforations:

The area of perforation shall be between 30% and 45% of the total area of the corresponding face of the bricks.

The perforation shall be uniformly distributed over the surface. In the case of rectangular perforations, the **larger** dimension shall be parallel to the longer side of the brick. The shorter side of the perforation shall be less than 20 mm incase of rectangular perforations and less than 25 mm diameter in case of circular perforations.

The area of **each** perforation shall not exceed 500 mm2.

The thickness of any shell shall not be less then 15 mm and that of any web not less than 10 mm.

3.3.1 Compressive Strength:

The bricks when tested in accordance with the procedure laid down in IS 3495 (Parts 1 to 4) shall have a minimum average compressive strength of 7 N/ mm2 on net area.

The compressive strength of any individual brick tested shall not fall below the minimum compressive **strength** specified for the corresponding class of bricks. The lot shall then be checked for next lower class of brick.

3.3.2 Water Absorption:

The bricks when tested in accordance with the procedure laid down in IS 3495 (parts 1 to 4): after immersion in cold water for 24 hours water absorption shall not be more than 20 percent by weight.

3.3.3 Efflorescence:

The bricks when tested in accordance with the procedure laid down in IS 3495 (Parts 1 to 4) shall have a rating of efflorescence not more than 'slight'.

3.3.4 Warpage:

The bricks when tested in accordance with the procedure laid down in IS 3495 (parts1 to 4) the average warpage shall not exceed 3%.

3.4 BRICK WORK IN ARCHES

The detailed specifications for brick work mentioned in 3.2 shall apply, in so far as these are applicable. In plain arches, uncut bricks shall be used.

Brick forming skew-backs shall be dressed or cut so as to give proper radial bearing to the end voussiors. Defects in dressing of bricks shall not be covered by extravagant use of mortar, nor shall the use of chips or bats etc. be permitted.

The bricks of the spandrel wall at their junctions with the extrudes of the arch shall be cut to fit the curvature of the arch.

3.4.1 Circular Arches

These shall be either (a) plain arches, and shall be built in half brick concentric rings with break joints, or (b) gauged arches built with bricks cut or moulded to proper shape. The arch work shall be carried up from both ends simultaneously and keyed in the centre. The bricks shall be flush with mortar and well pressed into their positions so as to squeeze out a part of their mortar and leave the joints thin and compact. All joints shall be full of mortar and thickness of joints shall not be less than 5 mm nor more than 15 mm. After the arch is completed, the haunches shall be loaded by filling up the spandrels upto the crown level of the arch. Care shall be

taken to load the haunches on two sides of the spandrels. When the arch face is to be pointed (and not plastered), the face bricks shall be cut to proper shape or moulded, so as to have the joints not more than 5 mm thick. These shall be laid with radial joints to the full depth of the arch. The voussoirs shall break joints to the full depth of the arch.

3.4.2 Centring and Shuttering

The centring and shuttering for the arch shall be got approved by the Engineer-in-Charge before the arch work is started. It shall be strong enough to bear the dead load of the arch and the live loads that are likely to come upon it during construction, without any appreciable deflections. The shuttering shall be tightened with hard wood wedged or sand boxes, so that the same could be eased without jerks being transmitted to the arch. The sequence of easing the shuttering shall be got approved from the Engineer-in-Charge. The shuttering shall be struck within 48 hours of the completion of the arch but not before 24 hours. This shall be done after the spandrel has been filled in and the arch loaded.

3.4.3 Measurements

The length of the arch shall be measured as the mean of the extrados and intrados of the arch correct to a cm. The thickness of the arch shall be measured in multiples of the half brick. The breadth in the direction of the thickness of wall shall be measured as specified. The cubical contents shall be calculated in cubic metre, correct to two places of decimal. For arches exceeding 6 m in spans extra payment shall be made on the actual area of the soffit for additional cost of centring including all strutting, bolting, wedging, easing, striking and its removal.

3.4.4 Rate

The rate is inclusive of the cost of the materials and labour required for all the operations described above.

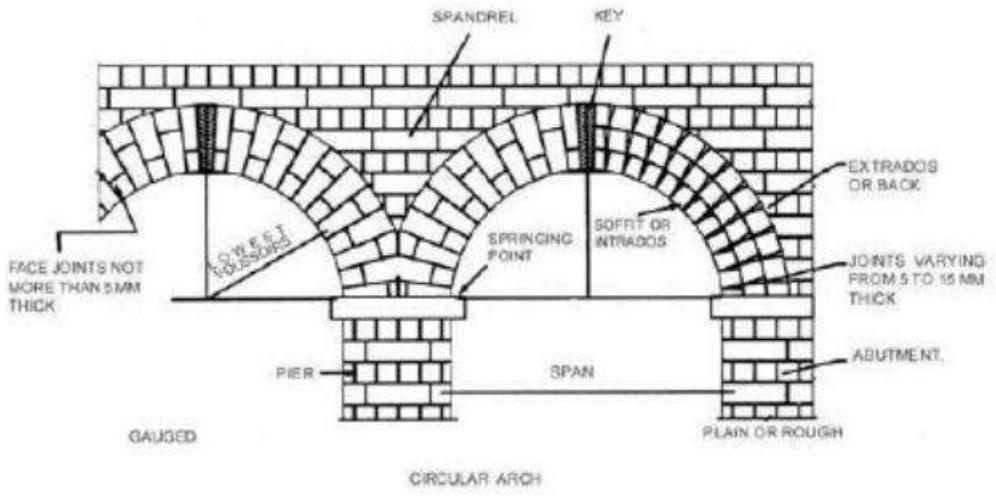


Fig. : Brick Work in Arches

3.5 HALF BRICK WORK

Brick work in half brick walls shall be done in the same manner as described above in 3.2.2 except that the bricks shall be laid in stretcher bond. When the half brick work is to be reinforced, 2 Nos. M.S. bars of 6 mm dia., shall be embedded in every third course as given in the item (the dia of bars shall not exceed 8 mm). These shall be securely anchored at their end where the partitions end. The free ends of the reinforcement shall be keyed into the mortar of the main brick work to which the half brick work is joined. The mortar used for reinforced brick work shall be rich dense cement mortar of mix 1:4 (1 cement: 4 coarse sand). Lime mortar shall not be used. Over laps in reinforcement, if any shall not be less than 30 cm. The mortar interposed between the reinforcement bars and the brick shall not be less than 5 mm.

The mortar covering in the direction of joints shall not be less than 15 mm.

3.5.1 Measurements

The length and height of the wall shall be measured correct to a cm. The area shall be calculated in sq.m. where half brick wall is joined to the main walls of one brick or greater thickness and measurements for half brick wall shall be taken for its clear length from the face of the thicker wall.

3.5.2 Rate

The rate includes the cost of the materials and labour involved in all the operations described above except reinforcement which is to be paid for separately.

3.6 BRICK TILE WORK

The work shall be done in the same manner as described in 3.2.2 except that brick tile shall be used instead of bricks. The measurement and rate shall be same for normal brick work.

3.7 HONEY COMB BRICK WORK

The honeycomb brick work shall be done with specified class of brick, laid in specified mortar. All joints and edges shall be struck flush to give an even surface.

The thickness of the brick honeycomb work shall be half-brick only, unless otherwise specified.

Openings shall be equal and alternate with half brick laid with a bearing of 2 cm on either side.

3.7.1 Measurements

The length and height shall be measured correct to a cm. Area shall be calculated in square metres correct to two places of decimal. Honeycomb openings shall not be deducted.

3.7.2 Rate

The rate includes the cost of materials and labour involved in all the operations described above.

3.8 JOINING OLD BRICK WORK WITH NEW BRICK WORK

In case the height of the bricks of old as well as new work is same, the old work shall be toothed to the full width of the new wall and to the depth of a quarter of brick in alternate courses. In case the height of the bricks is unequal, then the height of each course of new work shall be made equal to the height of the old work by adjusting

thickness of horizontal mortar joints in the new wall. Where necessary, adjustment shall be made equal to thickness of old wall by adjusting the thickness of vertical joints.

For joining new cross wall to old main walls, a number of rectangular recesses of width equal to the thickness of cross wall, three courses in height and half a brick in depth shall be cut in the main walls. A space of the three courses shall be left between two consecutive recesses. The new cross wall shall be bonded into the recesses to avoid any settlement.

Joining of old brick work with the new brick work shall be done in such a way that there shall not be any hump or projection at the joint.

3.8.1 Measurement

The height and thickness of vertical face in contact with new work shall be measured to the nearest 0.01 m and the area shall be calculated to the nearest 0.01 sqm.

3.8.2 Rate

The rate includes the cost of labour and material involved in all the operations described above.

3.9 MOULDING AND CORNICES

The specifications described under 3.2 shall apply in so far these are applicable. Mouldings and cornices shall be made with bricks as specified for brick work. The bricks shall be cut and dressed to the required shape as shown in the architectural drawings.

Cornices shall not ordinarily project by more than 15 cm to 20 cm and this projection shall be obtained by projecting each brick course by more than one fourth of the length. For cornices projecting more than 20 cm and requiring more than quarter bricks projection, metal cramps shall be used and paid for separately.

Corbelling shall be brought roughly to shape by plastering with the specified mortar. When the mortar is still green, the mouldings shall be finished straight and true with the help of metal templates.

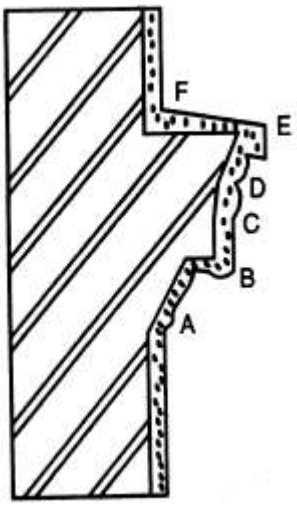
3.9.1 Curing and Protection

The mouldings and cornices shall be cured for at least seven days. These shall be protected from the effects of sun and rain by suitable covering and also from damage during the execution of the work.

3.9.2 Measurements

For the purpose of measurements, the sectional periphery of mouldings and cornices (excluding the portion in contact with wall) shall be measured in centimetres and length in metres (fig. below). The girth and length shall be measured correct to a cm.

No deduction shall be made from the masonry of wall for the bearing of the moulding and cornices.



Note : 1 The sectional periphery curve ABCDEF.

2. Length FA shall not be measured.

3.9.3 Rate

The rate includes the cost of materials and labour involved in all the operations described above.

3.10 CAVITY WALL

It is a wall comprising of two leaves, each leaf being built of masonry units and separated by a cavity so as to provide an air space within the wall and tied together with metal ties or bonding units to ensure that two leaves act as one structural unit. The width of the cavity shall not be less than 50 mm and not more than 115 mm. Each leaf of the cavity wall shall not be less than 75 mm. The space between the leaves being either left as cavity or filled with non-load bearing insulating and water proofing material.

3.10.1 Metal Ties

These may be of galvanised iron, wrought iron, gun metal, brass, copper, stainless steel or any such corrosion resistant metal, made of flats 20 x 5 mm cranked or twisted at their mid point with ends split and fish tailed. The ties shall be built into horizontal bed joints during erection, placed sloping towards the exterior side to prevent water from flowing along it from outer to inner leaf side

3.10.2 Bonding Units

These shall be preferably precast R.C.C. units having cross-section as per drawing

Length of the Bonding units will be sum of thickness of both leaves plus width of cavity if the leaves are 75 mm or 115 mm. If the leaves are more than 115 mm thick, then the length of a unit will be 2 ×115 + width of cavity. Precast RCC units shall be provided with 2 no., 6 mm mild steel reinforcement bars tied with 2 no. 3 mm. dia. M.S. wire/hard drawn wire cross bars placed in the centre of units.

Cement concrete used in the bonding units shall not be leaner than 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size).

3.10.3 Spacing

Metal ties/bonding units shall be spaced not more than 90 cm apart horizontally and 45 cm vertically and staggered in each course. Additional ties shall be used near openings.

3.10.1 Restrictions

Cavity walls shall not normally be built more than 7.5 metres in height and 9 metres in length. Where large lengths and heights are desired, the wall shall be divided into panels with strengthening measures such as pillars etc. Cavity shall be covered at the top with at least two courses of masonry unit and/or a coping over it.

Adoption of cavity walls is not recommended when heavy concentrated load from beam etc. are to be supported by walls.

3.10.2 Measurements and Rate

(a) Brick work in cavity walls shall be included and measured with general brick work. The width of the cavity shall not be measured. Skin of cavity wall, half brick thickness shall be measured as and paid as described in para 3.2 and 3.5.

(b) The forming of the cavity shall be given in square metres stating the width of the cavity and shall include the metal ties/bonding unit specifying the numbers per square metre.

(c) Labour and material for closing cavities at the jambs, sills and heads of opening shall be as described and measured separately in running metres.

(d) The item shall include use of device for keeping cavity clear and forming the requisite weep and vent holes and nothing extra on this account shall be payable.

3.11 UNCOURSED RANDOM RUBBLE MASONRY, IN FOUNDATION. PLINTH AND SUPERSTRUCTURE

3.11.1 Material

3.11.2 Stone

The stone shall be of the type specified such as granite, trap, limestone, sand stone, quartzite, etc. and shall be obtained from the quarries, approved by the Engineer-in-

Charge. Stone shall be hard, sound, durable and free from weathering decay and defects like cavities, cracks, flaws, sand holes, injurious veins, patches of loose or soft materials and other similar defects that may adversely affect its strength and appearance. As far as possible stones shall be of uniform colour, quality or texture.

Generally stone shall not contain crypst crystalline silica or chart, mica and other deleterious materials like iron-oxide organic impurities etc.

Stones with round surface shall not be used.

The compressive strength of common types of stones shall be as per Table 3.1 and the percentage of water absorption shall generally not exceed 5% for stones other than specified in Table 3.1. For laterite this percentage is 12%.

TABLE 3.1

Type of stone	Maximum Water Absorption Percentage by weight	Minimum Compressive Strength kg./sq.cm.
Granite	0.5	1000
Basalt	0.5	400
Lime stone (Slab & Tiles)	0.15	200
Sand stone (Slab & Tiles)	2.5	300
Marble	0.40	500
Quartzite	0.40	800
Laterite (Block)	12	35

Note 1: Test for compressive strength shall be carried out as laid down in IS 1121 (Part I).

Note 2: Test for water absorption shall be carried out as laid down in IS 1124.

3.11.3 Size of Stones

Normally stones used should be small enough to be lifted and placed by hand. Unless otherwise indicated, the length of stones for stone masonry shall not exceed three times the height and the breadth on base shall not be greater than three-fourth of the thickness of wall, or not less than 150 mm. The height of stone for rubble masonry may be upto 300 mm. The selection and grading of stones for rubble masonry is largely done at site and the smaller stones are used in the hearting of wall.

Random Rubble Masonry shall be uncoursed or brought to courses as specified. Uncoursed random rubble masonry shall be constructed with stones of sizes as referred to in para 3.11 and shapes picked up random from the stones brought from the approved quarry. Stones having sharp corners or round surfaces shall, however, not be used.

Random rubble masonry brought to the course is similar to uncoursed random rubble masonry except that the courses are roughly levelled at intervals varying from 300 mm to 900 mm in height according to the size of stones used.

3.11.4 Dressing

Each stone shall be hammer dressed on the face, the sides and the beds. Hammer dressing shall enable the stones to be laid close to neighbouring stones such that the bushing in the face shall not project more than 40 mm on the exposed face.

(i) ***Face stone:*** At least 25% stones shall be headers tailing into the work at least 2/3rd the thickness of wall in super structure masonry. Such stones shall not be less than 200 sq. cm in cross sections.

(ii) ***Hearting Stones:*** The hearting or interior filling of a wall face shall consist of rubble stones not less than 150 mm in any direction, carefully laid, hammered down with a wooden mallet into position and solidly bedded in mortar. The hearting should be laid nearly level with facing and backing.

(iii) ***Quoin Stone:*** Quoin stone shall be less than 0.03 cum in volume.

(iv) ***Jamb stones:*** The jambs shall not be made with stones specified for quoins except that the stones which were required to be provided at 1 metre centre to centre on both the exposed faces shall here be provided only on the jamb and the length shall be equal to the thickness of the wall for wall upto 60 cm and a line of headers shall be provided for walls thicker than 60 cm as specified for bond.

3.11.5 Courses

The masonry shall be carried out in regular courses of height not exceeding 50 cm and masonry on any day will not be raised more than 60 cm in height when using mortars having compressive strength less than 20 kg./sq. cm at 28 days and 100 cm when using mortars exceeding this strength.

3.11.6 Thickness of Joints

The joint thickness shall not exceed 30 mm at any point on the face. Chips of the stone and spalls shall be wedged into seating bed of face stones to avoid excessive bed thickness. No pinning shall be allowed to avoid excessive joint thickness.

3.11.7 Mortar

The mortar used for joining shall be as specified.

3.11.8 Laying

Stone shall be laid on their natural bed and shall be solidly bedded full in mortar with close joints, chips of stone spalls be wedged into the work wherever necessary. No dry work or hollow spaces shall be allowed and every stone whether large or small shall be carefully selected to fit snugly the interstices between the large stones.

Masonry shall be built breaking joints in all the three directions. Bond stone and headers shall be properly laid into the work and shall be marked by the contractor with white lead paint. The bond stones shall be provided as specified in para 3.11.10

The masonry work in wall shall be carried up true to plumb or to specified batter.

Random rubble masonry shall be brought to the level courses at plinth, window sills, lintel and roof levels. Levelling shall be done with concrete comprising of one part of the mortar as used for masonry and two parts of graded stone aggregate of 20 mm nominal size.

The masonry in structure shall be carried uniformly. Where the masonry of one part is to be delayed, the work shall be raked back at an angle not steeper than 45°.

3.11.9 Raking out joints

All the joints on the faces to be pointed or plastered shall be racked out with racking tool to a depth of 20mm while the mortar is still green.

3.11.10 Bond Stones

Though bond stones shall be provided in walls upto 600 mm thickness, a set of two or more bond stones overlapping each other by at least 150 mm shall be provided in a line from face to back. In case of highly absorbent types of stones (porous lime stone and sand stone etc.) the bond stone shall extend about two-third into the wall, as through stones in such walls a set of two or more bond stones overlapping each other by at least 150 mm shall be provided. Each bond stone or a set of bond stones shall be provided for every 0.5 m2 of the wall surface and shall be provided at 1.5 m to 1.8 m apart clear in every course. In case of highly absorbent types of stones (porous lime stone and sand stone etc.) single piece bond stones may give rise to dampness. For all thicknesses of such walls a set of two or more bond stones overlapping each other by at least 15 cm shall be provided. Length of each such bond stone shall not be less than two-third of the thickness of the wall. Where bond stones of suitable lengths are not available pre-cast cement concrete block of 1:3:6 mix (1 cement : 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) of cross section not less than 225 square centimeters and length equal to the thickness.

At least one bond stone or a set of bond stones shall be provided at 1.5 m to 1.8 m apart clear in every course. (Bond stones shall be marked suitably with paint as directed by the Engineer-in-Charge).

3.11.11 Quoin and Jamb Stones

The quoin and jamb stones shall be of selected stones neatly dressed with hammer or chisel to form the required angle. Quoin stones shall not be less than 0.01 cum in volume. Height of quoins and jamb stones shall not be less than 15 cm. Quoins shall be laid header and stretcher alternatively.

3.11.12 Joints

Stones shall be so laid that all joints are fully packed with mortar and chips. Face joints shall not be more than 20 mm thick. The joints shall be struck flush and finished at the time of laying when plastering or pointing is not to be done. For the surfaces to be plastered or pointed, the joints shall be raked to a minimum depth of 20 mm when the mortar is still green.

3.11.13 Scaffolding

Single scaffolding having one set of vertical support shall be allowed. The supports shall be sound and strong, tied together by horizontal pieces, over which the scaffolding planks shall be fixed. The inner end of the horizontal scaffolding member may rest in a hole provided in the masonry. Such holes, however, shall not be allowed in pillars under one metre in width or near the skew back of arches. The holes left in masonry work for supporting scaffolding shall be filled and made good with cement concrete 1 : 3 : 6 (1 cement : 3 coarse sand : 6 stone aggregate 20 mm nominal size).

3.11.14 Curing

Masonry work in cement or composite mortar shall be kept constantly moist on all faces for a minimum period of seven days. In case of masonry with fat lime mortar curing shall commence two days after laying of masonry and shall continue for at least seven days thereafter.

3.11.15 Protection

Green work shall be protected from rain by suitable covering. The work shall also be suitably protected from damage, mortar dropping and rain during construction.

3.11.16 Measurements

The length, height and thickness shall be measured correct to a cm. The thickness of wall shall be measured at joints excluding the bushing. Only specified dimensions shall be allowed; anything extra shall be ignored. The quantity shall be calculated in cubic metre nearest to two places of decimal.

The work under the following categories shall be measured separately.

(i) From foundation to plinth level (level one) :

(a) work in or under water and or liquid mud,

(b) work in or under foul positions.

(i) Above plinth level and upto floor five level.

(ii) Above floor five level to every floor/floors or part thereof.

(iv) Stone masonry in parapet shall be measured together with the corresponding item in the wall of the storey next below.

No deduction shall be made nor extra payment made for the following :

(i) Ends of dissimilar materials (that is joists, beams, lintels, posts, girders, rafters purlins, trusses, corbels, steps etc.) upto 0.1 sqm in section.

(ii) Openings each upto 0.1 sqm in area. In calculating the area of openings, any separate lintels or sills shall be included alongwith the size of opening but the end portions of the lintels shall be excluded and the extra width of rebated reveals, if any, shall also be excluded.

(iii) Wall plates and bed plates, and bearing of chajjas and the like, where the thickness does not exceed 10 cm and the bearing does not extend over the full thickness of the wall.

Note: The bearing of floor and roof shall be deducted from wall masonry.

(iv) Drain holes and recesses for cement concrete blocks to embed hold fasts for doors, windows etc.

(v) Building in masonry, iron fixture, pipes upto 300 mm dia, hold fasts of doors and windows etc.

(vi) Forming chases in masonry each upto section of 350 sq cm.

Masonry (excluding fixing brick work) in chimney breasts with smoke of air flues not exceeding 20 sq dm (0.20 sq m) in sectional area shall be measured as solid and no extra payment shall be made for pargetting and coring such flues. Where flues exceed 20 sq dm (0.20 sq m) sectional area, deduction shall be made for the same and pargetting and coring flues shall be measured in running metres stating size of flues and paid for separately. Aperture for fire place shall not be deducted and no extra payment made for splaying of jambs and throating.

Apertures for fire places shall not be deducted and extra labour shall not be measured for splaying of jambs, throating and making arch to support the opening.

3.11.17 Square or Rectangular Pillars:

These shall be measured as walls, but extra payment shall be allowed for stone work in square or rectangular pillars over the rate for stone work in walls. Rectangular pillar shall mean a detached masonry support rectangular in section, such that its breadth does not exceed two and a half times the thickness.

3.11.18 Circular Pillars (Columns):

These shall be measured as per actual dimensions, but extra payment shall be allowed for stone work in circular pillars over the rate for stone work in walls. The diameter as well as length shall be measured correct to a cm.

Tapered walls shall be measured net, as per actual dimensions and paid for as other walls.

3.11.19Curved Masonry:

Stone masonry curved on plan to a mean radius exceeding 6 metres shall be measured and included with general stone work. Stone work circular on plan to a mean radius not exceeding 6 metres shall be measured separately and shall include all cuttings and waste and templates. It shall be measured as the mean length of the wall.

3.11.20 Rate

The rate shall include the cost of materials and labour required for all the operations described above and shall include the following :

(a) Raking out joints for plastering or pointing done as a separate item, or finishing flush as the work proceeds.

(b) Preparing tops and sides of existing walls for raising and extending.

(c) Rough cutting and waste for forming gables cores, skew backs or spandrels of arches, splays at eaves and all rough cutting in the body of walling unless otherwise specified.

(d) Bond stones or cement concrete bond blocks.

(e) Leading and making holes for pipes etc.

(f) Bedding and pointing wall plates, lintels, sills etc. in or on walls, bedding roof tiles and corrugated sheets in or on walls.

(g) Building in ends of joists, beams, lintels etc.

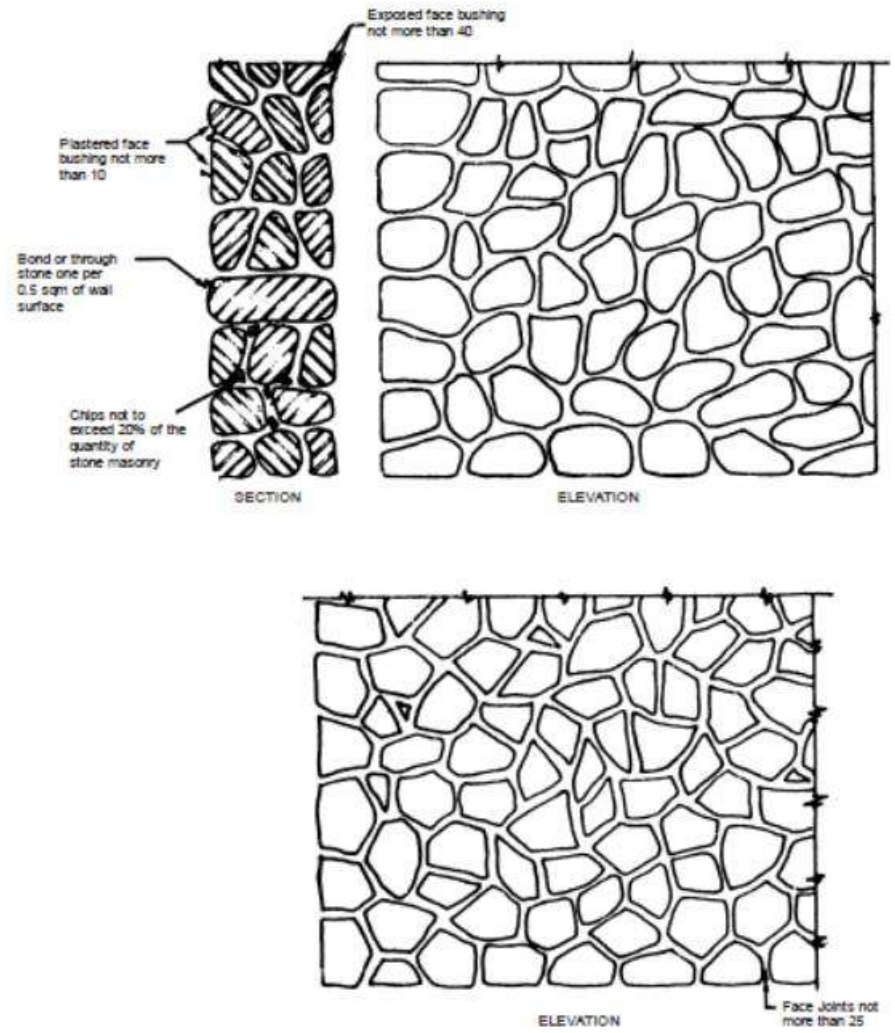


Fig. : Random Rubble Masonry

3.12 COURSED RUBBLE MASONRY - FIRST SORT

3.12.1 Stone:

Shall be as specified in 3.11.2.

3.12.2 Size of Stone:

Shall be as specified in 3.11.3.

3.12.3 Dressing

Face stones shall be hammer dressed on all beds, and joints so as to give them approximately rectangular block shape. These shall be squared on all joints and beds. The bed joint shall be rough chisel dressed for at least 80 mm back from the face, and side joints for at least 40 mm such that no portion of the dressed surface is more than 6 mm from a straight edge placed on it The remaining unexposed portion of the stone shall not project beyond the surface of bed and side joint. The bushing on the face shall not project more than 40 mm as an exposed face and 10 mm on a face to be plastered. The hammer dressed stone shall also have a rough tooling for minimum width of 25 mm along the four edges of the face of the stone, when stone work is exposed.

3.12.4 Mortar

The mortar for jointing shall be as specified.

3.12.5 Laying

All stones shall be wetted before use. The walls shall be carried up truly plumb or to specified batter. All courses shall be laid truly horizontal and all vertical joints shall be truly vertical. The height of each course shall not be less than 15 cm nor more than 30 cm.

Face stones shall be laid alternate headers and stretchers. No pinning shall be allowed on the face. No face stone shall be less in breadth than its height and at least one third of the stones shall tail into the work for length not less than twice their height.

The hearting or the interior filling of the wall shall consist of stones carefully laid on their proper beds in mortar; chips and spalls of stone being used where necessary to avoid thick beds of joints of mortar and at the same time ensuring that no hollow spaces are left anywhere in the masonry. The chips shall not be used below the hearting stone to bring these upto the level of face stones. The use of chips shall be restricted to the filling of interstices between the adjacent stones in hearting and these shall not exceed 10% of the quantity of stone masonry.

The masonry in a structure shall be carried up uniformly but where breaks are unavoidable, the joints shall be raked back at angle not steeper than 45°. Toothing shall not be allowed.

3.12.6 Bond Stones

Shall be as specified in 3.11.10 except that a bond stone or a set of bond stones shall be inserted 1.5 to 1.8 metres apart, in every course.

3.12.7 Quoins

The quoins shall be of the same height as the course in which these occur. These shall be at least 450 mm long and shall be laid stretchers and headers alternatively.

These shall be laid square on the beds, which shall be rough-chisel dressed to a depth of at least 100 mm. In case of exposed work, these stones shall have a minimum of 25 mm wide chisel drafts at four edges, all the edges being in the same plane.

3.12.8 Joints

All bed joints shall be horizontal and all side joints vertical. All joints shall be fully packed with mortar, face joints shall not be more than one cm thick. When plastering or pointing is not required to be done, the joints shall be struck flush and finished at the time of laying. Otherwise, joints shall be raked to a minimum depth of 20 mm by raking tool during the progress of work, when the mortar is still green.

3.12.9 Curing, Scaffolding, Measurements and Rates.

Shall be as specified under 3.11.

3.13 COURSED RUBBLE MASONRY - SECOND SORT

3.13.1 Stone :

Shall be as specified in 3.11.2.

3.13.2 Size of Stone :

Shall be as specified in 3.11.3.

3.13.3 Dressing:

Shall be as specified in 3.14.1 except that no portion of dressed surface of joints shall show a depth of gap more than 10 mm from a straight edge placed on it and use of chips shall not exceed 15 per cent of the quantity of stone masonry.

3.13.4 Mortar

The mortar for jointing shall be as specified.

3.13.5 Laying:

Shall be as specified in 3.14.3 except that the use of chips shall not exceed 15% of the quantity of stone masonry and stone, in each course need not be of the same height but not more than two stones shall be used in the height of a course.

3.13.6 Bond Stone, Quoins:

Shall be as specified in 3.14.4 and 3.14.5 respectively.

3.13.7 Joints

All bed joints shall be horizontal and all side vertical. All joints shall be fully packed with mortar, face joints shall not be more than 20 mm thick. When plastering or pointing is not required to be done, the joints shall be struck flush and finished at the

time of laying. Otherwise, the joints shall be raked to a minimum depth of 20 mm by raking tool during progress of work, where the mortar is still green.

3.13.8 Curing, Scaffolding, Measurement and Rates.

Shall be as specified under 3.14.

3.14 PLAIN ASHLAR MASONRY

Stone shall be of the type specified. It shall be hard, sound, durable and tough, free from cracks, decay and weathering and defects like cavities, cracks, flaws, sand holes, veins, patches of soft or loose materials etc. before starting the work, the contractor shall get the stones approved by Engineer-in-Charge.

3.14.1 Kota Stone for Vineering

Kota stone shall be of selected quality, hard, sound, dense & homogeneous in texture free from cracks, decay, weathering and flaws. They shall be machine cut to requisite size and thickness. They shall be of colour indicated in the drawings or as instructed by the Engineer-in-Charge. The stone shall have the top (exposed) face polished before being brought to site unless otherwise specified. Before starting the work, the contractor shall get the samples of kota stone approved from the Engineer-in- Charge.

3.14.2 Dressing :

Every stone shall be cut to the required size and shape and fine machine dressed to the full depth so that a straight edge laid along the side of stone shall be in full contact with it. The thickness of the slab after it is dressed shall be 20, 25, 30 or 40 mm as specified in the item. Tolerance of ± 2 mm shall be allowed for the thickness.

3.14.3 Red Sand Stone & White Sand Stone Ashlar Masonry

The stone shall be red or white as specified in the description of item. The stone shall be hard, sound, tough, free from cracks, decay & weathering. In case of red sand stone, white patches or streaks shall not be allowed. However scattered spots upto 10 mm diameter will be permitted. Before starting the work the contractor shall get samples of stone approved by the Engineer-in-Charge.

3.14.4 Size of Stone

Normally stones used should be small enough to be lifted and placed by hand. The length of the stone shall not exceed three times the height and the breadth on base shall not be greater than threefourth of the thickness of wall nor less than 15 cm. The height of stone may be upto 30 cm.

3.14.5 Dressing

Every stone shall be cut to the required size and shape chisel dressed on all beds and joints so as to be free from waviness and to give truly vertical and horizontal

joints. In exposed masonry, the faces that are to remain exposed in the final position and the adjoining faces to a depth of 6 mm shall be the fine chisel dressed so that when checked with 60 cm straight edge, no point varies from it by more than 1 mm. The top and bottom faces that are to form the bed joints shall be chisel dressed so that variation from 60 cm straight edge at no point exceeds 3 mm. Faces which are to form the vertical joints should be chisel dressed so that variation at any point with 60 cm straight edge does not exceed 6 mm. Any vertical face that is to come against backing of masonry shall be dressed such that variation from straight edge does not exceed 10 mm. All angles and edges that are to remain exposed in the final position shall be true, square and free from chippings.

A sample of dressed stone shall be prepared for approval of Engineer-in-Charge. It shall be kept at the worksite as a sample after being approved.

3.14.6 Mortar

The mortar for jointing shall be as specified.

3.14.7 Laying

All stones shall be wetted before placing in position. These shall be floated on mortar and bedded properly in position with wooden mallets without the use of chips or under pinning of any sort. The walls and pillars shall be carried up truly plumb or battered as shown in drawings. All courses shall be laid truly horizontal and all vertical joints shall be truly vertical.

In case of ashlar work without backing of brick work or coursed rubble masonry, face stone shall be laid headers and stretchers alternately unless otherwise directed. The headers shall be arranged to come as nearly as possible in the middle of stretchers above and below. Stone shall be laid in regular courses of not less than 30 cm in height and all the courses shall be of same height, unless otherwise specified. For ashlar facing with backing of brick work or coursed rubble masonry face stone shall be laid in alternate courses of headers and stretchers unless otherwise directed. Face stone and bond stone course shall be maintained throughout. All connected masonry in a structure shall be carried up nearly at one uniform level throughout, but where breaks are avoidable, the joint shall be made in good long steps so as to prevent cracks developing between new and old work. Bond stone provided in the masonry shall be payable in the item of Ashlar masonry. Neither any deduction will be made from the brick masonry for embedding the bond stone in the backing nor any extra payment shall be made for any extra labour involved in making holes in brick masonry backing.

When necessary, jib crane or other mechanical appliances shall be used to hoist the heavy pieces of stones and place these into correct positions, care being taken that the corners of the stone are not damaged. Stone shall be covered with gunny bags, before tying chain or rope is passed over it, and it shall be handled carefully. No piece which has been damaged shall be used in work.

3.14.8 Bond Stones :

Shall be as specified in 3.11.10.

3.14.9 Joints

All joints shall be full of mortar. These shall be not more than 6 mm thick. Face joints shall be uniform throughout and a uniform recess of 20 mm depth from face shall be left with the help of the steel plate during the progress of work.

3.14.10 Pointing

All exposed joints shall be pointed with mortar as specified. The pointing when finished shall be sunk from stone face by 5 mm or as specified. The depth of mortar in pointing work shall not be less than 15 mm.

3.14.11 Curing

Masonry work in cement or composite mortar shall be kept constantly moist on all faces for a minimum period of seven days. In case of masonry with fat lime mortar, curing shall commence two days after laying of masonry and shall continue for at least seven days thereafter.

3.14.12 Protections

Green work shall be protected from rain by suitable covering. The work shall also be suitably protected from damage, mortar dropping and rain during construction.

3.14.13 Scaffolding

Double scaffolding having two sets of vertical supports shall be provided. The supports shall be sound and strong, tied together with horizontal pieces over which scaffolding planks shall be fixed.

3.14.14 Measurements

The finished work shall be measured correct to a centimetre in respect of length, breadth and height.

The cubical contents shall be calculated in cubic metre nearest to two places of decimal.

No deduction nor any extra payment shall be made for the following :

(i) Ends of dissimilar materials (that is joists, beams, posts, girders, rafters, purlins, trusses, corbels, steps etc.) upto 0.1 sqm in section.

(ii) Openings upto 0.1 sqm in area. In calculating the area of opening, any separate lintels or sills shall be included alongwith the size of the opening but the end portion of the lintels shall be excluded and extra width of rebated reveals, if any, shall also be excluded.

(iii) Wall plates and bed plates and bearing of chajja and the like, where the thickness does not exceed 10 cm and the bearing does not extend over the full thickness of the wall.

Note : The bearing of floor and roof slabs shall be deducted from wall masonry.

(iv) Drainage holes and recesses left for cement concrete blocks to embed hold-fasts for doors and windows, building in the masonry iron fixture and pipes upto 300 mm diameter.

(v) Stone walling in chimney breasts, chimney stacks, smoke or air flues not exceeding 0.20 sqm in sectional area shall be measured as solid and no extra measurement shall be made for pargetting and coring such flues. Where flues exceed 0.20 sqm in sectional area, deduction shall be made for the same and pargetting and coring flues paid for separately.

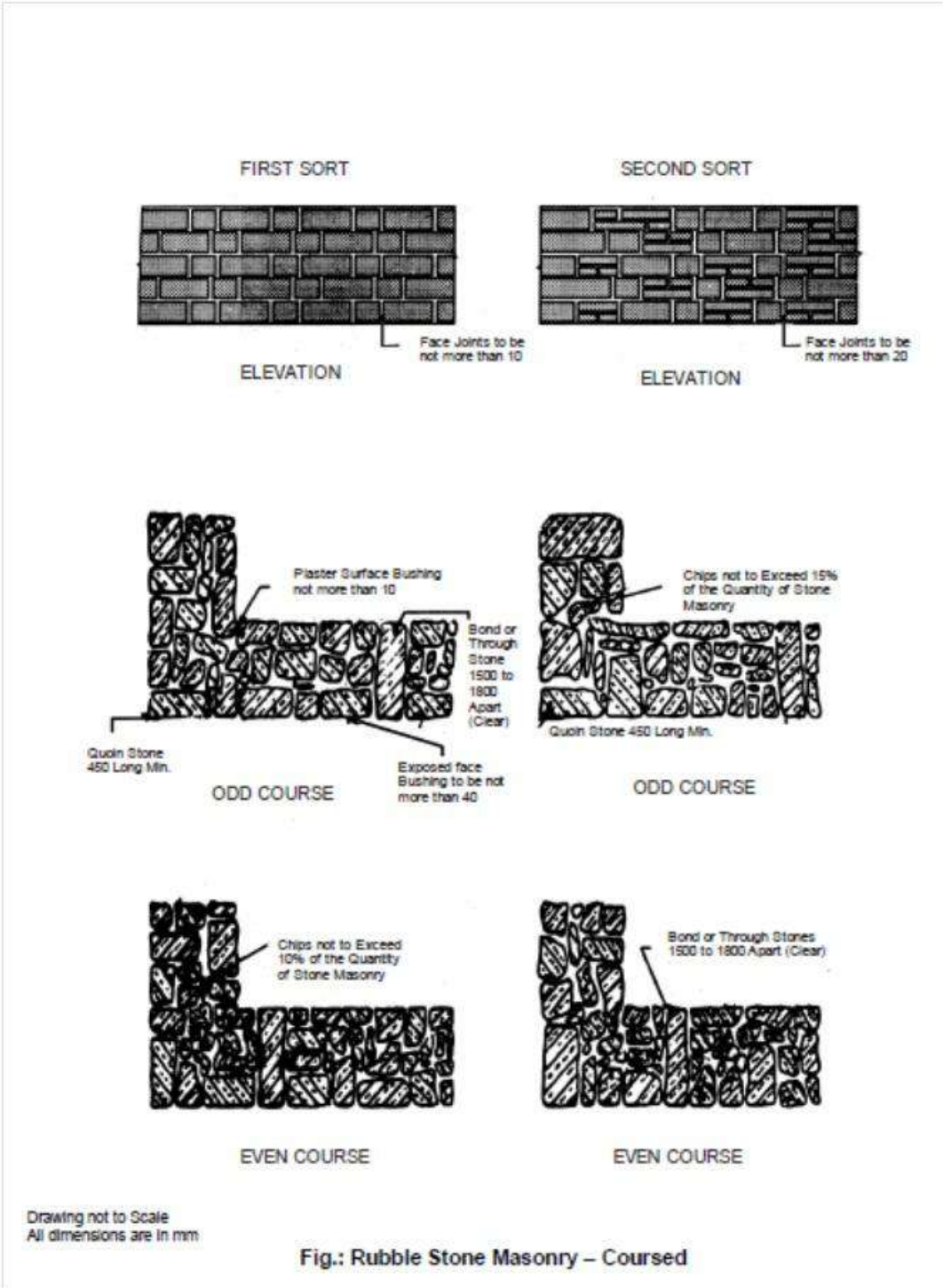


Fig.: Rubble Stone Masonry – Coursed

3.14.15 Square, Rectangular or Circular Pillars:

Shall be measured and paid for as walls, but extra payment shall be allowed for such pillars and columns over the rate for stone work in walls.

Rectangular pillars shall mean a detached masonry support, rectangular in section, such that its breadth shall not exceed two and half times the thickness.

3.14.16 Curved Stone Work:

Stone work curved on a plan to a mean radius exceeding six metres shall be measured net and included with general stone work. Stone work circular on a plan to a mean radius not exceeding six metres shall be measured separately and extra payment shall be allowed and shall include all cutting and waste and templates. It shall be measured as the mean length of wall.

3.14.17 Rate

The rate shall include the cost of materials and labour required for all the operations described above. Stone facing or wall lining upto and not exceeding 8 cm thickness shall be paid for under “Stone work for wall lining etc. (Veneer work)”. The stone work of thickness exceeding 8 cm shall be paid under relevant items of work.

3.15 PUNCHED ASHLAR (ORDINARY) MASONRY

3.15.1 Stone:

Shall be as specified in 3.16.1. In case of red or white sand stone, stone shall be red or white as specified in the item. In red sand stone, white patches or streaks shall not be allowed. However, scattered spots upto 10 mm diameter will be permitted.

3.15.2 Size of Stone :

Shall be as specified in 3.16.4.

3.15.3 Dressing:

Shall be as specified in 3.16.6 except that the faces exposed in view shall have a fine dressed chisel draft 2.5 cm wide all round the edges and shall be rough tooled between the drafts, such that the dressed surface shall not be more than 3 mm from a straight edge placed over it.

3.15.4 Other Details

The specifications for mortars, laying and fixing, bond stone, joints, pointing, curing, protections, scaffolding, measurements and rates shall be same as specified in 3.16.

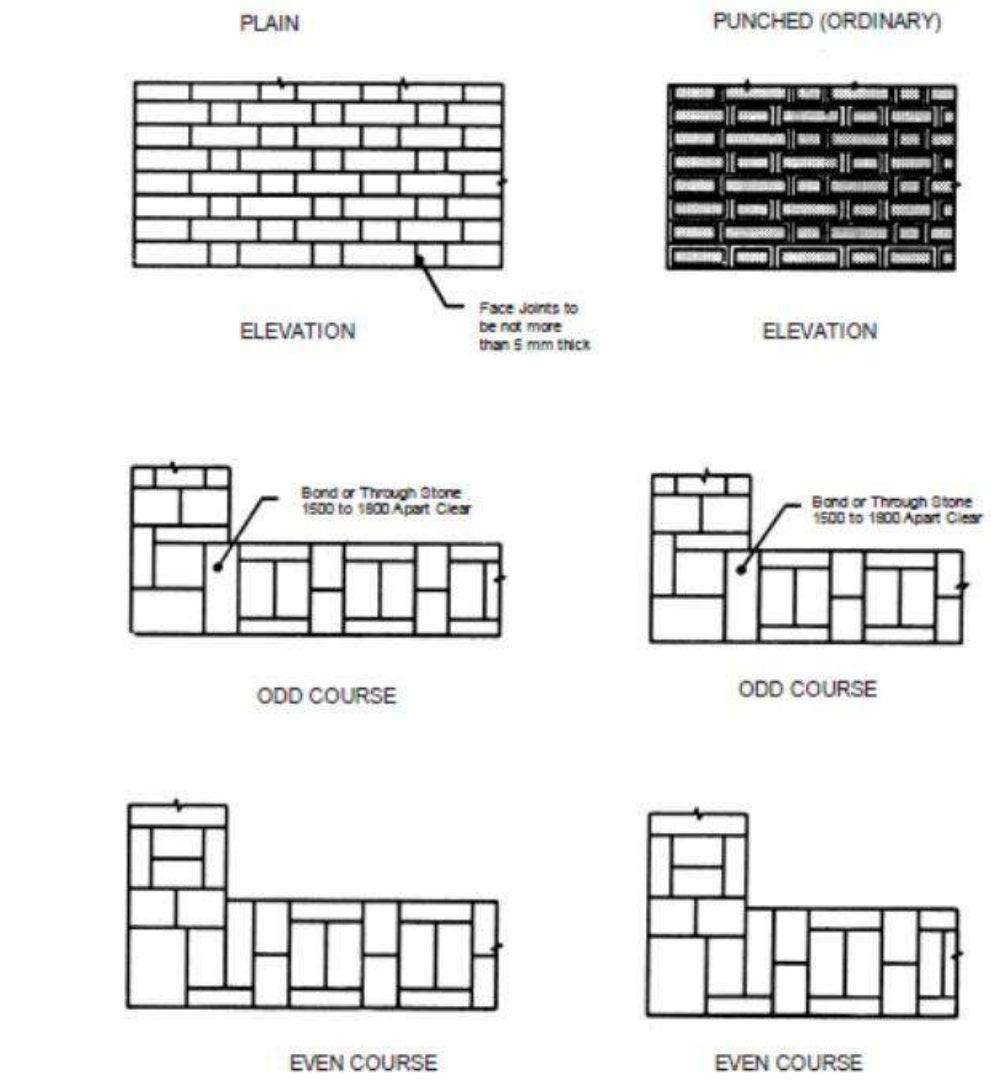
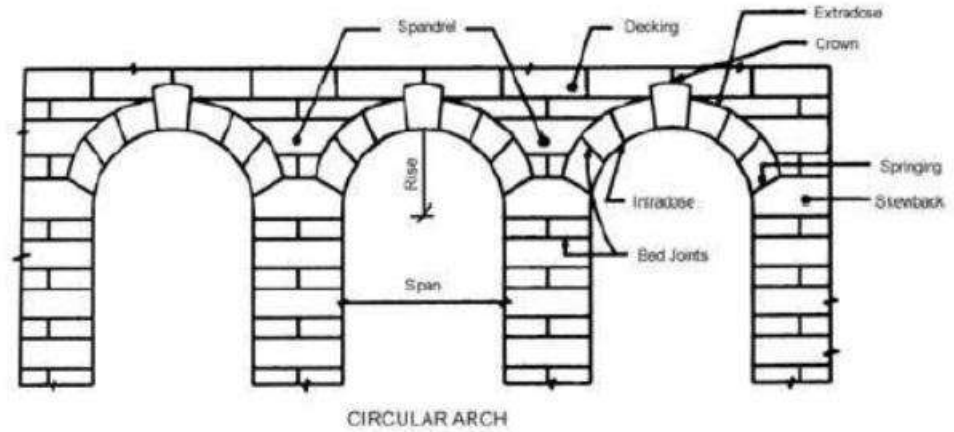


Fig.: Ashlar Stone Masonry



Drawing not to scale
All dimensions are in mm

Fig. : Stone Work in Arches & Chajjas

3.16 SHELVES, COPING, PLAIN, CORNICES, STRING COURSES ETC.

3.16.1 Stone

Stone shall be of uniform colour and texture and of the kind as stipulated.

3.16.2 Dressing

The exposed faces and sides of shelves shall be chisel dressed such that the dressed surface shall not be more than 3 mm from a straight edge placed on it. All visible angles and edges shall be free from chippings. The surfaces to be burried in the masonry shall be rough dressed.

3.16.3 Laying

These shall be laid in mortar of specified mix and fixed as shown in drawing or as directed by the Engineer-in-Charge.

3.16.4 Other Details

Specifications for pointing, curing, protections and scaffolding shall be as specified under 3.16.

3.16.5 Measurements

3.16.6 Shelves:

The length and breadth shall be measured inclusive of bearings correct of a cm. The thickness shall be as specified with permissible tolerance of ± 2 mm. The area shall be calculated in sqm correct to two places of decimal.

3.16.7 Copings:

The dimensions of the circumscribing rectangles of the dressed stones as used in work shall be measured correct to a cm. The cubical contents shall be calculated correct to two places of decimal in cum.

3.16.8 Plain Cornices, String Courses and Plinth Courses:

The length, breadth and depth of the stone including bearing shall be measured correct to a cm. The cubical contents shall be calculated correct to two places of decimal in cu. m.

No deduction shall be made from the masonry of wall for the bearing of stone shelves, cornices, string courses.

3.16.9 Rate

The rate shall include the cost of all materials and labour required in all the operations described above.

3.17 DRY STONE CLADDING

3.17.1 Material

Stone shall be of the type as specified in the item. It shall be hard, sound durable and tough free from cracks, decay and weathering and defects like cavities cracks, flaws, holes, veins, patches of soft or loose materials etc. Thickness of stone shall be as specified

Stone shall be cut with the gang saw to the required size and shape on all beds and joints so as to free from any waviness and to give truly vertical horizontal surface as required. The exposed face and sides of stones forming joints shall be such that the straight edge laid along the face of the stone is in contact with every point on it. All the visible angle and edges shall be square and free from chipping. The dressed stone shall be of the thickness specified with permissible tolerance of + 2 mm.

Before starting the work, the contractor shall get the samples of stone approved by Engineer-Incharge. Approved sample shall be kept in custody of Engineer-in-Charge

and stones supplied and used on the work shall conform to sample with regard to soundness, colour, veining and general texture. The stone shall be cut by gang saw into slabs of required thickness along the places parallel to the natural bed. When necessary double scaffolding for fixing the stone at greater heights, jib crane or other mechanical appliances shall be used to hoist the heavy pieces of stone and placed them into correct positions. Care shall have to be taken that corners of the stone are not damaged. Stone shall be covered with gunny bags before tying chain or rope is passed over and it shall be handled carefully. No pieces which has been damaged shall be used that work

3.17.2 Stacking and Storing

Stone slabs are thin and brittle and should never be stacked flat across timber supports. They should therefore, be stacked on edge on timber or like runners. Packing pieces inserted between the slabs may be rope or timber. Slabs shall be well covered with plastic sheeting to protect them from any possible staining.

3.17.3 Scaffolding

As specified in 3.16.13

3.17.4 Fixing

The size & shape of the cramps shall be as per drawing and as per directions of Engineer-in-charge.

The samples of steel cramps should be approved in advance before starting the stone cladding work.

The cramp shall be attached to top and bottom of the stone. The cramps shall have inbuilt adjustment for vertical and horizontal alignment. The cramps used to hold support and transfer the load of stone unit to the supporting structured steel shall be designed by the manufacturer and approval of the same shall be obtained from the Engineer-in-Charge. The minimum number of clamps required shall be as per requirement of design to carry the load of individual stone slabs. The cramps shall be spaced not more than 60 cm horizontally and vertically along the stone side for insertion of pins / bolt attached with the steel cramps. Adequate cutting in stone shall be made with precision instrument to hold the cramps pins at the joints. Stone shall be secured with clamps with high quality workmanship. The walls shall be carried up truly plumb. All the courses shall be laid truly horizontal and all the vertical joints truly vertical. The sequence of execution for cladding work shall be approved by the Engineer-in-Charge.

3.17.5 Jointing:

Joints horizontal and vertical shall be filled with weather sealant of make as approved by Engineer-in-charge with the help of pouring gun for filling the sealant. Before filling the joint with sealant, masking tape are required to be fixed on stones surface on both edges of joints of the stones, so that sealant may not spoil the

surface of the stone. When all the joints are filled and sealant has dried, the masking tape may be removed.

3.17.6 Protection:

Work shall be protected from rain by suitable covering. The work shall also be suitably protected from damage and rain during construction.

3.17.7 Measurement:

The length and breadth shall be measured correct to a cm. The area shall be calculated in square metre correct to two places of decimal. Any opening of area 0.01 sqm. or less shall not be deducted.

3.17.8 Rate:

The rate includes the cost of materials and labour involved in all operations described above including cost of support scaffolding staging, sealant, pouring guns but excluding the cost of steel cramps drilling holes / making recesses in stones which shall be paid for separately.

3.17.9 STRUCTURAL STEEL FRAME WORK FOR DRY STONE CLADDING

Specification for structural frame work for dry stone cladding are same specifications as for steel work in built up sections (welded or bolted).

3.17.10 Fixing of Frame

The properly designed structural frame for withstanding the weight of stone slab are fixed/supported on wall surface with the help of M.S. brackets/lugs of angle iron/flat etc. which is welded at each junctions of member of frame and also embedded in cement concrete block 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) of size 300 x 230 x 300 mm. The concrete block can be made by cutting the hole of size as mentioned in brick wall and filling the hole with cement concrete including provision of necessary centring/shuttering for holding of concrete. The frame can also be supported on RCC surface with the help of approved expansion hold fastener by drilling the holes in RCC surface.

Steel cramps are either welded or bolted to the frame (by making necessary holes in frame work) for holding of stone.

3.17.11 Measurement

The mode of measurement shall be the same, as specified for steel work in built up section except that the weight of welding material shall not be added in weight of members for payment and nothing extra shall be paid for making holes for temporary fastening of members during erection before welding, which also includes cost of cement concrete block, centring and shuttering and making holes in walls, but excluding the cost of expansion fastener, steel clamps which shall be paid for separately.

3.17.12 Rate

The rate shall include the cost of all labour and material involved in all the operation described above.

3.18 ADJUSTABLE STAINLESS STEEL CRAMPS

The cramps shall be stainless steel of make approved by the Engineer-in-charge.

The weight of the stainless steel clamp (including weight of nut and washer) shall not be less than 260 gms.

Necessary holes at suitable locations are to be done on steel frame work for dry stone cladding to be fixed.

Necessary recessed are required to be done in stone slab which is required to be supported by clamps.

The one end of steel clamp is fixed on frame with nut and bolt and other end is inserted into recesses/hole for fixing the dry cladding stone on frame.

The rate includes cost of materials and other operations mentioned as above.

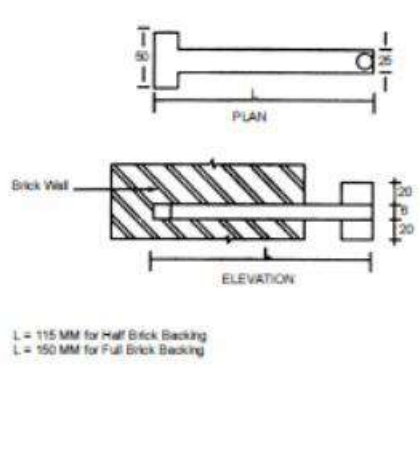


Fig.A : Cramp for Brick Backing

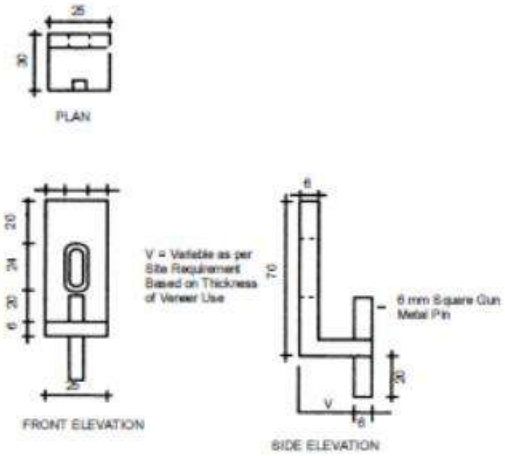


Fig. B : Cramp for R.C.C. Work Backing

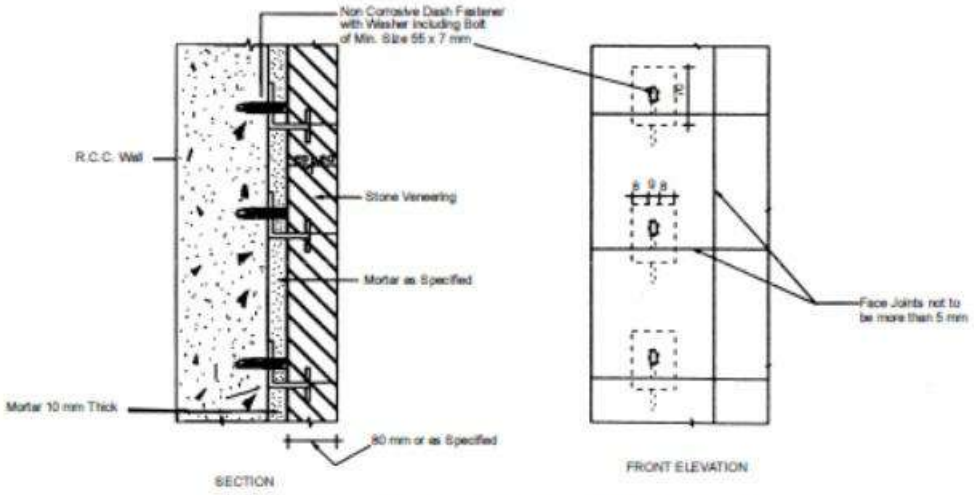
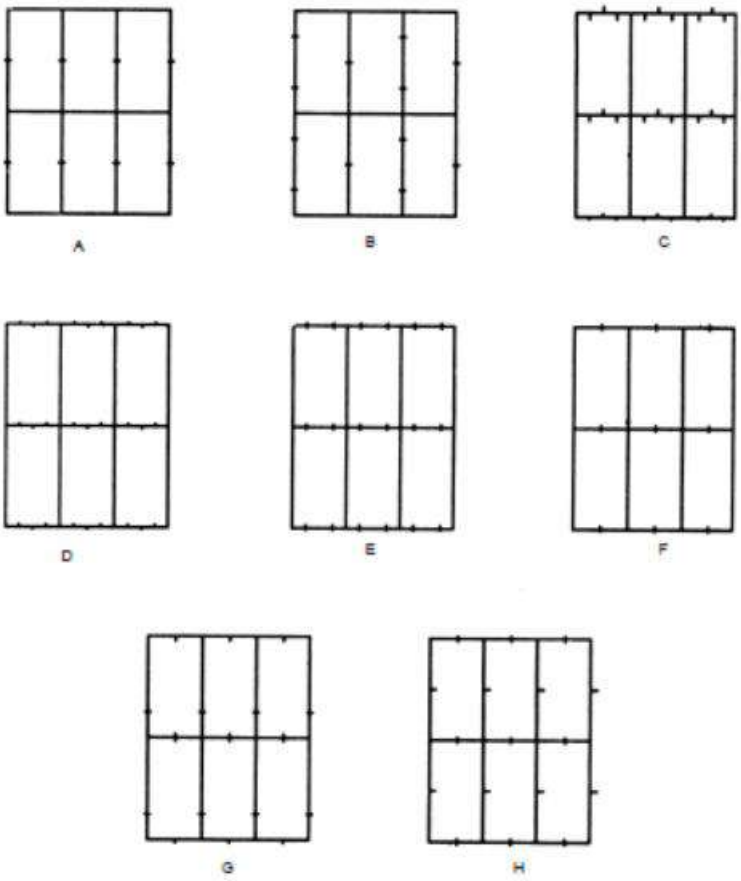


Fig. C :Typical Details of Cramps for R.C.C. Backing

Drawing not to scale
All dimensions are in mm

Fig. : Stone Veneering (Typical Fixing Arrangement)



Note : Cramps arrangement is shown above for veneerings with longer sides vertical. For veneerings having the longer sides horizontal, cramps would be arranged to suit the altered positions.

Drawing not to scale

Fig. : General Arrangement of Cramps

Chapter -5

Plastering

1. SCOPE

1.1. This specification covers the general requirements for plastering, pointing works and related works. The works under this specification shall consist of furnishing of all tools, plants, labour, materials, and everything necessary for carrying out the works.

2. GENERAL

2.1. The following codes, standards and specifications are made a part of this specification. All standards, specifications, codes of practice referred to herein shall be the latest version on the date of offer made by the Bidder.

In case of discrepancy between this specification and those referred to herein, this specification shall govern.

IS:280	-	Specification for mild steel wire for general engineering purposes.
IS:383	-	Specification for coarse and fine aggregates from natural sources for concrete.
IS:712	-	Specification for building limes.
IS:1200 (Part 12)	-	Method of measurement of building and civil engineering works.
IS:1542	-	Specification for sand for plaster.
IS:1661	-	Code of practice for application of cement and cement-lime plaster finishes.
IS:2402	-	Code of practice for external rendered finishes.
IS:2750	-	Specification for steel scaffoldings.
IS:3696	-	Safety code of scaffolds and ladders (Part 1).
IS:3696	-	-DO- (Part 2).
IS:4443	-	Code of practice for use of resin type chemical resistant mortars.
IS:4832	-	Specification for chemical resistant mortars (Part 2).
IS:4948	-	Specification for welded steel wire fabric for general use.
IS:8042	-	Specification for white Portland cement.

IS:8112	-	Specification for 43 grade ordinary Portland cement.
IS:8543	-	Methods of Testing Plastics (Part 4 / Section 1)
IS:13360 (Part 5-sec-11)	-	Method of testing plastics Part-5-Mechanical properties. Sec-11- Determination of hardness

3. CEMENT PLASTERING WORK

3.1. MATERIALS

The proportions of the cement mortar for plastering shall be 1:4 (one part of cement to four parts of sand) unless otherwise specified under the respective item of work. Cement and sand shall be mixed thoroughly in dry condition and then water added to obtain a workable consistency. The quality of water and cement shall be as per relevant IS. The quality and grading of sand for plastering shall conform to IS:1542. The mixing shall be done thoroughly in a mechanical mixer unless hand mixing is specifically permitted by the Engineer-in-charge. If so desired by the Engineer-in-charge, sand shall be screened and washed to meet the specification requirements. The mortar thus mixed shall be used as soon as possible preferably within 30 minutes from the time water is added to cement. In case the mortar has stiffened due to evaporation of water this may be re-tempered by adding water as required to restore consistency but this will be permitted only up to 30 minutes from the time of initial mixing of water to cement. Any mortar which is partially set shall be rejected and removed forthwith from the site **at no extra cost**. Droppings of plaster shall not be re-used under any circumstances.

3.2. WORKMANSHIP

3.2.1. Preparation of surfaces and application of plaster finishes shall generally confirm to the requirements specified in IS:1661 and IS:2402.

3.2.2. Plastering operations shall not be commenced until installation of all fittings and fixtures such as door/window frames, pipes, conduits, inserts, etc. are completed.

3.2.3. All joints in masonry shall be raked as the work proceeds to a depth of 10mm and 20mm for brick and stone masonry respectively with a tool made for the purpose when the mortar is still green. The masonry surface to be rendered shall be washed with clean-water to remove all dirt, loose materials, etc., Concrete surfaces to be rendered shall be roughened suitably by hacking or bush hammering for proper adhesion of plaster and the surface shall be evenly wetted to provide the correct suction. The masonry surfaces should not be too wet but only damp at the time of

plastering. The dampness shall be uniform to get uniform bond between the plaster and the masonry surface.

3.2.4. **Interior plain faced plaster** - This plaster shall be laid in a single coat of 12mm thickness unless otherwise specified in the respective item. The mortar shall be dashed against the prepared surface with a trowel. The dashing of the coat shall be done using a strong whipping motion at right angles to the face of the wall or it may be applied with a plaster machine. The coat shall be trowelled hard and tight forcing it to surface depressions to obtain a permanent bond and finished to smooth surface. Interior plaster shall also be carried out on jambs, lintel and sill faces, etc. as shown in the drawing and as directed by the Engineer-in-charge. Rate quoted for plaster work shall be deemed to include for plastering of all these surfaces.

3.2.5. **Plain Faced Ceiling plaster** - This plaster shall be applied in a single coat of 6mm thickness unless otherwise specified in the respective item. Application of mortar shall be as stipulated in clause 3.2.4.

3.2.6. **Exterior plain faced plaster** - This plaster shall be applied in 2 coats. The first coat or the rendering coat shall be approximately 14 mm thick. The rendering coat shall be applied as stipulated in clause 3.2.4 except finishing it to a true and even surface and then lightly roughened by cross scratch lines to provide bond for the finishing coat. Each coat shall be kept damp continuously for at least two days. The second coat or finishing coat shall be 6 mm thick. Before application of the second coat, the rendering coat shall be evenly damped. The second coat shall be applied from top to bottom in one operation without joints and shall be finished leaving an even and uniform surface. The mortar proportions for the coats shall be as specified in the respective item of work. The finished plastering work shall be cured for at least 7 days.

3.2.7. Interior plain faced plaster 20mm thick if specified for uneven faces of brick walls or for random/coursed rubble masonry walls shall be executed in 2 coats similar to the procedure stipulated in clause 3.2.6.

3.2.8. **Exterior Sand Faced Plaster** - This plaster shall be applied in 2 coats. The first coat shall be 14mm thick and the second coat shall be 6mm thick. These coats shall be applied as stipulated in clause 3.2.6. However, only approved quality sand shall be used for the second coat and for the finishing work. Sand for the finishing work shall be coarse and of even size and shall be dashed against the surface and sponged. The mortar proportions for the first and second coats shall be as specified in the respective items of work.

3.2.9. Wherever more than 20mm thick plaster has been specified, which is intended for purposes of providing beading, bands, etc. this work shall be carried out in two or three coats as directed by the Engineer-in-charge duly satisfying the requirements

of curing each coat (rendering/floating) for a minimum period of 2 days and curing the finished work for at least 7 days.

3.2.10. In the case of pebble faced finish plaster, pebbles of approved size and quality shall be dashed against the final coat while it is still green to obtain as far as possible a uniform pattern all as directed by the Engineer-in-charge.

3.2.11. Where specified in the drawings, rectangular grooves of the dimensions indicated shall be provided in external plaster by means of timber battens when the plaster is still in green condition. Battens shall be carefully removed after the initial set of plaster and the broken edges and corners made good. All grooves shall be uniform in width and depth and shall be true to the lines and levels as per the drawings and as directed by the Engineer-in-charge.

3.2.12. Curing of plaster shall be started as soon as the applied plaster has hardened sufficiently so as not to be damaged when watered. Curing shall be done by continuously applying water in a fine spray and shall be carried out for at least 7 days.

3.2.13. When the specification items of work calls for waterproofing plaster the CONTRACTOR shall provide the waterproofing compound as specified while preparing the cement mortar. Payment for water-proofing compound will be made separately if it is not included as a combined item of work.

3.2.14. Where lath plastering is specified, it shall be paid for at the same rate as for plaster work except that separate payment for metal lath will be made.

3.2.15. For external plaster, the plastering operations shall be commenced from the top floor and carried downwards. For internal plaster, the plastering operations for the walls shall commence at the top and carried downwards. Plastering shall be carried out to the full length of the wall or to natural breaking points like doors/windows etc. Ceiling plaster shall be completed first before commencing wall plastering.

3.2.16. Double scaffolding having two sets of vertical supports shall be provided to facilitate execution of the masonry works. The scaffolding shall be designed adequately considering all the dead, live and possible impact loads to ensure safety of the workmen, in accordance with the requirements stipulated in IS:2750 and IS:3696 (Part 1). Scaffolding shall be properly maintained during the entire period of construction. Single scaffolding shall not be used on important works and will be permitted only in certain cases as decided by the Engineer-in-charge. Where single scaffolding is adopted, only minimum number of holes, by omitting a header shall be left in the masonry for supporting horizontal scaffolding poles. All holes in the masonry shall be carefully made good by plastering

3.2.17. The finished plaster surface shall not show any deviation more than 3.2mm when checked with a straight edge of 2m length placed against the surface.

3.2.18. To overcome the possibility of development of cracks in the plastering work, following measures shall be adapted.

3.2.18.1. Plastering work shall be deferred as much as possible so that fairly complete drying shrinkage in concrete and masonry works takes place.

3.2.18.2. Steel wire fabric shall be provided at the junction of brick/block masonry and concrete to overcome reasonably the differential drying shrinkage/thermal movement. This steel item shall be measured and paid for separately.

3.2.18.3. Ceiling plaster shall be done, with a trowel cut at its junction with wall plaster. Similarly trowel cut shall be adopted between adjacent surfaces where discontinuity of the background exists.

3.3. MEASUREMENTS

3.3.1. Measurement for plastering work shall be in square meter correct to two places of decimal. Unless a separate item is provided for grooves, moldings, etc., these works are deemed to be included in the unit rates quoted for plastering work. The quantity of work to be paid for under these items shall be calculated by taking the projected surface of the areas plastered after making necessary deductions for openings for doors, windows, fan openings etc as per latest issue of IS 1200-1976 (part 12). The actual plaster work carried out on jambs /sills of windows, openings, etc. shall be measured for payment.

4. CEMENT POINTING

4.1. MATERIALS

4.1.1. The cement mortar for pointing shall be in the proportion of 1:3 (one part of cement to three parts of fine sand) unless otherwise specified in the respective items of work. Sand shall conform to IS:1542 and shall be free from clay, shale, loam, alkali and organic matter and shall be of sound, hard, clean and durable particles. Sand shall be approved by ENGINEER and if so directed it shall be washed/screened to meet specification requirements.

4.2. WORKMANSHIP

4.2.1. Where pointing of joints in masonry work is specified on drawings /respective items of work, the joints shall be raked at least 15mm and 20mm deep in brick /

block and stone masonry respectively as the work proceeds when the mortar is still green.

4.2.2. Any dust/dirt in the raked joints shall be brushed out clean and the joints shall be washed with water. The joints shall be damp at the time of pointing. Mortar shall be filled into joints and well pressed with special steel trowels. The joints shall not be disturbed after it has once begun to set. The joints of the pointed work shall be neat. The lines shall be regular and uniform in breadth and the joints shall be raised, flat, sunk or 'V' as may be specified in the respective items of work. No false joints shall be allowed.

4.2.3. The work shall be kept moist for at least 7 days after the pointing is completed. Whenever coloured pointing is to be done, the colouring pigment of the colour required shall be added to white/ grey cement in such proportions as recommended by the manufacturer and as approved by the Engineer-in-charge.

4.3. MEASUREMENT

4.3.1. The quantity of work to be paid for under all pointing Items shall be measured in sq.m correct to two places of decimal by taking the projected surface of the area pointed after making necessary deductions for openings, etc.

5. METAL LATH AND WIRE FABRIC

5.1. MATERIALS

5.1.1. Welded steel wire fabric shall conform to IS:4948.

5.1.2. Expanded metal shall conform to IS:412.

5.1.3. Galvanized wire mesh shall be of approved quality.

5.2. WORKMANSHIP

5.2.1. The type and details of the steel material to be used for metal lath plastering work and at the junctions of brick masonry/concrete before wall plastering shall be as specified in the respective items of work.

5.2.2. For metal lath plastering work, the weight of steel material shall be not less than 1.6 kg/sq m.

5.2.3. Steel material for use at the Junction of brick masonry/ concrete shall have the mesh dimensions not greater than 50 mm.

5.2.4. Steel material shall be obtained in maximum lengths as manufactured to restrict joints to the minimum. Overlap at the joints shall be minimum 25 mm which shall be securely tied with wires of diameter not less than 1.25 mm at spacing not more than 100 mm for lath plastering work. Nailing to wall shall be at spacing not exceeding 200 mm. The material shall be straightened, cut and bent to shape if required for fixing as per the details indicated in the drawings.

5.3. MEASUREMENT

5.3.1. Measurement shall be in square meter correct to two places of decimal for the type as specified in the respective items of work.

6. WATERPROOFING ADMIXTURE

6.1. Water-proofing admixture shall conform to the requirements of IS:2645 and shall be of approved manufacture. The admixture shall not contain calcium chloride. The quantity of the admixture to be used for the works and method of mixing etc. shall be as per manufacturer's instructions and as directed by the Engineer.

Payment shall be made for the actual quantity of such admixture used unless it is already covered in the rate for the relevant item of work.

END.

Chapter -6

Water Proofing Work

WATERPROOFING WORKS

1.0 SCOPE

This specification covers the general requirements for Waterproofing works comprising water- proofing of roofs with bitumen felt, roofs with lime concrete, admixtures, waterproofing compounds, membranes, block bat and such other related works forming a part of this job, which may be required to be carried out though not specifically mentioned above. The work under this specification shall consist of furnishing of all tools, plants, labour, materials, and everything necessary for carrying out the work.

2.0 APPLICABLE CODES AND SPECIFICATIONS

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

In case of discrepancy between this specification and those referred to herein, this specification shall govern.

IS:269/1989 - Specification for 33 grade ordinary portland cement.

IS:383/1970 - Specification for coarse and fine aggregates from natural sources for concrete.

IS:702/1988 - Specification for industrial bitumen.

IS:712/1984 - Specification for building limes.

IS:1077/1992 - Specification for common burnt clay building bricks.

IS:1322/1993 - Bitumen felts for water- proofing and damp proofing.

IS:1346/1991 - Code of practice for water-proofing of roofs with bitumen felts.

IS:1542/1992 - Specification for sand for plaster.

IS:1580/1991 - Specification for bituminous compounds for water-proofing and caulking purposes.

IS:1661/1972 - Code of practice for application of cement and cement-lime plaster finishes.

IS:1834/1984 - Specification for hot applied sealing compound for joint in

concrete.

IS:2212/1991 - Code of practice for brickwork.

IS:2250/1981 - Code of practice for preparation and use of masonry mortars.

IS:2402/1963 Code of practice for external rendered finishes.

IS:2571/1970 Code of practice for laying in-situ cement concrete flooring.

IS:2572/1963 Code of practice for construction of hollow concrete block masonry.

IS:2645/1975 Specification of integral cement water-proofing compounds.

IS:2691/1988 Specification for burnt clay facing bricks.

IS:3036/1992 Code of practice for laying lime concrete for a water-proofed roof finish.

IS:3067/1988 Code of practice of general design details and preparatory work for damp-proofing and water-proofing of buildings.

IS:3068/1986 Specification for broken brick (burnt clay) coarse aggregates for use in lime concrete.

IS:3384/1986 Specification for bitumen primer for use in water-proofing and damp-proofing.

IS:3495/1992 Method of test for burnt clay building bricks: Part 1 to 4.

IS:4832/1969 Specification for chemical resistant mortars (Part 2).

IS:6042/1969 Code of practice for construction of light weight concrete block masonry.

IS:8042/1989 Specification for white Portland cement.

3.0 WATER-PROOFING OF ROOFS WITH BITUMEN FELTS

3.1 MATERIALS

Bitumen felt shall be either Hessian-base self-finished felt Type 3 Grade I conforming to IS:1322 or glass fibre base self-finished felt Type 2 Grade-1 conforming to IS:7193.

Bitumen primer shall conform to IS:3384.

Bitumen used as bonding material shall be Industrial blown type bitumen of Grade 85/25 conforming to IS:702.

Pea sized gravel shall be hard, round, of size 6mm and down, free from fine sand, dust etc.

3.2 WORKMANSHIP

Water-proofing treatment to roofs shall be either normal, heavy or extra heavy depending upon the requirements. The type of treatment and the type of bitumen felt to be used shall be as specified in the item of work.

Normal treatment which provides for one layer of felt shall comprise of five courses as under.

a) Bitumen primer at the rate of 0.27 litre/sq.m (min)

b) Bitumen bonding material hot applied at the rate of 1.20 kg/sq.m (min).

c) One layer of bitumen felt.

d) Bitumen bonding material hot applied at the rate of 1.20 kg/sq.m (min).

e) Pea sized gravel at the rate of 0.006 cu.m/sq.m.

Heavy treatment which provides for two layers of felt shall comprise of seven courses as under.

a) Bitumen primer at the rate of 0.27 litre/sq.m (min)

b) Bitumen bonding material hot applied at the rate of 1.20 kg/sq.m (min)

c) One layer of bitumen felt.

d) Bitumen bonding material hot applied at the rate of 1.20 kg/sq.m (min)

e) Second layer of bitumen felt.

f) Bitumen bonding material hot applied at the rate of 1.20 kg/sq.m (min)

g) Pea sized gravel at the rate of 0.006 cum/sq.m.

Extra heavy treatment provides for three layers of felt and comprises of nine courses laid in the same procedure as above.

The roof slope shall be at least 1 in 100. Concrete or mortar screed to achieve the specified slope as per drawings shall be executed and properly cured before taking up water-proofing treatment.

The surfaces over which water-proofing treatment is to be carried out, shall be cleaned of all foreign matter by wire brushing, dusting and made thoroughly dry. Preparation of surfaces shall be as stipulated In IS:3067. Bitumen primer shall then be applied uniformly.

Each length of felt shall be prepared by brushing them clean and laid out flat on the roof for softening to eliminate curls. Bitumen bonding material shall be heated to the correct working temperature for pouring across the full width of the rolled felt and the felt steadily rolled out and pressed down. Excess bonding material squeezed out at the ends shall be removed as the laying proceeds.

Felts shall be laid in lengths at right angles to the direction of the run-off gradient, commencing at the lowest level and working upto the crest. Minimum overlaps of l00mm at the ends and 75mm at the sides of the felt strip shall be provided. All overlaps shall be firmly bonded with hot bitumen. Laying of the second layer of felt shall be so arranged that the joints are staggered with those of the layer beneath it.

It shall be ensured that a concave fillet 75mm in radius is provided in cement mortar 1:4 at the junction of the roof and vertical face of masonry or RCC parapet wall or column projections.

Water-proofing treatment shall be taken up on the brick masonry wall/parapet/column projection by a minimum of 150 mm. Felts shall be laid as flashing with minimum overlap of 100mm. The lower edge of the flashing shall overlap the felt laid on the flat portion of the roof and the upper edge shall be tucked into the groove. Each layer shall be arranged so that the joints are staggered with those of the layer beneath it. For the vertical portion of the felt, two coats of bitumenous paint at the minimum rate of 0.10 litres/sq.m shall be provided in lieu of pea size gravel finish. Groove 75mm wide and 65mm deep shall be left for tucking in the waterproofing treatment and the groove filled with cement mortar 1:4 for securing it satisfactorily. Curing of the mortar shall be carried out properly for atleast 4 days to avoid shrinkage cracks.

Water-proofing treatment for gutters shall normally contain 2 layers of felt corresponding to heavy treatment. The sixth course of hot bitumen shall however be at the rate of 1.50 kg/sq.m (minimum). Pea sized gravel finish shall however be replaced by 2 coats of bituminous paint at the minimum rate of 0.1 litre/sq.m. The felt layers shall be carried down the outlet pipes for a minimum depth of l00mm.

Expansion joints shall be treated with water-proofing treatment in a manner as illustrated in IS:1346 in accordance with the type and details specified in the construction drawings.

In order to avoid damage to water-proofing treatment where it is subjected to traffic, additional surface treatment by provision of cement concrete flooring tiles conforming to IS:1237 or machine made burnt clay flat terracing tiles conforming to IS:2690 (Part 1) shall be made if so specified in the item of work. Execution of these works shall be as specified in clauses 29.2.11 or 29.2.12.

3.3 MEASUREMENT

Measurement shall be in sq.m correct to two places of decimal. Measurement shall be for the plan area where the treatment is executed. No separate payment will be made for the overlapping of the felts, fillets and work as specified on vertical faces. Screed an top of roof, cement concrete tiling work or machine pressed clay tile work shall be paid for separately unless they are specifically included in the item of work.

3.4 WATER-PROOFING OF ROOFS WITH LIME CONCRETE

3.4.1 MATERIALS

Broken brick coarse aggregates prepared from well/over burnt bricks shall be well graded having a maximum size of 25mm and shall generally conform to IS:3068.

Lime shall be class "C lime (fat lime)" or factory made hydrated lime conforming to IS:712.

3.5 WORKMANSHIP

Lime concrete shall be prepared by thoroughly mixing the brick aggregates inclusive of brick dust obtained during breaking with the slaked lime in the proportions of 2 ½ (two and a half) parts of brick aggregates to 1 part of slaked lime by volume. Water shall be added just adequate to obtain the desired workability for laying.

Washing soap and alum shall be dissolved in the water to be used. The quantity of these materials required per cum of lime concrete shall be 12kg of washing soap and 4kg of alum. Brick aggregates shall be soaked thoroughly in water for a period of not less than six hours before use in the concrete mix. Lime concrete shall be used in the works within 24 hours after mixing.

The roof surface over which the water-proof treatment is to be carried out shall be cleaned of all foreign matter by wire brushing, dusting and made thoroughly dry. Preparation of surfaces shall be as stipulated in IS:3067.

The slope of the finished waterproofing treatment shall be not less than 1 in 60 for efficient drainage. This shall be achieved either wholly in the lime concrete layer or otherwise as indicated in the drawings.

The average thickness of lime concrete, slope and the finish on top of machine made burnt clay flat terracing tiles conforming to IS:2690 (part 1) shall be as specified in the item of work. Cement concrete flooring tiles in lieu of clay terracing tiles shall be provided if so specified in the item of work, duly considering the traffic the terrace will be subjected to.

The minimum compacted thickness of lime concrete layer shall be 75mm and average thickness shall not he less than l00mm. In case, the thickness is more than l00mm, it shall be laid in layers not exceeding 100mm to 125mm.

Laying of lime concrete shall be commenced from a corner of the roof and proceeded diagonally towards centre and other sides duly considering the slopes specified for effectively draining the rain-water towards the downtake points.

Lime concrete fillet for a minimum height of 150mm shall be provided all along the junction of the roof surface with the brick masonry wall/parapet/column projections. These shall then be finished an top with provision of clay terracing tiles/cement concrete tiles.

After the lime concrete is laid it shall be initially rammed with a rammer weighing not more than 2 Kg and the finish brought to the required evenness and slope. Alternatively, bamboo strips may be used for the initial ramming. Further consolidation shall be done using wooden THAPIES with rounded edges. The beating will normally have to be carried an for atleast seven days until the THAPI makes no impression on the surface and rebounds readily from it when struck. Special care shall be taken to properly compact the lime concrete at its junction with parapet walls or column projections.

During compaction by hand-beating, the surface shall be sprinkled liberally with lime water (1 part of lime putty and 3 to 4 parts of water) and a small proportion of sugar solution for obtaining improved water-proofing quality of the lime concrete. On completion of beating, the mortar that comes on the top shall be smoothened with a trowel or float, if necessary, with the addition of sugar solution and lime putty. The sugar solution may be prepared in any one of the following ways as directed by the ENGINEER

a) By mixing about 3 Kg of Jaggery and 1.5 Kg of BAEL fruit to 100 litres of water.

b) By mixing about 600 gm of KADUKAI (the dry nuts shall be broken to small pieces and allowed to soak in water), 200 gm of jaggery and 40 litres of water for 10 sq.m of work. This solution shall be brewed for about 12 to 24 hours and the resulting liquor decanted and used for the work.

The lime concrete after compaction shall be cured for a minimum period of seven days or until it hardens by covering with a thin layer of straw or hessian which shall be kept wet continuously.

Machine made flat terracing tiles shall be of the size and thickness as specified in the item of work. Tiles shall be soaked in water for at least one hour before laying. Bedding for the tiles shall be 12mm thick in cement mortar 1:3. Tiles shall be laid, open jointed with 4 to 6 mm wide joints, flat on the mortar and lightly pressed and set to plane surface true to slope, using a trowel and wooden straight edge. They shall be laid with their longitudinal lines of joints truly parallel and generally at right angles to the direction of run-off gradient. Transverse joints in alternate rows shall come

directly in line with each other. Transverse joints in adjacent courses shall break joints by atleast 50 mm. The joints shall be completely filled and flush pointed with cement mortar l:2 mixed with water proofing compound as per manufacturer's instructions. Curing shall be carried out for a minimum period of seven days.

Finishing on top with cement concrete tiles if specified shall be carried out in similar fashion as described for clay tiles in clause 29.2.11. Tiles to be used shall be supplied after the first machine grinding of the surface.

3.6 MEASUREMENT

Measurement shall be in sq.m correct to two places of decimal. Measurement shall be for the plan area where the treatment is executed. No separate payment shall be made for the fillets.

3.7 WATER-PROOFING ADMIXTURE

Water-proofing admixture shall conform to the requirements of IS:2645 and shall be of approved manufacture. The admixture shall not contain calcium chloride. The quantity of the admixture to be used for the works and method of mixing etc. shall be as per manufacturer's instructions and as directed by the Engineer. Payment shall be made for the actual quantity of such admixture used unless it is already covered in the rate for the relevant item of work.

WATERPROOFING WORK

Work shall include design, supply, install and test waterproofing systems to underground structure, terraces, toilet sunk slabs, UG and Overhead water tanks, water bodies, landscape areas etc. This shall be guaranteed for 10 years on Rs.100/- stamp paper in proforma to be approved by the Engineer in-charge.

A) Water proofing of basement including sealing of services junctions, drain points, sumps shall be as per membrane treatment.

B) Water proofing of terrace with insulation inclusive of grouting, sealing rainwater down takes outlets, other services outlets, junctions of walls, slab, beam, columns, parapet wall etc., where required expansion joints all as per approved terrace treatment.

Work shall include design, supply, install and test systems for basement, terrace, toilets, water retaining structures as approved by the Engineer in-charge. This shall be guaranteed for 10 years on Rs.100/- Stamp paper in proforma to be approved by the Engineer in-charge.

Work shall conform to minimum standards specified. Systems detailed hereunder are to clarify type of water proofing system expected. Contractor is at liberty to suggest and submit equivalent system with products meeting / exceeding standards.

4.0 GENERAL

Quality Assurance (The sentences are incomplete, Please complete the sentences such that bidder should not interpret otherwise. For example refer first clause below. This is applicable till 3.1.3)

4.1.1 Manufacturer's Qualification

A) Bidder should have at least five years experience in manufacturing of membrane roofing.

1. Obtain primary materials from single manufacturer. Manufacturer's name shall appear on containers and accessories.

2. Provide secondary materials as required by manufacturer of primary materials.

4.1.2 Applicators Qualification

A) Approved by manufacturer prior to execution of this Contract, with experience on at least five projects.

B) Foreman of Field Crew: Minimum five years experience with system of waterproofing being installed.

4.1.3 Certifications

Manufacturer's certifications on manufacturer's letterhead:

1. Certify system design; penetration, transition, and perimeter details; and system specifications are appropriate and satisfactory for this particular project.

2. Certify products proposed for use comply with standards.

3. Certify materials ordered and supplied are compatible with each other, suited for local and purpose intended and shipped in sufficient quantity to ensure proper timely installation.

4. Certify materials have express warranty of merchantability and fitness for particular purposes of this Project.

5. Certify manufacturer has reviewed Project and will issue warranty upon successful completion of installation.

6. Certify materials shipped to site meet membrane manufacturer's published performance standards and requirements of this Specification.

7. Membrane manufacturer's approval of insulation type and method of installation.

8. Manufacturer's approval of installer.

Sub Contractor / Specialist shall be from the approved list and same shall be approved by the Engineer in-charge in writing before being employed by the Contractor.

4.2 Submittals

The Contractor shall submit

Statement giving detailed brief of work he proposes to carry out.

A) Name of agency with his experience certificate and quantum of work carried out. List of technical persons with their details

B) Technical Specifications

C) Product data sheets of material to be used

D) Shop drawing detailing

Sections co-ordinated with typical installation details

Vertical termination and sealing

Laps needed if any

Typical expansion, construction and control jointing details with minimum requirement

Horizontal fixing and laying details

Typical finishing arrangement

Flashings if required

E) Protective measures to be taken.

F) Installation guidance

G) Samples of each product in duplicate fixed over plywood boards or similar to enable proper cross sections.

H) Manufacturer's certificate that product and material to be used is correct and shall give intended results when applied through authorized agency.

4.3 Warranty

.Warranty with attachments for full replacement value of completed installation signed by manufacturer, applicator and Contractor warranting against water infiltration and defects of materials and workmanship for period of ten years.

Provide warranty that covers labour and workmanship, including labour for access to waterproofing, for watertight warranty.

A. Warrant penetrations, terminations, changes of direction, and membrane.

B. Warranty shall include removing and reinstalling superimposed work covering waterproofing.

5.0 MATERIALS

5.1 Cement

Cement shall be ordinary Portland Cement conforming to IS and shall be of grade 43 or 33.

It shall be received in bags of 50 kg and each batch shall be accompanied with a test certificate of the factory. Also it shall be tested before use to ascertain its strength, setting time, etc. In case cement has been stored for over 6 months or for any reasons the stored cement shows signs of deterioration or contamination, it shall be tested as per the direction of the Engineer in-charge prior to use in the works.

Cement shall be stored in such locations so as to prevent deterioration due to moisture dampness. A dry and water proof shed shall be provided. Bags shall be stacked on rigid water-proof platforms about 15 to 20 cm clear above the floors and 25 to 35 cm clear or away from the surrounding walls. A maximum high stack of 12 bags is permitted. Stacks shall be so arranged that the first batches are used first (FIFO), and that they permit easy access for inspection and handling.

5.2 Sand

Natural sand deposited by stream or glacial agencies as a result of disintegration of rock is the best form of sand and shall be used.

Sometimes it is obtained from crushed stone screenings but often contains a high percentage of dust and clay. It tends to be flaky and angular. This type produces harsh concrete and should be avoided.

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

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

Grading of sand shall conform to IS and shall fall within limits.

Sand shall be stored in such a way that it does not get mixed with mud, grass, vegetables and other foreign matter. The best way is to have a hard surface platform

made out of concrete, bricks or planks. It should be to the approval of the Engineer in-charge.

5.3 Water

Water used for mixing and curing shall be clean, reasonably clear and free from objectionable quantities of silt, oils, alkalies, acids, salts so as not to weaken mortar, or concrete or cause efflorescence or attack the steel in RCC while curing. It shall be free of elements, which significantly affects the hydration reaction. Potable water is generally satisfactory but it shall be tested prior to use in the works.

Water tested shall be in accordance with IS 3025. Maximum permissible limits of deleterious materials in water should be as given in IS 456.

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

Water shall be tested and approved in writing by the Engineer in-charge prior to use in the works.

6.0 ACCESSORIES

Primers, bonding agents, water stops or plugs etc. As per recommendations of the manufacturer.

6.1 Mixes

A) Mix materials in accordance with manufacturer's instructions

B) Mix in clear containers

C) Do not re-temper mix after initial set.

6.2 Membrane

6.2.1 APP Modified Membrane

It is a polymeric water proofing membrane manufactured to high standards. It is five layered APP modified polymeric membrane with centre core as 20 micron HMHDPE/100 micron HMHDPE High Molecular High Density Polythylene Film, is the heart of the membrane and protects against water and moisture. The centre core is sandwiched on both sides by high quality polymeric mix with properties of high softening point, high heat resistance and cold resistively to make it ideal for all water proofing treatment. The polymeric mix is protected on both sides with 20 micron HMHDPE film. The membrane is available in variable thickness and weights. Usual width is 1.0 m.

6.2.2 TPO (Thermoplastic Polyolefin) Membrane

TPO roofing membrane is typically based on polypropylene and EP (ethylene-propylene) rubber polymerized together using state-of-the-art polymer manufacturing technology. TPO membranes are flexible at low temperatures without the use of polymeric or liquid plasticizers. The membrane is comprised of TPO based top and bottom plies encapsulating a reinforcing fabric that enhances the physical properties of the sheet. The combination of the fabric and TPO plies provide reinforced membranes with high breaking and tearing strength and puncture resistance.

Tensile Strength (N/mm²) : ≥ 9.0 N/mm² (UNI EN 12311- 2)

Elongation at break (%) : ≥ 550% (UNI EN 12311 - 2)

Puncture resistance (mm) : ≥ 400 (DIN 16726-5.12)

Root resistance : No penetration (DIN 4062)

Tear Resistance (N) : ≥ 130 (UNI EN 12310 – 2)

Resistance to static punching (KG) : ≥ 20 (UNI EN ISO 12236)

The membrane shall be of a twin colour co extrusion to give a visual indication when damage occurs.

The membrane shall be double seam welded which shall be subject to a pneumatic test at 2 bar pressure. The pressure loss shall not exceed 10% over a period of 120 seconds and 20% over 300 seconds or vacuum testing for single seam weld.

The slip membrane under the membrane shall be a geotextile manufactured from virgin polypropylene and shall be with a specific weight of minimum 300 gm/m2.

6.2.3 PVC Membrane

The PVC membrane system shall conform to the following specifications.

Minimum Thickness: 2.0 mm (UNI EN 1849 -2)

Elongation at Break : >300% (UNI EN ISO 527 -3)

Puncture resistance : > 1100mm (DIN 16726-5.12)

Water impermeability: no penetration @ 5 bar

Tensile Strength: >17Mpa (UNI EN ISO 527 -3)

Tear resistance: > 50 N/mm

6.2.4 Extruded Polystyrene

Extruded polystyrene shall be rigid foam insulation boards having following properties

- K value $\leq$ 0.022 W/Sqm-deg C at 25^0 C
- Density 32-35 Kg/Cum.
- Compressive strength 200-220 KN/Sqm

6.2.5 Light weight concrete blocks

Block bats shall be of approved make light weight blocks. Flaky and elongated pieces shall be avoided. It should also be free from adherent coatings of soil or silt. Block bats should be free from alkalies, soft fragments, organic impurities, etc. In such quantities as not to affect strength and durability of concrete.

Water absorption for the blocks after 24 hours immersion in cold water shall not exceed 10%.

6.2.6 Waterproofing compounds

Waterproofing compounds shall be cementitious (cement based) non-shrinking, self curing mixtures. These shall be

- Free from sodium and chlorides
- Free from material detrimental to concrete and reinforcement.
- Able to create a membrane in one or multiple coats as per manufacturer's instruction.
- Membrane capable to prevent infiltration when applied to interior faces and ponded.
- Permeability, shear bond strength, compressive strength, volume changes meets minimum requirements of codes.

6.3 Accessories

All other accessories materials such as primers, bonding agents, polymers etc. Shall be as recommended by waterproofing manufacturer.

6.3.1 Delivery / Storage

All materials shall be delivered and stored at site conforming to following minimum requirements.

- Material received is approved by Engineer in-charge.
- Material is in unopened container and labeled with manufacturer’s name, brand name and instructions for use.
- Material received shall be along with manufacturer’s certificate for quality and period of manufacture.
- Material shall be stored in dry, well ventilated and covered storage if so desired by manufacturer.
- Primers, adhesives etc. Shall be as recommended by the membrane manufacturer.

7.0 WORKMANSHIP

7.1 Preparation of Surfaces

A) The surfaces to receive the treatment shall be thoroughly cleaned of

Laitance, scales, loose material on surface.

Grease, oil or other contaminants by etching with 10-15% of solution of muriatic acid using commercial grade alkaline cleaner, flushing with clean water drying and vacuuming.

B) Surfaces shall be examined and well-defined cracks grouted by making 'V' groove / notches with cement slurry, shall be cured and dried well before treatment.

C) Any honeycombs shall be carefully cut and plugged, and cured well before treatment.

D) Examination of surface shall account for the fact that,

Surfaces are cured for 14 days and no condensation has taken place.

Horizontal and vertical surfaces have smooth finish, free from defects.

Surfaces are dry, clean, free of grease, oil, dirt, rust, corrosion, other coatings and contaminants which could affect bond of water proofing system.

7.2 TESTING

On completion of installation and prior to next operation or as directed by Engineer in-charge work shall be tested by the Contractor. Required water shall be arranged and disposed of by the contractor at his cost.

A) All openings, drains etc. Shall be plugged.

B) Water shall be flooded about 200 mm over the Sunk portion. Water shall be kept for 72 hours.

C) Surfaces shall be observed critically and in case any leakage is observed areas shall be treated again and tests to be carried out again to the satisfaction of the Engineer in-charge.

Approval of water test does not relieve the contractor of his obligation of providing installed water proofing guaranteed for 10 years as per contract.

All arrangement of material, labour etc. Required including preserving and maintaining areas flooded shall be carried out by the Contractor at his cost.

7.3 GUARANTEE

All waterproofing systems described above are to be referred as guide-lines only. The contractor shall propose the system before starting waterproofing work giving full description for approval of Engineer in-charge.

The system shall be guaranteed for 10 years against all defects and liabilities thereof from the date of completion of project. The guarantee shall be on Stamp Paper of Rs.100/- in proforma to be approved by Engineer in-charge. (The contractor shall submit proforma for approval of Engineer in-charge before being written on Stamp Paper.) The cost of Stamp Paper shall be to the contractor's account.

Work shall be carried through approved specialist agency as per method of working approved in writing by the Engineer in-charge.

7.3.1 In-Situ seven course waterproofing treatment with APP (Atatic Polypropylene) Modified Polymeric membrane over roof

Various experienced water proofing specialists shall carry out the following or similar types of water proofing treatments. The treatment shall be taken over vertical surfaces as required / specified. Final finished surfaces may be laid with paving tiles, stones or finished smooth in cement and marked with false chequered marking or China mosaic. Points given below are just for guide lines. The actual steps and details shall be submitted by the contractor for approval of the Engineer in-charge. Work shall be carried out as per approved method by the Engineer in-charge.

7.3.2 Surface preparation

The surface to be treated shall be cleaned and inspected thoroughly

A) All minor, medium cracks shall be marked.

B) All cracks shall be well defined and `V' groove made. These shall be cleaned with compressed air, grouted with cement sand mortar 1:4 (1 cement : 4 sand) slurry mixed with non shrinking and waterproofing compound. Areas well cured.

C) Then again surfaces shall be well cleaned of all loose particles, laitance, moss, oil/greasy material, cement etc.

D) Roof areas shall be well marked with spot datum to create ridge, lines, slopes and drain points for easy draining of water (Nominal slopes shall be about 1:100).

E) Slope of 1:100 to be achieved by laying light weight coba mixed in proportion of brick bat 60% and cement sand mortar 40% mixed proportion 1:4, mortar mixed with 4% waterproofing compound.

F) Also proving and fixing 75mm thick insulation material with K < 0.022 W/m2-deg C at 25 C to achieve the ECBC (Energy Conservation Building Code)

recommended roof assembly values including cleaning and preparing the surface, fixing and jointing with approved adhesive all complete.

G) Protective layer, geotextile mat of 160 gsm min. And shall be loose laid over the roof slab. Laying of 1.2 mm thick approved TPO (Thermoplastic Polyolefin) Membrane sheet of approved make on horizontal surface and fully adhered on vertical surface. The size of Membrane shall be large enough to minimize the number of joints. Adjacent sheet shall be laid in similar fashion with an overlap at least 150 mm. The overlap shall be cleaned using a primer as specified by the manufacturer. The overlap joint then be sealed as per manufacturer specification, sealing corners and drains etc. The Membrane will be mechanically fastened using base tie-in fastening system. The counter flashing will cover the top of the fastening system by a minimum of 100 mm. Sealing corners and drains etc. The Membrane shall be terminated on vertical surface using Aluminium Termination strip and sealed with water block and sealant. Thereafter protective layer of geo-textile mat of 120 gsm shall be laid over Membrane with an overlap of 75 mm spot stuck with neoprene base bonding adhesive.

H) Protect horizontal surfaces with 30 mm thick IPS 1:2:4 (1 cement : 2 sand : 4 aggregates) laid to gradient; with adding waterproofing compound 2% by weight of cement and vertical surfaces shall be plastered with cement sand mortar in a ratio of 1:4 (1 cement : 4 sand) with using 2% waterproofing compound by weight of cement.

I) Wattas and rounding of corners, junctions with walls and floors and finished smooth and cured.

J) Curing shall be done for 7 days.

K) All expansion joints shall be cleaned, primed and finished with sealant as specified by manufacturer of sealant and approved by Engineer.

The surface shall be finished neatly with cement mortar in a ratio of 1:4 and marked with false marking. It shall be covered with white tiles with spacers in specified sizes. These shall be bedded in 12 mm thick cement sand mortar. Joints shall be pointed with CM in a ratio of 1:3, mixed with 5% water proofing compound by weight.

7.3.3 Testing

Treatment shall be tested again by pending water about 250 mm high for 72 hours. Surfaces shall be examined for leakage seepage, dampness, sweating etc.

7.3.4 Guarantee

The work shall be covered by guarantee as per additional condition.

7.3.5 Measurement

Measurements shall be in square metre for finished surface area.

7.3.6 Rates

Rates shall include all items right from cleaning of surface to completion and testing required against defects such as leakage, seepage, dampness, sweating etc.The rate includes the cost of all materials, labour charges and other inputs involved in all the operations described above and in the description of item.

7.4 Membrane Waterproofing to Podium / Landscape area

Terraces and roof slabs shall be covered with light weight concrete laid to slope. The treatment shall be taken over vertical surfaces as required / specified. Final finished surfaces may be laid with paving tiles, stones or finished smooth in cement and marked with false chequered marking. Points given below are just for guide lines. The actual steps and details shall be submitted by the contractor for approval of the Engineer in-charge. Work shall be carried out as per approved manufacturer's specifications and approval of Engineer in-charge.

7.4.1 Surface preparation

The surface to be treated shall be cleaned and inspected thoroughly

A) All minor, medium cracks shall be marked.

B) All cracks shall be well defined and `V' groove made. These shall be cleaned with compressed air, grouted with cement sand mortar 1:4 (1 cement : 4 sand) slurry mixed with non shrinking and waterproofing compound. Areas well cured.

C) Then again surfaces shall be well cleaned of all loose particles, laitance, moss, oil/greasy material, cement etc.

D) Applying crystalline waterproofing compound in one / two coat at specified intervals and as recommended by manufacturer and allowed to cure.

E) Light weight concrete having density 450 Kg/Cum (for non traffic area) shall be mixed as specified by the manufacturer, with clean water and layer of about minimum 75 mm thickness at draining point and rest are sloped. Rain water inlet, pipes etc. Shall be well grouted; edge, corners shall be well rounded (watta) by taking up treatment about 300 mm above proposed finished level.

F) Slab and roof soffits shall be examined for dampness from under. Any leakage / dampness noticed shall be treated with pressure grouting and again checked by dipping the area for 3 days.

G) When no dampness noticed, area shall be drained out and cement sand mortar mixed in ratio 1:4 (1 cement : 4 sand) shall be spread over the entire area and well grouted.

H) Surfaces shall be finished / prepared to receive about 30 mm thick cement sand mortar screed about 30mm thick and cured.

I) All expansion joints shall be cleaned, primed and finished with sealant as specified by manufacturer of sealant and approved by Engineer in-charge.

7.4.2 Guarantee

The work shall be covered by guarantee as per additional condition.

7.4.3 Measurements

Measurements shall be in square metre for finished surface area.

7.4.4 Rates

Rates shall include all items right from cleaning of surface to completion and testing required against defects such as leakage, seepage, dampness, sweating etc.The rate includes the cost of all materials, labour charges and other inputs involved in all the operations described above and in the description of item.

7.5 Crystalline Waterproofing System to inside surface of the water retaining structures.

Crystalline waterproofing compound one / two coat shall be applied to water retaining structures.

Steps followed shall be as per the directions of the manufacturers and approval of the Engineer in-charge. For guideline following steps may be followed.

1. Surface preparation

   Clean the surface to remove dust, loose particles and laitance.

2. Apply Crystalline waterproofing compound one / two coats at specified intervals as recommended by the manufacturer on concrete / plastered surface.

3. Protect horizontal surfaces with 30 mm thick IPS 1:2:4 (1 cement : 2 sand : 4 aggregates) laid to gradient; with adding waterproofing compound 2% by weight of cement and vertical surfaces shall be plastered with cement sand mortar in a ratio of 1:4 (1 cement : 4 sand) with using 2% waterproofing compound by weight of cement.

4. Wattas and rounding of corners, junctions with walls and floors and finished smooth and cured.

5. Curing shall be done for 7 days.

Treatment shall be tested by ponding water about 250 mm high for 72 hours. Surfaces shall be examined for leakage seepage, dampness, sweating etc.

7.5.1 Guarantee

The work shall be covered by guarantee as per additional condition.

7.5.2 Measurements

Measurements shall be in square metre for finished surface area.

7.5.3 Rates

Rates shall include all items right from cleaning of surface to completion and testing required against defects such as leakage, seepage, dampness, sweating etc.The rate includes the cost of all materials, labour charges and other inputs involved in all the operations described above and in the description of item.

8.0 WATERPROOFING WORKS

8.1 General

It is the intent of this specification to secure a completely water tight basement, toilets and terraces etc. Guaranteed for at least 10 (Ten) years from the date of final completion. The guarantee shall be executed & extended by the Contractor & not by the water proofing agency. The contractor shall provide all materials, labour, plant, equipment, incidentals and everything necessary for securing a fully waterproof job as called for above.

All water proofing work shall be carried out by specialists as approved by the Engineer-In-Charge. Installation and materials shall be as per best practices for obtaining water proof work and as recommended by the manufacturer.

Water proofing work shall be commenced only after the surface is prepared, smooth rendered, cleaned free of dirt, dust and foreign matters, inspected and approved. Compressed air shall be used for effective cleaning of all surfaces. The vents and other projections through the roof shall be made absolutely secure before flashing.

8.2 Workmanship

Horizontal Surface: After the excavation and PCC levelling course, water proofing course shall be laid consisting of cement mortar 1:3 (1 cement:3 sand) and mixed with Acrylic water proofing chemicals and embedding aggregate by hand pack at random in two layers each of 25mm thick thus the total water proofing course shall be about 50mm thick. After the necessary curing, and fixing raft reinforce cement in partition provide 20 mm pipe sleeves at 1.2 m c/c on both ways by tying it with reinforcement in such a manners to ensure that the bottom end of the pipe remain free from getting chocked and the length of the pipes shall be that of total thickness of the raft plus 25 mm above to protrude from the surface of the raft.

After concreting the raft, grouting Acrylic based waterproofing chemical mixed with neat cement slurry through the pipe sleeves shall be carried and for the required period. The projected pipe ends shall be cut after grouting the mouths. The same procedure shall be adopted for all joints around the column wall joints.

Vertical Surfaces: The vertical surfaces shall be treated by making holes on the surface at 1.20 m centre to centre on both ways and also at 0.75 m along construction joints, corners and fixing nozzles of 20 mm dia pipe and inject Acrylic based chemicals mixed with neat cement slurry as explained above. After grouting the pipe, nozzles shall be removed and the packets shall be made good. The external surface of the walls shall be neatly plastered with cement mortar (1:3) admixed with Acrylic Chemicals of 12 to 15 mm thick.

8.3 Testing

As directed by Engineer-In-Charge.

8.4 Measurement

Measurement shall be done in Sqm.

8.5 Rate

Rate Shall be include all operation mentioned in bill of

8.6 Drainage Mat with Geo Textile

8.7 SCOPE

Providing & laying Drainage mat of approved make with Geo-textile in all soft scape areas including sides & bottom including cutting fixing etc. complete

8.8 MATERIALS

8.8.1 Sub soil drainage modules

The sub-soil drainage modules (‘draincells’) shall have a compressive strength of at least 100 T/Sqm to accommodate both static and dynamic loads during and after installation. It shall have good resistance to petroleumbased chemicals and naturally occurring soil chemicals.

The draincells shall have surface perforations each not exceeding 350 Sqmm to prevent the entry of large fill aggregates. The openings on the horizontal surface shall be at least 65% of the total surface area to provide optimum water flow.

The draincells shall be at least 30 mm high and shall be either interlocked with or butted to adjacent draincells along connecting edges to form a continuous entity.

The draincells shall comprise of one or more layers to ensure a total flow rate of at least 16.5 l/m.s to account for maximum rainfall conditions.

8.8.2 Geo textile filter fabric

The geotextile filter fabric shall be an approved non-woven needle-punched fabric consisting of polypropylene, polyethylene, polyester or a combination of any of these materials.

Typical properties of geotextile filter fabric are:

PROPERTY	VALUE
Minimum weight	> 120 g/m2
Pore size	< 190 microns
Tensile strength @ 40% elongation	> 4 kN
Grab strength @ 60% elongation	> 440 N
Puncture resistance	> 800 N
Trapezoidal tear strength	> 270 N
Flow rate	> 50 l/ms

8.8.3 Geo Mesh

The geomesh shall be manufactured from high density polyethylene.

Typical properties of geomesh filter netting are:

PROPERTY	VALUE
Material	High-density Polyethylene
Twine	300 Denier
Mesh size	1.5 mm square
Dimension	1.8 m x 10.2 m
Stabilizer	UV Inhibitors
Weight	105 g/m2

8.8.4 Growth Media

The growth media shall be a pH-stabilised mix comprising any of the following components: peat, compost, expanded clay aggregate/vermiculite, washed coarse river sand, free-draining loamy soil, composted sawdust, bark and bark fines, wetting and water retention agents and controlled release N-P-K micro-element fertilizer as specified.

The planting mix for all trees, palms, shrub beds and turf areas of the intensive rooftop garden and on top of basement structures shall comprise the components listed below, which shall be mechanically cultivated to the correct proportions, prior to placement on site. Planting mix shall have the following properties:

- contain less than 20% silt and clay by volume
- retain more than 45% (volumetric) moisture at maximum water capacity
- contain more than 20% air content at field capacity
- contain less than 12% organic matter (by mass)
- have a pH between 6 to 7

- have a cation exchange capacity higher than 10 cmol/kg soil

- have an apparent density of between 1200 – 1800 kg/cum when wet

The planting mix can comprise the following:

- Top soil

- washed coarse river sand

- Lightweight aggregate: expanded clay, shale, volcanic cinder, perlite

- Soil conditioner 1 kg/m3 of slow release NPK 15-15-15 fertilizer (coarse granule)

- Any other additives to balance pH and organic matter content as determined by the soil test

- Mix thoroughly before placing in the planting pit

8.9 WORKMANSHIP

The proprietary materials specified herein shall be provided/installed in accordance to the project requirement.

Proprietary materials supplied shall be identified clearly with the product name and production information.

The ends and edges of all installed draincells shall be properly sealed with geotextile/geomesh to ensure soil particles/aggregates cannot enter the draincells.

Prior to installation, the Contractor shall submit Method Statements and/or Shop Drawings for the installation of the draincells system. The latter shall be on at least A3 size paper or larger and in a CAD-recognisable format.

In trench applications, draincells installed vertically shall be temporarily supported in position either manually or by props until backfilling takes place.

Sand or other suitable backfill material shall be used and compacted in layers by hand or using light hand tools for a maximum depth of 300 mm. Backfilling may then be completed mechanically with vibratory compacting equipment. Care should be taken not to damage the draincells or the geotextile / geomesh covering during backfilling.

Clay material shall not be used as backfill. The displaced clay soil shall be replaced with aggregates / sand backfill. Sharp stones that may puncture the geotextile / geomesh shall be removed from the backfill material before backfilling.

The Contractor shall inspect the draincells installation prior to completing the installation of other drainage works and backfilling unless otherwise directed.

The installed draincells shall be protected from construction traffic, be maintained free from silt and debris or other foreign material.

8.10 MODE OF MEASUREMENT

Measurements shall be in Sqm

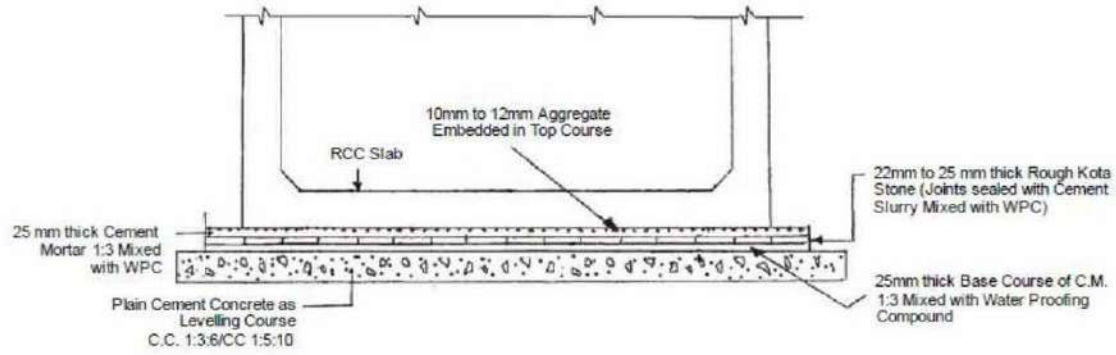


Fig. : Waterproofing of Horizontal Surface of U.G. Structure

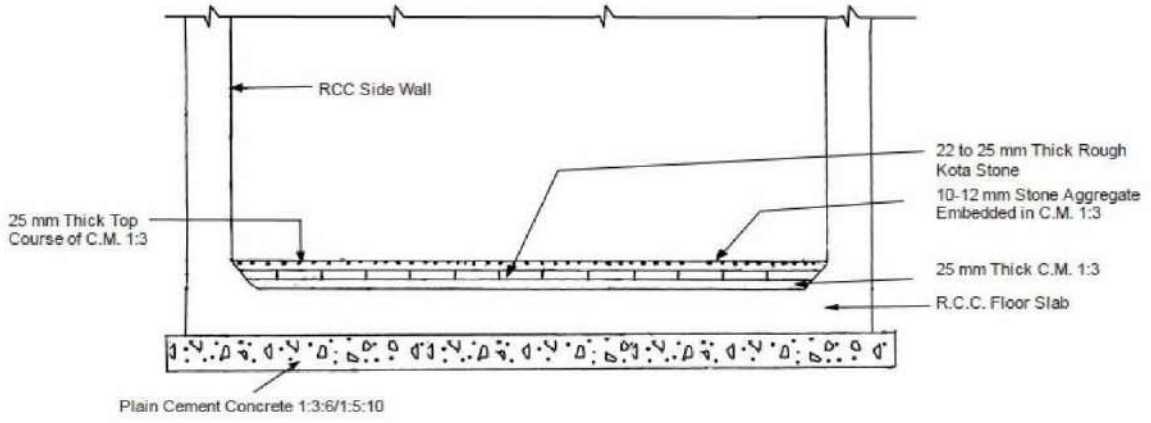


Fig. : Water Proofing Horizontal Surfaces from Inside of a U.G. Structure

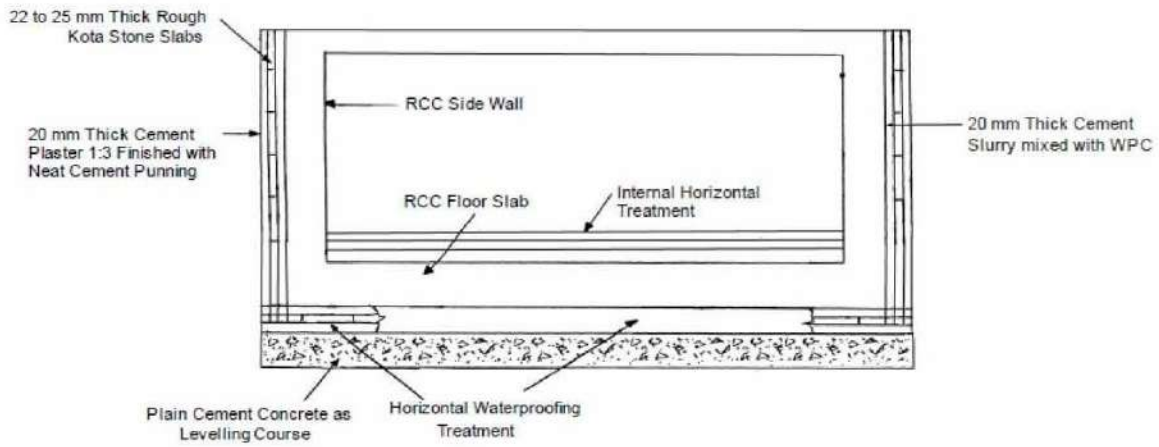


Fig. : Waterproofing on Vertical Surfaces of Under Ground Structures

Sub Head : Water Proofing Treatment

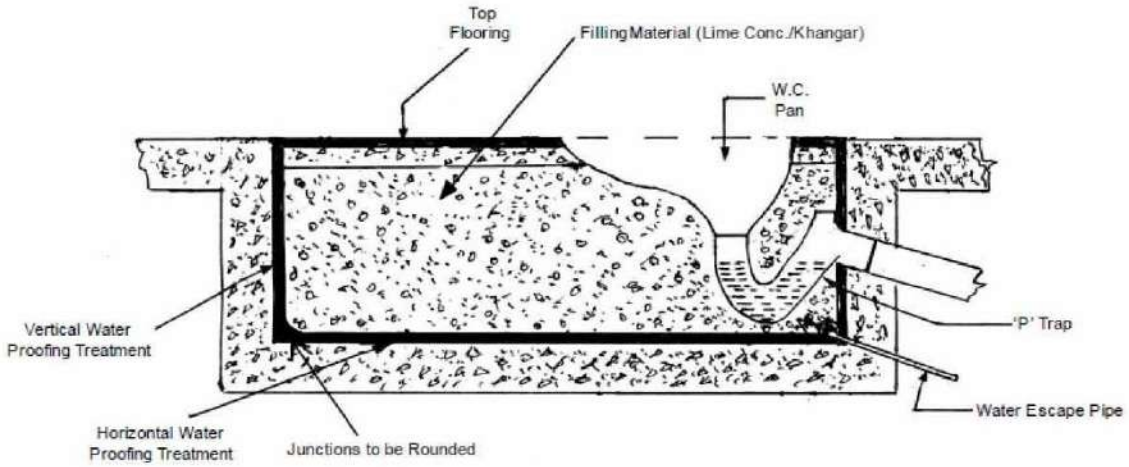
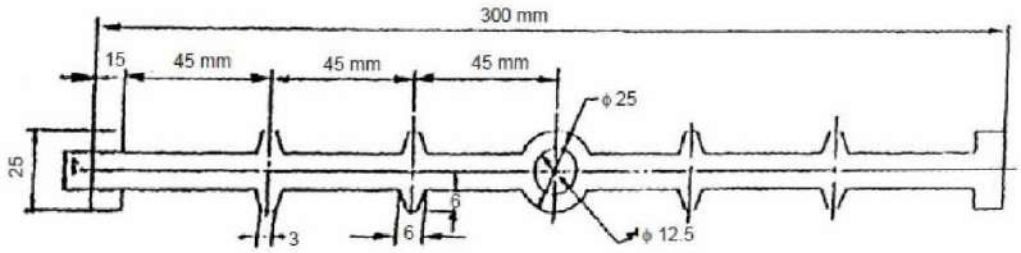


Fig. : Position of Horizontal and Vertical Waterproofing Treatment in Sunken Portion of W.C./Kitchen and the like



All dimensions in millimeters

Fig. : Typical Cross-Section of PVC Water-Stop

Sub Head : Water Proofing Treatment

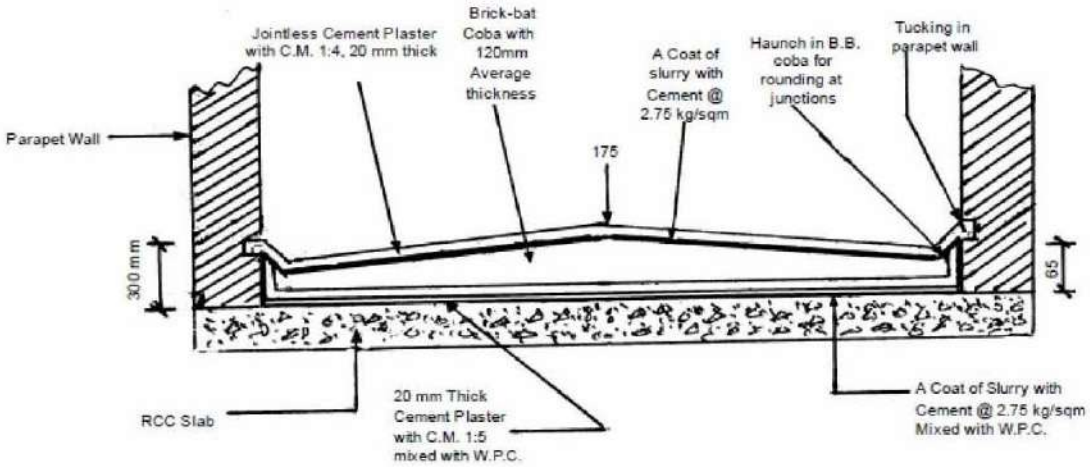


Fig. : Integral Cement based Waterproofing Treatment with Brick-bat Coba Over a RCC Slab

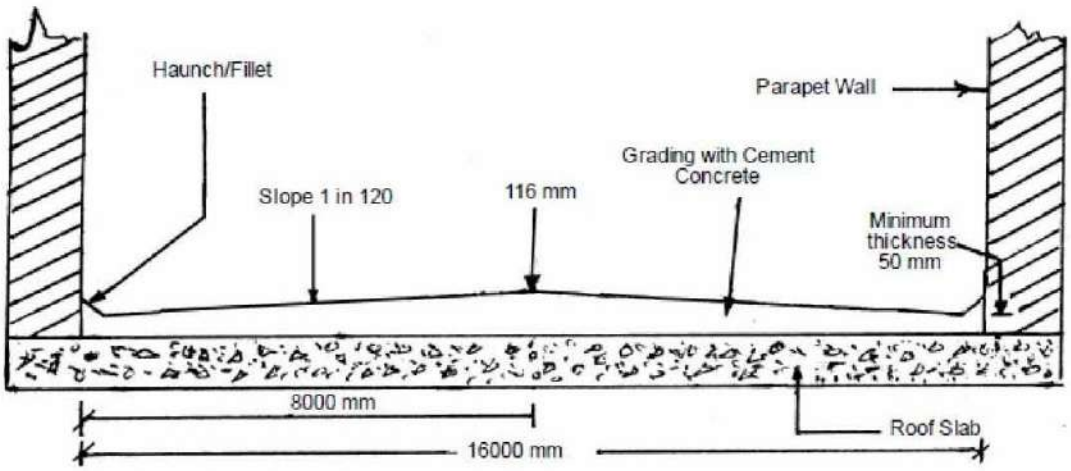


Fig. : Grading Roof Slab with Cement Concrete

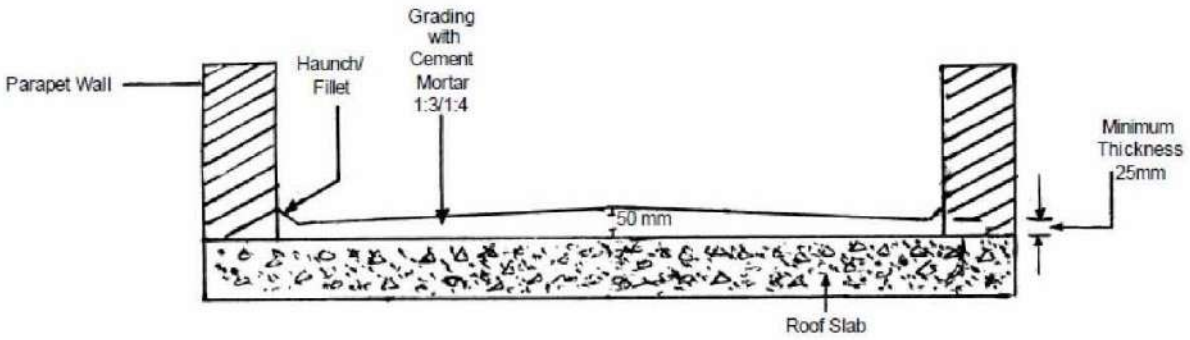


Fig. : Grading Roof Slab with Cement Mortar 1:3/1:4

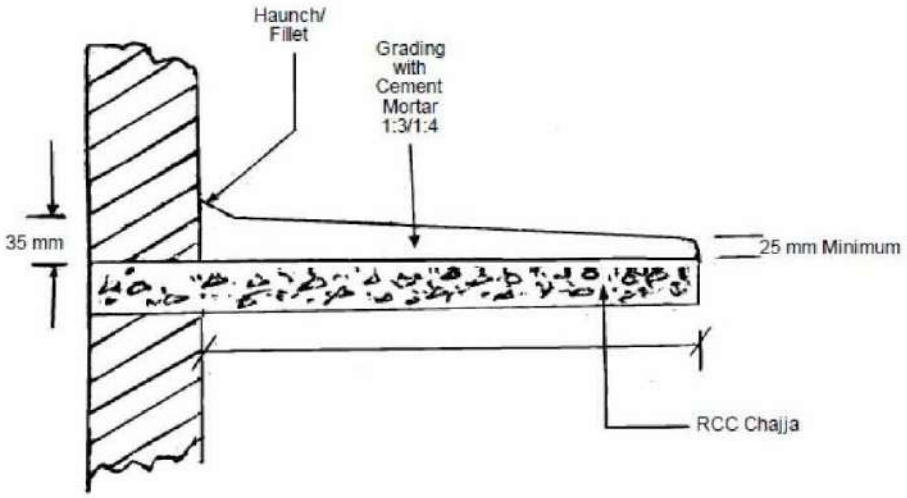


Fig. : Grading Chajja with Cement Mortar 1:3/1:4

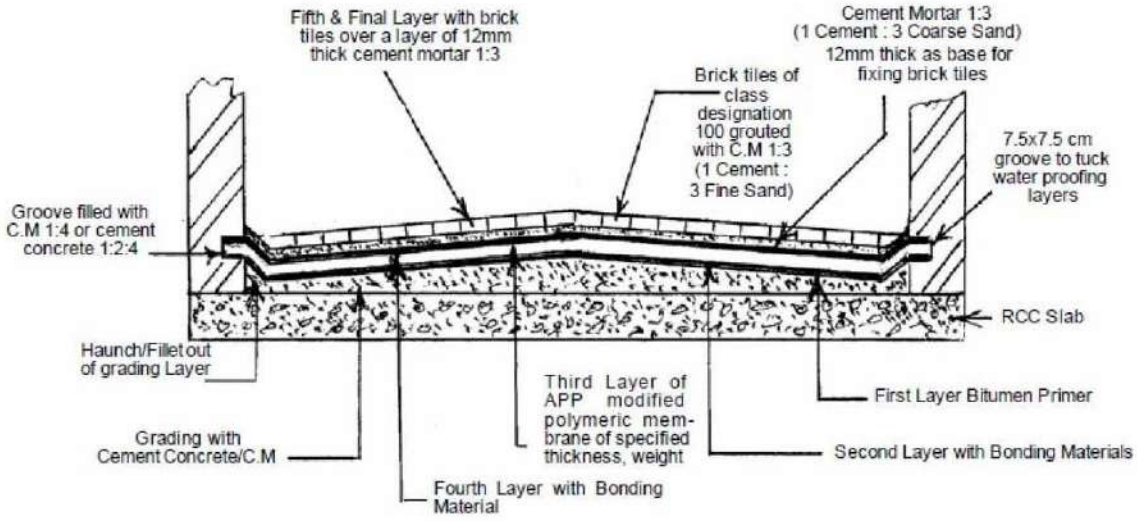


Fig. : Five Course Water Proofing Treatment with APP Modified Polymeric Membrane

Sub Head : Water Proofing Treatment

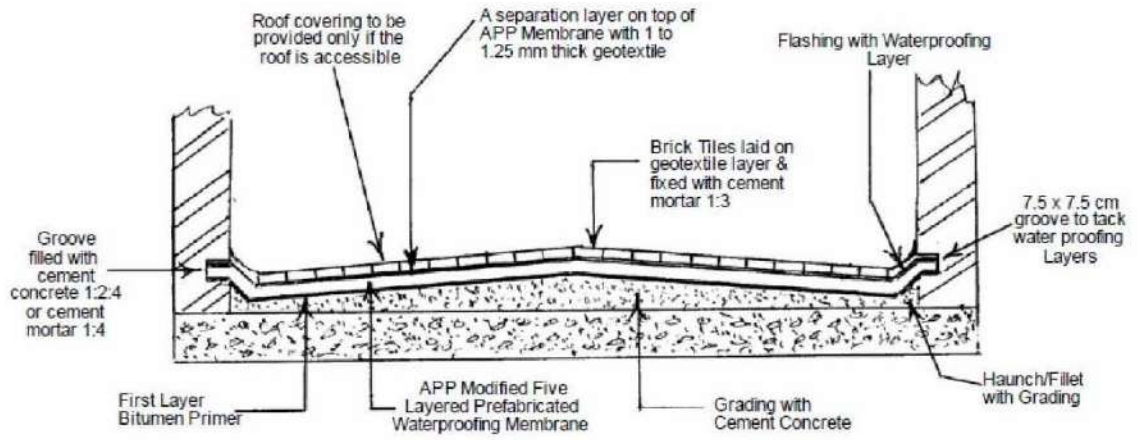


Fig. : Five Layers Water-Proofing Treatment with APP Modified Prefabricated Membrane

Chapter -7

Painting

1. SCOPE

1.1 This specification covers the general requirements for building works comprising painting and such other related works forming a part of this job, which may be required to be carried out though not specifically mentioned above. The works under this specification shall consist of furnishing of all tools, plants, labour, materials, and everything necessary for carrying out the works.

1.2 This specification also covers the general requirements for shop and field painting for Structural Steel works using hot /cold rolled steel sections joined by using bolting and/or welding.

1.2.1 Briefly the scope of works covered under this specification are;

i. Supply of all primers, paints and all other materials required for painting other than Owner's supply.

ii. Furnishing of all labour, materials, tools & equipment and the performance of all operations and incidentals necessary for surface preparation, painting, handling, storing, transporting, scaffolding, etc.

iii. Testing of paints as per the relevant codes in the Standard Laboratory identified by the Owner and furnishing of required test certificates for Owner's approval.

iv. Repair work of damaged / pre-erection / fabrication shop primer and weld joints at field.

v. Inspection of painting system after its application to conform to the specification requirement.

vi. Any other requirement as required for satisfactory completion of specified work.

1.2.2 Reference shall be made to Data Sheet for Paint system for the structures covered in the scope of works.

1.3 EXCLUSIONS:

This specification excludes paintings of the following structures /equipment, Mechanical & electrical equipment and parts.

a) Buried & Overhead piping works
b) Storage tanks
c) Insulated parts
d) Any other items of work specifically excluded in the scope of works.

2. GENERAL

2.1. The following codes, standards and specifications are made a part of this specification. All standards, specifications, codes of practice referred to herein shall be the latest version on the date of offer made by the Bidder.

In case of discrepancy between this specification and those referred to herein, this specification shall govern.

2.2. INDIAN CODES:

IS:110	-	Ready mixed paint, brushing, grey filler, for enamels for use over primers.
IS:337	-	Varnish, finishing interior.
IS:419	-	Specification for putty for use on window frames.
IS:426	-	Paste filler for colour coats.
IS:427	-	Distemper, Dry, colour as required.
IS:428	-	Distemper, oil emulsion, colour as required.
IS:1200 (Part XIII)	-	Method of measurement of building and civil engineering works. White Washing, Colour Washing Distempering and Painting of Building Surfaces.
IS:1200 (Part XV)	-	Method of measurement of building and civil engineering works. Painting, Polishing, Varnishing etc.
IS:2074	-	Ready mixed paint, air drying, red oxide-zinc chrome, priming.
IS:2339	-	Aluminum paint for general purposes, in dual container.
IS:2645	-	Specification of integral cement water-proofing compounds.
IS:2750	-	Specification for steel scaffoldings.
IS:2932	-	Specification for enamel, synthetic, exterior type (a) Undercoating, (b) Finishing.
IS:3536	-	Specification for ready mixed paint, brushing, wood primer, pink.

IS:3696	-	Safety code of scaffolds and ladders (Part 1).
IS:3696	-	-DO- (Part 2).
IS:5410	-	Cement paint, colour as required.
IS:5411	-	Specification for plastic emulsion paint (Part 1).
IS:5411	-	-DO- (Part 2)
IS:6278	-	Code of Practice For White Washing and Colour Washing.
IS:8042	-	Specification for white Portland cement.
IS:5	-	Colours for ready mixed paints and Enamels
IS:101	-	Methods of sampling and test for paints, varnishes and related products (all parts & all sections).
IS:104	-	Ready mixed paint, brushing, zinc chrome, priming
IS:158	-	Ready Mixed paint, Brushing, Bituminous, Black, Lead free, Acid, Alkali and heat resisting.
IS:1303	-	Glossary of Terms relating to paints
IS:1477	-	Code of practice for painting of ferrous metals in Buildings.
IS:2932	-	Enamel, synthetic, exterior:(a) undercoating (b) finishing-Specification
IS: 9954	-	Pictorial Surface Preparation Standards for Painting of Steel Surfaces.
IS:13183	-	Aluminium paint, Heat resistant-specification.
IS:3698 (Part I)	-	Safety code for Scaffolds.
IS:3698 (Part II)	-	Safety code for Ladders.

2.3. INTERNATIONAL CODES:

i.	SSPC	Society for Protective Coatings (USA) Volt I & II
ii.	NACE	National Association of Corrosion Engineers, USA (NACE)
iii.	ISO 8501	Preparation of Steel Substrates before application of paints and related products. Visual assessment of surface cleanliness.(Part 1&2)
iv.	ISO 8502	Preparation of Steel Substrates before application of paints and related products-Tests for assessment of surface cleanliness .(Part 1-4)
v.	ISO 8503	Preparation of Steel Substrates before application of paints and related products-Surface roughness characteristics of blast-cleaned steel substrates. Part 1& 2
vi.	ISO 8504	Preparation of Steel Substrates before application of paints and related products-Surface preparation methods Part 1-3
vii.	ISO 12944	Paints & Varnishes-Corrosion Protection of Steel Structures by Protective Paint System

3. MATERIALS

Oil bound distemper shall conform to IS: 428. The primer shall be alkali resistant primer of the same manufacture as that of the distemper. Cement paint shall conform to IS: 5410. The primer shall be a thinned coat of cement paint. Acrylic emulsion paint shall be of an approved manufacture. Plastic emulsion paint shall conform to IS: 5411. Lead free acid, alkali and chlorine resisting paint shall conform to IS: 9862. All the materials shall be of the best quality from an approved manufacturer. CONTRACTOR shall obtain prior approval of the ENGINEER for the brand of manufacture and the colour / shade. All materials shall be brought to the site of works in sealed containers.

Paints, oils varnishes etc. of approved brand and manufacture shall be used. Ready Mixed paints as recovered from the manufacturer without any admixture shall be used.

If for any reason, thinning is necessary in case of ready mixed paint, the brand of thinner recommended by the manufacturer or as instructed by the Engineer-in-charge shall be used. Approved paints, oils or varnishes shall be brought to the site of work by the contractor in their original containers in sealed condition. The materials shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnights work. The materials shall be kept

in the joint custody of the contractor and the Engineer-in-charge. The empties shall not be removed from the site for work, till the relevant item of work has been completed and permission obtained from the Engineer-in-charge.

The contractor shall associate the chemist of paint manufacturers before commencement of work, during and after the completion of work who shall certify the suitability of the surface to receive painting and the paint before use etc.

4. COMMENCING WORK

4.1. SCAFFOLDING

Wherever scaffolding is necessary, it shall be erected on double supports ties together by horizontal pieces, over which scaffolding planks shall be fixed. No bellies, bamboos or planks shall rest on or touch the surface which is being painted. Where ladders are used, pieces of old gunny bags shall be ties on their tops to avoid damage or scratches to walls. For painting of the ceiling, proper stage scaffolding shall be erected. Painting shall not be started until and unless the Engineer-in-charge has inspected the items of work to be painted, satisfied himself about their proper quality and given his approval to commence the painting work. Painting, except the priming coat, shall generally be taken in hand after all other builders work, practically finished. The rooms should be thoroughly swept out entire building cleaned up at least one day in advance of the paint work being started.

4.2. PREPERATION OF SURFACE

4.2.1. CONTRACTOR shall obtain the approval of the Engineer-in-charge regarding the readiness of the surfaces to receive the specified finish, before commencing the work on painting.

4.2.2. Painting of new surfaces shall be deferred as much as possible to allow for thorough drying of the sub-strata.

4.2.3. The surfaces to be treated shall be prepared by thoroughly brushing them free from dirt, mortar droppings and any loose foreign materials. Surfaces shall be free from oil, grease and efflorescence. Efflorescence shall be removed only by dry brushing of the growth. Cracks shall be filled with Gypsum or in C.M. as specified in respective item at no extra cost to the Municipal Corporation of Greater Mumbai. Workmanship of painting shall generally conform to IS: 2395.

4.2.4. Surfaces of doors, windows etc. shall be protected suitably to prevent paint finishes from splashing on them.

4.3.WORKMANSHIP

4.3.1. WHITE WASH

The prepared surfaces shall be wetted and the finish applied by brushing. The operation for each coat shall consist of a stroke of the brush first given horizontally from the right and the other from the left and similarly, the subsequent stroke from bottom upwards and the other from top downwards, before the first coat dries. Each coat shall be allowed to dry before the next coat is applied. Minimum of two coats shall be applied unless otherwise specified in the item of work. The dry surface shall present a uniform finish without any brush marks

4.3.2. COLOUR WASH

Colour wash shall be applied in the same way as for white wash. A minimum of two coats shall be applied unless otherwise specified in the item of work. The surface shall present a smooth and uniform finish without any streaks. The finished dry surface shall not show any signs of peeling/powdery and come off readily on the hand when rubbed.

4.3.3. CEMENT PAINT

The prepared surfaces shall be wetted to control surface suction and to provide moisture to aid in proper curing of the paint. Cement paint shall be applied with a brush with stiff bristles. The primer coat shall be a thinned coat of cement paint. The quantity of thinner shall be as per manufacturer's instructions. The coats shall be vigorously scrubbed to work the paint into any voids for providing a continuous paint film free from pinholes for effective water- proofing in addition to decoration. Cement paint shall be brushed in uniform thickness and the covering capacity for two coats on plastered surfaces shall be 3 to 4 kg/sq.m. A minimum of 2 coats of the same colour shall be applied unless otherwise specified in the item of work. At least 24 hours shall be left after the first coat to become sufficiently hard before the second coat is applied. The painted surfaces shall be thoroughly cured by sprinkling with water using a fog spray at least 2 to 3 times a day. Curing shall commence after about 12 hours when the paint hardens. Curing shall be continued for at least 2 days after the application of final coat. The operations for brushing each coat shall be as detailed in 3.3.1.

4.3.4.OIL BOUND DISTEMPER

The prepared surfaces shall be dry and provided with one coat of alkali resistant primer by brushing. The surface shall be finished uniformly without leaving any brush marks and allowed to dry for at least 48 hours. A minimum of two coats of oil bound distemper shall be applied unless otherwise specified in the item of work. The first coat shall be of a lighter tint. At least 24 hours shall be left after the first coat to become completely dry before the application of the second coat. Broad, stiff, double bristled distemper brushes shall be used for the work. The operations for brushing each coat shall be as detailed in 3.3.1.

4.3.5.SYNTHETIC ENAMEL PAINT (OIL PAINT)

4.3.5.1. **Plastered Surface:** The prepared surface shall be dry and provided with one coat of primer which shall be a thinned coat of enamel paint. The quantity of thinner shall be as per manufacturer's instructions. The paint shall be laid an evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area with paint, brushing the surface hard for the first time over and then brushing alternately in opposite directions two or three times and then finally brushing lightly in a direction at right angles. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off constitutes one coat. The next coat shall be applied only after the first coat has dried and sufficiently become hard which normally takes about 2 to 3 hours. A minimum of 2 finishing coats of the same colour shall be applied unless otherwise specified in the item of work. Paint may also be applied using rollers. The surface on finishing shall present a flat velvety smooth finish and uniform in shade without any patches.

4.3.5.2. **Iron & steel work:** All the rust and scales shall be removed by scrapping or by brushing with steel wire brushes. Hard skin of oxide formed on the surface of wrought iron during rolling which becomes loose by rusting shall be removed. A coat of red oxide shall be applied before primer coat. The Primer and other coats shall be applied as per item description.

4.3.6.PLASTIC EMULSION PAINT

The prepared surface shall be dry and provided with one coat of primer which shall be a thinned coat of emulsion paint. The other procedure of the painting shall be same as specified in 4.3.5.1.

4.3.7.ACRYLIIC EMULSION PAINT

Acrylic emulsion paint shall be applied in the same way as for plastic emulsion paint. The minimum of 2 finishing coats over one coat of primer shall be provided unless otherwise specified in the item of work.

4.3.8.ACID, ALKALI RESISTING PAINT

A minimum of 2 coats of acid/alkali resisting paint shall be applied over the prepared dry surfaces by brushing. Primer coat shall be as per manufacturer's instructions.

4.4.MEASUREMENT

Measurement shall be in sq.m or running meters correct to two places of decimal as specified in the item description. Measurement shall be for the areas as executed duly deducting the opening as per I.S. 1200 for the openings etc. In measuring painting, the modified payable areas shall be as per table 1. The coefficients shall be applied measured flat and not girthed in all cases. Rate quoted shall take into account the provision of necessary enabling works such as scaffolding, painter's cradle etc and post painting cleaning work.

5. PAINTING AND POLISHING OF WOOD WORK

5.1. MATERIALS

5.1.1.Wood primer shall conform to IS:3536E.

5.1.2. Filler shall conform to IS:110 or IS 345.

5.1.3. Varnish shall conform to IS:337.

5.1.4. French polish shall conform to IS:348.

5.1.5. Synthetic enamel paint shall conform to IS:2932.

5.1.6. All the materials shall be of the best quality from an approved manufacturer. CONTRACTCOR shall obtain prior approval of the Engineer-in-charge for the brand of manufacture and the colour/shade. All materials shall be brought to the site of works in sealed containers.

5.2.WORKMANSHIP

5.2.1. The type of finish to be provided for woodwork, (either painting or polishing) the number of coats, etc. shall be as specified in the respective items of work.

5.2.2. Primer and finish paint shall be compatible with each other to avoid, cracking and wrinkling. Primer and finish paint shall be from the same manufacturer.

5.2.3. Painting shall be either by brushing or spraying. CONTRACTOR shall procure the appropriate quality of paint for this purpose as recommended by the manufacturer. The workmanship shall generally conform to the requirements of IS:2338 (Part I).

5.2.4. All the wood surfaces to be painted shall be thoroughly dry and free from any foreign matter. Surfaces shall be smoothened with abrasive paper using it across the grains and dusted off. Wood primer coat shall then be applied uniformly by brushing. The number of primer coats shall be as specified in the item of work. Stopping as per IS 426 shall be used to fill up large holes & cracks on the surface. For small holes or minor cracks, fillers as per IS 110 should be used. Any slight irregularities of the surface shall then be made up by applying an optimum coat of filler conforming to IS:110 and rubbed down with an abrasive paper for obtaining a smooth surface for the

undercoat of synthetic enamel paint conforming to IS:2932. Paint shall be applied by brushing evenly and smoothly by means of crossing and laying off in the direction of the grain of wood. After drying, the coat shall be carefully rubbed down using very fine grade of sand paper and wiped clean before the next coat of finishing is applied. At least 24 hours shall elapse between the applications of successive coats. Each coat shall vary slightly in shade and this shall be got approved by the Engineer-in-charge. The number of coats of paint to be applied shall be as specified in the item of work.

5.2.5. All the wood surfaces to be provided with clear finishes shall be thoroughly dry and free from any foreign matter. Surfaces shall be smoothened with abrasive paper using it in the direction of the grains and dusted off.

Any slight irregularities of the surface shall be made up by applying an optimum coat of transparent liquid filler conforming to IS 345. The Surface when hard shall be rubbed down with fine abrasive paper. All dust and dirt shall be cleaned and on this surface water or spirit stains shall be applied to enhance the natural grain or figuring effect of wood. After the surface is dry, a suitable sealer shall be applied to prevent bleeding of stain and filler into the finish coat. The surface shall be rubbed down lightly, wiped off and allowed to dry. Over this prepared surface, varnish conforming to IS: 337 shall be applied by brushing. Varnish should not be retouched once it has begun to set. Staining if required shall be provided as directed by the Engineer-in-charge. When two coats of varnish is specified, the first coat should be a hard-drying undercoat or flatting varnish which shall be allowed to dry hard before applying the finishing coat. The number of coats to be applied shall be as per the item of work. For works where clear finish of French polish is specified the prepared surfaces of wood shall be applied with the polish using a pad of woolen cloth covered by a fine cloth. The pad shall be moistened with polish and rubbed hard and the surface in a series of overlapping circles to give an even finish over the entire area. The surface shall be allowed to dry before applying the next coat. Finishing shall be carried out using a fresh clean cloth over the pad, slight dampening with methylated spirit and rubbing lightly and quickly in circular motions. The finished surface shall have a uniform texture and high gloss. The number of coats to be applied shall be as per the item of work.

5.3.MEASUREMENT

Measurement shall be in sq.m correct to two places of decimal. Measurement shall be for the areas as executed duly deducting the opening as per I.S. 1200 for the openings etc. In the painting measurements, the modified payable areas shall be as per table 1. The coefficients shall be applied measured flat and not girthed in all cases. Measurement and payment is

applicable only if a separate item is specified and not if it is already made as part of a combined item. Rate quoted shall take into account the provision of necessary enabling works such as scaffolding, painter's cradle etc and post painting cleaning work.

6. PAINTING OF STRUCTURAL STEEL WORK

6.1. HEALTH, SAFETY AND REGULATORY REQUIREMENTS

6.1.1. The work covered in this specification, shall comply with all relevant government and local laws, regulations and standards. For subjects not covered by regulations, codes, standards or specifications, the materials and construction shall be based on good engineering practice, subject to approval by Owner.

6.1.2. Contractor shall ensure that all health and safety regulations are observed for the erection of scaffolding and use of the selected paint material.

6.1.3. All necessary precautions shall be taken to ensure the safety of personal and property. Extreme caution shall be used when working with oil or oil-based paints, cleaning fluids etc., especially in close proximity to oxygen piping or oxygen equipment. Heavy concentrations of volatile or toxic fumes must be avoided and in confined areas, blowers or exhaust fans shall be used.

6.1.4. Rags and other waste material soiled with paints, thinners or solvents shall be kept in tightly closed metal containers while on the jobsite and not in use. Legal disposal of waste materials outside plant site premises is Contractor’s responsibility

6.2. SURFACE PREPARATION OF STEEL

One or more of the following methods of surface preparation shall be followed, depending on condition of steel surface and as specified data sheet. Engineer reserve the right to instruct the type of surface preparation depending upon the condition of material. Recommended methods of surface preparation of steel briefly are as under.

a) Solvent Cleaning.
b) Manual or hand tool cleaning
c) Mechanical or power tool cleaning.
d) Abrasive Blast cleaning.

It is necessary that the Contractor may have to resort to any one or combination of the above method of surface preparation to achieve the required acceptable standard. Hence the rate quoted shall take into account for such preparation.

6.2.1. SOLVENT CLEANING

All contaminants like oil, grease removal shall be carried out either by special solvents or by degreasing agents. Application and cleaning of solvents shall be as per manufacturer's instructions and shall be in accordance with SSPC-SP1.

6.2.2.MANUAL OR HAND TOOL CLEANING

This method of cleaning shall be used to remove all loose mill scale, loose rust, loose paint and other loose detrimental foreign matter by use of non-powered hand tools. The minimum acceptable standards in case of manual or hand tool cleaning shall be in accordance with ISO 8501- St2 / SSPC-SP2.

6.2.3.MECHANICAL OR POWER TOOL CLEANING

This method of cleaning shall be used to remove all mill scale, rust, paint and other detrimental foreign matter by use of power assisted hand tools. The minimum acceptable standards in case of power tool cleaning shall be in accordance with ISO 8501- St3 / SSPC-SP3.

6.2.4.ABRASIVE BLAST CLEANING (SHOT BLASTING / GRIT BLASTING)

6.2.4.1. Shot / Grit blasting shall be resorted to only after removal of grease, oil and other contaminants as per SP-1. Special care shall be taken on weld areas to remove flux and spatter. Precautions shall be taken when grit or shot blasting of light gauge steel surfaces, to ensure that buckling does not occur due to continuous impingement of grit or steel shots under high velocity. Surface anchor profiles shall be measured by Testex tape – press-o-film and the finished surfaces shall conform to the requirements of ISO 8501- Sa 2½ / SSPC-SP10.

6.2.4.2. Blast cleaning shall not be performed where dust can contaminate surfaces undergoing such cleaning or during humid weather conditions having humidity exceeding 85%.

6.2.5.TESTS ON SURFACE PREPARATIONS:

The following inspection and tests shall be performed on the steel surfaces subjected to surface preparation. Test / inspection reports shall be submitted to Engineer for his approval and acceptance.

i. Visual examination of surface preparation with comparators.
ii. Profile check of the prepared surface with suitable "profilometer "eg.TESTEX method.

6.3.PAINT MATERIAL

6.3.1.PROCUREMENT:

All types of paint required for the work shall be procured from the reputed manufacturers. Contractor shall obtain the detailed list of approved paint manufacturers from the Engineer before initiating the procurement action.

6.3.2.STORAGE

The Paint material shall be stored strictly in accordance with the instructions of the paint manufacture. In general painting materials should be stored in dry, cool, well ventilated and frost free area.

6.3.3.PACKING

All paints delivered to the fabrication shop / site shall be in original sealed container, as packed by the manufacturer. Paint containers shall clearly mark with paint manufacturer's name, batch number, date of manufacture, shelf life and a clear indication of the type and colour of the product.

6.3.4.MIXING

Paint shall be thoroughly mixed prior to application. Mixing shall be done in a well-ventilated, clean and dust -free area. Paint shall be mixed by rotating power mixers or rolling rigs, until a uniform consistency is achieved.

Multiple pack paint materials shall be mixed in accordance and under the conditions as specified by the paint manufacturer. Pot life as specified by the paint manufacturer shall be strictly followed.

6.3.5.THINNER AND SOLVENTS;

Only additives, thinners, solvent etc as recommended by the paint manufacturer shall be used. A possible extension of the "pot life" by additions of thinners is prohibited.

6.3.6.TESTS ON PAINT:

In order to ensure that the supplied paint meets the stipulations, samples of paint shall be tested in laboratories to establish quality of paint with respect to

i. Viscosity
ii. Adhesion/ bond of paint in steel surfaces
iii. Adhesion / simulated salt spray test
iv. Chemical analysis (percentage of solids by weight)
v. Normal wear resistance as encountered during handling & erection
vi. Resistance against exposure to acid fumes etc.

Alternatively manufacturer's test certificates shall be furnished by the Painting Contractor in respect of above tests for Engineer's approval and acceptance. Engineer reserves the right

to test the paint material either before the commencement of work or during the progress of work if in his opinion the paints supplied are of inferior quality and does not meet the codal requirements.

6.3.7.PAINT SAMPLE

Before buying the paint in bulk, it is recommended to obtain sample of paint and establish “Control Area of Painting”. On control area surface preparation, painting shall be carried out in the presence of Engineer and the Manufacturer of paint.

6.3.8.FINISHING PAINT

Color /Shade of the finishing paint shall be as per the choice of the Owner and Contractor shall obtain prior approval before procurement action is initiated.

6.4.PAINT APPLICATION:

Painting shall be carried out by any one or the combination of the following method of application to suit the site condition and the type of paint being used. Manufacturer’s recommended method of application shall be strictly followed.

i. Brush Application.
ii. Roller Application.
iii. Spray Application.

6.4.1.BRUSH APPLICATION:

Brush application of paint shall be in accordance with the following.

i. Brushes shall be of a style and quality that will enable proper application of paint
ii. Round, Oval or Wide flat brushes shall be used depending upon the surface irregularity, rough or pitted steel, large flat painting areas etc
iii. There shall be a minimum of brush marks left in the applied paint.
iv. Surfaces not accessible to brushes shall be painted by spray.

6.4.2.ROLLER APPLICATION

Suitable rollers of different nap length to suit varying surface roughness shall be used. Rollers are not generally recommended for application of primers. Roller application shall only be used if the first or priming coat of paint has been applied by brush or other means. Manufacturer’s recommendation shall be strictly followed for roller applied paints.

6.4.3.SPRAY APPLICATION:

6.4.3.1. Airless or pneumatic spray application shall be in accordance with the following

i. Airless spray application shall be as per steel structure paint Manual Vol 1 & Vol 2 SSPC, USA.

ii. Spraying shall be carried out keeping the spray gun at the minimum suitable distance from the work piece and consistently at 90 ^{0} to the surface being painted.

iii. Correct spray tips, air pressures etc as recommended by the equipment supplier shall be used.

6.4.3.2. Air spray application shall be in accordance with the following:

i. The equipment used shall be suitable for the intended purpose, shall be capable of properly atomizing the paint to be applied, and shall be equipped with suitable pressure regulators and gauges.

ii. Appropriate pressure and nozzles shall be those recommended by the manufacturer of the equipment for the material being sprayed. The equipment shall be kept in satisfactory condition to permit proper paint application.

iii. Correct combination of air volume, air pressure and fluid flow to give good atomization shall be ensured to get a defect free painted surface.

iv. Traps or separators shall be provided to remove oil and condensed water from the air. These traps or separators must be of adequate size and must be drained periodically during operations. The air from the spray gun impinging against the surface shall show no condensed water or oil.

v. Ingredients shall be kept properly mixed in the spray pots or containers during application by continuous mechanical agitation.

vi. Spray equipment shall be kept sufficiently clean so that dirt, dried paint and other foreign materials are not deposited in the paint film. Any solvents left in the equipment shall be completely removed before applying paint to the surface being painted.

5.4.3.3 Selection of type of spray application shall depend upon the type of paint coating being used. At all time paint manufacturer's recommendation shall be strictly followed.

6.5.COATING PROCEDURE

6.5.1.COMPATIBILITY

General Compatibility between primer, intermediate and top coats, as applicable for individual painting system shall be established through the paint manufacturer supplying the paints. Primer and finishing paint for the entire project shall preferably be procured from the same manufacturer. Mixing of material from different manufacturers is strictly prohibited

6.5.2.Surface shall not be coated in rain, wind, when steel surface temperature is less than 5^{0} C, or when the relative humidity is greater than 85%.

6.5.3.Applied paint system shall be allowed to cure at ambient and surface temperatures between 10 ° C and 60 ° C with relative humidity below 85%. All paint shall be air curing.

6.5.4.A suitable test area (approx 0.5 $m^{2)}$ shall be painted with agreed paint system. The test area shall be fully coated with all coats of the agreed coating system using the tools and equipment to be used for the actual coating work. The painted test area shall be maintained for the duration of the project. Painting on test piece shall be carried out such that all the coats shall be made visible for reference at all time.

6.5.5.Structural steel shall be preferably prime coated at shop and subsequent finish coats shall be carried out at site after the alignment and erection is complete. Portions of structural steel members to be embedded into the concrete shall not be painted.

6.5.6.Surfaces inaccessible after assembly shall receive two coats of primer prior to assembly.

6.5.7.Surfaces inaccessible after erection, including top surfaces of floor beams supporting grating / chequered plate /RC Slabs shall receive one additional coat of finish paint over and above the number of coats specified prior to erection.

6.5.8.Each coat of paint material shall be applied as continuous film uniform thickness free of porous. Any spot or areas missed in application shall be recoated and permitted to dry before the next coat is applied. Applied paint should have the desired wet film thickness.

6.5.9.Each coat shall be in proper state of cure or dryness before the application of succeeding coat. Material shall be considered dry for recoating when an additional coat can be applied without development of any detrimental film irregularities, such as lifting or loss of adhesion of the under coat. Manufacturer’s instruction shall be strictly followed for intercoat intervals.

6.5.10.No paint shall be force dried under conditions which will cause checking, wrinkling, blistering formation of pores or detrimentally affect the condition of the paint.

6.5.11.No drier shall be added to paint on the job unless specifically called for in the manufacturer's specification for the paint.

6.5.12.Paint shall be protected from rain, condensation, contamination, snow and freezing until dry to the fullest extent practicable.

6.5.13.Blast cleaned surface shall be coated with one coat of primer before surface degradation occurs but in no case later than 3hrs. Irrespective of the method of surface preparation, the first coat of primer shall be applied not later than 2-3 hours after preparation and on dry surface.

6.5.14.When the successive coat of the same color is specified, alternate coat shall be tinted as far as practicable; sufficiently to produce enough contrast to indicate complete coverage of the surface. The tinting material shall be compatible with the material and not detrimental to its service life.

6.5.15.All field welded areas on shop painted item shall be mechanically cleaned (including the weld area proper, adjacent areas contaminated by weld spatter or fumes and areas where existing primer, intermediate / finishing paint is burnt). Subsequently, new primer and finishing coats of paint shall be applied as per painting specification.

6.5.16.Care shall be taken to protect adjacent equipment, piping, structures etc., from spillage and spatter during field painting by use of adequate temporary covers. If surfaces are accidentally spattered or sprayed, the paint shall be immediately and thoroughly removed. For cleaning of spillages an inert absorbent material shall be used

6.5.17.All structures shall receive appropriate number of primer, intermediate and finishing coats in order to achieve overall DFT as per the drawings / specifications/ data sheets.

6.6.PAINTING SYSTEM

The recommended painting system of all Structural Steel Works covering surface preparation, application of Primer coats, Intermediate coats (if specified) and Final coats to develop required minimum DFT shall be as per DATA SHEET.

6.7.REPAIR OF COATED SURFACE

6.7.1. Wherever shop primer painting is scratched, abraded or damaged, the surfaces shall be thoroughly cleaned using emery paper and power driven wire brush wherever warranted, and touched up with corresponding primer. Touching up paint shall be matched and blended to eliminate conspicuous marks.

6.7.2.If more than 30% area of the painted surface of an item requires repair, the entire surface shall be repainted. In such an event no extra payment will be permitted.

6.8.TEST ON PAINTING SYSTEM

Following inspection and tests shall be performed during and after the application of paint system.

i. Wet film thickness (WFT) spot checks shall be carried out during the course of painting operation to ensure that film thickness is being maintained.
ii. Dry film thickness (DFT) check of intermediate and final coating layers in accordance with the specification and /or paint manufacturer's recommendation.
iii. Quality of adhesion between the coating system and the steel substrate and of the adhesion between the coatings layers shall not be less than those specified in the Codes / Standards.
iv. Porosity Check: Holiday detection test shall be carried out and all indications shall be repaired as per approved repair procedures.

6.9.FINAL INSPECTION

6.9.1. As part of the Quality Assurance, a final inspection in the presence of the representatives of Owner and Contractor shall be conducted prior to the final acceptance of the paintwork. Part of this final inspection checks shall be carried as follows.

i. Visual check of the appearance
ii. Checks on DFT's of the total applied coating system
iii. Shade verification
iv. Holiday Testing
v. Scratch Test
vi. Adhesion test.

6.9.2. As part of acceptance procedure, a report shall be prepared that shall include:

i. General:
- Names of the Painting Contractor and the responsible personal
- Scope of work
- Dates when the work was carried out.
- Copy of the work and quality plan
- Deviations from this Specification and/or the quality plan.

ii. Inspection equipment

- Type and calibration of instruments used.

iii. Surface Preparation
- Condition of surface before preparation
- Checks on the requirements as specified for cleaned surface.

iv. Coating application
- Information on coating systems being applied (i.e. product names, DFT's)
- Checks on requirements as specified for coating application
- Check on dry film thicknesses of the total coating system applied

v. Conditions
- Checks on humidity, dew point and substrate temperature.

vi. Inspection reports
- Copy of the inspection reports of the Contractor
- Inspection from an independent third party

6.10.DOCUMENTATION

Contractor shall keep records and furnish the following documents to the Owner

i. A written quality plan with procedure for qualification trials and for the actual work
ii. Daily progress report with details of weather conditions, particular of applications, number of coats and type of material applied, anomalies, progress of work versus program,
iii. Results of measurement of temperatures relative humidity, surface profile, film thickness, holiday detection, adhesion tests with signature of appropriate authority.
iv. Particulars of surface preparation and paint application during trials and during the work.
v. Details of non-compliance, rejects and repairs.
vi. Type of testing equipments and calibration.
vii. Code and batch numbers of paint materials used including shelf life.
viii. Visual examination of surface preparation compared with the standards.
ix. Profile check of the prepared surface with suitable "profilometer.
x. Dry film thickness check of intermediate and final coating layers, in accordance with the specification and/or paint manufacturer's recommendation
xi. Checks/ tests carried out as per clauses above.

6.11.GUARANTEE

6.11.1.The paint system shall provide sufficient protection of the underlying steel surface against the attack of the environment, other than mechanical damage, chemical

spillage as result of operational activities or other unusual occurrences from the outside caused by others.

6.11.2.The Contractor is fully responsible for the quality of the work and for all related QA/QC activities as indicated in the specification.

6.11.3.The Contractor shall guarantee quality of their coating works for the period specified in Data Sheet-B and for the coating condition as specified below.,

6.11.4.The guarantee period starts from the date of acceptance of Contractor's paint work.

6.11.5.Initial acceptance of any new coating work by Owner will not release the Contractor of his obligation under this section until final inspection has been carried out and acceptance of the completed work has been agreed in writing.

6.11.6.These guarantee clauses regarding coating specifications are prevailing and supersede the warrantee requirements in General Conditions of Contract.

6.12.MEASUREMENT

6.12.1.Painting work shall not be measured separately, if primer painting and/or primer and finish painting are already included in the scope of the item of work of fabrication and erection of structural steel since the rate per ton of steel is deemed to include for painting as specified.

In cases where primer and/or finish painting work as specified is carried out on erected structural steel executed by a different agency, the method of measurement for painting shall be on the basis of tonnage of the steel erected. For this purpose, the tonnage of erected steel as certified for payment to the different agency shall be considered as the basis and no measurement will be carried out separately.

7. TABLE 1

Sr. No.	Description of Surfaces to be paint	How to measure	Multiplying coefficients.
A) General Works			
1	Corrugated iron sheet in roof & side cladding	Measure flat (Not girthed)	1.14 (On painted surface)
2	Semi-corrugated A.C. sheets in roof & side cladding or Nainital pattern roof (Plain sheets with rolls)	Measure flat (Not girthed)	1.10 (On painted surface)
3	Nainital pattern roof with corrugated sheets	Measure flat (Not girthed)	1.25 (On painted surface)
4	Corrugated A.C. sheets in roof & side cladding	Measure flat (Not girthed)	1.20 (On painted surface)
5	External wall of palin brickwork faced with recessed, raised or weather stuck pointing	Measure flat	1.20 (On painted surface)
6	Sand faced plaster with up to 4mm size	Measure flat	1.50 (On painted surface)
7	Rough cast with stone aggregate upto 10mm	Measure flat	2.0 (On painted surface)
8	Pebble dash finish beyond 10mm	Measure flat	2.75 (On painted surface)
9	Sponge finished plaster	Measure flat	1.25 (On painted surface)
10	RCC Jalies- For painting of one side	Measure flat	1.00 (On painted surface)
11	RCC Jalies- For painting of one side and inside (i.e. through the thickness)	Measure flat	1.50 (On painted surface)
12	RCC Jalies- For painting of both side and inside (i.e. through the thickness)	Measure flat	2.00 (For painting all over)
B) Door, Window, grill, railing & gate Works			
1	Panelled or framed and braced or ledged and battened or ledged, battened and braced joinery	Measured flat (not girthed) including frame. Edges, chocks, cleats, etc. shall be deemed to be included in the item.	1.30 (for each side)

Sr. No.	Description of Surfaces to be paint	How to measure	Multiplying coefficients.
2	Flush joinery	----- Do ----	1.20 (for each side)
3	Flush shutter	Measured flat overall	1.20 (for each side)
4	Fully glazed or gauzed joinery	Measured flat (not girthed) including frame. Edges, chocks, cleats, etc. shall be deemed to be included in the item.	0.80 (for each side)
5	Partly panelled and partly glazed or gauzed joinery	Measured flat (not girthed) including frame. Edges, chocks, cleats, etc. shall be deemed to be included in the item.	1.0 (for each side)
6	Fully venetianed or louvered joinery	Measured flat (not girthed) including frame. Edges, chocks, cleats, etc. shall be deemed to be included in the item.	1.8 (for each side)
7	Weather boarding	Measured flat (not girthed) supporting framework shall not be measured separately.	1.2 (for each side)
8	Wood shingle roofing	Measured flat (not girthed)	1.1 (for each side)
9	Boarding with cover fillets and match boarding	Measured flat (not girthed)	1.05 (for each side)
10	Tile and slate battening	Measured flat overall; no deduction shall be made for open spaces.	0.8 (for painting all over)
11	Trellis or Jaffri work one way or two way	Measured flat overall; no deduction shall be made for open spaces; supporting members shall not be measured separately.	2.0 (for painting all over)
12	Guard bars, balustrades, gates, gratings, grills, expanded metal and railings.	Measured flat overall; no deduction shall be made for open spaces; supporting members shall not be measured separately.	1.0 (for painting all over)
13	Gates and open palisade fencing including standards, braces, rails, stays, etc.	Measured flat overall; no deduction shall be made for open spaces; supporting members shall not be measured separately.(see note 1)	1.0 (for painting all over)
14	Carved or enriched work	Measured flat	2.0 (for each side)
15	Steel roller shutters	Measured flat (size of opening) overall; jamb, guides, bottom rails and locking arrangement, etc. shall be included in the item (Top cover shall be measured separately)	1.1 (for each side)
16	Plain sheet doors and windows	Measured flat (not girthed) including frame. Edges, etc.	1.1 (for each side)
17	Fully glazed or gauzed steel doors	Measured flat (not girthed) including frame. Edges, etc.	0.5 (for each side)

Sr. No.	Description of Surfaces to be paint	How to measure	Multiplying coefficients.
	and windows		
18	Partially paneled and partially glazed or gauzed steel doors.	Measured flat (not girthed) including frame. Edges, etc.	0.8 (for each side)
19	Collapsible gate	Measured flat (size of opening)	1.5 (for painting all over)

Notes:

1) The height shall be taken from bottom of lowest rail, if palisades, do not go below it or from lower end of palisades, if they project below lowest rail, up to top of palisades, but not up to top of standards if they are higher than palisades.

2) Where doors, windows, etc. are of composite types other than those included in this table, different portions shall be measured separately with their appropriate coefficients, center line of common rail being taken as the dividing line between the two portions.

3) Measurement of painting of doors, window, collapsible gates, rolling shutters, etc. as given in this table shall be deemed to include painting, if required, of all iron fittings in the same table.

4) When two faces of doors, window etc. are to be treated with different specified finishes, measurable under separate items, edges of frames and shutters shall be treated with the one or the other type of finish and measurement thereof shall be deemed to be included in the measurement of the face treated with that finish.

5) In case where shutters are fixed on both faces of a frame, measurement for the door frame and shutter on the face shall be taken in the manner already described, while the additional shutter on the other face shall be measured exclusive of the frame.

6) Where shutter is provided with clearance exceeding 15cm at top and/or at bottom, such openings shall be deducted from the overall measurement and relevant coefficients applied.

7) Painting of rain water, soil, waste, vent and water pipes etc. shall be measured in running meters of the particular diameter of the pipe concerned. Painting of specials such as bends, heads, branches, junctions, shoes etc. shall be included in the length and no separate measurement shall be taken for these or for painting brackets, clamps etc.

8) No deduction shall be made for opening not exceeding 0.05 Sqmt and no addition shall be made for painting to the beading, molding, edges, jambs, soffits, sills, architraves etc. of such openings.

9) In case of painting of door shutters with push plates in plastic laminates, deductions shall be made for the area of such laminates.

8. PRECAUTION:

All furniture, lightings, fixtures, sanitary fittings, glazing, floors etc. shall be protected by covering and stains, smears, splashing, if any shall be removed and any damage done shall be made good by the contractor at his cost.

9. DATA SHEET:

Paint System	Surface Preparation	Primer Coat (µm)	Intermediate Coat (µm)	Top Coat (µm)	Dft (µm)
PS-1	St-2	Inorganic Zinc Phosphate		Synthetic Enamel	
		2x35=70		2x25=50	120
PS-2	Sa 2 ½	Inorganic Zinc Silicate		HB Epoxy Polyamide (pigmented)	
		1x75 =75		1x75=75	150
PS-3	Sa 2 ½	Inorganic Zinc Silicate	HB MIO Epoxy	Aromatic Polyurathane Acid Resistant	
		1x75 =75	1x75=75	1x50=50	200
PS-4	Sa 2 ½	Inorganic Zinc Silicate	HB MIO Epoxy	HB Epoxy Polyamide (pigmented)	
		1x75 =75	1x75=75	1x75=75	225
PS-5	Sa 2 ½	Inorganic Zinc Silicate		Aliphatic Polyurathene(UV Resistant)	
		1x75 =75		1x50=50	125
PS-6	Sa 2 ½	Inorganic Zinc Silicate	HB MIO Epoxy	HB Epoxy Polyamide (pigmented)	
		1x75 =75	1x75=75	1x75=75	225
PS-7	Sa 2 ½	Inorganic Zinc Silicate	HB MIO Epoxy	Aromatic Polyurathane Acid Resistant	
		1x75 =75	1x75=75	2x50=100	250
PS-8	Sa 2 ½	Inorganic Zinc Silicate	HB MIO Epoxy	HB Epoxy Polyamide (pigmented)	
		1x75 =75	1x75=75	2x75=150	300
PS-9	Sa 2 ½	Inorganic Zinc Silicate	HB MIO Epoxy	Aliphatic Polyurathene (UV Resistant)	
		1x75 =75	1x75=75	1x50=50	200
PS-10	Sa 2 ½	Inorganic Zinc Silicate	HB MIO Epoxy	HB Epoxy Polyamide (pigmented)	
		1x75 =75	1x75=75	2x75=150	300

Paint System	Surface Preparation	Primer Coat (µm)	Intermediate Coat (µm)	Top Coat (µm)	Dft (µm)
PS-11	Sa 2 ½	Inorganic Zinc Silicate	HB MIO Epoxy	Aromatic Polyurathane Acid Resistant	
		1x75 =75	1x100=100	2x50=100	275
PS-12	Sa 2 ½	Inorganic Zinc Silicate	HB MIO Epoxy	HB Epoxy Polyamide (pigmented)	
		1x75 =75	2x75=150	2x75=150	375
PS-13	Sa 2 ½	Inorganic Zinc Silicate	HB MIO Epoxy	Aliphatic Polyurathene(UV Resistant)	
		1x75 =75	1x75=75	2x50=100	250
PS-14	Sa 2 ½	Inorganic Zinc Silicate or Epoxy Zinc Rich		Heat resistant -Silicon Based aluminum paint	
		1x75=75		1x40=40	115

END.

Chapter -8

Flooring

1. SCOPE

1.1. This specification covers the general requirements for flooring and related works. The works under this specification shall consist of furnishing of all tools, plants, labour, materials, and everything necessary for carrying out the works.

2. GENERAL

2.1. The following codes, standards and specifications are made a part of this specification. All standards, specifications, codes of practice referred to herein shall be the latest version on the date of offer made by the Bidder.

In case of discrepancy between this specification and those referred to herein, this specification shall govern.

IS:456	-	Plain and reinforced concrete – Code of Practice.
IS:1130	-	Specification for Marble (Block, Slab & tiles)
IS:1200	-	Method of measurement of building and civil engineering works.
IS:1237	-	Specification for cement concrete flooring tiles.
IS:1443	-	Code of practice for laying and finishing of cement concrete flooring tiles.
IS:1542	-	Specification for sand for plaster.
IS:2114	-	Code of practice for laying in-situ terrazzo floor finish.
IS:2250	-	Code of practice for preparation and use of masonry mortars.
IS:2402	-	Code of practice for external rendered finishes.
IS:2571	-	Code of practice for laying in-situ cement concrete flooring.
IS:4443	-	Code of practice for use of resin type chemical resistant mortars.
IS:4457	-	Specification for ceramic unglazed vitreous acid resisting tile.
IS:4631	-	Code of practice for laying epoxy resin floor toppings.

IS:4832	-	Specification for chemical resistant mortars (Part 2).
IS:5491	-	Code of practice for laying of in-situ granolithic concrete floor topping,
IS:8042	-	Specification for white Portland cement.
IS:8112	-	Specification for 43 grade ordinary Portland cement.
IS:9197	-	Specification for epoxy resin, hardeners and epoxy resin composites for floor topping.
IS:15622	-	Pressed ceramic tiles - specification.
IS:15658	-	Precast concrete blocks for Paving - specification.
IRC:SP:63	-	Guidelines for the use of interlocking concrete block pavement.

3. SHAHABAD / KADAPPA / TANDUR / KOTA / MARBLE AND GRANITE STONE TILE / SLAB FLOORING, SKIRTING, TREAD, RISERS, PLATFORM, ETC. WORKS

3.1. MATERIALS

3.1.1. The slabs/tiles shall be of approved selected quality, colour, hard, sound, dense and homogenous in texture, free from cracks, decay, weathering and flaws. The percentage of water absorption shall not exceed 5 percent as per test conducted in accordance with IS:1124.

3.1.2. The slabs/tiles shall be hand or machine cut to the required thickness. Tolerance in thickness for dimensions of tile more than 100 mm shall be ±5mm. This shall be +2mm on dimensions less than 100mm.

3.1.3. Slabs/tiles shall be supplied to the specified size with machine cut edges or fine chisel dressed to the full depth. All angles and edges of the slabs shall be true and square, free from any chipping giving a plane surface. Slabs/tiles shall have the top surface machine polished (first grinding) before being brought to site wherever required as per item. The slabs shall be washed clean before laying.

3.1.4. The sample of the slabs/tiles shall be submitted for approval of Engineer-In-Charge and all the slabs/tiles and material incorporated in the work shall conform to the approved samples.

3.2. WORKMANSHIP

3.2.1. Flooring Work

3.2.1.1. The type, size, thickness and colour/shade etc. of the slabs for flooring/dado/ skirting shall be as specified in the respective items of the work and or as directed by Engineer-In-Charge.

3.2.1.2. Before the tiling work is taken up, the base concrete or structural slab shall be hacked and cleaned of all loose materials, mortar droppings, dirt, laitance etc. using steel wire brush and well wetted without allowing any water pools on the surface. Concrete base shall be finished below the finished floor level equal to the thickness of stone slab and cement mortar below. The slabs / tiles shall be close jointed and joints shall be as thin as possible except in the case of flooring with pointing.

3.2.1.3. A layer of 25mm (unless specified in the respective item) average thickness of cement mortar consisting of one part of cement to four parts of sand shall be provided as bedding for the tiles over the base concrete. The thickness of bedding mortar shall not be less than 10mm at any place. The quantity of just adequate water (conforming to I.S. 456) shall be added for the mortar to obtain the workability for laying. Sand for the mortar shall conform to IS: 2116 and shall have minimum fineness modulus of 1.5. The surface shall be left rough to provide a good bond for the tiles. The bedding shall be allowed to harden for a day before laying of the tiles.

3.2.1.4. Neat cement slurry using 4.4 kg of cement per one sq.m of floor area shall be spread over the hardened mortar bedding over such an area at a time as would accommodate about 20 tiles. Tiles shall be fixed in this slurry one after the other, each tile being gently tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints shall be in straight lines and shall normally be 1.5mm wide. The tiles shall be extended up to the masonry wall and under side of the plaster. On completion of laying of the tiles in a room or area, all the Joints shall be cleaned and washed fairly deep with a stiff broom/wire brush to a minimum depth of 5mm. The day after the tiles have been laid, the joints shall be filled with cement grout of the same shade on the colour of the matrix of the tile. For this purpose white cement or grey cement with or without pigments shall be used. The flooring should be kept moist and left undisturbed for at least 7 days for the bedding/joints to set properly. Heavy traffic shall not be allowed on the floor for at least 14 days after fixing of the tiles.

3.2.1.5. Machine grinding and polishing shall be commenced only after a gap of 14 days of laying. The sequence and three numbers of machine grinding operations, usage of the type of carborundum stones except coarse grade carborundum, filling up of pin holes, watering etc. shall be carried out all as specified in IS: 1443.

3.2.1.6. The decorative pattern shall be made of single or multiple types of stone tile/slab dressed /cut to shape and jointed using cement paste or approved adhesives and as per the drawing or as directed by Engineer-In-Charge. The maximum size of the pattern shall be 600mm x 600mm. The mortar bedding, laying and curing of the decorative pattern shall be as per the clause 5.2.1.2 to clause 5.2.1.4 The polishing shall be as per clause 5.2.1.5.

3.2.2. Dado, Jamb, Skirting Work

3.2.2.1. The thickness of the slabs/tiles for dado/skirting work shall not be more than 25mm. Tile skirting and dado work shall be executed only after laying tiles on the floor. For dado and skirting work, the vertical wall surface shall be thoroughly

cleaned and wetted. Thereafter it shall be evenly and uniformly covered with 12mm thick backing of 1:4 cement sand mortar. If the backing coat is already provided with smooth finish, the same shall hacked to make it rough and cleaned. If required the existing backing coat shall be broke in line for flush skirting. The debris / broken material shall be disposed off as directed. For this work the tiles as obtained from the factory shall be of the size required and practically full polished. The back of each tile to be fixed shall be covered with a thin layer of neat cement paste and the tile shall then be gently tapped against the wall with a wooden mallet. Fixing shall be done from the bottom of the wall upwards. The joints shall be in straight lines and shall normally be 1.5mm wide. Any difference in the thickness of the tiles shall be evened out in the backing mortar or cement paste so that the tile faces are in conformity & truly plumb. Tiles for use at the corners shall be suitably cut with beveled edges to obtain a neat and true joint. The continuous horizontal grooves at top of the skirting shall be provided if specified in the drawing or as directed by Engineer-In-Charge. No extra will be paid for such grooves. After the work has set, hand polishing with carborundum stones shall be done so that the surface matches with the floor finish.

3.2.3. Sill and Coping Work

3.2.3.1. The stones shall be cut to the required size as approved by Engineer-In-Charge. The stones shall have machine cut and double machine polished wherever specified. The edges to be pointed shall be true to line and dressed to the required depth all around. All the exposed edges shall be neatly polished to give neat appearance. The slab/tile shall be laid on a bedding of 20mm thick cement mortar 1:4 to a true plane, level or slopes as per relevant drawings. The workmanship shall be similar to the flooring work described above. Sills/copings should project beyond the finished plastered surface as shown in the drawing or as directed by Engineer-In-Charge. Continuous horizontal grooves wherever specified shall be provided as per the drawings and quoted rate is deemed to include for the same. The surface shall be re-polished with hand to satisfaction of the Engineer-In-Charge. The skirting/dado shall be cured for minimum 7 days.

3.2.4. Platform / Otta Work

3.2.4.1. **Kadappa Platform:** The kadappa used for the platform and supports shall be minimum 40mm thk. The Kadappa top shall be one side polished while the supports shall be both side polished. The sizes of the top and supports shall be as per the relevant item of the platform. The vertical supports shall be fixed in the wall by making the min. 40 mm deep slots by the cutter machine. The gaps shall be filled by cement mortar and the junction shall be neat smooth plastered. The kadappa top slab shall be laid min. 2 days after fixing of supports along with readymade sink as per relevant drawings or as directed by Engineer-In-Charge. The polished face shall be on upward /exposed side and to a true plane, level or slopes as directed. The approved adhesive shall be used for jointing the top and supports. The necessary sleeves, cutouts in the top and supports (for example for sink, piping etc.) shall be provided. The facia with top edges chamfered or rounded shall be fixed using adhesive as per the respective item. The quoted rate is deemed to include making the cutouts, fixing the sink (excluding the cost of sink), facia edge chamfers / rounding etc. All the cement work shall be cured for minimum 7 days.

3.2.4.2. **Marble /Granite Platform:** All the supporting work shall be done as per the 3.2.4.1. The sizes of the top and supports shall be as per the relevant item of the platform. The kadappa base slab shall be laid min. 2 days after fixing of supports along with readymade sink as per relevant drawings or as directed by Engineer-In-Charge. The un-polished /rough face shall be on upward side and to a true plane, level. The approved adhesive shall be used for jointing the top and supports. For the top, marble/granite shall be laid over the kadappa base slab with cement mortar bedding 1:4 in proportion to a true plane, level or slopes as directed. The necessary sleeves, cutouts in the top and supports (for example for sink, piping etc.) shall be provided. The facia with top edges chamfered or rounded shall be fixed using adhesive as per the respective item. The quoted rate is deemed to include making the cutouts, fixing the sink, facia edge chamfers / rounding etc. All the cement work shall be cured for minimum 7 days.

3.2.5. Cladding Work

3.2.5.1. Slabs shall be so placed that the back surface is at a distance of 12mm from the wall. If necessary, slabs shall be held in position temporarily by suitable method. After checking for verticality, the gap shall be filled and packed with cement sand mortar of proportion 1:3. Neat cement slurry shall be poured between the hardened mortar backing and cladding material. After the mortar has acquired sufficient strength, the temporary arrangement holding the slab shall be removed. The recommended mortar mix for joints and beddings for stone blocks shall be two parts of white cement and seven parts of stone dust. The thickness of joints shall be 5mm or as directed by Engineer-in-Charge.

For fixing of stones to the walls, fixing clamps of non-ferrous metal can be used. The approved chemical adhesive can be used as per the manufacturer s specification. The quoted rate is deemed to include chemical adhesives and metal clamps etc.

3.2.6. Tread and Risers

3.2.6.1. The specifications mentioned for flooring shall be generally applicable for this item.

3.2.7. Partitions

3.2.7.1. The thickness of stones used for partition shall be as per the relevant item. The both side polished stone slab shall be cut to the required size and fixed by making the min. 40 mm deep slot by the cutter machine in the wall or in the dado tiling. The partition shall be temporarily supported by suitable method. The gaps in the joints shall be filled by cement mortar with neat smooth plastering or by approved cement grout. After the mortar has acquired sufficient strength, the temporary arrangement holding the slab shall be removed. The exposed edges of the partitions shall be chamfered. All the cement work included in this work shall be cured for min. 7 days.

3.2.8. Shelf

3.2.8.1. The thickness of stones used for shelf shall be as per the relevant item. The both side polished stone slab shall be cut to the required size and fixed by making the slot by the cutter machine in the supporting wall /stone slab partition. The shelf shall be temporarily supported by suitable method. The gaps in the joints shall be filled by cement mortar and either with neat smooth plastering or by approved cement grout. The approved adhesive shall be used for stone slab

joints. After the mortar and adhesive have acquired sufficient strength, the temporary arrangement holding the slab shall be removed. The exposed edges of the shelf shall be chamfered. All the cement work included in this work shall be cured for min. 7 days.

3.2.9. Door frames

3.2.9.1. The stones slab shall be cut to the required size as approved by Engineer-In-Charge. The stones shall have machine cut and machine polished on the exposed side as directed. The edges shall be true to line. Total thickness of frame member shall not be less than 35mm. The member can be single piece or formed by pasting two various slabs by means of approved adhesive. The shape and cross section of the frame member shall be as per drawing or as directed by Engineer-In-Charge. The fixing of such members shall be generally as per the dado described above. Before fixing the members the wall / concrete surface shall be hacked and cleaned if required. The total width of the door frames shall be such that it should flush / projected from the surface of the plaster/dado as directed by Engineer-In-Charge. The gaps behind frame member shall be filled by cement mortar in 1:3 and smooth plastered along the edges.

3.3. MEASUREMENT

3.3.1. Measurement for floor shall be as per Table 1 depending upon the type of work. No deduction shall be made and for opening less than 0.2sqm

4. CHAMFERING AND EDGE MOULDING

4.1. WORKMANSHIP

4.1.1. Chamfering and edge molding to the tile/ stone slab shall be done using grinding machine. The pre chamfered or pre edge molded tiles /stone slab can be used for work. The shape, size and finish of the chamfer /molding shall be as per drawing or as directed by Engineer-In-Charge.

4.2. MEASUREMENT

4.2.1. Measurement for chamfering/ edge molding shall be as per Table 1.

5. CERAMIC / VITRIFIED TILE FLOORING, DADO ETC. WORK

5.1. MATERIALS

5.1.1. Glazed / Matt earthenware (Ceramic tiles) /vitrified tiles shall conform to the requirements of IS 15622. Tiles shall be of the best quality from an approved manufacturer. The tiles shall be flat, true to shape and free from flaws such as crazing, blisters, pinholes, specks or welts. Edges and underside of the tiles shall be free from glaze and shall have ribs or indentations for a better anchorage with the bedding mortar. Dimensional tolerances shall be as specified in IS: 15622.

5.2. WORKMANSHIP

5.2.1. The size, thickness, colour, with or without designs etc of the tiles for flooring/ dado/ skirting shall be as specified in the respective items of work.

5.2.2. The total thickness of glazed tile finish including the bedding mortar shall be maximum 20 mm in flooring/ dado/ skirting. The minimum thickness of bedding mortar shall be 12mm for flooring and 10mm for dado/ skirting work.

5.2.3. The bedding mortar shall consist of 1 part of cement to 3 parts of sand (unless specified in the respected item) mixed with just sufficient water to obtain proper consistency for laying. Sand for the mortar shall conform to IS: 2116 and shall have minimum fineness modules of 1.5.

5.2.4. The ceramic tiles shall be soaked in water for about 10 minutes just before laying while for vitrified tiles no need to do so. Where full size tiles cannot be fixed, tiles shall be cut to the required size using special cutting device and the edges rubbed smooth to ensure straight and true joints.

5.2.5. Coloured tiles with or without designs shall be uniform and shall be preferably procured from the same batch of manufacture to avoid any differences in the shade.

5.2.6. Tiles for the flooring shall be laid over hardened concrete base. The surface of the concrete base shall be cleaned of all loose materials, mortar droppings etc, well wetted without allowing any water pools on the surface. The bedding mortar shall then be laid evenly over the surface, tamped to the desired level and allowed to harden for a day. The top surface shall be left rough to provide a good bond for the tiles. For skirting and dado work, the brick walls the joints shall be raked to a depth of 15mm. In case of concrete walls, the surfaces shall be hacked. The raked / hacked masonry surfaces shall be cleared, wet and then the bedding mortar to specified thickness shall be applied. The mortar surfaces shall be roughened using wire brush and allowed to harden.

5.2.7. Neat cement slurry using 3.3 kg cement per one sq.m. of floor area shall be spread over the hardened mortar bed over such an area as would accommodate about 20 tiles. Tiles shall be fixed in this slurry one after the other, each tile being gently tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. For skirting and dado work, the back of the tiles shall be smeared with cement slurry for setting on the backing mortar. Fixing of tiles shall be done from the bottom of the wall upwards. The joints shall be in perfect straight lines and as thin as possible but shall not be more than 1 mm wide. Tiles used for corners shall be suitably beveled to obtain a true and neat joint. The surface shall be checked frequently to ensure correct level/ required slope. Floor tiles near the walls shall enter skirting/ dado to a minimum depth of 10mm. Tiles shall not sound hollow when tapped.

5.2.8. All the joints shall be cleaned of grey cement with wire brush to a depth of at least 3mm (except for vitrified/ jointless tiles) and all dust, loose mortar etc. shall be removed. White cement with or without pigment shall then be used for flush pointing the joints. Curing shall then be carried out for a minimum period of 7 days for the bedding and joints to set properly. The surface shall then be cleaned using a suitable detergent, fully washed and wiped dry.

5.2.9. Specials consisting of coves, internal and external angles, cornices, beads and their corner pieces shall be of thickness not less than the tiles with which they are used.

5.3. MEASUREMENT

5.3.1. Measurement for floor shall be as per Table 1 depending upon the type of work. No deduction shall be made and for opening less than 0.2sqm

6. IN-SITU CEMENT CONCRETE FLOOR TOPPING (IPS FLOORING)

6.1. MATERIALS

6.1.1. The mix proportion for the in-situ concrete floor topping shall be 1: 2½: 3½ (one part cement : two and half parts sand : three and half parts coarse aggregates) by volume unless otherwise specified in the item of work.

6.1.2. The aggregates shall conform for the requirements of IS:383

6.1.3. Coarse aggregates shall have high hardness, surface texture and shall consist of crushed rock of granite, basalt, trap or quartzite. The aggregate crushing value shall not exceed 30 percent. The grading of the coarse aggregates shall be of size 12.5mm and below and shall be as per IS:2571.

6.1.4. Grading of the sand shall be within the limits indicated in IS:2571.

6.2. WORKMANSHIP

6.2.1. The thickness of the floor topping shall be as specified in the item of work. The minimum thickness of the floor topping shall be 25mm, if it is laid separately. 15mm thick wearing course of cement mortar 1:2 (1cement: 2 stone aggregate of size 4.75 & below) by volume shall be applied monolithically over floor topping, if called for in the schedule of item. Wearing course shall be 20mm thick, if it is cast monolithically over ground floor slab. Laying and finishing of in-situ topping shall conform to the requirements of IS 2571.

6.2.2. Preparation of base concrete/ structural slab before laying the topping shall be as per clause 3.2.1.2. The surface shall be rough to provide adequate bond for the topping. It shall be finished to a level below the finished floor equal to the thickness of topping and / or wearing courses, if specified.

6.2.3. Mixing of concrete shall be done thoroughly in a mechanical mixer unless hand mixing is specifically permitted by the Engineer-In-Charge. The concrete shall be as stiff as possible and the amount of water added shall be the minimum necessary to give just sufficient plasticity for laying and compacting. The mix shall be used in the work within 30 minutes of the addition of water for its preparation.

6.2.4. Floor finish shall be laid in suitable panels to reduce the risk of cracking. No dimension of a panel shall exceed 2 meters and the length of a panel shall not exceed one and a half times its breadth. Topping shall be laid in alternate panels, the intermediate panels being cast after a gap of at least one day. Construction joints shall be plain vertical butt joints.

6.2.5. Screed strips shall be fixed dividing the area into suitable panels. Immediately before depositing the concrete topping, neat cement slurry at 2.75 kg/sq.m of area shall be thoroughly brushed into the prepared surface. Topping shall then be laid, very thoroughly tamped, struck off level and floated with wooden float.

The surface shall then be tested with a straight edge and mason's spirit level to detect any inequalities from that specified in the drawings and these shall be made good immediately.

6.2.6. Finishing of the surface by trowelling shall be spread over a period of one to six hours depending upon the temperature and atmospheric conditions. The surface shall be trowelled 3 times at intervals so as to produce a smooth uniform and hard surface. Immediately after laying, the first trowelling just sufficient to give a level surface shall be carried out avoiding excessive trowelling at this stage. The surface shall be re-trowelled after sometime to close any pores and to scrap off excess water or laitance, which shall not be trowelled back into the topping. Final trowelling shall be done well before the concrete has become too hard but at a time when considerable pressure is required to make any impression on the surface. Sprinkling of dry cement or cement-sand mixture for absorbing moisture shall not be permitted.

6.2.7. Immediately after the surface is finished, it shall be protected suitably from rapid drying due to wind/ sunlight. After the surface has hardened sufficiently to prevent any damage to it, the topping shall be kept continuously moist for a minimum period of 10 days.

6.2.8. It is preferable to lay the topping on hardened base concrete, as against being laid monolithically with a lesser thickness, since proper levels and slopes with close surface tolerance, is achievable in practice, owing to its greater thickness. Further, as this would be laid after all other building operations are over, there will be no risk of any damages or discoloration to the floor finish which are difficult to repair satisfactorily.

6.3. MEASUREMENT

6.3.1. Measurement shall be in sq.m correct upto two places of decimal.

7. FLOOR HARDENER TOPPING

7.1. MATERIALS & WORKMANSHIP

7.1.1. Floor hardener topping shall be provided either as integrally finished over the structural slab/ grade slab or laid monolithically with the concrete/ granolithic floor finish on top of hardened concrete base.

7.1.2. Floor hardener of the metallic or non-metallic type suitable for the performance of normal/ medium/ heavy duty function of the floor, the quantum of ingredients and the thickness of topping shall be as specified in the respective items of work.

7.1.3. For monolithic application with the floor finish/ slab, the thickness of the layer shall be 15mm. It shall be 20mm if it is laid separately over floor slab. The topping shall be laid within 2 to 3 hours after concrete is laid and it is still plastic but stiffened enough for the workmen to tread over it by placing planks. The surface of the concrete layer shall be kept rough for providing adequate band for the topping. Laitance shall be removed before placing the topping. The topping shall be screeded and thoroughly compacted to the finished level. Trowelling to a smooth finish shall be carried out. Straight edge and steel floats shall be used to bring the surface true to the required level in such a manner that the maximum

amount of main topping ingredients come up and spread uniformly all over the surface. After the surface has hardened sufficiently, it shall be kept continuously moist for at least 10 days.

7.1.4. The procedure for mixing the floor hardener topping shall be as per manufacturer's instructions.

7.1.5. Floor hardener topping shall be prevented from any damages due to subsequent building operations by covering with 75 mm thick layer of sand, if it is laid monolithically with the slab.

7.2. MEASUREMENT

7.2.1. Measurement shall be in sq.m correct to two places of decimal. This work could be either separate or combined along with the floor finish as indicated in the respective items of work.

8. ACID RESISTING FLOORING, DADO WORK

8.1. MATERIALS

8.1.1. The ceramic unglazed vitreous acid resisting tiles shall conform to the requirements of IS: 4457.

8.1.2. The finished tile when fractured shall appear fine grained in texture, dense and homogeneous. Tile shall be sound, true to shape, flat, free from flaws and any manufacturing defects affecting their utility. Tolerance in the dimensions shall be within the limits specified in the respective IS.

8.1.3. The tiles shall be bedded and jointed using chemical resistant mortar prepared from resin type conforming to IS: 4832 (Part II) filter, accelerator and catalyst mixed in proportion as recommended by manufacturers. Method of usage shall generally be as per the requirements of IS: 4443.

8.2. WORKMANSHIP

8.2.1. The size and thickness of tiles for use in the flooring/ skirting/ dado shall be as specified in the respective items of work.

8.2.2. The resin shall have viscosity for readily mixing with the filler by manual methods. The filler shall have graded particles which permit minimum joint thickness of 1.5 mm.

8.2.3. The base concrete surface shall be free from dirt and thoroughly dried. The surface shall be applied with a coat of bitumen primer conforming to IS: 3384. The primed surface shall then be applied with a uniform coat of bitumen conforming to IS: 1530. Tiles shall be laid directly without the application of bitumen, if epoxy or polyester resin is used for the mortar.

8.2.4. Just adequate quantity of mortar which can be applied within the pot life as specified by the manufacturer shall be prepared at one time for bedding and jointing. Rigid PVC/ Stainless steel/ chromium plated tools shall be used for mixing and laying.

8.2.5. For laying the floor 6 to 8 mm thick mortar shall be spread on the back of the tile/ brick. Two adjacent sides of the tile/brick shall be smeared with 4 to 6 mm thick mortar. Tile/brick shall be pressed into the bed and pushed against the floor and with the adjacent tile/ brick, until the joint in each case is 2 to 3 mm thick. Excess mortar shall then be trimmed off and allowed to harden fully. Similar procedure shall be adopted for the work on walls by pressing the tile/brick against the prepared wall surfaces and only one course shall be laid at a time until the initial setting period.

8.2.6. The mortar joints shall be cured for a minimum period of 72 hours with 20 to 25% hydrochloric acid or 30 to 40% sulphuric acid. After acid curing, the joints shall be washed with water and allowed to dry thoroughly. The joints shall then be filled with mortar to make them smooth and plane. Acid curing is not required to be carried out if epoxy or polyester resin is used for the mortar.

8.2.7. Resin mortars are normally self curing. The area tiled shall not be put to use before 48 hours in case epoxy, polyester and furane type of resin is used for the mortar. If phenolic or cashewnut shell liquid resin is used for the mortar, the area tiled shall not be put to use for 7 to 28 days respectively, without heat treatment. This period shall be 2 to 6 days respectively if heat treatment is given with infrared lamp.

8.2.8. Temperature during preparation of mortar, its application, curing etc. shall be controlled and maintained as recommended by manufacturer.

8.2.9. It is necessary that the concrete slab/ wall shall be made leak proof against water, if necessary by pressure grouting etc. before taking up any titling works. Cost of such works shall be deemed to have included in the cost of tiling works, whether same is specifically mentioned or not.

8.3. MEASUREMENT

8.3.1. Measurement for floor shall be as per Table 1 depending upon the type of work. No deduction shall be made and not any extra to be paid for openings not exceeding 0.20 sq.m.

9. PRECAST PAVING BLOCK FLOORING FOR NON TRAFFIC AREAS

9.1. MATERIALS

9.1.1. The length of the precast paving block shall be greater than the twice the mean width and 280mm. The width generally shall be in the range of 75 to 140 mm. The maximum chamfer of 10mm. The sides of the blocks shall be perpendicular to the top and bottom faces except that the top edges may be chamfered. The permissible tolerance for the blocks shall be as below.

Plan Dimensions: ± 2 mm

Thickness: ± 3 mm

The average water absorption shall not exceed 5%.

The bedding sand and the joint filling sand shall be as per IRC: SP: 63.

9.1.2. The subgrade layer shall be provided as the foundation layer for the paving. The water table shall be min. 600mm below subgrade. The subgrade preparation & sub base shall be as per IRC: SP: 63 and to a true plane, level or slopes as directed by Engineer-In-Charge.

9.2. WORKMANSHIP

9.2.1. The thickness of the sand bed after compaction shall be 20 to 40mm or as specified in the relevant item. The bedding sand shall not be used to fill up the local depressions on the surface of the base or subbase. The depressions shall be repaired in advance before placing the sand for bedding. The sand shall be uniformly in loose condition and shall have uniform moisture content.

9.2.2. The sand is spread with the help of screed boards to the required thickness. The screed boards are provided with nails at 2-3m apart which when dragged gives the desired thickness. The length of nail should take into account the surcharge to be provided in the uncompacted thickness. The sand is compacted with plate vibrators weighing 0.6 tons or more. The level check shall be carried out on the grid pattern to establish that the desired level is achieved. Local correction can be done either by removing or adding extra sand followed by leveling and compacting the layer. There will be some settlement of sand after the blocks are placed and compacted, which must be allowed for, while fixing the level of sand bed.

9.2.3. Normally, laying of the blocks shall commence from the edge strip and proceed towards inner side. The laying shall be done in one direction only, along the entire width of the area to be paved. While locating starting point, following shall be considered.

a) On the sloping side, start from the lowest point and proceed uphill on a continuous basis, to avoid downhill creep in incomplete areas.

b) In case of irregular shaped edge restrains or strip, it is better to start from straight string line.

c) Influence of alignment of edge restraints on achieving and maintaining laying bond.

The blocks are embedded using hammer after the screeding the sand. Laying pattern of the paving blocks shall be as per drawing or as directed by Engineer-In-Charge. Care shall be taken to see that paving blocks are not tightly butted against each other. The paving shall be compacted after laying the blocks by vibratory plate compactors with min. two passes. The compaction shall be continued till the top of each block is leveled with its adjacent blocks.

9.2.4. A thin layer of spreading sand shall be spread over the block surface and worked the sand into each joint by brooming. Following a far passes of plate compactor are applied to facilitate fine sand to fill the joints.

9.2.5. The free edges of the entire paving shall be confined by chamfering in the cement mortar 1:3.

9.3. MEASUREMENT

9.3.1. Measurement for precast block paving shall be as per Table 1. No deduction shall be made and not any extra to be paid for openings not exceeding 0.20 sq.m

10. GLAZED TILE FINISH

10.1. MATERIALS

10.1.1. Glazed earthenware tiles shall conform to the requirements of IS:13756. Tiles shall be of the best quality from an approved manufacturer. The tiles shall be flat, true to shape and free from flaws such as crazing, blisters, pinholes, specks or welts. Edges and underside of the tiles shall be free from glaze and shall have ribs or indentations for a better anchorage with the bedding mortar. Dimensional tolerances shall be as specified in IS: 13756.

10.2. WORKMANSHIP

10.2.1. The size, thickness, colour, with or without designs etc of the tiles for flooring/dado/skirting shall be as specified in the respective items of work.

10.2.2. The total thickness of glazed tile finish including the bedding mortar shall be maximum 20 mm in flooring/dado/skirting. The minimum thickness of bedding mortar shall be 12mm for flooring and l0mm for dado/skirting work.

10.2.3. The bedding mortar shall consist of 1 part of cement to 3 parts of sand mixed with just sufficient water to obtain proper consistency for laying. Sand for the mortar shall conform to IS: 2116 and shall have minimum fineness modules of 1.5.

10.2.4. Tiles shall be soaked in water for about 10 minutes just before laying. Where full size tiles cannot be fixed, tiles shall be cut to the required size using special cutting device and the edges rubbed smooth to ensure straight and true joints.

10.2.5. Coloured tiles with or without designs shall be uniform and shall be preferably procured from the same batch of manufacture to avoid any differences in the shade.

10.2.6. Tiles for the flooring shall be laid over hardened concrete base. The surface of the concrete base shall be cleaned of all loose materials, mortar droppings etc well wetted without allowing any water pools on the surface. The bedding mortar shall then be laid evenly over the surface, tamped to the desired level and allowed to harden for a day. The top surface shall be left rough to provide a good band for the tiles. For skirting and dado work, the brick walls shall be raked to a depth of 15mm. In case of concrete walls, the surfaces shall be hacked. The raked / hacked masonry surfaces shall be cleared, wet and then the bedding mortar to specified thickness shall be applied. The mortar surfaces shall be roughened using wire brush and allowed to harden.

10.2.7. Neat cement slurry using 3.3 kg cement per one sq.m of floor area shall be spread over the hardened mortar bed over such an area as would accommodate about 20 tiles. Tiles shall be fixed in this slurry one after the other, each tile being gently tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. For skirting and dado work, the back of the tiles shall be smeared with cement slurry for setting on the backing mortar. Fixing of tiles shall be done from the bottom of the wall upwards. The joints shall be in perfect straight lines and as thin as possible but shall not be more than l mm wide. Tiles

used for corners shall be suitably bevelled to obtain a true and neat joint. The surface shall be checked frequently to ensure correct level/required slope. Floor tiles near the walls shall enter skirting/dado to a minimum depth of 10mm. Tiles shall not sound hollow when tapped.

10.2.8. All the joints shall be cleaned of grey cement with wire brush to a depth of atleast 3mm and all dust, loose mortar etc. shall be removed. White cement with or without pigment shall then be used for flush pointing the joints. Curing shall then be carried out for a minimum period of 7 days for the bedding and joints to set properly. The surface shall then be cleaned using a suitable detergent, fully washed and wiped dry.

10.2.9. Specials consisting of caves, internal and external angles, cornices, beads and their corner pieces shall be of thickness not less than the tiles with which they are used.

10.3. MEASUREMENT

10.3.1. Measurement for floor tiling and dado shall be in sq.m correct to two places of decimal. Actual quantity of tiling work as laid shall be measured for payment as per the respective items of work after making deductions for openings etc. No deduction shall be made nor any extra to be paid for openings not exceeding 0.20 sq. m Measurement for skirting be in running metres correct to two places of decimal for the specified height as per the item of work.

11. PVC SHEET / TILE FLOORING

11.1. MATERIALS

11.1.1. PVC floor covering shall be of either unbacked homogeneous flexible type in the form of sheets/tiles conforming to IS:3462 or homogeneous PVC asbestos tiles conforming to IS:3461.

11.1.2. The surface of the sheets/tiles shall be free from any physical defects such as pores, blisters, cracks etc. which affects the appearance and serviceability. Tiles/ sheets shall meet with the tolerance limits in dimensions specified in the IS codes. CONTRACTOR shall submit the test certificates, if so desired by the ENGINEER.

11.1.3. Each tile/sheet shall be legibly and indelibly marked with the name of the manufacturer or his trade mark, IS certificate mark and batch number.

11.1.4. The adhesive to be used for laying the PVC flooring shall be rubber based conforming to IS 12830 and of the make as recommended and approved by the manufacturer of PVC sheets/tiles.

11.1.5. The type, size, thickness, colour, plain or mottled and the pattern shall be as specified in the respective items of work.

11.2. WORKMANSHIP

11.2.1. Laying of PVC sheets / tiles shall conform IS 5318. PVC floor covering shall be provided over an underbed of cement concrete floor finish over the base concrete or structural slab. It is essential that the sub-floor and the underbed are perfectly dry before laying the PVC flooring. This shall be ensured by methods of testing as stipulated in Appendix-A of IS:5318. Concrete floor on the ground / basement shall be treated with an effective damp proof course.

11.2.2. The surface of the underbed shall have trowelled finish without any irregularities which creates poor adhesion. Surface shall be free of oil or grease and thoroughly cleaned of all dust, dirt and wiped with a dry cloth.

11.2.3. PVC sheets/tiles shall be brought to the temperature of the area in which they are to be laid by stacking in a suitable manner within or near the laying area for a period of about 24 hours. Where air-conditioning is installed, the flooring shall not be laid on the underbed until the A/C units have been in operation for atleast 7 days. During this period, the temperature range shall be between 20^0C and 30^0C and this shall be maintained during the laying operations and also for 48 hours thereafter.

11.2.4. Layout of the PVC flooring shall be marked with guidelines on the underbed and PVC tiles/sheets shall be first laid for trial, without using the adhesive, according to the layout.

11.2.5. The adhesive shall be applied by using a notched trowel to the surface of the underbed and to the backside of PVC sheets/tiles. When the adhesive has set sufficiently for laying, it will be tacky to the touch, which generally takes about 30 minutes. The time period need be carefully monitored since a longer interval will affect the adhesive properties. Adhesive shall be uniformly spread over only as much surface area at one time which can be covered with PVC flooring within the stipulated time.

11.2.6. PVC sheet shall be carefully taken and placed in position from one end onwards slowly so that the air will be completely squeezed out between the sheet and the background surface and no air pockets are formed. It shall then be pressed with a suitable roller to develop proper contact. The next sheet shall be laid edge to edge with the sheet already laid, so that there is minimum gap between joints. The alignment shall be checked after each row of sheet is completed and trimmed if considered necessary.

11.2.7. Tiles shall be laid in the same manner as sheets and preferably, commencing from the centre of the area. Tiles should be lowered in position and pressed firmly on to the adhesive with minimum gap between the joints. Tiles shall not be slided on the surface. Tiles shall be rolled with a light wooden roller of about 5kg to ensure full contact with the underlay. Work should be constantly checked to ensure that all four edges of adjacent tiles meet accurately.

11.2.8. Any excess adhesive which may squeeze up between sheets/tiles shall be wiped off immediately with a wet cloth. Suitable solvents shall be used to remove hardened adhesive.

11.2.9. A minimum period of 24 hours shall be given after laying for the development of proper bond of the adhesive. When the flooring in thus completed, it shall be cleaned with a wet cloth soaked in warm soap solution.

11.2.10. Metallic edge strips shall be used to protect the edges of PVC sheets/tiles which are exposed as in doorways/ stair treads.

11.2.11. Hot sealing of joints between adjacent PVC sheet flooring to prevent creeping of water through the Joints shall be carried out, if specified in the item of work, using special equipment as per manufacturer's instructions.

11.2.12. It is desirable that the PVC flooring are taken up after completing all other works in the area so as to avoid any accidental damage to the flooring.

11.3. MEASUREMENT

11.3.1. Measurement shall be in sq.m correct to two places of decimal. The item could be either separate or as a combined item with the floor finish as specified in the respective items of work.

12. TABLE 1

Sr. No.	Type of work	Unit & Method of measurement
1	Flooring, Paving	Measurement shall be in square meters correct to two places of decimal. The measurements shall be taken before fixing skirting, dado and wall plaster.
2	Skirting	Measurement shall be in running meters correct to two places of decimal.
3	Dado	Measurement shall be in square meters correct to two places of decimal.
4	Riser of Staircase	Measurement shall be in running meters correct to two places of decimal. The measurements shall be taken before fixing skirting and wall plaster.
5	Tread of Staircase	Measurement shall be in running meters correct to two places of decimal. The measurements shall be taken before fixing skirting and wall plaster.
6	Sill and Jambs	Measurement shall be in running meters correct to two places of decimal.
7	Door Frames	Measurement shall be in running meters of the frame member correct to two places of decimal.
8	Partitions	Measurement shall be in square meters correct to two places of decimal.
9	Platforms/ Otta	Measurement shall be in running meters correct to two places of decimal. The measurements shall be taken before fixing dado and wall plaster.
10	Shelf	Measurement shall be in square meters correct to two places of decimal.
11	Chamfering/ Edge molding	Measurement shall be in running meters correct to two places of decimal.

END.

Chapter -9
Roofing Work

1. SCOPE

This specification covers the general requirements for supply, delivery and erection of all GI sheeting for roofing and side cladding including all accessories and fixtures necessary to provide weather exposed surfaces of roof and building walls.

2. APPLICABLE CODES AND SPECIFICATIONS

The following specifications, standards and codes, including all official amendments and revisions and other specification referred to therein shall be considered as a part of this specification. In all cases the latest issue/edition revision shall apply. In case of discrepancy between the guidelines given in the codes, & this specification shall govern:

a) IS : 277 Specification for galvanized steel sheets.

b) IS : 513 Cold rolled low carbon steel sheets & strips.

c) IS : 8869 Specifications for washers for corrugated sheet roofing

d) IS : 12093 Code of practice for laying & fixing of sloped roof covering using plain & corrugated galvanized steel sheets.

3. MATERIALS

3.1. Galvanised steel corrugated sheets shall be hot dipped galvanised conforming in all respects to IS: 277 with a coating of grade 600.

3.2. The thickness, quality and manufacture of Galvanised sheets shall be as approved by Engineer.

3.3. The sheets shall be free from cracks, pitting, blisters, split edges, twists, laminations, scales and other surface defects. Sheets shall be clearly sheared and be free from twist or buckle and shall have uniform corrugations, true in depth and pitch parallel to the sides of the sheet. The galvanised coating shall be clean, bright, smooth and free from ungalvanised spots and other defects. The sheets supplied shall show no sign of rust or white powdery deposits on the surface.

SR. NO.	PROPERTY	REQUIREMENT
1	Scratch & Mark resistance	Fair
2	Impact resistance	Greater than 10 Joules

SR. NO.	PROPERTY	REQUIREMENT
3	Pencil hardness	F minimum
4	Bend test	6 T
5	Heat resistance	Suitable for continuous service upto 100 deg . C
6	Corrosion resistance	
I	Salt spray	No more than (8) density size A blisters, less than 2mm undercutting from a score & no visible loss of adhesion after 1000 hrs.
Ii	Humidity resistance	No more than (8) density size A blisters, no visible loss of adhesion after 1000 hrs.
iii	QAV weatherometer	A chalk rating of 8-10 after 1000 light hours.
7	Outdoor durability	The sheets in standard colours under normal well washed conditions of exposure should show no cracking, flaking or peeling of the paint film in 10 years. Colour change during service determined according to ASTM D2244, should not exceed 5 E Hunter lab. Units on light colours.
8	Surface spread of flame	Class 1

3.4. The accessories like flashings, cappings, barge boards etc. shall be of the same material as sheets.

3.5. Sealants shall be of silicon non-hardening type.

3.6. Screws used for fixing shall be hot dip zinc coated steel, hexahead self drilling screws with EPDM washer & colour heads, colour matched to sheeting.

4. STORAGE OF MATERIALS

4.1. Sheets shall be stacked to a height of not more than one metre on firm and level ground, with timber or other packing beneath them.

4.2. Galvanised steel materials of same variety and size shall be stacked together.

4.3. All galvanised materials shall be protected from damage while stored on site preferably in sheltered store. If they are required to be placed in an exposed position then they shall be protected from damage by wind and rain by providing a suitable cover.

4.4. 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.

4.5. Manufacturer's instructions regarding delivery, stacking and storing shall be followed.

5. LAYING

5.1. The sheets shall be laid on the purlins/other roof members and side girts as indicated on the drawings or as instructed by Engineer.

5.2. 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.

5.3. The bearing surfaces of all purlins /other roof members and side girts 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 girts. The finished roof shall present a uniform slope and the lines of corrugations shall be straight and true and the completed work shall present a neat and uniform appearance and be leak proof. For side sheeting, corrugations shall be vertical and in one plane.

5.4. The sheets shall be laid with a minimum lap of 150 mm at the ends and 2 ridges of corrugations at each side. In the case of roofs with pitch flatter than 22 degrees, minimum end laps shall be 200 mm. The side laps shall be laid on the side facing away from the prevailing monsoon winds. The minimum lap of sheets with ridges, hips and valleys shall

be 200 mm measured at right angles to the line of ridge, hip & valley respectively. The free overhang of the sheets at the eaves shall not exceed 300 mm.

5.5. 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 corrugations at hips and valleys. They shall be cut carefully with a straight edge and chiseled to give a smooth and straight finish. The sheets shall not generally be built into gables and parapets. They shall be bentup along their side edges close to the wall and the junction shall be protected by suitable flashing or by a projecting drip course covering the junction by at least 75 mm.

5.6. Where slopes of roofs are less than 22 degrees, sheets shall be joined together at the side laps by galvanised iron seam bolts and nuts of size 25 mm x 6 mm, each bolt with a bitumen and G.I. limpet washer or with a G.I limpet washer filled with white lead. The seam bolts shall be placed zig-zag over the two overlapping corrugations at a spacing not exceeding 600mm along each of the staggered rows.

5.7. All laps in G.I sheets shall be painted with one coat of zinc rich primer and two coats of approved paint before fixing in place.

6. FIXING

6.1. Sheets shall be secured to the purlins and other roof members by means of 8mm diameter galvanised 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. 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 bitumen washer and a galvanised 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 ridges of corrugations in each sheet on every purlin and spacing shall not exceed 300mm. Bitumen 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.

6.2. Where sheets are laid on tubular purlins, the fixing bolts shall be designed to encompass at least half the tube circumference and precautions should be taken to prevent its rotation.

6.3. Holes for hook bolts etc. shall be drilled and not punched in the ridges of the corrugations 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 hole 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.

6.4. Direct fixing of sheets to drilled steel frame work or by stud welding or fixing by coach screws shall not be permitted.

7. GENERAL

7.1. All work shall proceed in a diligent and systematic manner.

7.2. Contractor shall not allow access to any person other than workmen employed for laying and fixing sheeting while the above work is in progress. If, however, it is not possible to keep the area clear, suitable safety measures shall be taken by contractor during the progress of the work.

7.3. Contractor shall use roof ladders or planks while laying and fixing the sheets, to avoid damage to sheets and to provide security to the workmen.

7.4. Contractor shall arrange any staging or other temporary structures required for the purpose of installing the roof and side sheeting at his own cost.

7.5. At no time shall the sheets or accessories be laid and left unfixed. Temporary fixing /supporting shall not be acceptable. In case of any loss or damage due to infringement of these conditions by contractor, the same shall be made good by Contractor at no extra cost to Owner.

8. ACCESSORIES

8.1. **Ridges and hips.**

8.1.1. Ridges and hips of precoated galvanised roofs shall be covered with ridge and hip sections of precoated sheets with a minimum 200 mm lap on either side over the precoated sheets. The end laps at the ridges and hips and between ridges and hips shall also be not less than 200 mm. The ridges and hips shall be fixed as shown on the drawings.

8.1.2. Ridges and hips shall be fixed to the purlins below with the same bolts and nuts and washers which fix the sheets to the purlins. At least one of the fixing bolts shall pass through the end laps of ridges & hips, on either side. If this is not possible, extra bolts shall be provided.

8.1.3. The end laps of ridges and hips shall be joined together by G.I seam bolts 25 x 6 mm size each with a bitumen and G.I limpet washer. There shall be at least two such bolts in each end lap.

8.1.4. The edges of the ridges and hips shall be straight from end to end and their surfaces shall be plane and parallel to the general plane of the roof. the ridges and hips shall fit in squarely on the sheets and shall be leak proof.

8.2. **Valleys and Flashings**

8.2.1. Valleys shall be as per drawing and fixed as shown on the drawings or as directed by Engineer. Laps with sheets shall not be less than 250 mm on either side. The end laps of valleys shall also not be less than 250.

8.2.2. Flashing shall be of precoated sheet having required girth, bent to shape and fixed as shown on the drawings. They shall lap not less than 150 mm over the roofing sheets. The end laps between flashing pieces shall not be less than 250 mm.

8.2.3. Laying and fixing shall be in the same manner as sheets for ridges and Hips.

8.3. **Eaves and Valley Gutters & Fixed Louvers.**

8.3.1. Gutters shall be fabricated from GI sheets 1.25mm thick or as specified.

8.3.2. Eaves or valley gutters shall be of the shapes and section as shown on the drawings or as directed by the Engineer. The overall width of the sheets referred to therein shall mean the peripheral width of the gutter including the rounded edges. The longitudinal edges shall be turned back to the extent of 12 mm, and beaten to form a rounded edge. The ends of the sheets at junctions of pieces shall be hooked into each other and beaten flush to avoid leakage.

8.3.3. Gutters shall be laid with a minimum fall of 1 in 120. Gutters shall be true to line and slope and shall be supported on and fixed to MS flat iron brackets bent to shape. Where the brackets are to be fixed to the purlins, the brackets shall consist of 50 mm x 3 mm flats bent to shape with one end turned at right angle and fixed to face of purlins with 10 m dia. bolt, nut & washer. The requisite slope in the gutters shall be given in the line of brackets. The brackets shall be placed at a spacing of not more than 1.2 m. The connecting bolts shall be above the water line of the gutters.

8.3.4. For connections to downtake pipes, Contractor shall fabricate a proper drop end or funnel-shaped connecting piece, stop ends, etc. and flat iron brackets and bolts and nuts required for fixing the latter to the roof members.

8.3.5. The gutter shall be sand blasted. It shall be painted with one coat of protective paint and one coat of synthetic enamel paint of approved colour & shade prior to erection. It shall then receive one coat of rubberised waterproof paint on the exposed side & one coat of synthetic enamel paint on the underside after erection

8.3.6. The fixed louvers shall be 100 mm deep of the similar material as sheets with all necessary framing & fixtures.

9. MEASUREMENT AND PAYMENT

9.1. The measurement shall be taken for the finished work on the flat in the plane of the roof/ side measured in sq.m without allowance for laps and corrugations and payment shall be effected based on the rates quoted by Contractor after making necessary deductions for openings.

9.2. The laps between the sheets both at the ends and at the sides shall not be measured. However, the overlaps of the sheets over valley gutters, ridge, hip and flashing pieces shall be included in the measurement.

9.3. No deduction shall be made for opening less than 0.4 sq. m in area and nothing extra shall be paid for forming such openings. For openings exceeding 0.4 sq. m in area, deductions shall be made separately. Cutting across corrugations shall be measured flat and not girthed. No additions shall be made for laps cut through.

9.4. Roofs with curved sheets shall be measured and paid for separately. Measurement shall be taken on the flat and not girthed. The breadth of the roof shall be measured along the trough of the curved sheets.

9.5. If separate rates are called for accessories in the Schedule of Quantities, these shall be measured and paid for separately or else the rate quoted for roof/side sheeting shall be deemed to include for all accessories.

9.6. Where called for separately the accessories shall be measured for the finished work taken along the centre line. The measured length of the finished work shall include the length over accessories and the rate for the same shall include the cost of accessories. Laps shall not be measured.

9.7. The rate shall include the cost of all materials and labour involved in all the operations described in these specifications and as may be necessary for the work, including one coat of approved primer and two coats of paint on overlappings of C.G.I. sheets and accessories. The materials shall include sheets, accessories, galvanised iron J or L hook bolts, and nuts, G.I seam bolts and nuts, bituminous and G.I limpet washers, brackets etc.

9.8. The rate quoted shall also include providing any staging or any temporary structure required for the purpose of installing the roof and side sheeting.

10. Providing and fixing GI sheet of approved base metal thickness with zinc coating not less than 275 GSM, fabricated to required form as per the slab profile fixed to structural steel with fastener, self-drilling screw, shear studs, connector etc. Complete at all heights and leads as per design & drawing and direction of Engineer-in-Charge.

1.0 SCOPE:

Supply & fixing of Structural decking panel made of 1.0 to 1.6 mm thick GI sheet.

1.1 Zinc Coating

The weight of coating referred to in this specification shall represent the total weight of zinc both sides inclusive.

On any sample selected at random from the delivery, one set of three samples each 50 x 50 mm or 50 mm diameter shall be selected at random from one sheet for every 500 G.S. sheets, the coating for the different classes shall be within the limit specified in table below:

Mass of Coating (Total Both Sides)

Grade of Coating	Minimum average coating Triple spot test g/sqm	Minimum coating single spot test g/sqm *
600	600	510
450	450	380
350	350	300
275	275	235

* minimum individual value obtained in triple spot test

2.0 APPLICABLE CODE:

1. AS1397
2. BS EN 10147:2000
3. CPWD specifications.

3.0 WORKMANSHIP

The decking sheets shall be laid continuously over each slab span without any intermediate splicing or jointing .The sheets are to be supported on structural steel with minimum bearing of 100mm at the intermediate supports and 50mm minimum at the end supports. The sheets shall be laid with the ribs aligned in the direction of the designed spans. The side laps shall be crimped for the proper engagement of laps. The decking sheets shall be fastened to the structural steel at every support, temporary and permanent, with Hex head min. 25 micron Zinc-Tin alloy coated, self-drilling screw of HILTI or equivalent make approved by EIC. The shear studs or connector of size as per the design of approved make to be welded to the structural steel.

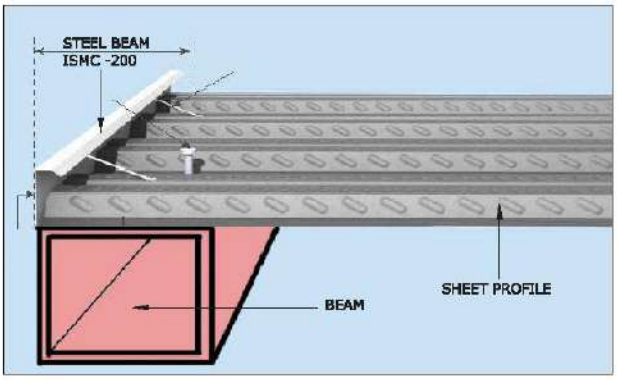
The fixing details as per manufacturers specification and fixed by specialized & approved agency by the Engineer-In-Charge. The sheet shall be filled with 75mm thick M25 grade concrete reinforced with 8mm dia. HYSD bars placed 150 mm C/C both ways.

4.0 MEASUREMENT:

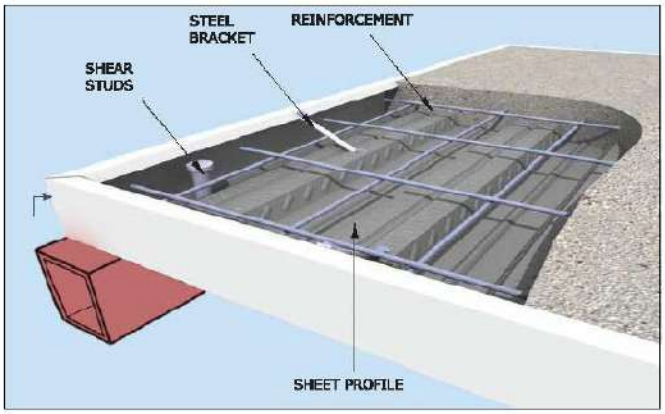
Plan area of the decking sheet to be measured and paid for.

5.0 RATES:

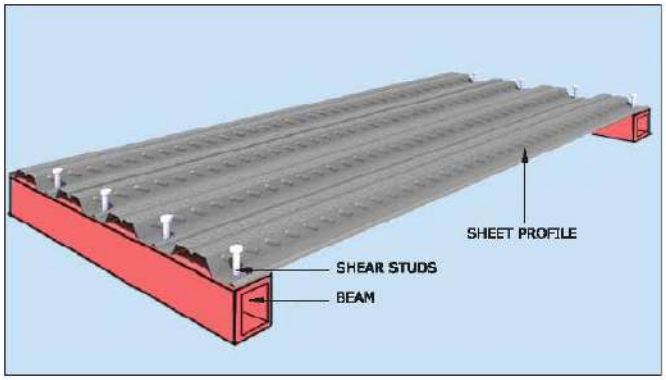
The rate shall include all materials including edge profile etc, labour and all operations at all heights and leads. Structural steel framework / support system shall be paid for separately.



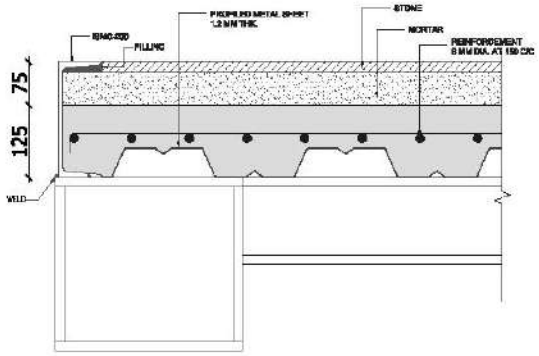
END CAPING VIEW



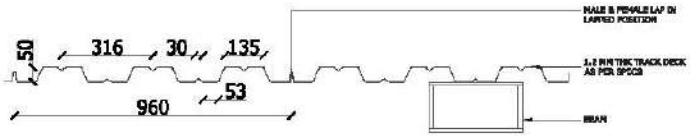
REINFORCEMENT IN SCREED OVER TRACK DECK



SHEAR STUD FIXING DETAIL



EDGE DETAIL OF METAL DECK



TYPICAL DETAIL OF TRACK DECK OVERLAPPING

END OF SECTION

1. SCOPE

This specification covers the general requirements for supply, delivery and erection of all Non-asbestos high impact Polypropylene reinforced cement corrugated sheeting for roofing and side cladding including all accessories and fixtures necessary to provide weather exposed surfaces of roof and building walls.

2. APPLICABLE CODES AND SPECIFICATIONS

The following specifications, standards and codes, including all official amendments and revisions and other specifications referred to therein shall be considered as a part of this specification. In all cases the latest issue/edition/revision shall apply. In case of discrepancy between this specification and those referred to herein, this specification shall govern.

a)	IS : 14871-2000	:	Specification for Non Asbestos corrugated and semi corrugated Non-asbestos cement sheets.
b)	IS : 730	:	Specification for hook bolts for corrugated sheet roofing.
c)	IS : 3007 (Parts 1 & 2)	:	Codes of practice for laying of sheets - corrugated and semi corrugated sheets.
d)	IS : 8869	:	Specification for washers for corrugated sheet roofing.

3. MATERIALS

3.1. Non-asbestos high impact Polypropylene reinforced cement corrugated sheets shall conform in all respects to IS:14871-2000.

3.2. The sheets shall be of the specified thickness and of approved quality.

3.3. The sheets shall be free from cracks, chipped edges or corners and other damage.

4. STORAGE OF MATERIALS

4.1. Sheets shall be stacked to a height of not more than one metre on firm and level ground, with timber or other packing beneath them.

4.2. Non-asbestos cement materials of same variety and size shall be stacked together.

5. LAYING

5.1. The sheets shall be laid on the purlins/other roof members and side girts as indicated on the drawings or as instructed by Engineer.

5.2. For 6 mm thick sheets, the maximum spacing of purlins shall be 1.4 m and for side girts 1.7 m.

5.3. 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.

5.4. The bearing surfaces of all purlins/other roof members and side girts 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 girts. The finished roof shall present a uniform slope and the lines of corrugations shall be straight and true and the completed work shall present a neat and uniform appearance and be leak proof. For side sheeting, corrugations shall be vertical and in one plane.

5.5. The sheets shall be laid with a side lap of half a corrugation and minimum end lap of 150 mm. In the case of roofs with a pitch flatter than 22o or in the case of very exposed situations, larger end laps shall be provided as directed by Engineer. The side laps shall be laid on the side facing away from the prevailing monsoon winds. The free overhang of the sheets at the eaves shall not exceed 300 mm.

5.6. The sheets shall be laid with smooth side upwards and shall generally be laid from left to right or from right to left starting at the eaves depending upon the prevailing direction of the wind. If laid from left to right, the first sheet shall be laid uncut, but the remaining sheets in the bottom row shall have the top left hand corners cut or mitred. The sheets in the second and other intermediate rows except the first and the last sheets shall have both the top left hand corner and bottom right hand corner cut. The first sheet in those rows shall have only the bottom right hand corner cut or mitred. The last or top row sheets shall have the bottom right hand corner cut with the exception of the last sheet which shall be laid uncut. If for any reason, laying is started from bottom right hand corner, then the whole procedure shall be reversed. The ‘mitre’ described above is necessary to provide a snug fit where four sheets meet at a lap. It is cut from a point 150 mm on the length of the end lap up the vertical side of the sheet to a point 45 mm along the horizontal edge. The cutting may be done with an ordinary wood saw at site. Any gap that may result due to over cutting of the sheets shall be packed with mastic/cement-mastic filler/other sealant as directed at no extra cost.

6. FIXING

6.1. Sheets shall be secured to the purlins and other roof members by means of 8 mm dia. galvanised iron J or L hook bolts and nuts. 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 bitumen washer and G.I. washer placed over the sheet before the nut is screwed down from above. On each purlin there shall be one hook bolt on the crowns adjacent to the side lap on either side. In areas subjected to stormy wind conditions four hook bolts shall be used per sheet per purlin. The G.I. flat washer shall be 25 mm in dia. and 1.6 mm thick and the bitumen washer 35 mm dia. and 1.5 mm thick 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 joint. The bolts shall be sufficiently long so that after fixing they project at least 12 mm above the top of their nuts.

6.2. Where sheets are laid on tubular purlins, the fixing bolt shall be designed to encompass at least half the tube circumference and precautions should be taken to prevent its rotation.

6.3. Holes for hook bolts, etc. shall be drilled and not punched in the ridges of the corrugations in the exact positions to suit the purlins while the sheets are on the roof in their correct position. The diameter of holes shall be 2 mm more than the diameter of the fixing bolts. No hole shall be nearer than 40 mm to any edge of a sheet or an accessory.

6.4. Direct fixing of sheets to drilled steel framework or by stud welding shall not be permitted.

7. GENERAL

7.1. All work shall proceed in a diligent and systematic manner.

7.2. Contractor shall not allow access to any person other than workmen employed for laying and fixing sheeting while the above work is in progress. If, however, it is not possible to keep the area clear, suitable safety measures shall be taken by Contractor during the progress of the work.

7.3. Contractor shall use roof ladders or planks while laying and fixing the sheets, to avoid damage to sheets and to provide safety to the workmen.

7.4. Contractor shall arrange any staging or other temporary structures required for the purpose of installing the roof and side sheeting at his own cost.

7.5. At no time shall the sheets or accessories be laid and left unfixed. Temporary fixing/supporting shall not be acceptable. In case of any loss or damage due to infringement of these conditions, by Contractor, the same shall be made good by Contractor at no extra cost.

8. NON ASBESTOS CEMENT ACCCSSORIES

8.1. Corners of building shall be properly closed with standard Non-asbestos cement corner pieces, butt jointed. Corner pieces shall be fastened directly to the side sheeting with fasteners spaced 600 mm centres, maximum.

8.2. Ridge pieces shall, as far as possible, be secured to the ridge purlins by the same bolts which secure the sheeting.

8.3. Other Non-asbestos cement accessories such as barge boards, eaves filler pieces and apron flashing pieces, shall be secured either to the supporting structure or to the sheeting by roofing bolts.

8.4. Galvanised iron roof bolts and nuts with polymer coating bearing on galvanised iron limpet washers and bitumen washers shall be used for fixing on the sheets, fixtures like ridge pieces, corner piece, cowl type ventilators, north light curves, etc.

8.5. All specials such as

a) Apron flashing pieces, eaves filler pieces, north light and ventilator curves, barge boards, corner pieces, expansion joints for sheets.

b) Ridge finials, cowl type ventilators, curved barge boards for north light curved, roof lights, expansion joints for ridges, expansion joints for north light curves, and

c) 'S' type louvers shall be of the type appropriate for use with the corrugated or semi-corrugated sheets which form the roofing or side sheeting.

8.6. The accessories shall be of the same manufacture as the corrugated or semi corrugated sheets used for the roof or side sheeting.

8.7. The material of all specials shall be free from cracks chipped edges or corners and other damages.

9. LAYING AND FIXING ACCESSORIES

The laying and fixing arrangement for all the specials shall be as described for corrugated or semi corrugated sheeting for roof and side sheeting or as per manufacturer's instructions and/or as directed by Engineer, whichever is more stringent.

10. MEASUREMENT AND PAYMENT

10.1. The measurement shall be taken for the finished work in superficial area on the flat in the plane of the roof/side measured in sq.m. without allowance for laps and corrugations and payment shall be effected based on the rates quoted by Contractor after making necessary deductions for openings.

10.2. The laps between the sheets both at the ends and at the sides shall not be measured. However, the overlaps of the corrugated sheets over valley, gutters, roof light sheets and eaves filler pieces and the under lay of the corrugated sheets below ridges, north light curves, apron flashing pieces, roof light sheets and barge boards shall be included in the measurement.

10.3. No deduction shall be made for opening less than 0.4 sq.m in area and nothing extra shall be paid for forming such openings.

10.4. Roofs with curved sheets shall be measured and paid for separately. Measurement shall be taken on the flat and not girthed. The breadth of the roof shall be measured along the trough of the curved sheets.

10.5. If separate rates are called for accessories in the Schedule of Quantities, these shall be measured and paid for separately or else the rate quoted for the roof/side sheeting shall be deemed to include for all accessories.

10.6. Where called for separately the accessories listed under group (a) in para 8.5 shall be measured for the finished work in metres. Laps between adjacent pieces shall not be measured. The accessories listed under group (b) shall be measured and paid for in numbers. In case of Ridge finials the unit shall consist of a pair of interlocking pieces. The 'S' type louvers listed under group (c) shall be measured for the finished work in length of each row of louvers measured in metres. The laps between adjacent pieces of louvers shall not be taken into account in the measurement.

10.7. The rate shall include the cost of all materials and labour involved in all the operations described in these specifications and as may be necessary for the work. The material shall interalia include sheets, accessories, galvanised iron J or L hook bolts and nuts. G.I. seam bolts and nuts, bituminous and G.I. limpet washers, brackets, etc.

10.8. The rate quoted shall also include providing of staging or any temporary structure required for the purpose of installing the roof and side sheeting.

11. LAYING AND FIXING GUTTER

11.1. Eaves and valley gutters shall be of the type and size as shown on the drawings and shall be of a manufacture approved by Engineer. The gutter sections and their accessories such as drop ends, nozzles, angles and union clips shall be free from cracks, chipped edges or corners and other damages.

11.2. Gutters shall be laid with a minimum slope of 1 in 120. Gutters when fixed shall be true to line and slope and shall be rigid and laid with the requisite accessories as indicated on

drawings or as directed by Engineer. The size of outlet of drop ends and nozzles shall be the same as the size of the rain water pipes, into which they shall be discharging.

11.3. The gutters shall be fixed to rafters, purlins etc. by means of clamps made from 25 mm x 6 mm galvanised M.S. flats spaced not more than 1.2 m centres. The gutters shall be fixed to the clamps with 2 nos. 8 mm dia. bolts and nuts, each nut with a pair of bitumen and G.I washers fixed above the water line of the gutters.

11.4. Where both ends of gutters and/or their accessories to be connected together are spigot ends, they shall be laid as butt joints with 1.5 mm gap in between over union clips. The union clip shall be connected to the two butt ends of the gutter with two rows of 8 mm dia. galvanised iron bolts and nuts, each bolt and nut being provided with a pair of bitumen and galvanised iron washers. The gap between the union clip and the butt ends of gutter shall be packed with approved bitumastic roofing compound flanked at both edges by 6 mm dia. Non-asbestos rope. The joints shall have overlap of at least 225 mm and the whole joint shall be made water tight by tightening the bolts.

12. MEASUREMENT AND PAYMENT OF GUTTERS

12.1. The work of gutters shall be measured in metres taken for the finished work along the centre line of the gutters. The measured length of the finished gutters shall include the length over accessories such as drop ends, stop ends, nozzles and angles and the rate for the same shall include the cost of the accessories. Laps shall not be measured.

12.2. The rate for gutters shall include the cost of providing and fixing all accessories necessary for completion of the work including G.I bolts, nuts, and bitumen and G.I washers, M.S. or G.I. brackets/supports and their fixture to the gutter sections and to roof members, Non-asbestos rope and bitumastic roofing compound.

END

1. SCOPE

This specification covers the general requirements for supply, delivery and erection of all precoated sheeting for roofing and side cladding including all accessories and fixtures necessary to provide weather exposed surfaces of roof and building walls for industrial, residential and commercial types of buildings, complete with openings for doors, windows, roof lights, ventilators, pipes, etc.

2. APPLICABLE CODES AND SPECIFICATIONS

The following specifications, standards and codes, including all official amendments and revisions and other specification referred to therein shall be considered as a part of this specification. In all cases the latest issue/edition revision shall apply. In case of discrepancy between the guidelines given in the codes, & this specification shall govern:

A	IS : 277	Specification for galvanized steel sheets.
B	IS : 513	Cold rolled low carbon steel sheets & strips.
C	IS : 12093	Code of practice for laying & fixing of sloped roof covering using plain & corrugated galvanized steel sheets.

3. MATERIALS

3.1. Precoated sheets shall be procured by the CONTRACTOR from approved suppliers of OWNER/ENGINEER. The colour & shade shall be approved by the OWNER/ENGINEER. No insulation should be provided for cladding.

3.2. The base material shall be cold rolled steel with yield strengths of 345 Mpa or 550 Mpa profiled to suit purlin spacing as shown on the drawings. The steel manufacturers test certificate for the chemical and mechanical properties of steel must be produced prior to installation.

3.3. **Metallic Coating**: The sheets shall have a hot dip metallic Aluminium-Zinc alloy coating of Aluminium (55%) & Zinc (45 %) with total mass coating of 150 gms/sq.mt on both sides as Zincalume AZ150 as per AS 1397;2007/ IS 15961:2012.

3.3.1 Metal cladding

Permanent colour coated sandwiched insulated metal cladding system

Troughed zinc-aluminium alloy coated (both sides) MS sheet having 0.6 mm minimum thickness (or high tensile steel sheet of 0.5 mm minimum thickness) shall be used on external face (outer face) of cladding system. Weight of coating shall not be less than 150 gms/sq.m. The outer side (exposed face) shall be permanently colour coated with Polyfluro Vinyl Coating (PVF2) of Dry Film Thickness (DFT) 20 microns (min) over primer. Inner side of external sheet shall be provided with suitable pre-coating of minimum 7 microns.

Galvanised MS sheets of minimum 0.6 mm thickness shall be used as inner liner (internal face) of cladding system. The exposed face shall be permanently colour coated with silicon modified polyester paint of DFT 20 microns (min) over primer. Inner face of external sheet shall be provided with suitable pre-coating of minimum 7 microns. The rate of galvanisation shall not be less than 180 gms/sq.m.

The permanent colour coated sheet shall meet the general requirements of IS:14246 and shall conform to class 3 for the durability.

Inner sheet shall be fixed directly to side runners and Z spacers made out of atleast 2 mm thick galvanised steel sheet of grade 375 as per IS:277. Inner sheet shall be fixed at the rate not more than 1.50 m centre to centre to hold the insulation and external sheeting.

The insulation shall be of bonded mineral wool of minimum thickness 50 mm conforming to IS:8183, having a density of 32 kg / cu.m for glass wool & 48 kg / cum for rock wool.

3.3.2 Permanent colour coated (non-insulated) metal cladding system

Troughed zinc-aluminium alloy coated not less than 150 gm/sq.m M.S.sheets having 0.6 mm minimum thickness (or High tensile steel sheet of 0.5 mm minimum thickness) shall be used for the cladding system. The outerside (exposed face) shall be permanently colour coated with PVF2 paint of minimum DFT 20 microns over primer and the inner side (internal face) shall be coated with same paint of minimum DFT 12 microns over primer. These shall be fixed directly to runners. The sheets shall meet the general requirement of IS:14246 and shall conform to class 3 for the durability.

Flashings, caps, trim closures etc

All flashings, trim closures, caps etc. required for the metal cladding system shall be made out of plain sheets having same material and coating specification as mentioned above for the outer face of the sandwiched metal cladding.

3.4. **Colour Coating**: Colorbond XRW steel quality paint coat with Super Durable Polyester or equivalent oven-baked conforming to AS/NZS 2728 Class 4/ IS 15965:2012 class-3, the total coating thickness of 35 µm (nominal) of Colorbond XRW steel or equivalent quality paint system. It comprising of nominal 20 µm exterior Super Durable polyester coat on top surface and nominal 5 µm reverse polyester coat on back surface over nominal 5 µm primer coat on both surfaces of approved colour shade for the top sheet. The sheet shall have brand marking of the manufacturer giving product details on the back of the sheet at regular interval confirming genuinity of the material.

3.5. **Profile**: The external roof panel shall be trapezoidal profile, 930- 1020 mm effective cover width, 28- 32 mm crest at 186 – 333 centre to centre, manufactured out of 0.45 mm BMT (Base Metal Thickness) /0.50mm TCT (total coated thickness excluding paint coating), Hi Tensile Zincalume/Galvalume steel pre-painted with super durable polyester Colorbond XRW paint system or equivalent of approved color shade suitable for external exposure condition. The sheet shall have subtle square fluting or shall have 2 - 3 nos. stiffening ribs in profile pan for better strength and effective water shedding. The sheet shall have special male/ female ends with full return legs on side laps for purlin support and anti- capillary groove to avoid any seepage of water through lateral overlap.

3.6. The coating shall be tested in accordance with ASTM or equivalent standards and shall have minimum performance requirements as below. A test certificate from a recognized institute/manufacturer shall be produced prior to the delivery of the sheets.

SR. NO.	PROPERTY	REQUIREMENT
1	Scratch & Mark resistance	Fair
2	Impact resistance	Greater than 10 Joules
3	Pencil hardness	F minimum
4	Bend test	6 T
5	Heat resistance	Suitable for continuous service upto 100 deg . C
6	Corrosion resistance	
I	Salt spray	No more than (8) density size A blisters, less than 2mm undercutting from a score & no visible loss of adhesion after 1000

SR. NO.	PROPERTY	REQUIREMENT
		hrs.
Ii	Humidity resistance	No more than (8) density size A blisters, no visible loss of adhesion after 1000 hrs.
iii	QAV weatherometer	A chalk rating of 8-10 after 1000 light hours.
7	Outdoor durability	The sheets in standard colours under normal well washed conditions of exposure should show no cracking, flaking or peeling of the paint film in 10 years. Colour change during service determined according to ASTM D2244, should not exceed 5 E Hunter lab. Units on light colours.
8	Surface spread of flame	Class 1

3.7. The sheets shall have a protective film at the time of delivery which shall be removed after erection.

3.8. The accessories like flashings, cappings, barge boards etc. shall be of the same material as sheets.

3.9. Sealants shall be of silicon non-hardening type.

3.10. Screws used for fixing shall be hot dip zinc coated steel, hexahead self drilling screws with EPDM washer & colour heads, colour matched to sheeting.

4. STORAGE OF MATERIALS

4.1. Sheets shall be stacked to a height of not more than one metre on firm and level ground, with timber or other packing beneath them.

4.2. Materials of same variety and size shall be stacked together.

4.3. All 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.

4.4. 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.

4.5. Manufacturer's instructions regarding delivery, stacking and storing shall be followed.

5. LAYING

5.1. The sheets shall be laid on the purlins/other roof members and side girts as indicated on the approved fabrication drawings or as instructed by Engineer.

5.2. 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.

5.3. The bearing surfaces of all purlins /other roof members and side girts 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 girts. The finished roof shall present a uniform slope and the lines of corrugations shall be straight and true and the completed work shall present a neat and uniform appearance and be leak proof. For side sheeting, corrugations shall be vertical and in one plane.

5.4. The sheets shall be laid with a minimum lap of 150 mm at the ends and 2 ridges of corrugations at each side. In the case of roofs with pitch flatter than 22 degrees, minimum end laps shall be 200 mm. The side laps shall be laid on the side facing away from the prevailing monsoon winds. The minimum lap of sheets with ridges, hips and valleys shall be 200 mm measured at right angles to the line of ridge, hip & valley respectively. The free overhang of the sheets at the eaves shall not exceed 300 mm.

5.5. 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 corrugations at hips and valleys. They shall be cut carefully with a straight edge and chiselled to give a smooth and straight finish. The sheets shall not generally be built into gables and parapets. They shall be bentup along their side edges close to the wall and the junction shall be protected by suitable flashing or by a projecting drip course covering the junction by at least 75 mm.

6. FIXING

6.1. Sheets shall be secured to the purlins and other roof members by means of self fixing hexahead screws with EPDM washers (Buildex or equivalent). The instructions of the manufacturers shall be strictly followed.

6.2. Where sheets are laid on tubular purlins, the fixing bolts shall be designed to encompass at least half the tube circumference and precautions should be taken to prevent its rotation.

6.3. No bolt shall be nearer than 40 mm to any edge of a sheet or an accessory. Sheets with holes drilled wrongly shall be rejected.

7. GENERAL

7.1. All work shall proceed in a diligent and systematic manner.

7.2. Contractor shall not allow access to any person other than workmen employed for laying and fixing sheeting while the above work is in progress. If, however, it is not possible to keep the area clear, suitable safety measures shall be taken by contractor during the progress of the work.

7.3. Contractor shall use roof ladders or planks while laying and fixing the sheets, to avoid damage to sheets and to provide security to the workmen.

7.4. Contractor shall arrange any staging or other temporary structures required for the purpose of installing the roof and side sheeting at his own cost.

7.5. At no time shall the sheets or accessories be laid and left unfixed. Temporary fixing /supporting shall not be acceptable. In case of any loss or damage due to infringement of these conditions by contractor, the same shall be made good by Contractor at no extra cost to Owner.

8. ACCESSORIES

8.1. **Ridges and hips.**

8.1.1. Ridges and hips of precoated galvanised roofs shall be covered with ridge and hip sections of precoated sheets with a minimum 200 mm lap on either side over the precoated sheets. The end laps at the ridges and hips and between ridges and hips shall also be not less than 200 mm. The ridges and hips shall be fixed as shown on the drawings.

8.1.2. Ridges and hips shall be fixed to the purlins below with the same bolts and nuts and washers which fix the sheets to the purlins. At least one of the fixing bolts shall pass through the end laps of ridges & hips, on either side. If this is not possible, extra bolts shall be provided.

8.1.3. The edges of the ridges and hips shall be straight from end to end and their surfaces shall be plane and parallel to the general plane of the roof. the ridges and hips shall fit in squarely on the sheets and shall be leak proof.

8.2. **Valleys and Flashings**

8.2.1. Valleys shall be as per drawing and fixed as shown on the drawings or as directed by Engineer. Laps with sheets shall not be less than 250 mm on either side. The end laps of valleys shall also not be less than 250.

8.2.2. Flashing shall be of precoated sheet having required girth, bent to shape and fixed as shown on the drawings. They shall lap not less than 150 mm over the roofing sheets. The end laps between flashing pieces shall not be less than 250 mm.

8.2.3. Laying and fixing shall be in the same manner as sheets for ridges and Hips.

8.3. **Eaves and Valley Gutters & Fixed Louvers.**

8.3.1. Gutters shall be fabricated as specified the Schedule of Quantities.

8.3.2. Eaves or valley gutters shall be of the shapes and section as shown on the drawings or as directed by the Engineer. The overall width of the sheets referred to therein shall mean the peripheral width of the gutter including the rounded edges. The longitudinal edges shall be turned back to the extent of 12 mm, and beaten to form a rounded edge. The ends of the sheets at junctions of pieces shall be hooked into each other and beaten flush to avoid leakage.

8.3.3. Gutters shall be laid with a minimum fall of 1 in 120. Gutters shall be true to line and slope and shall be supported on and fixed to MS flat iron brackets bent to shape. Where the brackets are to be fixed to the purlins, the brackets shall consist of 50 mm x 3 mm flats bent to shape with one end turned at right angle and fixed to face of purlins with 10 m dia. bolt, nut & washer. The requisite slope in the gutters shall be given in the line of brackets. The brackets shall be placed at a spacing of not more than 1.2 m. The connecting bolts shall be above the water line of the gutters.

8.3.4. For connections to downtake pipes, Contractor shall fabricate a proper drop end or funnel-shaped connecting piece, stop ends, etc. and flat iron brackets and bolts and nuts required for fixing the latter to the roof members.

8.3.5. The gutter shall be sand blasted. It shall be painted with one coat of protective paint and one coat of synthetic enamel paint of approved colour & shade prior to erection. It shall then receive one coat of rubberised waterproof paint on the exposed side & one coat of synthetic enamel paint on the underside after erection

8.3.6. The fixed louvers shall be 100 mm deep of the similar material as sheets with all necessary framing & fixtures.

9. MEASUREMENT AND PAYMENT

9.1. For PEB Structure mode of measurement shall be Lump sum Basis, and the price of this activity shall be included in the quote along with other activities of scope of work. Please refer the Schedule of Quantities for the type of quote (Lumpsum or item rate). For item rate contract the measurement shall be as follows.

9.2. The measurement shall be taken for the finished work on the flat in the plane of the roof/ side measured in sq.m without allowance for laps and corrugations and payment shall be effected based on the rates quoted by Contractor after making necessary deductions for openings.

9.3. The laps between the sheets both at the ends and at the sides shall not be measured. However, the overlaps of the sheets over valley gutters, ridge, hip and flashing pieces shall be included in the measurement.

9.4. No deduction shall be made for opening less than 0.4 sq. m in area and nothing extra shall be paid for forming such openings. For openings exceeding 0.4 sq. m in area, deductions shall be made separately. Cutting across corrugations shall be measured flat and not girthed. No additions shall be made for laps cut through.

9.5. If separate rates are called for accessories in the Schedule of Quantities, these shall be measured and paid for separately or else the rate quoted for roof/side sheeting shall be deemed to include for all accessories.

9.6. Where called for separately the accessories shall be measured for the finished work taken along the centre line. The measured length of the finished work shall include the length over accessories and the rate for the same shall include the cost of accessories. Laps shall not be measured.

9.7. The rate shall include the cost of all materials and labour involved in all the operations described in these specifications and as may be necessary for the work.

9.8. The rate quoted shall also include providing any staging or any temporary structure required for the purpose of installing the roof and side sheeting.

9.9. The supplier shall submit complete, detailed fabrication drawings fifteen days prior to the start of erection for approval of the Engineer. The erection shall commence based on the approved drawings only.

END

Chapter -10

Structural Steel Work

1.0 SCOPE

This specification covers the general requirements for erection of structural steel. It covers the supply and delivery of all necessary materials, labour, scaffolding, tools, tackles, equipment and everything that is necessary for the satisfactory completion of the job on schedule. Tender Data Sheet covers the specific requirements for the project. The two parts are complementary and are to be read together for a correct interpretation of the provisions of this specification, where requirements of the two sections conflict, those of Tender Data Sheet shall govern.

2.0 APPLICABLE CODES & SPECIFICATIONS

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

2.2 In case of discrepancy between this specification and other documents referred to herein, this specification shall govern. In case of discrepancy between tender drawings and this specification, the tender drawings shall govern.

2.3 Structural

(a) IS: 800 Code of Practice for General Construction in Steel

(b) IS: 801 Code of Practice for Use of Cold Formed Light Gauge Steel Structural Members in General Building Construction

(c) IS: 806 Code of Practice for Use of Steel Tubes in General Building Construction

(d) IS: 7205 Safety Code for Erection of Structural Steel Work

(e) IS: 7215 Tolerances for Fabrication of Steel Structures

(f) IS: 4000 High Strength Bolts in Steel Structure - Code of Practice

(g) AISC Specifications for Design, Fabrication and Erection of Buildings

3.0 ERECTION SCHEME

3.1 Each Bid shall be accompanied by a broad erection scheme with dates and estimated completion time for various parts of the work prepared by BIDDER after a thorough study of the Bid drawings and the site conditions. This erection scheme shall describe the methods proposed to be employed by BIDDER for transporting his equipments, tools, tackles, gas cylinders, electrodes and all that is necessary to site, unloading, transporting within the site, handling, assembling, hoisting and erecting of the structural steel components and the type, capacity and quantity of equipment that BIDDER proposes to bring to site for all these operations. The scheme shall also indicate the strength and tradewise composition of the

work force and supervisory personnel that will be deployed by BIDDER for the various operations.

4.0 ERECTION PROGRAMME

4.1 Within two weeks of the acceptance of his Bid, the successful BIDDER shall submit, a detailed erection programme. This programme shall be accompanied by a layout plan identifying the areas proposed for unloading, main storage, subsidiary storage, assembly and the transportation of equipment and fabricated material between the storage and work areas. The layout shall clearly indicate the points at which proposed erection begins, direction in which it is proposed to progress, the deployment of equipment, access route for cranes to reach work areas, etc. The locations and extent of site offices and stores shall also be indicated in detail on the above layout. Full details of the method of handling, transport, hoisting and erection including false work/staging, temporary bracing, guying, etc. shall be furnished by CONTRACTOR in this erection programme along with complete details of the quantity and capacity of the various items of erection equipment that will be used. A site organisation chart showing the number of supervisory personnel, and the number and composition of the various gangs shall also accompany the erection programme.

4.2 Any modifications to the erection programme directed by ENGINEER for the reasons of inadequacy of the quantity and/or capacity of the erection equipment, erection personnel and supervisors, temporary bracing, guying etc., or safety of the erection methods, or stability of the erected portions of structures, or unsuitability of the erection sequence due to interference with the work of other agencies shall be incorporated by CONTRACTOR and the work shall be carried out in accordance with the revised programme. Approval by ENGINEER shall not relieve CONTRACTOR from the responsibility for the safe, sound, accurate and timely erection of structural steel work as required by ENGINEER/OWNER. CONTRACTOR shall also make no extra claims for bringing additional equipment to site for erection, if so directed by ENGINEER. CONTRACTOR shall be deemed to have visualised all erection problems while bidding for the work and no additional compensation shall be claimed on this account.

5.0 SITE OPERATIONS

5.1 An experienced and qualified Superintendent shall be in full time charge of the job.

5.2 CONTRACTOR shall complete all preliminary works at site well before the arrival of structural steel, such as establishment of a well equipped and adequately staffed site office, stores, unloading gantry, unloading and pre-assembly yard, labour quarters if any, electrical and water connections, electrical winches, derricks, cranes, compressors, all tools and tackles, rivet guns, welding sets, torque wrenches, spud wrenches, staging, etc. as well as experienced erection and supervisory personnel as part of this contract and any other work that may be necessary so as to start erection immediately after the arrival of the first batch of steel at site.

5.3 CONTRACTOR shall furnish at his own expense, the necessary non-inflammable staging and hoisting materials or equipment required for the erection work and shall remove and take them away after completion of the job. CONTRACTOR shall also provide necessary passageways, fences, safety belts, helmets, lights and other fittings to the satisfaction of

OWNER/ENGINEER and to meet the rules of local authorities and for protection to his men and materials. A licensed electrician shall be kept on the job for the entire duration of the work to maintain CONTRACTOR's electrical equipment and connections.

5.4 CONTRACTOR must ensure suitable safety precautions in consultation with ENGINEER against all existing electrical installations which are live in the adjacent structures.

5.5 If a portion of the work of the project area cannot be made available to CONTRACTOR for his activities due to operations being carried out by other agencies, he shall suitably modify his sequence of operations so as to continue work without interruption. CONTRACTOR shall work in coordination with other agencies working on the project site and plan his work suitably so as not to hinder the progress of construction at site.

5.6 Crane fitness shall be checked by competent person and fitness of Operating person shall be certified by ENGINEER at site.

6.0 ACCEPTANCE OF STEEL, ITS HANDLING & STORAGE

6.1 Point of delivery of fabricated steel shall be as specified in Tender Data Sheet.

6.2 CONTRACTOR shall carefully check the steel to be erected at the time of acceptance. Any fabrication defects observed should be brought to the notice of OWNER/ ENGINEER.

6.3 No dragging of steel shall be permitted. All shall be stored 300mm above ground on suitable packing to avoid damage. It shall be stored in the order required for erection, with erection marks visible. All storage areas shall be prepared and maintained by CONTRACTOR. Steel shall not be stored in the vicinity of areas where excavation or grading will be done and, if so stored temporarily, this shall be removed by CONTRACTOR well before such excavation and/or grading commences to a safe distance to avoid burial under debris.

6.4 Scratched or abraded steel shall be given a coat of primer specified under tender Data Sheet for protection after unloading and handling prior to erection. All milled and machined surfaces shall be properly protected from rust/corrosion by suitable coating and also from getting damaged.

7.0 ANCHOR BOLTS & FOUNDATIONS

7.1 CONTRACTOR shall carefully check the location and layout of anchor bolts embedded in foundations constructed, to ensure that the structures can be properly erected as shown on the drawings, any discrepancy in the anchor bolts/foundation shall be reported to ENGINEER.

7.2 Levelling of column bases to the required elevation may be done either by providing shims or three nuts on the upper threaded portion of the anchor bolt. All shim stock required for keeping the specified thickness of grout and in connection with erection of structures on foundations, crane brackets or at any other locations shall be of good M.S. plates and shall be supplied by CONTRACTOR at his cost.

7.3 A certain amount of cleaning of foundations and preparing the area is considered normal and shall be carried out by CONTRACTOR at not extra cost.

7.4 Where beams bear in pockets or on walls, bearing plates shall be set and levelled as part of the work.

8.0 ASSEMBLY & CONNECTIONS

8.1 Field connections may be effected by either riveting, bolting, welding or by use of high strength friction grip bolts as specified in Data Sheet-A, and as shown on the design and erection drawings.

8.2 All field connection work shall be carried out in accordance with enclosed Tender Data Sheet. All bolts, nuts, washers, rivets, electrodes required for field connections shall be supplied by Erector free of cost.

8.3 All assembling shall be carried on a level platform.

8.4 Drifts shall be used only for drawing the work to proper position and must not be used to such an extent as to damage the holes. Size of drifts larger than the nominal diameter of hole shall not be used. Any damaged holes or burrs must be rectified to the satisfaction of ENGINEER.

8.5 Corrections of minor misfits and reasonable amount of reaming and cutting of excess stock from rivets shall be considered as a part of erection. Any error in the shop, which prevents proper fit on a moderate amount of reaming and slight chipping or cutting, shall be immediately reported to ENGINEER.

9.0 ERECTION

9.1 All structural steel shall be erected as shown on the drawings. Proper size steel cable slings, etc., shall be used for hoisting. Guys shall not be anchored to existing structures, foundations, etc. unless so permitted by ENGINEER in writing. Care shall be taken to see that ropes in use are always in good condition.

9.2 Steel columns in the basement, if any, are to be lowered and erected carefully with the help of a crane and/or derrick without damaging the basement walls steel or floor.

9.3 Structural steel frames shall be erected plumb and true. Frames shall be lifted at such points that they are not liable to buckle and deform. Trusses shall be lifted only at node points. In the case of trusses, roof girders, all of the purlins and wind bracing shall be placed simultaneously and the columns shall be erected truly plumb on screed bars over the pedestals. All steel columns and beams shall be checked for plumb and level individually before and after connections are made. Temporary bracings shall be introduced wherever necessary to take care of all loads to which the structure may be subjected, including erection equipment and the operation thereof. Such bracings shall be left in place as long as may be required for safety and stability.

9.4 As erection progresses, the work shall be securely bolted to take care of all dead load, wind, seismic and erection stresses.

9.5 No riveting or welding or final bolting shall be done until the structure has been properly aligned and approved by ENGINEER. No cutting, heating or enlarging of the holes shall be carried out without the prior written approval of ENGINEER.

9.6 Test certificates as specified in Tender Data Sheet shall be furnished by CONTRACTOR.

10.0 INSPECTION

10.1 ENGINEER/OWNER or their authorised representatives shall have free access to all parts of the job during erection and all erection shall be subjected to their approval. In case of faulty erection, all dismantling and re-erection required will be at CONTRACTOR's cost. No paint shall be applied to rivet heads or field welds or bolts until these have been approved by ENGINEER.

11.0 TOLERANCES

Tolerances mentioned below shall be achieved after the entire structure or part thereof is in line, level and plumb. The tolerances specified below do not apply to steel structures where the deviations from true position are intimately linked with and directly influence technological process. In such cases, the tolerances on erected steel structures shall be as per recommendations of process technologists/suppliers which will be indicated in the drawings.

11.1 Columns

11.1.1 Deviation of column axes at foundation top level with respect to true axes :

(a) In longitudinal direction : ± 5 mm

(b) In lateral direction : ± 5 mm

11.1.2 Deviation in the level of bearing surface of columns at foundation top with respect to true level : ± 5 mm

11.1.3 Out of plumbness (verticality) of column axis from true vertical axis, as measured at column top :

(a) For columns upto and including 15 metres in height : ± 1/1000 of column height in mm or ±15mm whichever is less

(b) For columns exceeding 15 metres in height : ± 1/1000 of column height in mm or ± 20 mm whichever is less

11.1.4 Deviation in straightness in longitudinal and transverse planes of column at any point along the height : : ± 1/1000 of column height in mm or ± 10 mm whichever is less

11.1.5	Difference in erected position of adjacent pairs of columns along length or across width of building prior to connecting trusses/ beams with respect to true distance	:	± 10 mm
11.1.6	Deviation in any bearing or seating level with respect to true level	:	± 5 mm
11.1.7	Deviation in differences in bearing levels of a member on adjacent pair of columns both across and along the building	:	± 10 mm

11.2 Trusses And Beams

11.2.1	Shift at the centre of span of top chord member with respect to the vertical plane passing through the centre of bottom chord	:	± 1/250 of height of truss in mm or ± 15 mm whichever is less
11.2.2	Lateral shift of top chord of truss at the centre of span from the vertical plane passing through the centre of supports of the truss	:	± 1/1500 of span of truss in mm or ± 15 mm whichever is less
11.2.3	Lateral shift in location of truss from its true vertical position	:	± 10 mm
11.2.4	Lateral shift in location of purlin true position	:	± 5 mm
11.2.5	Deviation in difference of bearing levels of trusses or beams from the true difference	:	i) ±20 mm for trusses ii) For beams : Depth < 1800mm : ±6mm Depth > 1800mm : ±10 mm
11.2.6	Deviation in sag in chords and diagonals of truss between node points	:	1/1500 of length in mm or 10mm whichever is smaller
11.2.7	Deviation in sweep of trusses, beams etc. plane	:	1/1000 of span in mm in the horizontal subject to a maximum of 10 mm

11.3 Crane Girders & Rails

11.3.1	Shift in the centre line of crane rail with respect to centre line of web of crane girder	:	± 5 mm
11.3.2	Shift in plan of alignment of crane rail with respect to true axis of crane rail at any point	:	± 5 mm

11.3.3	Difference in alignment of crane rail in plan measured between any two points 2 metres apart along rail	:	± 1 mm
11.3.4	Deviation in crane track with respect to time gauge		
	(a) For track gauges upto and including 15 metres	:	± 5 mm
	(b) For track gauges more than 15 metres	:	± [5 + 0.25 (S-15)] where S in metres is true gauge
11.3.5	Deviation in the crane rail level at any point from true level	:	1/1200 of the gauge distance or ± 10mm whichever is less
11.3.6	Difference in the crane rail actual levels between any two points 2 metres apart along the rail length	:	± 2 mm
11.3.7	Difference in levels between crane track rails at		
	(a) Supports of crane girders	:	± 15 mm
	(b) Mid span of crane girders	:	± 20 mm
11.3.8	Relative shift of crane rail surfaces at a joint in plan and elevation	:	2 mm subject to grinding of surfaces for smooth transition
11.3.9	Relative shift in the location of crane stops (end buffers) along the crane tracks with track gauge S in mm	:	1/1000 of track gauge S in mm subject to maximum of 20 mm
11.4	Chimneys And Towers		
11.4.1	Out of plumbness (verticality) from the true vertical axis	:	1/1000 of the height of the chimney or tower in mm
11.5	Bunkers		
11.5.1	Deviation in length of bunker from true length	:	± 1/1000 of length in mm
11.5.2	Deviation in width of bunker from true width	:	± 1/1000 of width in mm
11.5.3	Deviation in height of bunker from true height	:	± 1/500 of height in mm

11.5.4	Deviation in diagonal length in any horizontal cross section from the true diagonal length	:	± 1/500 of diagonal length in mm

12.0 PAINTING

12.1 Cleaning with shot blasting SA 2.5 before applying primer, Two shop coats of epoxy red oxide zinc phosphate primer of 30 microns each, One shop coat and one site coat of epoxy CR enamel of 30 microns each and touch-up with spray painting after erection.

13.0 METHOD OF MEASUREMENT

13.1 For the purpose of payment, the weight of the actual, completed structures shall be calculated from the approved drawings for different items of work. CONTRACTOR shall submit to OWNER relevant material list containing weight of each item.

13.2 No allowance will be permitted for weights of rivets, bolts, washers, screws etc. in calculating the weight of the completed structure. No allowances will be permitted for galvanizing, welding or for rolling margins. One tonne for the purpose of payment shall mean ONE METRIC TONNE i.e. 1000 Kg.

13.3 The weight of a member made out of standard rolled sections such as beams, channels, angles, etc. shall be based on the weight of the member given in IS 808, without deducting for holes, notches, bevel cuts, etc. Where a component consists of a cut joist or channel, the full weight of the rolled section shall be considered only if more than half the depth of the section is used. Otherwise only half the section unit weight shall be taken. Deductions shall be made in the weight of gussets/plates including chequered plates for skew cuts, notches and openings of 900 sq.cm. or larger.

13.4 For gussets/ plates used in trusses, bracings, columns, beams etc., the area shall be that of the minimum circumscribing rectangle, except as stated in clause 13.2 above.

13.5 The weight of any built-up member shall be separated into the weight of each component.

13.6 Erection bolts installed by erector may be left in position on completion of erection; however, no additional payment shall be made either for supply or use of such bolts. If erection bolts are removed after erection is complete, holes shall be plug welded and ground smooth. No extra payment shall be made for such plug welding.

END

1.0 SCOPE

1.1 This specification covers the general requirements for supply where specified, fabrication and delivery at site of structural steel. The bill of quantities covers the specific requirements for the project. The two parts are complementary and are to be read together for a correct interpretation of the provisions of this specification.

1.2 This specification also covers design of all connections and substituted members, preparation of all shop fabrication drawings, inspection and shop painting of structures.

2.0. APPLICABLE CODES & SPECIFICATIONS

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

In case of discrepancy between this specification and other documents referred to herein, this specification shall govern.

a) Materials

i)	IS : 808	Dimensions for Hot Rolled Steel sections
ii)	IS : 801	Dimensions for Cold Formed light gauge steel sections
iii)	IS : 814	Covered Electrodes for Manual Metal Arc Welding of Carbon and Carbon Manganese Steel
iv)	IS : 1161	Steel Tubes for structural purposes
v)	IS : 1239	Mild steel tubes, tubulars and other Wrought steel fittings Part 1 - Mild steel tubes Part 2 - Mild steel Tubulars and other wrought steel pipe fittings
vi)	IS : 1363	Hexagon Head Bolts, Screws and Nuts of product (Parts 1 to 3) Grade C (Size range M5 to M64)
vii)	IS : 1367	Technical Supply Conditions for Threaded Fasteners (All Parts)
viii)	IS : 1852	Rolling and Cutting Tolerances for Hot Rolled Steel Products
xi)	IS : 1977	Structural Steel (Ordinary Quality)
x)	IS : 2062	Steel for General Structural Purposes
xi)	IS : 2074	Ready Mixed Paint, Air drying, Red Oxide Zinc Chrome and Priming

xii)	IS : 3502	Steel Chequered Plate
xiii)	IS : 3757	High Strength Structural Bolts
xiv)	IS : 5369	General Requirements for Plain Washers and Lock Washers
xv)	IS : 5372	Taper Washers for Channels
xvi)	IS : 5374	Taper Washer for I Beams
xvii)	IS : 6610	Heavy Washers for Steel Structures
xviii)	IS : 8500	Structural Steel-microalloyed (medium and high strength qualities)

b) Codes Of Practice

i)	IS : 800	Code of Practice for General Construction in Steel
ii)	IS : 801	Code of practice for use of Cold formed light gauge steel structural members in general building construction
iii)	IS : 803	Code of practice for design, fabrication and erection of vertical mild steel cylindrical welded storage tanks
iv)	IS : 806	Code of practice for use of steel tubes in general building construction
v)	IS : 816	Code of Practice for use of Metal Arc Welding for General construction in Mild Steel
vi)	IS : 822	Code of Procedure for Inspection of Welds
vii)	IS : 1182	Recommended Practice for Radiographic examination of Fusion - Welded Butt Joints in Steel Plates
viii)	IS : 1200	Method of Measurement in Building Civil Engineering Works
ix)	IS : 1477	Code of Practice for Painting of (Parts 1 & 2) Ferrous Metals in Buildings
x)	IS : 2595	Code of Practice for Radiographic Testing
xi)	IS : 3658	Code of Practice for Liquid Penetrant Flaw Detection
xii)	IS : 4000	High strength bolts in Steel Structures - Code of Practice
xiii)	IS : 5334	Code of Practice for Magnetic Particle Flaw Detection of Welds
xiv)	IS : 7215	Tolerances for Fabrication of Steel Structures

xv) IS : 9595 Recommendations for Metal Arc Welding of Carbon and Carbon Manganese Steel

xvi) IS: 819 - Code of practice for Resistance Spot welding for light Assemblies in mild steel.

xvii) IS: 823 - Procedure Code for metal are welding of mild steel.

xviii) IS: 824 - Code of practice for welding of structure subject to Dynamic loading.

xix) IS: 1261 - Code of practice for seam welding in mild steel.

xx) IS: 1323 - Code of practice for oxy-acetylene welding for structural work in mild steel

3.0 STEEL MATERIALS

Steel materials shall comply with the specifications laid down under clause 2.0 and/or as called for on the design drawings.

All materials used shall be new, unused and free from defects.

Steel conforming to IS: 1977 or ASTM shall be used only for the following:

Fe310-0(St 32-0) : For general purposes such as door/ window frames, grills, steel gates, handrails, fence posts, tee bars and other non-structural use.

Fe410-0(St 42-0) : For structures not subjected to dynamic loading other than wind loads such as: Platform roofs, foot over bridges, building, factory sheds etc.

Fe410-0(St 42-0) : grade steel shall not be used
a) if welding is to be employed for fabrication.
b) if site is in severe earthquake zone.
c) if plastic theory of design is used.

4.0 DRAWINGS PREPARED BY THE VENDOR/CONTRACTOR

4.1 The VENDOR/CONTRACTOR shall prepare all fabrication and erection drawings based on the structural design for the entire work. All the drawings for the entire work shall be prepared in metric units. The drawings shall preferably be of one standard size and the details shown there in shall be clear and legible.

4.2 The VENDOR/CONTRACTOR shall not commence detailing unless ENGINEER's design drawings are officially approved for preparation of shop drawings. The VENDOR/CONTRACTOR shall be responsible for the correctness of all fabrication

drawings. Fabrication drawings shall be revised by the VENDOR/CONTRACTOR to reflect all revisions in design drawings as and when such revisions are made by the ENGINEER.

4.3 All fabrication drawings shall be submitted to the ENGINEER for approval.

4.4 No fabrication drawings will be accepted for ENGINEER's approval unless checked and approved by the VENDOR/CONTRACTOR's qualified structural engineer and accompanied by an erection plan showing the location of all pieces detailed. The VENDOR/CONTRACTOR shall ensure that connections are detailed to obtain ease in erection of structures and in making field connections.

4.5 Fabrication shall be started by the VENDOR/ CONTRACTOR only after ENGINEER's approval of fabrication drawings. Approval by the ENGINEER of any of the drawings shall not relieve the VENDOR/CONTRACTOR from the responsibility for correctness of engineering & design of connections, workmanship, fit of parts, details, material, errors or omissions of any and all work shown thereon. The ENGINEER's approval shall constitute approval of the size of members, dimensions and general arrangement but shall not constitute approval of the connections between members and other details. The CONTRACTOR will solely be responsible for any sort of delay in fabrication/ erection work.

4.6 The drawings prepared by the VENDOR/CONTRACTOR and all subsequent revisions etc. shall be at the cost of the VENDOR/CONTRACTOR for which no separate payment will be made.

5.0 FABRICATION

5.1 General

Fabrication activity shall be strictly started only after final approval of fabrication/erection drawing from owner and engineer. All workmanship and finish shall be of the best quality and shall conform to the best approved method of fabrication. All materials shall be finished straight and shall be machined/ground smooth true and square where so specified. All holes and edges shall be free of burrs. Shearing and chipping shall be neatly and accurately done and all portions of work exposed to view shall be neatly finished. Unless otherwise directed/ approved, reference may be made to relevant IS codes for providing standard fabrication tolerance. Material at the shops shall be kept clean and protected from weather.

5.2 Connections

5.2.1 Shop/field connections shall be as per approved fabrication drawings.

5.2.2 In case of bolted connections, taper washers or flat washers or spring washers shall be used with bolts as necessary. In case of high strength friction grip bolts, hardened washers be used under the nuts or the bolt heads whichever are turned to tighten the bolts. The length of the bolt shall be such that atleast one thread of the bolt projects beyond the nut, except in case of high strength friction grip bolts where this projection shall be atleast three times the pitch of the thread.

5.2.3 In all cases where bearing is critical, the unthreaded portion of bolt shall bear on the members assembled. A washer of adequate thickness may be provided to exclude the threads from the bearing thickness, if a longer grip bolt has to be used for this purpose.

5.2.4 All connections and splices shall be designed for full strength of members or loads as per design drawings. Column splices shall be designed for the full tensile strength of the minimum cross section at the splice.

5.2.5 All members likely to collect rain water shall have drain holes provided.

5.3 Straightening

All materials shall be straight and, if necessary, before being worked shall be straightened and/or flattened by pressure and shall be free from twists. Heating or forging shall not be resorted to without the prior approval of the ENGINEER in writing.
The straightening work shall be carried out as per IS: 1852 Class B

5.4 Cutting, punching, drilling, welding and fabrication tolerances shall be generally as per relevant IS codes.

5.5 Rolling And Forming

Plates, channels, R.S.J. etc., for portal columns, girts, gantry girders, etc., shall be accurately laid off and rolled or formed to required profile/ shape as called for on the drawings. Adjacent sections shall be match-marked to facilitate accurate assembly, welding and erection in the field.

5.6 High Strength Friction Grip Bolting

5.6.1 Inspection after tightening of bolts shall be carried out as stipulated in the appropriate standards depending upon the method of tightening and the type of bolt used.

5.7 Welding

5.7.1 Welding procedure shall be submitted to ENGINEER for approval. Welding shall be entrusted to only qualified and experienced welders who shall be periodically tested and graded as per IS 817, IS: 7310 (Part 1) and IS: 7318 (Part 1).

5.7.2 While fabricating plated beams and built up members, all shop splices in each component part shall be made before such component part is welded to other parts of the members. Wherever weld reinforcement interferes with proper fit-up between components to be assembled for welding, these welds shall be ground flush prior to assembly.

5.7.3 Approval of the welding procedure by the ENGINEER shall not relieve the CONTRACTOR of his responsibility for correct and sound welding without undue distortion in the finished structure.

5.7.4 No welding shall be done when the surface of the members is wet nor during periods of high wind.

5.7.5 Each layer of a multiple layer weld except root and surfaces runs may be moderately peened with light blows from a blunt tool. Care shall be exercised to prevent scaling or flaking of weld and base metal from overpeening.

5.7.6 No welding shall be done on base metal at a temperature below -5 Deg.C. Base metal shall be preheated to the temperature as per relevant IS codes.

5.7.7 Electrodes other than low-hydrogen electrodes shall not be permitted for thicknesses of 32 mm and above.

5.7.8 Inspection of Welds

All welds shall be inspected for flaws by any of the methods described under clause 6 "Inspection". The choice of the method adopted shall be determined by the ENGINEER.

5.7.9 The correction of defective welds shall be carried out as directed by the ENGINEER without damaging the parent metal. When a crack in the weld is removed, magnetic particle inspection or any other equally positive means as prescribed by the ENGINEER shall be used to ensure that the whole of the crack and material upto 25 mm beyond each end of the crack has been removed. Cost of all such tests and operations incidental to correction shall be to the VENDOR / CONTRACTOR's account.

5.8 Tolerances

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

5.9 End Milling

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

6.0 INSPECTION

6.1 The VENDOR/ CONTRACTOR shall give due notice to the ENGINEER in advance of the works getting ready for inspection. All rejected material shall be promptly removed from the shop and replaced with new material for the ENGINEER's approval / inspection. The fact that certain material has been accepted at the VENDOR / CONTRACTOR's shop shall not invalidate final rejection at site by the ENGINEER if it fails to conform to the requirements of these specifications, to be in proper condition or has fabrication inaccuracies which prevents proper assembly nor shall it invalidate any claim which the ENGINEER may make because of defective or unsatisfactory materials and/or workmanship.

6.1.1 No materials shall be painted or despatched to site without inspection and approval by the ENGINEER unless such inspection is waived in writing by the ENGINEER.

6.1.2 The VENDOR / CONTRACTOR shall provide all the testing and inspection services and facilities for shop work except where otherwise specified.

6.1.3 For fabrication work carried out in the field the same standard of supervision and quality control shall be maintained as in shop fabricated work. Inspection and testing shall be conducted in a manner satisfactory to the ENGINEER.

6.2 Inspection and tests on structural steel members shall be as set forth below :

6.2.1 Material Testing

If mill test reports are not available for any steel materials the same shall be got tested by the VENDOR/CONTRACTOR to the ENGINEER's satisfaction to demonstrate conformity with the relevant specification.

6.3 Tests on Welds

6.3.1 Magnetic Particle Test

Where welds are examined by magnetic particle testing, such testing shall be carried out in accordance with relevant IS codes. If heat treatment is performed, the completed weld shall be examined after the heat treatment. All defects shall be repaired and retested. Magnetic particle tests shall be carried out using alternating current. Direct current may be used with the permission of the ENGINEER.

6.3.2 Liquid Penetrant Inspection

In the case of welds examined by Liquid Penetrant Inspection, such tests shall be carried out in accordance with relevant IS Code. All defects shown shall be repaired and rechecked.

6.3.3 Radiographic Inspection

All full strength butt welds shall be radiographed in accordance with the recommended practice for radiographic testing as per relevant IS code.

6.4 Dimensions, Workmanship & Cleanliness

Members shall be inspected at all stages of fabrication and assembly to verify that dimensions, tolerances, alignment, surface finish and painting are in accordance with the requirements shown in the VENDOR/CONTRACTOR's approved fabrication drawings and the ENGINEER's drawings.

6.5 Test Failure

In the event of failure of any member to satisfy inspection or test requirement, the CONTRACTOR shall notify the ENGINEER or his authorised representative. The VENDOR / CONTRACTOR must obtain permission from the ENGINEER before repair is undertaken. The quality control procedures to be followed to ensure satisfactory repair shall be subject to approval by the ENGINEER.

6.6 The ENGINEER has the right to specify additional testing as he deems necessary, and the additional cost of such testing shall be borne by the MCGM, only in case of successful testing.

6.7 The VENDOR / CONTRACTOR shall maintain records of all inspection and testing which shall be made available to the ENGINEER or his authorised representative.

8.0 SHOP MATCHING

For structures like portals etc. shop assembly is essential. For other steel work, such as purlins along with bracings may have to be shop assembled to ensure satisfactory fabrication, obtaining of adequate bearing areas etc. if so desired by the ENGINEER. All these shop/ field assemblies shall be carried out by VENDOR/ CONTRACTOR at no extra cost to the MCGM.

9.0 DRILLING HOLES FOR OTHER WORKS

As a part of this Contract, holes in members required for installing equipment or steel furnished by other manufacturers or other contractors shall be drilled by the VENDOR/ CONTRACTOR at no extra cost to the MCGM. The information for such extra holes will be supplied by the ENGINEER.

10.0 MARKING OF MEMBERS

10.1 After checking and inspection, all members shall be marked for identification during erection. This mark shall correspond to distinguishing marks on approved erection drawings and shall be legibly painted and stamped on it. The erection mark shall be stamped with a metal dye with figures at least 20 mm high and to such optimum depth as to be clearly visible.

10.2 All erection marks shall be on the outer surface of all sections and near one end, but clear of bolt holes. The marking shall be so stamped that they are easily discernible when sorting out members. The stamped marking shall be encircled boldly by a distinguishable paint to facilitate easy location.

10.3 Erection marks on like pieces shall be in identical locations. Members having lengths of 7.0 m or more shall have the erection mark at both ends.

11.0 ERRORS

Any error in shop fabrication which prevents proper assembling and fitting up of parts in the field by moderate use of drift pins or moderate amount of reaming will be classified by the ENGINEER as defective workmanship. In case ENGINEER rejects such material or defective workmanship, the same shall be replaced by the materials and workmanship conforming to the ENGINEER's requirements by VENDOR / CONTRACTOR free of cost at site.

12.0 PAINTING

12.1 All fabricated steel material, except those galvanised shall receive protective paint coating as specified in specification No. SP-CS-SS-2.

12.2 Galvanising of fabricated steel wherever specified, shall be as per SP-CS-SS-3.

13.0 METHOD OF MEASUREMENT

13.1 For PEB Structure mode of measurement shall be Lump sum Basis, and the price of this activity shall be included in the quote along with other activities of scope of work. Please refer the section C for the type of quote (Lumpsum or item rate). For item rate contract the measurement shall be as follows.

13.2 For the purpose of payment, the weight of the actual completed structures shall be calculated from the approved drawings for different items of work. The VENDOR / CONTRACTOR shall submit to the MCGM relevant material list containing weight of each item.

13.3 No allowances will be permitted for bolts, nuts, washers, studs, screws etc, galvanizing, welding or for rolling margins. One tonne for the purpose of payment shall mean ONE METRIC TONNE i.e. 1000 Kg.

13.4 The weight of a member made out of standard rolled section such as beams, channels, angles, etc. shall be based on the standard IS:808 without deductions for holes, notches, bevel cuts, etc. Where a component consists of a cut joist or channels, the full weight of the rolled section shall be considered only if more than half the depth of the original section is used. Otherwise, only half the section unit weight shall be considered for calculation of the weight of the components.

13.5 Deductions shall be made in the weight of gussets/plates for cuts and notches of 900 sq. cm. or larger.

13.6 For gussets/ plates used in trusses, bracings, columns, beams, etc, the area shall be that of the minimum circumscribing rectangle except as stated in 13.3 above.

13.7 The weight of any built-up members shall be based on the weight of each component.

END

1. SCOPE

This specification covers the general requirements for supply, delivery and erection of MS Gates including all accessories and fixtures necessary etc. complete.

2. MATERIALS

2.1. All structural steel work shall be of sizes and sections as per drawings. They shall generally conform to relevant I.S Specifications. All the materials for the same shall be procured from approved list of manufacturers.

3. INSTALLATIONS

3.1. For each leaf of the gate, the internal members shall be welded to the internal angle iron frame of required size by means of suitable welding. The internal angle iron frame is then fixed to the outer frame by means of suitable angle iron lugs welded together. Suitable cleats for the locking arrangement are welded at the height as shown in the drawings. Both the leaves of the gates thus be fixed over suitable hinges provided on the M.S Channel posts of specified sizes. The side post which shall be erected prior to fixing the gates shall be welded with suitable size M.S plates at the bottom. These posts shall be properly embedded in cement concrete foundations of specified sizes and allowed to set properly.

3.2. All the assembly mentioned above shall be properly erected correct to line, level, plumb and render easy and proper movement of shutters.

4. SURFACE FINISHING

4.1. The shutters, channels posts and all other steel parts shall be thoroughly cleaned and painted with Zinc Chromate primer of approved make and shade. Final painting with two coats of Synthetic enamel paints of approved shade and make shall be done as directed by Engineer in charge as per specifications.

5. MODE OF MEASUREMENT

5.1. The gate shall be measured on area or its weight basis.

5.2. The length of the gate shall be measured outside to outside of the extreme M.S Channel posts and height between the extreme ends of the top and bottom channel members of shutters.

5.3. The rate shall include the cost of all materials mentioned in the drawings viz. M.S sections, guide plates & wheels, channels, hinges, locking arrangements, other accessories and painting etc. all complete.

END

1.0 SCOPE

1.1 This specification covers the general requirements for painting structural steel work involving the supply and delivery of all necessary materials, labour, scaffolding, tools and equipment. This document covers the aspects of surface treatment, application of primer paint and finish painting.

2.0 APPLICABLE CODES AND SPECIFICATIONS

The following Standard Specifications and Codes of Practice are made a part of this Specification. All standards and codes referred to herein shall be the latest editions including all applicable official amendments and revisions.

In case of discrepancy between this specification and those referred to herein, this specification shall govern.

i) IS:102 Ready Mixed paint, Brushing, Red Lead, Non-setting, Priming.

ii) IS:110 Ready Mixed paint, brushing, grey filler for enamels for use over primers.

iii) IS:117 Ready Mixed paint, Brushing, Finishing, Exterior Semigloss for general purposes, to Indian Standard colours.

iv) IS:158 Ready Mixed paint, Brushing, Bituminous, Black, Lead free, Acid, alkali and heat resisting.

v) IS:159 Ready Mixed paint, Brushing, Acid resisting.

vi) IS:341 Black Japan, Types A, B and C

vii) IS:1477 Codes of Practice for painting of ferrous metals in buildings.
Part I - Pre-treatment
Part II - Painting

viii) IS:2074 Ready Mixed paints, Red Oxide Zinc chrome priming.

ix) IS:2339 Aluminium paint for general purposes, in Dual container

x) IS:2932 Specification for enamel, synthetic, exterior, type 1,
(a) undercoating (b) finishing

xi) IS:2933 Specification for enamel, exterior, type 2,
(a) undercoating, (b) finishing

xii) IS:5905 Sprayed aluminium and zinc coatings on Iron and Steel.

xiii) IS:6005 Code of practice for phosphating of Iron and Steel.

xiv)IS:9862 Specification for ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water & chlorine resisting.

xv) IS: 13183 Aluminium paint, Heat resistant.

xvi) SIS-05-5900 Swedish Standard

3.0 SURFACE TREATMENT

3.1 All the surfaces of steel work to be painted shall be thoroughly cleaned of all loose mill scale, rust, grease, dirt and other foreign matter. The type of surface treatment shall be shot blasting if otherwise specified. The workmanship shall generally conform to the requirements of IS 1477-Part I.

3.2 Oil and grease removal shall be carried out either by solvent cleaning or by using alkali type degreasing agents. To remove grease material the surface shall be cleaned with solvents containing emulsifier. After cleaning, the surface shall be washed with water. When the surface has cement pelts or salts, the cleaning shall be done with strong alkalies. After cleaning, water rinsing and subsequent passivation by dilute chromic acid rinsing shall be carried out to ensure that no traces of alkali is left on the surface. The procedure for cleaning by above mentioned methods shall be as per manufacturer's instructions.

3.3 Derusting and descaling of steel shall be carried out either manually, mechanically or chemically.

3.3.1 Manual or Hand Tool Cleaning

Loose mill scale, loose rust and loose paint shall be removed by wire brushing, scrapping, chipping and rubbing with abrasive paper or steel wool. This method shall not be employed when the surface has firmly adhering mill scale. After hand tool cleaning, the surface shall be rubbed with sand paper so as to ensure that no loose material exists and the surfaces shall be dusted off.

3.3.2 Mechanical Cleaning

3.3.2.1 Power Tool Cleaning

This shall be carried out by employing power operated wire brushes. Power tool cleaning shall be resorted to only if sand/shot blasting is not possible/ permissible and high quality of surface preparation is required.

The surface prior to such cleaning shall be cleaned of dust, grease etc. and heavier layers of rust shall be removed by chipping.

The powertool cleaning shall remove loose mill scale and rust by adopting very thorough scrapping, grinding and machine brushing. After the surfaces are cleaned by compressed air, it shall have a pronounced metallic sheen.

3.3.2.2 Flame Cleaning

Hard mill scale and rust shall be removed through Oxy- acetylene flame. The work shall be carried out by trained workmen to ensure that only mill scale is removed without affecting the parent steel. The work shall be carried out carefully on welded surfaces so that the strength of weld is not affected due to heating.

3.3.3 Shot Blasting

3.3.3.1 Shot blasting shall be resorted to only after removal of grease, oil and other contaminants. The work shall be carried out by impinging under pressure of air, a jet of sharp or granulated steel (steel grits) on to the metal surface. The process shall ensure complete removal of rust and firmly adhering mill scale. Special care shall be taken on weld areas to remove flux and spatter. Blasting shall ensure an even colour of the surface and the surface shall have silver grey colour. Precautions shall be taken when shot blasting of light gauge steel surfaces to ensure that buckling does not occur to continuous impingement of steel shots under high velocity.

3.3.3.2 Shot blasting shall be adopted for structures which are exposed to corrosive conditions for which superior paint protection is to be adopted. The finished surfaces shall conform to the requirements of Sa 2½ or Sa 3 as per Swedish Standard SIS-05-5900 as specified in the item of work.

3.4 Chemical Cleaning (Pickling)

3.4.1 The cleaning shall be done by pickling in sulphuric, hydrochloric or phosphoric acids. Pickling shall be carried out in accordance with detailed procedure as given in IS 6005.

3.4.2 Washing after pickling shall remove all traces of the acids. All work pieces shall be thoroughly inspected and in particular the inaccessible corners.

4.0 MATERIALS

4.1 Primer Paint

4.1.1 Anti-corrosive primers shall be either lead free types. Red lead primer shall conform to IS 102 and red oxide zinc chrome primer shall conform to IS 2074.

4.2 Finish Paint

4.2.1 Acid, alkali and heat resistant bituminous paint shall conform to IS 158.

4.2.2 Acid, alkali, water and chlorine resisting bituminous paint shall conform to IS 9862.

4.2.3 Epoxy primer and epoxy paint shall be of the type as specified in the item of work from an approved manufacturer.

4.2.4 Chlorinated rubber based paint shall be of the manufacture as specified or any equivalent approved manufacture.

4.3 All the materials shall be of the best quality from an approved manufacturer. CONTRACTOR shall obtain prior approval of the ENGINEER for the brand of manufacture and the colour/shade prior to procurement for usage in the works.

4.4 Primer and finish paints shall be compatible with each other to avoid cracking and wrinkling. As such it is recommended that the primer and finish paint shall be from the same manufacturer.

4.5 The colour and shade shall conform to IS Standards referred to in Appendix 'D' of IS 1477-Part II. To facilitate choosing the correct shade/number from the alternatives available, CONTRACTOR shall adopt trial painting in small patches in consultation with and as directed by the ENGINEER.

4.6 All paint delivered to the fabrication shop/site shall be ready mixed, in original sealed containers, as packed by the manufacturer. Thinner shall not be permitted for usage unless specifically directed by the ENGINEER.

4.7 Paints shall be stirred thoroughly to keep the pigment in suspension.

4.8 CONTRACTOR shall at his own cost arrange for testing of paints as per relevant Indian Standards in standard laboratory whenever OWNER wants the tests to be carried out for each batch of paints. Test results shall be submitted to the OWNER for obtaining approval.

5.0 WORKMANSHIP

5.1 The type and the number of coats of the primer paint and finish paint shall be as specified in the respective items of work.

5.2 Painting shall be carried out only on thoroughly dry surfaces.

5.3 No painting shall be done in frosty/foggy weather or when the humidity is high enough to cause condensation on the surface to be painted. Paint shall not be applied when the temperature of the surface to be painted is at 5°C or lower.

5.4 Primers shall adhere to the surface firmly and offer a key to the subsequent coats.

5.5 The application of paint film shall serve the twin purpose of protecting the steel from corrosion and giving the decorative appearance. A paint which gives the steel adequate protection over a long period together with good appearance shall therefore be adopted.

5.6 Workmanship shall generally conform to requirements specified in IS:1477-Part II.

5.7 It is essential to ensure that immediately after preparation of the surfaces, the first coat of primer paint shall be applied by Spray painting and working it well to ensure a continuous film without "holidays". After the first coat becomes hard dry a second coat of primer shall be applied by Spray painting to obtain a film free from holidays.

5.8 Structural steel surfaces shall be given the first coat of primer at shop and the second coat after it is erected in position. Further, any abraded surfaces of the first coat during transport from shop to site and during erection shall be provided with a touch-up coat of the primer.

5.9 The dry film thickness of each coat of primer shall be not less than 25 microns.

5.10 Application of finishing paints shall be carried out within the shortest possible time interval after primer since the primer coats are too thin to give adequate corrosion protection to the steel surface over a long duration.

5.11 Filler coats shall be applied to fill dents and to obtain a smooth finish wherever necessary. Only factory prepared filler suitable for steel work shall be used. Fillers prepared by whiting and linseed oil by craftsmen at site shall never be used as such fillers may be unbalanced and incompatible with primer and finishing coats. Application of filler shall be done with good `putty knife' and necessary skill. Filler applied shall be just sufficient to fill the depression or unevenness and it shall be restricted to the minimum. It shall be applied in thin layers. In filling depression or unevenness, due as many coats as are necessary may be applied allowing each layer to dry hard. The hardened coat shall be cut down by wet rubbing before the subsequent coat is applied. Where necessary, filler coats shall be applied over the undercoats also.

5.12 Painting shall be carried only by spraying. CONTRACTOR shall procure the appropriate quality of paint for this purpose as recommended by the manufacturer.

5.13 After the second coat of primer is hard dry, the entire surface shall be wet rubbed cutting down to a smooth uniform surface. When the surface becomes dry, the undercoat of paint of optimum thickness shall be applied by brushing/spraying with minimum of brush marks. The coat shall be allowed to hard-dry. The under coat shall then be wet rubbed cutting down to a smooth finish, taking adequate care to ensure that at no place the undercoat is completely removed. The surface shall then be allowed to dry.

5.14 The first finishing coat of paint shall be applied by spraying and allowed to hard-dry. The gloss from the entire surface shall then be gently removed and the surface dusted off. The second finishing coat shall then be applied by spraying.

5.15 At least 24 hours shall elapse between the applications of successive coats. Each coat shall vary slightly in shade and this shall be got approved by the ENGINEER.

5.16 Minimum dry film thickness of each coat of finish paint of synthetic enamel shall be 25 microns. Minimum dry film thickness of other finish paints shall be as specified in the respective item of work.

5.17 The thickness of film shall be measured by an Elcometer to be supplied by the CONTRACTOR. The CONTRACTOR shall calibrate the Elcometer frequently for different settings. Necessary calibrating accessories should be kept ready for calibration/testing of Elcometer at any time.

5.18 Epoxy primer and epoxy paint shall be applied within the specified pot life all as per recommendations of the manufacturer.

5.19 Surfaces inaccessible after assembly shall receive two coats of primer prior to assembly.

5.20 Surfaces inaccessible after erection, including top surfaces of floor beams supporting grating or chequered plate shall receive one additional coat of finish paint over and above the number of coats specified prior to erection.

5.21 Portion of steel members embedded/to be encased in concrete shall not be painted. Joints to be site welded shall have no shop paint for atleast 50mm from the welding zone. Similarly, the steel surfaces shall not be painted in areas where connection is by use of friction grip bolts. On completion of the joint, the surfaces shall receive the painting as specified.

5.22 Maintenance painting of steel structures will become necessary if the painting already carried out shows signs of chalking, hairline cracking, deep checking, fine checking, peeling, blistering and rusting. The breakdown of a paint film is progressive from the top finish paint to the primer coat and the object of maintenance painting is to renovate periodically to effectively check the breakdown and protect the steel surfaces from corrosion. It is essential that same quality of paint as specified earlier need be adopted to ensure compatibility. The general workmanship for maintenance painting shall conform as per Clause. 7 of IS 1477-Part II.

5.23 CONTRACTOR shall provide suitable protection as necessary to prevent paint finishes from splashing on equipment, floors, walls etc.

6.0 MEASUREMENT

6.1 Method of measurement for payment for painting shall be in sq. metres, correct to two places of decimals, if so specified, in the respective item of work.

6.2 Painting work shall not be measured separately, if primer painting and / or primer and finish painting is already included in the scope of the item of work of fabrication and erection of structural steel since the rate per tonne of steel is deemed to include for painting as specified.

6.3 In cases where primer and / or finish painting work as specified is carried out on erected structural steel executed by a different agency, the method of measurement for painting shall be on the basis of tonnage of the steel erected. For this purpose, the tonnage of erected steel as certified for payment to the different agency shall be considered as the basis and no measurement will be carried out separately.

END

Chapter -11

Steel Work

A. STEEL DOORS / WINDOWS / VENTILATORS

1. SCOPE

The work covered under this specification consist of fabricating, supplying and installing in position steel doors / windows / ventilators, in strict accordance with these specifications and drawings.

2. APPLICABLE CODES AND SPECIFICATIONS

The following specifications, standards and codes, including all official amendments and revisions and other specification referred to therein shall be considered as a part of this specification. In all cases the latest issue/edition revision shall apply. In case of discrepancy between the guidelines given in the codes, & this specification shall govern:

No.	I.S. No.	I.S. Particulars
1	I.S. 1081	Code of practice for fixing and glazing of steel and aluminium doors, windows and ventilators.
2	I.S. 1200 (Part-VIII)	Method of measurement of building and civil engineering works.
3	I.S. 1038	Steel doors windows and ventilators.
4	I.S. 4351	Specifications for steel door frames.

3. GENERAL

3.1. Generally all steel doors shall be standardized flush type or as specified and shall be supplied by the approved steel manufacturers, properly machine welded, adequately stiffened and prepared for all hardware attachments including fixing, fixtures, and fittings as specified in the drawing.

3.2. The contractor shall submit shop drawings for all types of steel doors, for approval of Engineer-In-charge.

3.3. Fabrication of door shall be commenced only after the drawings are approved.

3.4. The shop drawing shall indicate all dimensions, details of fabrication, the gauge of the sheets, stiffeners, reinforcing anchorages, installation and other works required for complete installation.

3.5. The contractor should note that he has to get the fabrication work from some established and good firm and shall inform the name of the firm immediately to Engineer-In-charge for his concurrences.

3.6. A sample of each type of finished door complete with fittings and fixtures shall be submitted for approval of Engineer-In-charge. Sample shall be the property of the contractor.

4. FABRICATION

4.1. The pressed steel frames and shutter shall be fabricated with CRCA steel sheets of different gauges as indicated in relevant drawings and as specified in the item of schedule.

4.2. The shutter frame and stiffeners shall be fabricated with standard M. S. sections. The rebates in the door frames shall have sharp right angle corners.

4.3. All the joints shall be continuously reinforced at the back, fitted and continuously welded along the abutting edges.

4.4. For installing the pressed steel frames against the concrete like R.C.C. columns, lintels, walls etc. the hold fasts shall be welded to reinforcements or anchor plates provided in the concrete members and the pockets shall be grouted with cement concrete of strength specified for the concrete member. The anchor plates shall be paid separately.

4.5. The pressed sheet of steel frames for opening wider then one metre shall be properly reinforced to prevent sagging. Necessary reinforcement for attaching different hardwares shall be provided and frames and shutters shall be cut and suitably stiffened with steel plates to suit the hardware template for securing butts, strikes checks and other hardware.

4.6. Necessary hardware fittings and fixtures such as butt hinges mortice lock with handles, tower bolts, etc. will not be supplied by the department.

4.7. All hardware items shall be fixed in a good workmanlike manner with requisite galvanized M. S. counter sunk machine screws or as specified and directed by the Engineer-In-charge.

4.8. The contractor shall also see properly that the stains, grease, rust etc. is thoroughly removed before application of one coat of steel primer.

4.9. All the steel doors shall be approved by the Engineer-In-charge before shop painting work is undertaken by the contractor or manufacturer regarding the quality of work.

4.10. Suitable neoprene linings shall be provided around the frames as well as on intermediate hinge lines and meeting styles as shown in the drawings to make the doors perfectly airtight.

5. MODE OF MEASUREMENT :

5.1. The length and breadth of the doors / windows / ventilators in complete finished position shall be measured for outside dimensions of the frame.

5.2. The rate shall include for all materials, labour for fabrication and erection, all fittings and fixtures including locks, neoprene lining, T.W. fillers for the frames and a coat of approved steel primer.

5.3. Where there are no thresholds the height shall be measured from the finished floor levels.

B. SPECIFICATIONS FOR ROLLING SHUTTERS

1. General

Rolling shutters complete with accessories shall be of approved quality and as specified. These shall be suitable for fixing in position as specified i.e. outside or inside; on or below lintel or between jambs of the opening. Rolling shutter shall be hand/gear operated as specified in the item of schedule of quantities. For hand operated shutters, it shall be push and pull type. For

gear operated shutters, it shall be provided with reduction gear operated by mechanical device with chain, crank, shaft and handle. The shutter shall consist of 80 mm. wide m.s. laths 1.25 mm. thick or gauge as specified of best quality mild steel sheet machine rolled. Laths shall be inter locked together throughout their entire length and jointed together at the end with end locks. These shall be mounted on specially designed pipe shaft. The spring shall be of best quality and shall be manufactured from the tested tensile spring steel wire or strip of adequate strength to balance the shutter in all positions. The spring, pipe shaft etc. shall be supported on strong mild steel or malleable cast iron brackets. Both the side guides and bottom rails shall be joint less and of single piece of pressed steel of minimum 16 gauge thickness. The top cover of shaft, spring etc. shall be of the same materials as that of lath. No extra payment shall be made for the hood, brackets etc. to cover the shaft etc. The reduction gear arrangement operated by the mechanical device shall be of the best quality and shall be easy in operation.

2. FIXING:

2.1. Brackets shall be fixed on the lintel/beam or under the lintel/beam as specified in item with rawl plugs and screws, bolts, washers etc. The shaft along with the spring shall then be fixed on the brackets. The lath portion (shutters) shall be laid on ground and the side guide channels shall be bound with it. The shutter shall then be placed in position. The side guide channels shall be fixed to the wall through the plates welded to the guides. These plates and brackets shall be fixed by means of steel screws, bolts and rawl plugs drilled into the wall. The plates and screws, bolts shall be concealed in plaster to make their locations invisible. Fixing shall be done accurately in a workman like manner that the operation of the shutter is easy and smooth. All grout holes and damages on the wall while fixing of shutters shall be made good by the contractor at no extra cost to the Department. The contractor shall ensure smooth and easy working of shutters. All the members of the rolling shutter shall be thoroughly cleaned off dust, scales, rust etc. and shall be given approved priming coat of red oxide paint before fixing the shutter in position and then shall be painted with two coats of flat/synthetic enamel paint of approved quality and shade.

3. MODE OF MEASUREMENT:

3.1. The area of rolling shutters shall be measured in square metre correct up to two places of decimal. Width and height shall be taken for net opening correct to a centimeter.

3.2. The rate shall include the cost of materials, labour involved in all the operations described above.

C. SPECIFICATIONS FOR MS GRILLS / RAILING

1. GENERAL:

The contractor shall submit 6 copies of shop drawings covering all types of work under these specifications before manufacture. The drawing shall show all dimensions, details of construction, installation relating to the adjoining work.

2. MATERIALS:

All structural steel shall conform to I.S. 226 sections for grills and shall be free from loose mill scales, rusts, pittings or any other defects affecting its strength and durability.

3. FABRICATION:

3.1. The grill shall be fabricated to the design and pattern shown in the drawings. All joints shall be made in best workman like manner with slotting and welding as required to the specified size and shape. The edge of the M.S. flats shall be suitably mitred before welding to get the desired shape. The joints shall be filled to remove excess stay after welding. Screws, nuts, washers, bolts, rivets and any other miscellaneous fastenings, devices shall be of steel and shall be provided by the contractor.

3.2. Manufactured M.S. grills then are fixed in between the posts, balusters, M.S. frame work etc. to correct alignment. Any undulations, bends etc. found shall be rectified by the contractor at his own cost. The complete assembly of grill/railing so fixed shall be firm and there shall not be any lateral movements.

4. SAMPLES:

Samples of grill and railings shall be submitted for approval of the Engineer-in-Charge and to be got approved before taking up for mass fabrication.

5. INSTALLATION:

The approved grills shall be fixed in position where specified and shown in drawings including in masonry walls, teakwood frames, hand railings etc. Any damages to walls, frames etc. Caused during fixing the grills shall be made good by grouting with cement mortar/packing/repairing properly at the contractors cost.

6. PAINTING:

Painting shall be done as per the specifications specified under painting.

7. FINISHING/ PAINTING/ POLISHING FOR RAILING:

Teak wood hand rail shall be polished with wax polish / French polish / solignum with two or more coats over one coat of wood primer or painted with two coats of synthetic enamel paint / flat oil paint of approved make and shade over one coat of approved primer. M.S. grills, balusters etc. also to be painted as per specifications specified under painting / polishing.

8. MODE OF MEASUREMENT:

M.S. GRILL:

Actual area of M.S. grill manufactured and fixed in position shall only be measured in square metre or in kg for payment. All measurements shall be taken to two places of decimal of a metre and area shall be calculated to second place of decimals of a square metre.

The rate is to include the cost of all materials, labour, transporting, fabricating, installing, and scaffolding if necessary, grouting etc. complete.

HAND RAIL:

Hand railing shall be measured for payment in running meter or in kg. The length shall be measured along the top centre line of the hand rail and shall be measured between ends of balusters, newels, posts as the case may be up to two places of decimals of a meter. Rate shall be include fabrication, leaving suitable pockets, grouting the same, providing and fixing suitable teak wood plugs, fixing, all labour, materials, transport, painting/polishing, finishing and scaffolding if necessary.

END

Chapter -12

Wood Work

1. SCOPE

This specification covers the general requirements for supply, delivery and installation of all wooden frames and shutters for doors, windows and ventilators including all fittings and fixtures necessary etc.

2. APPLICABLE CODES AND SPECIFICATIONS

The following specifications, standards and codes, including all official amendments and revisions and other specification referred to therein shall be considered as a part of this specification. In all cases the latest issue/edition revision shall apply. In case of discrepancy between the guidelines given in the codes, & this specification shall govern:

No.	I.S. No.	I.S. Particulars
1	IS:287	Recommendations for maximum permissible moisture content of timber.
2	IS:337	Varnish, finishing interior.
3	IS:348	French polish.
4	IS:401	Code of practice for preservation of timber.
5	IS:419	Specification for putty for use on window frames
6	IS:710	Specification for marine plywood.
7	IS:851	Specification for synthetic resin adhesives for construction work in wood.
8	IS:1003	Specification for timber paneled and glazed shutters (Part 1 & 2)
9	IS:1141	Code of practice for seasoning of timber.
10	IS:1200 (Part-XXI)	Method of measurement of building and civil engineering works. (Wood work and joinery)
11	IS:1708(Part-1 to 18)	Method of testing of small clear specimens of timber.
12	IS:2202	Specification for wooden flush door shutters (Solid core type): Part 1 & 2
13	IS:2338	Code of practice for finishing of wood and wood based materials Part 1 & 2.
14	IS:2932	Specification for enamel, synthetic, exterior (a) undercoating, (b) finishing.

15	IS:3536	Specification for ready mixed paint, brushing, wood primer.
16	IS:3564	Specification for door closers (hydraulically regulated.)
17	IS:4020	Methods of test for wooden flush door (Part 1 to 16).
18	IS:4021	Specification for timber door, window and ventilator frames.
19	IS:7196	Specification for hold fast.
20	IS:204 (Part – I)	Specification for tower bolts (Ferrous metal)
21	IS:204 (Part – II)	Specification for tower bolts (non Ferrous metal)
22	IS:208	Specification for door handles
23	IS:723	Specification for steel countersunk head wire nails.
24	IS:848	Specification for synthetic resin adhesives for plywood
25	IS:1200 (Part-XXI)	Method of measurement of building and civil engineering works. (Wood work and joinery)
26	IS:1341	Specification for steel butt hinges
27	IS:1659	Specification for block board
28	IS:1708 (Part-1 to 18)	Method of testing of small clear specimens of timber
29	IS:1734 (Part-1 to 20	Method of test for plywood
30	IS:2202 (Part-I&II)	Specification for wooden flush door shutter (Solid core type)
31	IS:2209 (Part-I)	Specification for mortice lock of timber
32	IS:3564	Specification for door closures
33	IS:4992	Specification for door handles for mortice lock
34	IS:6760	Specification for slotted counter sunk head wood screws
35	IS:303	Plywood for general purposes specifications
36	IS:2380 (Part 1TO 21)	Method of test for wood particle boards and boards from other lignocellulosic materials
37	IS:2380 (Part 22)	Method of test for wood particle boards and boards from other lignocellulosic materials : Determination of surface glueability test
38	IS:2380 (Part 23)	Method of test for wood particle boards and boards from other lignocellulosic materials: Vibration tests for particle board
39	IS:1868	Anodic Castings to Aluminum and it's alloys.

40	IS:3818	Continuous (Piano) hinges specifications
41	IS:2681	Non ferrous metal sliding door bolts (aldrops) for with padlocks
42	IS:281	Mild steel sliding door bolts for usewith padlocks
43	IS:2209	Mortice Lock (Vertical type)
44	IS:1823	Specification for floor door stoppers.

PART I – FRAMING

3. MATERIAL FOR WOOD WORK FRAMES

Timber is classified as under:

(i) Teak wood

(ii) Sal wood

The timber shall be free from decay, fungal growth, boxed heart, pitch pockets or streaks on the exposed edges, splits and cracks. The timber shall be graded as first grade and second grade on the basis of the permissible defects in the timber. For both the grades, knots should be avoided over a specified limit.

1. MOISTURE CONTENT, SEASONING & PRESERVATION , STORAGE

1.1. MOISTURE CONTENT

Control on moisture content of timber is necessary to ensure its proper utility in various climatic conditions. For specifying the permissible limit of moisture content in the timber the country has been divided into four climatic zones as per Appendix B of Chapter 9. In each of the zones, maximum permissible limit of moisture content of timber for different uses, when determined in accordance with the procedure laid down, as per Table below

Maximum Permissible Moisture Content of Timber

Sr. No.	Use	Max Moisture Content Percent
1	Beams, Rafters & Posts	**14**
2	Doors and windows	
	(a) 50 mm and above thickness	**12**
	(b) Thinner than 50 mm	**10**
3	Flooring strips	**10**
4	Furniture & Cabinet making	**12**

Tolerance on Moisture Content:

Average Moisture content of all the samples from a lot shall be within + 3 per cent and moisture content of individual samples within + 5 per cent of maximum permissible moisture content as specified in above Table.

1.2. STORAGE

All timber shall be kept dry and well protected from rain and moisture during construction and shall be stored in dry godown approved by the Engineer-In-Charge to protect from fungi insects and marine borers. A platform has to be prepared about 150mm above prepared ground to store.

2. TEAK / SAL WOOD FRAMES (For door / windows):

Frames shall be of best quality timber as specified and wrought and put up to section as indicated on the drawings or as directed by the Engineer-In-charge.

They shall be properly framed and mortised and tongued together at right angles and set correctly in the masonry or concrete.

The frame shall rest on structural slabs and not on finished floor level.

M.S. holdfasts 230 mm long, 40 mm wide and 3 mm thick shall be fixed as shown in drawing or as directed by the Engineer-In-charge to hold the teakwood rough ground frames firmly in the masonry.

Where the rough ground/ frames are placed by the side of concrete surface they shall be fixed firmly against the concrete surface by means of teak wood gutties and screws.

All M. S. hold fast shall be fastened to the frame using adequate number of M. S. screws.

The frame shall be as per drawing and shall be provided with triangular keys for the plaster if indicated in the drawing.

While fixing the frames in position, the vertical members shall be held rigid temporarily by means of wooden battens to avoid bending or distortion of members and to keep frame exactly in plumb.

The teakwood beading/ cover mould/ stopper of the specified sizes shall be fixed on to the frame as shown in the drawings and shall be fixed on to the frame as shown in the drawings and shall be free from knots and sap wood.

3. TEAK / SAL WOOD HAND RAIL :

Teak wood hand railing and M. S. balusters frame work etc. shall be fixed in position to true line, inclination and level in best workmanlike manner as per details shown in the drawing.

M. S. balusters frame work etc. shall be bent to proper shape and embedded in concrete or masonry walls with necessary base plate or hold fast.

The embedded length of M. S. bracket/ balusters/ frame work etc. shall be sufficient enough to give the strength required to the railing.

The M. S. bracket/ blusters/ frame work etc. shall be in one piece bent to proper shape. M.S. flat for teak wood rail shall be welded to M.S. bracket/ balusters/ frame work etc. to proper inclination and level.

Grouting of the brackets/ balusters/ frame work etc. shall be done in cement concrete 1:2:4 and finish smooth.

The teak wood hand rail shall be plained to proper shape and fixed to M.S. flat by means of chromium plated screws of suitable size.

The end pieces and corner bends of the railing shall match with the inclined portion of the railing. The minimum number of joints shall be provided in teak wood railing.

All the welds shall be ground flush smooth to match with the surfaces of steel work.

The specifications for teak wood for hand rail shall be similar to teak wood frames mentioned in above para.

All the steel surfaces shall be painted with one coat of approved steel primer.

4. **MODE OF MEASUREMENT :**

The frame shall be measured in cubic metre. The cubic contents for wood work shall be measured for the finished size, limiting to those shown in the drawings or ordered by the Engineer-In-charge.

The cubical content shall be worked out correct up to three places of decimals of a cubic metre. The cross sectional dimensions shall be measured equivalent to nearest enclosing rectangle (least rectangle/ square) for wrought and planed sizes.

The frames embedded below finished floor shall not be measured. The mode of measurement for teak wood hand rail shall be running metre.

The rate for teak wood hand rail includes cost of teak wood, M. S. brackets/ balusters /frame work including all labour for fabricating, erecting and fixing in position, painting etc., AS SPECIFIED.

The rate of wood works shall include the cost of all the labour, tools and materials including wood preservative paint nails, pins, keys, wedges, screws, holdfasts etc. and erecting the same in position and for painting with one coat of approved wood primer all specified.

The rate shall also include for wastage if any.

PART II – DOOR / WINDOWS SHUTTERS

4. **BLOCK BOARD FLUSH SHUTTER**

1.1. **GENERAL**

Flush door / window shutter shall have a solid core and may be of the decorative or non-decorative type conforming to I.S. 2202.

The thickness and type of shutter shall be as specified in item of schedule of quantities. Width and height of shutter shall be as shown in the drawings or as directed by the Engineer-In charge. All four edges of shutter shall be square.

The shutter shall be free from twist or wrap in it's plane. The moisture content in timbers used in the manufacture of flush door / window shutters shall be not more than 12 percent when tested according to I.S. 1708.

The core of flush door / window shall be a block board having wooden strips held in a frame constructed of stiles and rails. Each stile and rail shall be a single piece without any joint. The width of the stiles and rails shall not be less than 75 mm and not more than 100 mm. The width of each wooden strip shall not exceed 25 mm. Stiles, rails and wooden strips forming the core of a shutter shall be of equal and uniform thickness. Wooden strips shall be parallel to the stiles.

End joints of the pieces of wooden strips of small lengths shall be staggered. In a shutter, stiles and rails shall be of one species of timber. Wooden strips shall also be one species only but it may or may not be the same species as that of the stiles and rails.

The face panel shall be formed by gluing by the hot-press process on both faces of the core either plywood or cross-bands and face veneers. The thickness of the cross bands as such or in the plywood shall be between 1.0 mm and 3.0 mm. The thickness of the face veneers as such or in the plywood shall between 0.5 mm and 1.5 mm for commercial veneer and between 0.5 and 1.0 mm for decorative veneers. The direction of the veneer adjacent to the core shall be at right angles to the direction of the wooden strips. Finished faces shall be sanded to smooth even texture.

Lipping where specified, shall be provided internally on all edges of the shutters. Lipping shall be

done with battens of first class teakwood or as specified. Joints shall not be permitted in Lipping.

The shutters shall be single leaf or double leaves as shown in the drawings or as directed by the Engineer-In-charge. In case of double leaves shutters the meeting at stiles shall be rebated by one third the thickness of the shutter. The rebating shall be either splayed or square type.

Wherever specified the opening for glazing of size as shown in drawing or as directed shall be made in the shutter for vision panel and or louver. Opening for glazing shall be lipped internally with teakwood batten of specified size.

Tolerance on width and height shall be (±) 3 mm and on thickness it shall be (±) 1.2 mm. The thickness of the door / window shutter shall be uniform throughout with a permissible variation of not more than 0.8 mm when measured at any two points.

Adhesive used for bonding various components like core, core frame, lipping, cross bands, face veneers, plywood etc. of flush door / window shutters and for bonding plywood shall be phenol formaldehyde synthetic resin conforming to I.S. 848.

Samples of flush door / window shutters shall be subjected to following tests in accordance with I.S. 2202 (Part – I & II):
End immersion test
Knife test
Glue adhesion test

All the sample shutters when tested shall satisfy the requirements of the tests as laid down in I.S. 2202 (Part – I & II) if the number of samples found unsatisfactory or a test is two or more the entire lot shall be considered unsatisfactory.

Fittings shall be provided to the contractor free of cost by the Department as decided by Engineer-In-charge. Screws for fixing these fittings shall be provided by the contractor and nothing extra shall be paid for the same.

1.1.1. MODE OF MEASUREMENT:

Length and width of the shutter shall be measured to the nearest centimeter in closed position covering the rebates of the frames but excluding the gap between the shutters and the frame. Over laps of two shutters will not be measured.

All work shall be measured net as fixed and area calculated in square metre to nearest two places of decimal.

No deduction shall be made for providing openings for vision panel/ louvers.

Rate quoted for the items shall cover all the specifications described above and for the complete work as per item of work including all labour and materials.

The work of providing vision/ louver opening and making rebates in double shutter doors/ windows shall be measured and paid for under relevant item of schedule of quantities.

1.2. TEAK WOOD PANELLED SHUTTERS:

Teak wood door / window shutter shall generally conform to standard laid in I.S. 1002 or the latest revision for requirements of materials, construction workmanship and shall be of specified thickness and of 1st class C.P. teak wood or as specified of approved design with stiles, top, bottom and lock rail generally as per drawing. Wherever shown, each panel shall be in a single width piece, but when two or more pieces have to be used and are permitted, all of them shall be of equal width and shall be jointed with a tongue and groove joint with chamfered edges glued together and reinforced with metal dowels.

Timber panels shall be preferably made of timber of larger width. The minimum width and thickness of a panel shall be 150 mm and 15 mm respectively. When made from more than one piece, the pieces shall be joined with a continuous tongue and groove joint, glued together and reinforced with metal dowels. The grains of timber panels shall run along the longer dimensions of the panels. The panels shall be designed such that no single panel exceeds 0.5 square metres in area.

1.3. TEAK WOOD GLAZED SHUTTERS:

The specifications for teak wood panelled shutter shall generally apply to glazed shutters for frame, stiles etc. The sash and beading required for glazing shall be of the best teak wood and shall be fixed as per the design shown in relevant drawing. Any mouldings, carvings shown shall be worked out from the teak wood member of bigger size.

1.4. GLAZING:

Glazing shall be generally with 4 mm. thick plain sheet glass/ bajra (frosted) glass unless otherwise mentioned in the schedule of quantities. The detailed specifications for glazing given hereafter shall be followed generally.

1.5. MISCELLANEOUS:

Wherever mentioned in the Schedule of quantities, vision panels, venetians, plastic laminates, push plates etc. shall be provided in all door / windows. The vision panels shall be of size mentioned in the drawing and shall be provided with teak wood lipping all-round the glass. The glass shall be 4 mm. thick or as specified of best quality, free from defects.

Teak wood venetians or louvers shall generally conform to relevant specifications of timber. Necessary grooves and rebate in frames shall be provided as per drawing. Formica or approved equivalent plastic laminate of required design, required shade and colour shall be provided and fixed on flush door / window to the required size on any side of the shutter as shown in drawing. It shall be fixed with Fevicol or any other approved adhesive. Fixing shall be done in such a way that there shall not be any air gap, warpage or undulations on the surface. Finished surface of Formica shall be cleaned with wax polish. The shutters shall be painted on commercial facing side with two coats of synthetic/flat oil paint of approved shade and make over an approved coat of primer. The decorative veneer side of the shutter shall be wax or French polished with two or more coats so as to render a satisfactory surface.

The flush door / windows shall be single leaf or double leaf type as mentioned in the schedule of quantities. In case of double leaf shutters, the meeting of the stiles shall be rebated 20 mm. and shall be either splayed or square type and the T.W. lipping around the meeting shall not be less than 35 mm. deep. The meeting stiles shall be in single piece. Sufficient care shall be taken to prevent any damage and loss of shape during handling, transporting, stacking, fixing etc. The door / window shutters shall be handled with utmost care to prevent any surface damage, warping etc.

1.6. MODE OF MEASUREMENT:

The work covered under the respective items in schedule and the above specifications shall be measured as follows:

The cubic contents for wood work shall be measured for the finished size, limiting to those shown in the drawings or ordered by the Engineer-in-charge. The cross sectional dimensions shall be measured equivalent to nearest enclosing rectangle (least rectangle/square) for wrought and planed sizes. The cubical content shall be worked out correct up to three places of decimals of a cubic metre. The frames embedded below finished floor shall not be measured.

The square meter areas for shutters shall be measured for the exposed surfaces of shutter between frames from inside or outside whichever is more. The linear dimensions shall be measured upto two places of decimals of a metre. The area for payment shall be worked out correct upto two places of decimals of a square metre. The rate for shutters shall include:

i) Cost of supply assembly and erecting in position.

ii) Cost of polishing, painting, supplying wood preservative, screws, nails, hold fasts etc.

iii) Cost of labour for making adjustments in frames, if required, shutters and also for fixing required fittings and fixtures.

iv) In case of flush door / windows, the rate for individual item mentioned in the schedule of quantities shall include cost of shutters, labour for provision of glass for vision panel, plastic laminate sheet push plate, teak wood louvers etc., transporting charges and labour for fixing of fixtures and fastenings except fixing of door / window closers and painting and polishing as specified.

2. FACTORY MADE PARTICLES BOARD PANELLED DOOR / WINDOW SHUTTERS

2.1. GENERAL:

Factory made particle board paneled door / window shutters shall be made of kiln seasoned and chemically treated timber as specified generally with stiles and top rails of 100 mm. in width, bottom rail and lock rails of 150/175 mm. width and panels made of 12 mm. thick both side commercial veneered teak wood particle board or as specified in schedule of quantities, bonded with phenol formaldehyde synthetic resin adhesive and generally conforming to I.S. 3091.

Factory made shutters, as specified shall be obtained from factories to be approved by the Engineer-in-Charge and shall conform to I.S. 2202 (Part-I). The contractor shall inform well in advance to the Engineer-in-Charge the name and address of the factory where from the contractor intends to get the shutters manufactured. The contractor will place order for manufacture of shutters only after written approval of the Engineer-in-Charge in this regard is given. The contractor is bound to abide by the decision of the Engineer-in-Charge and recommend the name of another

factory from the approved list, in case the factory already proposed by the contractor is not found competent to manufacture quality shutters.

The contractor will also arrange stage-wise inspection of the shutters at factory of the Engineer-in-Charge or his authorized representative. Contractor will have no claim if the shutters brought at site are rejected by Engineer-in-Charge in part or in full lot due to bad workmanship/quality. Such shutters will not be measured and paid and the contractor shall remove the same from the site of the work within seven days after the written instructions in this regard are issued by Engineer-in-Charge or his authorized representative.

2.2. TIMBER:

The timber to be used in door / window shutters shall generally conform to relevant I.S. specifications for materials, moisture content, seasoning, preservation and workmanship.

All timber shall be from the heart of a sound tree of mature growth, entirely free from sapwood. It shall be uniform in texture, straight in fiber and shall be well and properly seasoned. It shall be free from large, loose, dead or cluster knots, soft or spongy spots, hollow pockets, pith or centre heart, waves, injurious open shakes, borer holes, rot, decay date, discoloration and all other defects or any other damages of harmful nature which will affect the strength, durability, appearance of its usefulness for the purpose for which it is required.

2.3. PARTICLE BOARD PANELS:

It shall be of well seasoned teak timber particles of uniform thickness, bonded with liquid phenol formaldehyde synthetic resin adhesive of the hot press type. The particle board shall be either flat plate on press or extrusion type as approved by the Department conforming to the latest I.S. specifications. Panels shall be embedded into frames to a minimum of 12 mm. with 1.5 mm. air gaps.

2.4. SEASONING AND TREATMENT:

All timber to be used for sills and rails shall be kiln seasoned to the required standards as per I.S. 1141-1973.

2.5. ADHESIVE:

The adhesive for bonding of stiles, rails etc. shall be of highly water resistant type synthetic resins (liquid type) adhesive conforming to relevant specifications for synthetic resins.

2.6. WORKMANSHIP AND FINISH:

The workmanship shall be of best quality. All members shall be in continues length. All the faces of the door / window shutter shall be secured and in true planes. All wrought timber is to be sawn, planed, drilled or otherwise moulded work to the correct size and shapes indicated in drawing or as specified. All joinery work shall fit truly and without wedging or filling. All the faces of the shutters shall be sanded to smooth even texture. The finished sizes and sections shall be as per drawing or as specified. The shutters shall be got approved from the Engineer-in-Charge at factory site before carting the same to the site of work. The shutters damaged during the cartage and if any sub-standard materials or bad workmanship is detected, the contractor shall forthwith remove them and replace the same at his own cost, all as directed by the Engineer-in-charge.

2.7. PRIMER COAT:

All factory-made panel door / window shutters with seasoned teak wood/hard wood frame shall be painted with approved Primer coat as per I.S. specifications 1003 (Part-I).

2.8. TESTS:

Tests shall be conducted if required by the Department at the contractors cost. All shutters shall have manufacturer's trademarks. Tests shall be confirming to relevant IS codes.

2.9. TOLERANCES:

Tolerances on nominal width and height shall be (+/-) 3 mm. Tolerance on nominal thickness shall be (+/-) 1.5 mm. The thickness of the shutter frame shall be uniform throughout with a variation not exceeding 1 mm, when measured at two points.

2.10. SAMPLES:

Sample of door / window shutter shall be got approved before manufacturing on large scale.

2.11. FIXING:

The shutter shall be fixed to teak wood or rolled M.S./ EZ door / window frame (teak wood/rolled steel in door / window frames paid under relevant items) with necessary fittings as per drawing (cost of fittings and fixtures paid under relevant items). The shutter shall be painted as specified.

The shutters of specified thickness and of required sizes as fixed in position as shown in drawing/schedule of quantities shall be measured for payment. The length and width of the shutter fixed in position shall be measured correct up to three places of decimal of a metre and the areas so worked out shall be corrected up to two places of decimal of a square metre. The area of the shutter shall be measured for the exposed surfaces of shutter between frames from inside or outside whichever is more.

2.12. RATE TO INCLUDE:

The rate quoted by the contractor shall be: i) for supplying and fixing in position of finished shutters with necessary fittings and fixtures as per drawings (excluding cost of fittings and fixtures which shall be paid under relevant items). ii) painting/polishing as specified and as directed by the Engineer-in-charge.

3. FACTORY MADE PLYWOOD BOARD PANELLED DOOR / WINDOW SHUTTERS

Plywood boards are formed by gluing and pressing three or more layers of veneers with the grains of adjacent veneers running at right angles to each other. The veneers shall be either rotary cut or sliced and shall be sufficiently smooth to permit an even spread of glue. Face veneers may be either decorative on both sides or one side commercial and the other decorative. Plywood shall be of BWP grade or BWR grade as per IS 303.

3.1. Adhesive :

Adhesive used for bonding BWP grade of plywood boards shall be BWP type synthetic resins conforming to IS 848.

The thickness of all veneers shall be uniform, within a tolerance of ± 5 %. Corresponding veneers on either side of the centre one shall be of the same thickness and species. The requirements of thickness and core veneers shall be as follows:

(a) In 3 ply boards upto 5 mm thick. The combined thickness of the face veneers shall not exceed twice the thickness of centre ply.

(b) In multiply boards, the thickness of any veneer shall not be more than thrice the thickness of any other veneer.

(c) The sum of the thickness of the veneers in one direction shall approximate to the sum of the thickness of the veneers at right angle to them and shall not be greater than 1.5 times this sum except for 3 ply as specified in (a).

3.2. **Thickness:**

Plywood boards are available in thickness ranging from 3 to 25 mm. Tolerance in thickness shall be ± 10% for boards upto and including 5 mm; ± 7% for boards from 6 to 9 mm and ± 5% for boards above 9 mm thickness. The boards shall be of uniform thickness and the surfaces of the boards shall be sanded to a smooth finish. Number of plys in plywood boards shall be as per Table below

Board	Thickness in mm	Board	Thickness in mm
1	2	1	2
3 ply	3, 4, 5, 6	9 ply	12, 15, 16, 19
5 ply	5, 6, 8,9	11 ply	19, 22, 25
7 ply	9, 12, 15, 16	Above 11 play	As ordered

Note: Plywood of 9 mm thick of 5 or 7 ply may be used generally.

Moisture content of the plywood boards when tested in accordance with IS 1734 (Part 1) shall not be less than 5 per cent and not more than 15 per cent.

PART III SPECIFICATIONS FOR FITTINGS AND FIXTURES

1. SCOPE OF WORK:

The work covered under these specifications consists of supplying different types of fittings and fixtures required for door / windows, windows, ventilators etc. The supply shall be in accordance with the specification, drawings / approved samples. Samples of various fittings and fixtures proposed to be incorporated in the work shall be submitted by the contractor for approval of the Engineer-in-charge before order for bulk supply is placed.

2. GENERAL:

All fittings and fixtures shall conform to relevant IS code and made of brass, anodised aluminium, iron oxidised (M.S.) or as specified. These shall be well made reasonably smooth and free from sharp edges, corners, flaws and other defects. Screw holes shall be counter sunk to suit the heads of the specified screws. All hinges pins shall be of steel for brass hinges and aluminium alloy NR-6 or steel pins for aluminium hinges with nylon washers or as specified. All riveted heads pertaining to hinge pins shall be well formed. Screws supplied for fittings shall be of the same metal and finish

as the fittings. However brass cadmium plated/chromium plated screws shall be supplied with aluminium fittings. Samples of each fixture/ fitting shall be furnished by the contractor for approval of the Engineer-in-Charge. Order for procurement of fittings and fixtures in bulk shall be placed only after approval by the Engineer-in-Charge.

The fittings and fixtures to be incorporated in the work shall be strictly according to the approved sample. Fittings shall be fixed in proper position as shown in the drawing and as directed by the Engineer-in-Charge. These shall be truly vertical or horizontal as the case may be. Screws shall be driven home with a screwdriver and not hammered in. Recess shall be cut to the exact size and depth for the counter sinking of hinges. The fittings and fixtures shall be fixed in a workman like manner and any damages done either to fittings and fixtures or to the shutter frames etc. should be rectified by the contractor at his own cost.

Fittings shall be of Mild steel, Stainless steel, aluminium, brass or as specified. The fittings shall be well made, smooth, and free from sharp edges and corners, flaws and other defects.

Mild steel fittings shall be bright satin finish black stone enamelled or copper oxidised (black finish), nickel chromium plated or as specified.

Brass fittings shall be finished bright satin finish or nickel chromium plated or copper oxidised or as specified.

Aluminium fittings shall be anodised to natural matt finish or dyed anodic coating less than grade AC 10 of IS: 1868

Stainless steel fittings shall be non-magnetic, rust & moisture proof, strong & sturdy. Pin of hinges shall also be of stainless steel.

3. BUTT HINGES:

Brass and aluminium hinges shall be manufactured from the extruded sections and shall be free from cracks and other defects. M.S. butt hinges shall be cranked and manufactured from M.S. sheets. All butt hinges shall conform to latest I.S. specifications butt hinges shall generally condorm to releval I.S viz IS 1341 (M.S.) IS : 205 (Cast brass & aluminium, IS : 362 (Parliament hinges); IS : 453 sprig higes, IS : 3818 (Piano higes) etc. The size of butt hinges shall be taken as the length of the hinge. Width of the hinge shall be measured from the centre line of hinge pin to end of flange.

4. PARLIAMENTARY HINGES:

These shall be manufactured from extruded section for brass and aluminium and from M.S. sheets

for iron oxidised and shall be free from cracks and other defects. The size of the parliamentary hinges shall be taken as the width between open flanges, while the depth shall be as specified.

5. PIANO HINGES:

These shall be generally conformed to I.S. 3818 and shall be made of either brass oxidized, aluminium anodized, iron oxidized (M.S.) or as specified. Piano hinges shall be fixed in the entire length of the cupboard shutters in a single piece. No joints shall be allowed.

6. TOWER BOLTS:

These shall generally conform to IS 204 (Part II & I). They shall be well made and shall be free from defects.

The tower bolts shall be of the following types:

i) MS semi barrel tower bolt with ms sheet pressed barrel and G.I. bolt or with MS barrel and MS Sheet bolt.

ii) Oxidised brass barrel tower bolt with brass sheet barrel and rolled or drawn brass bolt.

iii) Anodised aluminium tower bolt with barrel and bolt of extruded sections of aluminium alloy.

In case of M.S. tower bolt plates and straps after assembly shall be firmly riveted or spot welded properly.

The knobs of brass tower bolts shall be cast and the bolt fixed into the knob firmly as per I.S. specifications. The tower bolt shall be finished to correct shape and pattern so as to have a smooth action. Wherever specified, aluminium barrel tower bolts shall be manufactured from extruded sections of barrel & bolts.

Knobs shall be properly screwed to the bolt and riveted at the back. The size of the tower bolt shall be taken as the length of barrel without top socket.

7. DOOR / WINDOW LATCH:

This shall be of MS, cast brass or as specified shall have smooth sliding action. MS Latch shall be copper oxidised (black finish) or as specified. Brass Latch shall be finished bright, CP or oxidised or as specified

8. ALDROPS:

These shall be oxidized brass or anodized aluminium, iron oxidized or as specified and shall be capable of smooth sliding action and shall be as per relevant I.S. Brass sliding door / window bolt (aldrop) shall be made from rolled brass generally confirming to IS : 2681. M.S. sliding door /

window bolt shall generally conform to I.S.281. The hasp shall be of cast brass and screwed to the bolt in a workman like manner. Alternatively the hasp and the bolt may be in one piece. Bolts shall be finished to shape and threaded with worth standard and provided with round brass washers and nuts of square or hexagonal shape. All components shall be smooth and polished. The leading dimensions of aldrop shall be as the length of the bolt and specified diameter.

9. DOOR / WINDOW HANDLES- BOW/PLATE HANDLES:

These should generally conform to IS : 208. Unless otherwise specified door / window handles shall be of 100 mm size & windows handles of 75 mm size. These shall be of cast brass of specified size, shape and pattern as approved by the Engineer-in-charge. All edges and corners shall be finished smooth and correct to shape and dimensions. Brass handles shall be finished bright, chromium plated or oxidized as specified. Anodized aluminium or iron oxidized (m.s.) handles shall be of specified size, shape and pattern. The size of the handle is taken as the inside grip of the handle. In case of iron oxidized handles, the same shall be manufactured from m.s. sheet pressed into oval section as per I.S.

10. MORTISE LOCK & LATCH:

This should generally conform to I.S. 2209. Handles shall conform to IS 4992. Mortise lock with latches and a pair of level handles shall be 6 levers, with zinc alloy pressure die cast/brass or as specified body of approved quality, and shall be right or left handed as specified. The pair of handles shall be either brass chromium plated or anodized aluminium of approved shape and pattern or as specified. It shall be of the best Indian make of approved quality. The size of the lock shall be determined by its length. The lock for single leaf door / window shall have plain face and that for double leaf door / window a rebated face. Level handles with springs shall be mounted on plates and shall be of approved quality, anodized aluminium or as specified.

11. HYDRAULIC DOOR / WINDOW CLOSER:

This shall be generally conform to IS : 3564. Hydraulic door / window closer shall be of approved quality and make. The operation of the Hydraulic door / window closer shall be very smooth. This should be of H.D.-66 for external/main door / windows and elegant -63 for all internal door / windows. The overall height should not be more than 170 mm. for H.D.-66 and 160 mm. for elegant - 63, base shall be 110 x 60 mm. for H.D.-66 and 100 x 55 mm. for elegant 63 weighing not less than 4.5 kg. for H.D.-66 and 4 Kg. for elegant - 63. Speed of the Hydraulic door / window

closer shall be adjustable and latch closing also shall be adjustable type. Suspension and lubrication of door / window closer shall be in perfect line and level.

The contractor shall provide for all the incidentals required for fixing these fixtures and fittings such as cadmium plated screws etc. Fittings and fixtures shall be fixed securely in a workman like manner all as directed by the Engineer-in charge. Any of the fixtures damaged during the fixing shall be removed and new one fixed in their place and the surface of joinery made good where affected, at his own expense. Mortise plates shall be used over holes where the bolts enter in the wood work. Metal sockets shall be provided to all bolts where the shoot enter brick, stone, concrete etc. The incidental Fixtures like mortise plates, metal sockets, screws etc. shall not be paid for separately.

12. MORTICE NIGHT LATCH:

This is a mortice lock having a single spring bolt withdrawn from the outside by using the key and from inside by turning the knob and with an arrangement whereby the lock can be prevented from being opened by its key from outside while the night latch is used from inside the room.

This should generally conform to IS: 3847. It shall be cast or sheet brass, cast or sheet aluminium alloy or mild steel as specified and of approved make. These shall be bright finished or copper oxidized (black) finish as specified. Normal size of the latch shall be denoted by the length of the face over the body in millimeters.

13. FLOOR DOOR / WINDOW STOPPER:

The floor door / window stopper shall conform to IS: 1823. This shall be made of cast brass of overall size as specified and shall have rubber cushion. The shape and pattern of stopper shall be approved by the Engineer-in-Charge. It shall be of brass finished bright, chromium plated or oxidized or as specified. The size of door / window stopper shall be determined by the length of its plate. The body of the door / window stopper shall be cast in one piece. All parts of the door / window stopper shall be of good workmanship and finish and free from surface and casting defects. Aluminium stopper shall have anodic coating of not less than grade AC-10 of IS 1868.

14. MODE OF MEASUREMENT:

All the fittings with all the necessary accessories shall be measured in numbers and the rate shall include the cost of all materials including taxes, excise duty, if any, loading, unloading, transporting, cost of screws, bolts and other accessories complete, if the same are not to be

paid for separately as per schedule of quantities.

END

Chapter -13

FRP-PVC

1. SCOPE

This specification covers the general requirements for supply, delivery and installation of all UPVC, FRP frames and shutters for doors excluding all fittings and fixtures necessary etc.

2. APPLICABLE CODES AND SPECIFICATIONS

The following codes, standards and specifications are made a part of this specification. All standards, specifications, codes of practice referred to herein shall be the latest version on the date of offer made by the Bidder. In case of discrepancy between this specification and those referred to herein, this specification shall govern.

No.	I.S. No.	I.S. Particulars
1.	IS 204 (Part I)	Specification for tower bolts (ferrous bolt)
2.	IS 204 (Part II)	Specification for tower bolts (non ferrous metals)
3.	IS 205	Specification for non ferrous metal butt hinges
4.	IS 206	Specification for Tee and strap hinges
5.	IS 207	Specification for Gate and shutter hook and eye
6.	IS 208	Specification for door handles
7.	IS 281	Specification for mild steel door bolts for use with pad locks
8.	IS 363	Specification for hasps and stapple
9.	IS 1341	Specification for steel butt hinges
10.	IS 1823	Specification for floor door stopper
11.	IS 2046	Specification for Decorative thermosetting synthetic resin bonded laminated sheet
12.	IS 2209	Specification for mortice lock (Vertical Type)
13.	IS 4992	Specification for rebated mortice lock
14.	IS 5187	Specification for flush bolts
15.	IS 5930	Specification for mortice latch
16.	IS 6607	Specification for rebated mortice lock (Vertical type)
17.	IS 6760	Specification for slotted counter sunk head wood screws.
18.	IS 12817	Specification for stainless steel Butt Hinges
19.	IS 14856	Specification for glass fiber reinforced plastic (FRP) panel type door
20.	IS 10151	Polyvinyl chloride (PVC) and it's copolymers for its safe use in contact with food stuffs, pharmaceuticals and drinking water.
21.	IS 4020	Door Shutters: Method of tests (Part 1 to 16)
22.	IS 14182	Solvent cement for use with unplasticized polyvinylchloride plastic pipe and fittings

3. UPVC- DOOR FRAMES

3.1. Material

Polyvinyl chloride Resin suspension grade is the basic raw material for forming PVC compound. PVC resin then is mixed with chemicals like Calcium, Stearate, Hydrocarbon Wax, Titanium Dioxide, Calcium Carbonate, and Acrylic processing aids. Further, additives like impact modifiers, pigments, epoxy plasticizer, UV stabilizer, lubricants, chemical blowing agent

etc. are added. The purpose of adding the chemicals and additives is to impart cellular structure, strength, surface finish, colour and resistance to fading by light rays. These chemicals are mixed in the desired proportion and shall be used in the formulation of PVC material and for free and smooth extrusion of PVC profiles.

3.2. UPVC Door Frame

UPVC door frame shall be made of PVC material conforming to IS 10151. The door frame shall be made from extruded UPVC section having overall dimensions of 48 x 40 mm or 42 x 50 mm having wall thickness of 2.0 mm + 0.2 mm. Corners of the door frame to be joined by M.S. galvanized brackets. Joints mitered and plastic welded. The hinge side vertical outer frames shall be reinforced by galvanized M.S. Tube of size 19 x 19 mm of wall thickness 1 mm + 0.1 mm and a tie rod shall be provided at the bottom of the frame. The frame shall be fabricated in factory as per nomenclature of the item and directions of Engineer-in-Charge.

3.3. Fixing of Frames

The frames are to be fixed in prepared openings in the walls. All civil work and tiling should be completed before the fixing of the frames. The frames are to be fixed directly on the plastered wall. In case tiling is to be done in the place the frames are to be fitted, a 50 mm strip should be left untiled at the location where the frames are to be fitted. The frames are erected in the prepared opening such that the vertical members of the door frame are embedded 50 mm in the floor. The frame shall be fitted truly in plumb. A minimum of three anchor bolts or screws of size 65/100 shall be used to fix each vertical member. One bolt shall be fixed at 200 mm from the top member and one bolt shall be fixed at 200 mm from the floor. The third anchor bolt shall be fixed in the center. The top horizontal member shall be fixed using two 65/100 size anchor bolts or screws at a distance of 200 mm from both the corners.

3.4. Measurements

The outer length of the vertical and horizontal members of UPVC door frame shall be measured in running meters including embedded length in floor corrected up to a cm.

3.5. Rate

The rate includes the cost of the materials and labour involved in all the operations described above. The cost of anchor bolts or screws for joining the frame is included in the rate. Any other hardware, which may be required, shall be paid for separately.

4. PVC DOOR SHUTTERS

The shutters shall be fabricated at factory as per nomenclature of the item and directions of Engineer-in-Charge. Shutter shall be made of PVC material conforming to IS 10151.

4.1. Sampling and Criteria for Conformity

4.1.1. General Precautions

4.1.1.1. The test specimens shall not have been exposed to a temperature below 40°C for 24 hours immediately preceding the test and shall be free from all visible moisture. The specimen shall be inspected and any specimen with visible flaws shall be discarded.

4.1.1.2. If any test specimen fails because of mechanical reason, such as failure of testing equipment or improper specimen preparation, it shall be discarded and another specimen taken.

4.1.2. Sampling

4.1.2.1. Sampling criteria for conformity shall be in accordance with IS 4020 (Part –I)

4.1.2.2. Lot in any consignment of shutters shall be of the same grade and type and manufactured under similar conditions of production which shall be grouped together to form a lot.

4.1.2.3. The number of shutters to be selected at random from a lot shall depend upon its size and shall be in accordance with Col. 1 and Col. 2 of Table-I.

TABLE - I
No. of Sample and Criteria for Conformity

Sr. No.	Sample size	Permissible No. of Defects
26 to 50	8	1
51 to 100	13	1
101 to 150	20	1
151 to 300	32	1
301 to 500	50	2
501 and above	80	2

Note: For lot size 25 or less, number of samples to be taken for testing shall be as agreed to between the manufacturer & Engineer-in-Charge.

Number of Tests: The samples selected as in column 2 of Table-I shall be as agreed to between the manufacturer & Engineer-in-Charge.

4.1.2.4. Criteria for Conformity: The lot shall be considered conforming to the requirements if the number of samples failing to satisfy the requirements of characteristics does not exceed the permissible number mentioned in col. 3.

4.2. Test

4.2.1. The door shutters shall be subjected to the following tests in accordance with IS 4020 (Part 1 to 16).

(a) Dimension and Squareness Test: Door shutters when tested in accordance with IS 4020 (Part 2) the dimensions of nominal width and height will be within a limit of + 5 mm. The door shutter shall not deviate by more than 1 mm on a length of 500 mm. The thickness of the door shutter shall be uniform throughout with the permissible variation of not more than 0.8 mm between any two points. The nominal thickness of the shutter shall be within a limit of + 1.5 mm.

(b) General Flatness Test: Door shutter, when tested in accordance with IS 4020 (Part 3) the twist, cupping and warping shall not exceed 6 mm.

(c) Local Planeness Test: Door shutters, when tested in accordance with IS 4020 (Part 4), the depth of deviation measured at any point shall not be more than 0.5 mm.

(d) Impact Indentation Test: Door shutters, when tested in accordance with IS 4020 (Part 5), shall have no defects such as cracking, tearing or delamination and the depth of indentation shall not be more than 0.2 mm.

(e) Edge Loading Test: Shutters of door, when tested in accordance with IS 4020 (Part 7) the deflection of the edge at the maximum load shall not be more than 5 mm. On removal of the loads, the residual deflection shall not be more than 0.5 mm, failing which the test may be repeated on the other edge in the reverse direction. Also there shall be no lateral buckling by more than 2 mm during loaded condition and no residual lateral buckling after removal of the load.

(f) Shock Resistance Test: Door shutters, when tested in accordance with 2.1 of IS 4020 (Part 8), there shall be no visible damage in any part of the door after twenty five blows on each end.

(g) Buckling Test: Door shutters, when tested in accordance with IS 4020 (Part 9), shall not show any deterioration and any residual deformation more than 5 mm after 15 min. of unloading and the initial deflection also shall not be more than 50 mm.

(h) Slamming Test: Door shutters, when tested in accordance with 2.1 of IS 4020 (Part 10), shall not have any damage in any part of the door at the end of successive impacts. Door shutters, when tested in accordance with 3.1 of IS 4020 (Part 10), shall not have any visible damage in part of the door at the end of 100 successive impacts.

(i) Misuse Test: Door shutters, when tested in accordance with IS 4020 (Part 11), there shall not be any permanent deformation of the fixing or any other part of the door set in hindering its normal working after the test.

(j) Screw Holding Test: Door shutters, when tested in accordance with IS 4020- Part 16, the load shall not be less than 1000 N.

(k) End Immersion Test: Shutters of door, when tested in accordance with IS 4020- Part 13, the shutter shall not show any delamination.

(l) Knife Test: Door shutter, when tested in accordance with IS 4020 – Part 14, the grading shall be standard & excellent.

(m) Glue Adhesion Test: Door shutters shall be tested in accordance with IS 4020 – Part 15. There should be no delamination.

4.3. Fixing of Shutters

PVC door shutter shall be side hung on three bolt hinges of size 100 mm, one at the centre and the other two at 200 mm from the top and bottom of the shutter. The flat of the hinges shall be neatly counter sunk in to the recesses cut out to the exact dimensions of the hinge flap. The door shall be drilled on the thickness to fit hinges. Screws for fixing the hinges shall be

screwed in with screwdrivers and not hammered. The length of the screws should be 8 mm/30 mm. The hinges used should be of stainless steel.

4.4. Tolerance

The tolerance on the width and the height of the door shall be + 5 mm and the tolerance on the nominal thickness of the door shall be + 2 mm.

4.5. Fittings

Fittings shall be provided as per schedule of fittings decided by Engineer-in-Charge. In moisture prone areas M.S. fittings and screws should not be used. Hardware such as handles, tower bolt, stopper, buffer etc. should be directly screwed (not pre-drilled) and fitted on the door.

4.6. Measurements

Length and width of the shutters shall be measured to the nearest cm in closed position covering the rebates of the frames but excluding the gap between the shutter and the frame. Area is calculated to the nearest 0.01 sqm.

4.7. Rate

The specified rate includes the cost of the door shutter and labour involved in fixing of the shutter. Fittings & fixtures on the door shutter except hinges & screws shall be paid extra as provided.

5. PVC DOOR FRAME

Solid PVC door frame and shutter shall be as per clause 2.1.

5.1. Solid PVC Door Frames consisting of section 50 x 47 mm shall be fabricated from 5 mm PVC sheet having density of 600 kg/cum. The sheet used may be in plain colour, printed design or prelam veneer shade as approved by the Engineer-in-Charge. The weight per running meter of the door frame including reinforcement should be a minimum of 1.5 kg/sq. m. The depth of the rebate of door frame shall be 10 mm. Frames shall have smooth surface, without any warping or bending in any member. All the parts of the door frame are to be joined to each other using solvent adhesive conforming to IS 14182. A tolerance of + 3 mm shall be permitted in the specified dimension of PVC section in the door frames. The solid PVC door frames shall be fabricated in factory as per nomenclature of the item and directions of the Engineer-in-charge.

5.2. Fixing of Frames

As per clause 1.3.

5.3. Measurements

As per clause 1.4.

5.4. Rate

As per clause 1.5.

6. Panel PVC Door Shutter

6.1. Panel PVC Shutters are factory made shutter and shall be brought to site fully assembled. The Solid Panel PVC Door shall be fabricated from 5 mm PVC sheet. The sheets used may be in plain colour, printed design or prelam veneer shade as approved by the Engineer-in-Charge. The shutters shall be fabricated at factory as per nomenclature of the item and directions of the Engineer-in-charge.

(a) 30 mm thick panel PVC door shutters.

6.2. Sampling and Criteria for Conformity

As per clause 2.1.

6.3. Tests

As per clause 2.2 (k), (l) & (m).

6.4. Fixing of Shutters

As per clause 2.3. In addition, it may be ensured that while fixing hinges the screws pass through the two opposites surfaces of the M.S. reinforcement.

6.5. Tolerance

As per clause 2.4.

6.6. Fittings

As per clause 2.5

6.7. Measurements

As per clause 2.6.

6.8. Rate

As per clause 2.7.

7. FIBRE GLASS REINFORCED PLASTIC (FRP) DOOR FRAMES

7.1. Door Frames shall be three legged of cross section 90 mm x 45 mm having single rebate of size 32 mm x 15 mm to receive shutter of 30 mm thickness. The frame shall be made of laminate of thickness of 2 mm and shall be filled with wooden blocks of exterior grade MDF or seasoned and treated hard wood inside the laminate in all the three legs of the frame. The frame to be moulded by either hand lay up or resin transfer moulding process. The process shall consist of laying gel coat at 1000 gms/m2 and laid over with layer of FRP Mat (CSM mat) gel coat and FRP (CSM Mat) are defined in IS 14856. The CSM mat shall be bonded with Isopatholic resin in the ratio not less than 1:2 (One part of Mat to two parts of Isopatholic resin and fillers & additives) by weight. The edge shall be sealed with gel coat and FRP mat to obtain smooth finish. Sufficient roving shall be laid in the corner to have smooth curve while laying the CSM mat.

7.2. FRP door shall be manufactured as per specifications laid down in IS 14856, nomenclature of items & direction of Engineer-in-Charge.

7.3. Tolerance

Tolerance in the size of frame to be +2 mm and for size of rebate to be +1 mm.

7.4. Finish

The surface of the moulded frame shall be free from any visible defects such as small pores, crazing, blistering, wrinkling, impurities, defective impregnation, colour blots and aggregate defects, as mentioned in IS 14856. Scattered pin holes duly repaired and finished by applying resin and not noticeable shall be acceptable. Frame laminate shall be flat and shall have smooth and level surface. Laminate shall be finished in colour & shade as approved by Engineer-in-Charge.

7.5. Fixing of Frame

As per clause 1.3.

7.6. Measurement

As per clause 1.4.

7.7. Rate

As per clause 1.5.

8. FIBRE GLASS REINFORCED PLASTIC (F.R.P.) SHUTTERS

8.1. F.R.P. Shutters shall be manufactured conforming to the specifications as per IS 14856 and nomenclature of item & direction of Engineer-in-Charge.

8.2. Blocks of any seasoned hardwood of bulk density not less than 450 kg/m3 at 12 per cent moisture content or any other material of sufficient thickness and length shall be provided inside the shutter at suitable place to hold fittings and fixtures such as aldrops, tower bolt,

handle, sliding door bolt, mortice lock etc. Blocks for hinges shall be provided at three locations, unless otherwise specified by the purchaser. One at the centre and other two at 200 mm from the top and the bottom of the shutter. Blocks shall be provided at predetermined places in the shutter so as to fix hinges mortice locks, tower bolts, aldrops, door closures, etc. The finished surface shall be buffed and polished with wax.

8.3. Location of Fittings and Accessories

The lock rail of door shutters shall be so placed that is centre line is at a height 850 + 5 mm from the bottom of the shutter. Door shutter shall be fixed to the frame with three hinges, unless otherwise specified by the purchaser, of the type specified. These locations shall be, one at centre and other two at 200 mm from the top and the bottom of the shutter, where blocks have already been provided and suitable indication by depressing the profile has been made. Screws for fixing the hinges shall be screwed in with screwdrivers & not hammered. The length of screw should be 8/30 mm. The hinges used shall be stainless steel or aluminum.

8.4. Sampling & criteria for conformity Shall be as per clause 2.1.

8.5. Finish

As per clause 5.4.

8.6. Tests

As per clause 2.2 (j), (k), (l) & (m).

8.7. Fixing of Shutter

As per clause 2.3.

8.8. Tolerance

As per clause 2.4.

8.9. Measurement

As per clause 2.6.

8.10. Rate

As per clause 2.7.

9. SOLID PVC FOAM PROFILE DOORS

9.1. Solid PVC Foam Profile Frame

Solid PVC foam profile frame doors are made from solid PVC foam profiles 60 x 30 mm with integral skin cut to required size. Doors are provided with naturally strong stiffener frame and sandwich paneled to offer sound and heat insulation with pressure laminate/infill panel to provide scratch resistance surface. Supporting bar at bottom side of frame shall be provided for maintaining frame in plumb. The frame shall be fabricated in factory as per nomenclature of the item and directions of the Engineer-in-charge. PVC door frame should have shore hardness more than 70.

9.2. Fixing of Frames

As per clause 1.3.

9.3. Test in PVC Foam Profiles

Tests on PVC Foam Profiles shall be as per Table-II below:

TABLE - II

Sr. No.	Property	Test Method	Unit	Acceptable Value
1	Density (at 27°C)	ASTM D 792	gm/cc	0.5-0.7
2	(A)Tensile strength at yield	ASTM D 638	PSI %	2000
	(B) Elongation at Break	ASTM D 638		20

Sr. No.	Property	Test Method	Unit	Acceptable Value
3	Tensile Modulus (Modulus of Elasticity)	ASTM D 638	N/Sq.mm	200
4	Impact strength (Charpy Unnotched)	ASTM D 256	ftlb/sq.In	7
5	Durometer Hardness	DIN 53505	Shore D	70
6	Vicat Softening Point (at 10N Load)	ASTM D 1525	C	75
7	Flammability	UL 94		Self Extinguishing

9.4. Measurements

As per clause 1.4.

9.5. Rate

As per clause 1.5.

10. Solid PVC Foam Shutters

Solid PVC foam shutters are made from solid PVC foam profiles with integral skin. Doors are provided with naturally strong stiffener frame and sandwich panelled to offer sound and heat insulation with pressure laminate /infill panel provides scratch resistance surface. Door shutters can be nailed, screwed, drilled, glued, sawn lapped or welded just like wood and characterized by excellent screw holding strength (200 kgf.).

10.1. 28 MM Thick Door Shutters

Profile is cut in required length to make vertical & horizontal stile. Mitered cut joint are made using solvent based PVC adhesive & epoxy solvent. GI 'C' stiffener 39 x 19 x 19 or 40 x 20 x 19g. M.S Pipe is fixed in the grooves made in frame. Telescopic polymeric corners are provided at corners for better rigidity. Infill panel 3 mm thick HPL sheet is fixed with CSK screws of required size to the profile frame as specified. Mirror image of shutter frame is joined using solvent based PVC adhesive as well as CSK type sheet metal screws of required size at four corners at top & bottom. Additional bonding strength is provided by using silicone sealant epoxy sealant at joints. Lock rail is provided by using PVC profile & 'C' type GI stiffener 40 x 10 in the groove & fixed with adhesive to frame & infill. Decorative corner moulding is fixed to impart elegant look. The fabrication shall be done in factory as per nomenclature of the item and directions of Engineer-in-Charge.

10.2. Sampling and Criteria for Conformity

As per clause 2.1.

10.3. Tests

As per clause 2.2.

10.4. Fixing of Shutters

As per clause 2.3.

10.5. Tolerance

As per clause 2.4.

10.6. Fittings

As per clause 2.5.

10.7. Measurements

As per clause 2.6.

10.8. Rate

As per clause 2.7.

END

Chapter -14

Aluminium Work

1. SCOPE

The work covered under this specification consist of fabricating, supplying and installing in position aluminum glazed doors, windows, ventilators and wall spans in strict accordance with these specifications and drawings.

2. APPLICABLE CODES AND SPECIFICATIONS

The following specifications, standards and codes, including all official amendments and revisions and other specification referred to therein shall be considered as a part of this specification. In all cases the latest issue/edition revision shall apply. In case of discrepancy between the guidelines given in the codes, & this specification shall govern:

No.	I.S. No.	I.S. Particulars
1	I.S. 1081	Code of practice for fixing and glazing of steel and aluminum doors, windows and ventilators.
2	I.S. 1200 (Part-VIII)	Method of measurement of building and civil engineering works.
3	I.S. 1868	Specification for anodic coating on aluminum and its alloys.
4	I.S. 1948	Specifications for aluminum doors, windows and ventilators.
5	I.S. 1949	Specification for aluminum windows for industrial buildings.
6	I.S. 2835	Transparent sheet glass for glazing and framing purposes. Alloys.
7	I.S. 5523	Method of testing anodic coating on aluminum and its alloys.
8	I.S 733.	Wrought aluminum and aluminum alloys, bars, rods and sections for general engineering purposes
9	I.S.4021	Timber door, window & ventilator frame specifications.
10	I.S.5437	Figured rolled and wired glass specifications.
11	I.S.14900	Transparent Float glass specifications.

3. GENERAL

3.1. The contractor shall submit shop drawings of fabrication and erection for approval of the Engineer-In-charge.

3.2. No fabrication work shall be undertaken prior to the approval of the Engineer In-charge.

3.3. The contractor shall submit samples of all materials/ aluminum sections to be used for manufacturing of doors, windows, ventilators and wall spans for approval of the Engineer-In charge before bulk procurement.

4. MATERIALS

4.1. The frames of all the doors, windows, ventilators and wall spans shall be fabricated from extruded aluminum sections of standard INDAL/ JINDAL or other approved equivalent sections.

4.2. Aluminum alloy used in the manufacture for extruded sections for this work shall correspond to I.S. 733 and shall be anodized before incorporating in the work. The rate quoted for these items is deemed to include the cost of anodizing or powder coating also.

4.3. The frame work, style, mullions, beadings, transom and handles etc. shall be of aluminum anodized sections as shown in the detailed drawings.
4.4. All sections and hard ware shall have minimum anodic film (natural matt finish) of thickness not less than 15 microns.
4.5. Stainless steel or Cadmium plated brass counter sunk screws, nuts, bolts, washers, rivets and other miscellaneous fastening devices shall be of approved quality or as specified in the drawing.
4.6. Each door / window leaf shall be prepared to receive glass panel of required thickness of special selected quality of float or other approved equivalent as specified in the schedule.
4.7. Glazing shall be done with neoprene dry set glazing gasket of best quality and approved make with snam-in -beveled white anodized matt aluminum metal glazing stops inside and outside.
4.8. All aluminum surfaces in contact with masonry or concrete shall be given a heavy coat of bitumastic paint.
4.9. After fabrication aluminum metal shall be protected from construction hazards that may damage their appearance or finish therefore all exposed surfaces of all aluminum members shall be protected by masking tape during the shipment and erection.
4.10. All doors shall have offset pivots, double action floor springs (180 degree minimum swing) with oil check of approved manufacture embedded in floor automatic door closer sunk flush.
4.11. One concealed mortice lock of specified lever on one style of each shutter concealed as per manufacturer's design with concealed flush bolt shall be provided.
4.12. All doors shall have push plates of design shown in the drawing and as described in item of schedule.
4.13. All doors/ windows shall be without threshold.

5. FABRICATION

5.1. The frames shall be square and flat and the corners of the frame shall be fabricated to a true right angle. All the fixed, sliding, opening frames shall be fabricated with sections which have been cut to length mitered and mechanically fixed at the corners.
5.2. In case welded joints are used anodizing shall be done after fabrication as a whole unit is completed. All welding shall be on unexposed sides in order to prevent pitting, discolouration of other surfaces, imperfection after fixing etc.
5.3. Necessary allowances shall be made while manufacturing the door frames and wall spans for receiving plaster.
5.4. Thick layer of clear transparent lacquer based on methacrylates or cellulose butyrate shall be applied on the finished sections of the aluminum work by the supplier to protect the surfaces from wet cement, lime, dirt, dust etc. during installation.
5.5. The frame work for louvered windows shall be of aluminum box sections as specified in the item of work and drawings. The louvered frame shall be rigidly fixed in the masonry or concrete with adequate holdfasts, anchors plates etc. in true plumb, line and level as per drawing.

5.6. Aluminum louvers shall be fabricated out of aluminum sheets of specified gauge and pressed to the required shape as shown in the detailed drawing.

5.7. The pressed aluminum louvers of required shape shall be fixed to frame work in proper inclination with necessary screws, nuts, bolts, cleats, etc. as shown in drawing or as directed by Engineer–In–charge.

6. HARDWARE

6.1. All the hardware, accessories shall be of best approved types and of anodized finish same as for the frames and other sections.

6.2. The contractor shall guarantee for all hardware that they shall remain free from defects of any kind of material and workmanship for a period of one year from the date of delivery.

6.3. The contractor shall repair or replace any and all defective work and damage caused thereby at any time or times during that period within 3 days from the written notice. This shall be done without any cost to the department and to the complete satisfaction of the Engineer-In-charge.

6.4. In case the same are not replaced immediately after the receipt of the notice the department shall do so at the cost of the contractors. The cost as certified by the Engineer-In-charge shall be final and binding on the contractors.

6.5. All hardware shall be free from defects which may affect appearance and serviceability.

6.6. All hardware shall be fixed after obtaining the prior approval of the Engineer-In-charge.

6.7. Approved samples of hardware shall be kept in the custody of the Engineer-In-charge. Working and moving parts of lock sets shall be accurately fitted to smooth, close bearings and shall be free from rattle.

6.8. All cut-outs, recesses, mortising or milling operations required for fixing the hardware shall be accurately made reinforced with backing plate as required to ensure adequate strength of the connection.

6.9. Each door lock shall be supplied with 2 keys and each keys shall be with the numbers stamped thereon according to the door numbers, where it is installed.

7. FIXING IN POSITION

7.1. The frames shall be accurately fixed to the flooring /concrete member / brick masonry or concrete member in accordance with I.S.1081.

7.2. The fixing of the frame shall be done with stainless steel or cadmium plated brass counter sunk screws driven onto the teak wood rough grounds already fixed to the wall with holdfasts.

7.3. The screws, nuts, washers, bolts, rivets and other miscellaneous fastenings, devices shall be of approved brass cadmium plated or stainless steel as specified in the drawings or as directed by the Engineer-In-charge.

7.4. No field fabrication of the frame shall be permitted. All aluminum and glazing work shall be fixed in position as per relevant Indian standard specifications and code of practices.

7.5. All joints between metal and masonry shall be fully caulked with mastic in order to ensure water tightness.

7.6. The joints shall be neatly pointed with matching cement and excess material shall be removed.
7.7. All hardware shall be fixed in workmanship like manner and as directed by the Engineer-In-charge.
7.8. The protective film of lacquer wherever provided shall be preserved and the contractor further shall take all precautions to protect the windows from wet cement, lime, dirt, mortar, dust, etc. by suitably covering them during plastering work.

8. GLAZING WORK:

8.1. The glazing shall be done with float process or other equivalent approved sheet glass of special selected quality and of thickness as specified.
8.2. The glazing shall be uniform in appearance and free from flaws, specks, scratches, air bubbles, cracks, strains and other defects.
8.3. All glazing shall be either transparent or ground or figured as specified in the drawing or as directed by Engineer-In-charge.
8.4. The glass shall be cut so as to give a clearance of not more than 1.5 mm alround the frames.
8.5. All the glass panels shall have properly squared corners and straight edges.
8.6. The glass panels shall be fixed to the frame with approved neoprene dry-set glazing gaskets of best quality and approved make with shape-in beveled white anodized matt finished aluminum metal glazing stops inside and out.
8.7. The glass panels shall be fixed firmly and truly parallel to the plane of frames.
8.8. All damages or breakages during glazing shall be at the contractor's own risk and cost till the work is fully accepted and taken over by the Engineer-In-charge.
8.9. All the windows / doors / wall-spans and fixed glazing shall be tested for water tightness. Any leakages found during testing, it is the responsibility of the contractor to rectify the same without any extra claim.
8.10. The contractor shall also remove all lacquer paint and PVC cover and clean the windows thoroughly before handling over them to the Engineer-In-charge.
8.11. The tolerances for float glass shall be as under

Nominal Thickness (in mm)	Tolerance (in mm)
4.0	± 0.3
5.0	± 0.3
6.0	± 0.3
8.0	± 0.6

8.12. MODE OF MEASUREMENT

8.13. The unit of measurement for aluminum work shall be in Kg and for all glazing work shall be in sq.mt basis or as specified in the item for all types of doors, windows, ventilators and wall spans.
8.14. The rate of aluminum door, windows, ventilators and wall spans includes the cost of all materials, accessories, labour for fabrication, packing charges and transportation, installation and commissioning with all types of taxes and levies.

8.15. TOLERANCES

8.16. The sizes for doors, windows and ventilators frames shall not vary by more than ±1.5 mm .

8.17. TESTS

8.17.1. **Thickness:** The thickness of float glass shall be measured with micrometers or a caliper which is graduated to 0.01 mm or with a measuring instrument having an equivalent capacity.

8.17.2. **Scratches, Rubs and Crush :** Place the sample of float glass in a vertical position approximately 50 cm from the viewer's position and look through it using either day light without direct sunlight or a background light suitable for observing each type of defect.

Intensity of Scratches, Rubs, Crush	Intensity Distance Limit
Faint	Shall not be detectable beyond 50 cm
Light	Detectable between 50-100 cm and not beyond 100 cm.

8.17.3. **Bow :** Depending on the side on which bow is present, stand the sample vertically on a wooden plank. Stretch a thread edge to edge. Measure the longest perpendicular. Distance from the thread to the surface of float glass facing the thread and express it as percentage of the length of float glass from edge along the thread.

8.17.4. **Reams, Strings and Lines :** Focus a light projector with a 500 W lamp and an objective lens with an approximate 5 cm aperture and about 30 cm focal length on a flat white projection screen placed about 760 cm from the light source in a dark room. Place the float glass in a vertical position parallel to the screen between the light and the screen. Move the glass slowly towards the screen with a vertical oscillating motion. The shadowgraph read out is the distance at which the distortion just blends with the general shadow of the glass on the screen.

Intensity of Reams, Strings and Lines	Intensity Distance Limit
Light	7.5 cm
Medium	5.0 cm
Heavy	2.5 cm

8.17.5. **Perspective Distortion:** When tested as per test procedure described below it shall not give distorted vision of straight stripe pattern.

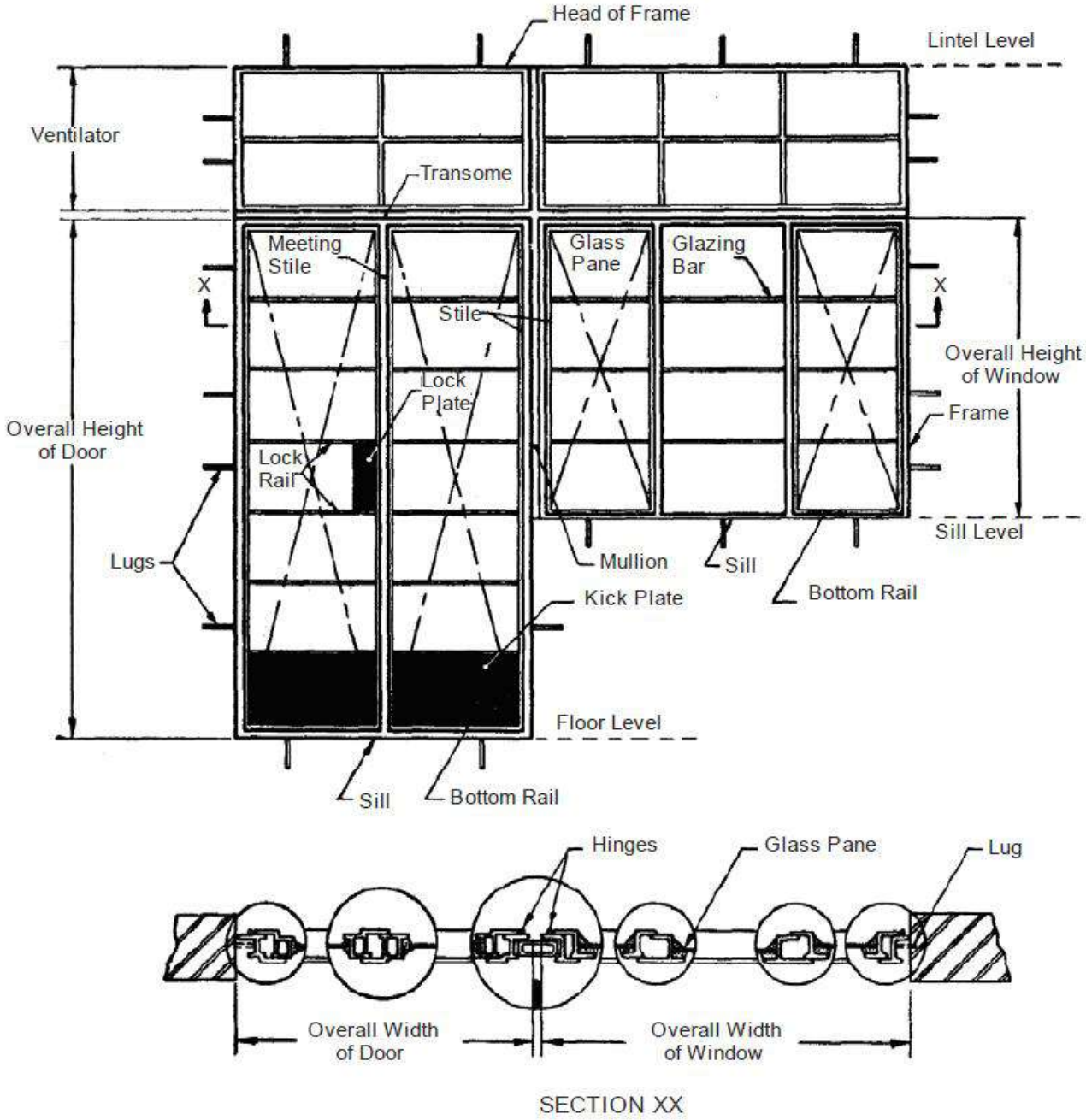
Test Procedure for Perspective Distortion

Perspective distortion shall be examined by looking through the specimen glass which may be placed at about 4.5 m distance in such a direction that the incident angle to it is 50 degree (4 mm or
above) and by observing a screen set up perpendicularly to the line of vision about 4.5 m further ahead of the specimen over the total width of about middle part of the specimen from the horizontal direction. The specimen glass shall be kept with the drawn direction at manufacture vertical and, on the surface of the screen, the strip pattern of white and black

parallel straight lines of 25 mm width and inclined 45 degrees from the vertical shall be provided and its surface shall be luster less.

9. TERMINOLOGY FOR ALUMINUM DOORS, WINDOWS AND VENTILATORS

The terminology for aluminum doors, windows and ventilators is shown in figure below



SECTION XX

Chapter -15

Hardware

1. SCOPE

The work covered under this specification consist of iron-mongeries and furniture fixtures for which specification changes depending upon make and brand. So vendor specification and drawings in strict accordance should be followed for the approved make.

END.

Chapter -16
Piling Work

1.0 PILE FOUNDATIONS

1.1. DESCRIPTION

This work shall consist of construction of all types of piles for structures in accordance with the details shown on the drawings and conforming to the requirements of these specifications.

The construction of pile foundations requires a careful choice of the piling system depending upon sub-soil conditions and loading characteristics and type of structure. The permissible limits of total and differential settlements, unsupported length of pile and any other special requirements of project are also equally important criteria for selection of the piling system. The method of installing the piles, including details of the equipment shall be submitted by the Contractor and got approved from the Engineer.

The work shall be done as per IS: 2911 except as modified herein.

1.2. SUB-SURFACE INVESTIGATION

The complete sub-surface investigation of strata in which pile foundations are proposed shall be carried out in advance and by in-situ pile tests. The detailed geotechnical sub-surface explorations shall be carried out in accordance with IS 1892. Borings should be carried up to sufficient depths so as to ascertain the nature of substrata around the pile shaft and below the pile tip. However, depth of boring shall not be less than:

i) 1.5 times estimated length of pile in soil but not less than 15m beyond the probable length of pile

ii) 15 times diameter of pile in weak/jointed rock but minimum 15m in such rock

iii) 4 times diameter of pile in sound, hard rock but minimum 3m in such rock

The sub-surface investigation shall define adequately stratification of sub-strata including the nature and type of strata, its variation and extent and specific properties of the same. The investigation shall be adequate for the purpose of selection of appropriate piling system and for estimating design capacities for different diameters and length of piles.

Pressure meter tests may be used in the case of rock, gravel or soil for direct evaluation of strength and compressibility characteristics. Though these tests are of specialized nature they are most appropriate for difficult/uncertain sub-strata especially for important projects. For piles socketed into rocks, it is necessary to determine the uniaxial compressive strength of the rock and its quality.

The investigation shall also include location of ground water table and other parameters including results of chemical tests showing sulphate and chloride content and any other deleterious chemical content in soil and/or ground water, likely to affect durability.

1.3. TYPE OF PILES

The piles may be of reinforced concrete, prestressed concrete, steel or timber. The piles may be of solid or hollow sections or steel cased piles filled with concrete.

Concrete piles may be driven cast-in-situ or precast or bored cast-in-situ or precast piles driven into preformed bores. The shape of piles may be circular, square, hexagonal, octagonal, "H" or "I" Section.

1.4. MATERIALS

The basic materials shall conform to the specifications for materials given in Structural Concrete Work. The specifications for steel reinforcement, structural concrete, prestressed concrete and structural steel to be used in pile foundations shall be as given Structural Concrete Work.

1.5. CONCRETE IN PILES

Grade of concrete to be used in cast-in-situ piles shall not be less than M 35 and the cement content shall not be less than 400 kg per cubic meter of concrete. Grades of concrete for precast reinforced and prestressed concrete piles shall not be less than M 25 and M 35 respectively. Maximum water cement ratio shall be 0.5 for cast-in-situ piles and 0.45 for precast piles. (Clause 709.1.9 of IRC:78: 2000 was amended as IRC notification No: 54 dated 28.05.2009)

For both precast and cast-in-situ-piles, the values regarding grade of concrete, water cement ratio, slump shall be as follows:

TABLE 1100-1 PROPERTIES OF CONCRETE

	Concrete Cast-in-situ by Tremie	Precast Concrete
Grade of Concrete	M 35	M 35
Min. cement concretes	400 kg/m^3	400 kg/m^3
Max. WC ratio	0.45	0.45
Slump (mm)	150-200	50-75

The minimum slump of concrete for driven cast-in-situ piles shall be 100 mm to 150 mm and that of bored cast-in-situ piles 150 mm to 200 mm. The slump should not exceed 200 mm in any case.

Concrete mix should have homogeneous mixture with required workability for the system of piling adopted. Suitable and approved admixtures may be used in concrete mix where necessary.

Where piles are exposed to action of harmful chemicals or severe conditions of exposure due to presence of sulphate, chloride etc, it may be preferable to opt for higher grades of concrete restricting water cement ratio to 0.45. Special types of cement, such as sulphate resistant cement may be used where considered appropriate.

1.6. TEST PILES

Test piles which are shown on the drawings or specified in the contract or installed by the Contractor on his own to determine the lengths of piles to be furnished shall

conform to the requirements for piling as indicated in these specifications, if they are to be incorporated in the completed structure.

Test piles that are to become a part of the completed structure shall be installed with the same type of equipment that is proposed to be used for piling in the actual structure.

Test piles which are not to be incorporated in the completed structure shall be removed to at least 600 mm below the proposed soffit level of pile cap and the remaining hole shall be backfilled with earth or other suitable material.

The piles shall be load tested in accordance with provisions laid down in this section.

1.7. PRECAST CONCRETE PILES

1.7.1. General

Precast concrete piles shall be of the size and circular or square shape as shown in the approved drawings. If a square section is employed, the corners shall be chamfered at least 25 mm unless otherwise specified on the drawings. The length of pile shall not normally exceed 25 metres. However, where special equipments for handling and installation are available to the satisfaction of the Engineer, longer length could be permitted.

Piles shall be cast with a driving point and for hard driving, shall be shod with a metal shoe approved by the Engineer.

1.7.2. Stacking, Storing and Handling

Care shall be taken that at all stages of transporting, lifting and handling, piles are not damaged or cracked. During transport and stacking of piles, they shall be supported at the same points as those provided for lifting purposes. If the piles are put down temporarily during handling, they shall be placed on trestles or blocks located at the same points.

Plies shall be stored at least 300 mm above firm level ground which is not liable to unequal subsidence or settlement under the weight of the stack of piles. They shall be placed on Umber supports which are level and spaced so as to avoid bending. The supports shall be vertically one above the other. Spaces shall be left round the piles to enable them to be lifted without difficulty. The order of stacking shall be such that the older piles can be withdrawn without disturbing newer piles. Separate stacks shall be provided for different lengths of piles. Where piles are stacked in layers, the number of layers shall not exceed three.

Whenever curing is needed during storage, arrangements shall be made to enable the piles to be watered. For detailed precautions with regard to curing operations specifications for structural concrete shall apply.

Before the operation of handling and driving the piles, the minimum periods counted from the time of casting shall be allowed for as indicated in Table 1 Pre-stressed piles shall not be lifted or handled until fully stressed.

TABLE 1 TIME FOR CURING PRECAST PILES

Type of cement used In casting, the pile	Minimum periods from time of casting			
	Strike side-shutters (hours)	End of wet curing (days)	Lift from casting bed (days)	Drive (days)
Ordinary Portland	22	7	10	28
Rapid hardening Portland	12	7	7	10

1.7.3. Lengthening of Piles

Where a pile is to have another length cast on it during driving, the longitudinal reinforcement shall preferably be joined by full penetration butt welding. The concrete at the top of the original pile shall be cut down to expose not less than 200 mm of the bars to avoid spalling of the concrete by heat. The added bars have to be held accurately and rigidly in position during welding. Where facilities on site are insufficient to make proper butt welding practicable, the joint may be made by lapping. The reinforcement at the head of pile will need to be exposed for full anchorage length or 600 mm whichever is greater and the new bars over-lapped for this distance. Unless otherwise specified, the, extension of the pile shall be formed to the same cross-sectional profile and with concrete of at least the same strength as that specified for the original pile. The stirrup spacing shall in no case be greater than 150 mm. Not more than one extension shall be permitted. In case more than one extension is permitted by the Engineer, only approved mechanical couplers shall be used.

Driving shall not be resumed until:

(i) The strength of the concrete in the extension is at least equal to the specified characteristic strength of concrete in pile, and

(ii) The approval of the Engineer has been obtained.

1.7.4. Removal of Surplus length

Any length of pile surplus to that required for incorporation in the structure shall be cut off neatly and removed. During the process of cutting off, it shall be ensured that projecting reinforcement to be anchored into the pile cap and the pre-stressing strands/wires are not damaged. When stripping pre-stressed concrete piles, shock release of tendons shall be avoided. Reference may also be made to clause 7.7.1. of IS:2911 (Part I Section 3) in this connection.

1.7.5. Risen Piles

Level reading should be taken on each pile after driving and again after all the piles are driven. Piles which are found to have risen due to ground heave or as a result of driving adjacent piles, shall be re-driven to the original depth or resistance unless re-driving tests on adjacent piles have shown this to be unnecessary.

1.7.6. Manufacture

The pile should be cast in one continuous operation from end to end of each pile. Manufacture of precast concrete piles shall conform to the guidelines contained in clause Nos. 7.1, 7.2 and 7.3 of IS:2911 (Part I, Section 3).

Pile shall be provided with suitable shoe for protecting the point of the pile during driving in hard ground.

In case of precast piles to be lowered in the prebored holes, M.S. tube of 30 to 50mm has to be casted at the centre for injecting grout material.

Piles shall not be moved from casting bed until the concrete has hardened sufficiently.

Piles shall not be driven in less than 28 days after casting or unless their strength at the time of driving is at least that specified for 28 days.

1.7.7. Pre-stressed Concrete Piles

Additional specifications for precast pre-stressed concrete piles shall conform to those contained in clause 8 of IS:2911 (Part 1 Section 3).

1.8. CAST-IN-SITU CONCRETE PILES

Cast-in-situ concrete piles may be either installed by making a bore into the ground by removal of material or by driving a metal casing with a shoe at the tip and displacing the material laterally. The two types of piles are termed as "bored piles" and "driven piles" respectively. Cast-in-situ concrete piles may be cast in metal shells which may remain permanently in place. However, other types of cast-in-situ concrete piles, plain or reinforced, cased or uncased, may be used if in the opinion of the Engineer the soil conditions permit their use and if their design and the methods of placing are satisfactory.

The metal casing shall be of sufficient thickness and strength to hold its original form and show no harmful distortion after it and adjacent casings have been driven and the driving core, if any, has been withdrawn. Cast-in-situ concrete driven piles shall be installed using a properly designed detachable shoe at the bottom of the casing.

Any liner or bore-hole which is improperly located or shows partial collapse that would affect the load carrying capacity of the pile, shall be rejected or repaired as directed by the Engineer at the cost of the Contractor. The minimum thickness of liner shall be 6mm. (Clause 709.1.4 of IRC:78: 2000 was amended as IRC notification No: 54 dated 28.05.2009)Wherever practicable, concrete should be placed in a clean dry hole. Where concrete is placed in dry and there is casing present, the top 3 m of the pile shall be compacted using internal vibrators. The concrete should invariably be poured through a tremie with a funnel so that the flow is directed and concrete can be deposited in the hole without segregation.

Where the casing is withdrawn from cohesive soils for the formation of cast-in-situ pile, the concreting should be done with necessary precautions to minimize the softening of the soil by excess water. Where mud flow conditions exist, the casing of cast-In-situ piles shall not be allowed to be withdrawn.

Care shall be taken during concreting to prevent as far as possible the segregation of the ingredients. The displacement or distortion of reinforcement during concreting and also while extracting the tube shall be avoided.

If the concrete is placed inside precast concrete 'tubes or consists of precast sections, these shall be free from cracks or other damage before being installed.

The concrete shall be properly graded, shall be self-compacting and shall not get mixed with soil, excess water, or other extraneous matter.

Special care shall be taken in silty clays and other soils with the tendency to squeeze into the newly deposited concrete and cause necking. Sufficient head of green concrete shall be maintained to prevent inflow of soil or water into the concrete.

The placing of concrete shall be a continuous process from the toe level to the top of the pile. To prevent segregation, a tube or tremie pipe as appropriate shall be used to place concrete in all piles.

To ensure compaction by hydraulic static heads, rate of placing concrete in the pile shaft shall not be less than 6 m (length of pile) per hour.

Bored cast-in-situ piles in soils which are stable, may often be installed with only a small casing length at the top. A minimum of 2.0m length of top of bore shall invariably be provided with casing to ensure against loose soil falling into the bore. In cases in which the side soil can fall into the hole, it is necessary to stabilise the side of the bore hole with drilling mud, or a suitable steel casing. The casing may be left in position permanently specially in cases where the aggressive action of the ground water is to be avoided, or in the cases of piles built in water or in cases where significant length of piles could be exposed due to scour.

For bored cast-in-situ piles, casing/liner shall be driven open ended with a pile driving hammer capable of achieving penetration of the liner to the length shown on the drawing or as approved by the Engineer. Materials inside the casing shall be removed progressively by air lift, grab or percussion equipment or other approved means.

Where bored cast-in-situ piles are used in soils liable to flow, the bottom of the casing shall be kept enough in advance of the boring tool to prevent the entry of soil into the casing, thus preventing the formation of cavities and settlements in the adjoining ground. The water level in the casing should generally be maintained at the natural ground water level for the same reasons. The joints of the casing shall be made as tight as possible to minimize inflow of water or leakage of slurry during concreting.

Boring shall be carried out using rotary or percussion type equipment. Unless otherwise approved by the Engineer, the diameter of the bore-holes shall be not more than the inside diameter of the liner. Prior to the lowering of the reinforcement cage into the pile shaft, the shaft shall be cleaned of all loose materials. Cover to reinforcing steel shall be maintained by suitable spacers.

The diameter of the finished pile shall not be less than that specified and a continuous record shall be kept by the Engineer as to the volume of concrete placed in relation to the pile length cast.

Before concreting under water, the bottom of the hole shall be cleaned of drilling mud and all soft or loose material very carefully. In case a hole is bored with use of drilling mud, concreting should not be taken up when the specific gravity of bottom slurry is more than 1.2. The drilling mud should be maintained at 1.5m above the ground water level.

Concreting under water for cast-in-situ concrete piles may be done either with the use of tremie method or by the use of an approved method specially designed to permit under water placement of concrete.

General requirements and precautions for concreting under water are as follows:

a) The concreting of a pile must be completed in one continuous operation. Also, for bored holes, the finishing of the bore, cleaning of the bore, lowering of reinforcement cage and concreting of pile for full height must be accomplished in one continuous operation without any stoppage.

b) The concrete should be coherent, rich in cement with high slump and restricted water cement ratio.

c) The tremie pipe will have to be large enough with due regard to the size of aggregate. For 20 mm aggregate the tremie pipe should be of diameter not less than 150 mm and for larger aggregate, larger diameter tremie pipes may be necessary.

d) The first charge of concrete should be placed with a sliding plug pushed down the tube ahead of it to prevent mixing of water and concrete.

e) The tremie pipe should always penetrate well into the concrete with an adequate margin of safety against accidental withdrawal if the pipe is surged to discharge the concrete.

f) The pile should be concreted wholly by tremie and the method of deposition should not be changed part way up the pile to prevent the laitance from being entrapped within the pile.

g) All tremie tubes should be scrupulously cleaned after use.

1.9. DRIVING EQUIPMENT

Piles or their casings may be driven with any type of drop hammer, diesel hammer or single-acting steam or compressed air hammer, provided they penetrate to the prescribed depth or attain the designed resistance without being damaged. The weight or power of the hammer should be sufficient to ensure a penetration of at least 5 mm per blow, unless rock has been reached. It is always preferable to employ the heaviest hammer practicable and to limit the stroke, so as not to damage the pile. The minimum weight of the hammer shall be 2.5t. In the case of precast concrete piles the mass of the hammer shall be not less than 30 times the mass of 300 mm length of pile.

Steam or air hammers shall be furnished along with boiler or air compressor of capacity at least equal to that specified by the manufacturer of the hammers. The boiler or air compressor shall be equipped with an accurate pressure gauge at all times. The valve mechanism and other parts of steam, air or diesel hammers shall be maintained in first class condition so that the length of stroke and number of blows

per minute for which the hammer is designed, will be obtained. Inefficient steam, air or diesel hammers shall be removed from the work.

1.10. DRIVING

1.10.1. General Procedure

Details of the equipment and the method proposed for driving the piles shall be submitted with the tender for scrutiny and approval of the Engineer.

Piles shall be installed from firm ground or from temporary supports or from fixed platform. The arrangement shall provide sufficient rigidity to ensure accuracy of pile driving under all conditions of tide, stream flow or hammer drop.

During driving the top of pile shall be protected by a suitable helmet of substantial steel construction. The helmet shall provide uniform bearing across the top of the pile and shall hold the pile centrally under the hammer. No pile shall be driven unless inspected and approved by the Engineer.

Piles shall be driven from a fixed frame of sufficient rigidity to ensure accuracy of driving within specified tolerances. Forces producing undue bending or torsional stresses in piles shall not be applied during driving. The force of the hammer shall be directed centrally and axially during driving.

The stroke of a single acting or drop hammer shall be limited to 1.2 m unless otherwise permitted by the Engineer. A shorter stroke may be necessary when there is danger of damaging the pile.

Piles shall not be bent or sprung into position but shall be effectively guided and held on-line during the initial stages of driving. Attempts to correct any tendency for the pile to run off-line by the application of significant horizontal restraint will not be permitted. Shortly after the commencement of driving and at regular intervals throughout the driving operation, checks shall be made to ensure that the pile frame does not exert any undue lateral force on the pile due to restraint within the helmet.

If the indications are that a pile will finish outside the specified tolerances, driving operations on that pile will cease. The pile shall be withdrawn, the hole filled and the pile re-driven at no extra cost.

To avoid the possibility of premature "set-up" pile driving shall be continuous in the later stages, without any deliberate stops. (Delays of an hour or less may lead to significant "set-up" in piles i.e. resistance to further driving increases after driving is stopped).

If any pile is damaged in any way during driving, it shall be repaired or replaced as directed by the Engineer, at no extra cost. If during driving, the head of a pile is damaged to the extent that further driving is not possible, the head shall be cut off and driving continued. The cost of cutting off shall be borne by the Contractor and where, as a result of such cutting off the head, the pile is too short, the Contractor, shall, at his own cost, supply and splice on sufficient length of pile to restore the pile to its correct length.

Piles should be driven to the minimum acceptable penetration shown on the drawings. This may require pre-boring and/or jetting as indicated in these specifications with the full approval of the Engineer.

Piles shall be driven to nominal refusal or the required ultimate dynamic capacity nominated on the drawings or until the top of the pile is at the level required and specified on the drawing whichever gives the lowest toe elevation. The Engineer's decision in these matters shall be final. Nominal refusal shall be taken as equivalent to 25 mm total penetration for the final 20 blows using a hammer of driving energy as specified and shall be used as the criterion for acceptance for piles founded on rock. Severe driving which results in an average set per blow less than 0.5 mm will not be permitted.

Where hard drilling is encountered because of dense strata or obstructions located above the predetermined pile tip level, nominal refusal shall not be considered to have been achieved unless the Engineer is satisfied that the total number of blows, as the average driving resistance specified for nominal refusal, indicates that further driving will not advance the pile through dense strata or obstructions.

The pile shall be driven as accurately as possible to the vertical or to specified batter. Straining the pile into position can damage it and the driving equipment should be adjusted as much as possible to follow the position of the pile. Any deviation from the proper alignment shall be noted and promptly reported to the Engineer. If the deviation is to such an extent that the resulting eccentricity cannot be taken care of by strengthening the pile cap or pile ties, such a pile shall, at the discretion of the Engineer, be replaced or supplemented by an additional pile. Unless otherwise specified, the permissible positional deviation for piles shall be limited to those indicated in Clause 2.8.

Care shall be taken not to damage the pile by over-driving. Any sudden change in the rate of penetration which cannot be ascribed to the nature of the ground shall be noted and its cause ascertained, if possible, before driving is continued.

When employing a tube which is subsequently withdrawn for the formation of cast-in-situ pile, consideration shall be given to the possibility of doing harm to a pile recently formed by driving the tube nearby before the concrete has sufficiently set. The danger of doing harm is greater in compact soils than loose soils. No pile shall be bored or driven within 3 m of a newly cast pile until at least 24 hours after completion of its installation.

Driving piles in loose sand tends to compact the sand which in turn increases the skin friction. Therefore, driving a number of friction piles in a group shall proceed outward from the centre as otherwise it will be difficult to drive the inner piles to the same depth as the others.

In the case of stiff clay also, the driving for a group of piles shall proceed outward from the centre. However, in case of very soft soil, the driving may proceed from outside to inside, so that the soil is restrained from flowing out during driving operations.

If there is a major variation between the depth at which adjacent foundation piles in a group meet refusal, a boring shall be made nearby to ascertain the cause of this difference. If the boring shows that the soil contains pockets of highly compressive material below the level of the shorter pile, it will be necessary to enforce penetration of all the piles to a level below the bottom of the zone which shows such pockets.

1.10.2. Pre-boring and Jetting

Driving of the piles may be assisted by pre boring holes or by the use of jets or both subject to the approval of the Engineer. These may be used essentially to achieve the minimum penetration shown on the drawings where such penetration is not reached under normal conditions of driving indicated in Clause 1.10.1.

The diameter of the hole shall not be greater than the diagonal dimension of the pile less 100 mm.

The maximum depth of the pre-boring shall be such that the specified set (or less) is obtained when the toe of the pile is at founding level.

Pre-boring shall be as approved by the Engineer and shall not extend below one meter above the founding level and the pile shall be driven to at least one meter below the pre-bored hole. To ensure that the pile is properly supported laterally in the hole, any space remaining around the pile at the ground level after driving is finished shall be backfilled with approved granular material.

When water jetting is used, at least two jets shall be attached to the pile symmetrically when this type of technique is used. The volume and pressure of water at the outlet nozzles shall be sufficient to freely erode material adjacent to the toe of the pile. The maximum depth of jetting shalf be such that the specified set (or less) is obtained when the toe of the pile is at founding level. Jetting shall cease as directed by the Engineer and shall not proceed below one meter above the founding level and the pile shall be driven at least one meter below the pre-bored hole.

To avoid very hard driving and vibration in materials, such as sand, jetting of piles by means of water may be carried out only by express permission of the Engineer and in such a manner as not to impair the bearing capacity of piles already in place, the stability of the soil or the safety of any adjoining buildings. Details of the arrangement for jetting shall be approved from the Engineer in advance.

If, for jetting, large quantities of water are used, it may be necessary to make provision for collection of water when it comes to the ground surface, so that the stability of the piling plant is not endangered by the softening of the ground.

Jetting shall be stopped before completing the driving which shall always be finished by ordinary methods. Jetting shall be stopped if there is any tendency for the pile tips to be drawn towards the pile already driven owing to the disturbance to the ground.

1.11. RAKER (INCLINED) PILES

The maximum rake to be permitted in piles shall not exceed the following:

i) 1 in8 for large diameter cast-In-situ piles viz 0.75 m diameter and above

ii) 1 in 5 for smaller diameter cast-in-situ piles

iii) 1 in4 for precast driven piles

2.0 PILE TESTS

2.1. GENERAL

The bearing capacity of a single pile may be determined from test loading a pile. The load test on a concrete pile may not be carried out earlier than 28 days from the time of casting of the pile.

There shall be two categories of tests on piles, namely, initial tests and routine tests. Initial tests should be carried out on test piles which are not to be incorporated in the work. Routine tests shall be carried out as a check on working piles. The number of initial and routine tests on piies shall be as determined by the Engineer depending upon the number of foundations, span length, type of superstructure and uncertainties of founding strata. In any case, the initial load tests shall not be less than 2 in number, while the routine load tests shall not be less than 2 per cent of the total number of piles in the structure not less than 2 in number.

The above stipulations hold good for both vertical as well as lateral load tests on pile foundations.

However, both initial and routine tests may be suitably increased for important structures or cases with large variation in the subsurface strata.

The methodology of carrying out load tests and of arriving at safe load on piles shall conform to IS:2911 (Part IV).

In case of any doubt of workmanship or load carrying capacity of working piles not subjected to routine tests, or when ordered. by the Engineer, or when provided in the contract, load tests on working piles may be supplemented by non-destructive testing. Such tests may include "Integrity Testing" of concrete in the installed pile and utilisation of "Pile Driving Analyser" which gives an indication of pile capacity in end bearing and side friction.

2.2. INITIAL LOAD TEST

Immediately on mobilization to site, the CONTRACTOR shall prepare to install piles for conducting initial vertical load (downward and pull-out) and lateral pile load tests.

In case the cut-off is below ground level, a suitable excavation shall be made to provide access to the level after breaking off the unsound concrete.

For the compression type of test, the pile head shall be cut off level and capped by a R.C. cap to provide a horizontal plane bearing surface upon which a steel plate shall be placed. Earth from under the pile cap shall be scooped out so that pile cap has no soil support. Thereafter, the kentledge and all other accessories outside the pit pertaining to and necessary for conducting the test shall be set up. An easy access to the pile test head shall be provided.

If the pile test head is below the ground water level, the CONTRACTOR shall provide suitable sumps and dewater the pit so as to render the pit dry enough to enable conducting the test. Any dewatering will be considered as part of the test and the CONTRACTOR shall not be separately paid for the same.

The test load shall be so applied that it reaches the pile in a static manner. The loading may be applied directly by kentledge or jacking against a reaction system

provided by means of kentledge, tension piles or ground anchors. Where kentledge is used it shall be supported on a properly designed frame or gantry such that there is no possibility of the load tilting or collapsing. The foundations of this frame or gantry should be sufficiently far away from the test pile so as not to affect its behaviour to any significant extent. Where tension piles or ground anchors are used, they shall be located a minimum distance of three times the test pile size from the centre of the test pile to the centre of the pile/ anchor.

The displacement of the test pile shall be related to a fixed datum. This may consist of a reference beam (datum bar) supported by two foundations positioned outside the zones of influence of the reaction support area. The deflection measuring equipment must be set up in such a way that any tilting of the test pile will not cause errors in the measurements. Dial gauges shall be used for measuring deflection. The least count of the dial gauges shall be at least 0.02mm. At least two but preferably four dial gauges shall be used and shall be placed at diagonally opposite corners.

The reference bars for the strain gauges shall be adequately rigid and on firm supports. The supports for the reference bars shall be so located that they are beyond the zone of influence of the loaded test pile (equal to three times the pile size from pile edge) and the zone of influence of kentledge supports. The bars shall be adequately stiffened and placed on supports in a manner such that any effect due to ambient temperature variations and vibrations due to traffic etc. are minimised. The reference bars and strain gauges shall not be exposed to direct sun and the pit shall be protected by tarpaulin sheets while the test is in progress.

The total test load shall be two and half (2.5) times the estimated safe load carrying capacity of the pile or failure, whichever is earlier, and shall be applied in equal increments of 20 percent of the estimated safe load. Unloading may however be in higher decrements with total number not less than five. At each load increment, pile deflection shall be observed accurate to 0.02mm at an interval of 1, 5, 10, 15, 25, 35, 50 and 60 minutes and thereafter at half hourly intervals, upto a time when the rate of deflection of the pile top reduces to 0.1mm in half hour or 0.2mm in one hour. The load increment in any case shall be maintained for 1 hour at least. The design load as well as the final load shall be maintained for 24 hours at least or as directed by Engineer. At these load increments, after the first hour, deflection readings shall be taken at every one hour interval.

During the release stage, each load decrement shall be maintained at least for 30 minutes and readings of deflection noted. When the load is fully released to zero, measurements of rebound shall be continued till the deflection of the pile top is not more than 0.1 mm per half hour.

Initial cyclic tests shall be carried out to determine skin friction and point resistance of piles. This shall be carried out as per IS: 2911 (Part-IV). However, each cycle of loading and unloading shall be repeated allowing a time interval of 10 minutes between the end of one cycle and the beginning of the next.

For the initial lateral pile load test pairs of piles for lateral load tests shall be driven. Lateral load test shall be conducted as per IS: 2911 (Part-IV) with horizontal loading increment as directed by Engineer, stagewise till failure occurs. Load shall be applied at cut-off level.

Piles specified for pull out test shall be subjected to pull-out force in equal increments of not more than 2.5 tonne till the rise exceeds 12mm or specified ultimate pull-out force is reached whichever is earlier. A graph of pull out force and the corresponding rise of pile top shall be plotted immediately.

If the initial test pile(s) which is (are) load tested fails (fail) to attain the specified safe structural capacity of piles and if this can be attributed to defective workmanship and/or negligence on the part of the CONTRACTOR, the OWNER reserves the right to terminate the contract and to award the contract to other parties. In such an event, all costs of mobilization, installation and testing of test pile(s) and any other work in connection with the test piles, shall be borne entirely by the CONTRACTOR.

While executing the pile bore for all test piles, a record of bore log and Standard Penetration Tests shall be maintained over the continuous length of boring in an approved format. Subsoil samples and rock cuttings shall be collected and systematically preserved.

2.3. ROUTINE LOAD TEST

These tests shall be carried out on piles selected by the ENGINEER after they have been cast. Tests to be carried out on working piles shall essentially be ordinary compression type. The test will be similar to that conducted on initial test piles, except that the capacity of the pile shall be limited to 1.5 times the safe pile capacity, the maximum settlement during test loading not exceeding 12mm.

The working pile shall be considered to have stood the test satisfactorily if total settlement under final test load is not more than 12mm and net (residual) settlement after removal of test load not more than 6 mm.

If the pile does not satisfy these requirements and if this can be attributed to defective workmanship or negligence on the part of the CONTRACTOR, all costs of the load test, the cost of providing and installing additional piles, cost of additional or enlarged pile caps and other work necessitated because of the defective pile, shall be at the cost of the CONTRACTOR.

2.4. LOW STRAIN NON-DESTRUCTIVE TEST

Piles shall be subject to low strain non-destructive testing. The Contractor shall appoint an approved agency for conducting these tests. The Bidder shall indicate the name of the agency for conducting these tests along with the tender. The scope of the tests shall include conducting the tests, with properly calibrated equipment, submission of all the test records and a report giving the interpretation of the test results. Testing of a pile shall be done 21 days after it is cast. All testing shall be done in the presence of the Engineer or his representative. The report shall be submitted after all the piles at the Site have been tested. However, in case any deficiency is observed, while the testing is in progress, it shall be brought to the notice of the Engineer, forthwith.

Digital data processing technique shall be used for monitoring of stress wave. The test shall be conducted by striking pile head by a small hand held hammer. The reflections shall be picked up by an accelerometer pressed on pile top, close to the location of hammer blow. The observed signal is amplified by the computer controlled amplifier. Tests results shall be immediately submitted to the Engineer.

2.5. CROSS HOLE ULTRASONIC MONITORING (CHUM) OF PILES

This test shall be carried one test for each piling rig and operator. Whenever the operator has been changed the test shall be conducted within three days from the date of installation of pile and report shall be submitted within two days from the date of completion of test.

2.5.1. Installation of pipes

Minimum numbers of pipes as directed by Engineer against each diameter of piles, pipes of 40mm ID and having wall thickness not less than 4mm shall be provided inside the pile shaft during the pile installation for the full length of pile at diametrically opposite point, also pipes shall be long enough to protrude about 200 mm above the ground level. The pipes shall be closed at both the ends by caps to prevent the possible entry of soil or concrete. For convenience the pipes shall be filled up with water while lowering and it will remain water filled all through as the test shall be conducted in that condition by a specialised agency. PVC pipes shall be of Oriplast PVC 1120 make conforming to ASTM D1785 or equivalent. Pipes shall be joined by threaded sockets and attached strongly to the main reinforcement bars through binding wires. The piling contractor shall be responsible for proper installation of these pipes and its maintenance till the tests are over. The Pile shall be cast with the pipes intact. It is the responsibility of the piling contractor to ensure that all the access pipes are free from any obstruction. Moreover, installed pipes protruding above ground level shall be protected by the piling contractor for carrying out the integrity tests. Since ensuring the integrity of the piles is extremely important the entire responsibility of installation and protection of all the access pipes shall lie with the piling contractor. No payment for the test and nor for pipes shall be made to the contractor if access pipes are found either chocked or inaccessible at ground level. The pipes shall be filled with sand on completion of test.

2.5.2. Testing Agency

Contractor shall engage a firm experienced in conducting CHUM test and the same shall be approved by the Engineer for conducting ultrasonic test. The site work and interpretation of the results shall be carried out by an experienced Geotechnical Engineer.

2.5.3. Equipment

The ultrasonic test equipment shall consist of two transducers. An emitter sending not less than one pulse per second with a frequency of not less than 50 KHz. a compatible receiver and a suitable computer for control, measurement and recording functions. All components shall be in good working order. All software of the latest released version shall be used.

2.5.4. Preparations

Before commencing the test, the Contractor shall ensure that there is adequate access to the pipes. The piling contractor shall then open the top of the pipes and ensure, with an approved dummy probe having a length of 300mm and diameter of 25mm, that the pipes are straight and free of obstacles throughout its length. The Contractor shall keep them full of water until all testing on site is concluded. Test shall be conducted after 3 days of the installation of piles.

2.5.5. Testing Method

Testing shall consist of inserting the transducers in parallel into two pipes of the same pile, using a pulley with an automatic depth meter. The transducers shall be lowered to the bottom, brought to the same level, activated and then pulled back with arrival times versus depth continuously recorded. The output for all tests shall clearly identify the project, pile designation, date, time, depth scale, defect if any and all other relevant information.

2.5.6. Report

A final report for each testing stage shall be presented not later than three working days after completion of test. The report shall consist of a printout of the original output, as well as a summary table including, for every panel tested, the depth and the Engineers' interpretation regarding its integrity. The report shall also recommend the suitable corrective measures for the identified defects.

2.5.7. High Strain Dynamic Load Test

Conducting routine vertical load test for 1.5 times safe load carrying capacity by means of High strain Dynamic Load Test including provision and erection of crane-hammer-drop mechanism, acceleration and displacement velocity transducers to record both force and velocity including excavation, dewatering, preparation, preparation of pile head including building up of pile, additional reinforcement if any etc. all complete as per approved method (ASTM D4945-89) and instructions of the engineer. Hammer shall be of suitable weight which is 1 to 2% of test load or 7 to 10% of the dead weight of the pile whichever is higher is used unless specified otherwise by Test Engineer. The fall height generally varies from 0.5m to 3.0m.

2.6. PILE CAP

Pile Caps shall be of reinforced concrete. A minimum offset of 150 mm shall be provided beyond the outer faces of the outer most piles in the group. If the pile cap is in contact with earth at the bottom, a levelling course of minimum 100 mm thickness of M 15 nominal mix concrete shall be provided.

The attachment of the pile head to the cap shall be adequate for the transmission of loads and forces. A portion of pile top may be stripped of concrete and the reinforcement anchored into the cap. Manual chipping may be permitted after three days of pile casting, while pneumatic tools for chipping shall not be used before seven days after pile casting. The top of pile after stripping shall project at least 150 mm into the pile cap. A layer of surface reinforcement may be provided with a cover of 25 mm to retain the integrity of concrete below the main cap reinforcement which is to be laid 25 mm above the pile top.

Concreting of the pile cap shall be carried out in dry conditions. The bottom of the pile cap shall be laid preferably as low as possible taking account of the water level prevalent at the time of casting.

The top of concrete in a pile shall be brought above cut-off level to permit removal of all laitance and weak concrete before pile cap is laid. This will ensure good concrete at the cut-off level.

The minimum thickness of pile cap should be atleast 1.5 times diameter of pile. Such a cap can be considered as rigid. Casting of pile cap should be at level higher than water level unless functionally it is required to be below water level at which time sufficient precaution should be taken to dewater, the forms to allow concreting in dry condition. In marine condition or in areas exposed to the action of harmful chemicals, the pile cap shall be protected with a suitable anti-corrosive paint. High alumina cement, i.e. quick setting cement shall not be used in marine constructions (Clause 709.5.4 of IRC:78: 2000 was amended as IRC notification No: 54 dated 28.05.2009).

2.6.1. IMPORTANT CONSIDERATIONS, INSPECTION/PRECAUTIONS FOR DIFFERENT TYPES OF PILES

2.6.2. Driven Cast-in-Situ Piles

Specialist literature and the guidelines from the pile construction industry shall be consulted regarding the method of installation, equipment and accessories for pile driving and recording of data.

During installation of piles the final "set" of penetration of pile per blow of hammer shall be checked taking an average of last 10 blows.

The pile shoes which may be of either cast iron conical type or mild steel flat type shall have double reams for proper seating of the removable casing tube inside the space between the reams.

Before commencement of pouring of concrete, it shall be ensured that there is no ingress of water in the casing tube from the bottom. Further adequate control during withdrawal of the casing tube is essential so as to maintain sufficient head of concrete inside the casing tube at all stages of withdrawal.

Concrete in piles shall be cast upto a minimum height of 600 mm above the designed top level of pile, which shall be stripped off at the time of construction of pile cap.

2.6.3. Bored Cast-in-situ piles

While concreting uncased piles, voids in concrete shall be avoided and sufficient head of concrete is to be maintained to prevent inflow of soil or water into the concrete. It is also necessary to take precautions during concreting to minimise the softening of the soil by excess water. Uncased cast-in-situ piles shall not be allowed where mudflow conditions exist.

The drilling mud such as bentonite suspension shall be maintained at a level sufficiently above the surrounding ground water level to ensure the stability of the strata which is being penetrated throughout the boring process until the pile has been concreted.

Where bentonite suspension is used to maintain the stability of the bore-hole, it is essential that the properties of the material! be carefully controlled at stages of mixing, supply to the bore-hole and immediately before concrete is placed. It is usual to limit:

i) The density of bentonite suspension to 1.05 g/cc

ii) The marsh cone viscosity between 30 and 40

iii) The pH value between 9.5 and 12

iv) The silt content less than 1 per cent

v) The liquid limit of bentonite not less than 400 per cent

These aspects shall act as controlling factors for preventing contamination of bentonite slurry for day and silt.

The bores shall be washed by bentonite flushing to ensure clean bottom at two stages viz. after completion of boring and prior to concreting after placing of reinforcement cage. Flushing of bentonite shall be done continuously with- fresh bentonite slurry till the consistency of inflowing and out-flowing slurry is similar.

Tremie of 150 mm to 200 mm diameter shall be used for concreting. The tremie should have uniform and smooth cross-section inside, and shall be withdrawn slowly ensuring adequate height of concrete outside the tremie pipe at all stages of withdrawal. Other recommendations for tremie concreting are:

(i) The sides of the bore-hole have to be stable throughout

(ii) The tremie shall be water-tight throughout its length and have a hopper attached at its head by a water-tight connection

(iii) The tremie pipe shall be large enough in relation to the size of aggregates. For 20 mm aggregate the tremie pipe shall be of diameter not less than 150 mm and for larger size aggregate tremie pipe of larger diameter is required.

(iv) The tremie pipe shall be lowered to the bottom of the bore-hole, allowing water or drilling mud to rise inside it before pouring concrete.

(v) The tremie pipe shall always be kept full of concrete and shall penetrate well into the concrete in the bore-hole with adequate margin of safety against accidental withdrawal if the pipe is surged to discharge the concrete.

For very long or large diameter piles, use of retarding plasticiser in concrete is desirable.

For large diameter piles, it may be essential to conduct nondestructive pile integrity tests to evaluate integrity of the pile.

Where possible, it may be desirable to grout the base of pile with cement slurry under suitable pressure after concrete in the pile attains the desired strength. For this purpose, conduit pipes with easily removable plugs at the bottom end should be placed in the bore along with reinforcement cage before concreting.

2.7. TOLERANCES

2.7.1. Permissible Tolerances for Pile

i) Precast Concrete Piles:

a) Variation in cross-sectional dimensions : ±5mm

b) Variation in length : ±2Smm

c) Surface irregularities measured with 3 m straight edge : 5mm

d) Bow for length in mm Pile length in mm 1000

ii) Driven Piles

a) Variation in cross-sectional dimensions : +50mm, -10mm

b) Variation from vertical or specified rake : 1 in 50

c) Variation in the final position of the head in plan : 75mm

d) Variation of level of top of piles : ±25mm

iii) Bored Piles

a) Variation in cross-sectional dimensions : +50mm, -10mm

b) Variation from vertical or specified rake : 1 in 50

c) Variation in the final position of the head in plan : 50mm

d) Variation of level of top of piles : ±25mm

2.7.2. Permissible Tolerances for Pile Caps

(a) Variation in dimensions : +50 mm -10 mm

(b) Misplacement from specified position in : 15mm

(c) Surface irregularities measured with 3 m plan straight edge : 5mm

(d) Variation of levels at the top : ±25 mm

2.8. TESTS AND STANDARDS OF ACCEPTANCE

The materials shall be tested in accordance with these Specifications and shall meet the prescribed criteria.

The work shall conform to these Specifications and shall meet the prescribed standards of acceptance.

2.9. MEASUREMENTS FOR PAYMENT

For supply of precast concrete piles of specified cross-section, the measurement shall be in meters of the length of piles ordered in writing by the Engineer measured from the head to the butt of the shoe or the tapered point. Reinforcement, in precast concrete piles shall not be measured for payment.

For cast-In-situ driven and bored concrete piles of specified cross-section, the measurement shall be the length in meters of the accepted pile that remains in the finished structure complete in place. Reinforcement in cast-in-situ driven and bored concrete piles shall be measured for payment as per specification of Structural Concrete Work.

Routine and Initial Pile load Tests shall not be measured for payment

For installation of the pile, i.e. by driving in the case of precast concrete and cast-in-situ driven piles, and by boring in the case of cast-in-situ bored piles the measurement shall be the length in meters that remains in the finished structure complete in place, limited to that shown on drawings or ordered by the Engineer. No distinction shall be made for penetration through hard strata or rock and socketing into rock.

For steel liners/casing shown on the drawings to be permanently left in place, the measurement shall be by weight in tonnes that remains in the finished structure complete in place, limited to that shown on drawings or ordered by the Engineer.

For the pile cap, the quantity of concrete and reinforcement shall be measured in cubic meters and in tones respectively as per specification of structural concrete work.

3.0 SHEET PILE

3.1. SUBJECT

This document describes in general the salient features of Steel Sheet Piling system being proposed to be used for (NAME OF APPLICATION) in (NAME OF PROJECT) in (LOCATION). The sheet pile system is an installed vertical pile elements connected through row of interlocking; forming a continuous wall, retaining soil and / or water.

Permanent and or temporary retaining walls and cofferdams erected for the purpose of excavation, protection, diversion of soil/ water are the major applications of steel sheet piling.

For installation of steel sheet piles, Vibrating hammers and or impact hammers, crane, driving template are generally used.

There are permanent and temporary applications. Permanent sheet piles remain in the ground and serve as permanent retaining structures. Temporary sheet piles are designed to provide safe access for construction and are then removed.

For permanent sheet pile application, the work shall include supply, installation of sheet pile, arrangement strutting system/ anchors/ connecting hardware.

For temporary sheet pile application, the work shall include supply, installation of sheet pile, arrangement strutting system/ anchors/ connecting hardware when required to attach the system to an existing substructure unit and/or facilitate stage construction.

3.2. MATERIAL

Steel Sheet Piles shall be produced in Hot Rolled process and conforming to EN10248 (I & II) or equivalent ASTM standards. The interlocks of sheet piling shall be Larsen type free-sliding, provide a swing angle suitable for the intended installation but not less than 5 degrees when interlocked and maintain continuous interlocking when installed.

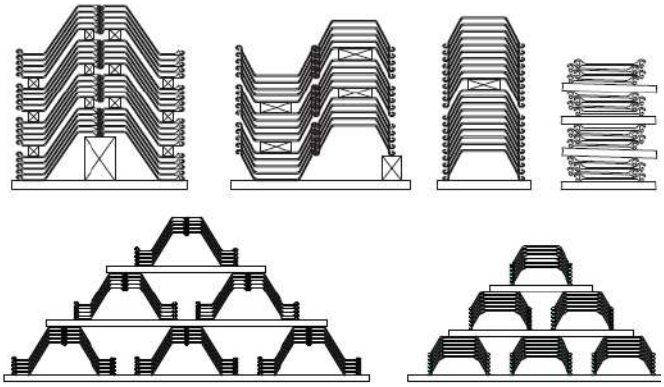
The properties of sheet piling sections including dimension shall conform to the profiles as shown in Annexure A & Annexure B. Sheet piling shall be provided with standard pulling holes.

Accessories, e.g., Metal plates, shapes, bolts, nuts, rivets, and other appurtenant fabrication and installation materials shall conform to manufacturer's standards and to the requirements specified in the respective sheet piling.

3.3. INSTALLATION

3.3.1. Material Storing

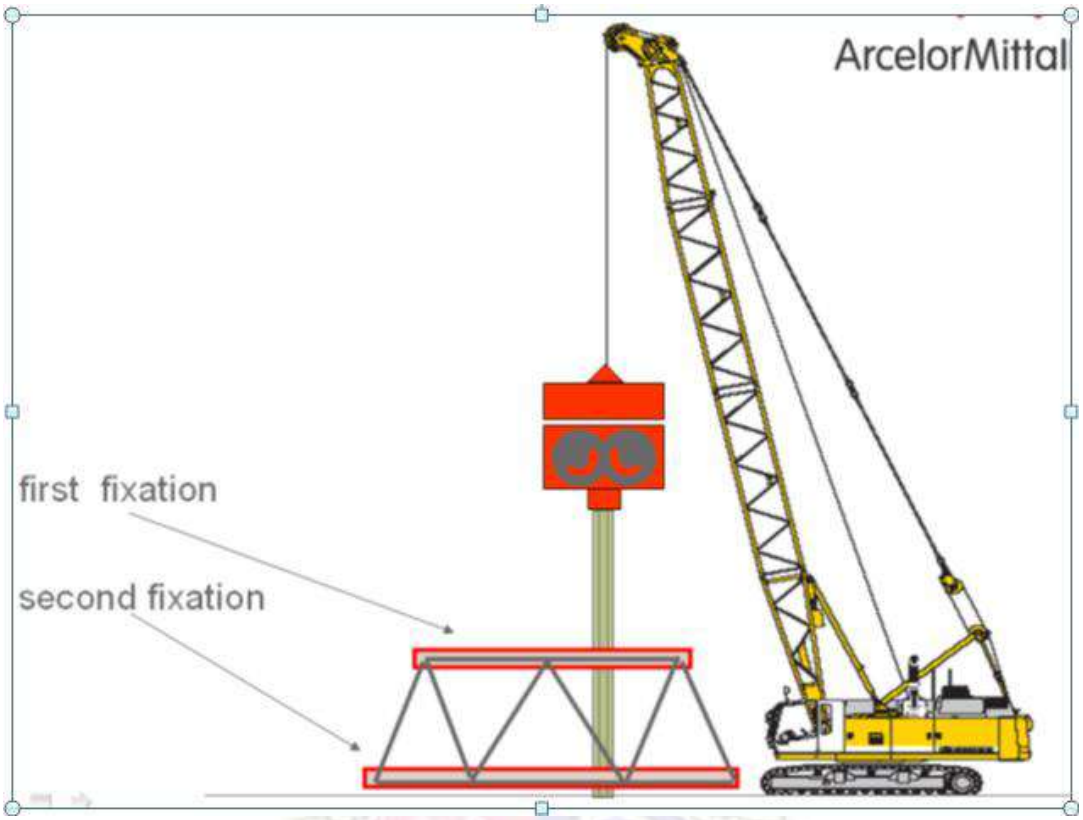
Sheet piles should be stored in such a way that they can be lifted easily in sequence of use. Spacers shall be inserted between the individual sheet piles in a stack, if required.



The Contractor shall verify locations of all underground utilities before driving any sheet piling. Any disturbance or damage to existing structures, utilities or other property, caused by the Contractor's operation, shall be repaired by the Contractor in a manner satisfactory to the Engineer at no additional cost to the Department. The Contractor shall be responsible for determining the appropriate equipment necessary to drive the sheeting to the tip elevation(s) specified on the plans or according to the Contractor's approved design. The Contractor shall be responsible for determining the appropriate equipment necessary to drive the sheeting to the tip elevation(s) specified on the plans or according to the Contractor's approved design. The sheet piling shall be driven, as a minimum, to the tip elevation(s) specified, prior to commencing any related excavation. If unable to reach the minimum tip elevation, the adequacy of the sheet piling design will require re-evaluation by the PMC/ Owner prior to allowing excavation adjacent to the sheet piling in question. The Contractor shall not excavate below the maximum excavation line shown on the plans without the prior permission of the Engineer. The sheet piling shall remain in place until the Engineer determines it is no longer required.

The sheet piling shall be removed and take away from site by the Contractor when directed by the Engineer. When allowed, the Contractor may elect to cut off a portion of the sheet piling leaving the rest in place. The remaining piling shall be a minimum of 12 in. (300 mm) below the finished grade or as directed by the Engineer.

Removed sheet piling becomes the property of the Contractor. When an obstruction is encountered, the Contractor shall notify the Engineer and upon concurrence of the Engineer, the Contractor shall begin working to break up, push aside, or remove the obstruction. An obstruction shall be defined as any object (such as but not limited to, boulders, logs, old foundations etc.) where it's presence was not obvious or specifically noted on the plans prior to bidding, that cannot be driven through or around with normal driving procedures, but requires additional excavation or other procedures to remove or miss the obstruction.



3.4. INSTALLATION PROCEDURE

The following are the general installation procedure:-

a) Pile Driving Equipment

Pile driving equipment shall conform to the following requirements.

- Driving Hammers

Hammers shall be impact / vibratory type as per manufacturer's specifications.

- Jetting Equipment

Jetting equipment shall have a minimum of two removable or fixed jets of the water or be a combination of air a water type. The water jets shall be designed so that the discharge volume and pressure are sufficient to freely erode the material under and adjacent to the piling. Use of jetting equipment shall be as per manufacturer specifications and design requirement

b) Placing

Pilings shall be carefully located as directed. Pilings shall be placed plumb with out-of-plumbness as per tolerance limit specified to manufacturer EN / ASTM specifications. Temporary wales, templates, guide structures shall be provided to insure that the pilings are placed and driven to the correct alignment. At least two templates shall be used in placing each piling and the maximum spacing of templates shall not exceed 6m.Pilings properly placed and driven shall be interlocked throughout their length with adjacent pilings toform a continuous diaphragm throughout the length or run of piling wall.

c) Driving

Adequate precautions shall be taken to insure that pilings are driven plumb. If the forward or leading edge of the piling wall is found to be out-of-plumb, the piling being driven shall be driven to the required depth and tapered pilings shall be driven to interlock with the out-of-plumb leading edge. If approved, other corrective measures may be taken to insure the plumbness of succeeding pilings. Pilings in each run or continuous length of piling wall shall be driven alternately, in increments of depth, to the required elevation. No piling shall be driven to a lower elevation than those behind it in the same run, except when the pilings behind it cannot be driven deeper. If the piling next to the one being driven tends to follow below final elevation, it may be pinned to the next adjacent piling. If obstructions restrict driving, a piling to the specified penetration the obstructions shall be removed or penetrated with a chisel beam. If the Contractor demonstrates that removal or penetration is impractical, the Contractor shall make changes in the design alignment of the piling structure as directed to insure the adequacy and stability of the structure. Pilings shall be driven to depths shown and shall extend up to the elevation indicated for the top of pilings.

d) Cutting-off and Splicing

Pilings driven to refusal or to the point where additional penetration cannot be attained and are extending above the required top elevation in excess of the specified tolerance shall be cut off to the required elevation. Pilings driven below the required top elevation and pilings damaged by driving and cut off to permit further driving shall be extended as required to reach the top elevation by splicing when directed at no additional cost to the Owner

e) Inspection of Driven Piling

The contractor shall inspect the interlocked joints of driven sheet piles extending above ground. If contractor find out that the sheet piles are out of interlock, then the sheet piles have to be removed.

f) Pulling and Re-driving

In the pulling and redriving of piles, the Contractor shall pull selected pilings to determine the condition of the underground portions of pilings. Any piling pulled and found to be damaged to the extent that its usefulness in the structure is impaired shall be removed and replaced at the Contractor's expense. Pilings pulled and found to be in satisfactory condition shall be redriven when directed

g) Removal for temporary application

The removal of sheet pilings shall consist of pulling, sorting, cleaning the interlocks, inventorying and storing previously installed sheet pilings as shown and directed.

3.5. MEASUREMENT

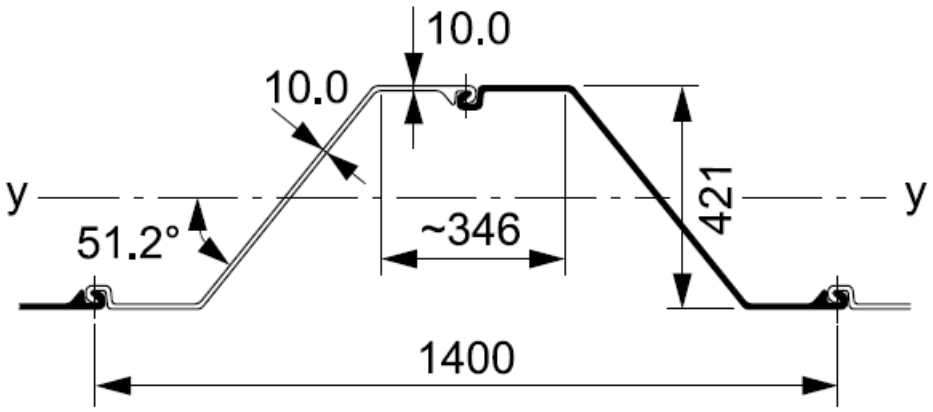
The Steel Sheet Piling will be measured for payment in Square Meter. Any cut off, left in place, or driven to dimensions other than those shown on the contract plans without the written permission of the Engineer, shall not be measured for payment but shall be done at the contractor’s expense. If the Contractor is unable to drive the sheet pile to the specified tip elevation(s) and can demonstrate that any further effort to drive it would only result in damaging the sheet pile, then the Contractor shall be paid based on the plan quality of sheet piling involved. However, no additional payment will be made for any walers, bracing, or other supplement to the steel sheet piling, which may be required as a result of the re-evaluation in order to insure the original design intent was met.

3.6. REPORT/DOCUMENTATION

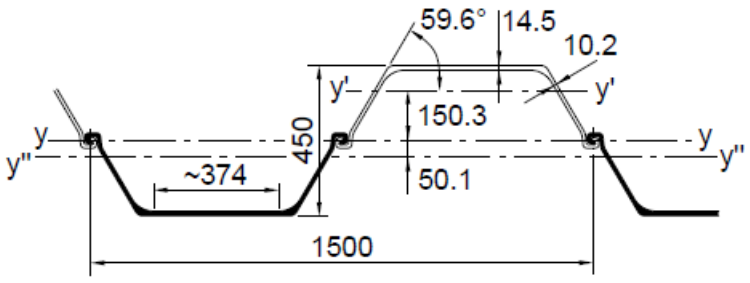
- **Sheet Pile Profile Shop Drawing**
- **Interlock Drawing**
- **Material Test Report**
- **Driving Plan**
- **Equipment Details**
- **Driving Records**

ANNEXURE – A

Sl	Description	Tender requirement
	I. Dimensions & Properties	
1	Width (Distance between the centre of the locks)	700 mm
2	Height	421mm
3	Thickness	10mm
4	Weight per meter pile	83.5 Kgs/meter
5	Weight per Sq. meter of wall	119 Kgs/m²
6	Section Modulous per meter of wall	1945 cm³/m
7	Length	12.00m
	II. Chemical Compositions (Ladle Analysis)	
1	Phosphorus	0.050% (max)
2	Sulphur	0.050% (max)
	II. Mechanical Properties	
1	Tensile Strength (min)	510 N/mm²
2	Yield Point (min)	430 N/mm²
3	Elongation	19% (min)
IV	**Steel Quality:** The Steel which will be used to make above Z-Type Steel Sheet Piles should conform to the Standards:	EN 10248
V	**Tolerance:**	As per EN 10248
	Drawing	



ANNEXURE – B

Sl	Description	Tender requirement
	I. Dimensions & Properties	
1	Width (Distance between the centre of the locks)	750 mm
2	Height	450mm
3	Thickness	14.5mm/10.2mm
4	Weight per meter pile	110.4 Kgs/meter
5	Weight per Sq. meter of wall	147 Kgs/m²
6	Section Modulous per meter of wall	2500 cm³/m
7	Length	12.00m
	II. Chemical Compositions (Ladle Analysis)	
1	Phosphorus	0.050% (max)
2	Sulphur	0.050% (max)
	II. Mechanical Properties	
1	Tensile Strength (min)	510 N/mm²
2	Yield Point (min)	430 N/mm²
3	Elongation	19% (min)
IV	**Steel Quality:** The Steel which will be used to make above U-Type Steel Sheet Piles should conform to the Standards:	EN 10248
V	**Tolerance:**	As per EN 10248
	Drawing	
		

Chapter -17

Plumbing & Sanitation

PLUMBING WORKS

1.0 SCOPE

This specification covers the general requirements of providing and laying water mains and water supply piping, providing and fixing sanitary fixtures and piping and providing and laying drainage lines.

For specifications, mode of measurements and scope of work covered under the respective items for the work included under this contract, following documents shall be referred to in the order of precedence as given below:

Description of the items and notes if any given in the Schedule of Quantities.

Specifications.

Additional Conditions of Contract.

General Conditions of Contract.

Applicable Codes and Standards as specified herein with amendments/ revisions issued till date.

In the event of any discrepancy among the documents referred above, the document in the higher order of precedence shall prevail.

In the event of any element of specification not being available in any of the documents mentioned above, the instructions of the Engineer-in-Charge in writing shall be followed by the Contractor.

The Work shall be carried out in accordance with the drawings and designs as would be issued to the Contractor by the Engineer-in-Charge duly signed and stamped by him. The Contractor shall not take cognisance of any drawings, designs, specifications, etc. not bearing Engineer-in-Charge's signature and stamp. Similarly the Contractor shall not take cognisance of instructions given by any other Authority except the instructions given by the Engineer-in-Charge in writing.

The Work shall be executed and measured as per metric dimensions given in the Schedule of Quantities, drawings etc.

The Contractor shall acquaint himself fully with the partial provisions for supports that may be available in the structure and utilise them to the extent possible. In any case the Contractor shall provide all the supports regardless of provisions that have been already made. Nothing extra shall be payable for situations where bed plates (for supports) are not available or are not useful.

The Contractor shall incorporate seismic considerations of anchoring and isolation in the design of the systems as called for the different equipment.

Shop coats of paint that may be damaged during shipment or erection shall be cleaned off with mineral spirits, wire brushed and spot primed over the affected areas, then coated with paint to match the finish over the adjoining shop painted surface.

In addition to the sectional testing carried out during the construction, the Contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains. He shall rectify all leakage and shall replace all defective materials in the system. Any consequential damage done, on account of Contractors carelessness, open or burst pipes or failure of fittings, during testing and commissioning to the building, furniture and fixtures shall be made good by the Contractor.

2.0 Scaffolding

Only steel tube scaffolding of approved design shall be used for all works. The scaffold structure shall comply with the requirements of IS:4014 and IS:3696. An independent tied scaffold (double scaffold), which has two lines of standards, shall be provided with the inner line kept at least one board clear of the finished face with extended transoms, or hop up baskets to carry an inside board. Diagonal braces shall not prevent the material being moved along the scaffold run. The scaffolding shall be suitably packed at the ends to prevent damage to the finished work.

3.0 Protection

Protection against damage: Care shall be taken to avoid damage from any cause at all stages. Packing pieces used for protection shall not disfigure or otherwise permanently mark the Works.

Surface protection shall be afforded by careful handling and the avoidance of the use of hooks, crowbars, or other implements that are likely to damage the works.

Protection during construction: Decorative surfaces shall be carefully protected during construction by a temporary cover.

Protection of finished work: At all stages of the Contract it is essential that all works are properly protected.

Suitable packing shall be used to ensure that scaffolding does not damage erected stone, marble, granite or other finished works.

Any disfigurement, discolouration or imperfection whatsoever due to any reason shall not be accepted and the Contractor shall either remedy the same or redo the work at no extra cost. The decision of the Engineer-in-Charge as to whether any work either in whole or in part is acceptable or not shall be final and binding on the Contractor.

4.0 Guarantee

The Contractor shall guarantee and undertake to maintain and rectify the various components of the Plumbing work installed by him for their successful performance for a period of 10 years. The Contractor shall indemnify the Engineer-in-Charge for a similar period against any damage to property and injury to persons on account of any defective work or maintenance carried out by the Contractor. The format and text of the Guarantee and the Indemnity Bond shall be given by the Engineer-in-Charge.

5.0 APPLICABLE CODES, STANDARDS AND PUBLICATIONS

All equipment, supply, erection, testing and commissioning shall comply with the requirements of Indian Standards and code of practices given below as amended till date. All equipment and material being supplied by the contractor shall meet the requirements of IS, and other Codes/ Publications as given below.

5.1.1 General

SP:6(1)	Structural steel sections
IS:27	Pig lead
IS:554	Dimensions for pipe threads where pressure tight joints are required on the threads
IS:779	Specification for water meters (domestic type)
IS:782	Specification for caulking lead
IS:800	Code of Practice for general construction in steel
IS:1068	Electroplated coatings of nickel plus chromium and copper plus nickel plus chromium
IS:1172	Code of Basic requirements for water supply drainage and sanitation
IS:1367	(Part 1) Technical supply conditions for threaded steel fasteners: Part I Introduction and general information
IS:1367	(Part 2) Technical supply conditions for threaded steel fasteners: Part 2 Product grade sand tolerances.
IS:1726	Specification for cast iron man hole covers and frames
IS:1742	Code of practice for building drainage
IS:2064	Selection, installation and maintenance of sanitary appliances - Code of practice
IS:2065	Code of practice for water supply in buildings

IS:2104	Specification for water meter boxes(domestic type)
IS:2373	Specification for water meters (bulk type)
IS:2379	Colour code for identification of pipelines.
IS:2527	Code of practice for fixing rain water gutters and down pipes for roof drainage
IS:2629	Recommended practice for hot dip galvanizing on iron and steel
IS:3114	Code of practice for laying of cast iron pipes
IS:4111(Part 1)	Code of practice for ancillary structures in sewerage system: Part 1Manholes
IS:4127	Code of practice for laying glazed stoneware pipes
IS:4853	Recommended practice for radiographic inspection of fusion welded butt joints in steel pipes
IS:4985	Unplasticised PVC pipes for potable water supplies – specification.
IS:5329	Code of practice for sanitary pipe work above ground for buildings
IS:5455	Cast iron steps for manholes
IS:6159	Recommended practice for design and fabrication of material prior to galvanising
IS:7558	Code of practice for domestic hot water installations
IS:8321	Glossary of terms applicable to plumbing work
IS:8419 (Part 1)	Requirements for water filtration equipment: Part 1 Filtration media sand and gravel
IS:8419 (Part 2)	Requirements for water filtration equipment: Part 2 Under drainage system
IS:9668	maintenance of water supplies and fire fighting.
IS:9842	Preformed fibrous pipe insulation
IS:9912	Coal tar based coating materials and suitable primers for protecting iron and steel pipe lines
IS:10221	Code of practice for coating and wrapping of underground mild steel pipelines
IS:10234	Recommendations for general pipeline welding
IS:10446	Glossary of terms relating to water supply and sanitation

IS:11149	Rubber Gaskets
IS:11790	Code of practice for preparation of butt welding ends for pipes, valves, flanges and fittings
IS:12183 (Part 1)	Code of practice for plumbing in multi-storeyed buildings: Part 1 Water Supply
IS:12251	Code of practice for drainage of building basements
BS:5572	Code of practice for sanitary pipe work
BS:6700	Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages
BS:8301	Code of practice for building drainage
BSEN274	Sanitary tap ware, waste fittings for basins, bidets and baths. General technical specifications
IS:458	Specification for precast concrete pipes(with and without reinforcement)
IS:651	Salt glazed stoneware pipes and fittings
IS: 1239 (Part 1)	Mild steel tubes, tubulars and other wrought steel fittings: Part 1 Mild steel tubes
IS:1239	Mild steel tubes, tubulars and other wrought steel fittings:
IS:1536	Centrifugally cast (spun) iron pressure pipes for water, gas and sewage
IS:1537	Vertically cast iron pressure pipes for water, gas and sewage.
IS:1538	Cast iron fittings for pressure pipes for water, gas and sewage
IS:1729	Sand cast iron spigot and socket soil, waste and ventilating pipes, fitting sand accessories
IS:1879	Malleable cast iron pipe fittings
IS:1978	Line pipe
IS:1979	High test line pipe
IS:2501	Copper tubes for general engineering purposes
IS:2643 (Part 1)	Dimensions for pipe threads for fastening purposes: Part 1 Basic profile and dimensions
IS: 2643 (Part 2)	Dimensions for pipe threads for fastening purposes: Part 2 Tolerances

IS:2643 (Part 3)	Dimensions for pipe threads for fastening purposes: Part 3 Limits of sizes
IS:3468	Pipe nuts
IS:3589	Seamless or electrically welded steel pipes for water, gas and sewage(168.3mm to 2032mm outside diametre)
IS:3989	Centrifugally cast (spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories
IS:4346	Specifications for washers for use with fittings for water services
IS:4711	Methods for sampling steel pipes, tube sand fittings
IS:6392	Steel pipe flanges
IS:6418	Cast iron and malleable cast iron flanges for general engineering purposes.
IS:7181	Specification for horizontally cast iron double flanged pipes for water, gas and sewage.
IS:778	Specification for copper alloy gate, globe and check valves for water works purposes
IS:780	Specification for sluice valves for water works purposes (50mm to 300mmsize)
IS:1703	Specification copper alloy float valves(horizontal plunger type) for water supply fittings.
IS:2906	Specification for sluice valves for water works purposes (350mm to 1200 mm size)
IS:3950	Specification for surface boxes for sluice valves
IS:5312 (Part 1)	Specification for swing check type reflux (non return) valves: Part 1Single door pattern
IS:5312	Specification for swing check type reflux (non return) valves: Part 2 Multidoor pattern
IS:12992	Safety relief valves, spring loaded: (Part 1) Part1Design
IS:13095	Butterfly valves for general purposes
IS:771 (Part 1 to 3)	Specification for glazed fire clay sanitary appliances
IS:774	Specification for flushing cistern for water closets and urinals (other than plastic cistern)
IS:775	Specification for cast iron brackets and supports for wash basins and sinks
IS:781	Specification for cast copper alloy screw down bib taps and

	stop valves for water services
IS:1700	Specification for drinking fountains
IS:2326	Specification for automatic flushing cisterns for
IS:2548 – Part1	Specification for plastic seats and covers for water closets: Part 1:Thermoset seats and covers
IS: 2548(Part 2)	Specification for plastic seats and covers for water closets: Part 2:Thermoplastic seats and covers
IS:2556(Part 1)	Specification for vitreous sanitary appliances (vitreous china): Part 1:General requirements
IS:2556(Part 2)	Specification for vitreous sanitary appliances (vitreous china) Part 2:Specific requirements of washdown water closets
IS:2556(Part 3)	Specification for vitreous sanitary appliances (vitreous china) Part 3 :Specific requirements of squatting pans
IS:2556(Part 4)	Specification for vitreous sanitary appliances (vitreous china) Part 4 :Specific requirements of wash basins
IS:2556 (Part 6 Sec 2)	Specification for vitreous sanitary appliances (vitreous china) Part 6 :Specific requirements of urinals, Section 2 Half stall urinals
IS:2556 (Part 6 Sec 4)	Specification for vitreous sanitary appliances (vitreous china) Part 6 :Specific requirements of urinals, Section 4 Partition slabs
IS:2556 (Part 6 Sec 5)	Specification for vitreous sanitary appliances (vitreous china) Part 6 :Specific requirements of urinals, Section 5 waste fittings
IS:2556 (Part 6 Sec 6)	Specification for vitreous sanitary appliances (vitreous china) Part 6 :Specific requirements of urinals, Section 6 Water spreaders for half stall urinals
IS:2556(Part 7)	Specification for vitreous sanitary appliances (vitreous china) Part 7 :Specific requirements of half round channels
IS:2556(Part 8)	Specification for vitreous sanitary appliances (vitreous china) Part 8 :Specific requirements of siphonic washdown water closets.
IS:2556 (Part 11)	Specification for vitreous sanitary appliances (vitreous china) Part 11:Specific requirements for shower rose
IS: 2556(Part 12)	Specification for vitreous sanitary appliances (vitreous china) Part 12:Specific requirements of floor traps
IS:2556 (Part 15)	Specification for vitreous sanitary appliances (vitreous china) Part 15:Specific requirements of universal water closets

IS:2692	Specification for ferrule for water services
IS:2717	Glossary of terms relating to vitreous enamel ware and ceramic metal systems
IS:2963	Specifications for copper alloy waste fittings for wash basins and sinks
IS:3311	Specification for waste plug and its accessories for sinks and wash basins.
IS:5961	Specification for cast iron gratings for drainage purposes.
IS:6249	Specification for flush valves and fittings for marine use
IS:6411	Specification for gel coated glass fibre reinforced polyester resin bath tubs
IS:8931	Specification for copper alloy fancy single taps, combination tap assembly and stop valves for water services
IS:9758	Specification for flush valves and fitting for water closets and urinals

6.0 QUALITY ASSURANCE AND QUALITY CONTROL

The Work shall conform to high standards of design and workmanship, shall be structurally sound and aesthetically pleasing. Quality standards prescribed shall form the backbone for the quality assurance and quality control system.

At the site level the Contractor shall arrange the materials, their stacking/ storage in appropriate manner to ensure the quality. Contractor shall provide equipment and manpower to test continuously the quality of materials, assemblies etc. as directed by the Engineer-in-Charge. The test shall be conducted continuously and the result of tests maintained. In addition the Contractor shall keep appropriate tools and equipment for checking alignments, levels, slopes and evenness of surface.

The Engineer-in-Charge shall be free to carry out tests as may be considered necessary by him at his sole discretion, from time to time, in addition to those specified in this document. The Contractor shall provide the samples and labour for collecting the samples. Nothing extra shall be payable to the Contractor for samples or for the collection of the samples.

The test shall be conducted at the site laboratory that may be established by Engineer-in-Charge or at any other Standard Laboratory selected by Engineer-in-Charge.

The Contractor shall transport the samples to the laboratory for which nothing extra shall be payable. In the event of Contractor failing to arrange transportation of the samples in proper time Engineer-in-Charge shall have them transported and recover two times the actual cost from the Contractor's bills.

Testing charges shall be borne by the Engineer-in-Charge.

Testing may be witnessed by the Contractor or his authorised representative. Whether witnessed by the Contractor or not, the test results shall be binding on the Contractor.

7.0 SANITARY AND OTHER APPLIANCES

7.1 Scope of Work

Without restricting to the generality of the foregoing, sanitary and other appliances shall inter-alia include the following:-

Sanitary appliances and fixtures for toilets

Chromium plated brass fittings

Stainless steel sinks

Accessories e.g. towel rods, toilet paper holders, soap dish, liquid soap dispensers, towel rails, coat hooks etc.

Mirrors, hand driers, drinking water fountains, etc.

Whether specifically mentioned or not the Contractor shall provide for all appliances and fixtures all fixing devices, nuts, bolts, screws, hangers as required.

All exposed pipes within toilets and near appliances/ fixtures shall be of chromium plated brass or copper unless otherwise specified.

7.2 General requirements

All materials shall be new and of quality conforming to specifications and subject to the approval of the Engineer-in-Charge. Wherever particular makes are mentioned, the choice of selection shall remain with the Engineer-in-Charge.

All appliances, fixtures and fittings shall be provided with all such accessories as are required to complete the item in working condition whether specifically mentioned or not in the Schedule of Quantities, specifications, drawings. Accessories shall include proper fixing arrangement, brackets, nuts, bolts, washers, screws and required connection pieces.

Fixing screws shall be half round head chromium plated (CP) brass screws, with CP brass washers unless otherwise specified

Porcelain sanitary ware shall be glazed vitreous china of first quality free from warps, cracks and glazing defects conforming to IS:2556. The choice of the colour of the Sanitary ware shall be that of the Engineer-in-Charge and nothing extra shall be payable to the Contractor for fixing of Sanitary ware of any colour.

Sinks for kitchen shall be of stainless steel or as specified in the Schedule of Quantities.

Chromium plated fittings shall be cast brass chromium plated of the best quality approved by the Engineer-in-Charge.

All appliances, fittings and fixtures shall be fixed in a neat workmanlike manner true to level and to heights shown on the drawings and in accordance with the manufacturer recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, tiling, plaster, paint, insulation or terrace shall be made good by the Contractor at his own cost.

All materials shall be rust proofed; materials in direct or indirect contact shall be compatible to prevent electrolytic or chemical (bimetallic) corrosion.

Sanitary appliances, subject to the type of appliance and specific requirements, shall be fixed in accordance with the relevant standards and the following:

Contractor shall, during the entire period of installation and afterwards protect the appliances by providing suitable cover or any other protection in order to absolutely prevent any damage to the appliances until handing over. (The original protective wrapping shall be left in position for as long as possible).

The appliance shall be placed in correct position or marked out in order that pipe work can be fixed or partially fixed first.

The appliance shall be fixed in a manner such that it will facilitate subsequent removal if necessary.

All appliances shall be securely fixed. Manufacturers' brackets and fixing methods shall be used wherever possible. Compatible rust proofed fixings shall be used. Fixing shall be done in a manner that minimises noise transmission.

Appliances shall not be bedded (e.g. WC pans, pedestal units) in thick strong mortar that could crack the unit (e.g. a ceramic unit).

Pipe connections shall be made with de-mountable unions. Pipework shall not be fixed in a manner that it supports or partially supports an appliance.

Appliances shall be fixed so that water falls to the outlet (e.g. baths).

Appliances shall be fixed true to level firmly fixed to anchor or supports provided by the manufacturer and additional anchors or supports where necessary.

Sizes of Sanitary fixtures given in the Specifications or in the Schedule of Quantities are for identification with reference to the catalogues of makes considered. Dimensions of similar models of other makes may vary within +10% and the same shall be provided and no claim for extra payment shall be entertained nor shall any payment be deducted on this account.\

7.3 Squatting type Water Closet - Orissa pattern

Squatting type water closet (WC) pan shall be of Orissa pattern of size as specified in Schedule of Quantities. Each WC pan shall be provided with a 100mm dia cast iron or porcelain P or S trap with or without vent horn as directed by the Engineer-in-Charge.

WC shall be flushed by means of concealed type or exposed type (as detailed in the drawings or as directed by the Engineer-in-Charge) 32mm size CP brass flush valve with regulator valve.

7.4 Wash Down Water Closet

WC shall be wash down or siphonic wash down type floor or wall mounted set, as shown in the drawings, designed for low volume flushing from 5-7litres of water, flushed by means of a porcelain flushing cistern or an exposed or concealed type (as detailed in the drawings or as directed by the Engineer-in-Charge) 32mm size CP brass flush valve with regulator valve. Flush pipe/ bend shall be connected to the WC by means of a suitable rubber adaptor. Wall hung WC shall be supported by CI floor mounted chair which shall be fixed in a manner as approved by the Engineer-in-Charge.

Each WC set shall be provided with a solid plastic seat, rubber buffers and chromium plated hinges. Plastic seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the WC.

Each WC set shall be provided with a fixed type CP brass ablution jet, if called for in schedule of quantities, complete with CP/ plastic piping, concealed type CP brass angle cock etc. all of approved make and brand. The nozzle of the ablution jet and its holding down plate shall have smooth and rounded edges and shall not be capable of causing any injury to a user or cleaner.

7.5 Universal type Water Closet

Universal type water closet shall be wash down or siphonic type floor mounted porcelain ware flushed by means of a porcelain flushing cistern or an exposed or concealed type (as detailed in the drawings or as directed by the Engineer-in-Charge) 32mm size CP brass flush valve with regulator valve. Flush pipe/ bend shall be connected to the WC by means of a suitable rubber adaptor.

Each WC set shall be provided with a solid plastic seat, rubber buffers and chromium plated hinges. Plastic seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the WC.

7.6 Urinals

Urinals shall be lipped type half stall white glazed vitreous china of size as called for in the Schedule of Quantities.

Half stall urinals shall be provided with 15mm dia CP spreader, 32mm dia CP domical waste and CP cast brass bottle trap with pipe and wall flange and shall be fixed to wall by CI brackets, CI wall clips and CP brass screws as recommended by manufacturer complete as directed by the Engineer-in-Charge.

Flushing for urinals shall be by means of no hand operation, PVC Flushing cistern with all internal fittings, mounted on a C.I. brackets, and painted with two coats of approved paint of approved shade and confirming to IS:2326.

Flush pipes shall be GI pipes concealed in wall chase but with chromium plated bends at inlet and outlet or as given in Schedule of Quantities. These shall be measured and paid for separately.

GI waste pipes shall be provided for urinals. Waste pipes may be exposed on wall or concealed in chase as directed by the Engineer-in-Charge. These shall be measured and paid for separately.

7.7 Urinal partitions

Urinal partitions shall be white glazed vitreous china of size specified in the Schedule of Quantities.

Porcelain partitions shall be fixed at proper heights with CP brass bolts, anchor fasteners and MS clips as recommended by the manufacturer and directed by the Engineer-in-Charge.

7.7.1 Wash basin

Wash basins shall be white glazed vitreous china of size, shape and type specified in the Schedule of Quantities.

Each basin shall be provided with painted MS angle or C.I. brackets and clips and the basin securely fixed to wall. Placing of basins over the brackets without secure fixing shall not be accepted. The MS angle shall be provided with two coats of red oxide primer and two coats of synthetic enamel paint of make, brand and colour as approved by the Engineer-in-Charge.

Each basin shall be provided with 32mm dia CP waste with overflow, pop-up waste or rubber plug and CP brass chain as specified in the Schedule of Quantities, 32mm dia CP brass bottle trap with CP pipe to wall flange.

Wash basin shall be provided with hot and cold water mixing fitting or as specified in the Schedule of Quantities.

Basins shall be fixed at proper heights as shown on drawings. If height is not specified, the rim level shall be 790mm from finished floor level or as directed by the Engineer-in-Charge.

7.8 Sinks

Sinks shall be stainless steel or any other material as specified in the Schedule of Quantities.

Each sink shall be provided with painted MS or CI brackets and clips and securely fixed. Counter top sinks shall be fixed with suitable painted angle iron brackets or clips as recommended by the manufacturer. Each sink shall be provided with 40mm dia CP waste and rubber plug with CP brass chain as given in the Schedule of Quantities. The MS angle shall be provided with two coats of red oxide primer and two coats of synthetic enamel paint of make, brand and colour as approved by the Engineer-in-Charge.

Supply fittings for sinks shall be deck mounted CP swivel faucets with or without hot and cold water mixing fittings as specified in the Schedule of Quantities. These shall be measured and paid for separately.

7.9 Mirrors

Mirrors shall be electro coated, 6.0 mm thick glass of approved make, plane or bevelled edge. The size shall be as specified in the Schedule of Quantities or as shown on the drawings. The image shall be clear and without waviness at all angles of vision.

Mirrors shall be provided with backing of 12mm thick marine plywood, fixed with CP brass semi-round headed screws and cup washers or CP brass clamps as specified or instructed by Engineer-in-Charge.

7.10 Shower set

Shower set shall comprise of two CP brass concealed stop cocks, four/ five way auto-diverter, adjustable type overhead shower, all with CP wall flanges of approved quality all as specified in the Schedule of Quantities. Bath spout, hand showers and pop up wastes shall also be provided wherever specified.

Wall flange shall be kept clear off the finished wall. Wall flanges embedded in the finishing shall not be accepted.

7.11 Toilet Paper Holder

Toilet paper holder shall be white glazed vitreous china of size, shape and type specified in the Schedule of Quantities or of stainless steel/powder coated brass.

Porcelain toilet paper holder shall be fixed in walls and set in cement mortar 1:2 (1 cement: 2coarse sand) and fixed in relation to the tiling work.

The latter shall be fixed by means of crews/capping having finish similar to the toilet paper holder in wall/ timber partitions with rawl plugs or nylon sleeves. When fixed on timber partition, it shall be fixed on a solid wooden base ember provided by the Engineer-in-Charge through another agency.

7.12 Towel Rail

Towel rail shall be chromium plated brass or of stainless steel or powder coated brass of size, shape and type specified in the Schedule of Quantities.

Towel rail shall be fixed with screws/capping having finish similar to the towel rail in wall with rawl plugs or nylon sleeves and shall include cutting and making good as required or directed by the Engineer-in-Charge.

7.13 Liquid Soap Dispenser

Liquid Soap dispenser shall be wall/ counter mounted suitable for dispensing liquid soaps, lotions, detergents.

Liquid soap dispenser shall be with C.P. brass bracket, caps etc. fixed to wall with C.P. brass screws, and screwed onto wooden rawl plug. The container shall be of C.P. brass.

7.14 Drinking water fountain

Drinking water fountain shall be wall mounting type made of vitreous china, stainless steel or any other material as given in the Schedule of Quantities.

The drinking water fountain shall be with anti-squirt bubble less, self closing valve type with automatic volume regulator.

The drinking water fountain shall be provided with an anti-splash back and integral strainer with 32mm or 40mm cast brass trap.

7.15 Hand Drier

The hand drier shall be no touch operating type with solid state time delay to allow user to keep hand in any position.

The hand drier shall be fully hygienic, rated for continuous repeat use (CRU).

The rating of hand drier shall be such that time required to dry a pair of hands up to wrists is approximately 30 seconds.

The hand drier shall be of wall mounting type suitable for 230 V, single phase, 50 Hz, ac power supply.

7.16 Measurement and rates

Sanitary fixtures (Porcelain ware and CP fittings) shall be measured by numbers.

Rate for providing and fixing of sanitary fixtures, accessories, shall include all items, and operations stated in the respective specifications and Schedule of Quantities and nothing extra is payable.

Rates for all items under specification Clauses above shall be inclusive of cutting holes and chases and making good the same, CP brass screws, nuts, bolts and any other fixing arrangements required and recommended by manufacturers, testing and commissioning etc. complete.

8.0 SOIL, WASTE, VENT AND RAINWATER PIPES

8.1 Scope of Work

All soil, waste and storm water disposal for the portion above ground level to the public sewers shall be by gravity whereas from the basements it shall be by pumping. Without restricting to the generality of the foregoing, the soil, waste, vent and rain water pipes system shall inter-alia include the following:

Vertical and horizontal soil, waste, vent and rainwater pipes and fittings, joints, clamps and connections to fixtures.

Connection of all pipes to sewer lines as shown on the drawings at ground level.

Floor and urinal traps, clean out plugs, inlet fittings and rainwater (roof) outlets.

Testing of all pipes and fittings in the workshop.

Testing of all pipes lines after installation.

8.2 General requirements

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

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

Pipes shall be securely fixed to walls, and ceilings by suitable clamps at intervals specified. Only approved type of anchor fasteners shall be used for fixing pipes on RCC ceilings and RCC/ masonry walls.

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

Short or long bends shall be used on all main pipelines as far as possible. Use of elbows shall be restricted for short connections.

Wherever piping is going across the separation/expansion joints of buildings, piping shall be provided with flexible connectors on both sides of such joints or on single side depending on whether any wall is to be crossed or not.

8.3 Cast iron pipes and fittings

Soil, waste, vent and anti-siphonage pipes, fittings and accessories shall be cast iron pipes. All pipes shall be straight and smooth and their inside free from irregular

bore, blow holes, crack sand other manufacturing defects. Pipes shall be centrifugally cast (spun) iron soil pipes conforming to IS:3989 or sand cast to IS:1729.

Lead as per IS:782 shall be used in the joints and caulked to a depth not less than that given in IS:3114.

8.3.1 Fittings

Fittings shall conform to the same Indian Standard as for pipes. Contractor shall use pipes and fittings of matching specifications.

Fittings shall be of the required degree of curvature with or without access door as detailed in the drawings or as directed.

Access door shall be made up with 3mm thick insertion rubber washer and white lead. The bolts shall be lubricated with grease or white lead for easy removal later. The fixing shall be air and water tight.

8.3.2 Fixing

All vertical pipes shall be fixed by MS clamps truly vertical. Branch pipes shall be connected to the stack at the same angle as that of the fittings. No collars shall be used on vertical stacks. Each stack shall be terminated at top with a cowl (terminal guard).

Horizontal pipes running along ceiling shall be fixed on structural adjustable clamps of special design shown on the drawings or as directed. Horizontal pipes shall be laid to uniform slope and the clamps adjusted to the proper levels so that the pipes fully rest on them.

Contractor shall provide all sleeves, openings, hangers, inserts during the construction. He shall provide all necessary information to the building Contractor for making such provisions in the structure as necessary. All damages shall be made good by the Contractor at his own cost to restore the surfaces.

8.3.3 Clamps

Holder bat clamps shall be of standard design fabricated from MS flats 40x3mm thick and 12mm dia MS rod and 6mm nuts and bolts; painted with two coats of black bitumen paint before fixing. The clamps shall be fixed in cement concrete 1:2:4 mix (1 cement:2 sand:4 stone aggregate 20mm nominal size) blocks 100x100x100mm deep.

Where holder bat clamps are to be fixed in RCC column or slotted angles, walls or beam they shall be fixed with 40x3mm flat iron "U" type clamps with anchor fasteners of approved design.

Structural clamps shall be fabricated from MS structural members e.g. rods, angles, channels, flats as per detailed drawing or as directed. Contractor shall provide all

nuts, bolts, welding material and paint the clamps with one coat of red oxide and two or more coats of black enamel paint to give an even shade.

Slotted angle/ channel supports on walls shall be provided wherever shown on drawings. Angles/channels/ bolts shall be of sizes shown on drawings or specified in Schedule of Quantities. Angles/channels shall be fixed to brick walls with bolts embedded in cement concrete blocks of 1:2:4 mix (1cement: 2sand: 4 stone aggregate 20mm nominal size) and to RCC walls with suitable anchor fasteners as directed by the Engineer-in-Charge. The spacing of support bolts horizontally shall not exceed 1m.

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

8.3.4 Traps

8.3.4.1 Cast iron "P" siphon traps

Cast iron "P" siphon traps shall be cast iron trap of self cleaning design. The trap and waste pipes shall be set in cement concrete blocks of size 300mm x 300mm and of required depth, firmly supported on the structural floor. The blocks shall be in 1:2:4 mix (1 cement:2 coarse sand : 4 stone aggregate 20mm nominal size) and extended to 40mm below finished floor level. Contractor shall provide all necessary shuttering and centering for the blocks at no extra cost.

8.3.4.2 Urinal traps

Urinal traps shall be cast iron P or S traps with or without vent and set in cement concrete block specified under clause 8.3.4 a)

8.3.4.3 Floor trap inlet

Floor trap shall be C.I. floor trap as per IS:3989. Bath room traps and connections shall ensure free and silent flow of discharging water. Where specified, Contractor shall provide a special type cast iron inlet hopper without or with one or two or three inlet sockets to receive the waste pipe. Joint between waste and hopper inlet socket shall be lead caulked. Hopper shall be connected to a CI P or S trap with at least 50mm seal (hopper and traps shall be paid for separately). Floor trap inlet hoppers and the traps shall be set in cement concrete blocks as specified under clause 8.3.4 above above without extra charge.

8.3.4.4 Cockroach trap

Floor/ urinal traps shall be provided with 100-150mm square or round stainless steel cockroach trap assembly complete with ring, outer cup, inner cup, jali etc. of an approved make.

8.3.5 Wire Balloons/ gratings for rain water pipes

The wire balloons and the domical gratings shall conform to IS:1729. The wire balloons shall be of galvanised steel. The CI domical gratings for the roof outlet shall be minimum 13mm thick.

Leaf and Gravel grates along with a perforated ring shall be made out of M.S. flat/bars of a design and dimension as shown in the drawing or as directed by the Engineer-in-Charge. These shall be painted with epoxy paint with a DFT of 200 microns.

8.4 Jointing

Soil, waste, vent, anti-siphonage and rain water pipes shall be jointed with refined pig lead conforming to IS:782. Sufficient skein of jute rope shall be caulked to leave a minimum space for the pig lead to be poured in. After the pouring, the lead shall be caulked into the joint with caulking tool and hammer. All surplus lead shall be cut and joint neatly finished flush with the rim of the socket.

The following minimum procedures shall be complied with while making the pipe joints:

Ensure that the pipes are clean internally and undamaged.

The pipes shall be cut square with sharp tools.

The cut ends of the pipes shall be filed/ reamed and finished smooth.

Any deformed ends shall be re-rounded.

It shall be ensured that the pipe ends shall enter the fittings and sockets to full depth of the jointing area.

The pipe work shall be assembled in a manner such that it does not entail making of joints in restricted locations.

Each metal pipe spigot shall be centered with three lightly wedged pieces of hardwood or folded lead.

The jointing surfaces shall be cleaned to remove any coatings or cutting oils, etc.

8.5 Clean out plugs

Contractor shall provide cast brass clean out plugs as required. Clean out plugs shall be threaded and provided with keyholes for opening. Clean out plugs shall be fixed to the pipe by a GI socket and lead caulked joint.

8.6 Waste pipe from appliances

Waste pipe from appliances e.g. washbasins, baths, sinks and urinals etc. shall be of Galvanized iron or as given in the Schedule of Quantities.

All pipes shall be fixed in gradient towards the outfalls of drains. Pipes inside a toilet room shall be in chase unless otherwise shown on drawings. Where required pipes may be run at ceiling level in suitable gradient and supported on structural clamps as directed by the Engineer-in-Charge. Spacing for the clamps shall be 3000mm for vertical runs and 2400mm for horizontal runs.

8.6.1 Galvanized pipes

Pipes shall be galvanized steel tubes conforming to IS:1239 (Heavy Class) and quality certificates shall be furnished. Pipes shall be provided with all required malleable fittings conforming to IS:1879 e.g. tees, couplings, bends, elbows, unions, reducers, nipples, plugs etc. All GI waste pipes shall be terminated at the point of connection with the appliance with an outlet of suitable diameter. Pipes shall be painted as specified under Clause 0.

8.7 Rainwater Pipes

All rainwater pipes shall be of PVC conforming to IS:4985 and 6 kg/sq.cm. pressure rating or as specified in the Schedule of quantities.

8.8 Cast iron pipes for drainage

All drainage lines passing under building, floors, in exposed position above ground e.g. basement ceiling shall be cast iron pipes. Position of such pipes shall generally be shown on the drawings.

Cast iron pipes shall be centrifugally spun iron pipes conforming to IS:1536 or sand cast conforming to IS:1729. Quality certificates shall be furnished.

8.8.1 Fittings

Fittings used for CI drainage pipe shall conform to IS:1538. Wherever possible junction from branch pipes shall be made by a “Y” tee.

Clean out plugs shall be provided on head of each drain and at location indicated on plans or directed by the Engineer-in-Charge. Clean out plugs shall be of size matching the full bore of the pipe. Plugs shall be made out with GI coupling caulked into the socket of the pipe or fittings. The end shall be provided with a brass screwed plug with suitable key for opening.

8.8.2 Laying

All cast iron pipes and fittings shall be jointed with best quality soft pig lead (conforming to IS:27) which shall be free from impurities. In wet trenches joints shall be made from lead wool. Nothing extra shall be paid for lead wool joints. Depth of pig lead and weight for joints shall be as per the relevant IS code.

The spigot of pipe or fittings shall be centered in the adjoining socket by caulking. Sufficient turns of tarred gaskin shall be given to leave unfilled the required depth of socket for depth of 45mm when the gaskin has been caulked tightly home. Joining ring shall be placed round the barrel and against the face of the socket. Molten pig

lead shall then be poured to fill the remainder of the socket. This shall be done in one pouring. The lead shall then be solidly caulked with suitable tools and hammers weighing not less than 2 kg.

For lead wool joints the socket shall be caulked with tarred gaskin, as explained above. The lead wool shall be inserted into the sockets and tightly caulked home, skein by skein, with suitable tools and hammers of not less than 2 kg weight until joint is filled.

8.8.3 Cement Concrete encasing

Cast iron soil and waste pipes under floor finish in sunken slabs and in wall chases (when cut specially for the pipe) shall be encased in cement concrete 1:4:8 mix (1 cement :4 coarse sand :8 stone aggregate 12mm size) 75mm in bed and all around. When pipes are running well above the structural slab, the encased pipes shall be supported with suitable cement concrete pillars, the details of which shall be furnished by the Engineer-in-Charge of required height at intervals of 1.8m. Rate for concrete all around pipes shall be inclusive of pillars, supports, shuttering and centering.

8.9 Painting

Soil, waste, vent, anti-siphonage and rain water pipes in any exposed location in shafts, pipe spaces etc. shall be painted with two coats of primer and two or more coats of synthetic enamel paint of colour as specified to give an even shade.

Pipes shall be painted with paint of approved quality and shade in accordance with approved pipe colour code.

GI waste pipes in chase shall be painted with two coats of bitumen paint. Exposed pipes shall be painted with two or more coats of synthetic enamel paint over two coats of etch primer.

CI soil and waste pipes below ground and those covered in cement concrete shall not be painted.

8.10 Cutting and making good holes/ chases

Pipes shall be fixed and tested as the building work proceeds. Contractor shall provide all necessary holes, cut outs and chases in structural members as the building work proceeds. Wherever holes are cut or left originally, they shall be made good with cement concrete 1:1:2 (1 cement: 1coarse sand :2 stone aggregate 20mm nominal size) or cement mortar 1:2 (1 cement :2 coarse sand) as directed by the Engineer-in-Charge and the surface restored as in original condition to the entire satisfaction of the Engineer-in-Charge at no extra cost.

8.11 Testing

Testing shall be done in accordance with IS:1172 and IS:5329 except as may be modified hereinunder.

Before use at site all CI pipes shall be tested by filling up with water for at least 30 minutes. After filling, pipes shall be struck with a hammer and inspected for blow holes and cracks. All defective pipes shall be rejected and removed from the site within 48 hours. Pipes with minor sweating may be accepted at the discretion of the Engineer-in-Charge.

Soil and waste pipes shall be tested in sections after installation, by filling up the stack with water. All openings and connections shall be suitably plugged as approved by the Engineer-in-Charge. The total head in the stack shall be 4.5m at the highest point of the section under test. A tolerance of 2 litres/cm of diametre/ km of pipeline measured during the last ten minutes of the period of test shall be allowed. The period of test shall be as directed by the Engineer-in-Charge. If any leakage is visible, the defective part of the work shall be cut out and made good. A slight amount of sweating which is uniform may be allowed but excessive sweating from a particular pipe or joint shall be watched and shall be construed to be a defect and shall be made good.

The Contractor shall test all vent pipes by a smoke testing machine. Smoke shall be pumped into the stack after plugging all inlets and connections and filling water in all trap seals. The test shall be conducted under a pressure of 25mm of water and shall be maintained for 15 minutes. The stack shall then be observed for leakages and all defective pipes and fittings removed or repaired as directed by the Engineer-in-Charge.

A test register shall be maintained and all entries signed and dated by Contractor and Engineer-in-Charge. A proforma of the proposed test register shall be submitted to the Engineer-in-Charge for approval.

All pipes in wall chase or meant to be encased or burried shall be hydro tested before the chase is plastered or the pipe encased or burried.

8.12 Measurement and rates

8.12.1 General

Rates for all items shall be inclusive of all work and items called for in the specifications given above and the Schedule of Quantities as applicable for the work under floors, in shafts or at ceiling level at all heights and depths.

All rates are inclusive of cutting holes and chases in RCC and masonry work and making good the same.

All rates are inclusive of shop testing, pre-testing at site and final testing of the installations, materials and commissioning.

8.12.2 Pipes

The unit of measurement shall be linear metre to the nearest centimetre.

All CI soil, waste, vent, anti-siphonage and rain water pipes shall be measured net, correct to a centimetre, including all fittings along their length after fixing. The length shall be taken along centre line of the pipes and fittings. No allowance shall be made for the portions of pipe lengths entering the sockets of the adjacent pipes or fittings. The above shall apply to all cases i.e. whether pipes are fixed on wall face or pillars or embedded in masonry or pipes running at ceiling level. The quoted rate shall include lead jointing.

GI pipes shall be measured in running metre correct to a centimetre for the finished work which shall include fittings e.g. bends, tees, elbows, reducers, crosses, sockets, nipples, nuts, unions etc. The length shall be taken along centre line of the pipes and fittings. All pipes and fittings shall be classified according to their diametre, method of jointing and fixing substance, quality and finish. The diametres shall be nominal diametre of internal bore. In case of fittings of unequal bore, the largest bore shall be considered.

8.12.3 Pipe Encasing/ supports

Cement concrete around pipes shall be measured along the centre of the pipe line measured per linear metre and include any masonry supports, shuttering and centering, curing, cutting etc. complete as described in the relevant specifications.

8.12.4 Angles/ channels

Slotted angles/ channels shall be measured per linear metre of finished length and shall include support bolts and nuts, length embedded in the cement concrete blocks of 1:2:4 (1cement: 2 coarse sand :4 stone aggregate 20mm nominal size) formed in the masonry walls; nothing extra shall be paid for the cement concrete block and making good the masonry wall, anchor fasteners etc. complete.

8.12.5 Traps

Unit of measurement shall be the number of pieces. All urinal traps, trap gratings, hoppers, clean out plugs shall be measured by number and shall include all items described in the relevant specifications and Schedule of Quantities. Cockroach traps shall not be measured separately and are deemed to be included in the rate for Traps.

8.12.6 Painting

Painting of pipes shall be measured per running metre for each diameter of pipe and shall be inclusive of all fittings and clamps. No deduction shall be made for fittings.

8.12.7 Excavation for soil pipes

No extra payment shall be admissible for excavation, dewatering, back filling, consolidation and disposal of surplus earth for soil and waste pipes.

8.12.8 Wire balloons/Gratings for rain water pipes

Wire balloons/gratings for rainwater pipes shall be measured by numbers for different sizes.

Leaf and gravel grates along with the perforated ring shall be measured in kgs.

9.0 WATER SUPPLY SYSTEM

9.1 Scope of Work

The water supply system shall inter-alia include the following:

Distribution system from main supply or overhead tank to all fixtures and appliances for cold and hot water.

Insulation for hot water pipes

Pipe protection and painting.

Control valves, masonry chambers and other appurtenances.

Connections to all plumbing fixtures, tanks, appliances and municipal mains

Inserts, nozzles for R.C.C. tanks

The term water supply is used as indicative of all water supply work required and necessary for the building including such external work as may be necessary to make the system functional.

9.2 General Requirements

If necessary and if approved by the Engineer-in-Charge, where unavoidable, bends may be formed by means of a hydraulic pipe bending machine for pipes upto 20mm dia. No bending shall be done for pipes of 25mm dia and above. After bending zinc rich paint shall be applied wherever the zinc coating is damaged.

Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs. Valves shall be located at a height not exceeding 1.6m above their operating floor/ platform level. Where such a provision is not possible and the valve is to be frequently operated a MS chain shall be provided for its operation.

9.3 GI pipes, fittings and valves

All pipes inside the buildings and where specified, outside the building shall be M.S. galvanized steel tubes conforming to IS:1239 of Class specified. When Class is not specified they shall be Heavy Class.

Fittings shall be of malleable cast iron galvanized, of approved make. Each fitting shall have manufacturer's trade mark stamped on it. Fittings for GI pipes shall

include couplings, bends, tees, reducers, nipples, unions, bushes etc. Fittings etc. shall conform to IS:1879.

Pipes and fittings shall be jointed with screwed joints using teflon tape suitable for water pipes. Care shall be taken to remove burr from the end of the pipe after cutting by a round file. All pipes shall be fixed in accordance with layout and alignment shown on the drawings. Care shall be taken to avoid air pockets. Necessary vents and drains shall be provided at all high and low points respectively. GI pipes inside toilets shall be fixed in wall chases well above the floor. No pipes shall be run inside a sunken floor as far as possible. Pipes may be run under the ceiling or floors and other areas as shown on drawings. All pipe joints after testing of the line shall be seal welded and the weld plus the adjoining portion shall be given two coats of zinc rich primer.

9.3.1 Bib cocks and stop cocks

All bib cocks and stop cocks shall be of C.P. brass conforming to IS:781 of tested quality and approved make and design, of diameter as specified in schedule of quantities.

9.3.2 Clamps

GI pipes in shafts and other locations shall be supported by GI clamps of design approved by the Engineer-in-Charge. Pipes in wall chases shall be anchored by iron hooks. Pipes at ceiling level shall be supported on structural clamps fabricated from MS structurals as described in Clause 8.3.3. Pipes in shafts shall be supported on slotted angles/ channels as specified/ as directed .

9.3.3 Unions

Contractor shall provide adequate number of unions on all pipes to enable easy dismantling later when required. Unions shall be provided near each gunmetal valve, stop cock or check valve and on straight runs as necessary at appropriate locations as required for easy dismantling and/ or as directed by the Engineer-in-Charge.

9.3.4 Flanges

Flanged connections shall be provided on pipes as required for maintenance/ ease in dismantling or where shown on the drawings, all equipment connections as necessary and required or as directed by the Engineer-in-Charge. Connections shall be made by the correct number and size of the GI nuts/ bolts as per relevant IS Standards and made with 3mm thick insertion rubber washer/gasket. Where hot water or steam connections are made insertion gasket shall be of suitable high temperature grade and quality approved by the Engineer-in-Charge. Bolt hole dia for flanges shall conform to match the specification for CI sluice valve as per IS:780. Gaskets shall conform to IS:11149.

9.3.5 Trenches

All GI pipes below ground shall be laid in trenches with a minimum cover of 600mm. The width and depth of the trenches shall be as follows except at places where welding/ jointing etc. needs larger width of trench. Additional width/ depth shall be provided as necessary for welding/ jointing etc. at no additional cost:

Diameter of pipe	Width of trench	Depth of trench
15mm to 50mm	300mm	750mm
65mm to 100mm	450mm	1000mm

9.3.6 Sand filling

GI pipes in trenches shall be protected with fine sand 150mm all around before filling in the trenches.

9.3.7 Painting

All pipes above ground shall be painted with one coat of red lead and

two coats of synthetic enamel paint of approved shade and quality to

give an even shade, or as specified by the Engineer-in-Charge.

Hot water pipes in chase:

All hot water pipes fixed in wall chase shall be painted with two coats of

bitumen paint and no insulation shall be provided.

9.3.8 Pipe protection

Where specified, pipes below floor or below ground shall be protected against corrosion by the application of two or more coats of solvent based rubberised asphaltic primer to give a uniform coat covered with 'Pipecoat Hiper', a puncture resistant non woven polyester mat. The application of pipecoat primer and "Hiper" membrane shall be as specified by the manufacturer.

9.4 Gunmetal valves

Valves 65mm dia and below shall be heavy gunmetal full way valves or globe valves conforming to Class I of IS:778. Valves shall be tested at manufacturer's works and the same stamped on it.

All valves shall be approved by the Engineer-in-Charge before they are allowed to be used in the Work.

9.5 Sluice valves

Unless otherwise specified all valves 80mm dia and above shall be CI double flanged sluice valves with non rising spindle. Sluice valves shall be provided with wheel when they are in exposed positions and with a cap top when they are located

underground. Contractor shall provide suitable operating keys for sluice valves with cap tops.

Sluice valves shall be of approved makes conforming to IS:780 of Class as specified.

9.6 Butterfly Valves

Where specified Valves 80mm dia and above shall be cast iron butterfly valve to be used for isolation and/ or flow regulation as directed by the Engineer-in-Charge. The valves shall be tight shutoff/ regulatory type with resilient seat suitable for flow in either direction and seal in both directions.

Butterfly valve shall conform to IS:13095.

9.7 Non Return Valve

Where specified non return valve (swing check type) shall be provided through which flow can occur in one direction only. It shall be single door swing check type of best quality conforming to IS:5312.

9.8 Testing

All pipes, fittings and valves shall be tested in accordance with IS:2065 except as may be modified herein under. All pipes, fittings and valves, after fixing at site, shall be tested to a hydrostatic pressure of 5kg/sqcm or 1.5 times the shut off head of the pump whichever is greater.

The test pressure shall be maintained for a period of at least thirty minutes without any drop in pressure.

A test register shall be maintained and all entries shall be signed and dated by Contractor(s) and the Engineer-in-Charge.

After commissioning of the water supply system, the Contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently and effectively. Valves which do not operate efficiently and effectively shall be replaced by new ones at no extra cost and the same shall be tested as above.

All pipes in wall chase or meant to be encased or burried shall be hydro tested before the chase is plastered or the pipe encased or burried.

9.9 Insulation

All open hot water flow and return pipes (not in chase), shall be insulated with preformed fibrous pipe sections conforming to IS:9842.

Insulation to pipes shall be with premoulded pipe sections, thickness for sections shall be:

Pipe 50mm dia and below - 25mm thick

Pipe 65mm dia and above - 40mm thick

9.9.1 Application:

All surfaces shall be thoroughly cleaned with a wire brush.

One layer of approved primer shall be applied and premoulded pipe insulation sections shall be fixed.

One layer of aluminium foil of thickness 0.711mm (20 SWG), shall be applied as a finish layer.

9.9.2 Insulation for hot water pipes in chase:

All hot water pipes fixed in wall chase shall be painted with two coats of bitumen paint of approved make.

9.10 Sterilization of installation

The water supply installation shall be sterilized as per standards and as follows:

Tanks and pipes shall be filled and flushed out.

All bib cocks (taps) shall be closed.

Tanks and pipes shall be re-filled while adding a sterilizing admixture containing 50 parts chlorine to one million parts water.

When the installation is filled all bib cocks (taps) shall be opened progressively and each allowed to run until the water smells of chlorine.

The installation shall be topped up and more sterilizer added.

The installation shall then be left for three hours and shall then be tested for residual chlorine; if none is found, the installation shall be drained and the process repeated.

The installation shall be finally drained and flushed with potable water before use.

9.11 Measurement and rates

9.11.1 GI pipes

GI pipes above ground shall be measured per linear metre (to the nearest cm) along the centre line of the pipe and shall be inclusive of all fittings e.g. couplings, tees, bends, elbows, unions, flanges, etc. Deduction for valves shall be made. Rates quoted shall be inclusive of all fittings, clamps, cutting holes chases and making good the same and all other items mentioned in the specifications and Schedule of Quantities.

GI pipes below ground shall be measured per linear metre (to the nearest cm) along the centre line of the pipe and shall be inclusive of all fittings e.g. couplings, tees, bends, elbows, unions and flanges, etc. Deduction for valves shall be made. Rates quoted shall be inclusive of all fittings, cutting holes and chases and making good the same and all other items mentioned in the specifications and Schedule of Quantities. Excavation, filling, back filling with selected excavated earth, compaction and disposal of surplus earth, fine sand filling around GI pipes, in external work shall be measured separately, as per respective items.

9.11.2 Valves, Bib cocks and stop cocks

Gunmetal and cast iron valves, Bib cocks and stop cocks shall be measured by numbers.

9.11.3 Flanges for Nozzles

Flanges for nozzles shall be measured by numbers and the quoted rate shall include welding of the flanges to the pipe nozzles.

Painting/ pipe protection/ insulation Unless otherwise specified painting/ pipe protection/ insulation for pipes shall be measured and paid for separately. These shall be measured per linear metre along the centre line of the pipe, over the finished surface and shall include all valves and fittings for which no deduction shall be made.

10.0 DRAINAGE

10.1 Scope of Work

Without restricting to the generality of the foregoing, the drainage system shall inter-alia include:

Sewer lines including earthwork for excavation, disposal, backfilling and compaction, pipelines, manholes, drop connections and connections to the municipal or existing sewer.

Storm water drainage, earth works for excavation, disposal, backfilling and compaction, pipe lines, manholes, catch basins and connections to the existing municipal storm water drain or connected as indicated by the Engineer-in-Charge.

10.2 General Requirements

Drainage lines and open drains shall be laid to the required gradients and profiles.

All drainage work shall be done in accordance with the Local municipal bye-laws.

Contractor shall obtain necessary approval and permission for the drainage system from the municipal or any other competent Authority.

Location of all manholes, etc. shall be got confirmed by the Engineer-in-Charge before the actual execution of work at site. As far as possible, no drains or sewers shall be laid in the middle of road unless otherwise specifically shown on the drawings or directed by the Engineer-in-Charge in writing.

10.3 Excavation

10.3.1 Alignment and grade

The sewer pipes shall be laid to alignment and gradient shown on the drawings but subject to such modifications as shall be ordered by the Engineer-in- Charge from time to time to meet the requirements of the Works. No deviations from the lines, depths of cutting or gradients of sewers shown on the plans and sections shall be permitted except by the express direction in writing of the Engineer-in-Charge.

10.3.2 Excavation in tunnels

Excavation for sewer works shall be open cutting unless the permission of the Engineer-in-Charge for the ground to be tunneled is obtained in writing. Where sewers have to be constructed along narrow passages, the Engineer-in-Charge may order the excavation to be made partly in tunnel and in such cases the excavated soil shall be brought back later on for refilling.

10.3.3 Opening out trenches

In excavating the trenches, etc. the solid road metalling, pavement, kerbing, etc. and turf shall be placed on one side and preserved for reinstatement after the trenches or other excavation are filled up. Before any road metal is replaced, it shall be carefully shifted and only clean metal used for replacing. The surface of all trenches and holes shall be restored and maintained to the satisfaction of the Engineer-in-Charge and of the Owners of the roads or other property traversed and the Contractor shall not cut out or break down any live fence of trees in the line of the proposed works but shall tunnel under them, unless the Engineer-in-Charge shall order to the contrary.

The Contractor shall grub up and clear the surface over the trenches and other excavations of all trees, stumps roots and all other encumbrances affecting execution of the work and shall remove them from the site.

10.3.4 Obstruction of roads

The Contractor shall not occupy or obstruct by his operation more than one half of the width of any road or street and sufficient space shall then be left for public and private transit. He shall remove the materials excavated and bring them back again when the trench is required to be refilled. The Contractor shall obtain the consent of the concerned authority in writing before closing any road to vehicular traffic. The foot walks must be clear at all times.

10.3.5 Removal of filth

All night soil, filth or any other offensive matter met with during the execution of the works, shall not be deposited on to the surface of any street or where it is likely to be a nuisance or passed into any sewer or drain but shall be immediately, after it is taken out of any trench, sewer or cess pool, put into the carts and removed to a suitable place to be provided by the Contractor.

10.3.6 Excavation to be taken to proper depths

The trenches shall be excavated to such a depth that the sewer shall rest on concrete as specified in the clauses relating thereto, so that the inverts may be at the levels given in the sections. In bad ground, the Engineer-in-Charge may order the Contractor to excavate to a greater depth than that shown on the drawings and to fill up the excavation to the level of the sewers with concrete, broken stone, gravel or other materials as directed by the Engineer-in-Charge. Such extra excavation, concrete, broken stone, gravel or other materials, shall be measured and paid for separately if the extra work was ordered by the Engineer-in-Charge in writing, but if the Contractor should excavate the trench to a greater depth than is required without a specific order to that effect in writing of the Engineer-in-Charge, the extra depth shall have to be filled up with cement concrete 1:4:8 (1 cement: 4coarse sand 8: stone aggregate 20mm nominal size) at the Contractor's own costs and charges, as directed by and to the satisfaction of the Engineer-in-Charge.

10.3.7 Refilling

After the sewer or other work has been laid and proved to be water tight, the trench or other excavations shall be back filled with selected excavated earth and compacted. Utmost care shall be taken in doing this, so that no damage shall be caused to the sewer and other permanent work. The filling in the haunches and up to 75mm above the crown of the sewer shall consist of the finest selected materials, as directed by the Engineer-in-Charge, placed carefully in 150mm layers, then flooded and consolidated. After this has been laid, the trench and other excavation shall be refilled carefully in 150mm layers with materials taken from the excavation, each layer being watered to assist in the consolidation unless the Engineer-in-Charge shall otherwise direct.

10.3.8 Contractor to restore settlement and damages

The Contractor shall, at his own costs and charges, make good promptly any settlement that may occur in the surfaces of roads, berms, footpaths, gardens, open spaces etc. whether public or private caused by his trenches or by his other excavations and he shall be liable for any accidents caused thereby. He shall also, at his own expense and charges, repair and make good any damage done to buildings and other property. If in the opinion of the Engineer-in-Charge he fails to make good such works with all practicable despatch, the Engineer-in-Charge shall be at liberty to get the work done by other means and the expenses thereof shall be paid by the Contractor or deducted from any money that may be or become due to

the Contractor or recovered from the Contractor in any other manner according to the law of the land.

10.3.9 Disposal of surplus soil

The Contractor shall at his own costs and charges provide places for disposal of all surplus materials not required to be used on the works. As each trench is refilled the surplus soil shall be immediately removed, the surface properly restored and the site cleared.

10.3.10 Timbering of sewer and trenches

The Contractor shall at all times support efficiently and effectively the sides of all the trenches and other excavations by suitable timbering, piling and sheeting and they shall be close timbered in loose or sandy strata and below the surface of the sub soil water level.

All timbering, sheeting and piling with their wallings and supports shall be of adequate dimensions and strength and fully braced and strutted so that no risk of collapse or subsidence of the walls of the trench shall take place.

The Contractor shall be held responsible and shall be accountable for the sufficiency of all timbering, bracing, sheeting and piling used and also for, all damage to persons and property resulting from improper quality, strength, placing, maintaining or removing of the same.

10.3.11 Shoring of buildings

The Contractor shall shore up all buildings, walls and other structures, the stability of which is liable to be endangered by the execution of the work and shall be fully responsible for all damages to persons or property resulting from any accident.

10.3.12 Removal of water from sewer, trench etc.

The Contractor shall at all times during the progress of the work keep the trenches and excavations free from water which shall be disposed of by him in a manner as shall neither cause injury to the public health nor to the public or private property nor to the work completed or in progress nor to the surface of any roads or streets nor cause any interference with the use of the same by the public at no extra cost.

10.3.13 Width of trench

The Engineer-in-Charge shall have power by giving an order in writing to the Contractor to increase the maximum width/ depth in respect of which payment shall be allowed for excavation and back filling in trenches for various classes of sewer, manholes, and other works in certain lengths to be specifically laid down by him, where on account of bad ground or other unusual conditions, he considers that such increased widths/ depths are necessary in view of the site conditions.

10.3.13.1 The width of trenches at the bottom shall be as follows:-

100mm dia pipe - 550mm

150mm dia pipe - 550mm

225-250mm dia pipe - 600mm

300mm dia pipe - 750mm

Maximum width of the bed concrete shall also be as above. No additional payment is admissible for widths greater than specified unless directed by the Engineer-in-Charge as given in clause above.

10.4 Salt glazed stoneware pipes

Stoneware pipes shall be new and of first Class quality salt glazed and free from rough texture inside and outside and straight. All pipes shall comply with IS:651 and have the manufacturers name marked on them.

10.4.1 Laying of salt glazed stoneware pipes

Pipes are liable to be damaged in transit and not withstanding tests that may have been made before despatch each pipe shall be examined carefully on arrival at site. Each pipe shall be lightly struck with a wooden hammer or mallet and those that do not ring true and clear shall be rejected. Sound pipes shall be carefully stacked to prevent damage. All defective pipes shall be segregated, marked in a conspicuous manner and their use in the works prevented by expeditiously removing them from the work site.

The pipes shall be laid with sockets leading uphill and should rest on solid and even foundations for the full length of the barrel. Socket holes shall be formed in the foundation sufficiently deep to allow the pipe jointer room to work right round the pipe and as short as practicable to admit the socket and allow the joint to be made.

Where pipes are not bedded on concrete the trench bottom shall be left slightly high and carefully bottomed up as pipe laying proceeds so that the pipe barrels rest on firm ground. If excavation has been carried too low it shall be made up with cement concrete 1:4:8 (1 cement: 4coarse sand: 8 stone aggregate 20mm nominal size) at the Contractor's cost and charges.

10.4.2 Jointing of salt glazed stoneware pipes

Tarred gaskin shall first be wrapped round the spigot of each pipe and the spigot shall then be placed into the socket of the pipe previously laid, the pipe shall then be adjusted and fixed in its correct position and the gaskin caulked tightly home so as to fill not more than one quarter of the total length of the socket.

The remainder of the socket shall be filled with stiff mix of cement mortar (1 cement: 1 clear sharp washed sand). When the socket is filled, a fillet shall be formed round the joint with a trowel forming an angle of 45 degrees with the barrel of that pipe. The mortar shall be mixed as needed for immediate use and no mortar shall be beaten up and used after it has begun to set.

After the joint has been made any extraneous materials shall be removed from the inside of the joint with a suitable scraper of "badger". The newly made joints shall be protected until set, from the sun, drying winds, rain or dust. Sacking or other materials which can be kept damp shall be used. The joints shall be exposed and space left all around the pipes for inspection by the Engineer-in-Charge. The inside of the sewer must be left absolutely clear in bore and free from cement mortar or other obstructions throughout its entire length, and shall efficiently drain and discharge.

10.4.3 Gully traps

Gully traps shall be fixed in a masonary chamber as detailed in CPWD specifications. The CI sealed cover and frame shall weigh not less than 7.3 kg. Where necessary, sealed cover shall be replaced with CI grating of the same size.

10.5 Reinforced cement concrete pipes

All underground storm water drainage pipes and sewer lines where specified (other than those specified as cast iron) shall be centrifugally spun S&S RCC pipes of specified Class conforming to IS:458. Pipes shall be true and straight with uniform bore, throughout. Cracked, warped pipes shall not be used on the work. All pipes shall be tested by the manufacturer and the Contractor shall produce, a certificate to that effect from the manufacturer.

10.5.1 Laying

RCC S&S spun pipes shall be laid on cement concrete bed or cradles as specified and shown on the detailed drawings. The cradles may be pre cast and sufficiently cured to prevent cracks and breakage in handling. The invert of the cradles shall be left 12mm below the invert level of the pipe properly placed on the soil to prevent any disturbance. The pipe shall then be placed on the bed concrete or cradles and set for the line and gradient by means of sight rails and bonding rods etc. Cradles or concrete bed may be omitted, if directed by the Engineer-in-Charge.

10.5.2 Jointing of pipes

Clauses under 10.4.2 shall apply.

10.6 POLYPROPYLENE RANDOM CO-POLYMER (PP-R) PIPES

10.6.1 The PP-R is a bonded, multilayer pipe consisting of different layers of the pipe:-

(a) The inner-most layer of the pipe to be Anti – bacterial to prevent bacteria growth inside pipe surface.

(b) The middle layer to be of plain PP-R which is neither in contact with Water and nor under direct effect of the atmospheric conditions.

(c) The outer-most layer to be of U.V. stabilized PP-R to prevent the pipe surface from sunlight under exposed atmospheric conditions.

The pipes should in general be conforming to the requirements of IS 15801 except that specified with in nomenclature of the item. The pipes should have smooth inner surface with non contracting diameters. The pipes shall be cleanly finished, free from cracks and other defects.

The pipes shall be clean and well cut along ends after taking into consideration the desired length, using the pipe scissors. The Polypropylene used for manufacturing the pipe shall conform to the requirements of IS 10951 and IS 10910. The specified base density shall be between 900 kg/m^3 and 910 kg/m^3 when determined at 27°C. The resin should be mixed with sufficient quantity of colour master batches. The colour master batch should be uniform throughout the pipe surface. The standard dimension ratio (SDR) i.e. ratio of the nominal outer diameter of a pipe to its nominal wall thickness should be 7.4/11 as given in the item.

10.6.2 Fittings

Plain fittings, Chrome plated brass threaded fittings and Valves shall be as per nomenclature of item or as directed by engineer- in- charge.

(a) The plain fittings shall be Polypropylene Random Copolymer and comply with all the requirements of the pipes. The plain fittings shall comprise of Socket, Elbow, Tee, Cross, Reducer socket, Reduction Tee, End Cap, Crossover, Omega, Threaded Plug and wall clamps in available sizes.

(b) The Chrome Plated Brass threaded fittings shall be Chrome Plated Brass threaded piece moulded inside Polypropylene random copolymer fitting. The maternal shall comply with all the requirements of the pipes. The Chrome plated Brass threaded fittings shall comprise of Socket, Elbow and Tee (Male & Female) in available sizes. These are the fittings for C.P. connections and for continuations from existing Galvanized Irion Pipes and fittings.

(c) The valves shall be Polypropylene Random Copolymer Valves. The valves comprise of Gate Valve, Ball Valve, Concealed stop valve and Chrome Coated Valve in available sizes.

The Valves sizes availability in Polypropylene Random Copolymer is as follows:-

(i) Gate Valve - 20 mm to 63 mm

(ii) Ball Valve - 20 mm, 25 mm, 32 mm, 40 mm, 50 mm & 63 mm

(iii) Concealed Stop valve - 20 mm & 25 mm

(iv) Chrome Coated Valve - 20 mm & 25 mm

However, the other Brass/Bronze Valves can be connected to Polypropylene Random pipes using C.P. Brass threaded fittings of desired sizes.

10.6.3 Laying and Jointing of Pipes and Fittings

The specifications described in 18.4 shall apply as far as possible. The pipes and fittings shall run in wall chase as specified. Pipes shall run only in vertical or horizontal alignment as far as possible. The installation of pipes is similar to that of the metal pipes with the only difference in the jointing procedure. The jointing of the PP-R pipes and fittings are done by fusion welding by means of a welding machine.

The marking on pipe shall carry the following information:-

c) Manufacturer's name/ trade mark

d) PPR pipe

e) SDR

f) Out side diameter and minimum wall thickness

g) Lot No. / Batch No. containing date of manufacturing. And machine number.

10.6.4 The out side diameter of pipes, tolerance in the same and ovality of pipe shall be as given in Table below.

Outside Diameter, Tolerance and Ovality of Pipes

Sl. No.	Nominal Size	Outside Diameter	Tolerance (Only positive tolerance)	Ovality
	DN	mm	mm	mm
(i)	16	16.0	0.3	1.2
(ii)	20	20.0	0.3	1.2
(iii)	25	25.0	0.3	1.2
(iv)	32	32.0	0.3	1.3
(v)	40	40.0	0.4	1.4
(vi)	50	50.0	0.5	1.4
(vii)	63	63.0	0.6	1.6
(viii)	75	75.0	0.7	1.6

(ix)	90	90.0	0.9	1.8
(x)	110	110.0	0.9	2.2

1. The values specified for tolerance on outside diameter have been calculated as 0.009DN, rounded off to the next higher 0.1 mm subject to minimum of 0.3 mm. No negative tolerances are allowed.

2. The basis for the values specified for ovality is:

(a) For nominal outside diameters ≤ 75 mm, the tolerance equals (0.008 DN+1.0) mm, rounded to the next higher 0.1 mm, with a minimum value of 1.2 mm.

(b) For nominal outside diameters ≥ 75 mm and ≤ 250 mm, the tolerance equals 0.20 DN, rounded to the next higher 0.1 mm.

(c) For nominal outside diameter > 250 mm, the tolerance equals 0.35 DN, rounded to the next higher 0.1 mm.

10.6.5 Wall Thickness

The minimum and maximum wall thickness of pipes shall be as given in Table below:-

Sl. No.	Nominal Size	SDR 11		SDR 7.4	
	DN	Min	Max	Min	Max
(i)	16	-	-	2.20	2.70
(ii)	20	1.90	2.30	2.80	3.30
(iii)	25	2.30	2.80	3.50	4.10
(iv)	32	2.90	3.40	4.40	5.10
(v)	40	3.70	4.30	5.50	6.30
(vi)	50	4.60	5.30	6.90	7.80
(vii)	63	5.80	6.60	8.60	9.70
(viii)	75	6.80	7.70	10.30	11.60
(ix)	90	8.20	9.30	12.30	13.80
(x)	110	10.00	11.20	15.10	16.90

Note: The wall thickness tolerances have been calculated on the following basis:
(a) Limit deviation=0.1e + 0.2 mm rounded up to the nearest 0.1 mm.

(b) A local increase in wall thickness of up to +0.2e is permissible for e up to 10 mm and up to 0.15e for e greater than 10 mm. The mean of the measurement shall, however, still lie within the given limit deviations.
The quality of each installation system ultimately depends on the tightness, stability and lifetime of its connections. The pipe of the desired length is cut using the pipe scissors. The proper heating piece is taken and mounted on the welding machine. The welding device is switched on - Control lamp and switch lamp will lit. When ready, control lamp gets off, which means that welding temperature of 260 Degrees ±10 Degrees Celsius has been reached. The pipe end and the fitting to be welded are heated on the welding machine. Before heating the fitting and the pipe, the dirty welding tools, pipe and fitting are cleaned with a cloth. When heated up (with heating time as per the Table shown below), the pipe and the fitting is removed from the welding machine and the two pieces connected together by applying a little pressure without twisting. The joint is allowed to cool down for a few seconds. The welding process is that safe because the properly heated part of Polypropylene create a homogeneous connection.

Guidelines for Welding PP-R Pipes and Fittings (DVS Guideline 2207, Part II)

Outer diameter of pipe(mm)	Heating Time (Seconds)	Cooling Period (Minutes)
16	5	2
20	5	2
25	7	2
32	8	4
40	12	4
50	18	4
63	24	6
75	30	8
90	30	8

The same procedure shall be adapted for exposed as well as concealed fittings. The Crossovers may be used wherever the overlapping of the PP-R pipes is required. The fixing shall be done by means of Wall Support Clamps keeping the pies about 1.5 cm clear of the wall where to be laid on the surface. Where it is specified to conceal the pipes, chasing may be adopted. For pipes fixed in the shafts, ducts etc. there should be sufficient space to work on the pipes with the usual tools. Pipe sleeves shall be fixed at a place the pipe is passing, through a wall or floor for reception of the pipe and allow freedom for expansion and contraction and other movements. Fixed supports prevent any movement of the pipe by fixing it at some points. Fittings are used in creating the fixed points. Fixed supports must not but installed at bending parts and the direction changes must be done in the pipe itself. In between the fixed supports some arrangements must be done to compensate any potential elongation or shrinkage in the pipe length. For exposed straight pipes having length more than 5 meters, to compensate the expansion an expansion piece must be used.

10.6.6 Piping Installation Support

Piping shall be properly supported by means of wall support clamps as specified and as required, keeping in view the proper designing for expansion and contraction. Risers shall be

supported at each floor with clamps.Due to high coefficient of thermal expansion the heat losses though the pipes is highly reduced. Therefore, for internal Bathroom hot geyser water distribution lines, the insulation is often not required.

10.6.7 Installation of Water Meter and Valves

PP-R lines shall be cut to the required lengths at the position where the meter and Valves are required to be fixed. Suitable C.P. Brass threaded fittings shall be attached to the pipes. The meter and Valves shall be fixed in a position by means of connecting pipes, 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 shall be installed exactly horizontally or vertically in the flow line in the direction shown by the arrow cast on the body of the meter. Care shall be taken to not to disturb the factory seal of the meter. Wherever the meter shall be fixed to a newly fitted pipeline, the pipeline shall have to be completely washed before fitting the meter.

10.6.8 Testing

All water supply system shall be tested to Hydrostatic pressure test. Maximum operating pressure at varying degree of temperature is given in Table below:-

Sl. No.	Temperature	SDR 11	SDR 7.4
		Pressure MPA	Pressure MPA
(i)	10	1.91	3.02
(ii)	20	1.63	2.58
(iii)	30	1.37	2.17
(iv)	40	1.15	1.84
(v)	50	0.98	1.55
(vi)	60	0.82	1.28
(vii)	70	0.62	0.98
(viii)	80	0.39	0.62
(ix)	95	0.27	0.40

The pressure test is performed in 3 steps being preliminary test, main test and final test. For the preliminary test a pressure which is 1.5 times higher than the possible working pressure is applied and this is repeated two times in 30 minutes with intervals of 10 minutes. After a test period of 30 minutes, the test pressure must not be dropped more than 0.6 bar and no leak must occur. Main test follows the preliminary test. Test time is two hours, in doing so the test pressure taken from the preliminary test must not have fallen more than 0.2 bar. After completion of these tests, the final test comes which has to be done under a test pressure of 10 bars and 5 bar in the interval of 15 minutes. Between the respective test courses, pressure has to be removed.
All leaks and defects in joints revealed during the testing shall be rectified and got approved at site by retest. Piping required subsequent to the above pressure test shall be retested in the same manner.System may be tested in sections and such sections shall be entirely checked on completion of connection to the overhead tanks or pumping system or mains. In case of improper circulation, the contractor shall rectify the defective connections. He shall bear all expenses for carrying out the above rectifications including the tearing up and refinishing of floors and walls as required. After commissioning of the water supply system, contractor shall

test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves which are not working efficiently shall be replaced by new ones.

10.6.9 Measurements

The net length of pipes as laid or fixed shall be measured in running meters correct to a cm for the finished work, which shall include PP-R pipe and fittings including plain fittings and Chrome Plated Brass Threaded fittings. Deductions for the length of valves shall be made. The cost includes cutting chases in the masonry wall and making good the same, trenching, refilling and testing of joints. The cost of gate valves/ wheel valves/union shall be paid for separately.

10.7 PTMT FITTINGS Polytetramethylene Terephthalate (THERMOPLASTIC)

P.T.M.T. fittings are bib-cock, push cock, stop cock, pillar cock, ball cock, bottle trap, towel ring, towel rail, shelf, urinal spreader, urinal cock, grating, ball cock, shower, soap dish, etc.

PTMT bib-cocks, push-cocks, etc. should confirm to Hydraulic Pressure tests as per I.S. 781-1979.

Material should have following physical properties:
a) Dimensionally stable up to 100 deg. C.
b) Tensile strength 500 kg/cm2.
c) Compressive strength 900 kg/cm2.
d) Wkg. Temperatures (-)45 deg C to (+) 100 deg C
e) Density 1.2 gm/cc

Material should be chemically resistant to:
a) Dilute hydrochloric acid 10%.
b) Dilute Sulphuric acid 3%
c) Ultraviolet rays.

After proper fixing with araldite, if effort is made to unscrew the tap, it (tap) shall come out only in broken / damaged / un-useable condition.

10.8 Cement concrete and masonry works (for manholes and chambers etc.)

10.8.1 Materials

All materials used in cement concrete and masonry works e.g., water, coarse aggregates, sand, cement, reinforcement bars, bricks etc. shall conform to relevant Indian Standards and the Specifications of the Central Public Works Department.

10.8.2 Cement concrete for pipe support

Wherever specified or shown on the drawings, all pipes shall be supported on a bed, all around or in haunches. The thickness and mix of the concrete shall be as given in the Schedule of Quantities. Width of the bedding shall be as per clauses under 10.3.13.

Unless otherwise directed by the Engineer-in-Charge cement concrete for bed, all around or in haunches shall be laid as follows:-

	Upto 1.5m Depth	Upto 3m Depth	Beyond 3m Depth
Stoneware pipes in open ground (no sub soil water)	All round (1:5:10)	In haunches (1:5:10)	In haunches (1:5:10)
RCC or SW in sub soil water	All round (1:3:6)	In haunches (1:3:6)	In haunches (1:3:6)
CI Pipes (in all conditions)	All round (1:3:6)	In haunches (1:3:6)	In haunches (1:3:6)
RCC Pipes or CI pipes under building	All round (1:3:6)	All round (1:3:6)	All round (1:3:6)

(1=cement, 3/5=coarse sand, 6/10=stone aggregate40mm nominal size)

RCC pipes or CI pipes shall be supported on brick masonry or pre cast RCC or in situ cradles as shown on the drawings or as directed by the Engineer-in-Charge.

Pipes in loose soil or above ground shall be supported on brick or stone masonry pillars as shown on the drawings or as directed by the Engineer-in-Charge.

10.9 Manholes and chambers

All manholes, chambers and other such works as specified shall be constructed in brick masonry in cement mortar 1:5 (1 cement: 5 coarse sand) or as specified in the Schedule of Quantities.

All manholes and chambers, etc. shall be supported on base of cement concrete of such thickness and mix as given in the Schedule of Quantities or shown on the drawings.

Where not specified, manholes shall be constructed as follows:-

(All dimensions are clear internal dimensions in mm)

Size / type of manhole	900x800 Rect.	1200x900 Rect.	900dia Conical	1400dia Conical
Maximum depth	1000	2400	2500	5000
Average thickness of RCC slab	150	150	-	-
Size of cover	600x450	500dia	500dia	500dia
Weight of	38kg light duty	116kg medium	116kg medium	116kg medium

cover		duty	duty	duty

Reinforcement - As directed by Engineer-in-charge.

All manholes shall be provided with cement concrete benching in 1:2:4 nominal mix. (1 cement: 2 coarse sand: 4 stone aggregate 20mm nominal size). The benching shall have slope of 1:10 towards the channel. The depth of the channel shall be full diameter of the pipe. Benching shall be finished with a floating coat of neat cement.

All manholes shall be plastered with 12/15mm thick cement mortar 1:3 (1 cement: 3 coarse sand) and finished with a floating coat of neat cement inside. Manhole shall be plastered outside as above but with rough plaster with waterproofing compound.

All manholes with depths greater than 1 m. shall be provided with 20mm square or 25mm round CI footrests set in cement concrete blocks 250x100x100m min 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20mm nominal size), at 300mm centre to centre vertically and staggered. Footrests shall be coated with coal tar before embedding.

All manholes shall be provided with cast iron covers and frames and embedded in reinforced cement concrete slab. Weight of cover, frame and thickness of slab shall be given above.

10.10 Making connections

Contractor shall connect the new sewer line to the existing manhole by cutting the walls, benching and restoring them to the original condition. A new channel shall be cut in the benching of the existing manhole for the new connection. Contractor shall remove all sewage and water if encountered in making the connection without additional cost. Back filling and compaction shall be done carefully in layers, simultaneously on both sides so as to prevent unequal earth pressure. Back filling shall not be taken up till testing has been successfully completed.

10.11 Testing

All testing shall be done in accordance with IS:1172 and IS:5329 except as may be modified herein under.

All lengths of the sewer/ drain/ pipelines shall be fully tested for water tightness by means of water pressure. Testing shall be carried out from manhole to manhole. All pipes shall be subjected to a test pressure of at least 2.5m head of water. The test pressure shall, however, not exceed 6m head at any point. The pipes shall be plugged preferably with standard design rubber plugs on both ends. The upper end shall, however, be connected to a pipe for filling with water and getting the required head. The sewer/ drain/ pipeline shall be filled with water and left to stand for 2 hours and topped up. The leakage over 30 minutes shall then be measured and the loss in water shall not exceed 2 litres/cm. of diameter/km of pipeline measured during the last 10 minutes of the period of test.

10.11.1 Sewer lines shall be tested for straightness by:

inserting a smooth ball 12mm less than the internal diameter of the pipe. In the absence of obstructions such as yarn or mortar projecting at the joints the ball should roll down the invert of the pipe and emerge at the lower end,

means of a mirror at one end and a lamp at the other end. If the pipe line is straight the full circle of light shall be seen other wise obstruction or deviation shall be apparent.

A test register shall be maintained which shall be signed and dated by the Contractor and the Engineer-in-Charge.

The pipeline shall be covered only after the testing is successfully completed.

10.12 Measurement and rates

10.12.1 Excavation

Measurement for excavation of pipe trenches shall be made per linear metre under the respective category of soil classification encountered at site.

Ordinary soil

Hard soil (hard murrum and soft rock)

Hard rock requiring chiselling

Hard rock requiring blasting.

Trenches shall be measured between outside walls of manholes at top and the depth shall be the average depth between the two ends to the nearest centimetre. The rate quoted shall be for a depth upto 1.5m or as given in the Schedule of Quantities.

Payment for trenches more than 1.5m in depth shall be made for extra depth as given in the Schedule of Quantities over and above the rate for depth upto1.5m.

The original ground levels shall be jointly recorded prior to start of work.

10.12.2 Timbering and Shoring

Rate quoted for excavation shall be inclusive of Timbering and shoring as specified and nothing extra shall be payable for the same.

10.12.1 Saturated Soil

Rate quoted for excavation shall be inclusive of pumping and bailing out of water encountered from any source whatsoever.

10.12.2 Refilling, Consolidation and Disposal of Surplus Earth

Rate quoted for excavation shall be inclusive of refilling, consolidation and disposal of surplus earth.

10.12.1 Stoneware/ RCC/ CI pipes

Stoneware/ RCC/ CI pipes shall be measured for the finished length of the pipeline per linear meter i.e.

Lengths between manholes shall be recorded from inside face of one manhole to inside face of other manhole,

Length between gully trap and manhole shall be recorded between socket of pipe near gully trap and inside face of manhole. Rate shall include all items given in the Schedule of Quantities and specifications.

10.12.2 Gully Traps

Gully traps shall be measured by the number and rate shall include all excavation, back filling, foundation, concrete brick masonry, cement plaster inside and outside, CI grating and sealed cover and frame etc. complete.

10.12.3 Cement Concrete for Pipes

Cement concrete in bed and all around or in haunches shall be paid per running metre between the outside wall of manholes at bottom of the trench. No additional payment is admissible in respect of concreting done for widths greater than that specified, for shuttering or centering, concreting and curing or work in subsoil water conditions.

10.12.4 Manholes

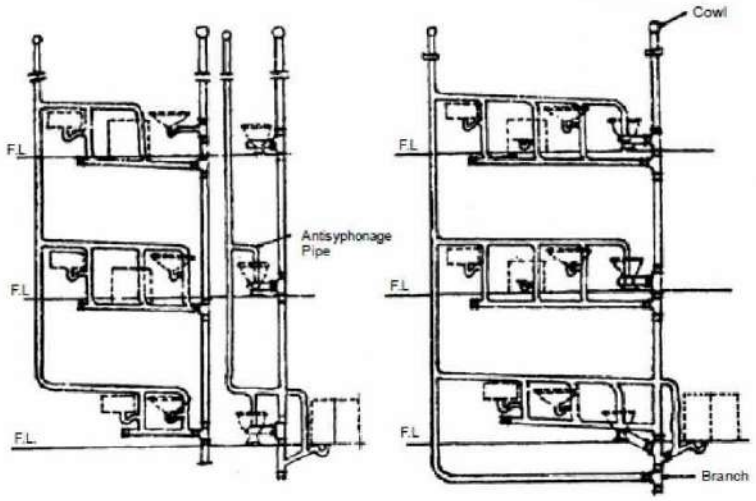
All manholes shall be measured by numbers and shall include all items specified above and necessary excavation in all types of soils, refilling, compaction and disposal of surplus earth.

Manholes with depths greater than that specified under the main item shall be paid for under "extra depth" and shall include all items as given for manholes. Measurement shall be done to the nearest centimetre. Depth of the manholes shall be measured from top of the manhole cover to bottom of channel.

C. I. covers, frames & steps shall be paid separately as per schedule of quantities.

10.12.5 Making Connections

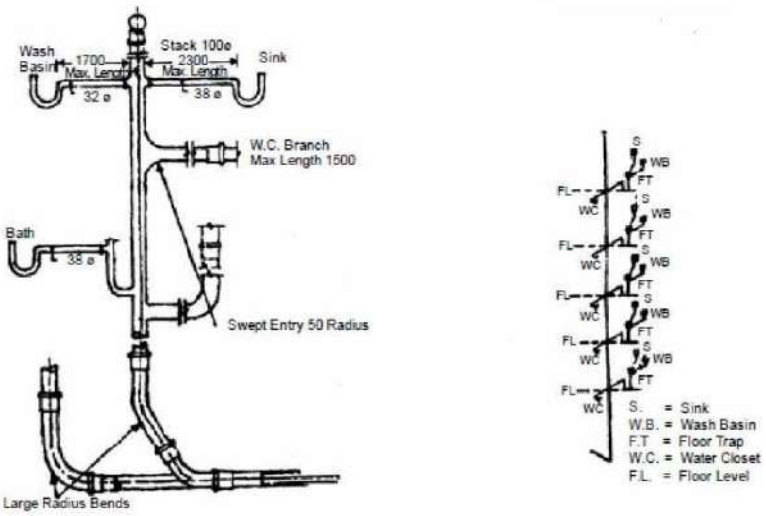
Item for making connection to municipal sewer shall be paid for by number and shall include all items given in the Schedule of Quantities and specifications.



TWO PIPE SYSTEM ONE PIPE SYSTEM

Drawing Not to Scale
All Dimensions are in mm

Fig. : Pipe Systems and Parts

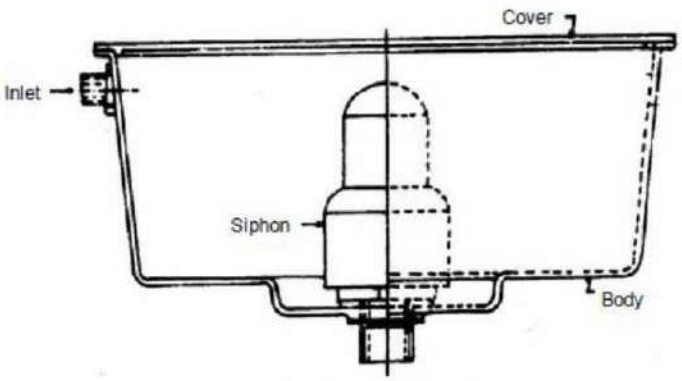


SINGLE STACK SYSTEM (WESTERN TYPE) SINGLE STACK SYSTEM (INDIAN TYPE)

Drawing Not to Scale
All Dimensions are in mm

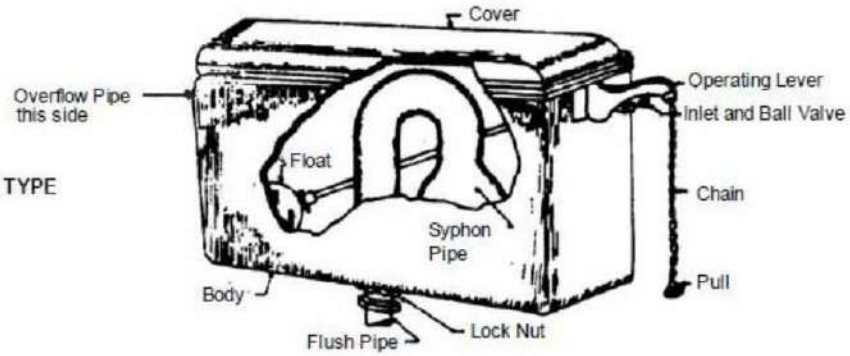
Fig. : Pipe Systems and Parts

AUTOMATIC TYPE

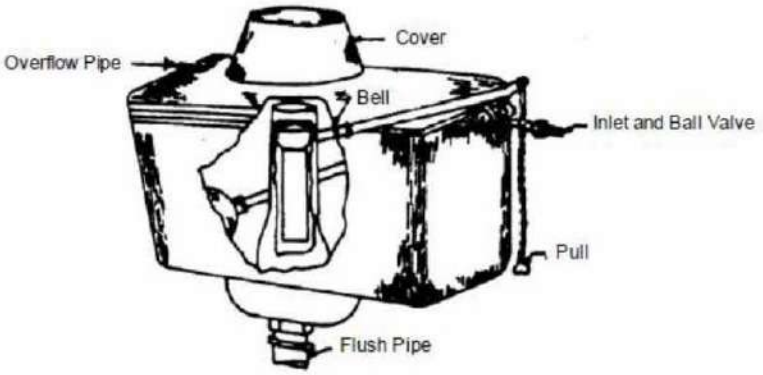


Body is Shown in Half Section

CURVED SIPHON TYPE

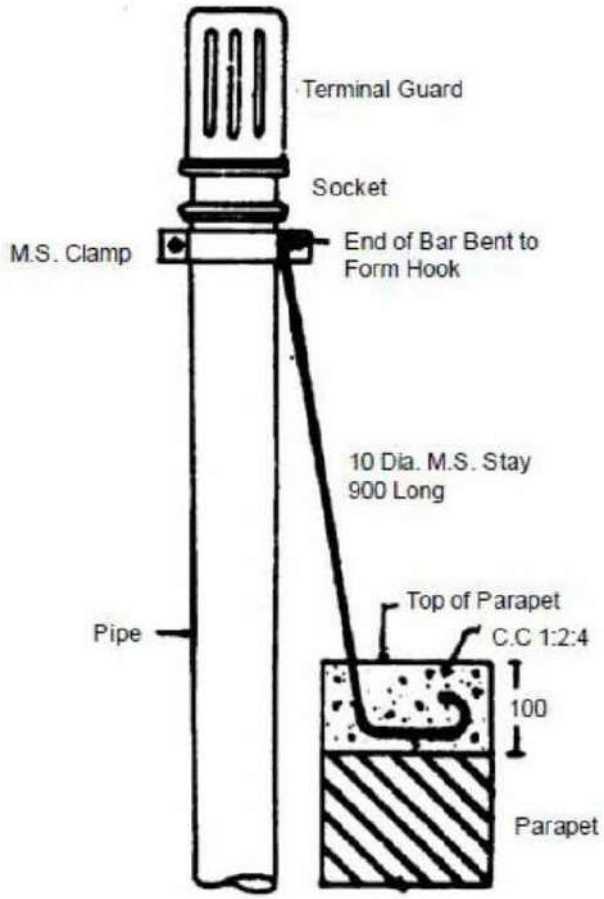


BELL TYPE

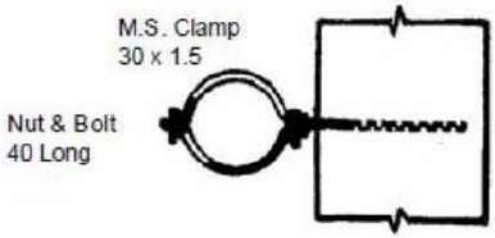


Drawing Not to Scale
All Dimensions are in mm

Fig. : Flushing Cisterns



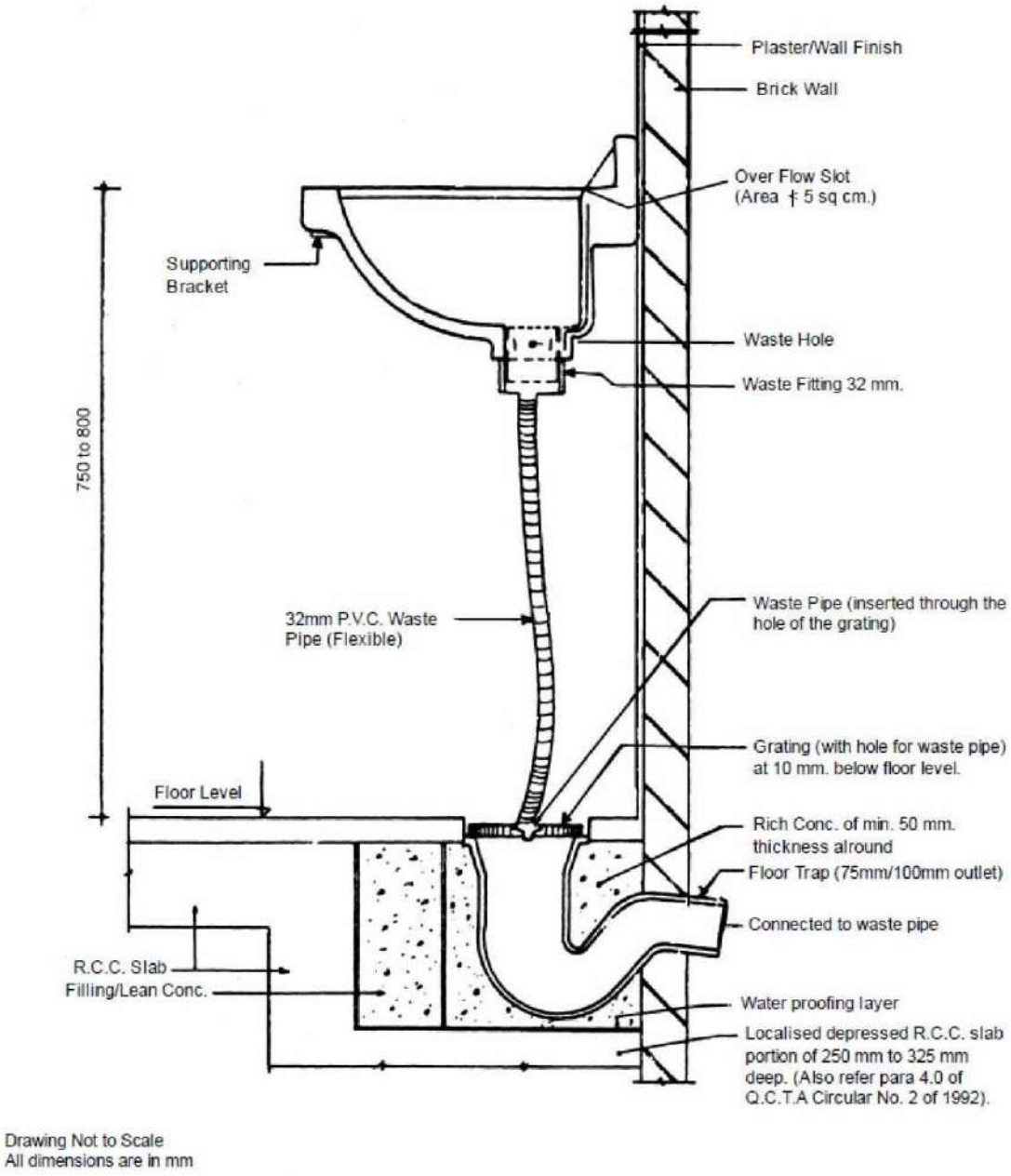
ELEVATION



PLAN

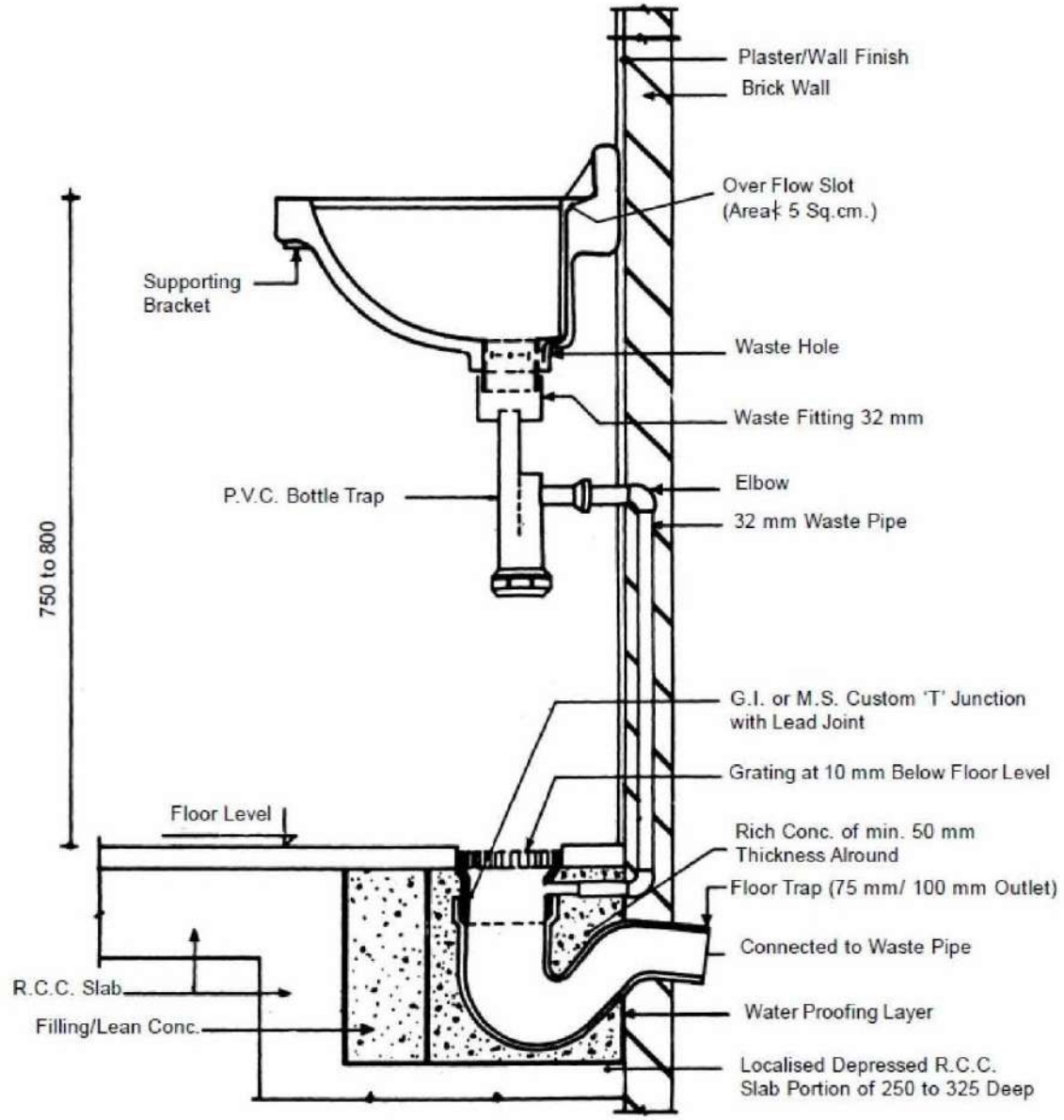
Drawing Not to Scale
All Dimensions are in mm

Fig. : M.S. Stays and Clamp



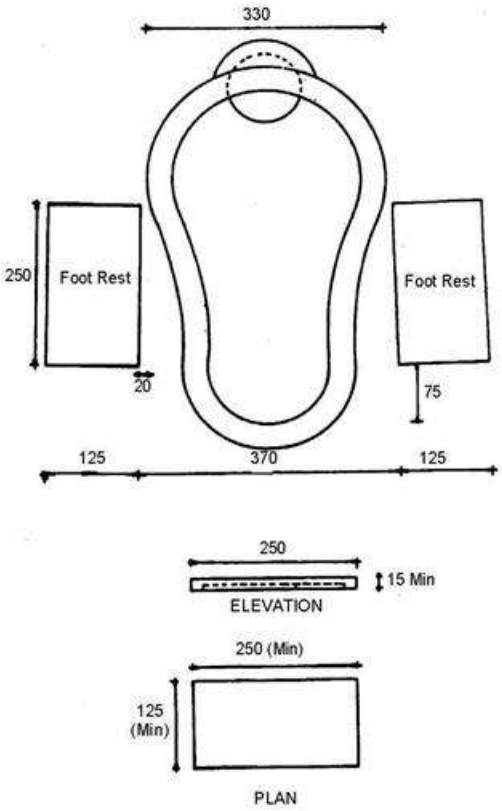
Drawing Not to Scale
All dimensions are in mm

Fig. : Typical Vertical Section of Wash Basin (Waste Pipe Open to View)



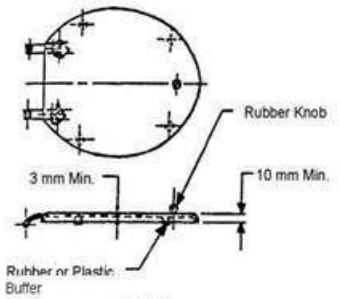
Drawing Not to Scale
All dimensions are in mm

Fig. : Typical Vertical Section of Wash Basin (Waste Pipe Concealed from View)

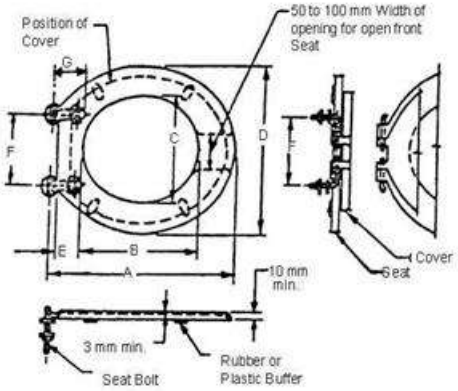


Drawing Not to Scale
All Dimensions are in mm

Fig. : Foot Rest



COVER



SEAT

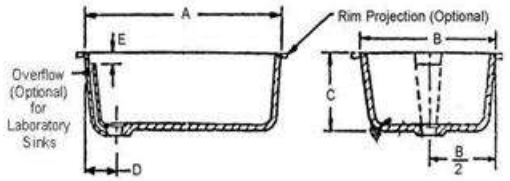
Table Dimensions of Seats and Covers

All dimensions in millimetres

Sl No.	Description	Dimensions	
		Min	Max
(1)	(2)		
(i)	Distance from centre line of hinge bolts to extreme edge of rim at front, *A*	445	475
(ii)	Length of opening at longest point, *B*	250	290
(iii)	Width of opening at widest point, *C*	215	240
(iv)	Overall width at widest point, *D*	380	—
(v)	Distance between inner and outer rims, *E*	55	—
(vi)	Centre-to-centre distance of seat bolt holes, *F*	145	175
(vii)	Distance from centre line of hinge bolts to inner rim of seat at the back, *G*	85	—
(viii)	Thickness of seat at thinnest point	3	—
(ix)	Thickness of cover at thinnest point	3	—

Note : Some hinging devices are made so as to provide adjustment in the longitudinal direction. This is not precluded by these figures.

Fig. : Plastic Seat and Cover

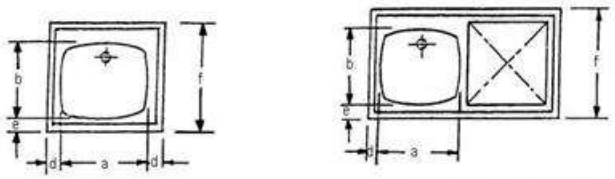


KITCHEN AND LABORATORY SINKS (WHITE GLAZED FIRE CLAY)

DIMENSIONS OF KITCHEN AND LABORATORY SINKS
(White Glazed Fire Clay)

All dimensions in millimetres

Pattern	*Size*	*A*	*B*	*C*	*D*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
(a) Kitchen sinks	750 x 450 x 250	750	450	250	150
	600 x 450 x 250	600	450	250	150
	600 x 450 x 200	600	450	200	150
(b) Laboratory sinks	600 x 400 x 200	600	450	200	90
	500 x 350 x 150	600	350	150	90
	450 x 300 x 150	450	300	150	90
	400 x 250 x 150	400	250	150	90

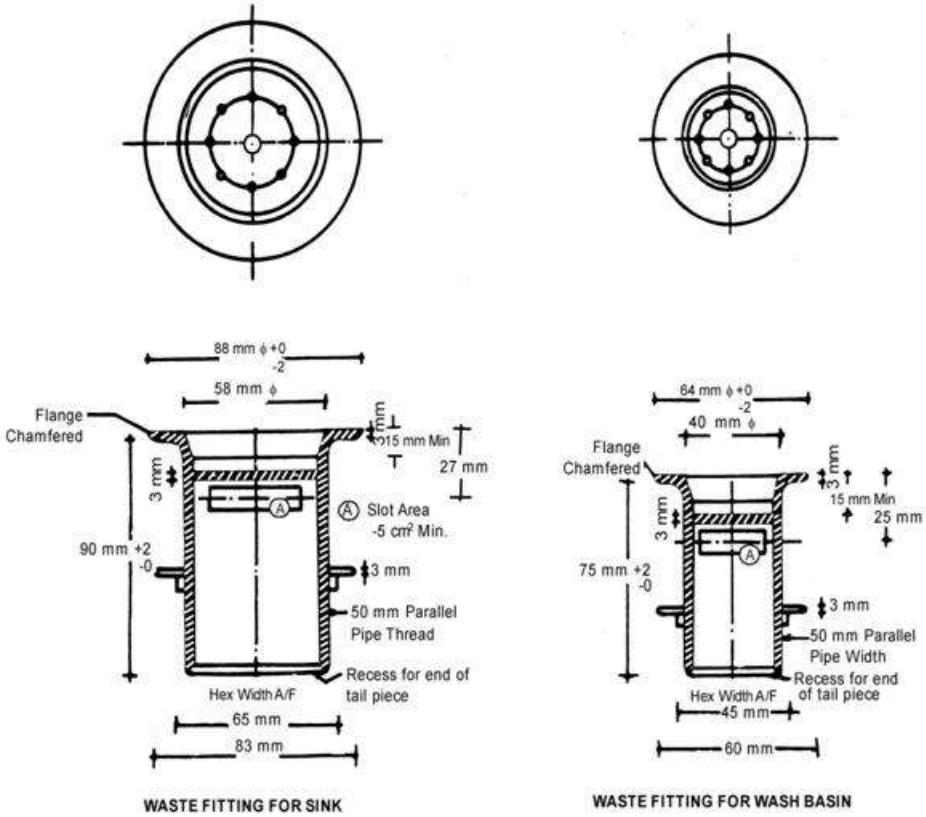


WITHOUT DRAINING BOARD WITH DRAINING BOARD

Reference to Fig. above	*Dimensions in mm (Minimum Unless Specified)*
a	380 (for rectangular bowl) 360 (for round bowl)
b	340
c	20
d	30
e	45
f	440 mm Max for 500 mm worktop 515 mm Max for 600 mm worktop

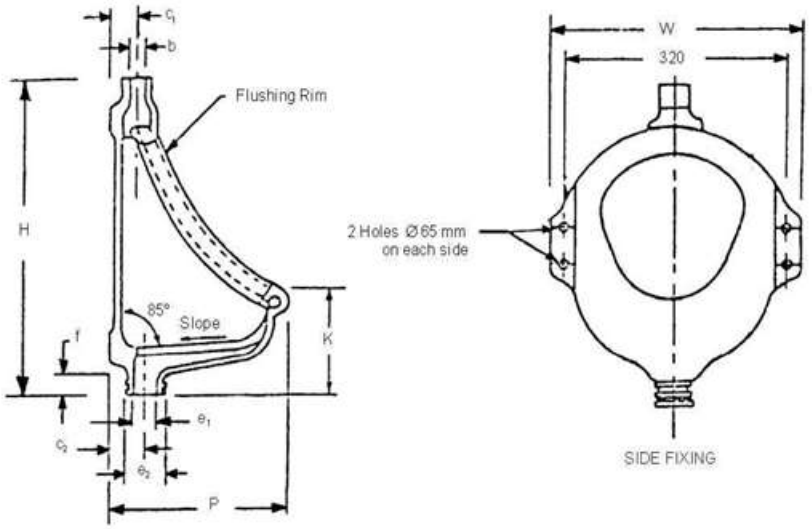
STAINLESS STEEL SINK

Fig. : Kitchen & Laboratory Sinks



Drawing Not to Scale
No. and Sizes of Holes Indicative

Fig. : Waste Fittings for W.B. & Sinks

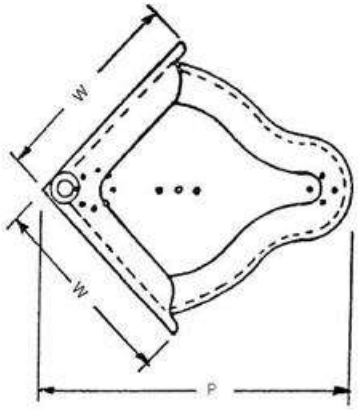


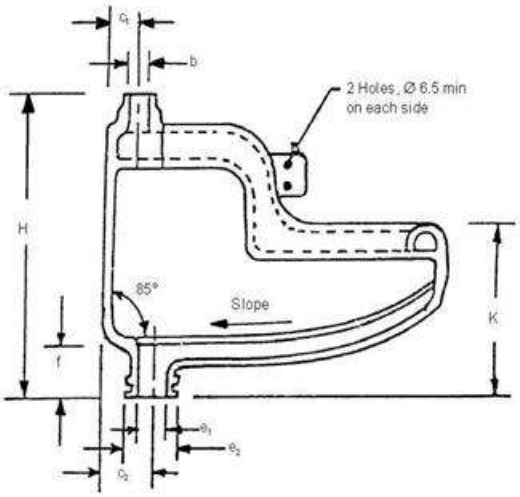
Note : Where a closed channel with overflow is not provided a domed grating with perforating starting from the base and the crown of which shall be 25 mm, minimum above surface shall be provided which may be integral or otherwise.

BOWL PATTERN URINAL (FLAT BACK)

All dimensions in millimetres

Fig. : Urinal Bowl Type

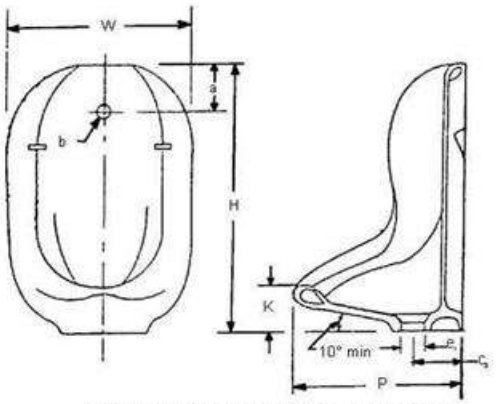




Note : Ovality of 5 percent is permissible on inlet and outlet diameters.

All Dimensions in Millimetres

Fig. : Urinal Bowl Type (Corner Wall Type)



BOWL TYPE FLAT BACK URINAL WITHOUT RIM

FUNCTIONAL DIMENSIONS OF BOWL PATTERN URINALS

All dimensions in millimetres

Sl No.	Pattern	Dimension			
		Height H	Projection P	Width W	Distance K, Min
1.	Flat back with flushing rim				
	Size 1	440	265	355	140
	Size 2	440	265	315	140
2.	Flat back without flushing rim				
	Size 1	410	265	305	100
	Size 2	590	375	390	100
3.	Angle back with flushing rim	345	420	270	190
4.	Angle back without flushing rim				
	Size 1	450	350	275	100
	Size 2	580	600	300	100

CONNECTING DIMENSIONS OF BOWL PATTERN URINALS

All dimensions in millimetres

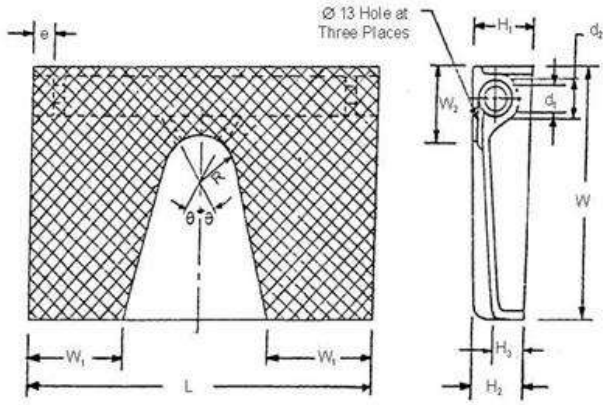
Sl No.	Pattern	Dimension in mm							
		a	b_s	c_1	c_2	d	e_1	e_2	f, Min
1.	Flat back, with flushing rim	—	20 ± 3	40 ± 5	50 ± 5	—	35 ± 2	55	20
2.	Flat back, without flushing rim	75 Max	20 ± 3	—	100 Min	65 ± 5	45 ± 2	60 Min	20
3.	Angle back, with flushing rim	—	20 ± 3	35 ± 5	65 ± 5	—	35 ± 2	55	20
4.	Angle back, without flushing rim	75 max	20 ± 3	—	150 (for size 1) 225 (for size 2)	65 ± 5	45 ± 2	60	20

Explanation for Legends Used

a = Dimension from top of bowl to centre of water supply hole or spreade
b = Diameter of water supply hole
c_1 = Distance from centre of water supply hole to back of bowl
c_2 = Distance from centre of waste outlet to back of bowl
d = Dimension of outlet of the waste flange
e_1 = Internal diameter of waste outlet
e_2 = Outside diameter of the outlet hole
f = Depth of waste outlet

Note : Distance between pairs of screw holes for flat back with flushing rim bowl urinal shall be 395 mm for top/bottom fixing arrangement and 320 mm for side fixing arrangement.
(1) Ovality is permissible within the variation allowed for the dimensions
(2) Ovality is permissible within ±2 mm of the dimensions.

Fig. : Urinal – Half Stall



SQUATTING PLATE URINAL

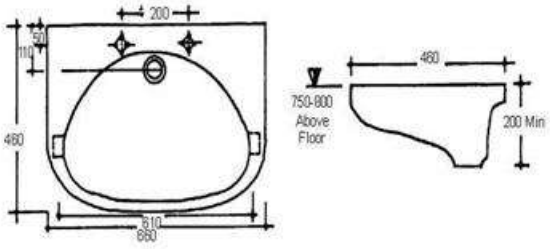
FUNCTIONAL DIMENSIONS OF SQUATTING PLATES (IN MM)

Sl No.	Description	Ref. in Fig. above	Size 1	Size 2
1.	Size	—	450 x 350	600 x 350
2.	Length	L	450	600
3.	Minimum foot rest width	W_1	125	165
4.	Width	W	350	350
5.	Height at back end	H_1	100	100
6.	Height at front end	H_2	85	85
7.	Minimum height at bowl draining surface	H_3	50	50
8.	Width at flat top	W_2	100	100
9.	Radius of curvature of the bowl	R	65	65
10.	Angle of direction of the two end spray hole with that of the central one	Ø	30°	30°

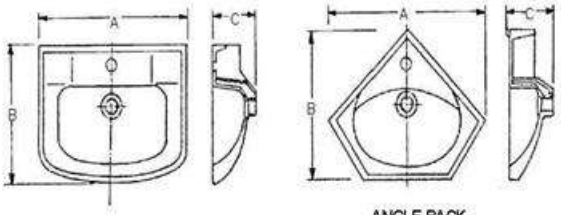
CONNECTING DIMENSIONS OF SQUATTING PLATES, MM

Description	Ref. in Fig. above	Size 1/Size 2
Diameter of inlet hole	d_1	40
Diameter of the inlet socket	d_2	50
Depth of the inlet socket, *Min*	e	25
1) Ovality is permissible within the variation allowed for the dimensions.		

Fig. : Urinal Squatting Plate



SURGEONS BASIN

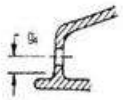


FLAT BACK ANGLE BACK

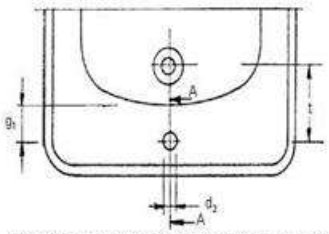
FUNCTIONAL DIMENSIONS OF WASH BASINS

All dimensions in millimetres

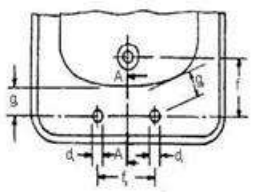
S. No.	Pattern	Size	Length A	Breadth B	Height C
(1)	(2)	(3)	(4)	(5)	(6)
(i)	Flat Back	660 x 460 (Surgeon's basin)	660	460	200, Min
		630 x 450	630	450	290, Max
		550 x 400	550	400	290, Max
		450 x 300	450	300	225, Max
(ii)	Angle back	600 x 480	600	480	290, Max
		400 x 400	400	400	290, Max

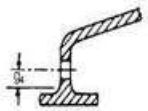


SECTION A-A



CONNECTING DIMENSIONS FOR SINGLE TAP HOLE WASH BASINS



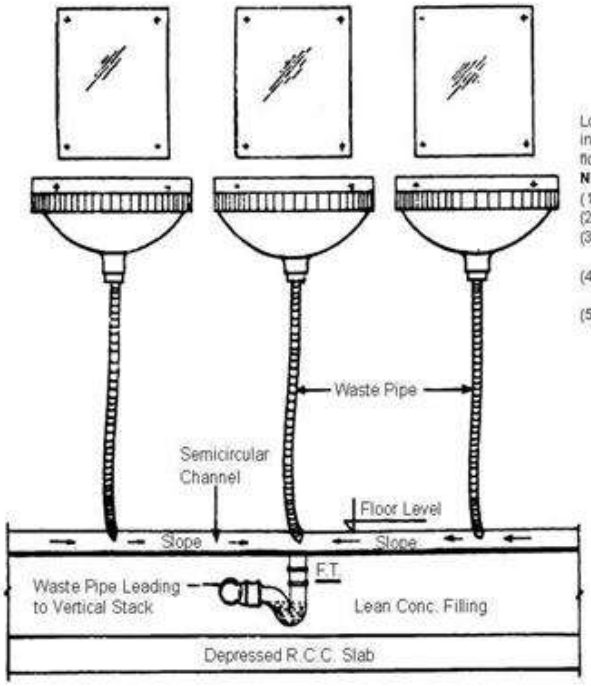


SECTION A-A

CONNECTING DIMENSIONS OF WASH BASINS AND TWO TAP

Drawing Not to Scale
All dimensions are in mm

Fig. : Wash Basins

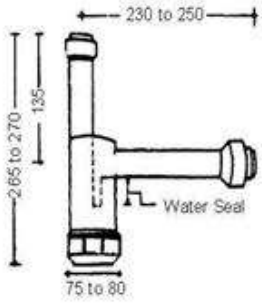


Location : General Offices Waste discharging in Semicircular open channel and collected in floor trap.

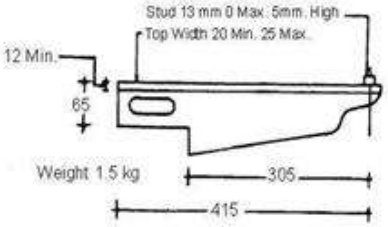
Notes:

(1) Slope : 1 in 10 to 1 in 50.
(2) F.T. Ref. G.C.T.A Circular No. 2 of 1992.
(3) Waste Pipe : P.V.C. flexible Type (32 mma)
(4) F.T. Location preferred in Centre to Achieve Max. Slope.
(5) Water supply connection not shown.

TYPICAL ELEVATION OF 3 WASH BASINS IN A ROW



TYPICAL DETAIL OF BOTTLE TRAP

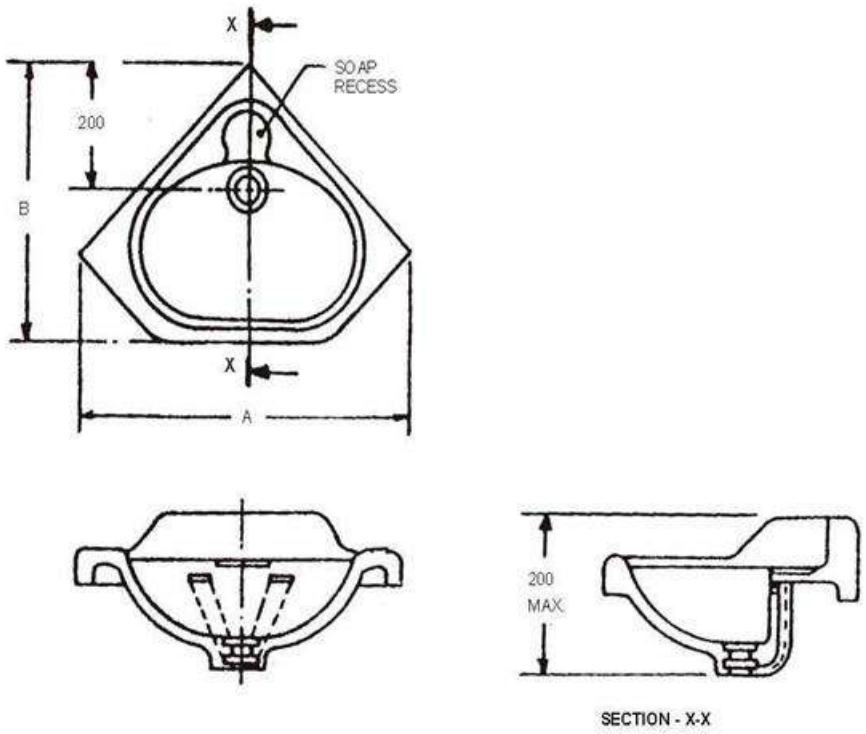


C.I. BRACKET

Note : Stud shall be provided for supports intended for glazed earthenware, vitreoware wash basins only.

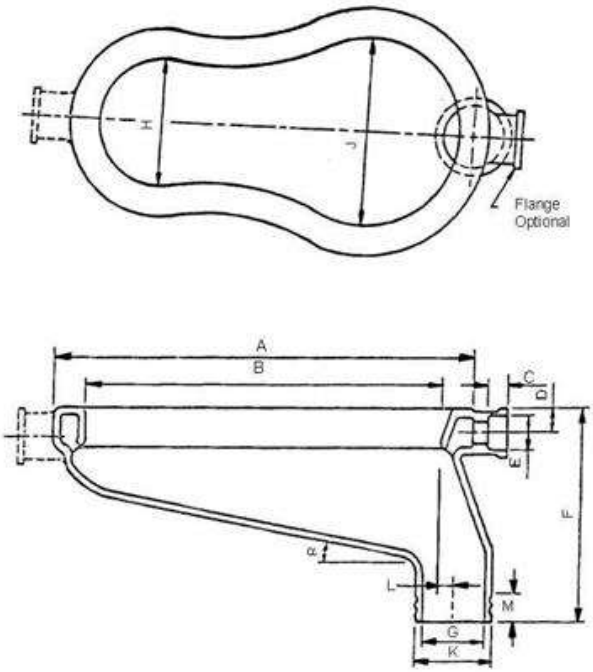
Drawing Not to Scale
All dimensions are in mm

Fig. : Fixing Arrangement of Wash Basin



Notes :
(1) Tap hole provisions are not shown. However provision shall be made for 1 or 2 Tap holes in any suitable position.
(2) Stud provisions are not shown but suitable provision shall be made for fixing purposes.
(3) Provision of soap recess need not be central in the case of single tap hole.
(4) Drawing not to scale.
(5) All dimensions are in mm.

Fig.: Angle Back Wash Basin (Pattern-2)



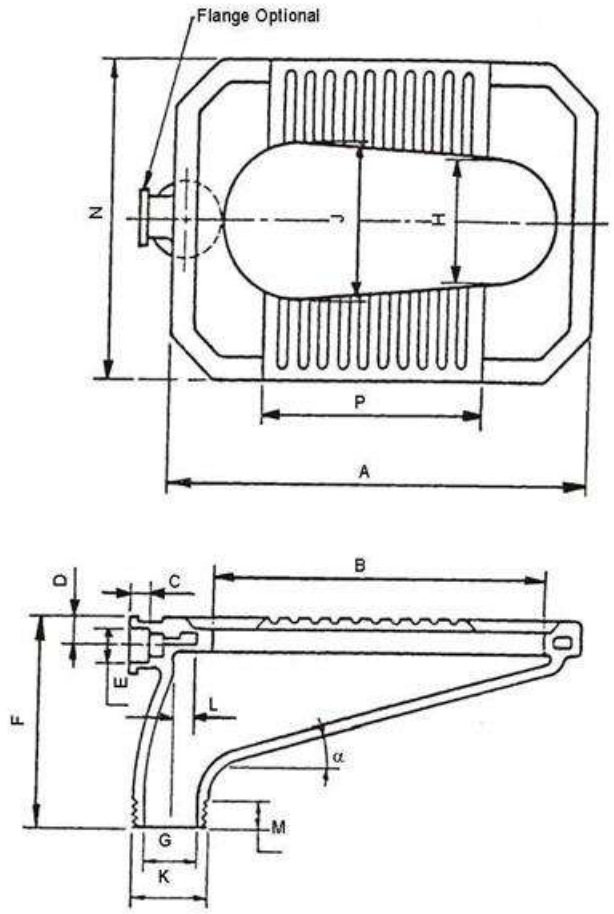
Functional Dimensions of Long and Orissa Pattern

All Dimensions in millimetres

Sl. No.	Description	Ref. Fig	Long Pattern of Size		Orissa Pattern of Size	
			580	630	580 x 440	630 x 450
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(i)	Length	A	580	630	580	630
(ii)	Length of opening, *Min*	B	480	530	470	500
(iii)	Height	F	300 ± 10	320 ± 10	300 ± 10	320 ± 10
(iv)	Width of opening, small end	H	170 ± 10	170 ± 10	180 ± 10	180 ± 10
(v)	Width of opening, wide end	J	260 ± 10	260 ± 10	210 ± 10	220 ± 10
(vi)	Slope of bottom of Pan	α	15°	15°	15°	15°
(vii)	Distance between the centre of outlet to the inside face of flushing rim at the back, *Max*	L	70	70	70	70
(viii)	Width	N	—	—	440	450
(ix)	Length of foot rest	P	—	—	310 ± 10	310 ± 10

Note : Tolerances where not specified shall conform to Part I of IS-2556

Fig. : Long Pattern Squatting Pan, Type I



Note : Footrest may be flushed or raised, clearance permissible between raised footrest and rim opening.

All Dimensions in Milliletres.

Fig. : Orissa Pattern Squatting Pan

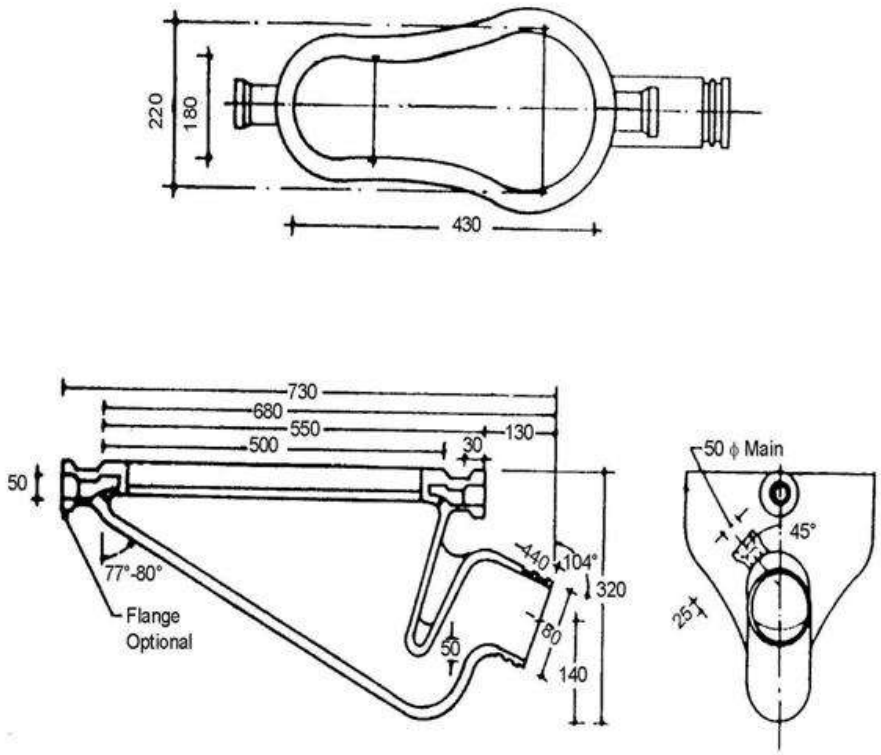


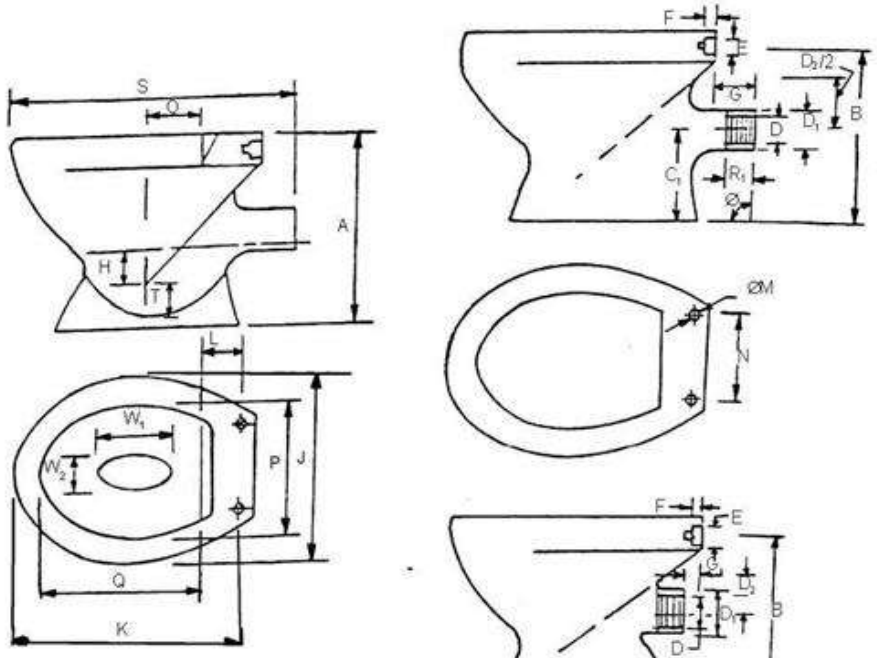
Fig. : Integrated Squatting Pan

FUNCTIONAL DIMENSIONS

All dimensions in millimetres

Sl.No.	Description	Ref. in Fig.	Pattern 1	Pattern 2	Pattern 3
(1)	(2)	(3)	(4)	(5)	(6)
(i)	Height	A	390 ± 10	390 ± 10	390 ± 10
(ii)	Depth of water seal, *Min*	H	50	50	50
(iii)	Width of water closet	J	360 ± 10	360 ± 10	360 ± 10
(iv)	Distance from centre of seat bolt hole to front of water closet	K	415 to 445	415 to 445	415 to 445
(v)	Distance from centre of seat bolt hole to inside face of flush rim at back, *Max*	L	80	80	80
(vi)	Distance between a vertical line from tip of back plate to inside face of flush rim at back, *Max*	O	70	70	70
(vii)	Width of opening, *Min*	P	240	240	240
(viii)	Length of opening, *Min*	Q	290	290	290
(ix)	Overall length	S	500-575	500-575	500 *Max*
(x)	Trap inlet depth, *Min*	T	75	75	75
(xi)	Water surface				
	Back to front	W_1	150 *Min*	100 *Min*	150 *Min*
	Side to side	W_2	110 *Min*	75 *Min*	110 *Min*

Note : In case of centre vent in S Trap, overall length should be taken as S + 75.

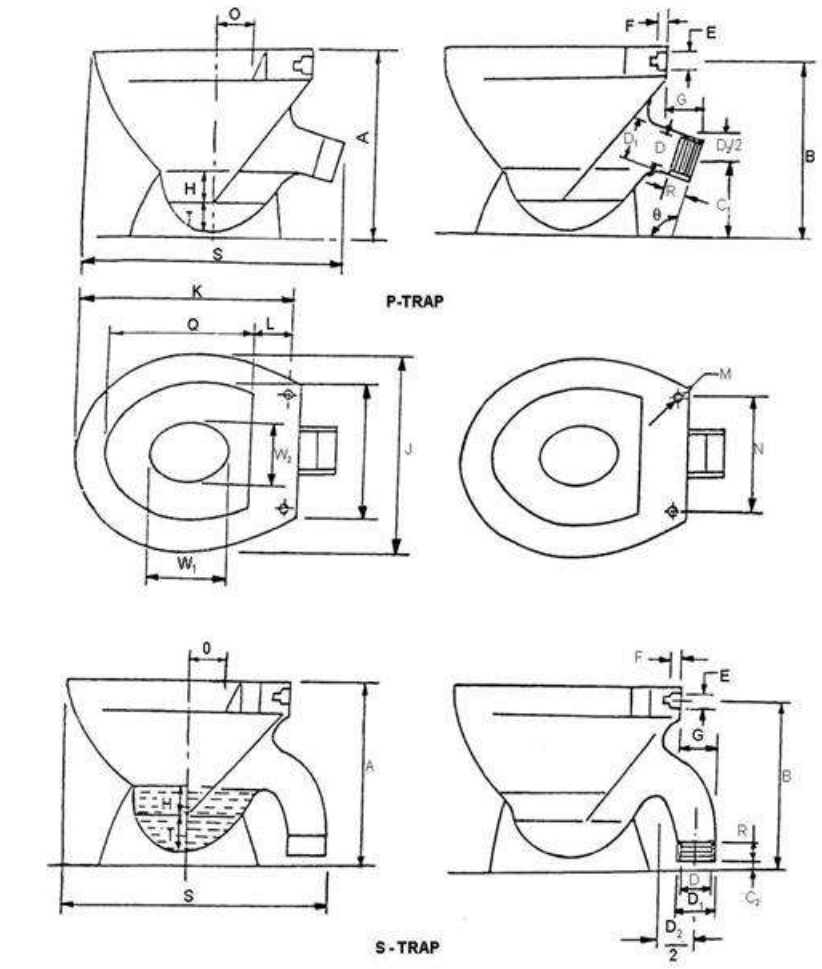


FUNCTIONAL DIMENSIONS

CONNECTING DIMENSIONS

All dimensions in millimetres

Fig. : Pattern-3 Water Closet with Horizontal P-Trap



All dimensions in millimetres

Fig. : Pattern 1 and Pattern 2 Water Closets

Chapter -18

Repair and Miscellaneous work

REPAIR WORKS

1.0 POLYMER MODIFIED CEMENT MORTAR

1.1 GENERAL

The cement based polymer modified mortar shall be prepared at the site by adding blended cement, polymer and aggregate or using ready to use components supplied by manufacturer's in pre-packed containers/ bags subject to approval of Engineer. The Polymer must be brought at the site in sealed packed containers directly from the manufacturer/source as specified and directed by the consultants.

1.2 QUALITY ASSURANCE

1.3 LABELING

Contractor shall clearly mark all containers with following information

a. Name of manufacturer

b. Manufacturer's product identification

c. Manufacturer's instruction for mixing

d. Warning for handling and toxicity

1.4 APPLICATION CONTROL

The contractor shall submit mixing application procedure for approval prior to use.

1.5 DELIVERY OF MATERIAL

Contractor shall deliver all materials in sealed containers with labels legible and intact.

1.6 STORAGE OF MATERIAL

Contractor shall arrange to store all materials a t the temperature recommended by the manufacturer and as directed by the consultants.

1.7 MATERIALS

The CEMENT used shall be blended cement conforming to IS:8112. IT must be free from any lumps and must be from fresh stock.

The sand shall be sharp washed, well graded and free from excessive fines. Quartz sand 1630 mesh size shall be used for all polymer modified work.

Water used for cementitious polymer modified mortar shall conform to the requirement of IS:456.

Polymer used shall be Acrylic base.

1.8 EXECUTION

1.9 PREPARATION OF CONCRETE SURFACE

A good base or foundation shall be prepared for successful application of polymer concrete.

Proper support must be provided to members under repair before exposing the same for repair. It is mandatory for the contractor to seek consultant's approval for the support system. The ultimate responsibility of the support system lies with the contractor. The gist of the point being the paramount importance of the safety of the building under repair.

The props must be tight against any jerks or jolts. The system should ensure that all loads of slab, beams and overhangs are properly redistributed by by-passing the column to be repaired. Necessary length of the wall, if required can be dismantled.

All unsound/ weak concrete material shall be first removed upto the required depth including undercut upto 6 mm behind the reinforcement bars, wherever required as directed by the Engineer. Chipping shall continue until there are no offsets in the cavity will cause an abrupt change in the thickness of the repaired surface.

While removal of cover, care is to be taken that the sound core of the column is not disturbed.

Exposed corroded steel is to be cleaned thoroughly by chipping hammer and wire brush. The steel surface is to be evenly coated twice by any rust converter in 4 hours interval and must be cleaned with running water after 12 hours. Subsequently, two coats of Rust pasivator of Polymer: Cement should be applied on cleaned reinforcement in 4 hours interval.

After it has been ensured that surface to which polymer modified cement mortar is to be bonded is sound, it shall be cleaned off all loose and foreign materials by means of wire brushing as directed by engineer.

1.10 METHODOLOGY

1.11 BOND COAT

The contractor shall wet the surface ensuring that they are saturated but free of surface water. Prepare a bonding slurry of 1.5 to 2 part of cement to 1 part of polymer mixed to a lump free creamy consistency. Alternatively, the primer (bonding slurry) shall be made as per manufacturer's recommendations. The bonding slurry shall be worked well into the surface of the parent body using stiff brush ensuring that no pinhole are visible. Bonding slurry shall not be applied at a thickness in excess of 2 mm. If in the opinion of engineer a second coat is necessary, the same shall be applied after the first coat is touch dry. The second

coat shall be applied at right angle to the first to ensure complete coverage. The bonding slurry shall be applied to prepare a concrete and reinforcement substrate after tying in new reinforcement wherever specified in the form of bars or welded wire fabric. Cement base polymer modified mortar shall be applied as soon as possible after application of bonding slurry but always during the open time of adhesive.

1.12 APPLICATION OF POLYMER MORTAR

Mixing of polymer with cement shall be done in proportion as recommended by manufacturer. Normally, 10 kg of polymer is to be mixed with 50 kg of cement.

The mixing shall be carried out in efficient concrete mixer. However, the Engineer may allow hand mixing in case total weight of mix per batch is less than 25 kg. Polymer must be prepared in a water tight G.I. tray.

The mixer shall be charged with required quantity of sand and cement and pre-mixing shall be carried for approximately one minute.

Rendering of cement based Polymer modified mortar shall be done immediately after applying the bonding slurry to the prepared surface preferably in coats of approximately 12-15 mm thickness, as greater thickness may lead to slumping. Further coats shall be applied fairly in rapid succession immediately after the previous layer gets set hard enough to receive the subsequent layer. After application of mortar the surface shall be either finished by impregnating 20 mm down graded metal pieces or closed using a wooden float or steel trowel and furrowed subsequently, while the mortar is still green. In case the thickness of damaged concrete is more than 12-15 mm, the first layer must be applied using quartz sand and subsequently layers can be built using thoroughly cleaned river sand and 10 mm down metal. A proper bond coat must be applied prior to application of each layer of polymer modified cement mortar.

1.13 INSPECTION AND QUALITY CONTROL

The mortar application work shall be continuously inspected by a qualified supervisor, who shall check materials, application of mortar, curing, etc.

Each completed work shall be systematically sounded with a hammer to check for drummy areas after hardening. In suspected areas or whenever directed by Engineer, contractor shall drill the cores from the finished work after 7 days and 28 days of mortar application. The cores shall be examined for evidence of poor workmanship by the engineer and if he feels that either bonding work or the subsequent layer of mortar are not required workmanship, the contractor at the instruction of the engineer shall dismantle such areas of work as required by the Engineer and redo the same after re-preparing the surface by chipping of mortar work and abrading the bonding slurry interface. Fogging to be carried out for atleast 4-5 days.

1.14 PAYMENT

Measurement shall be in sqm/swft basis of the actual exposed surface for repairs. All the measurement shall be taken before starting application work of polymer modified cement mortar. The corner of the P.C.M. work to be measured once, with one side only.

The rate shall include the cost of treatment given to old and new reinforcement and application of bond coat to exposed concrete surface and every successive layers.

Quartz sand shall be supplied by the contractor.

The rate is exclusive of providing and fixing of steel reinforcement.

The rate shall include the cost of scaffolding and working platform at all height and level.

The polymer consumption shall be strictly reconciled @ 200 gm/ per sft or 2.20 kg/ sq.m for all kind of repair work.

Incase of polymer consumption is exceeding more than 20% i.e. specified dose the same should be brought to the notice of consultants maximum within 3 days in writing, failing which it will be considered as a wastage of polymer and the extra consumption of polymer shall be borne by contractor only. Similarly, in case polymer consumption is less than that specified i.e. more than 20% shall be considered as a manipulation of measurement or poor grade or work due to less consumption of polymer.

2.0 JACKETING

2.1 PREPARATION OF SURFACE

A good base or foundation shall be prepared for successful application of jacketing.

Proper support must be provided to members under repair before exposing the same for repair. IT s mandatory for the contractor to seek consultant's approval for the support system. The ultimate responsibility of the support system lies with the contractor. The gist of the point being the paramount importance of the safety of the building under repair.

The props must be tight against any jerks and jolts. The system should ensure that all load of slab, beams and overhangs are properly redistributed by bypassing the column to be jacketed. Necessary length of wall etc. can be dismantled.

All sound/ weak concrete material shall first be removed up to the required depth as directed by Engineer. Chipping shall continue until there are no offsets in the cavity, which will cause an abrupt change in thickness of repaired surface.

Exposed corroded steel is to be cleaned thoroughly by chipping hammer and wire brush. The steel surface is to be evenly coated twice by any rust converter in 4 hours interval and must be cleaned with running water for 12 hours. Subsequently, two coats of Rust Passivator of Polymer: Cement should be applied on cleaned reinforcement in 4 hours interval.

After it has been insured that the surface to which jacket concrete is to be bonded is sound, holes of required depth and diameter shall be drilled using heavy dity “BOSCH” hammer dirll as per the spacing stated. The drilled holes shall be thoroughly cleaned off loose particles by oil free air blast. The treated steel bars of required length, shape and diameter shall then be driven inside the hole, packed with polymer mortar.

A polymer dash coat must be applied at least one day prior to casting of Jacket, impregnating 20 mm down metal pieces.

2.2 CASTING OF JACKET

Steel reinforcement is to be provided after proper binding, bending, etc. as specified by the Engineer. Hole to be drilled in the slab to pass the reinforcement to maintain the continuity of R.C.C. jacket. Proper form work/ shuttering is to be provided all around the column so as to provide a R.C.C. jacket. The jacket so provided will be min of 75 mm thickness over the R.C.C. Column/ beam and the same to be filled with M25 grade of concrete using super plasticizer to avoid honeycombing effect. Any kind of honey comb, if appeared after opening of shuttering next day, must be repaired as per the instruction of Engineer in charge at no cost to society.

All form work/ shuttering is to be removed min after 24 hours. The jacketed portion is to be cured properly for 7 days using gunny bags to cover new concrete surface. All steel props to be removed and load re-transformed as per the instruction of the Engineer all complete including any incidental work if required.

2.3 PAYMENT

Payment of jacketing shall be made on the basis of unit rate quoted in the schedule of quantities.

Measurement of jacketing shall be based on SqM of actual work done. The comer of jacket to be measured once, with one side only.

The rate shall include providing and fixing shuttering with all necessary support, platform, surface preparation, treatment to reinforcement, curing, using of super plasticizer and any other incidental work as required.

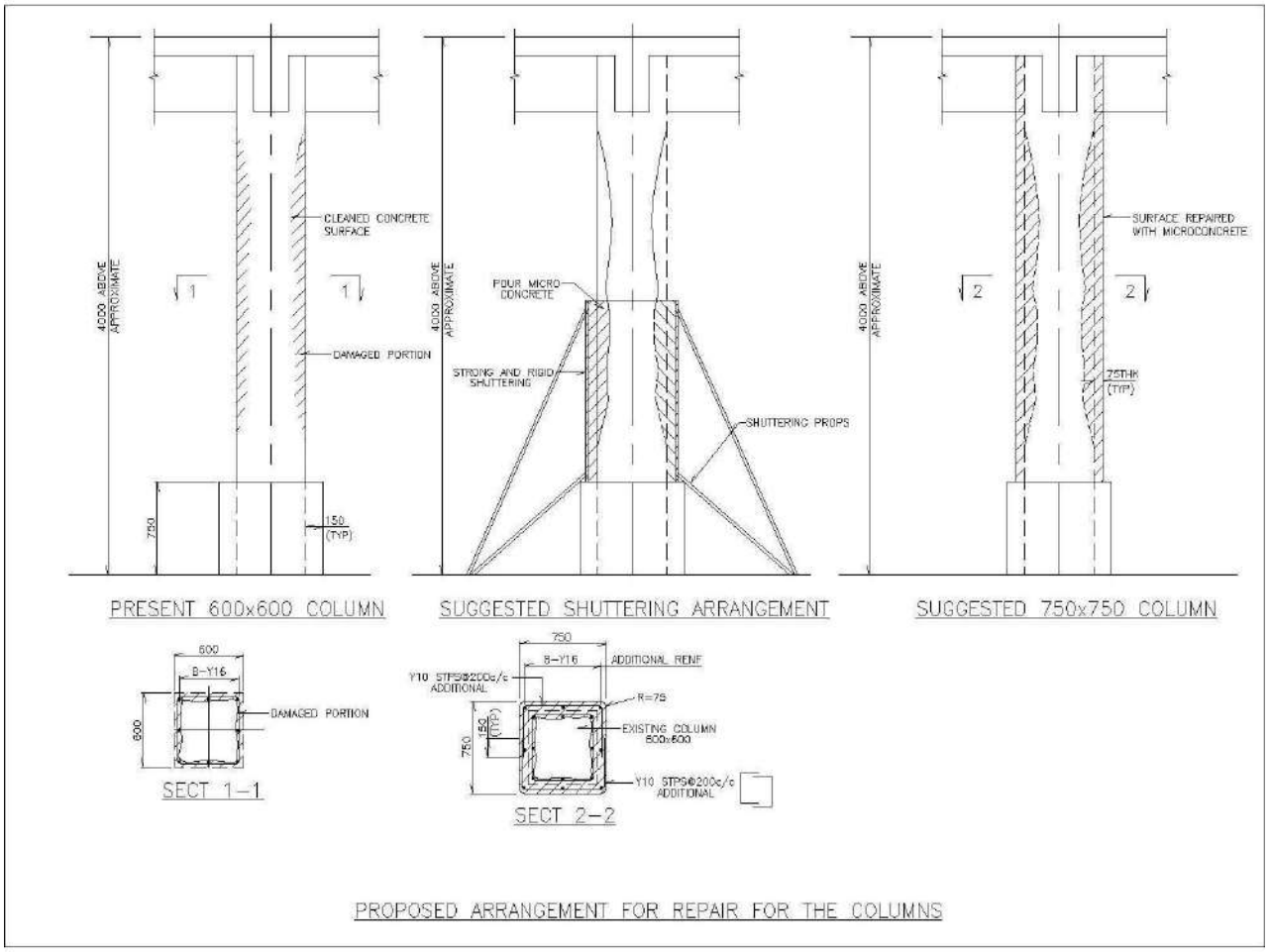
Nothing extra shall be paid for additional thickness of concrete if any, required to fill the excessive damaged cover/ core concrete.

Relieving of load from R.C.C. column and beam shall be paid separately under relevant item.

The rate shall exclude providing and fixing of reinforcement, which shall be paid under relevant item.

Rate is inclusive of applying polymer dash coat and impregnating metal pieces if required, but exclusive of cost of polymer, which shall be paid separately.

The rate should be inclusive of breaking of floor, P.C.C, removing of stone boulder, excavation in soil and backfilling the same after completion of jacketing work.



PROPOSED ARRANGEMENT FOR REPAIR FOR THE COLUMNS

3.0 REPAIRS TO PLASTER

The work includes cutting the patch and preparing the wall surface. Patches of 2.50 square metres and less in area shall be measured under item of 'Repairs to Plaster' under this sub-head.

Plastering in patches over 2.5 square metres in area shall be paid for at the rate as applicable to new work under sub head Finishing'.

3.1 Scaffolding

Scaffolding as required for the proper execution of the work shall be erected. If work can be done safely with the ladder or jhoola these will be permitted in place of scaffolding.

3.2 Cutting

The mortar of the patch, where the existing plaster has cracked, crumbled or sounds hollow when gently tapped on the surface, shall be removed. The patch shall be cut out to a square or rectangular shape at position marked on the wall as directed by the Engineer-in-Charge or his authorized representative. The edges shall be slightly under cut to provide a neat joint.

3.3 Preparation of Surface

The masonry joints which become exposed after removal of old plaster shall be raked out to a minimum depth of 10 mm in the case of brick work and 20 mm in the case of stone work. The raking shall be carried out uniformly with a raking tool and not with a basuli, and loose mortar dusted off. The surface shall then be thoroughly washed with water, and kept wet till plastering is commenced.

In case of concrete surfaces, the same shall be thoroughly scrubbed with wire brushes after the plaster had been cut out .

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

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

3.4 Application of Plaster

Mortar of specified mix with the specified sand shall be used. The method of application shall be as described for single coat plaster work of the specified mix and under SP-CS-PL-05. The surface shall be finished even and flush and matching with the old surrounding plaster. All roundings necessary at junctions of walls, ceilings etc. shall be carried out in a tidy manner as specified in sub-head SP-CS-PL-05.

All dismantled mortar & rubbish etc. shall be disposed off within 24 hours from its dismantling promptly as directed by the Engineer-in-Charge.

3.5 Protective Measure

Doors, windows, floors, articles of furniture etc. and such other parts of the building shall be protected from being splashed upon. Splashing and droppings, if any, shall be removed by the contractor at his own cost and the surface cleaned. Damages, if any, to furniture or fittings and fixtures shall be recoverable from the contractor.

3.6 Curing

Curing shall be done as per plaster work with special reference to the particular type of plaster mix as described under sub-head finishing'.

3.7 Finishing

After the plaster is thoroughly cured and dried the surface shall be white washed or colour washed to suit the existing finishing as required unless specified.

3.8 Measurements

Length and breadth shall be measured correct to a cm. The area shall be calculated in square metre correct to two places of decimal. Patches below 0.05 square metre in area shall not be measured for payment.

Pre-measurements of the patches to be plastered shall be recorded after the old plaster has been cut and wall surface prepared.

3.9 Rate

The rate includes the cost of all the materials and labour involved in all the operations described above including lead as described in the item for disposal of old dismantled plaster /material.

4.0 FIXING DOOR, WINDOW OR CLERESTORY WINDOW CHOWKHATS IN EXISTING OPENING

4.1 Making Holes

In case of door frames without sills, holes 40 mm deep shall be made in the floor for fixing the lower end of verticals of the frames. For doors with sills, the sill plates shall be partly fixed in the floor so that they project above the floor to the height as directed by the Engineer-in-Charge.

For embedding hold fasts of doors, windows or clerestory windows, the requisite number of holes at the correct positions shall be cut out in the masonry. The size of the holes shall be such that the chowkhats with the hold-fasts can be conveniently erected in position. Where necessary, masonry shall be chipped uniformly to facilitate easy insertion of the frame in the opening.

Special care shall be taken when holes are made in load bearing pillars or wall portions separated by openings to ensure that beams etc. supported by them are properly propped up. In such portions cutting holes shall be done on one side at a time. The sides of the holes shall be truly parallel and perpendicular to the plane of the wall. Due care shall be taken, not to disturb the adjoining masonry and the masonry under the bearings of lintels and arches etc. spanning the opening. The holes shall then be cleaned of all dust, mortar and brick bats or stone pieces and thoroughly wetted.

4.2 Fixing

The sides of chowkhats of door, window or clerestory window abutting against or to be embedded in masonry shall be painted with two coats of coal tar before being placed in position. The chowkhats shall than be inserted in position with their hold-fasts bolted tight. The chowkhats shall than be adjusted to proper line and plumb and secured in position by temporary bracing which shall not be disturbed or removed until the hold fasts are embedded in the masonry and the concrete block has set. The concrete to be used for embedding hold-fasts shall be cement concrete 1:3:6 mix (1 cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size).

The minimum size of concrete block in which the hold-fasts will be embedded shall be 30 x 10 x 15 cm for 35 cm long holdfasts. The concrete of the block shall completely fill the hole made in the masonry for the purpose. The chase cut in the floor shall be cut square and construction joint shall be provided filled in with cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) and rendered smooth at the top and finished to match the existing type of floor.

4.3 Finishing

After the surface surrounding the hold-fasts has sufficiently dried it shall be cleaned of dust etc. and wetted. It shall then be plastered with cement mortar 1:4 (1 cement : 4 fine sand) flush and matching with the surrounding plaster work. In case of exposed brick work, stone work, the finishing shall be done to match the surrounding. Any other portion of the wall opening, if damaged, shall be repaired in similar way.

After the cement plaster patches have been thoroughly cured and dried, they shall either be white washed or colour washed as required unless otherwise specified. All malba and debris obtained from cutting etc. shall be disposed off to the nearest dumping ground promptly as directed by Engineer-in-Charge.

4.4 Measurements

The chowkhats of doors, window and clerestory windows shall be enumerated separately.

4.5 Rate

The rate shall apply irrespective of the size of the chowkhat upto a maximum area of opening 3.75 square metres for doors, 2.5 square metres for windows and 1.2 square metres for clerestory windows.

The rate is inclusive of labour and materials involved in all the operations described above, excluding (a) cost of chowkhats and (b) cost of supplying and fixing the hold-fasts including C.C. block and bolts.

5.0 FIXING CHOWKHATS IN EXISTING OPENING IN BRICKS / RCC WALL WITH DASH

5.1 FASTNERS

In case of door frames without sills, holes 40 mm deep shall be made in the floor for fixing the lower end of verticals of the frames. For doors with sills, the sill plates shall be partly fixed in the floor so that they project above the floor to the height as directed by the Engineer-in-Charge.

For fixing dash fastners /chemical fastners of doors, windows or clerestory windows, the requisite number of holes at the correct positions shall be in the masonry/RCC wall. The size of holes shall be such that the fastners can be conveniently placed in position. Where necessary, masonry shall be chiped uniformly to facilitate easy insertion of the frame in the opening.

Special care shall be taken when holes are made in load bearing pillars or wall portions separated by openings to ensure that beams etc. supported by them are properly propped up. In such portions cutting holes shall be done on one side at a time. The sides of the holes shall be truly parallel and perpendicular to the plane of the wall. Due care shall be taken, not to disturb the adjoining masonry and the masonry under the bearings of the lintels and arches etc. spanning the opening. The holes shall then be cleaned of all dust, mortar and brick bats or stone pieces and thoroughly wetted.

5.2 Fixing

The sides of chowkhats of door, window or clerestory window abutting against or to be embedded in masonry shall be painted with two coats of coal tar before being placed in position. The chowkhats shall then be inserted in position tight. The chowkhats shall then be adjusted to proper line and plumb and secured in position by temporary bracing which shall not be disturbed or removed until the fastners are embedded in the masonry /RCC wall.

5.3 Finishing

After the surface surrounding the hold-fasts has sufficiently dried it shall be cleaned of dust etc. and wetted. It shall then be plastered with cement mortar 1:4 (1 cement: 4 fine sand) flush and matching with the surrounding plaster work. In

case of exposed brick work, stone work, the finishing shall be done to match the surrounding. Any other portion of the wall opening, if damaged, shall be repaired in similar way.

After the cement plaster patches have been thoroughly cured and have dried, they shall either be white washed or colour washed as required unless otherwise specified. All malba and debris obtained from cutting etc. shall be disposed off to the nearest dumping ground.

5.4 Measurements

The chowkhats of doors, window and clerestory windows shall be enumerated separately.

5.5 Rate

The rate shall apply irrespective of the size of the chowkhat upto a maximum area of opening 3.75 square metres for doors, 2.5 square metres for windows and 1.2 square metres for clerestory windows.

The rate is inclusive of labour and materials involved in all the operations described above, including cost of dash fastners chemical fasteners but excluding cost of chowkhat.

6.0 MAKING OPENING IN THE MASONRY CONSTRUCTION AND FIXING CHOWKHATS FOR DOORS, WINDOWS AND CLERESTORY WINDOWS

Before making opening it is necessary to examine that the wall exclusive of opening is adequate to take the load coming on the structure. All the structural members supported on the walls which have direct bearing over the area in which opening is to be made, shall be properly supported with props to relieve the load from masonry wall till the lintel over the opening is strong enough to take the load. Care should also be taken not to disturb the adjoining masonry.

All precautions as explained in Chapter 15.0 (Demolition and Dismantling) should be followed in case of dismantling the external walls. The portion to be dismantled may be clearly marked on both sides of the wall. Dismantling shall be carried out from top to bottom within the marked area. The sides of the opening shall be as far as possible, parallel and perpendicular to the plane of wall.

6.1 Making Opening

The openings for fixing door/window frames shall be to the extent of accommodating the hold fast. The hold fasts shall be fixed in cement concrete 1:3:6 (1 cement : 3 coarse sand : 6 stone aggregate 20 mm nominal size) or in masonry as required. Where only opening is to be made in the masonry, the width of the opening shall be such that the sides of the masonry can be built true to line and plumb and such masonry built shall conform to the specifications of the particular type of masonry in which the opening is made with particular reference

to size of corner stones etc. In order to get continuity with old masonry, proper key shall be provided. The height of the opening shall be such that it can accommodate the required depth of the RCC lintel also.

The sides of opening in masonry shall be cleaned of all dust, mortar, brick bats/loose stones, chips etc. and the surface left rough and thoroughly wetted.

The lintel shall be invariably cast first in the opening made for the purpose. One side of the shuttering shall be kept open in the beginning till the concrete is laid. The shuttering shall then be fixed for half of the opening and concreting completed.

Curing of lintel casted shall be done for a minimum period of 7 days.

Precast RCC lintel or R.S. Joist may also be used if directed by the Engineer-in-Charge.

6.2 Fixing Chowkhats

Fixing of chowkhats shall be done as specified in 4.2.

6.3 Finishing

After the surface of the sides of masonry opening and lintel are sufficiently dry and set, it shall be cleaned free of dust, loose mortar etc. and wetted thoroughly. It shall then be plastered or pointed as required flush with the surrounding masonry work. Any other portion of the wall if damaged shall be finished in similar manner.

After the cement plaster/pointing has been thoroughly cured and have dried the surface shall be either white or colour washed/painted as required. The surface of the wall which is spoiled due to splashing of mortar shall be cleaned forthwith.

6.4 Measurements

The openings made for doors, windows, clerestory windows shall be measured correct to cms and area shall be calculated in square metres correct to two places of decimal.

6.5 Rate

The rate shall apply per sqm of opening. The rate is inclusive of labour and material involved in all the operations described above.

Cost of Chowkhats, cost of CC blocks, cost of supplying the hold-fasts bolts, cost of R.C.C lintel or R.S. Joist which shall be paid for separately.

7.0 RENEWING FLOATING GLASS PANES WITH PUTTY AND NAILS

7.1 Removing Broken Glass Panes

Old putty shall be raked out with hack knife. The brad (small nails without head) and pieces of broken glass shall be removed from the rebates of the sash bars. The pieces of glass panes as found useful shall be handed over to the Engineer-in-Charge of the work. No glass shall be inserted in frames until they have been primed and prepared for painting so that the wood may not draw oil out of the putty.

7.2 Floating Glass Panes

The floating glass panes shall conform to specifications described in IS 14900.

7.3 Fixing

The floating glass panes shall be so cut that it fits slightly loose in the frame and as specified in A&B of IS 14900. A thin layer of Putty conforming to IS 419 shall be prepared by mixing one part of white lead with three parts of finely powdered chalk and then adding the boiled linseed oil to the mixture to form a stiff paste and adding varnish to the paste @ 1 litre of varnish to 18 kg. of paste. The putty so prepared in the form of a stiff paste shall be drawn along the inner edge of the rebate, for bedding the back of the glass panes. The glass pane shall then be put in position, pressed home against the thin layer of the putty, and secured in rebate by new brads. The brads shall not be spaced more than 7.5 cm from each corner and not more than 15 cm apart. The putty shall then be applied in the rebate uniformly, sloping from the inner edge of the rebate. In doing this care shall be taken to keep the putty a little within the inner edge of the rebate and surplus putty removed so that none of it is seen through the glass from the inside. The putty so filled in the rebates shall be levelled smooth and finished in a straight line. When dried the putty shall be covered with a coat of paint of approved quality and shade to match the existing finish of joinery work.

The floating glass panes shall be cleaned with methylated spirit. All splashings or droppings of washing and paints shall be removed. All rubbish and unserviceable materials shall be disposed off to the dumping ground promptly as per the direction of Engineer-in-Charge.

7.4 Thickness and Tolerance of Floating Glass

Thickness	Tolerance
4 mm	± 0.3 mm
5 mm	± 0.3 mm
6 mm	± 0.3 mm

Note : Frosted glass panes should be replaced with frosted glass panes. These shall be fixed with frosted face on the inside.

7.5 Measurements

Length and breadth of glass panes shall be measured correct to a cm. The area of the glass panes as fixed shall be calculated in square metre correct to two places of decimal.

7.6 Rate

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

8.0 RENEWING FLOATING GLASS PANES WITH WOODEN FILLETS

8.1 Removing Broken Glass Panes

The specifications shall be the same as in para 7.1 except that the wooden fillets including nails shall be taken out carefully.

8.2 Glazing

The specifications for glass panes and their fixing shall be the same as per IS 14900. The fillet shall either be fixed flush or projected uniformly to match with the existing work by means of nails (brads).

The new fillet provided shall be painted or finished otherwise to match with the existing finish of the joinery work.

The glass panes shall be cleaned with methylated spirit of all sorts of splashing and droppings of wash and paints.

All rubbish and unserviceable materials shall be disposed off in the dumping ground promptly as per the direction of Engineer-in-Charge.

8.3 Measurements

Length and breadth of glass panes shall be measured correct to a cm. The area of the glass panes as fixed shall be calculated in square metre correct to two places of decimal. The new wooden fillets fixed shall be measured in running metres correct to a cm.

8.4 Rate

The rates shall include the cost of labour and material involved in all the operations described above except that the cost of new wooden fillets used in the work and their finishing shall be paid for separately.

9.0 RENEWING FLOATING GLASS PANES AND REFIXING EXISTING WOODEN FILLETS

The specifications shall be same as described in 8.0 above.

9.1 PROVIDING NEW WOODEN FILLETS

The fillets shall be of wood, as specified in the item of work, these shall be cut and planed smooth to the required shape and dimensions.

9.2 Fixing

9.3 Glass Panels :

Float glass used shall be as specified in sub-head SP-BLD-AW-14 of this specifications. For panel exceeding 0.5 sqm in area, the nominal thickness of the glass to be used shall be as specified Glazing in the shutters of doors, windows and ventilators of bath, WC and Lavatories shall be provided with frosted glass the weight of which shall be not less than 10 kg/sqm. Frosted glass panes shall be fixed with frosted face on the inside. Glass panels shall be fixed by providing a thin layer of putty conforming to IS 419 applied between glass pane and all along the length of the rebate and also between glass panes and wooden beading.

The fillet shall either be fixed flush or projected uniformly to match the existing work.

The fillet shall be painted or finished otherwise to match with the existing finish of the joinery work.

The glass panes shall be cleaned with methylated spirit of all sorts of splashing and dropping of wash and paints.

9.4 Measurements

The fillets shall be measured in running metres. The lengths shall be measured correct to a cm.

9.5 Rate

The rate shall include the cost of all labour and materials involved in all the operations described above. The rate shall also include the cost of removal of worn out fillets, when these are met with in old work. The rate shall vary according to the class of wood used.

10.0 RENEWAL OF OLD PUTTY OF GLASS PANES

The old putty shall be removed as specified in 7.1 and new putty fixed as specified in 7.3

10.1 Measurements

The work shall be measured in running metres. The length along the rebate shall be measured correct to a cm.

10.2 Rate

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

11.0 REFIXING OLD GLASS PANES WITH PUTTY AND NAILS

Specification same as described in 7.0 above. Except for the glass panes, old glass panes will be used for which nothing extra will be paid.

12.0 FIXING OLD GLASS PANES WITH WOODEN FILLETS

Specifications same as described in para no. 8.0 above except for the glass panes. Old glass panes will be used for which nothing extra shall be paid.

12.1 FIXING FAN CLAMPS IN EXISTING R.C.C. SLABS

The fan clamps to be fixed in an existing R.C.C. slab shall be of type shown in Fig. 12.1.

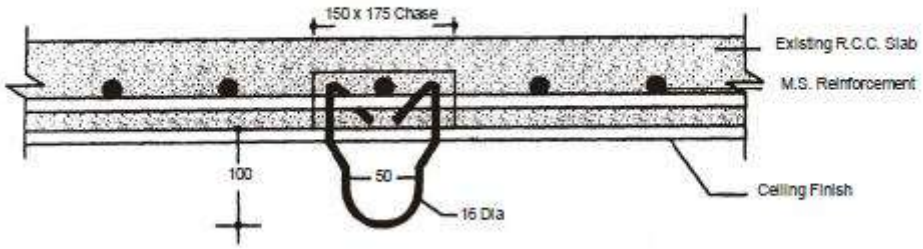


Fig 12.1

These shall be made of 16 mm dia M.S. bar.

12.2 Fixing

A 15 x 7.5 cm size chase shall be cut from the ceiling to expose the reinforcement and upto 2.5 cm clear round the reinforcement bar as directed. This shall be done without any damage to adjoining portion of the ceiling.

The two arms at the ends of the clamps shall be passed through the space over the reinforcement bar from the bottom of the slab. Then the two arms shall be bent down about 1.5 cm by means of a crow bar. The clamp shall be held in position

and chase in the ceiling filled with cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size). The ceiling shall then be finished to match the existing surface and properly cured.

The exposed portion of the clamp shall be given two or more coats of paint including one priming coat of shade as directed by the Engineer-in-Charge.

12.3 Measurements and Rate

Clamps shall be counted in numbers. The rate per fan clamp shall include the cost of labour and materials involved in all the operations described above. The rate shall apply irrespective of the thickness of the slab.

13.0 REGRADING OF MUD PHUSKA TERRACING

13.1 Dismantling

The specified area of roof as directed by the Engineer-in-Charge shall be dismantled carefully so that the minimum of tiles or bricks are damaged. The serviceable tiles or bricks shall be cleaned and stacked on places as directed by the Engineer-in-Charge, or on the parapet wall if convenient and safe or otherwise

carried to ground and stacked as directed by the Engineer-in-Charge for which nothing extra shall be paid.

All unserviceable tiles and debris shall be disposed off to the dumping ground as directed by the Engineer-in-Charge. Suitable earth shall be stacked separately for reuse.

13.2 Laying

Mud phuska shall be removed, cleaned of all foreign matter and brought to the ground. After approval of the Engineer-in-Charge it shall then be reduced to fine powder and then mixed with additional soil for regrading and additional fibrous reinforcing materials such as chopped straw or fresh bhusa at the rate of 8 kg/cum of mud mortar shall be mixed with old earth. The choppings used shall not be more than 20 mm in length. A pit shall be dug where the mixture shall be added and allowed to mature for a period of not less than 7 days. During this period the mixture shall be worked up at interval

with feet and spades so as to get pugged into homogeneous mass free from lumps and clods. The consistency of the mortar shall be adjusted by taking it in a trowel and observing how it slides off the face of the trowel. The mortar shall readily slide off, but at the same time shall be so wet as to part into large drops before falling.

13.3 Leeping Plaster

Shall be prepared by mixing soil which is free from coarse sand with approximately equal volume of cow dung and adding the required quantity of water. The mixture shall work to a homogeneous mass.

The quantity of gobar used in gobri leeping shall not be less than 0.03 cum per 100 sqm of plaster area.

13.4 Laying Tile Bricks and Grouting

After the gobri leaping has dried, brick tiles shall be laid using the minimum amount of plain mud mortar (without bhusa) as bedding so as to obtain correct slope and even surface of tile floors. Care shall be exercised to see that mud mortar does not rise into the vertical joints of the tiles more than 12 mm. The brick tiles shall be either flat tile bricks of class designation 100 or machine moulded tile bricks of class designation 125 conforming to IS 2690 (Prt I) as per the nomenclature of the item. The tiles shall be laid such that the thickness of joints shall not be less than 6 mm and more than 12 mm in width. After the tiles are well set and bedding mortar has dried, joints of the tiles shall be grouted with cement mortar of mix 1:3 (1 cement : 3 fine sand) such that all the joints of tiles are completely filled with mortar and the joints should be finished neat. Cement used for the mortar shall be mixed with 2% of integral water proofing compound which should conform to IS 2645.

New tile as necessary to replace the broken tiles shall be used. Half or cut brick tiles shall not be used except where necessary to complete the bond. New work shall be finished in level with surrounding surface.

13.5 Curing

As soon as cement grouting obtains initial set, the surface of the brick tile floor shall be covered with wet gunny bags, hessian cloth or wet sand to prevent quick drying. After 8-12 hours, the brick tile floor shall be cured by frequent sprinkling of water on the surface for a period of 7 days. After curing has been done, the surface shall be swept clean.

The tile surface as completed shall be even and true to slopes of 1 in 48 or as specified and should be leak proof.

Note: When surplus earth of a suitable quality exists at the site of work, the contractor shall be allowed to use the same free of cost for laying the mud terracing, mud plaster and gobri leaping on the top. The Engineer-in-Charge shall be the final authority to decide whether the earth obtained from excavation is surplus to the requirements at site and is suitable for mud phuska work.

13.6 Measurements

Length and breadth shall be measured correct to a cm. The measurements shall be taken for the finished work, (mud phuska terracing of stipulated thickness with

mud plaster, gobri leaping and tile paving and grouting) over the tiled surface, in superficial area.

No deductions in measurements shall be made for either openings or recesses for chimney stacks, roof lights or khurras, of area upto 0.40 sqm. No extra shall be paid either for any extra materials or labour involved in forming such openings, recesses etc. For areas exceeding 0.40 sqm deductions will be made in the measurements for the full opening but extra shall be paid for any extra labour, materials etc. in forming such openings.

For plus or minus deviation from the average thickness stipulated for the mud phuska in the item, payments will be adjusted in the rate admissible to the contractor for the relevant schedule item provided that such deviations were authorised by the Engineer-in-Charge in writing

13.7 Rate

The rate shall include the cost of all materials and labour involved in all the operations described above except for new tiles or bricks which shall be paid for separately.

14.0 REPLACING RED OR WHITE SAND STONE SLABS IN ROOFING

14.1 Dismantling Roof

The general specifications given in SP-BLD-DD-20 shall apply. The cracked or decayed stone slabs as marked by the representative of the Engineer-in-Charge shall be removed after dismantling the tile covering with mud phuska over it if any, or other type of covering over the stone slabs.

Mud phuska terracing with tile brick covering shall be dismantled as per 13.1 over the specified cracked or decayed tiles to an area extending 15 cm on all sides of stone slabs. This area may be increased by the Engineer-in-Charge, if found necessary. Stone slabs shall then be dismantled and carried down and stacked properly.

In case the stone slabs are not covered at top with mud phuska or lime terracing, the decayed or cracked stone slabs shall be dismantled and carried down or lowered with ropes and stacked properly.

14.2 Relaying of Stone Slab Roofing

Before placing the stone slab the condition of the existing wooden battens shall be checked by suitable methods and replaced if required by Engineer-in-Charge. The upper surface of the wooden battens and beams supporting the stone slab, shall be painted with two coats of coal tar if not already treated and with one coat of coal tar if originally treated.

14.2.1 Laying

The slabs shall be washed clean and wetted before being laid. The stone slabs shall be jointed in cement mortar 1:4 (1 cement : 4 coarse sand). The width of joints shall not be more than 8 mm not less than 5 mm. The top joints shall be finished flush and ceiling joints pointed with the cement mortar 1:3 (1 cement : 3 fine sand).

14.2.2 Finish

The finished surface shall be truly levelled or slopped as shown in the plan or as directed by the Engineer-in-Charge. It shall be cleaned off all mortar droppings and cement markings both on top and on the under side.

14.2.3 Curing

The slabs and their joints shall be kept wet during progress of work and for 7 days after completion.

14.3 Relaying of Mud Phuska with Tile

The specifications shall be as described in 13.2 to 13.4 and shall be paid for separately.

14.4 Curing and Measurements

Shall be done as described in 13.5 and 13.6.

14.4.1 All unserviceable material shall be disposed off to the dumping ground as directed by the Engineer-in-Charge.

14.5 Rate

The rate shall include the cost of materials and labour involved in all the operations described above, except the cost of wooden battens which shall be paid for separately.

15.0 RENEWING WOODEN BATTENS /BEAMS IN ROOFS

15.1 Dismantling Wooden Battens / Beams

Dismantling shall be done as described in SP-BLD-DD-20 of dismantling and demolishing. Proper scaffolding shall be erected and got inspected by Engineer-in-Charge. Propping and bracing as directed should be done adequately and members required to be dismantled should be removed carefully including nails/bolts etc. and dismantling of masonry wall. The dismantled members should not be thrown or dropped but lowered with ropes carefully and stacked properly.

15.2 Relaying of Wooden Battens

The wooden battens/beams of required section and size should be placed at proper interval and surface of the wooden batten/beams shall be painted with oil type wood preservative of approved brand and manufacture and as per the direction of Engineer-in-Charge.

15.2.1 All serviceable material shall be stacked properly and all the unserviceable material shall be deposited with the Engineer-in-Charge.

15.3 Measurement

The work shall be measured in cubic meters. The length, breadth and depth shall be measured correct to a cm.

15.4 Rate

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

16.0 PANELLED GLAZED OR PANELLED AND GLAZED SHUTTERS

16.1.1 Pannelled or glazed shutters for doors, windows, ventilators and cupboards shall be constructed in the form of timber frame work of stiles and rails with panel inserts of timber, plywood, block board, veneered particle board, fibre board wire gauze or sheet glass. The shutters may be single or multipanelled, as shown in the drawings or as directed by the Engineer-in-Charge. Timber for frame work, material for panel inserts and thickness of shutters shall be as specified. All members of the shutters shall be straight without any warp or bow and shall have smooth well planed face at right angles to each other.

Any warp or bow shall not exceed 1.5 mm. The right angle for the shutter shall be checked by measuring the diagonals and the difference between the two diagonals should not be more than ± 3 mm.

16.2 Frame Work

16.2.1 Timber for stiles and rails shall be of the same species and shall be sawn in the directions of grains. Sawing shall be truly straight and square. The timber shall be planed smooth and accurate to the required dimensions. The stiles and rails shall be joined to each other by plain or haunched mortise and tenon joints and the rails shall be inserted 25 mm short of the width of the stiles. The bottom rails shall have double tenon joints and for other rails single tenon joints shall be provided. The lock rails of door shutter shall have its centre line at a height of 800 mm from the bottom of the shutters unless otherwise specified. The thickness of each tenon shall be approximately one-third the finished thickness of the members and the width of each tenon shall not exceed three times its thickness.

16.2.2 **Gluing of Joints :** The contact surfaces of tenon and mortise shall be treated, before putting together, with bulk type synthetic resin adhesive conforming to IS

851 suitable for construction in wood or synthetic resin adhesive (Phenolic and aminoplastic) conforming to IS 848 or polyvinyl acetate dispersion based adhesive conforming to IS 4835 and pinned with 10 mm dia hardwood dowels or bamboopins or star shapped metal pins; after the frames are put together and pressed in position by means of press.

16.2.3 Stiles and bottom rail shall be made out of one piece of timber only. Intermediate rail exceeding 200 mm in width may be out of one or more pieces of timber. The width of each piece shall be not less than 75 mm. Where more than one piece of timber is used for rails, they shall be joined with a continuous tongued and grooved joint glued together and reinforced with metal dowels at regular intervals not exceeding 200 mm.

TABLE 16.1

Dimensions of Components of Frame Work

Sl. No.	Description	Width mm	Thickness mm
A. DOOR SHUTTERS			
(a)	Stile, top and freeze rail	100	35 or 40
(b)	Lock rail	150	35 or 40
(c)	Bottom rail	200	35 or 40
(d)	Muntin	100	35 or 40
(e)	Glazing bar	40	35 or 40
B. WINDOW, VENTILATOR & CUPBOARD SHUTTERS			
(a)	Stile, top and freeze rail	80	20, 25 or 30
(b)	Bottom rail	80	20, 25 or 30
(c)	Muntin	60	20, 25 or 30
(d)	Glazing bar	40	20, 25 or 30

16.2.4 Muntin and glazing bars where required shall be stubtenoned to the maximum depth which the size of the member would permit or to a depth of 25 mm whichever is less. Unless otherwise specified the finished dimensions of the components of frame work of shutters shall be as given in Table 16.1.

The tolerance on width of styles and rail shall be ± 3 mm. The tolerance in thickness will be ± 1 mm. The thickness of all components of frame work shall be the same as the thickness of the shutter. Tolerance on over all dimensions of the shutter shall be ± 3 mm.

16.3 Rebating

The shutters shall be single-leaf or double leaved as shown in the drawings or as directed by the Engineer-in-Charge. In case of double leaved shutters, the meeting of the stiles shall be rebated by one-third the thickness of the shutter. The rebating shall be either splayed or square type as shown in Fig. 16.1.

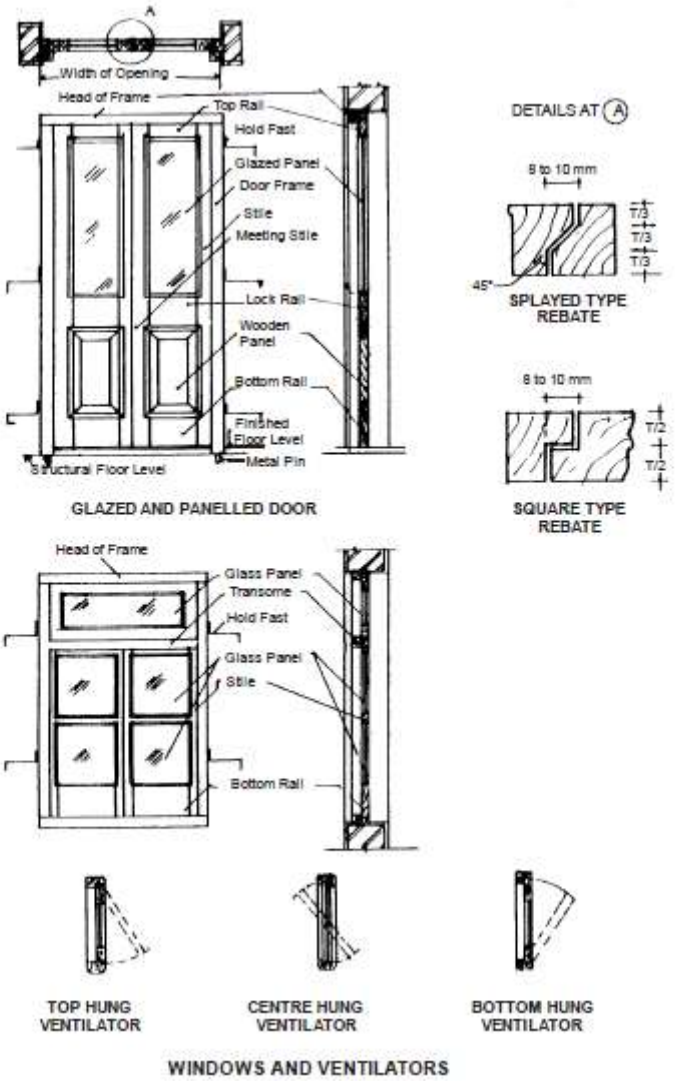


FIG 16.1

16.4 Panelling

The panel inserts shall be either framed into the grooves or housed in the rebate of stiles and rails. Timber, plywood, hard board and particle board panels shall be fixed only with grooves. The depth of the groove shall be 12 mm and its width shall accommodate the panel inserts such that the faces are closely fitted to the sides of the groove. Panel inserts shall be framed into the grooves of stiles and rails to the full depth of the groove leaving on space of 1.5 mm. Width and depth of the rebate shall be equal to half the thickness of stiles and rails. Glass panels, asbestos

panels wire gauze panels and panel inserts of cupboard shutters shall be housed in the rebates of stiles and rails.

16.5 Timber Panels :

Timber panels shall be preferably made of timber of large width; the minimum width and thickness of the panel shall be 150 mm, and 15 mm respectively. When made from more than one piece, the pieces shall be jointed with a continuous tongued and grooved joint glued together and reinforced with headless nails at regular intervals not exceeding 100 mm. Depth and thickness of such joint shall be equal to one-third of thickness of panel. The panels shall be designed such that no single panel exceeds 0.5 square metre in area. The grains of timber panels shall run along the longer dimensions of the panels. All panels shall be of the same species of timber unless otherwise specified.

16.6 Plywood Panels :

Plywood boards used for panelling of shutters shall be BWP type or grade as specified in SP-BLD-WW-12 Each panels shall be a single piece of thickness, 9 mm for two or more panel construction and 12 mm for single panel construction unless otherwise specified.

16.7 Block Board Panels :

Block board used for panelling of shutters shall be Grade I (Exterior Grade) bonded with BWP Type Synthetic resin adhesives as specified in SP-BLD-WW-12 Each panel shall be a single piece of thickness 12 mm unless otherwise specified.

16.8 Veneered Particle Board Panels :

Veneered Particle board used for panelling of shutters shall be Exterior Grade bonded with BWP type synthetic resin adhesive as specified in SP-BLD-WW-12. Each panel shall be a single piece of thickness 12 mm unless otherwise specified.

16.9 Fibre Board Panels

Fibre board used for panelling of shutters shall be Exterior Grade bonded with BWP type synthetic resin adhesive as specified in SP-BLD-WW-12. Each fibre board panel shall be a single piece of thickness 10 mm unless otherwise specified.

16.10 Wire Gauze Panels :

Wire Gauze used for panelling of shutters shall be woven with 0.63 mm dia galvanised mild steel wire to form average aperture size of 1.40 mm. Wire gauze shall be securely housed into the rebates of stiles and rails by giving right angles bend turned back and fixed by means of suitable staples at intervals of 75 mm and over this wooden beading shall be fixed. The space between the rebate and the beading shall be fixed with putty to give a neat finish. Each wire gauze panel shall be a single piece, and the panels shall be so designed that no single panels exceeds 0.5 sqm in area. However, care shall be taken to prevent sagging of wire

gauge, of panel by providing and fixing 20 x 20 mm square or equivalent beading to the external face in the required patterns as decided by the Engineer-in-Charge.

16.11 Glass Panels :

Glass panelling (Glazing) shall be done with float sheet glass as per IS 14900. Glazing in the shutters of doors, windows and ventilators of bath, WC and Lavatories shall be provided with frosted glass the weight of which shall be not less than 10 kg/sqm. Frosted glass panes shall be fixed with frosted face on the inside. Glass panels shall be fixed by providing a thin layer of putty conforming to IS 419 applied between glass pane and all along the length of the rebate and also between glass panes and wooden beading.

Putty can be prepared by mixing one part of white lead with three parts of finely powdered chalk and then adding boiled linseed oil to the mixture to form a stiff paste and adding varnish to the paste at the rate of 1 litre of varnish to 18 kg of paste. Fixing of glass panes without beading shall not be permitted. Glazing shall be done after the shutters have been primed and prepared for painting, so that wood may not draw oil out of putty.

16.12 Finish :

Panels of shutters shall be flat and well sanded to a smooth and level surface.

16.13 Beading

Beadings in panelled shutter shall be provided where specified in architectural drawings or directed by the Engineer-in-Charge. Each length of beading shall be single piece. Joints at the corners shall be mitred and exposed edges shall be rounded. Beading shall be fixed with headless nails at 75 mm intervals. For external shutters, the beading shall be fixed on the outside face.

16.14 Machine/Factory made Shutters

Machine made shutters, where specified, shall be procured from an approved factory. For machine made shutters, operations like sawing, planning, making tongue and tenons, cutting grooves, mortises and rebates, drilling holes and pressing of joints shall be done by suitable machines. Machines made shutters shall be brought to the site fully assembled but without any priming coat. Panel inserts of sheet glass and wire gauze may, however, be fixed at site.

16.15 Fixing of Shutters

For side hung shutters of height upto 1.2 m, each leaf shall be hung on two hinges at quarter points and for shutter of height more than 1.2 m, each leaf shall be hung on three hinges one at the centre and the other two at 200 mm from the top and bottom of the shutters. Top hung and bottom hung shutters shall be hung on two hinges fixed at quarter points of top rail or bottom rail. Centre hung shutter shall be suspended on a suitable pivot in the centre of the frame. Size and type of hinges and pivots be as specified. Flap of hinges shall be neatly counter sunk into the

recesses cut to the exact dimensions of flap. Screws for fixing the hinges shall be screwed in with screw driver and not hammered in. Unless otherwise specified, shutters of height more than 1.2 m shall be hung on butt hinges of size 100 mm and for all other shutters of lesser height butt hinges of size 75 mm shall be used. For shutter of more than 40 mm thickness butt hinges of size 125 × 90 × 4 mm shall be used. Continuous (piano) hinges shall be used for fixing cup-board shutters where specified.

16.16 Fittings

Fittings shall be provided as per schedule of fittings decided by Engineer-in-Charge.

Appendix H (P-361/SH 9.0) gives for guidance the schedule of fittings and screws usually provided. Cost of providing and fixing shutter shall include cost of hinges and necessary screws for fixing the same. All other fittings shall be paid for separately. Where the fittings are stipulated to be supplied by the department free of cost, screws for fixing these fittings shall be provided by contractor and nothing extra shall be paid for the same.

16.17 Wooden Cleats and Blocks

Wooden cleats and blocks shall be fixed to doors and windows as directed by Engineer-in-Charge, as per size and shape approved by him. These are included in the cost of providing and fixing the shutters.

16.18 Measurements

Framework and panelling shall be measured separately.

16.19 Frame Work of Shutters :

The overall length and width of the framework of the shutters shall be measured nearest to a cm in fixed position (overlaps not to be measured in case of double leaved shutters) and the area calculated in square metres correct to two places of decimeter. No deduction shall be made to form panel openings or louvers. No extra payments shall be made for shape, joints and labour involved in all operations described above.

For panelling of each type or for glazed panel length and width of opening for panels inserts or glazed panels shall be measured correct to a cm before fixing the beading and the area shall be calculated to the nearest 0.01 sq.m. The portions of the panel inserts or glazed panel inside the grooves or rebates shall not be measured for payment.

16.20 Rate

Rate includes the cost of materials and labour involved in all the operations described above. The frame work and panelling of each type or glazed panels shall be paid separately. The rate for frame work includes the cost of butt hinges

and necessary screws .However, extra shall be paid for providing moulded beading where specified. Nothing extra shall be paid for plain beading when specified in drawing.

16.21 TRELLIS (JAFFRI) WORK

Specified timber shall be sawn in the direction of the grains. Sawing shall be truly straight and square. The timber shall be plained smooth and accurate to the full dimensions, rebates, roundings, and mouldings as shown in the drawings made, before assembly. Patching or plugging of any kind shall not be permitted except as provided.

16.22 Plain Trellis (Jaffri)

This shall consist of wooden strips or laths 35 x 10 mm section unless otherwise specified plained and nailed together at every alternate crossing. The strips shall cross each other at right angle and shall be spaced 35 mm apart, so as to form 35 × 35 mm square opening or as shown in the drawing. These shall be fixed with nails to the frame. To cover the ends of strips, 50 × l2 mm beading shall be fixed to the frame with screws. The finished work with a tolerance of ± 1 mm may be accepted.

16.23 Trellis (Jaffri) Doors and Windows Shutters

Shutter frame of specified timber shall consist of two stiles and top, lock and bottom rails, each of section 75 × 35 mm unless otherwise specified. The stiles and rails shall be properly mortised and tenoned. The tenons shall pass through the stiles for at least 3/4th of the width of the stile. Shutter frame shall be assembled and passed by the Engineer-in-Charge before jointing. The joints shall be pressed and secured by bamboo pins of about 6 mm diameter. To this frame, plain trellis (Jaffri) work as directed by the Engineer-in-Charge.

16.24 Measurements

Width and height of plain trellis work and trellis shutters shall be measured overall correct to a cm.

The area shall be calculated in square metres nearest to two places of decimal. In case of shutters,

16.25 Rate

It includes the cost of materials and labour required in all the operations described above.

16.26 FITTINGS

Fitting shall be of mild steel brass, aluminium or as specified. Some mild steel fittings may have components of cast iron. These shall be well made, reasonably smooth, and free from sharp edges and corners, flaws and other defects. Screw

holes shall be counter sunk to suit the head of specified wood screws. These shall be of the following types according to the material used.

(a) Mild Steel Fittings

These shall be bright satin finish black stone enamelled or copper oxidised (black finish), nickel chromium plated or as specified.

(b) Brass Fittings

These shall be finished bright satin finish or nickel chromium plated or copper oxidised or as specified.

(c) Aluminium Fittings

These shall be anodised to natural matt finish or dyed anodic coating not less than grade AC 10 of IS 1868.

The fittings generally used for different type of doors and windows are indicated in Appendix H (P- 361/SH 9.0) attached. The fittings to be actually provided in a particular work shall, however, be decided by the Engineer-in-Charge.

Screws used for fittings shall be of the same metal, and finish as the fittings. However, chromium plated brass screws or stainless steel screws shall be used for fixing aluminium fittings. These shall be of the size as indicated in respective figures.

Fittings shall be fixed in proper position as shown in the drawings or as directed by the Engineer-in- Charge. These shall be truly vertical or horizontal as the case may be. Screws shall be driven home with screw driver and not hammered in. Recesses shall be cut to the exact size and depth for the counter sunking of hinges.

16.27 Butt Hinges

(a) Cast brass butt hinges light/ordinary or heavy.

16.28 Cast Brass Butt Hinges :

These shall be light/ordinary or heavy as specified. These shall be well made and shall be free from flaws and defects of all kinds. These shall be finished bright or chromium plated or oxidised or as specified. These shall generally conform to IS 205.

16.1 Hinge Pin

Hinge pin shall be made of brass or of phosphor bronze. The hinge pins shall be firmly rivetted and shall be properly finished. The movement of the hinge pin shall be free, easy and square and shall not have any play or shake.

16.2 Knuckles

The number of knuckles in each hinge shall not be less than five. The number of knuckles in case of sizes less than 40 mm shall be three. The sides of the knuckles shall be straight and at right angle to the flap. The movement of the hinge pin shall be free and easy and working shall not have any play or shake.

16.3 Screw Holes :

The screw holes shall be clean and counter sunk and of the specified size for different types and size of hinges. The size of the holes shall be such that when it is counter sunk it shall be able to accommodate the full depth of counter sunk head of wood screw specified.

16.4 Sampling and Criteria for Conformity :

The number of butt hinges to be selected from a lot shall depend on the size of lot and shall be in accordance with Table 10. Butt hinges for testing shall be taken at random from at least 10 per cent of the package subject to a minimum of three, equal number of hinges being selected from each package. All butt hinges selected from the lot shall be checked for dimensional and tolerance requirements. Defects in manufacture and finish shall also be checked. A lot shall be considered conforming to the requirements of this specification if the number of defective hinges among those tested does not exceed the corresponding number given in Table 16.2.

TABLE 16.2

Lot size	Sample size	Permissible No. of defective hinges
Upto 200	15	0
201 to 300	20	1
301 to 500	30	2
501 to 800	40	2
801 and above	55	3

Note: Any hinge which fails to satisfy the requirements of any one or more of the characteristics shall be considered as defective hinge.

16.1 Spring Hinges : (Single or double acting)

16.1.1 These shall be single acting when the shutter is to open on one side only or double acting when the shutter opens on both sides. These shall be made of M.S. or brass as specified, and shall generally conform to IS 453.

Hinges shall work smoothly and shall hold the door shutter truly vertical in closed position. Each double-acting spring hinge shall withstand the following tests which shall be carried out after fixing it to a swing door in the normal manner.

(a) When the door is pushed through 90° and released 2000 times on each side in quick succession the hinge shall show no sign of damage or any appreciable deterioration of the components during or on completion of the test.

(b) The door shall require a force of 2.0 ± 0.5 kg for 100 mm hinges and 3.0 ± 0.5 kg for 125 mm and 150 mm hinges at a distance of 4.5 cm from the hinge pin to move the door through 90º.

The size of spring hinge shall be taken as the length of the plate.

16.1.2 These shall be of the following type :

(a) Mild Steel : The cylindrical casing shall be made either from M.S. sheet of 1.60 mm thickness, lap jointed and brazed, welded and rivetted, or from solid drawn tube of thickness, pressed to from the two casing. It shall be stove enamelled black or copper oxidized or as specified.

(b) Cast Brass : The cylindrical casing shall be made either from brass sheet of 1.60 mm thickness, lap jointed and brazed, or from solid drawn brass tube of not less than 1.60 mm thickness. It shall be satin, bright nickle plated or copper oxidized or as specified.

16.2 Sampling

The number of spring hinges shall be selected from the lot and this number shall depend on the size of the lot and shall be in accordance with Table 16.3.

TABLE 16.3

Lot size	Sample size	Permissible No. of defective hinges
1 to 25	3	0
26 to 50	6	0
51 to 100	12	0
101 to 200	15	0
201 to 300	20	1

301 to 500	30	2
501 to 800	40	2
801 and above	55	3

16.3 Flush Bolts

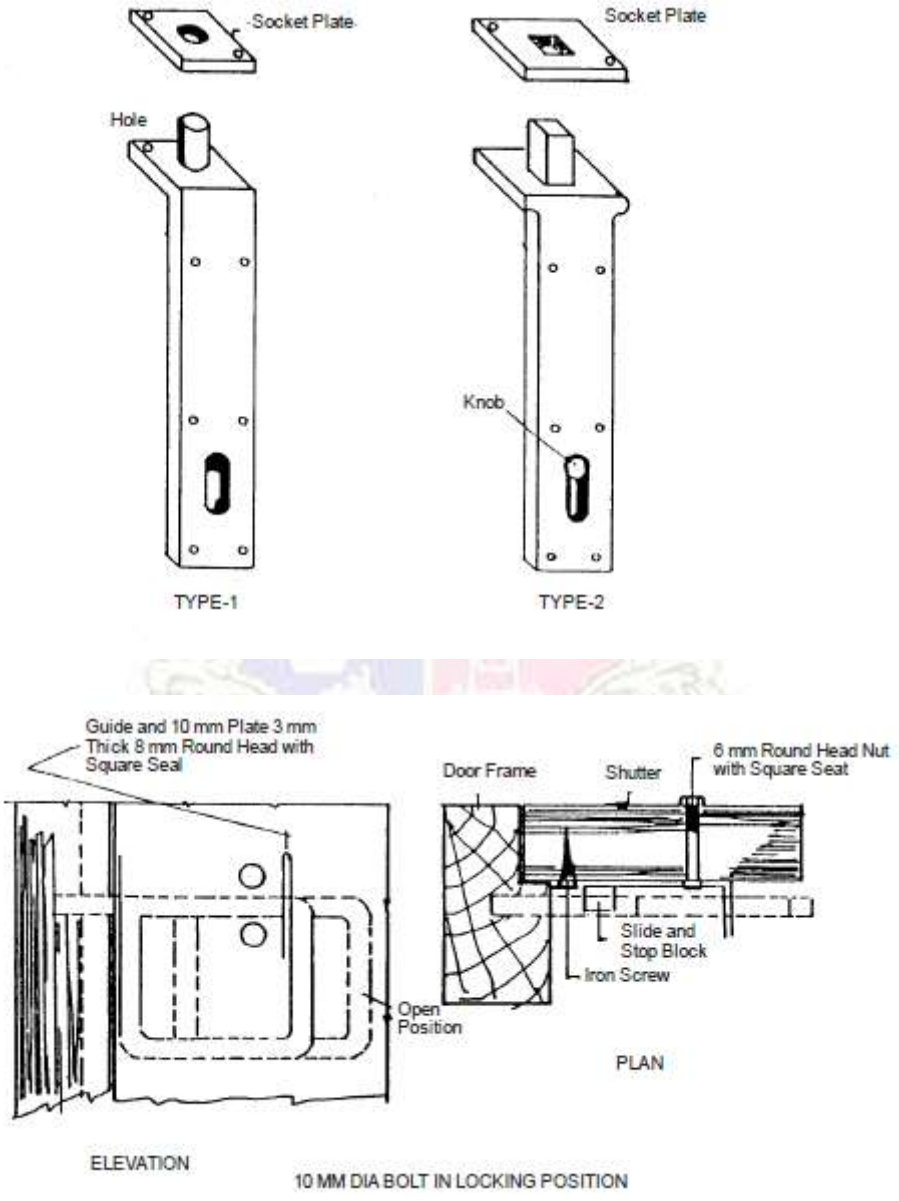


FIG: Flush Bolts

These should generally conform to IS 5187. These shall be of cast brass, cast aluminium alloy or extruded aluminium alloy as specified. Only one material shall be used in the manufacture of all the components of flush bolts except spring which shall be of phosphor bronze or steel strip.

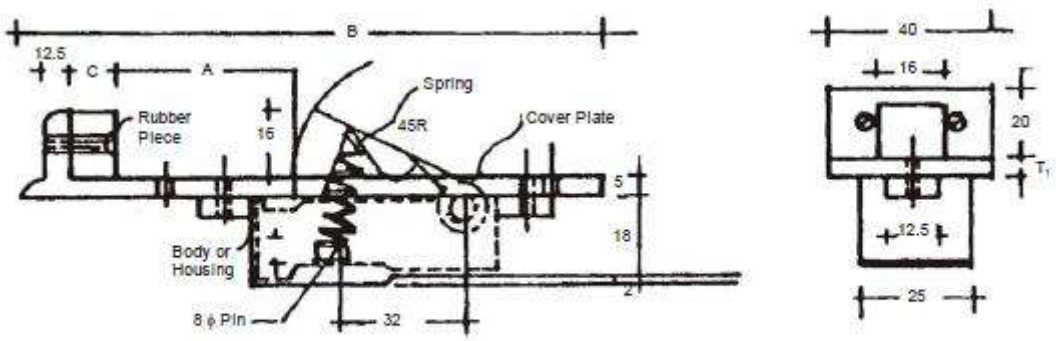
When the rod is completely in its maximum bolting position it shall be retained in that position by the spring. The length of the bolt shall be such that, when the bolt is pulled down, the top of the bolt shall be flush with the top of the lip face. The top of the bolt shall be given a taper of 45° to enable easy pull or push.

Brass flush bolts shall be satin or bright polished. Alternatively they may be nickel or chromium plated as specified in IS 4827 or copper oxidised in accordance with IS 1378. Aluminium flush bolts shall be anodised and the quality of the anodised finish shall not be less than grade AC 15 of IS 1868.

Note : The working of flush bolts is found satisfactory only in case of shutters made of high quality timber like teakwood properly seasoned and when there is no warping due to changes in weather

Brass flush bolts which give a more satisfactory performance are costly and uses scarce materials. Hence use of flush bolts is to be discouraged.

16.4 Floor Door Stopper



Floor Door Stopper - Cast Type

Dimensions						
Thickness of Door Shutter	A	B	C	Casting T_1	Screw Designation No.	No. of Holes For T_1
30	35.0 ± 0.5	140.0 ± 0.5	13	4.5 $^{+0.3}_{-0}$	9	4
35	40.0 ± 0.5	140.0 ± 0.5	8	4.5 $^{+0.3}_{-0}$	9	4
40	45 ± 0.5	150.0 ± 0.5	13	4.5 $^{+0.3}_{-0}$	9	4
45	50.0 ± 0.5	150.0 ± 0.5	8	4.5 $^{+0.3}_{-0}$	9	4

FIG: Floor Door Stopper

The floor door stopper shall conform to IS 1823. This shall be made of cast brass of overall size as specified and shall have rubber cushion. The shape and pattern of stopper shall be approved by the Engineer-in-Charge. It shall be of brass finished bright, chromium plated or oxidised or as specified. The size of floor stopper shall be determined by the length of its plate. It shall be well made and

shall have four counter sunk holes for fixing the door stoppers to the floor by means of wood screws. The body or housing of the door stopper shall be cast in one piece and it shall be fixed to the cover plate by means of brass or mild steel screws and cover plate shall be of casting or of sheet metal. The spring shall be fixed firmly to the pin. Tongue which would be pressed while closing or opening of the door shall be connected to the lower part by means of copper pin. On the extreme end a rubber piece shall be attached to absorb shock.

All parts of the door stopper shall be of good workmanship and finish, burrs and sharp edges removed. It shall be free from surface and casting defects. Aluminium stopper shall be anodised and anodic film shall not be less than grade AC-10 of IS 1868.

Sampling and Criteria for Conformity :

TABLE 16.4

Requirements for Rubber

Particulars	Requirements	Testing procedure
Relative density Max	1.3	IS 3400 (Part IX)
Hardness	60 ± 5	IS 3400 (Part II)
Change in initial hardness ageing for 24 hours at 100° ± 1° C	+5	IS 3400 (Part II)

16.5 Hanging Rubber Door Stopper

These shall be of cast brass, finished bright, chromium plated or as specified. Aluminium stopper shall be anodised and the anodic coating shall not be less than grade AC-10 of IS:1868. The size and pattern of the door stopper shall be approved by the Engineer-in-Charge. The size shall be determined by its length.

16.6 14.18.6 Casement Brass Stays (Straight Peg Type) (Fig. 16.2)

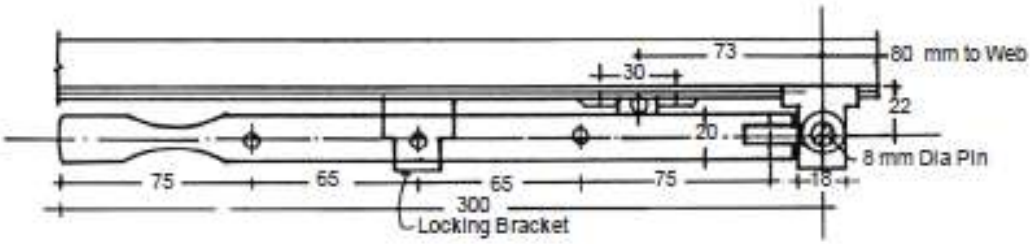


FIG: 16.2

These shall be made of mild steel, cast brass, aluminium (extruded section) or plastic

(Polypropylene) as specified. Mild steel casement stays shall be a copper oxidised(black finish) or as specified. Cast brass stays shall be finished bright or chromium plated or as specified. Aluminium stays shall be anodised and the anodic coating shall not be less than grade AC-10 of IS 1868. Aluminium and M.S. stays shall be made from channel section. The stays shall not weigh less than that indicated below :

200 mm 0.24 kg each

250 mm 0.28 kg each

300 mm 0.33 kg each

The shape and pattern of the stays shall be approved by the Engineer-in-Charge. The size of stays shall be determined by its length as shown in the plate. The plastic (Polypropylene) stays shall conform to IS 6318.

16.7 Fan Light Pivots

These shall generally conform to IS 1837. These shall be of mild steel or cast brass or Aluminium or as specified. The brass, fan light pivots shall be finished bright, chromium plated or as specified. M.S. fan light pivot shall be copper oxidized (black finish) or as specified. The base and socket plate of M.S. fan light pivots shall be made from minimum 3.0 mm M.S. sheet and the pivot shall be of round M.S. bar of minimum 10 mm diameter projecting out by minimum 12 mm length and firmly rivetted to the base plate.

The base and socket plate of cast brass fan light pivots shall be made from minimum 3.0 mm thick brass plate and the projected pivot shall not be less than 12 mm diameter and 12 mm length, cast in single piece with the base plate.

17.0 WHITE WASH WITH LIME

17.1 Scaffolding

Wherever scaffolding is necessary, it shall be erected on double supports tied together by horizontal pieces, over which scaffolding planks shall be fixed. No ballies, bamboos or planks shall rest on or touch the surface which is being white washed.

For all exposed brick work or tile work, double scaffolding having two sets of vertical supports shall be provided. The supports shall be sound and strong, tied together with horizontal pieces over which scaffolding planks shall be fixed.

Note : In case of special type of brick work, scaffolding shall be got approved from Engineer-in-Charge in advance.

Where ladders are used, pieces of old gunny bags shall be tied on their tops to avoid damage or scratches to walls.

For white washing the ceiling, proper stage scaffolding shall be erected.

17.2 Preparation of Surface

Before new work is white washed, the surface shall be thoroughly brushed free from mortar droppings and foreign matter.

In case of old work, all loose particles and scales shall be scrapped off and holes in plaster as well as patches of less than 50 cm area shall be filled up with mortar of the same mix. Where so specifically ordered by the Engineer-in-Charge, the entire surface of old white wash shall be thoroughly removed by scrapping and this shall be paid for separately. Where efflorescence is observed the deposits may be brushed clean and washed. The surface shall then be allowed to dry for at least 48 hours before white washing is done.

17.3 Preparation of Lime Wash

The lime wash shall be prepared from fresh stone white lime (Narnaul or Dehradun quality).

The lime shall be thoroughly slaked on the spot, mixed and stirred with sufficient water to make a thin cream. This shall be allowed to stand for a period of 24 hours and then shall be screened through a clean coarse cloth. 40 gm of gum dissolved in hot water, shall be added to each 10 cubic decimeter of the cream. The approximate quantity of water to be added in making the cream will be 5 litres of water to one kg of lime.

Indigo (Neel) upto 3 gm per kg of lime dissolved in water shall then be added and stirred well.

Water shall then be added at the rate of about 5 litres per kg. of lime to produce a milky solution.

17.4 Application

The white wash shall be applied with moonj brushes to the specified number of coats. The operation for each coat shall consist of a stroke of the brush given from the top downwards, another from the bottom upwards over the first stroke, and similarly one stroke horizontally from the right and another from the left before it dries.

Each coat shall be allowed to dry before the next one is applied. Further each coat shall be inspected and approved by the Engineer-in-Charge before the subsequent coat is applied. No portion of the surface shall be left out initially to be patched up later on.

For new work, three or more coats shall be applied till the surface presents a smooth and uniform finish through which the plaster does not show. The finished dry surface shall not show any signs of cracking and peeling nor shall it come off readily on the hand when rubbed.

For old work, after the surface has been prepared, a coat of white wash shall be applied over the patches and repairs. Then a single coat or two or more coats of white wash as stipulated in the description of the item shall be applied over the entire surface. The white washed surface should present a uniform finish through which the plaster patches do not appear. The washing on ceiling should be done prior to that on walls.

Note : In case of Hessian ceiling, on no account, lime shall be used as it rots cloth and hessian.

17.5 Protective Measures

Doors, windows, floors, articles of furniture etc. and such other parts of the building not to be white washed, shall be protected from being splashed upon. Splashings and droppings, if any shall be removed by the contractor at his own cost and the surfaces cleaned. Damages if any to furniture or fittings and fixtures shall be recoverable from the contractor.

17.6 Measurements

Length and breadth shall be measured correct to a cm. and area shall be calculated in sqm correct to two places of decimals.

Length and breadth shall be measured correct to a cm and its area shall be calculated in square metres correct to two places of decimal.

Thickness of the plaster shall be exclusive of the thickness of the key i.e. grooves, or open joints in brick work.

The measurement of wall plaster shall be taken between the walls or partitions (the dimensions before the plaster shall be taken) for the length and from the top of the floor or skirting to the ceiling for the height. Depth of coves or cornices if any shall be deducted.

The following shall be measured separately from wall plaster.

(a) Plaster bands 30 cm wide and under

(b) Cornice beadings and architraves or architraves moulded wholly in plaster.

(c) Circular work not exceeding 6 m in radius.

Plaster over masonry pilasters will be measured and paid for as plaster only.

A coefficient of 1.63 shall be adopted for the measurement of one side plastering on honey comb work having 6 x 10 cm. opening.

Moulded cornices and coves.

(a) Length shall be measured at the centre of the girth.

(b) Moulded cornices and coves shall be given in square metres the area being arrived at by multiplying length by the girth.

(c) Flat or weathered top to cornices when exceeding 15 cm in width shall not be included in the girth but measured with the general plaster work.

(d) Cornices which are curved in their length shall be measured separately.

Exterior plastering at a height greater than 10 m from average ground level shall be measured separately in each storey height. Patch plastering (in repairs) shall be measured as plastering new work, where the patch exceed 2.5 sqm. extra payment being made for preparing old wall, such as dismantling old plaster, raking out the joints and cleaning the surface. Where the patch does not exceed 2.5 sqm in area it shall be measured under the appropriate item under sub head 'Repairs to Buildings.'

Deductions in measurements, for opening etc. will be regulated as follows:

(a) No deduction will be made for openings or ends of joists, beams, posts, girders, steps etc. upto 0.5 sqm in area and no additions shall be made either, for the jambs, soffits and sills of such openings. The above procedure will apply to both faces of wall.

(b) Deduction for opening exceeding 0.5 sqm but not exceeding 3 sqm each shall be made for reveals, jambs, soffits sills, sills, etc. of these openings.

(i) When both faces of walls are plastered with same plaster, deductions shall be made for one face only.

(ii) When two faces of walls are plastered with different types of plaster or if one face is plastered and other is pointed or one face is plastered and other is unplastered, deduction shall be made from the plaster or pointing on the side of the frame for the doors, windows etc. on which width of reveals is less than that on the other side but no deduction shall be made on the other side.

Where width of reveals on both faces of wall are equal, deduction of 50% of area of opening on each face shall be made from area of plaster and/or pointing as the case may be.

(iii) For opening having door frame equal to or projecting beyond thickness of wall, full deduction for opening shall be made from each plastered face of wall.

(c) For opening exceeding 3 sqm in area, deduction will be made in the measurements for the full opening of the wall treatment on both faces, while at the same time, jambs, sills and soffits will be measured for payment.

In measuring jambs, sills and soffits, deduction shall not be made for the area in contact with the frame of doors, windows etc.

Corrugated surfaces shall be measured flat as fixed and the area so measured shall be increased by the following percentages to allow for the girthed area.

Corrugated asbestos cement sheet 20%

Semi corrugated asbestos cement sheet 10%

Cornices and other such wall or ceiling features, shall be measured along the girth and included in the measurements.

The number of coats of each treatment shall be stated. The item shall include removing nails, making good holes, cracks, patches etc. not exceeding 50 sq. cm. each with material similar in composition to the surface to be prepared.

Work on old treated surfaces shall be measured separately and so described.

17.7 Rate

The rate shall include all material and labour involved in all the operations described above.

18.0 DRY DISTEMPER

18.1 Materials

Dry distemper of required colour (IS 427) and of approved brand and manufacture shall be used. The shade shall be got approved from the Engineer-in-Charge before application of the distemper. The dry distemper colour as required shall be stirred slowly in clean water using 6 decilitres (0.6 litre) of water per kg of distemper or as specified by the makers. Warm water shall preferably be used. It shall be allowed to stand for at least 30 minutes (or if practicable over night) before use. The mixture shall be well stirred before and during use to maintain an even consistency.

Distemper shall not be mixed in larger quantity than is actually required for one day's work.

18.2 Preparation of Surface

Before new work is distempered, the surface shall be thoroughly brushed free from mortar droppings and other foreign matter and sand papered smooth.

New plastered surfaces shall be allowed to dry for at least two months, before applying, distemper.

In the case of old work, all those pieces and scales shall be removed by sand papering. The surface shall be cleaned of all grease, dirt, etc.

Pitting in plaster shall be made good with plaster of paris mixed with the colour to be used.

The surface shall then be rubbed down again with a fine grade sand paper and made smooth. A coat of the distemper shall be applied over the patches. The patched surface shall be allowed to dry thoroughly before the regular coat of distemper is applied.

18.3 Priming Coat

A priming coat of whiting shall be applied over the prepared surface in case of new work, if so stipulated in the description of the item. No white washing coat shall be used as a priming coat for distemper.

The treated surface be allowed to dry before distemper coat is given.

18.4 Application

In the case of new work, the treatment shall consist of a priming coat of whiting followed by the application of two or more coats of distemper till the surface shows an even colour.

Before new work is distempered, the surface shall be thoroughly brushed free from mortar droppings and other foreign matter and sand papered smooth.

New plastered surfaces shall be allowed to dry completely, before applying, distemper.

In the case of old work, all loose pieces and scales shall be removed by sand papering. The surface shall be cleaned of all grease, dirt, etc.

Pitting in plaster shall be made good with plaster of paris mixed with the colour to be used.

The surface shall then be rubbed down again with a fine grade sand paper and made smooth. A coat of the distemper shall be applied over the patches. The patched surface shall be allowed to dry thoroughly before the regular coat of distemper is applied.

The application of each coat shall be as follows:

The entire surface shall be coated with the mixture uniformly, with proper distemper brushes (ordinary white wash brushed shall not be allowed) in horizontal strokes followed immediately by vertical ones which together shall constitute one coat.

The subsequent coats shall be applied only after the previous coat has dried.

The finished surface shall be even and uniform and shall show no brush marks.

Enough distemper shall be mixed to finish one room at a time. The application of a coat in each room shall be finished in one operation and no work shall be started in any room, which cannot be completed the same day.

After each day's work, the brushes shall be washed in hot water and hung down to dry. Old brushes which are dirty or caked with distemper shall not be used.

The specifications in respect of scaffolding, protective measures, measurements and rate shall be as described in Plastering Chapter.

19.0 OIL EMULSION (OIL BOUND) WASHABLE DISTEMPERING

19.1 Materials

Oil emulsion (Oil Bound) washable distemper (IS : 428) of approved brand and manufacture shall be used. The primer where used as on new work shall be cement primer or distemper primer as described in the item. These shall be of the same manufacture as distemper. The distemper shall be diluted with water or any other prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of distemper required for day's work shall be prepared.

The distemper and primer shall be brought by the contractor in sealed tins in sufficient quantities at a time to suffice for a fortnight's work, and the same shall be kept in the joint custody of the contractor and the Engineer-in-Charge. The empty tins shall not be removed from the site of work, till this item of work has been completed and passed by the Engineer-in-Charge.

19.2 Preparation of the Surface

For new work the surface shall be thoroughly cleaned of dust, old white or colour wash by washing and scrubbing. The surface shall then be allowed to dry for at least 48 hours. It shall then be sand papered to give a smooth and even surface. Any unevenness shall be made good by applying putty, made of plaster of pairs mixed with water on the entire surface including filling up the undulations and then sand papering the same after it is dry.

In the case of old work, all loose pieces and scales shall be removed by sand papering. The surface shall be cleaned of all grease, dirt etc.

Pitting in plaster shall be made good with plaster of paris mixed with the colour to be used. The surface shall then be rubbed down again with a fine grade sand paper and made smooth. A coat of the distemper shall be applied over the patches. The patched surface shall be allowed to dry thoroughly before the regular coat of distemper is applied.

19.3 Application

19.4 Priming Coat :

The priming coat shall be with distemper primer or cement primer, as required in the description of the item. The application of the distemper primer shall be as described in Painting Chapter.

Note : If the wall surface plaster has not dried completely, cement primer shall be applied before distempering the walls. But if distempering is done after the wall surface is dried completely, distemper primer shall be applied.

Oil bound distemper is not recommended to be applied, within six months of the completion of wall plaster. However, newly plastered surfaces if required to be distempered before a period of six months shall be given a coat of alkali resistant priming paint conforming to IS 109 and allowed to dry for at least 48 hours before distempering is commenced.

For old work no primer coat is necessary.

19.5 Distemper Coat :

For new work, after the primer coat has dried for at least 48 hours, the surface shall be lightly sand papered to make it smooth for receiving the distemper, taking care not to rub out the priming coat. All loose particles shall be dusted off after rubbing. One coat of distemper properly diluted with thinner (water or other liquid as stipulated by the manufacturer) shall be applied with brushes in horizontal strokes followed immediately by vertical ones which together constitute one coat.

The subsequent coats shall be applied in the same way. Two or more coats of distemper as are found necessary shall be applied over the primer coat to obtain an even shade.

A time interval of at least 24 hours shall be allowed between successive coats to permit proper drying of the preceding coat.

For old work the distemper shall be applied over the prepared surface in the same manner as in new work. One or more coats of distemper as are found necessary shall be applied to obtain an even and uniform shade.

15 cm double bristled distemper brushes shall be used. After each days work, brushes shall be thoroughly washed in hot water with soap solution and hung down to dry. Old brushes which are dirty and caked with distemper shall not be used on the work.

The specifications in respect of scaffolding, protective measures and measurements shall be as described in Painting Chapter.

19.6 Rate

The rate shall include the cost of all labour and materials involved in all the above operations

20.0 CEMENT PAINT

20.1 Material

The cement paint shall be (conforming to IS 5410) of approved brand and manufacture.

The cement paint shall be brought to the site of work by the contractor in its original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnight's work. The materials shall be kept in the joint custody of the Contractor and the Engineer-in-Charge. The empties shall not be removed from the site of work till the relevant item of the work has been completed and permission obtained from the Engineer-in-Charge.

20.2 Preparation of Surface

For New Work, the surface shall be thoroughly cleaned of all mortar dropping, dirt dust, algae, grease and other foreign matter by brushing and washing. Pitting in plaster shall be made good and a coat of water proof cement paint shall be applied over patches after wetting them thoroughly.

20.3 Preparation of Mix

Cement paint shall be mixed in such quantities as can be used up within an hour of its mixing as otherwise the mixture will set and thicken, affecting flow and finish. Cement paint shall be mixed with water in two stages. The first stage shall comprise of 2 parts of cement paint and one part of water stirred thoroughly and allowed to stand for 5 minutes. Care shall be taken to add the cement paint gradually to the water and not vice versa. The second stage shall comprise of adding further one part of water to the mix and stirring thoroughly to obtain a liquid of workable and uniform consistency. In all cases the manufacturer's instructions shall be followed meticulously.

The lids of cement paint drums shall be kept tightly closed when not in use, as by exposure to atmosphere the cement paint rapidly becomes air set due to its hygroscopic qualities.

In case of cement paint brought in gunny bags, once the bag is opened, the contents should be consumed in full on the day of its opening. If the same is not likely to be consumed in full, the balance quantity should be transferred and preserved in an airtight container to avoid its exposure to atmosphere.

20.4 Application

The solution shall be applied on the clean and wetted surface with brushes or spraying machine. The solution shall be kept well stirred during the period of application. It shall be applied on the surface which is on the shady side of the building so that the direct heat of the sun on the surface is avoided. The method of

application of cement paint shall be as per manufacturer's specification. The completed surface shall be watered after the day's work.

The second coat shall be applied after the first coat has been set for at least 24 hours. Before application of the second or subsequent coats, the surface of the previous coat shall not be wetted.

For new work, the surface shall be treated with three or more coats of water proof cement paint as found necessary to get a uniform shade.

For old work, the treatment shall be with one or more coats as found necessary to get a uniform shade.

20.5 Precaution

Water proof cement paint shall not be applied on surfaces already treated with white wash, colour wash, distemper dry or oil bound, varnishes, paints etc. It shall not be applied on gypsums, wood and metal surfaces.

The specifications in respect of scaffolding, protective measures, measurements and rate shall be as described under SP-BLD-PN-07. The coefficient for cement paint on RCC Jalli shall be the same as provided in SP-BLD-PN-07 for painting trellis for Jaffri work.

21.0 PAINTING READY MIXED PAINT OVER G.S. SHEETS

Ready mixed paint, suitable for painting over G.S. sheets, of approved brand and manufacture and of the required shade shall be used. New or weathered G.S. sheets shall be painted with a priming coat of one coat of redoxide zinc chromate paint. Primer shall be applied before fixing sheets in place.

21.1 Preparation of Surface

21.2 Painting New Surface :

The painting of new G.S. sheets shall not usually be done till the sheets have weathered for about a year. When new sheets are to be painted before they have weathered they shall be treated with a mordant solution prepared by mixing 38 gm of copper acetate in a litre of soft water or 13 gm hydrochloric acid in a solution of 13 gm each of copper chloride, copper nitrate and ammonium chloride dissolved in a litre of soft water. This quantity of solution is sufficient for about 235 sqm. to 280 sqm of area and is applied for ensuring proper adhesion of paint. The painting with the mordant solution will be paid for separately.

Before painting on new or weathered G.S. sheets, rust patches shall be completely cleaned with coarse emery paper and brush. All grease marks shall also be removed and the surface washed and dried and rusted surface shall be touched with readymixed paint of red lead.

21.3 Painting Old Surface :

If the old paint is firm and sound, it shall be cleaned of grease, smoke etc. The surface shall then be rubbed down with sand paper and dusted. Rusty patches shall be cleaned up and touched with red lead.

If the old paint is blistered and flaked, it shall be completely removed as described in SP-BLD-PN-07. Such removal shall be paid for separately and painting shall be treated as on new work.

21.4 Application

The number of coats to be applied shall be as in the description of item. In the case of C.G.S. sheets, the crowns of the corrugations shall be painted first and when these get dried the general coat shall be given to ensure uniform finish over the entire surface without the crowns showing signs of thinning.

The second or additional coats shall be applied when the previous coat has dried.

The specifications described in SP-BLD-PN-07 shall hold good so far as they are applicable.

22.0 PAINTING CAST IRON RAIN WATER, SOIL, WASTE AND VENT PIPES AND FITTINGS

The primer shall be prepared on site or shall be of approved brand and manufacture as specified in the item.

Paint shall be anti-corrosive bitumastic paint aluminium paint or other type of paint as specified in the description of the item.

22.1 Painting New Surface

22.1.1 Preparation of Surface :

The surface shall be prepared for priming coat as described in SP-BLD-PN-07

22.1.2 **Application :** The number of coat of painting over the priming coat shall be as stipulated in the description of the item. The application of paint over priming coat shall be carried out as specified in SP-BLD-PN-07.

22.1.3 **Measurements :** Measurements will be taken over the finished line of pipe including specials etc. in running metres, correct to a cm.

Pipes of different diameters of bore shall be measured and paid for separately.

Specials and fittings such as holder bat clamps, plugs etc. will not be measured separately.

22.1.4 **Rate :** The rate shall include the cost of all materials and labour involved in all the operations described above, including painting of all specials and fittings.

Specifications described in SP-BLD-PN-07 shall hold good as far as they are applicable.

22.2 Painting on Old Surface

The surface shall be prepared as specified in SP-BLD-PN-07.

The specifications for application shall be as described in SP-BLD-PN-07.

Measurements, rate and other details shall be as specified in SP-BLD-PN-07.

22.3 PAINTING WITH WOOD PRESERVATIVE

Oil type wood preservative of specified quality and approved make, conforming to IS 218 shall be used. Generally, it shall be creosote oil type-I or anthracene oil.

22.4 Painting on New Surface

22.4.1 Preparation of Surface :

Painting shall be done only when the surface is perfectly dry to permit of good absorption. All dirt, dust or other foreign matter shall be removed from the surface to be painted. All roughness shall be sand papered and cleaned.

22.4.2 Application :

The preservative shall be applied liberally with a stout brush and not daubed with rags or cotton waste. It shall be applied with a pencil brush at the joints of the wood work. The first coat shall be allowed at least 24 hours to soak in before the second (the final) coat is applied. The second coat shall be applied in the same manner as the first coat. The excess of preservative which does not soak into the wood shall be wiped off with a clean dry piece of cloth.

The specifications described in SP-BLD-PN-07 shall hold good in so far as they are applicable.

22.5 Painting on Old Surface

The work shall be done in the same manner as on new surface except that only one coat shall be done.

23.0 WALL PAINTING WITH PLASTIC EMULSION PAINT

The plastic emulsion paint is not suitable for application on external, wood and iron surface and surfaces which are liable to heavy condensation. These paints are to be used on internal surfaces except wooden and steel.

Plastic emulsion paint as per IS 5411 of approved brand and manufacture and of the required shade shall be used.

23.1 Painting on New Surface

The wall surface shall be prepared as specified in SP-BLD-PN-07.

23.1.1 **Application :**

The number of coats shall be as stipulated in the item. The paint will be applied in the usual manner with brush, spray or roller. The paint dries by evaporation of the water content and as soon as the water has evaporated the film gets hard and the next coat can be applied. The time of drying varies from one hour on absorbent surfaces to 2 to 3 hours on non-absorbent surfaces.

The thinning of emulsion is to be done with water and not with turpentine. Thinning with water will be particularly required for the under coat which is applied on the absorbent surface. The quantity of water to be added shall be as per manufacturer's instructions.

The surface on finishing shall present a flat velvety smooth finish. If necessary more coats will be applied till the surface presents a uniform appearance.

23.1.2 Precautions

(a) Old brushes if they are to be used with emulsion paints, should be completely dried of turpentine or oil paints by washing in warm soap water.

Brushes should be quickly washed in water immediately after use and kept immersed in water during break periods to prevent the paint from hardening on the brush.

(b) In the preparation of wall for plastic emulsion painting, no oil base putties shall be used in filling cracks, holes etc.

(c) Splashes on floors etc. shall be cleaned out without delay as they will be difficult to remove after hardening.

(d) Washing of surfaces treated with emulsion paints shall not be done within 3 to 4 weeks of application.

Other details shall be as specified in SP-BLD-PN-07 as far as they are applicable.

23.2 Painting on Old Surface

23.2.1 **Preparation of Surface :** This shall be done, generally as specified in SP-BLD-PN-07 except that the surface before application of paint shall be flattened well to get the proper flat velvety finish after painting.

23.2.2 **Application :** The number of coats to be applied shall be as in description of item.

The application shall be as specified in SP-BLD-PN-07 except that thinning with water shall not normally be required.

Other details shall be as specified in SP-BLD-PN-07 as far as applicable.

24.0 PAINTING WITH ENAMEL PAINT

Enamel Paint (conforming to IS 2933) of approved brand and manufacture and of the required colour shall be used.

For the under coat, the paint of same quality but of shade to suit that of the top coat shall be used.

Preparation of surface and application shall be as specified under SP-BLD-PN-07 for painting on new surfaces or old surfaces, as the case may be.

Other details shall be as specified in SP-BLD-PN-07 as far as applicable.

25.0 14.28 PAINTING WITH SYNTHETIC ENAMEL PAINT

Synthetic enamel paint (conforming to IS 2932) of approved brand and manufacture and of the required colour shall be used for the top coat and an undercoat of ordinary paint of shade to match the top coat as recommended by the same manufacturer as far the top coat shall be used.

25.1 Painting on New Surface

Preparation of surface shall be as specified in SP-BLD-PN-07 as the case may be.

25.1.1 **Application :** The number of coats including the undercoat shall be as stipulated in the item.

(a) Under Coat : One coat of the specified ordinary paint of shade suited to the shade of the top coat, shall be applied and allowed to dry overnight. It shall be rubbed next day with the finest grade of wet abrasive paper to ensure a smooth and even surface, free from brush marks and all loose particles dusted off.

(b) Top Coat : Top coats of synthetic enamel paint of desired shade shall be applied after the undercoat is thoroughly dry. Additional finishing coats shall be applied if found necessary to ensure properly uniform glossy surface.

Other details shall be as specified in SP-BLD-PN-07as far as they are applicable.

25.2 Painting on Old Surface

25.2.1 **Preparation of Surface :** Where the existing paint is firm and sound it shall be cleaned of grease, smoke etc. and rubbed with sand paper to remove all loose particles dusted off. All patches and cracks shall then be treated with stopping and filler prepared with the specified paint. The surface shall again be rubbed and made smooth and uniform.

If the old paint is blistered and flaked it will be necessary to completely remove the same as described in SP-BLD-PN-07. Such removal shall be paid for separately and the painting shall be treated as on new surface.

25.2.2 **Painting :** The number of coats as stipulated in the item shall be applied with synthetic enamel paint. Each coat shall be allowed to dry and rubbed down smooth with very fine wet abrasive paper, to get an even glossy surface. If however, the surface is not satisfactory additional coats as required shall be applied to get correct finish.

Other details shall be specified in SP-BLD-PN-07 as far as they are applicable.

26.0 PAINTING WITH ALUMINIUM PAINT

Aluminium paint shall be (conforming to IS 2339) of approved brand and manufacture. The paint comes in compact dual container with the paste and the medium separately.

The two shall be mixed together to proper consistency before use.

26.1 Preparation of Surface

26.1.1 **Steel Work (New Surfaces) :** All rust and scales shall be removed by scraping or brushing with steel wire brushes and then smoothened with sand paper. The surface shall be thoroughly cleaned of dust.

26.1.2 **C.G.S. Sheets (New Surfaces) :** The preparation of surface shall be as specified in SP-BLD-PN-07

Steel Work or C.G.S. Sheets (Old Surfaces): The specifications shall be as described in SP-BLD-PN-07.

26.2 Application

The number of coats to be applied shall be as given in the item. Each coat shall be allowed to dry for 24 hours and lightly rubbed down with fine grade sand paper and dusted off before the next coat is applied. The finished surface shall present an even and uniform appearance.

As aluminium paste is likely to settle in the container, care shall be taken to frequently stir the paint during used. Also the paint shall be applied and laid off quickly, as surface is otherwise not easily finished.

27.0 PAINTING WITH ANTI-CORROSIVE BITUMASTIC PAINT

Ready mixed paint (conforming to IS 158) shall be of approved brand and manufacture. It shall be black, lead free, acid-alkali-heat-water resistant.

Preparation of surface and application shall be as specified in SP-BLD-PN-07 for painting on new or old surfaces as the case may be.

The drying time between consecutive coats, however, shall be not less than 3 hours.

Other details shall be as specified in SP-BLD-PN-07 as far as applicable.

28.0 VARNISHING

Ordinary copal varnish or superior quality spray varnish shall be used. The work includes sizing of transparent wood filler.

Varnish (conforming to IS 347) for the finishing and undercoats shall be of the approved manufacturer.

28.1 Varnishing on New Surfaces

28.1.1 **Preparation of Surface :** New wood work to be varnished shall have been finished smooth with a carpenter's plane. Knots shall be cut to a slight depth. Cracks and holes shall be cleaned of dust.

The knots, cracks etc. shall then be filled in with wood putty made as follows:

On a piece of wood say 20 x 15 cm face and on the side where cross grains appear, a small quantity of glue size shall be poured and the surface scraped with the edge of a fine carpenter's chisel. Very fine wood powder shall be mixed with the glue and the stiff paste thus formed shall be used for the filling.

The fillings when dry shall be rubbed down with a carpenter's file and then the entire surface shall be rubbed down perfectly smooth with medium grained and fine sand papers and wiped with dry clean cloth so that it presents uniform appearance. In no case shall sand papers be rubbed across the grains, as in this case even the finest marks will be visible when the varnishing is applied.

28.1.2 Sizing or Transparent Wood Filler Coat : The surface shall then be treated with either glue sizing or with transparent wood filler coat as stipulated in the description of item.

(a) Sizing : When sizing is stipulated, an application of thin clean size shall be applied hot on the surface.

When dry, the surface shall be rubbed down smooth with sand paper and cleaned. It shall then be given another application of glue size nearly cold. The sized wood work shall again be rubbed down smoothly with fine sand paper and cleaned. The

surface shall be perfectly dry and all dust shall be removed not only from the surface but also from the edges and joints before varnishing is commenced. If the wood work is to be stained, the staining colour shall be mixed with the second coat of the size which must be applied evenly and quickly keeping the colour on the flow.

Any joining up with work already dry will show badly. The object of application of the glue size is to seal the pores in wood to prevent absorption of the oil in the varnish.

Glue sizing is inadvisable on floors, table tops and other horizontal surfaces likely to carry wet household untensils which are likely to disturb the size coatings and thus expose bare wood.

Where glue sizing is omitted to be done the rate for the work shall be suitably reduced.

(b) Transparent Wood Filler Coat : Where instead of glue sizing, transparent wood filler application is stipulated in the item, then the surface prepared as described in SP-BLD-PN-07 shall be given as application of the filler with brush or rag in such a way that the filler fills up all the pores and indentations and levels up the surface. It shall be allowed to dry for 24 hours. Then it shall be cut and rubbed with emery paper so that the surface of the wood is laid bare, with the filler only in the pores and crevices of the wood.

28.1.3 **Application of Varnish :** The number of coats to be applied shall be as stipulated in the description of the item.

The undercoat shall be with a flatting varnish. This dries hard and brittle and when cut and rubbed down to produce a smooth surface enhances the gloss of the finishing varnish. The top coat shall be given with stipulated brand of finishing varnish.

The varnish shall be applied liberally with a full brush and spread evenly with short light strokes to avoid frothing. If the work is vertical the varnish shall be crossed and recrossed and then laid off, latter being finished on the upstrokes so that varnish, as it sets, flows down and eliminates brush marks, the above process will constitute one coat. If the surface is horizontal, varnish shall be worked in every direction, with light quick strokes and finish in one definite direction so that it will set without showing brush marks, in handling and applying varnish care should be taken to avoid forming froth or air bubbles.

Brushes and containers shall be kept scrupulously clean.

Rubbing down and flatting the surface shall be done after each coat except the final coat with fine sand paper.

The work shall be allowed to dry away from droughts and damp air. The finished surface shall then present a uniform appearance and fine glossy surface free from streaks, blister etc.

Any varnish left over in the small container shall not be poured back into the stock tin, as it will render the latter unite unfit for use.

Special fine haired varnishing brushes shall be used and not ordinary paint brushes. Brushes shall be well worn and perfectly clean.

Other details shall be as specified in SP-BLD-PN-07 as far as they are applicable.

28.2 Varnishing on Old Surface

28.2.1 **Preparation of Surface :** If the old varnished surface is firm and sound it shall be cleaned of grease and dirt with turpentine and then rubbed with wet sand paper until the surface is clean and smooth. It shall be dried and wiped clean with a soft cloth. Knots, holes and cracks shall be stopped as specified in SP-BLD-PN-07. The entire surface shall then be rubbed down smooth with sand paper and wiped clean.

If the old varnished surface is peeled or cracked then it will be necessary to remove the entire varnish as described in para SP-BLD-PN-07 and such removal shall be paid for separately outside the rate for varnishing. Further the varnishing itself will have to be done like new work and will be paid for as such.

28.2.2 **Application :** The specification shall be same as described in SP-BLD-PN-07 as far as applicable except that the coats to be applied will be with the stipulated quality of varnish for finishing coat.

Other details shall be as specified in SP-BLD-PN-07 far as they are applicable.

29.0 LETTERING WITH PAINT

Black, Japan paint (conforming to IS 341) or ready mixed paint as ordered by the Engineer-in- Charge shall be used. The paint shall be of approved brand and manufacture. Ordinary ready mixed paint shall be of the shade required by the Engineer-in-Charge.

29.1 Lettering on New Surface

29.1.1 **Application :** The letters and figures shall be to the heights and width as ordered by the Engineer-in-Charge. These shall be stenciled or drawn in pencil and got approved before painting. They shall be of uniform size and finished neatly. The edges shall be straight or in pleasant smooth curves.

The thickness of the lettering shall be as approved by the Engineer-in-Charge. Lettering shall be vertical or slanting as required.

Two or more coats or paint shall be applied till uniform colour and glossy finish are obtained.

29.1.2 **Measurements :** Measurements shall be taken in terms of letter cm (the measurement relates to the vertical height of the lettering). The letter heights shall be measured correct to a cm.

Dots, dashes, punctuations and other similar marks or lines shall not be measured for payment.

In Devanagari Script Dots & Matras occurring with the letters shall not be measured. Half letter shall be measured as full letter. The height of letters shall be measured excluding the Matras projecting above the heading and matras below the letters.

29.1.3 **Rate :** Rate shall include the cost of all labour and materials involved in the operations described above. The rate per cm height of letter shall hold good irrespective of the width of the letters or figures or the thickness of the lettering.

The same rate will apply irrespective of whether black Japan or ready mixed paint of any shade as required is used.

29.2 Relettering on Old Surface

Painting shall be done over the existing letters and shall accurately follow their lines and curves.

One or more coat of paints shall be applied till a uniform colour and glossy finish is obtained.

29.2.1 **Measurements :**

Measurements shall be taken in terms of letter cm (the measurement relates to the vertical height of the lettering). The letter heights shall be measured correct to a cm.

Dots, dashes, punctuations and other similar marks or lines shall not be measured for payment.

In Devanagari Script Dots & Matras occurring with the letters shall not be measured. Half letter shall be measured as full letter. The height of letters shall be measured excluding the Matras projecting above the heading and matras below the letters.

29.2.2 **Rate :**

Rate shall include the cost of all labour and materials involved in the operations described above. The rate per cm height of letter shall hold good irrespective of the width of the letters or figures or the thickness of the lettering.

The same rate will apply irrespective of whether black Japan or ready mixed Paint of any shade as required is used

30.0 DOUBLE SCAFFOLDING

Specifications are same as described in Concrete Chapter.

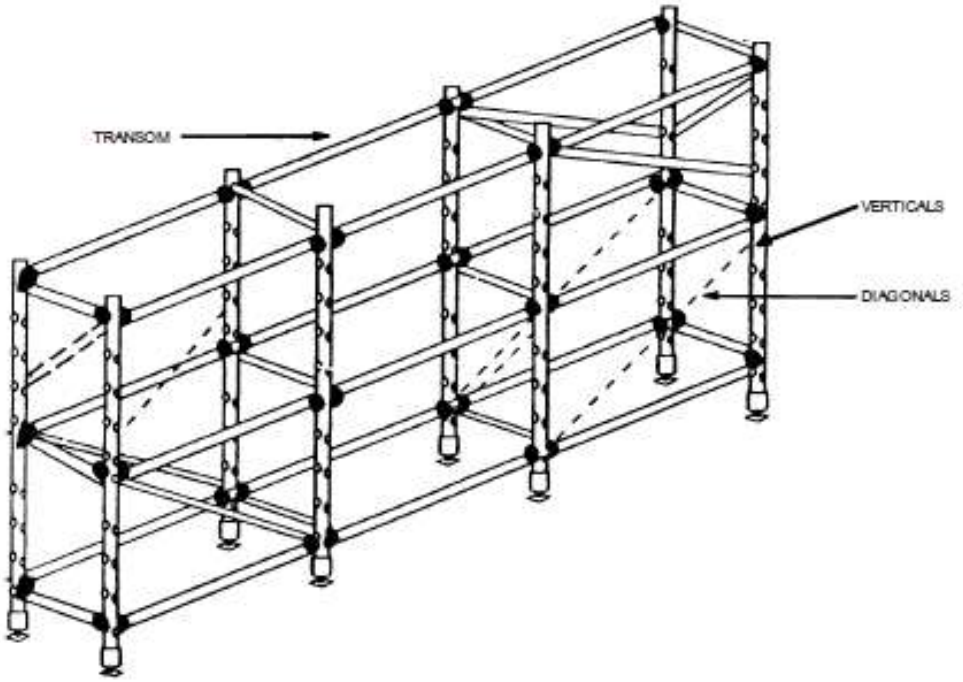
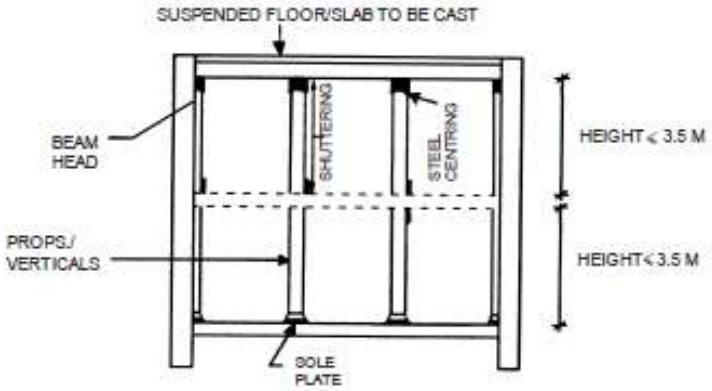


FIG:30.1

31.0 MULTI STAGE SHUTTERING

Specifications are same as described in Concrete Chapter.



SUSPENDED FLOOR-MULTI STAGE SHUTTERING (VERTICAL SECTION)

FIG:30.2

32.0 JOGGING TRACK (EPDM GRANULES METHOD)

32.1.1 **Material:** 2 layered, water permeable all-weather surface made of structural sprayed polyurethane layer on an in-situ polyurethane bonded rubber granulate sub-base.

Thickness :14 mm (12mm SBR Base Layer + 2mm Spray Coat top with EPDM Granules)

Colour :Terracotta

32.1.2 **System properties:**

The system should be IAAF certified system and should fulfil the Athlete surface interaction & System Properties of the Sports Surface:

- Vertical Ball Rebounce (prEN 12235 – DIN 18032) - > 98%
- Compression set (ASTM D-395-B) - 1.9 %
- Compression strength - > 4 N/mm (> 4 Mpa)
- Impact Resistance (EN 1517-1999) - > 8 Nm
- Resistance against static load (24 hours) - 15 kg/cm
- Behavior under a rolling load (EN 1569:1999) - > 1500 N
- Tensile strength - 0.62 MPa .. 0.72 MPa
- Elongation at break (IAAF requirement > 40 %) - > 75 %
- Spike resistance test DIN 18035 part 6 - class 1
- Sliding behavior (leather) sliding friction index dry - 0.97
- Sliding friction index wet - 0.73
- Shock absorption depending on layer thickness (9 to 16 mm) - from 30 % . . . 41 %
- Standard vertical deformation - from 0.9 mm . . . 1.4 mm
- Resistance to Fire (DIN 51960) - not flammable - class 1

32.1.3 **Preparation of Surface**: For installing the above Jogging Track, our subfloor requirement is as follows :

- Sub Base: We need a proper leveled, strong and uniform PCC sub-base duly cured for 4 weeks (in case of a new surface).
- Drain Slope: The sub floor should have a slope of 1: 100. Proper drain outlets to be provided for water to be drained out.
- Skirting – The height of skirting edge should be 14mm on both the sides of the Jogging Track. A 14mm step to be provided through civil work or through granite / stone edge. If the track is kept open ended, it tends to get damaged on the sides. Hence, to provide proper protection, we need 14mm skirting for the track.

32.1.4 **Application :** The polyurethane layer are extremely easy to install. One only needs to take a few simple things into consideration.

- The layer is laid out on any smooth, pre-prepared IPS/PCC surface.
- The sub-floor must be cleaned of all paint, polish, wax, oil, grease and other dust and dirt particles, prior to installation.
- Small cracks, structural joints, depressions, rough areas and uneven sections of the sub-floor must be repaired using suitable fillers, prior to installation.
- All protuberances and bulges on the sub-floor need to be leveled by sanding.
- After installation, the surface should be free of moisture or liquids for a minimum of 24 hours.
- Installation cannot be carried out during monsoon due to wet weather.

33.0 JOGGING TRACK (CONVENTIONAL METHOD)

33.1.1 **Material:**

1) Murum- Considering-60% of total filling qty.=(20M x 2M x0.20Mx0.6)

2) Brick Bats- Considering-40% of total filling qty.=(20M x 2M x0.20Mx0.4)

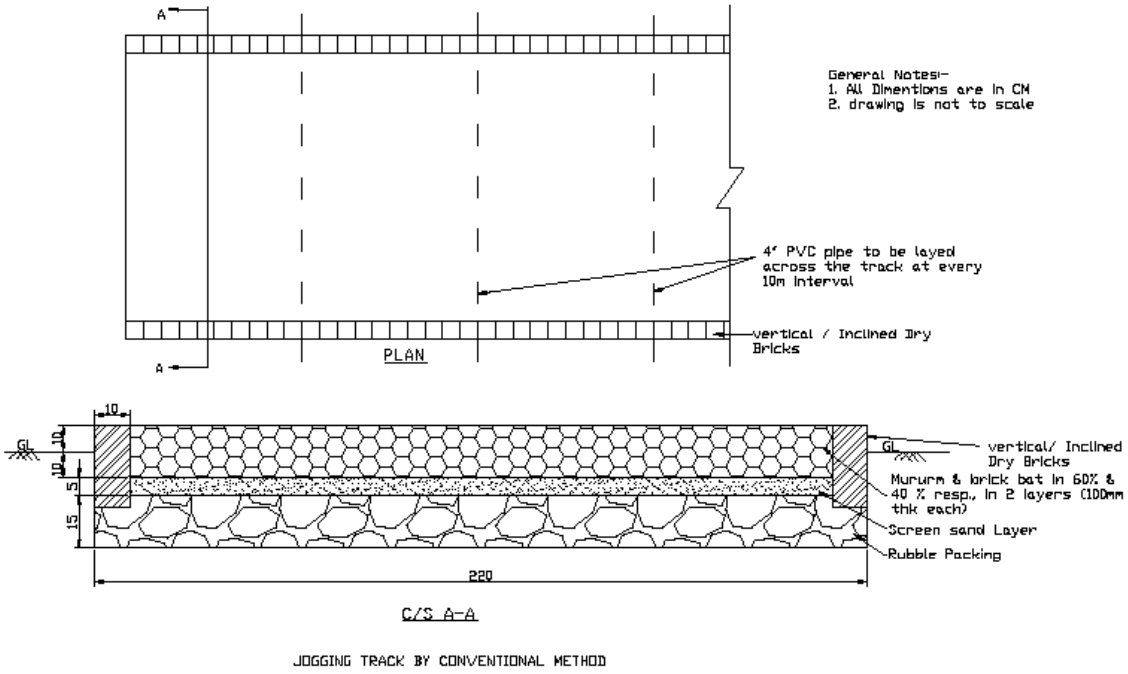
3) Screened sand- Considering 50 mm screened sand filling-(20Mx2Mx0.05)

4) Bricks- Considering laying of Dry Masonary both sides

33.1.2 **Preparation of Surface**:

Conventional method track is provided & layed by murum & brick bats in proportion (60%+ 40%) by volume resp. consolidated together to the total finished thk. 200 mm & rolling 100 mm layer in two stages with power roller weighing not less than 3 tonnes including excavation upto 300mm depth & laying of dry rubble stone packing150mm thk. as base course,hand set in regular lines, interstices being filled with small pices of stones, throughly rammed, layer of 50mm screened sand above soling, consolidated

and watered complete by protecting the track surface at edges on both sides by providing vertical or inclined dry bricks as directed by engineer including 4" dia. PVC pipe to be laid across the track at every 10 Mtr. intervals etc. complete.

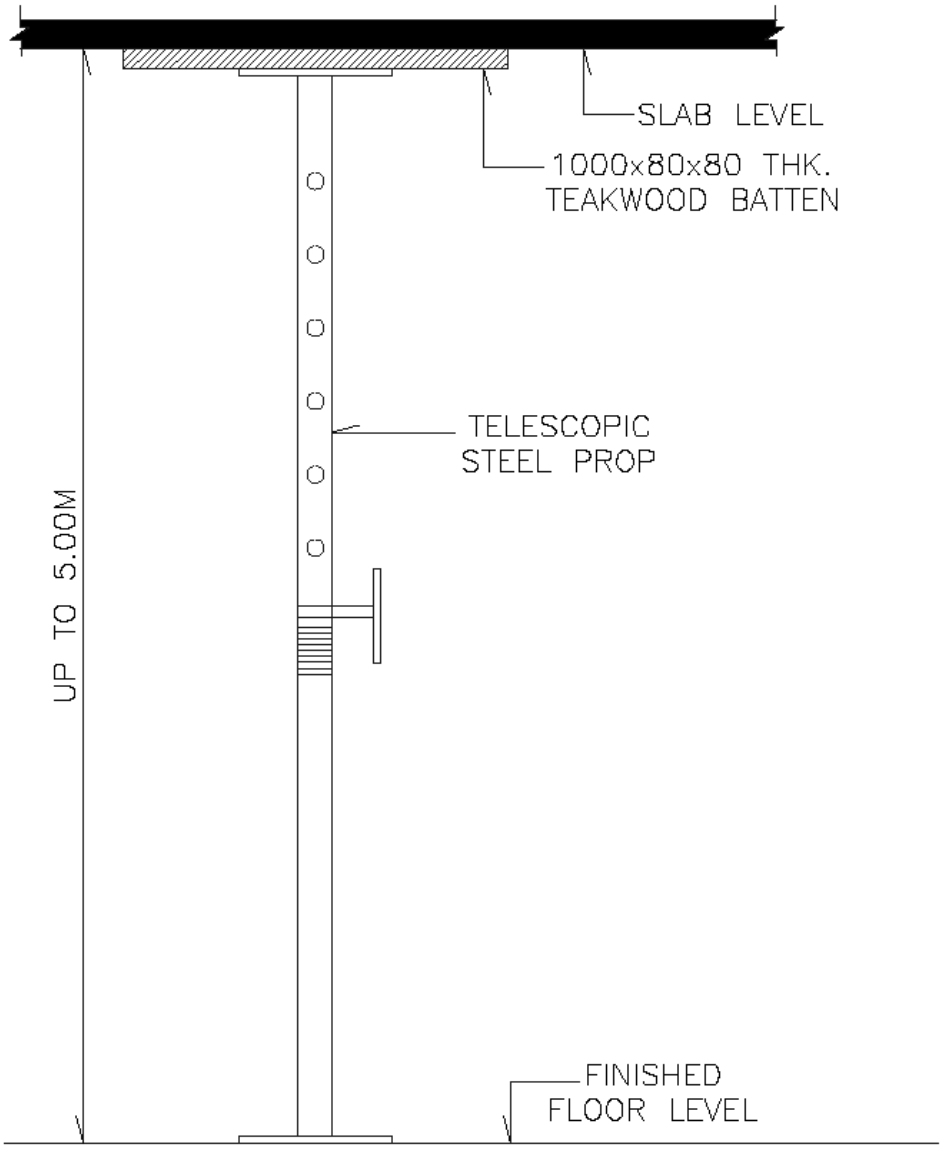


JOGGING TRACK BY CONVENTIONAL METHOD

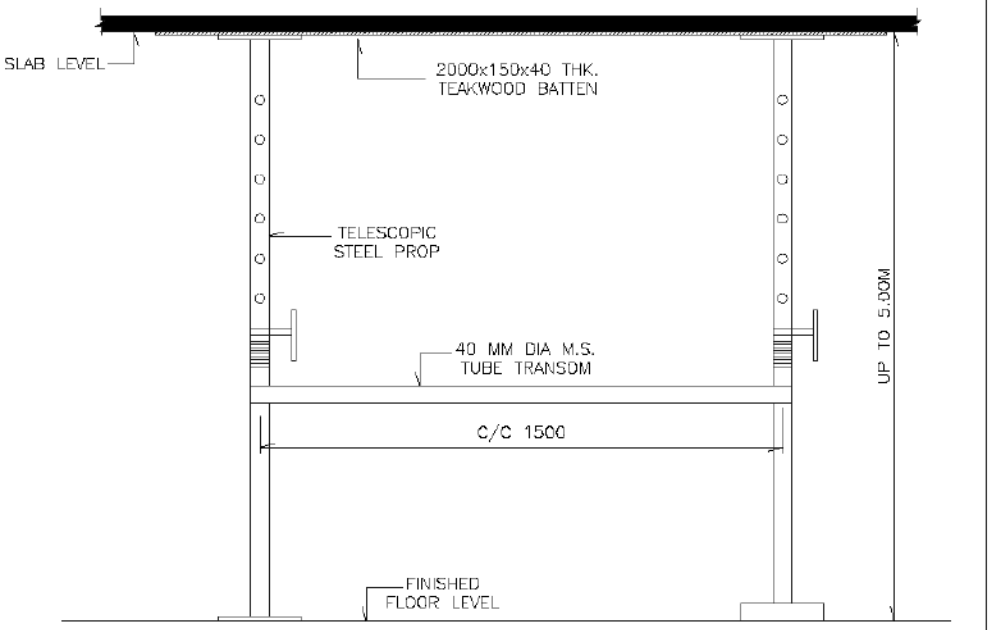
34.0 **PROPPING**

Specifications are same as described in Concrete Chapter.

Note: No timber props and transom shall be used as replacement for steel props.



SINGLE TELESCOPIC STEEL PROP



DOUBLE TELESCOPIC STEEL PROP

Chapter -19

Conservation of Heritage Structures

CONSERVATION OF HERITAGE STRUCTURES

1.0 SCOPE

This Specification covers the general requirements for conservation of heritage structures including requirements in regard to the quality, handling, storage of ingredients, proportioning, batching, mixing, transporting, placing, curing, protecting, repairing, finishing and testing ; formwork; requirements in regard to the quality, storage, bending and fixing of reinforcement; grouting as well as mode of measurement and payment for completed works.

It shall be very clearly understood that the specifications given herein are brief and do not cover minute details. However, all works shall have to be carried out in accordance with the relevant standards and codes of practices or in their absence in accordance with the best accepted current engineering practices or as directed by Engineer- in charge from time to time. The decision of Engineer –in-charge as regards the specification to be adopted and their interpretation and the mode of execution of work shall be final and binding on CONTRACTOR and no claim whatsoever will be entertained on this account.

2.0 APPLICABLE CODES AND SPECIFICATIONS

The following specifications, standards and codes, including all official amendments/revisions and other specifications & codes referred to therein, should be considered a part of this specification. In all cases the latest issue/edition/revision shall apply. In case of discrepancy between this specification and those referred to herein below or other specifications forming a part of this bid document, this specification shall govern.

2.1 MATERIALS

IS:269	-	Specification for 33 grade ordinary portland cement.
IS:455	-	Specification for portland slag cement.
IS:1489 (Parts 1 & 2)	-	Specification for portland-pozzolana cement.
IS:8112	-	Specification for 43 grade ordinary portland cement.
IS:12330	-	Specification for sulphate resisting Portland Cement.
IS:383	-	Specification for coarse and fine aggregates from natural sources for concrete.
IS:432 (Parts 1 & 2)	-	Specification for mild steel and medium tensile steel bars and hard dawn steel wires for concrete reinforcement.
IS:1786	-	Specification for high strength deformed steel bars and wires for concrete reinforcement.
IS:1566	-	Specification for hard-drawn steel wire fabric for concrete reinforcement.
IS:9103	-	Specification for admixtures for concrete.
IS:4900	-	Specification for plywood for concrete shuttering work.
IS:12269	-	Specification for 53 grade ordinary portland cement.

2.2 MATERIAL TESTING

IS:650	-	Specification for standard sand for testing of cement.
IS:2430	-	Methods for sampling of aggregates for concrete.
IS:2386- (Parts for concrete.1 to 8)		Methods of test for aggregates

IS:3025 -Methods of sampling and test (physical and chemical) water used in industry.

IS:6925 -Methods of test for determination of water soluble chlorides in concrete admixtures.

2.3 MATERIAL STORAGE

IS:4082 -Recommendations on stacking and storing of construction materials at site.

2.4 CONCRETE MIX DESIGN

IS:10262 - Recommended guidelines for concrete mix design.

SP:23 - Handbook on Concrete Mixes.(S&T)

2.5 CONCRETE TESTING

IS:1199 - Method of sampling and analysis of concrete.

IS:516 - Method of test for strength of concrete.

IS:9013 - Method of making, curing and determining compressive strength of accelerated cured concrete test specimens.

IS:8142 - Method of test for determining setting time of concrete by penetration resistance.

IS:9284 - Method of test for abrasion resistance of concrete.

IS:2770 - Methods of testing bond in reinforced concrete.

2.6 EQUIPMENT

IS:1791 -Specification for batch type concrete mixers.

IS:2438 -Specification for roller pan mixer.

IS:4925 -Specification for concrete batching and mixing plant.

IS:5892 -Specification for concrete transit mixer and agitator.

IS:7242 -Specification for concrete spreaders.

IS:2505 -General Requirements for concrete vibrators : Immersion type.

IS:2506 -General Requirements for screed board concrete vibrators.

IS:2514 -Specification for concrete vibrating tables.

IS:3366 -Specification for pan vibrators.

IS:4656 -Specification for form vibrators for concrete.

IS:11993 -Code of practice for use of screed board concrete vibrators.

IS:7251 -Specification for concrete finishers.

IS:2722 -Specification for portable swing weigh batchers for concrete (single and double bucket type).

IS:2750 -Specifications for steel scaffoldings.

2.7 CODES OF PRACTICE

IS:456 - Code of practice for plain and reinforced concrete.

IS:457 Code of practice for general construction of plain and reinforced concrete for dams and other massive structures.

IS:3370 -Code of practice for concrete structures for (Parts storage of liquid 1 to 4)

IS:3935 -Code of practice for composite construction.

IS:2204 -Code of practice for construction of reinforced concrete shell roof.

IS:2210 -Criteria for the design of reinforced concrete shell structures and folded plates.

IS:2502 -Code of practice for bending and fixing of bars for concrete reinforcement.

IS:5525 -Recommendation for detailing of reinforcement in reinforced concrete works.

IS:2751 -Code of practice for welding of mild steel plain and deformed bars used for reinforced concrete construction.

IS:9417 -Specification for welding cold worked bars for reinforced concrete construction.

IS:3558 -Code of practice for use of immersion vibrators for consolidating concrete.

IS:3414 -Code of practice for design and installation of joints in buildings.

IS:4326 -Code of practice for earthquake resistant construction of buildings.

IS:4014 -Code of practice for steel tubular scaffolding. (Parts 1 & 2)

2.8 CONSTRUCTION SAFETY

IS:3696 - Safety code for scaffolds and ladders.
(Parts 1 & 2)

IS:7969 - Safety code for handling and storage of building materials.

IS:8989 - Safety code for erection of concrete framed structures.

3.0 MEASUREMENT

IS:1200 - Method of measurement of building and engineering works.

4.0 GENERAL

ENGINEER shall have the right at all times to inspect all operations including the sources of materials, procurement, layout and storage of materials, the concrete batching and mixing equipment, and the quality control system. Such an inspection shall be arranged and ENGINEER's approval obtained, prior to starting of concrete work. This shall, however, not relieve CONTRACTOR of any of his responsibilities. All materials which do not conform to this specification shall be rejected.

Materials should be selected so that they can satisfy the design requirements f strength, serviceability, safety, durability and finish with due regards to the functional requirements and the environmental conditions to which the structure will be subjected. Materials complying with codes/standards shall generally be used. Other materials may be used after approval of the ENGINEER and after establishing their performance suitability based on previous data, experience or tests.

5.0 Grouting

The apparatus for mixing and placing grout shall be capable of mixing effectively and stirring the grout and forcing it into holes or grout connections in a continuous, uninterrupted flow at specified pressures. The arrangement of the grouting equipment shall be such as to provide a supply line and return line from the grout pump to the grout hole. Provision shall be made to permit continuous circulation and accurate control of grouting pressures and grout flows into the grout holes.

If, during the grouting of any hole, grout is found to flow from adjacent grout holes, those holes shall also be grouted as specified before the grout has set. Any leakage points through the concrete shall be plugged/sealed and grouting continued when the seal has set.

Grouting shall start with a cement grout with water cement ratio (by volume) of 20:1 at a pressure not exceeding 0.5 kg/cm^2. If grout is found to be readily flowing, the grout proportions can be made stiffer in steps of 5:1 upto 5:1 and finally 1:1 by volume.

Grout shall be prepared with clean potable water in a grout mixer. Cement shall conform to IS: 269. The mixing shall be continued for at least 15 minutes so that no lumps of cement are left in the mix and the whole slurry is colloidal. Only small quantities of slurry shall be mixed at a time. Preferably each batch shall contain not more than 5 kg of cement.

The grout nipples shall then be removed. The grout holes shall be properly sealed by 1:1 (Cement: sand) stiff mortar, by trodding it into the hole and then plastering the top 12 mm of the hole flush with the interior surface of the wall.

All the holes shall be so drilled and grouted so that it is possible to ascertain the intake of grout from each hole. Depending on the results of the grout intake, the Engineer-in-Charge shall decide the additional extent of drilling and grouting which shall be final and binding on the Contractor.

The grouting and sealing of the grout holes shall be taken three circular rows at a time starting from the lower elevation to the top.

All equipment required to mix and pump the grout shall be provided by the Contractor. A standby grout pump shall be kept ready at Site. Contractor shall ensure that sufficient quantity of cement is always available during the execution of the works. Grouting once started shall be done quickly and continuously.

No extra claim shall be entertained due to change in number, position and/or dimensions of the holes.

All arrangements for continued access to grout hole locations, ventilation, cleaning of Reservoir walls and other parts and safety during all operations shall be the responsibility of the Contractor. The Contractor will not be paid extra for all these works and his quoted percentage should include them.

6.0 Defining the damage area for the repair

Type of repair as mentioned in the para 1.1 shall be carried out as per the visual inspection and/ or as directed by the ENGINEER-IN-CHARGE.

The doubtful area shall be tapped with a light hammer. Any loose plaster or coating shall be removed to expose the concrete surface to be treated. In case the exposed concrete surface is found to be sound, but there is separation of plaster due to lack of bond then, the area shall be demarcated for replastering only.

In case the concrete is found damaged, the area around also shall be hammer tested and the total damaged area shall be demarcated.

7.0 Repair for cracks in the structure

The following procedure shall be adopted for repairing cracks in the structures:

Open the crack into ‘V’ groove of size 20x20 mm, cleanse and moisten.

Apply priming cum bonding coat of EPIBOND of approved make with brush to the groove surface.

Immediately, fill the groove with the non shrink grout or approved equivalent. On the exterior of the groove epoxy sealant of approvd make will be applied.

Cure the mortar for 7 days.

8.0 Specification for Structural Repairs to Jack Arch Floor System and the supporting joists

Remove all the loose concrete completely and clean the surface of the structural steel with a wire brush.

Apply Rusticide by means of cotton waste or swab to the surface of the structural steel.

After 24 hrs apply a passivating coat of Polyalk Fixoprime/ cement slurry in 1: 1.25 proportion to the chemically derusted surface of the steel.

Apply a priming cum bonding coat of Polyalk EP/ cement slurry in the proportion of 1:0.5 by weight by brush to the concrete surface.

Immediately place polymer modified mortar prepared by mixing 1kg of Polyalk EP, % kg fresh cement, 15 kg graded quartz sand and sufficient water to form a workable mix. Any other similar material approved by the Engineer in charge may be used for the operation.

Finish the surface with 1:4 cement sand and cure as usual.

If the Engineer in Charge feels that the structural steel section is damaged beyond repair, then the structural member will be replaced as directed by Engineer – in – charge.

Well designed propping arrangement approved by the Engineer- in- charge ill be provide before carrying out he repair work.

The bearing of the newly placed members shall be rammed packed.

9.0 Specification for Stone Façade Cleaning

Misting using orifice nozzle sprinklers shall be used followed by gentle brushing with soft brushes to help remove surface dirt and accretions.

Specialized stone cleaning shall be employed to remove lime wash, oil emulsion, oil based distemper and impervious coats and cementitious layers from the surface of the stone by means of chemical thinners, solvents or by chemical treatment.

Vegetation on the walls shall be removed by pulling out the root system embedded in the masonry and then applying hing, gur and hot lime formulations to arrest further growth of vegetation.

Damaged cement pointing in the joints of the stone surface shall be raked out carefully and fresh pointing matching with the colour of the surrounding stone shall

be provided. Care shall be taken to ensure clean lines and high level of workmanship.

Once the stone facade is cleaned up and the pointing is completed, the whole area shall be painted with silicon based paint to make the facade water repellant.

The decorative mouldings and cornices are intended to be cleaned up using poulticing so as to expose the actual surface and the texture of the stone which has for long been covered under multiple layers of paintings. Once cleaned these areas shall be treated with neeru finish or shall be left exposed. Cleaning shall bring to the fore intricate details of the beautiful mouldings and cornices which over the years have been covered up with multiple/ thick layers of paints.

Chapter -20

Dismantling and Demolishing Works

1.0 DISMANTLING AND DEMOLISHING WORKS

1.1 **Dismantling:** The term 'Dismantling' implies carefully separating the parts without damage and removing. This may consist of dismantling one or more parts of the building as specified or shown on the drawings.

1.2 **Demolition :** The term 'Demolition' implies breaking up. This shall consist of demolishing whole or part of work including all relevant items as specified or shown on the drawings.

This chapter refers to buildings only.

2.0 APPLICABLE CODES AND SPECIFICATIONS

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

In case of discrepancy between this specification and those referred to herein this specification shall govern.

2.1 **Measurement**

IS 1200 (Part- 18)	Method of Measurements of Building and Civil Engineering Works (Part –XVIII) Demolition and Dismantling

2.2 **Safety**

IS 4130	Demolition of Buildings–Code of Safety

3.0 SAFETY AND PRECAUTIONS

All materials obtained from dismantling or demolition shall be the property of the Government unless otherwise specified and shall be kept in safe custody until they are handed over to the Engineer in-Charge/ authorized representative.

The demolition shall always be well planned before hand and shall generally be done in reverse order of the one in which the structure was constructed. The operations shall be got approved from the Engineer-in-Charge before starting the work. Due care shall be taken to maintain the safety measures prescribed in IS 4130.

Necessary propping, shoring and or under pinning shall be provided to ensure the safety of the adjoining work or property before dismantling and demolishing is taken up and the work shall be carried out in such a way that no damage is caused to the adjoining work or property. Wherever specified, temporary enclosures or partitions and necessary scaffolding with suitable double scaffolding and proper cloth covering shall also be provided, as directed by the Engineer-in-Charge.

Necessary precautions shall be taken to keep noise and dust nuisance to the minimum. All work needs to be done under the direction of Engineer-in-Charge. Helmets, goggle, safety belts etc.should be used whenever required and as directed by the Engineer-in-Charge. The demolition work shall be proceeded with in such a way that it causes the least damage and nuisance to the adjoining building and the public.

Dismantling shall be done in a systematic manner. All materials which are likely to be damaged by dropping from a height or by demolishing roofs, masonry etc. shall be carefully removed first. Chisels and cuters may be used carefully as directed. The dismantled articles shall be removed manually or otherwise, lowered to the ground (and not thrown) and then properly stacked as directed by the Engineer-in-Charge.

Where existing fixing is done by nails, screws, bolts, rivets, etc., dismantling shall be done by taking out the fixing with proper tools and not by tearing or ripping off.

Any serviceable material, obtained during dismantling or demolition, shall be separated out and stacked properly as directed by the Engineer-in-Charge within a lead of 50 metres. All unserviceable materials, rubbish etc. shall be disposed off as directed by the Engineer-in-Charge.

The contractor shall maintain/disconnect existing services, whether temporary or permanent, where required by the Engineer-in-Charge.

No demolition work should be carried out at night especially when the building or structure to be demolished is in an inhabited area.

Screens shall be placed where necessary to prevent injuries due to falling pieces.

Water may be used to reduce dust while tearing down plaster from brick work.

Safety belts shall be used by labourers while working at higher level to prevent falling from the structure.

First-aid equipment shall be got available at all demolition works of any magnitude.

4.0 WORKMANSHIP

4.1 Roof Trusses

If a building has a pitched roof, the roof structure should be removed to wall plate level by hand method. Sufficient purlins and bracing should be retained to ensure

stability of the remaining roof trusses while each individual truss is removed progressively.

Temporary bracing should be added, where necessary, to maintain stability. The end frame opposite to the end where dismantling is commenced, or a convenient intermediate frame should be independently and securely guyed in both directions before work starts.

On no account should the bottom tie of roof trusses be cut until the principal rafters are prevented from making outward movement.

4.2 Heavy Floor Beams

Heavy bulks of timber and steel beams should be supported before cutting at the extremities and should then be lowered to a safe working place.

4.3 Jack Arches

Where tie rods are present between main supporting beams, these should not be cut until after the arch or series of arches in the floor have been removed. Particular care should be exercised and full examination of this type of structure undertaken before demolition is commenced. The floor should be demolished in strips parallel to the span of the arch. rings (at right angles to the main floor beams).

4.4 Brick Arches

Expert advice should be obtained and at all stages of the demolition, the closest supervision should be given by persons fully experienced and conversant in the type of work to ensure that the structure is stable at all times.

As much dead load as possible may be removed provided it does not interfere with the stability of the main arch rings but it should be noted that the load-carrying capacity of many old arches relies on the filling between the spandrels. On no account should the restraining influence of the abutments be removed before the dead load of the sprandrel fill and the arch rings are removed.

The normal sequence of demolition is as shown in Fig. 15.2-A, namely:

Remove spandrel in filling down to the springing line,

Remove the arch. rings and

Remove the abutment.

Special temporary support shall be provided in the case of skew bridges.

A single span arch. can be demolished by hand by cutting narrow segments progressively from each springing parallel to the span of the arch until the width of

the arch has been reduced to a minimum which can then be collapsed (see Fig. 15.2B).

Where it is impossible to allow debris to fall to the ground below, centering designed to carry the load should be erected and the arch demolished progressively. The design of the centering should make appropriate allowance for impact.

Where deliberate collapse is feasible the crown may be broken by the demolition ball method working progressively from edges to the centre (see Fig. 15.2C).

Collapse of the structure can be effected in one action by the use of explosives. Charges should be inserted into boreholes drilled in both arch and abutments. This method is the most effective for demolition of tall viaducts.

In multi-span arches before individual spans are removed, lateral restraint should be provided at the springing level. Demolition may then proceed as for a single span, care being taken to demolish the spandrels down to the springing line as the work proceeds (see Fig. 15.2D). Where explosives are used it is preferable to ensure the collapse of the whole structure in one operation to obviate the chance of leaving unstable portions standing.

5.0 CANTILEVERS (NOT PART OF A FRAMED STRUCTURE)

A cantilever type of construction depends for its stability on the super imposed structure. Canopies, cornices, staircases and balconies should be demolished or supported before the tailing down load is removed.

6.0 IN-SITU REINFORCED CONCRETE

Before commencing demolition, the nature and condition of the concrete, the condition and position of reinforcement, and the possibility of lack of continuity of reinforcement should be ascertained.

Attention should be paid to the principles of the structural design to determine which parts of the structure depend on each other to maintain overall stability.

Demolition should be commenced by removing partitions and external non-load bearing cladding. It should be noted that in some buildings the frame may rely on the panel walls for stability.

Where hard demolition methods are to be used, the following procedures should be used.

6.1.1 Reinforced Concrete Beams

For beams, a supporting rope should be attached to the beam. Then the concrete should be removed from both ends by pneumatic drill and the

reinforcement exposed. The reinforcement should then be cut in such a way as to allow the beam to be lowered under control to the floor (see Fig. 15.3A).

6.1.2 Reinforced Concrete Columns

For columns, the reinforcement should be exposed at the base after restraining wire guy ropes have been placed round the member at the top. The reinforcement should then be cut in such a way as to allow the column to be pulled down to the floor under control. (see Fig. 15.3B for sequence of operations).

6.1.3 Reinforced Concrete Walls

Reinforced concrete walls should be cut into strips and demolished as for columns (Fig. 15.3C).

7.0 MEASUREMENTS

All work shall be measured net in the decimal system, as fixed in its place, subject to the following limits, unless otherwise stated hereinafter.

Dimensions shall be measured correct to a cm.

Areas shall be worked out in sqm correct to two places of decimal.

Cubical contents shall be worked out to the nearest 0.01 cum.

Parts of work required to be dismantled and those required to be demolished shall be measured separately.

Measurements of all work except hidden work shall be taken before demolition or dismantling and no allowance for increase in bulk shall be allowed.

Specifications for deduction for voids, openings etc. shall be on the same basis as that adopted for new construction of the work.

Work executed in the following conditions shall be measured separately.

Work in or under water and/or liquid mud

Work in or under foul position.

8.0 ROOFS

Roof coverings generally including battens boarding, mats, bamboo jaffari or other subsidiary supports shall be measured in square metres except lead sheet roof covering which shall be measured in quintals (15.2.3) and stone slab roof covering which shall be measured in cubic metres.

Ridges, hips and valleys shall be girthed and included with the roof area. Corrugated or semi corrugated surfaces shall be measured flat and not girthed.

Mud phuska on roofs shall be measured in cubic metres.

Lead sheets in roofs shall be measured in quintals and hips, valleys, flashings, lining to gutter etc. shall be included in this weight.

R.B. or R.C.C. roofs shall be measured as specified in 15.3.11.

Supporting members, such as rafters, purlins, beams joists, trusses etc. of wood shall be measured in cubic metres and steel or iron sections, in quintals.

9.0 CEILING

The stripping of ceilings shall be measured in square metres.

Dismantling of supporting joists, beams, etc. shall be measured in cubic metres or in quintals as specified in 15.3.6(vi).

Height above floor level, if it exceeds 3.5 m shall be paid for separately.

10.0 FLOORING AND PAVINGS

Dismantling of floors (except concrete and brick floors) shall be measured in square metres. Supporting members, such as rafters, purlins, beams joists, trusses etc. of wood shall be measured in cubic metres and steel or iron sections, in quintals. Demolition of floors and roofs of concrete or brick shall be measured in cubic metres. Beams cantilevers or other subsidiary supports of similar materials, shall be included in the item. In measuring thickness of roofs provide with water proofing treatments with bitumen felts, the thickness of water proofing treatment shall be ignored.

11.0 CONCRETE AND BRICK ROOFS AND SUSPENDED FLOORS

Demolition of floors and roofs of concrete or brick shall be measured in cubic metres. Beams cantilevers or other subsidiary supports of similar materials, shall be included in the item. In measuring thickness of roofs provide with water proofing treatments with bitumen felts, the thickness of water proofing treatment shall be ignored.

12.0 WALLS AND PIERS

Taking down walls and independent piers or columns of brick, stone or concrete shall be measured, in cubic metres. All copings, corbels, cornices and other projections shall be included with the wall measurements.

In measuring thickness of plastered walls, the thickness of plaster shall be ignored.

Ashlar face stones, dressed stone work, pre-cast concrete articles, etc. if required to be taken down intact shall be so stated and measured separately in cubic metres.

Cleaning bricks stacking for measurements including all extra handling and removal and disposing off the rubbish as stated shall be enumerated in thousand of cleaned bricks.

Cleaning stone obtained from demolished/dismantling stone masonry of any description including ashlar facing dressed stone work, stone slabs or flagging and pre-cast concrete blocks including all extra handling and disposing off the rubbish as stated shall be measured in cubic metres of cleaned stone.

Honey comb works or cavity walls of bricks stone or concrete shall be measured as solid.

13.0 REINFORCED CONCRETE AND BRICK WORK

Reinforced concrete structures and reinforced brick roofs and walls shall be measured in cubic metres and if reinforcement is required to be salvaged, it shall be so stated.

Where reinforcement is required to be separated, scraped and cleaned, the work shall be measured separately in quintal of salvaged steel.

14.0 PARTITIONS, TRELLIS WORK ETC.

Partitions or light walls, of lath and plaster, trellis work, expanded metal, thin concrete or terracotta slabs and other similar materials including frame work if any shall be measured in square metres stating the over all thickness.

15.0 WOOD WORK

All wood work including karries average 40 sq cm or over in section, shall be measured in cubic metres, while that under 40 sq cm in section, in running metres. Ballies shall be measured in running metres. Boarding including wooden chajjas and sun shades along with supports shall be measured in square metres in its plane.

16.0 STEEL AND IRON WORK

All steel and iron work shall be measured in quintals. The weight shall be computed from standard tables unless the actual weight can readily be determined.

Riveted work, where rivets are required to be cut, shall be measured separately.

Marking of structural steel required to be re-erected shall be measured separately.

In framed steel items, the weight or any covering material or filling such as iron sheets and expanded metal shall be included in the weight of the main article unless such covering is not ordered to be taken out separately.

17.0 DOORS AND WINDOWS

Dismantling of doors, windows, clerestory windows, ventilators etc. (wood or metal) whether done separately or along with removal of wall by making recess in the wall shall be enumerated. Those exceeding 3 sqm each in area shall be measured separately. The item shall include removal of chowkhats architraves, holdfasts and other attachments. If only shutters are to be taken out it shall be measured separately.

18.0 PIPES AND SEWER LINES

Water pipe lines including rain water pipes with clamps and specials, sewer lines (salt glazed ware or concrete) etc. shall be described by their diameter and length measured in running metres inclusive of joints.

If the joints, special and fittings etc. are required to be separated, it shall be so stated and enumerated.

Pucca drains shall be measured under relevant items.

Valve cistern, public fountain platform, fire hydrants, etc. shall be enumerated.

Manholes and inspection chambers shall be enumerated stating the size and depth of manhole/inspection chamber. They shall be classified into different groups depending upon the depth, in unit of half and one metre depth. The depth of the manhole shall be the distance between the top of manhole cover and invert level of the drain.

Ventilating shafts, gully traps, flushing cisterns and other appurtenant items of work shall be enumerated.

19.0 POSTS OR STRUTS

Posts or struts (wood, steel or RCC) section including taking out embedded portion shall be measured in running metres.

20.0 FENCING WIRE MESH

Wire mesh fencing of any type with frame shall be measured in square metres.

21.0 GLAZING

Taking out any portion of serviceable glass except polished plate, from old sashes, skylights, etc. (any thickness, weight or size) raking out old putty, etc. shall be measured in square metres. Irregular circular panes shall be measured as rectangle or square enveloping the same. The width and height being measured correct to the nearest 0.5 cm.

22.0 ROAD WORK

(i) Different types of road surfaces shall be measured separately.

(ii.) Road surfaces metalling or soling (base) shall be measured in square metres.

(iii) Concrete paving shall be measured as in 8 or 9 as the case may be.

23.0 RATES

The rate shall include the cost of all labour involved and tools used in demolishing and dismantling including scaffolding. The rate shall also include the charges for separating out and stacking the serviceable material properly and disposing off unserviceable material within a distance of 50 metres.The rate shall also include for temporary shoring for the safety of portions not required to be pulled down, or of adjoining property, and providing temporary enclosures or partitions, where considered necessary.

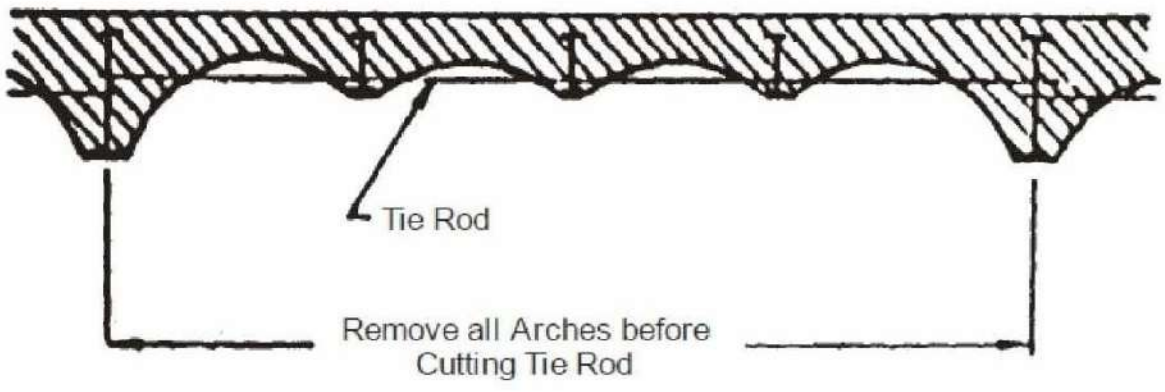


Fig. : Demolition of Jack Arches

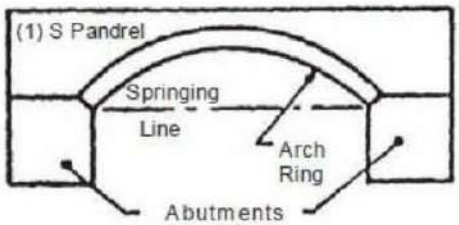


Fig. A

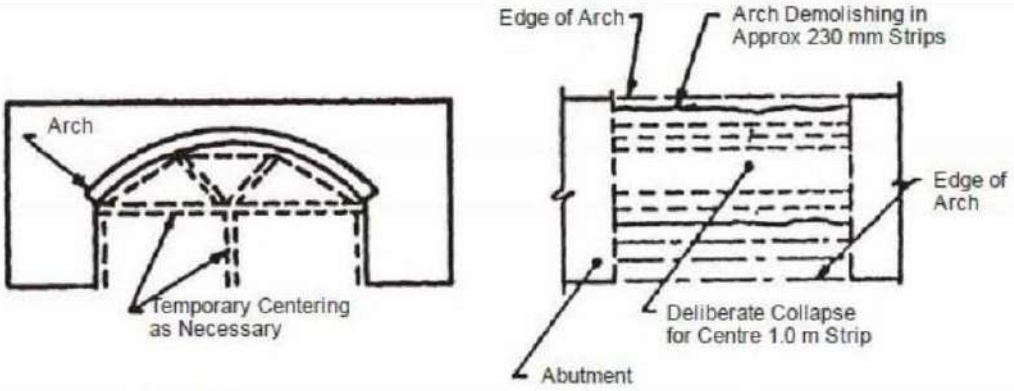


Fig. B

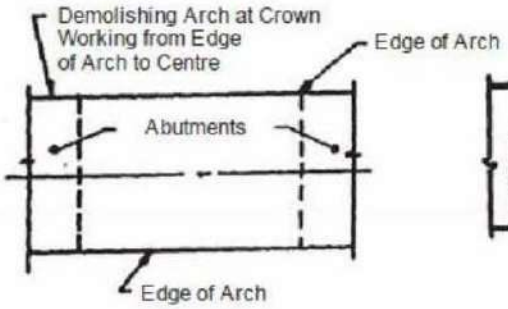


Fig. C

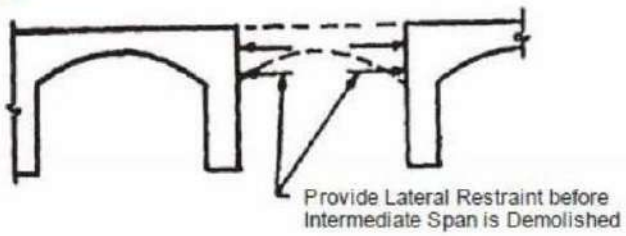
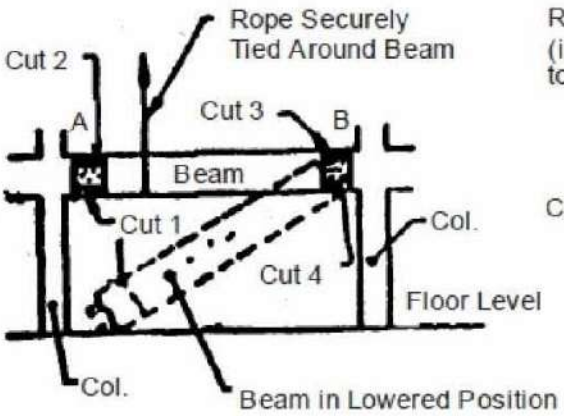


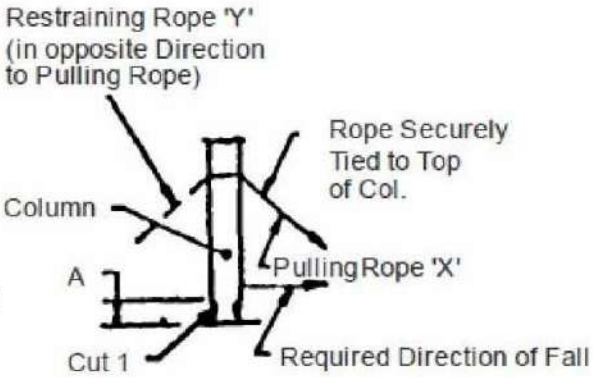
Fig. D

Note : Order of Demolition

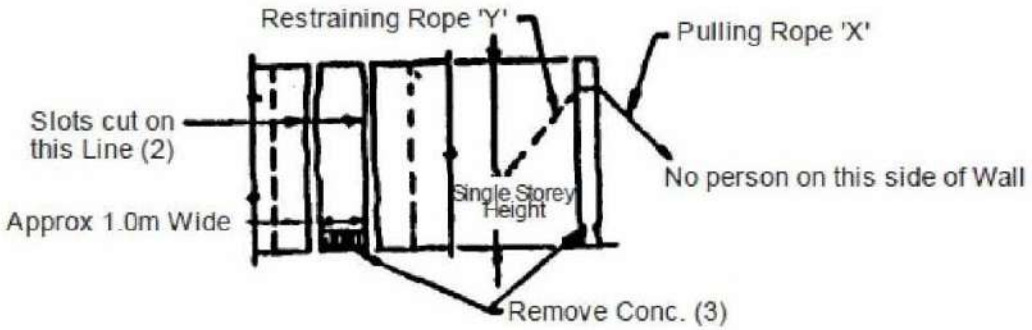
Fig. : Demolition of Masonry and Brickwork Arches



A : R.C. Beams



B : R.C. Columns



C : R.C. Walls

Fig. : Hand Demolition of In-Situ Concrete Structure

MATERIAL TESTS

Appendix-A
List of Standard Material Tests

Sr. No.	Material	Test	Test Procedure
1	**Cement**	Fineness	SP-TE-F-01
2		Soundness	SP-TE-S-02
3		Setting Time (Initial & Final)	SP-TE-ST-03
4		Consistency Test	SP-TE-C-04
5	**Sand**	Organic impurities	SP-TE-OI-05
6		Silt Content	SP-TE-SC-06
7		Particle size distribution	SP-TE-PS-07
8		Bulking of Sand	SP-TE-BS-08
9	**Stone Aggregate**	Particle size	SP-TE-PS-09
10		Surface Moisture	SP-TE-SM-10
11		Determination of 10% fine value	SP-TE-PF-11
12		Aggregate crushing strength value	SP-TE-CV-12
13		Flakiness index	SP-TE-FI-13
14		Elongation index	SP-TE-EI-14
15		Abrasion value	SP-TE-AV-15
16		Aggregate impact value	SP-TE-IV-16
17	**Concrete**	Slump test	SP-TE-ST-17
18		Cube test	SP-TE-CT-18
19		Determination of water and acid soluble chlorides in concrete	SP-TE-SC-19
20		Non Destructive test	SP-TE-AC-20
21		Compacting factor test	SP-TE-CF-21
22		Vee Bee Consistometer Test	SP-TE-VC-22
23	**Bricks and brick tiles**	Dimension Tolerance	SP-TE-DT-23
24		Compressive Strength	SP-TE-CS-24
25		Water Absorption	SP-TE-WA-25
26		Efflorescence	SP-TE-EF-26

Sr. No.	Material	Test	Test Procedure
27	**Flyash**	Physical requirements	SP-TE-FA-27
28	**Timber**	Moisture content	SP-TE-MT-28
29	**Bitumen**	Flash point and fire point	SP-TE-FP-29
30		Marshall stability	SP-TE-MS-30
31		Penetration	SP-TE-PN-31
32		Specific gravity	SP-TE-SG-32
33		Softening point	SP-TE-SF-33

1.01 TESTS ON CEMENT

1.1 FINENESS

AIM

To determine the fineness of cement by dry sieving as per IS: 4031 (Part 1) - 1996.

PRINCIPLE

The fineness of cement is measured by sieving it through a standard sieve. The proportion of cement, the grain sizes of which, is larger than the specified mesh size is thus determined.

APPARATUS

Fig1.1 IS SIEVE

i) 90mm IS Sieve

ii) Balance capable of weighing 10g to the nearest 10mg

iii) A nylon or pure bristle brush, preferably with 25 to 40mm bristle, for cleaning the sieve

PROCEDURE

i) Weigh approximately 10g of cement to the nearest 0.01g and place it on the sieve.

ii) Agitate the sieve by swirling, planetary and linear movements, until no more fine material passes through it.

iii) Weigh the residue and express its mass as a percentage R1, of the quantity first placed on the sieve to the nearest 0.1 percent.

iv) Gently brush all the fine material off the base of the sieve.

v) Repeat the whole procedure using a fresh 10g sample to obtain R2. Then calculate R as the mean of R1 and R2 as a percentage, expressed to the nearest 0.1 percent. When the results differ by more than 1 percent absolute, carry out a third sieving and calculate the mean of the three values.

REPORTING OF RESULTS

Report the value of R, to the nearest 0.1 percent, as the residue on the 90µm sieve.

1.02 SOUNDNESS

AIM

To determine the soundness of cement by Le-Chatelier method as per IS: 4031 (Part 3) - 1988.

APPARATUS

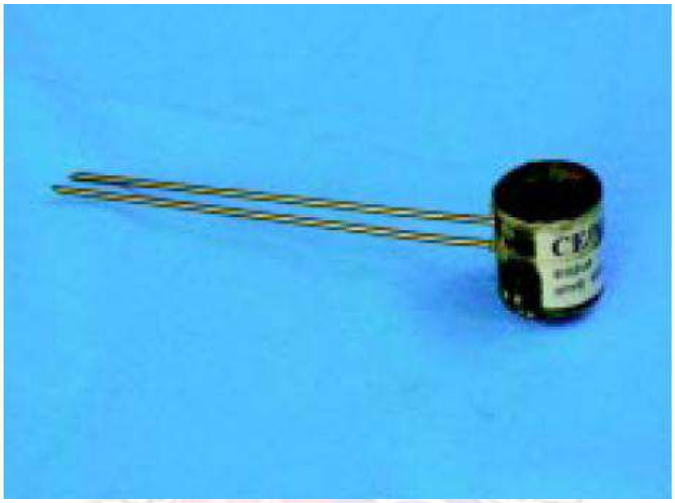


FIG. 2.1 : LE-CHATELIER'S TEST APPARATUS

i) The apparatus for conducting the Le-Chatelier test should conform to IS: 5514 - 1969

ii) Balance, whose pemissible variation at a load of 1000g should be +1.0g

iii) Water bath

PROCEDURE

i) Place the mould on a glass sheet and fill it with the cement paste formed by gauging cement with 0.78 times the water required to give a paste of standard consistency (see Para 1.2).

ii) Cover the mould with another piece of glass sheet, place a small weight on this covering glass sheet and immediately submerge the whole assembly in water at a temperature of 27 ± 2oC and keep it there for 24hrs.

iii) Measure the distance separating the indicator points to the nearest 0.5mm (say d l).

iv) Submerge the mould again in water at the temperature prescribed above. Bring the water to boiling point in 25 to 30 minutes and keep it boiling for 3hrs.

v) Remove the mould from the water, allow it to cool and measure the distance between

the indicator points (say d 2).

vi) (d 2 – d l) represents the expansion of cement.

REPORTING OF RESULTS

Calculate the mean of the two values to the nearest 0.5mm to represent the expansion of cement.

1.03 INITIAL AND FINAL SETTING TIME

AIM

To determine the initial and the final setting time of cement as per IS: 4031 (Part 5) 1988.

APPARATUS

i) Vicat apparatus conforming to IS: 5513 - 1976

ii) Balance, whose permissible variation at a load of 1000g should be +1.0g

iii) Gauging trowel conforming to IS: 10086 - 1982

PROCEDURE

i) Prepare a cement paste by gauging the cement with 0.85 times the water required to give a paste of standard consistency (see Para 1.2).

ii) Start a stop-watch, the moment water is added to the cement.

iii) Fill the Vicat mould completely with the cement paste gauged as above, the mould resting on a non-porous plate and smooth off the surface of the paste making it level with the top of the mould. The cement block thus prepared in the mould is the test block.

A) INITIAL SETTING TIME

Place the test block under the rod bearing the needle. Lower the needle gently in order to make contact with the surface of the cement paste and release quickly, allowing it to penetrate the test block. Repeat the procedure till the needle fails to pierce the test block to a point 5.0 ± 0.5mm measured from the bottom of the mould.

The time period elapsing between the time, water is added to the cement and the time, the needle fails to pierce the test block by 5.0 ± 0.5mm measured from the bottom of the mould, is the initial setting time.

B) FINAL SETTING TIME

Replace the above needle by the one with an annular attachment. The cement should be considered as finally set when, upon applying the needle gently to the surface of the test block, the needle makes an impression therein, while the attachment fails to do so. The period elapsing between the time, water is added to the cement and the time, the needle makes an impression on the surface of the test block, while the attachment fails to do so, is the final setting time.

REPORTING OF RESULTS

The results of the initial and the final setting time should be reported to the nearest five minutes.

1.04 CONSISTENCY

AIM

To determine the quantity of water required to produce a cement paste of standard consistency as per IS: 4031 (Part 4) - 1988.

PRINCIPLE

The standard consistency of a cement paste is defined as that consistency which will permit the Vicat plunger to penetrate to a point 5 to 7mm from the bottom of the Vicat mould.

APPARATUS

FIG. 4.1 : VICAT APPARATUS

i) Vicat apparatus conforming to IS: 5513 - 1976

ii) Balance, whose permissible variation at a load of 1000g should be +1.0g

iii) Gauging trowel conforming to IS: 10086 - 1982

PROCEDURE

i) Weigh approximately 400g of cement and mix it with a weighed quantity of water. The time of gauging should be between 3 to 5 minutes.

ii) Fill the Vicat mould with paste and level it with a trowel.

iii) Lower the plunger gently till it touches the cement surface.

iv) Release the plunger allowing it to sink into the paste.

v) Note the reading on the gauge.

vi) Repeat the above procedure taking fresh samples of cement and different quantities of water until the reading on the gauge is 5 to 7mm.

REPORTING OF RESULTS

Express the amount of water as a percentage of the weight of dry cement to the first place of decimal.

1.05 TEST FOR ORGANIC IMPURITIES

The aggregate must also be checked for organic impurities such as decayed vegetation humus, coal dust etc.
What is called the colour test is reliable indicator of the presence of harmful organic matter in aggregate, except in the area where there are deposits of lignite.
Fill a 350 ml clear glass medicine bottle upto 70 ml mark with a 3% solution of caustic soda or sodium hydroxide. The sand is next added gradually until the volume measured by the sandy layer is
125 ml. The volume is then made upto 200 ml by addition of more of solution. The bottle is then
stoppered and shaken vigorously and allowed to stand for 24 hours. At the end of this period, the colour of the liquid will indicate whether the sand contains a dangerous amount of matter. A colourless liquid indicates a clean sand, free from organic matter. A straw coloured solution indicates some organic matter but not enough to be seriously objectionable. Darker colour means that the sand contains injurious amounts and should not be used unless it is washed, and a retest shows that it is satisfactory.
Add 2.5 ml of two per cent solution of tannic acid in 10 per cent alcohol, to 97.5 ml of three per cent sodium hydroxide solution. Place in a 350 ml bottle, fix the stopper, shake vigorously and allow to stand for 24 hours before comparison with the solution above the sand.

Note: A three per cent solution of caustic soda is made by dissolving 3 g of sodium hydroxide in 100 ml of water, preferably distilled. The solution should be kept in a glass of bottle tightly closed with a rubber stopper. Handling sodium hydroxide with moist hands may result in serious burns. Care should be taken not to spill the solution for it is highly injurious to clothing, leather, and other materials.

1.06 TEST FOR SILT CONTENT

The sand shall not contain more than 8% of silt as determined by field test with measuring cylinder.

The method of determining silt contents by field test is given below:

A sample of sand to be tested shall be placed without drying in a 200 ml measuring cylinder. The volume of the sample shall be such that it fills the cylinder upto 100 ml mark

Clean water shall be added upto 150 ml mark. Dissolve a little salt in the water in the proportion one tea spoon to half a litre. The mixture shall be shaken vigorously, the last few shakes being sidewise direction to level off the sand and the contents allowed to settle for three hours.

The height of the silt visible as settled layer above the sand shall be expressed as a percentage of the height of sand below. The sand containing more than the above allowable percentage of silt, shall be washed so as to bring the silt contents within allowable limits.

1.07 TEST FOR PARTICLE SIZE (SIEVE ANALYSIS)

Apparatus: Perforated plate sieves of designation 10 mm, 4.75 mm and fine mesh sieve of designation
2.36 mm, 1.18 mm, 600 micron, 300 micron and 150 micron should be used.
The balance or scale shall be such that it is readable and accurate to 0.1 per cent of the weight of the test sample.

Sample: The weight of sample available shall not be less than the weight given in the table below. The sample of sieving shall be prepared from the larger sample either by quartering or by means of a sample divider.

TABLE SHOWING MINIMUM WEIGHTS FOR SAMPLING

Maximum size present in substantial proportions (mm) for	Minimum weight of sample sieving (Kg)
10	0.5
4.75	0.2
2.36	0.1

Test Procedure: The sample shall be brought to an air-dry condition before weighing and sieving. This may be achieved either by drying at room temperature or by heating at a temperature of 100 degree to 110 degree centigrade. The air dry sample shall be weighed and sieved successively on the appropriate sieves starting with the largest. Care shall be taken to ensure that the sieves are clean before use.

Each sieve shall be shaken separately over a clean tray until not more than a trace passes, but in any case for a period of not less than two minutes. The shaking shall be done with a varied motion, backwards and forwards, left to right, circular clockwise and anti-clockwise, and with frequent jarring, so that the material is kept moving over the sieve surface in frequently changing directions. Materials shall not be forced through the sieve by hand pressure, but on sieves coarser than 20 mm, placing of particles is permitted, Lumps of fine material, if present may be broken by gentle pressure with fingers against the side of the sieve. Light brushing of under side of the sieve with a soft brush may be used to clear the sieve openings.

Light brushing with a fine camel hair brush may be used on the 150 micron IS sieve to prevent segregation of powder and blinding of apertures. Stiff or worn out brushes shall not be used for this purpose and pressure shall not be applied to the surface of the sieve to force particles through the mesh.

On completion of sieving the material retained on each sieve, together with any material cleaned from the mesh, shall be weighed.

Reporting of Results: The results shall be calculated and reported as:

(a) The cumulative percentage by weight of the total sample passing each of the sieves, to the nearest whole number:
or
(b) The percentage by weight of the total sample passing one sieve and retained on the next smaller sieve, to the nearest 0.1 percent.

1.08 BULKING OF FINE AGGREGATES/SAND (FIELD METHODS)

Two methods are suggested for determining the bulking of sand/fine aggregate. The procedure may be suitably varied, if necessary. Both depend on the fact that the volume of inundated sand/fine aggregate is the same if the sand/fine aggregate were dry.

Method -1: Put sufficient quantity of sand loosely into a container until it is about two-third full. Level off the top of the sand and push a steel rule vertically down through the sand at the middle to bottom, measure the height. Suppose this is 'X' cm.

Empty the sand out of the container into another container where none of it is lost. Half fill the first container with water. Put back about half the sand and rod it with a steel rod, about 6 mm in diameter, so that its volume is reduced to a minimum. Then add the remainder and level the top surface of the inundated sand. Measure its depth at the middle with the steel rule. Suppose this is 'Y' cm.

The percentage of bulking of the sand due to moisture shall be calculated from the formula:

Percentage bulking = (X/Y -1) X 100

Method-2: In a 250 ml measuring cylinder, pour the damp sand, consolidate it by staking until it reached the 200 ml mark.

Then fill the cylinder with the water and stir the sand well (the water shall be sufficient to submerge the sand completely). It will be seen that the sand surface is now below its original level. Suppose the surface is at the mark of Yml, the percentage of bulking of sand due to moisture shall be calculated from the formula.

Percentage bulking= (200/Y – 1) x 100

1.09 DETERMINATION OF PARTICLE SIZE

The apparatus, sample size and test procedure shall be same as for mortars.
In order that the sieves shall not be overloaded, care must be taken to ensure that the maximum sieve loads shown in Table A-4.1 (below) are not exceeded at the completion of sieving.

TABLE A-9.1

I.S. Sieve Designation	Maximum weight for	
	45 cm dia sieve kg	30 cm dia sieve kg
45 mm	10	4.5
40 mm	8	3.5
31.5 mm or 22.1 mm	6	2.5
20 mm	4	2.0
16 mm or 12.5 mm	3	1.5
10 mm	2	1.0
5.6 mm	1.5	0.75
4.75 mm	1.0	0.50
3.35 mm	-	0.30

The sample weight taken will thus normally require several operations on each sieve. Each sieve should be taken separately over a clean tray or receiver until no more than a trace passes, but in any case for not less than two minutes. Materials should not be forced through the apertures but hand placing is permitted. A light brush should be used with fine sieves. The cumulative weight passing each sieve should be calculated as percentage of the total sample weight to the nearest whole number.

FIG 9.1

1.10 TEST FOR SURFACE MOISTURE

Take a sample of wet aggregate and weigh it (A). Then place it in a frying pan and gently apply heat, meanwhile stirring with a glass rod until the surface moisture disappears. This is apparent when the aggregate loses its shining wet appearance and becomes dull, or when it just attains a free funning condition. The saturated surface dry material is then weighed (B). Continue the heating thereafter until the moisture is evaporated and weigh the dry sample (C). The surface moisture is then calculated as follows:

$$\text{Surface moisture} = 100 \times \frac{A-B}{C}$$

It is expressed as a percentage of dry aggregate.

1.11 DETERMINATION OF TEN PERCENT FINE VALUE

Apparatus: The apparatus for the standard test shall consist of the following:

(a) A 15 cm diameter open-ended steel cylinder, with plunger and base-plate, as shown in Fig. in the end of this appendix. The surfaces in contact with the aggregate shall be machined and case hardened or otherwise treated so as to have a diamond (VH) pyramid hardness number of not less than 650 VH.

(b) A straight metal tamping rod of circular cross-section 16 mm in diameter and 45 to 60 cm long, rounded at one end.

(c) A balance of capacity 3 Kg, readable and accurate to one gram.

(d) I.S. Sieve of sizes 12.5, 10 and 2.36 mm.

(e) A compression testing machine capable of applying a load of 50 tonnes and which can be operated to give a uniform rate of loading so that the maximum load in any test is reached in 10 minutes. This load may vary from 0.5 to 50 tonnes.

(f) For measuring the sample, a cylindrical metal measure of sufficient rigidity to retain its form under rough usage and of the following internal dimensions:

Diameter	11.5 cm
Height	18.0 cm

(g) Means of measuring the reduction in the distance between the plates of the testing machine to the nearest one millimetre during the test (for example, dial gauge).

Test Sample: Material for the test shall consist of aggregate passing a 12.5 mm I.S. Sieve and retained on a 10 mm I.S. Sieve. The aggregate shall be tested in a surface dry condition. If dries by heating the period of drying shall not exceed four hours, the temperature shall be 100ºC to 110ºC and the aggregate shall be cooled to room temperature before testing.

The quantity of aggregate shall be such that the depth of material in the cylinder, after tamping as described below, shall be 10 cm.
The weight of material comprising the test sample shall be determined (weight A) and the same weight of sample shall be taken for the repeat test.

Note: About 6.5 kg of natural aggregate is required to provide the two test samoles. Less of light weight aggregate is required.

The measuring cylinder is filled in three layers of approximately equal depth with aggregate passing a 12.5 mm I.S. Sieve and retained on 10 mm I.S. Sieve. Each layer is subjected to 25 strokes from the tamping rod (16 mm dia and 45 to 60 cm long) rounded to one end, care being taken in case of weak materials not to break the particles. The surface of the aggregate shall be carefully levelled and the plunger inserted so that it rests horizontally on this surface.

Test Procedure: The apparatus, with the test sample and plunger in position, shall then be placed in the compression testing machine. The load shall be applied at a uniform rate so as to cause a total penetration of a plunger in 10 minutes of about: 15.0 mm for rounded or partially rounded aggregates (for example uncrushed gravel) 20 mm for nominal crushed aggregate & 24 mm for honey combed aggregate (for example expanded shales and slags). These figures may be varied according to the extent of the rounding or honey combing.

After reaching the required maximum penetration, the load shall be released and the whole of the material removed from the cylinder and sieved on a 2.36 mm I.S. Sieve. The fines passing the sieve shall be weighed, and this weight expressed as a percentage of the weight of the test sample. Normally, this percentage will fall within the range 7.5 to 12.5, but if it does not, a further test shall be made at a load adjusted appropriately, to bring the percentage fines within the range of 7.5 to 12.5.
A repeat test shall be made at the load that gives as percentage fines within the range 7.5 to 12.5.
Calculations: The mean percentage fines from the two tests at this load shall be used in the following formula to calculate the load required to give 10 percentage fines.

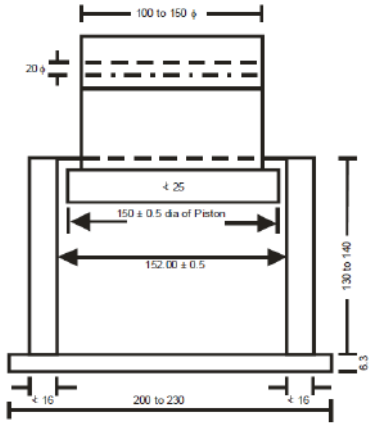
$$\text{Load required for 10 percent fines} = \frac{14 \times X}{Y + 4}$$

Where X = Load in tonnes and
Y= mean percentage fines from two test at X tonnes load.

Reporting of Results:
The load required to produce 10 percent fines shall be reported to the nearest whole number for loads of 10 tonnes or more, the nearest 0.5 tonne for loads of less than 10 tonnes.

The value expressed to the nearest 0.5 tonne should be as follows:

(a) For normal concrete, not less than 5 tonnes.
(b) For wearing surfaces, not less than 10 tonnes.
(c) For granolithic concrete, not less than 15 tonnes.



Drawing not to Scale
All dimensions in millimetres
Internal Diameter of Cylinder = 152.0 0.5

Fig. 11.1 : Apparatus for Determination of Ten per cent Fine Value

Fig. 11.2

1.12 AGGREGATE CRUSHING VALUE

AIM

To determine the aggregate crushing value of coarse aggregates as per IS: 2386 (Part IV) - 1963.

APPARATUS

FIG. 12.1 : CYLINDRICAL MEASURE AND PLUNGER

i) Cylindrical measure and plunger

ii) Compression testing machine

iii) IS Sieves of sizes - 12.5mm, 10mm and 2.36mm

PROCEDURE

i) The aggregates passing through 12.5mm and retained on 10mm IS Sieve are oven-dried at a temperature of 100 to110oC for 3 to 4hrs.

ii) The cylinder of the apparatus is filled in 3 layers, each layer tamped with 25 strokes of a tamping rod.

iii) The weight of aggregates is measured (Weight 'A').

iv) The surface of the aggregates is then levelled and the plunger inserted. The apparatus is then placed in the compression testing machine and loaded at a uniform rate so as to achieve 40t load in 10 minutes. After this, the load is released.

v) The sample is then sieved through a 2.36mm IS Sieve and the fraction passing through the sieve is weighed (Weight 'B').

vi) Two tests should be conducted.

REPORTING OF RESULTS

$$\text{Aggregate crushing value} = \frac{B}{A} \times 100\%$$

The result should be recorded to the first decimal place and the mean of the two results reported.

1.13 Test for Determination of Flakiness Index

The flakiness index of aggregate is the percentage by weight of particles in it whose least dimension (thickness) is less than three-fifths of their mean dimension. The test is not applicable to sizes smaller than 6.3mm.

This test is conducted by using a metal thickness gauge, of the description shown in fig. 13.1. A sufficient quantity of aggregate is taken such that a minimum number of 200 pieces of any fraction can be tested. Each fraction is gauged in turn for thickness of the metal gauge. The total amount passing in the gauge is weighed to an accuracy of 0.1 per cent of the weight of the samples taken. The flakiness index is taken as the total weight of the material passing the various thickness gauges expressed as a percentage of the total weight of the sample taken. Table 3.18 shows the standard dimensions of thickness and length gauges.

Table 13.1. Shows Dimensions of Thickness and Length Gauges

(IS: 2386 (Part I) – 1963)

size of aggregate thickness		Length of Gauge mm	Gauge mm
Passing through IS sieve	Passing through IS sieve		
63 mm	50 mm	33.90	-
50 mm	40 mm	27.00	81.0
40 mm	25 mm	19.50	58.5
31.5 mm	25 mm	16.95	-
25 mm	20 mm	13.50	40.5
20 mm	16 mm	10.80	32.4
16 mm	12.5 mm	8.55	25.6
12.5 mm	10.0 mm	6.75	20.2
10.5 mm	6.3 mm	4.89	14.7

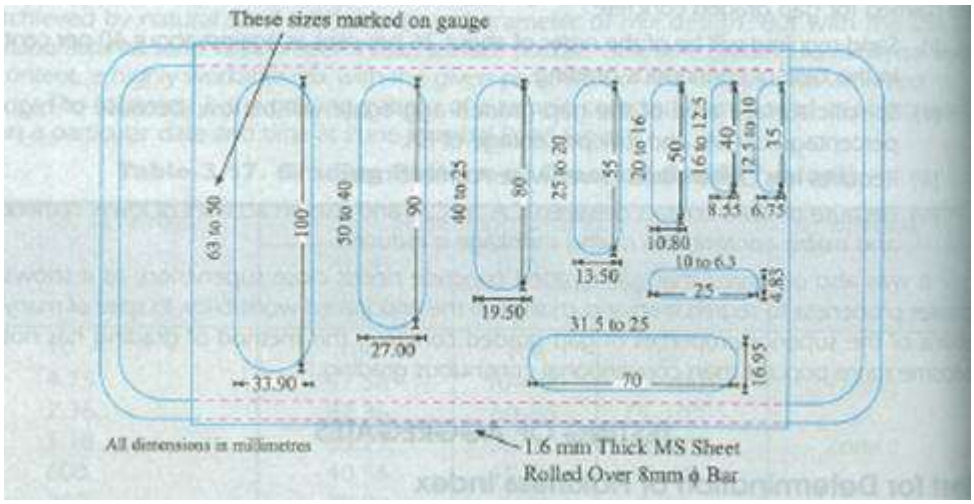

These sizes marked on gauge
63 to 50
100
33.90
50 to 40
90
27.00
40 to 25
80
19.50
25 to 20
55
13.50
20 to 16
50
10.80
16 to 12.5
40
8.55
12.5 to 10
35
6.75
10 to 6.3
25
4.85
31.5 to 25
70
16.95
All dimensions in millimetres
1.6 mm Thick MS Sheet
Rolled Over 8mm ϕ Bar

FIG 13.1

1.14 Test for Determination of Elongation Index

The elongation index on an aggregate is the percentage by weight of particles whose greatest dimension (length) is greater than 1.8 times their mean dimension. The elongation index is not applicable to sizes smaller than 6.3 mm.

This test is conducted by using metal length guage of the description shown in fig.14.1. A sufficient quantity of aggregate is taken to provide a minimum number of 200 pieces of any fraction to be tested. Each fraction shall be guaged individually for length on the metal guage. The guage length used shall be that specified in column of 4 of table 3.18 for the appropriate size of material. The total amount retained by the gauge length shall be weighed to an accuracy of at least 0.1 percent of the weight of the test samples taken. The elongation index is the total weight of the material retained on the various length gauges expressed as a percentage of the total weight of the sample gauged. The presence of elongated particles in excess of 10 to 15 percent is generally considered undesirable, but no recoganised limits are laid down.

Indian standard explain only the method of calculating both flakiness index and elongation index. But the specifications do not specify the limits British Standard do not specify the limits. British standard BS 882 of 1992 limits the flakiness index of the coarse aggregate to 50 for natural gravel and to 40 for crushed coarse aggregate. However, for wearing surfaces a lower values of flakiness index are required.

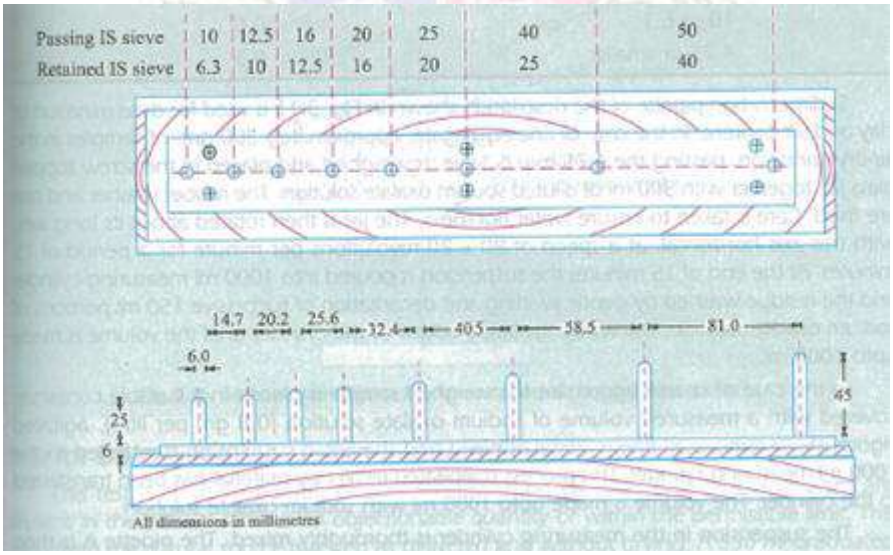


FIG 14.1

1.15 AGGREGATE ABRASION VALUE

AIM

To determine the abrasion value of coarse aggregates as per IS: 2386 (Part IV) - 1963.

APPARATUS

FIG. 15.1 : LOS ANGELES MACHINE

i) Los Angeles abrasion testing machine

ii) IS Sieve of size - 1.7mm

iii) Abrasive charge - 12 nos. cast iron or steel spheres approximately 48mm dia. And each weighing between 390 and 445g ensuring that the total weight of charge is 5000 + 25g

iv) Oven

PREPARATION OF SAMPLE

The test sample should consist of clean aggregates which has been dried in an oven at 105 to 110oC to a substantially constant weight and should conform to one of the gradings shown in the table below:

PROCEDURE

The test sample and the abrasive charge should be placed in the Los Angles abrasion testing machine and the machine rotated at a speed of 20 to 33 revolutions/minute for 1000 revolutions. At the completion of the test, the material should be discharged and sieved through 1.70mm IS Sieve.

Grading of test samples

Sieve size (Square hole)		**Weight in g of test sample for grade**						
		A	B	C	D	E	F	G
Passing through (mm)	**Retained Of (mm)**							
80	**63**	_	_	_	_	**2500***	_	_
63	**50**	_	_	_	_	**2500***	_	_
50	**40**	_	_	_	_	**5000***	**5000***	_
40	**25**	**1250**	_	_	_	_	**5000***	
25	**20**	**1250**	_	_	_	_	_	
20	**12.5**	**1250**	**2500**	_	_	_	_	_
12.5	**10**	**1250**	**2500**	_	_	_	_	_
10	**6.3**	_	_	**2500**	_	_	_	_
6.3	**4.75**	_	_	**2500**	_	_	_	_

4.75	**2.36**	_	_		**5000**	_	_	_

REPORTING OF RESULTS

i) The material coarser than 1.70mm IS Sieve should be washed, dried in an oven at a temperature of 100 to 110oC to a constant weight and weighed (Weight 'B').
ii) The proportion of loss between weight 'A' and weight 'B' of the test sample should be expressed as a percentage of the original weight of the test sample. This value should be reported as,

$$\text{Aggregate abrasion value} = \frac{A - B}{A} \times 100\%$$

A sample proforma for the record of the test results is given in Annexure-II.

1.16 AGGREGATE IMPACT VALUE

AIM

To determine the aggregate impact value of coarse aggregates as per IS: 2386 (Part IV) - 1963.

APPARATUS

FIG. 16.1 : AGGREGATE IMPACT TEST MACHINE

i) Impact testing machine conforming to IS: 2386 (Part IV)- 1963

ii) IS Sieves of sizes - 12.5mm, 10mm and 2.36mm

iii) A cylindrical metal measure of 75mm dia. and 50mm depth

iv) A tamping rod of 10mm circular cross section and 230m length, rounded at one end

v) Oven

PREPARATION OF SAMPLE

i) The test sample should conform to the following grading:- Passing through 12.5mm IS Sieve 100% - Retention on 10mm IS Sieve 100%

ii) The sample should be oven-dried for 4hrs. at a temperature of 100 to 110oC and cooled.

iii) The measure should be about one-third full with the prepare aggregates and tamped with 25 strokes of the tamping rod. A further similar quantity of aggregates should be added and a further tamping of 25 strokes given. The measure should finally be filled to overflow, tamped 25 times and the surplus aggregates struck off, using a tamping rod as a straight edge. The net weight of the aggregates in the measure should be determined to the nearest gram (Weight 'A').

PROCEDURE

i) The cup of the impact testing machine should be fixed firmly in position on the base of the machine and the whole of the test sample placed in it and compacted by 25 strokes of the tamping rod.

ii) The hammer should be raised to 380mm above the upper surface of the aggregates in the cup and allowed to fall freely onto the aggregates. The test sample should be subjected to a total of 15 such blows, each being delivered at an interval of not less than one second.

REPORTING OF RESULTS

i) The sample should be removed and sieved through a 2.36mm IS Sieve. The fraction passing through should be weighed (Weight 'B'). The fraction retained on the sieve should also be weighed (Weight 'C') and if the total weight 19 (B+C) is less than the initial weight (A) by more than onegram, the result should be discarded and a fresh test done.

ii) The ratio of the weight of the fines formed to the total sample weight should be expressed as a percentage.

$$\text{Aggregate impact value} = \frac{B}{A} \times 100\%$$

iii) Two such tests should be carried out and the mean of the results should be reported. A sample proforma for the record of the test results is given in Annexure-III.

1.17 SLUMP TEST

Apparatus: Mould shall consist of a metal frustum of cone having the following internal dimensions:

Bottom diameter……..20 cm
Top diameter……10 cm
Height……30 cm

The mould shall be of a metal other than brass and aluminium of at least 1.6 mm (or 16 BG) thickness. The top and bottom shall be open and at right angles to the axis of the cone. The mould shall have a smooth internal surface. It shall be provided with suitable foot pieces and handles to facilitate lifting it from the moulded concrete test specimen in a vertical direction as required by the test. A mould provided with a suitable guide attachment may be used.
Tamping rod shall be of steel or other suitable material 16 mm in diameter 60 mm long and rounded at one end.

Procedure: The internal surface of the mould shall be thoroughly cleaned and free form superfluous moisture and any set concrete before commencing the test. The mould shall be placed on a smooth horizontal, rigid and non-absorbent surface viz. levelled metal plate. The operator shall hold the mould firmly in place while it is being filled with test specimen of concrete. The mould shall be filled in four layers, each approximately one quarter of height of mould. Each layer shall be tamped with twenty five strikes of the rounded end of the tamping rod. The strokes shall be distributed in a uniform manner over the cross section of the mould and for the second and subsequent layers shall penetrate into the underlying layer. The bottom layer shall be tamped throughout its depth. After the top layer has been rodded, the concrete shall be struck off level with trowel or the tamping rod, so that the mould is exactly filled.
Any mortar which shall leak out between the mould and the base plate shall be cleaned away. The mould shall be removed from the concrete immediately after filling by raising it slowly and carefully in a vertical direction. The moulded concrete shall then be allowed to subside and the slump shall be measured immediately by determining the difference between the height of the mould and that of the highest point of specimen.
The above operations shall be carried out at a place free from vibration or shock, and within a period of two minutes after sampling.

Result: The slump shall be recorded in terms of millimeters of subsidence of the specimen during the test. Any slump specimen which collapses or shears off laterally give incorrect result. If this occurs, the test shall be repeated with another sample.
The slump test shall not be used for very dry mixes as the results obtained are not accurate.

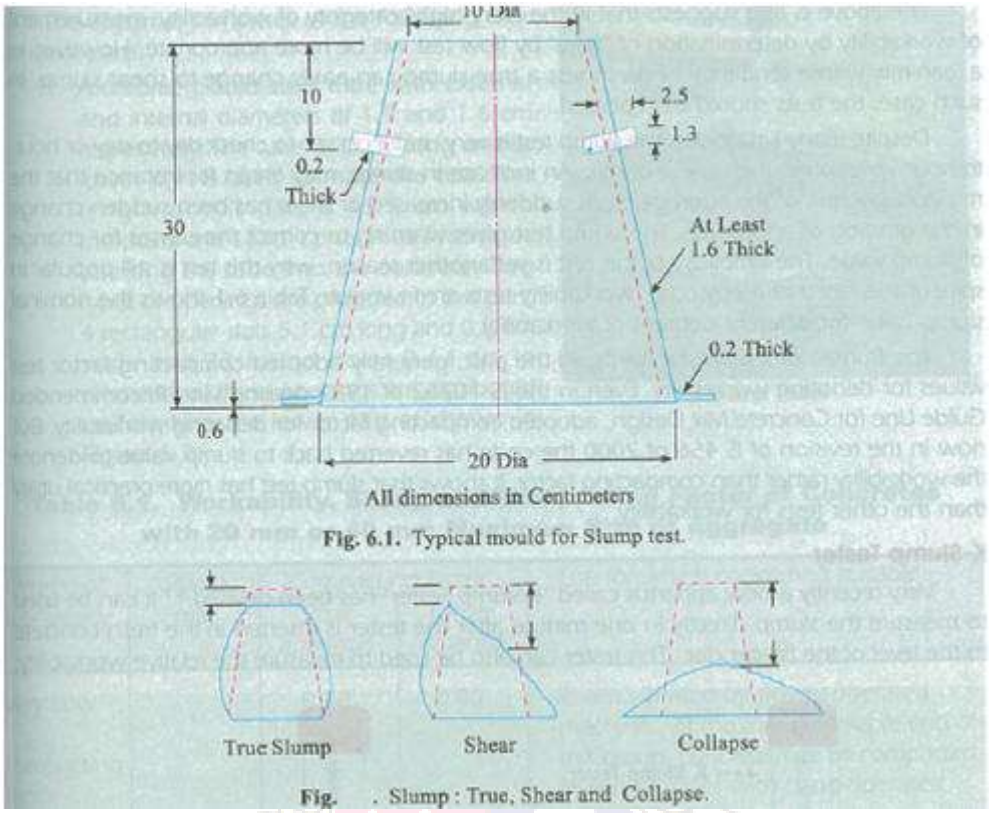


Fig. 6.1. Typical mould for Slump test.

Fig. . Slump : True, Shear and Collapse.

1.18 CUBE TEST FOR COMPRESSIVE STRENGTH OF CONCRETE - MANDATORY LAB TEST

A-0 One sample (consisting of six cubes 15x15x15 cm shall be taken for every 20 cum or part thereof concrete work ignoring any part less than 5cum or as often as considered necessary by the Engineer in- Charge. The test of concrete cubes shall be carried out in accordance with the procedure as described below. A register of cubes shall be maintained at the site of work in Appendix C. The casting of cubes, concrete used for cubes and all other incidental charge, such are curing, carriage to the testing laboratory shall be borne by the contractors. The testing fee for the cubes, if any, shall be borne by the department.

A-1 Test Procedure

A-1.1 Mould

The mould shall be of size 15 cmx15 cmx15 cm for the maximum nominal size of aggregate not exceeding 40 mm. For concrete with aggregate size more than 40 mm size of mould shall be specified by the Engineer-in-charge, keeping in view the fact that the length of size of mould should be about four times the size of aggregate.

The moulds for test specimens shall be made of non-absorbent material and shall be substantially strong enough to hold their form during the moulding of test specimens. They shall not vary from the standard dimensions by more than one percent. The moulds shall be so constructed that there is no leakage of water from the test specimen during moulding. All the cube moulds for particular site should, prior to use, be checked for accuracy in dimensions and geometric form and such test should at least be made once a year.
Each mould shall be provided with a base plate having a plane surface and made of non-absorbent material. This plate shall be large enough in diameter to support the moulds properly without leakage.
Glass plates not less than 6.5mm thick or plain metal not less than 12mm thick shall be used for this purpose. A similar plate shall be provided for covering the top surface of the test specimen when
moulded.

Note: Satisfactory moulds can be made from machine or steel castings, rolled metal plates or galvanized.

A-1.2 Sample of Concrete

Sample of concrete for test specimen shall be taken at the mixer or in the case of ready mixed concrete from the transportation vehicle discharge or as directed by Engineer-in-Charge. Such samples shall be obtained by repeatedly passing a scoop or pail through the discharge stream of concrete. The sampling operation should be spread over evenly to the entire discharging operation. The samples thus obtained shall be transported to the place of moulding of the specimen to counteract segregation. The concrete shall be mixed with a shovel until it is uniform in appearance. The location in the work of the batch of concrete this sampled shall be noted for further reference. In case of paving concrete, samples shall be taken from the batch immediately after deposition of the sub grade. At least five samples shall be taken from different portion of the pile and these samples shall be thoroughly mixed before being used to form the test specimen. The sampling shall be spread as evenly as possible throughout the day.
When wide changes occur during concreting, additional sample shall be taken if so desired by the Engineer-in-Charge.

A-1.3 Preparation of Test Specimens

The interior surfaces of the mould and base plate shall be lightly oiled before the concrete is placed in the mould. The samples of concrete obtained as described under the test specimen shall be immediately moulded by one of the following methods as indicated below:-

When the job concrete is compacted by manual methods, the test specimen shall be moulded by placing the fresh concrete in the mould in three layers, each approximately one third of the volume of the mould. In placing each scoopful of concrete the scoop shall be moved around the top edge do the mould as the concrete there sided from it, in order to ensure a uniform distribution of concrete within the mould.

Each layer shall be rodded 35 times with 16 mm rod, 60 cm in length, bullet pointed at the lower end.

The strokes shall be distributed in uniform manner over the cross section of the mould and shall penetrate into underlying layer. The bottom layer shall be rodded through its depth. After the top layer has been rodded, the surface of the concrete shall be struck off with a trowel and covered with a glass plate at least 6.5 mm thick or a machined plate. The whole process of moulding shall be carried out in such a manner as to preclude the change of the water cement ratio of the concrete, by loss of water either by leakage from the bottom or over flow from the top of the mould.

When the job concrete is placed by vibration and the consistency of the concrete is such that the test specimens cannot be properly moulded by hand rolling as described above, the specimens shall be vibrated to give a compaction corresponding to that of the job concrete. The fresh concrete shall be placed in mould in two layers, each approximately half the volume of the mould. In placing each scoopful of concrete the scoop shall be moved around the top edge of the mould as the concrete there slides from it, in order to ensure a symmetrical distribution of concrete within the mould. Either internal or external vibrators may be used. The vibration of each layer shall not be continued longer than is necessary to secure the required density. Internal vibrators shall only be used when the concrete is required to be compacted in layers. In compacting the first layer, the vibrators shall not be allowed to rest on the bottom of the mould. In placing the concrete for top extent that there will be no mortar loss during vibrations. After vibrating the second layer enough concrete shall be added to bring level above the top of the mould. The surface of the concrete shall then the struck off with a trowel and covered with a glass or steel plate as specified above. The whole process of moulding shall be carried out in such a manner as to preclude the alteration of water-cement ratio of the concrete by loss of water, either by leakage for the bottom or over flow from the top of the mould.

A-1.4 Curing and Storage of Test Specimen

In order to ensure reasonably uniform temperature and moisture conditions during the first 24 hours for curing the specimen and to protect them from damage, moulds shall be covered with wet straw or gunny sacking and placed a storage box so constructed and kept on the work site that its air temperature when containing concrete specimens shall remain 22ºC to 33ºC. Other suitable means which provide such a temperature and moisture conditions may be used.

Note:- It is suggested that the storage box be made of 25 mm dressed tongued and grooved timber, well braced with battens to avoid warping. The box should be well painted inside and outside and should be provided with a hinged cover and padlock.

The test specimen shall be removed from the moulds at the end of 24 hours and stored in a moist condition at a temperature within 24ºC to 30ºC until the time of test. If storage in water is desired, a saturated lime solution shall be used.

A-1.5 Testing

The specimens shall be tested in accordance with procedure as described below:

(a) The tests shall be made at an age of concrete corresponding to that for which the strengths are specified.
(b) Compression tests shall be made immediately upon removal of the concrete test specimen from the curing room i.e. the test specimen shall be loaded in damp condition. The dimensions of the test specimens shall be measured in mm accurate to 0.5 mm.
(c) The metal bearing plates of the testing machine shall be placed in contact with the ends of the test specimens. Cushioning materials shall not be used. In the case of cubes, the test specimen shall be placed in the machine in such a manner that the load is applied to sides of the specimens as cast. An adjustable bearing block shall be used to transmit the load to the test specimen. The size of the bearing block shall be the same or slightly larger than that of test specimen. The upper or lower section of the bearing block shall be kept in motion as the head of the testing machine is brought to a bearing on the test specimen.
(d) The load shall be applied axially without shock at the rate of approximately 140 kg. per sq.cm. per minute. The total load indicated by the testing machine at failure of test specimen shall be recorded and the unit compressive strength is calculated in kg per sq. cm. using the area computed from the measured dimension of the test specimen. The type of failure and Appearance of the concrete shall be noted.

1.19 DETERMINATION OF WATER SOLUBLE AND ACID SOLUBLE CHLORIDES IN CONCRETE

Determination of water soluble and acid soluble chlorides in Concrete shall be done as per method of test given in IS 14959 (Part 1) which covers volumetric method of test as described below :

(a) Quality of Reagents
Unless otherwise specified, pure chemicals of analytical reagent grade and distilled water (see IS
1070) shall be used in the test.

(b) Nitric Acid (HNO3) Concentrated (Specific Gravity 1.42)
Prepare the solution, (6N (approximately), by diluting 38ml of concentrated Nitric acid to 100 ml with distilled water.

(c) Ferric Alum(FeNH4 (SO4)2 12 H2O)
Dissolve 10 g of ferric alum in 100 ml of distilled water and add 1 ml of Nitric acid.

(d) Potassium Chromate 5% Solution
Dissolve 5 g of potassium chromate (K2 CrO4) 100 ml of distilled water to form 5% Solution.

(e) Nirabenzene

(f) Silver Nitrate (AgNO3)Solution, 0.02 N
Weigh 1.7 g of silver nitrate, dissolve in distilled water and dilute to 500 ml in a volumetric flask.
Standardize the silver nitrate solution against 0.02 N sodium chloride solution using potassium chromate solution as indicator (5 percent m/v) in accordance with the procedure given in IS 3025 (Part 32).

(g) Ammonium thiocyanate (NH4 SCN) Solution
Weigh 1.7 g of ammonium thiocyanate (NH4 SCN) and dissolve in one litre of distilled water in a volumetric flask. Shake well and standardize by titrating with 0.02 N silver nitrate solution using ferric alum solution as an indicator. Adjust the normality exactly to 0.02 N.

(h) Sodium chloride (NaCl) 0.02N
Weigh 1.1692 g of sodium chloride (NaCl) dried at 105 +/- 2ºC, dissolve in distilled water and make upto 1000 ml in a volumetric flask.

(i) Use of Filter Paper

(j) In the methods prescribed in this standard, relative numbers of Watman filter paper only have been prescribed since these are commonly used. However, any other suitable brand of filter papers with equivalent porosity may be used.

(k) Procedure for Water Soluble Chloride
Weigh 1 000+/-5 g of fresh mortar or concrete sample in a 2 litre capacity beaker and add 500 ml of distilled water (chloride free). Stir the mixture vigorously for 15 minutes. After allowing the mixture to stand for 10 to 15 minutes for settling, decant about 200 ml of the supernatant solution into a clean dry 250 ml capacity beaker. Immediately, filter the solution through Watman filter paper No.1 and collect the filtrate.

Pipette 50 ml of filtrate in a 250 ml capacity conical flask. Add 5 ml of 6 N Nitric acid. Add a known volume (X), preferably 25 ml of nitrobenzene. Shake vigorously to coagulate the precipitate. Titrate the excess silver nitrate with 0.02 N ammonium thiocyanate solution until a permanent faint reddish brown colour appears. Note down the volume (Y) of ammonium thiocyanate used.

(l) Procedure for Acid Soluble Chloride

Weigh about 1000 +/- 5 g of the fresh mortar or concrete sample in a 2 litre capacity beaker and add 50 ml of 6 N nitric acid and 450 ml of distilled water (chloride free) after stirring for few Minutes. Stir the mixture vigorously for 15 minutes. After allowing the mixture to stand for 10 to
15 minutes for settling, decant about 200 ml of the supernatant solution into a clean dry 250 ml capacity beaker. Immediately, filter the solution through Watman filter paper No.1 and collect the
filterate.

Pipette 50 ml of filtrate in a 250 ml capacity conical flask. Add 5 ml of 6 N nitric acid. Add a known volume (X) preferably 25 ml of standard silver nitrate solution. Add 1 ml ferric alum and 5 ml of nitrobenzene. Shake vigorously to coagulate the precipitate. Titrate the excess silver nitrate with 0.02 N ammonium thiocyanate solution until a permanent faint reddish brown colour appears. Note down the volume (Y) of ammonium thiocyanate used.

(m) Calculation

Calculate the percentage of chloride(acid soluble/water soluble) by mass of mortar or concrete
as follows:

Chloride, percent = 0.0007 1 (X – Y),

Where

X = volume of silver nitrate added, in ml; and

Y = volume of 0.02 N ammonium thiocyanate consumed.

Note: Interference of silver chloride particles (which are generated in situ) in titration by reacting with thiocyanants can be avoided by the addition of nitrobenzenes which forms
a film on silver chloride particles.

1.20 ADDITIONAL TESTS FOR CONCRETE

B-0 In case the concrete fails when tested as per the method prescribed in Appendix A, one or more of the following check tests may be carried out at the discretion of Engineer-in-Charge to satisfy the strength of the concrete laid. All testing expenditure shall be borne by the contractor, the number of additional tests to be carried out shall be determined by the Engineer-in-Charge. He shall be the final authority for interpreting the results of additional test and shall decide upon the acceptance or otherwise.
His decision in this regard shall be final and binding. For the purpose of payment, the Hammering test results only shall be the criteria. Some of the tests are outlined below:-

B-1 REBOUND HAMMER TEST
If a rebound hammer is regularly used by trained personnel in accordance with procedure described in IS 13311 (part II) and a continuously maintained individual charts are kept showing a large number of reading and the relation between the reading and strength of concrete cubes made from the same batch of concrete, such charts may be used in conjunction with hammer readings to obtain an approximate indication of the strength of concrete in a structure for element. If calibration charts are available from manufactures, it can be used. When making rebound hammer test each result should be the average of at least 12 readings. Reading should not be taken within 20mm of the edge of concrete members and it may be necessary to distinguish between readings taken on a trowled face and those on a moulded face. When making the tests on a precast unit, special care should be taken to bed them firmly against the impact of the hammer.

B-2 CUTTING CORES
This method involves drilling and testing cores from the concrete for determination of compressive strength. In suitable circumstances, the compressive strength of the concrete in the structure may be assessed by drilling cores from the concrete and testing. The procedure used shall comply with the requirements of IS 1199 and IS 516.
The points from which cores shall be taken shall be representative of the whole concrete and at least three cores shall be obtained and tested. If the average of the strength of all cores cut from the structure is less than the specified strength, the concrete represented by the cores shall be liable to rejection and shall be rejected if a static load test (B-5) either cannot be carried out or is not permitted by the Engineer-in-Charge.

B-3 ULTRASONIC TEST
If an ultrasonic apparatus is regularly used by trained personnel in accordance with IS 13311 (part I) and continuously maintained individual charts are kept showing a large number of readings & the relation between the reading and strength of cubes made from the same batch of concrete, such charts may be used to obtain approximate indications of the strength of concrete in the structures. In cases of suspected lack of compaction or low cube strength the results obtained from the ultrasonic test results on adjacent acceptable section of the structures may be used for the purpose of assessing the strength of concrete in the suspected portion.

B- 4 LOAD TESTS ON INDIVIDUAL PRECAST UNITS
The load tests described in this clause are intended as check on the quality of the units and should not be used as substitute for normal design procedure. Where members require special testing. Such special testing procedures shall be in a accordance with the specification. Test loads shall be applied and removed incrementally.

B-4.1 Non Destructive Tests
The unit shall be supported at its designed point of support and loaded for five minutes with a load equal to the sum of the characteristic dead load plus one and a quarter time the

characteristic imposed load. The deflection is then recorded. The maximum deflection after application of the load shall be in accordance with the requirements defined by the Engineer-in-Charge. The recovery is measured five minutes after the removal of the load and the load then reimposed. The percentage recovery after the second loading shall be not less than that after the first loading nor less than 90% of the deflection recorded during the second loading. At no time during the tests, shall the unit show any sign of weakness or faulty construction as defined by the Engineer-in-Charge in the light of reasonable interpretation of relevant data.

B-4.2 Destructive Tests

The unit is loaded while supported at its design point of support and must not fail at its design load for collapse, within 15 minutes of time when the test load becomes operative. A deflection exceeding
1/40 of the test span is regarded as failure of the unit.

B-4.3 Special Tests

For very large units or units not readily amenable to the above test e.g. columns, the precast parts of composite beams and members designed for continuity or fixity, the testing arrangements shall be agreed upon before such units are cast.

B-5 Load Test of Structures or Parts of Structures

The test described in this clause are intended as a check where there is a doubt regarding structural strength. Test loads are to be applied and removed incrementally.

B-5.1 Age at Tests

The test is to be carried as soon as possible after the expiry of 28 days from the time of placing of the concrete. When the test is for a reason other than the quality of concrete in the structure being in doubt, the test may be carried out earlier, provided that the concrete has already reached its specified characteristic strength.

B-5.2 Test Load

The test loads to be applied for the limit state of deflection and local damage are the appropriate design loads i.e., the characteristic dead and superimposed loads. When the limit state of collapse is being considered the test load shall be equal to the sum of characteristic dead load plus one and a quarter times the characteristic imposed load and shall be maintained or a period of 24 hours. In any of the test temporary supports of sufficient strength to take the whole load shall be placed in position underneath but not in contact with the members being tested. Sufficient precautions must be taken to safeguard persons in the vicinity of the structure.

B-5.3 Measurement During Tests

Measurements of deflection and crack width shall be taken immediately after applications of the load and, in the case of 24 hour sustained load test, at the end of 24 hour loaded period, after removal of the load and after 24 hour recovery period. Sufficient measurements shall be taken to enable side effect to be taken in account. Temperature and weather conditions shall be recorded during the tests.

B-5.4 Assessment of Results

In assessing the strength of a structure or a part of the structure following a loading test, the possible effects of variation in temperature and humidity during the period of the test shall be considered.

The following requirements shall be met:

(a) The maximum width of any crack measured immediately on application of the test load for local damage, is to be not more than 2/3 of the value of the appropriate limit state requirement.
(b) For members spanning between two supports the deflection measured immediately on application of the test load for deflection is to be not more than 1/500 of the effective span limits shall be agreed upon before testing cantilevered portions of structure.

(c) If maximum deflection in mm shown during 24 hour under load is less than 40L2/D where L is effective span in mm and D is overall depth of construction in mm, it is not necessary for the recovery to be measured and the requirement (D) does not apply, and

(d) If within 24 hours of the removal of test load for collapse as calculated in clause (a) a reinforced concrete structure does not show a recovery of at least 75 per cent of the maximum deflection shown during the 24 hour under load, the loading should be repeated. The structure should be considered to have failed to pass the test if the recovery after second loading is not at least 75 per cent of the maximum deflection shown during the second loading.

1.21 Compacting factor test

The compacting factor test is designed primarily for use in the laboratory but can also be used in the field. It is more precise and sensitive than the slump test and is particularly useful for concrete mixed of very low workability as are normally used when concrete is to be compacted by vibration. Such dry concrete are insensitive to slump test. The diagram of the apparatus is shown in figure 6.4. the essential dimensions of the hoppers and mould and the distance between them are shown in table 6.2.

The compacting factor test has been developed at the Road Research Laboratory U.K. and it is claimed that it is one of the most efficient tests for measuring the workability of concrete. This is test works on the principle of determining the degree of compaction achieved by a standard amount of work done by allowing the concrete to fall through a standard height. The degree of compaction, called the compacting factor is measured by the density ratio i.e., the ratio of the density actually achieved in the test to density of same concrete fully compacted.

Table 6.2 Essential Dimension of the Compacting Factor Appartus for Use with Aggregate not exceeding 40 mm Nominal Max. Size

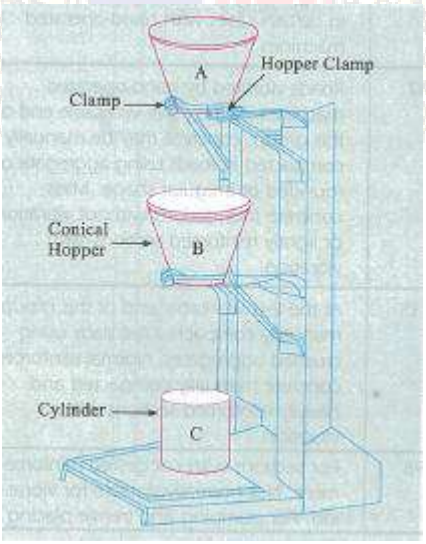
Upper hopper, A	dimension cm
Top internal diameter	25.4
Bottom internal diameter	12.7
Internal height	27.9
Lower hopper, A	
Top internal diameter	22.9
Bottom internal diameter	12.7
Internal height	22.9
Cylinder , C	
internal diameter	15.2
internal height	30.5
distance between bottom of upper hopper and	
Top of lower hopper	20.3
Distance between bottom hopper and	
Top internal cylinder	20.3

This sample of concrete to be tested is placed in the upper hopper up to the brim. The trap-door is opened so that the concrete falls into the lower hopper. Then the trap-door of the lower hopper is opened and the concrete is allowed to fall into the cylinder. In the case of a dry-mix, it is likely that the concrete may not fall on opening the trap-door. In such a case, a slight poking by a rod may be required to set the concrete in motion. The excess concrete remaining above the top level of the cylinder is then cut off with the help of plane blades supplied with the apparatus. The outside of the cylinder is wiped clean. The concrete is filled up exactly upto the top level of the cylinder. It is weighed to the nearest 10 grams. This weight is known as “weight of partially compacted concrete”. The cylinder is emptied and then refilled with the concrete from the same sample in layers approximately 5 cm deep. The layers are heavily rammed or preferably vibrated so as to obtain full compaction. The top surface of the fully compacted concrete is then carefully struck off level with the top of the cylinder and weighed to the nearest 10 gm. This weight is known as “weight of fully compacted concrete”'.

The compacting factor = $\frac{\text{Weight of partially compacted concrete}}{\text{Weight of fully compacted concrete}}$

The weight of fully compacted concreted concrete can also be calculated by knowing the proportion of materials, their respective specific gravities, and the volume of the cylinder. Is is seen from experience, that is makes very little difference in compacting factor value, whether the weight of fully compacted concrete is calculated theoretically or found out actually after 100 per cent compaction.

It can be realised that the compacting factor test measures the inherent characteristics of the concrete which relates very close to the workability requirements of concrete and as such it is one of the good tests to depict the workability of concrete.



1.22 Vee Bee Consistometer Test

This is a good laboratory test to measure indirectly the workability of concrete. This test consists of a vibrating table, a metal pot, a sheet metal cone, a standard iron rod. The apparatus is shown in figure 6.10.

Slump test as described earlier is performed, placing the slump cone inside the sheet metal cylindrical pot of the consistometer. The glass disc attached to the swivel arm is turned and placed on the top of the concrete in the pot. The electrical vibrator is then switched on and simultaneously a stop watch started. The vibration is continued till such a time as the conical shape of the concrete disappears and the concrete assumes a cylindrical shape. This can be judged by observing the glass disc from the top for disappearance of transparency. Immediately when the concrete fully assumes a cylindrical shape, the stop watch is switched off. The time required for the shape of concrete to change from slump cone shape to cylindrical shape in seconds is known as vee bee degree. This method is very suitable for very dry concrete whose slump value cannot be measured by slump test, but the vibration is too vigorous for concrete with a slump greater than about 50 mm.

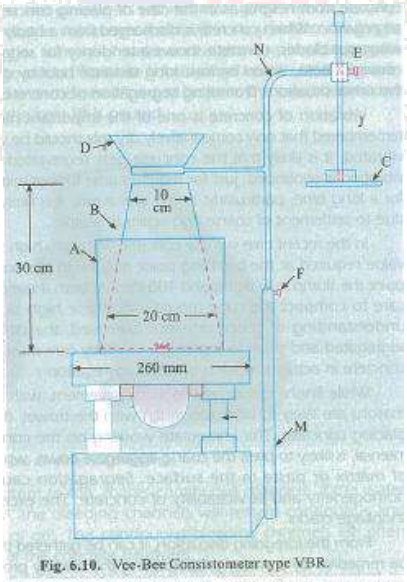


Fig. 6.10. Vee-Bee Consistometer type VBR.

1.23 TEST FOR DIMENSIONAL TOLERANCE

A -1. Sampling

As per para 6.1.3.1 and 6.1.3.2.

A -2. Procedure

All the blisters, loose particles of clay and small projections shall be removed from the surface of bricks. Each specimen of 20 bricks shall then be arranged upon a level surface successively as indicated in Fig. A, B and C of para A-4 below in contact with each other and in straight line. The overall length of the assembled bricks (20 Nos) shall be measured with a steel tape sufficiently long to measure the whole row at one stretch.

A-3. Tolerance

The actual dimensions of bricks when tested as described in A-2 shall be within the following limits per 20 bricks.

Modular Bricks

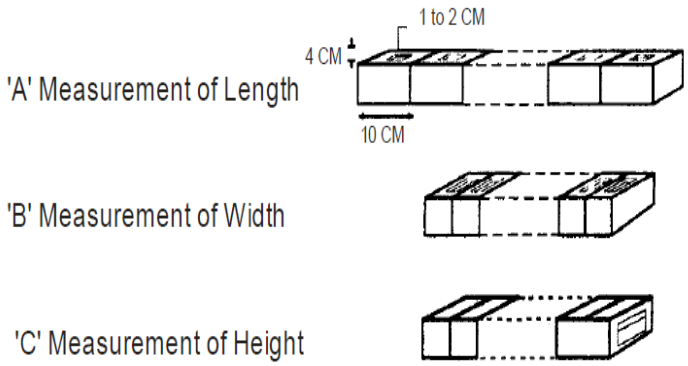
Length 3720 to 3880 mm (3800 ± 80 mm)
Width 1760 to 1840 mm (1800 ± 40 mm)
Height 1760 to 1840 mm (1800 ± 40 mm) for 90 mm high brick
760 to 840 mm (800 ± 40 mm) for 40 mm high brick

Non-Modular Bricks

For class 10
Length (4520 to 4680) mm (4600 ± 80 mm)
Width (2240 to 2160) mm (2200 ± 40 mm)
Height (1440 to 1360) mm (1400 ± 40 mm) for 70 mm high bricks
(640 to 560) mm (600 ± 40 mm) for 30 mm high bricks
For other classes
Length (4320 to 4680) mm
Width (2130 to 2310) mm
Height (1340 to 1460) mm for 70 mm high bricks
(840 to 920) mm for 44 mm high bricks

A-4. Criteria for Conformity

A lot shall be considered conforming to the requirements of dimensions and tolerances if all the groups of bricks are tested to meet the specified requirements.



1.24 TEST FOR COMPRESSIVE STRENGTH

B-1. Specimen

Five whole bricks shall be taken from the samples as specimens for this test. Length and width of each specimen shall be measured correct to 1 mm.

B-2. Apparatus

The apparatus consists of compression testing machine, the compression plate of which shall have a ball seating in the form of portion of a sphere the centre of which shall coincide with the centre of the plate.

B-3. Procedure

(a) *Pre-conditioning:* The specimen shall be immersed in the water for 24 hours at 25º to 29ºC. Any surplus moisture shall be allowed to drain at room temperature. The frog of the bricks should be filled flush with mortar 1:3 (1 cement : 3 clean coarse sand of grade 3 mm and down) and shall be kept under damp jute bags for 24 hours, after that these shall be immersed in clean water for three days.

After removal from water, the bricks shall be wiped out of any traces of moisture.

(b) *Actual Testing:* Specimen shall be placed with flat faces horizontal and mortar filled face upward between three 3 ply plywood sheets each of thickness 3 mm and carefully centred between plates of the testing machine. Plaster of Paris can also be used in place of plywood sheets to ensure a uniform surface.

Load shall be applied carefully axially at uniform rate of 14 N/mm2 per minute till the failure of the specimen occurs.

B-4. Reporting the Test Results

The compressive strength of each specimen shall be calculated in N/mm2 as under :

$$\text{Compressive Strength} = \frac{\text{Maximum load at failure (in N)}}{\text{Area of Specimen (in sq mm)}}$$

In case the compressive strength of any individual brick tested exceeds the upper limit of the average compressive strength specified for the corresponding class of brick, the same shall be limited to the upper limit of the class specified in 6.1.2 for the purpose of calculating the average compressive strength. Compressive strength of all the individual bricks comprising the sample shall be averaged and reported.

B-5. Criteria for Conformity

A lot shall be considered having satisfied the requirements of average compressive strength if the average compressive strength specified in 6.1.2 for the corresponding class of brick tested is not below

the minimum average compressive strength specified for the corresponding class of bricks by more than
20 per cent.

1.25 TEST FOR WATER ABSORPTION

C-1. No. of Specimen

Five whole bricks shall be taken from samples as specimen for this test.

C-2. Apparatus

A balance required for this test shall be sensitive to weigh 0.1 percent of the weight of the specimen.

C-3. Procedure

(a) Pre-conditioning: The specimen shall be allowed to dry in a ventilated oven at a 110°C to 115°C
till it attains a substantially constant weight. If the specimen is known to be relatively dry, this would be accomplished in 48 hours, if the specimen is wet, several additional hours may be required to attain a constant weight. It shall be allowed to cool at room temperature. In a ventilated room, properly separated bricks will require four hours for cooling, unless electric fan
passes air over them continuously in which case two hours may suffice.

The cooled specimen shall be weigh (W1) a warm specimen shall not be used for this purpose.
(b) Actual Testing: Specimen shall be completely dried before immersion in the water. It shall be
kept in clean water at a temperature of 27°C ± 2°C for 24 hours. Specimen shall be wiped out of
the traces of water with a damp cloth after removing from the water and then shall be weighed
within three minutes after removing from water (W2).

C-4. Reporting the Test Results

The water absorption of each specimen shall be calculated as follows and the average of five tests
shall be reported.

Water Absorption = ((W2 – W1)/ (W1)) x 100

C-5. Criteria for Conformity

A lot shall be considered having satisfied the requirements of water absorption if the average water
absorption is not more than 20% by weight.

1.26 TEST FOR EFFLORESCENCE

D-1. No. of Specimen
Five whole bricks shall be taken as specimen for this test.

D-2. Apparatus
Apparatus required for this test shall be a shallow flat bottom dish containing distilled water.

D-3. Procedure (actual testing)
The brick shall be placed vertically in the dish with 2.5 cm immersed in the water. The room shall be warm (18ºC to 30ºC) and well ventilated. The bricks should not be removed until it absorbs whole water.
When the whole water is absorbed and the brick appears to be dry, place a similar quantity of water in that dish and allow it to evaporate as before. The brick shall be examined after the second evaporation.

D-4. Reporting the Test Results
The rating to efflorescence in ascending order shall be reported as 'NIL', 'SLIGHT', 'MODERATE',
'HEAVY' or 'SERIOUS' in accordance with the following:

(a) NIL: When there is no perceptible deposit of efflorescence.

(b) SLIGHT: When not more than 10 per cent of the area of the brick is covered with a thin deposit of salts.

(c) MODERATE: When there is heavier deposit and covering upto 50% of the area of the brick surface but unaccompanied by powdering or flaking of the surface.

(d) HEAVY: When there is a heavy deposit of salts covering 50% or more of the brick surface but unaccompanied by powdering or flaking of the surface.

(e) SERIOUS: When there is heavy deposit of salts, accompanied powdering and/or flaking of the surface and tending to increase in the repeated wetting of the specimen.

D-5. Criteria for Conformity
A lot be considered having satisfied the requirements of efflorescence if for 4 out of the specimen of
5 bricks, the rating of efflorescence is not beyond "Moderate".

1.27 PHYSICAL REQUIREMENTS OF FLY ASH

Sl. No	Characteristics	Requirement of Fly Ash	
		For use as Pozzolana	For use as admixture in Cement Mortar and concrete
1	2	3	4
(i)	Fineness- Specific surface in m2/kg by Blaine's permeability method, min	320	200
(ii)	Lime reactivity – average compressive strength in N/mm2 Min	4.5	-
(iii)	Compressive strength at 28 days in N/ mm2	Not less than 80 per cent of the strength of corresponding mortar cubes.	
(iv)	Soundness of autoclave test expansion of specimens, per cent, max	0.8	0.8
(v)	Particles retained on 45 micron IS sieve (wet sieving) in percent maximum	34	50

1.28 MOISTURE CONTENT OF TIMBER

C-1 Moisture content of timber shall be checked for every 1 cum or part thereof by electrical moisture meters as per IS 287.

C-2 Electrical moisture meters are of resistance type and shall be used when the moisture content is within a range of 8 to 25 per cent. When checking moisture content with electrical moisture meter, it shall be ensured that :

(a) Timber is not hot or surface wet and the moisture gradient is not large due to wet cores.

(b) Electrode probes are of adequate depth (not less than one-fifth the thickness of the timber).

C-3 Sufficient number of reading at different positions are taken on each piece of timber to eliminate localised variations in surface moisture and species corrections are applied for the make of electrical resistance type moisture meter.

C-4 If for any reason, whatsoever, the result of electrical moisture are not to be relied upon the moisture content shall be checked by the oven drying method.

C-5 For checking moisture content by oven drying method, a complete test cross section, 12 to 19 mm long in the direction of timber grain, free from all defects shall be cut from each piece of timber selected for test as follows:

(a) If weighing can be done immediately, the test section shall be cut from a point at least 45 cm from one end of the piece or from its centre.

(b) In case cutting of test section from the piece is not permissible the moisture content in the whole section can also be determined by collecting a boring to a depth of half of the thickness of the piece by means of an auger, in a pre-weighed weighing bottle which should then be sealed properly.

C-6 The test sections obtained above shall be weighed, immediately after cutting, on a balance the sensitivity of which is not less than 10 mg. They shall be dried in a ventilated, and preferably thermostatically controlled, oven at a temperature of 100°C to 105°C untill the weight is constant.
The weight of the test section shall be deemed to have become constant if successive weighing at intervals of 2 to 5 hours do not differ from one another by more than 50 mg. The test weight shall be taken to be the oven dry weight of the test section.

C-7 The percentage moisture content in the test section shall be calculated as follows :

$$\text{Moisture content (Per cent)} = \frac{W1 - WO}{WO} \times 100$$

Where:

W1 = initial weight of test section and
WO = oven dry weight of test section

C-8 When moisture content of timber is checked by oven drying method, results of electrical moisture meter shall be ignored.

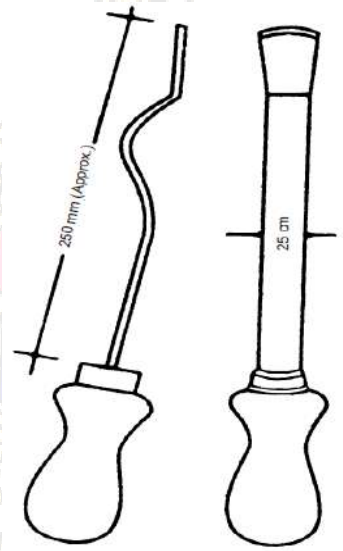
TESTS FOR FLUSH DOOR SHUTTERS

F-1. END IMMERSION TEST

Door shutters shall be tested for resistance of their base to immersion in water as follows:
The door shutter shall be immersed vertically to a height of 30 cm in water at room temperature for 24
hours and then allowed to dry for 24 hours at 27 ± 2°C and relative humidity of 65 ± 5 per cent. The cycle shall be repeated eight times. There shall be no delamination at the end of the test.

F-2. KNIFE TEST

(i) *Apparatus :* The type of knife required to be used in the test is given in Fig. below. It may be made from a 250 x 25 mm file. The cutting edge should be kept chiselsharp. The test shall be carried out on a stout table to which a wooden batten is screwed against which the edge of test piece is placed.



Drawing not to scale

KNIFE FOR TESTING PLYWOOD FOR ADHESION OF PLIES

(ii) *Procedure:* The knife is inserted with its cutting edge parallel to the grain of the outer veneer and worked into, or if possible along a glue line and the veneer is prised upwards. A hard and dense specie of plywood requires considerable force to effect entry and to prise and veneer. In a soft timber the knife tends to follow an easy course through the wood and in this case it is essential that the knife be firmly guided along the glue line.
The bond should just pass the requirement, it is judged by the relative amount of wood fibre left on the core veneer, and the area prised off. The grading is assessed chiefly on the appearance of the break.
The force needed to effect separation is also an accompanying requirement.
The bond is ‘excellent’, when it is difficult to find the glue line and impossible to keep the tool within it for more than 6 mm without cutting adjacent wood. On prising upwards, the veneer usually breaks off over a width slightly greater than that of the tool.
The bond is ‘poor’ when knife meets little opposition in the glue line and the prise results in the easy removal of almost all the veneers from one side of the test piece. The separated veneers are usually almost free from adherent fibre.

(iii) *Reporting of test results:* The results shall be reported as 'pass standard' 'excellent' or 'poor'.

F-3. GLUE ADHESION TEST

Four square sections, 150 x 150 mm shall be cut from the corners of the door. These four corner sections as cut from the door shall be immersed in boiling water for 4 hours, then dried at 27 ± 2°C and relative humidity of 65 ± 5 per cent for 24 hours. At the end of the drying period, the samples shall be examined for delamination. In the case of the glue lines in the plywood, all the four exposed edges of the plywood on both faces of a specimen shall be examined for delamination.

A specimen shall be considered to have passed the test if no delamination has occured in the glue lines in the plywood and if no single delamination more than 50 mm in length and more than 3 mm in depth has occured in the assembly glue lines between the plywood faces and the stile and rail.

Delamination at the corner shall be measured continuously around the corner. Delamination at a knot, knot hole, a pitch pocket and worm hole or other permissible wood defects shall not be considered in assessing the sample. A door shall be deemed to have passed this test if three of the four specimens tested pass the test.

1.29 FLASH POINT AND FIRE POINT

AIM

To determine the flash point and the fire point of asphaltic bitumen and fluxed native asphalt, cutback bitumen and blown type bitumen as per IS: 1209 - 1978.

PRINCIPLE

Flash Point - The flash point of a material is the lowest temperature at which the application of test flame causes the vapours from the material to momentarily catch fire in the form of a flash under specified conditions of the test.

Fire Point - The fire point is the lowest temperature at which the application of test flame causes the material to ignite and burn at least for 5 seconds under specified conditions of the test.

APPARATUS

FIG. 29 : PENSKY - MARTENS APPARATUS

i) Pensky-Martens apparatus

ii) Thermometer- Low Range : -7 to 110oC, Graduation 0.5oC High Range : 90 to 370oC, Graduation 2oC

SAMPLE

The sample should be just sufficient to fill the cup upto the mark given on it.

PROCEDURE

A) FLASH POINT

i) Soften the bitumen between 75 and 100oC. Stir it thoroughly to remove air bubbles and water.

ii) Fill the cup with the material to be tested upto the filling mark. Place it on the bath. Fix the open clip. Insert the thermometer of high or low range as per requirement and also the stirrer, to stir it.

iii) Light the test flame, adjust it. Supply heat at such a rate that the temperature increase, recorded by the thermometer is neither less than 5oC nor more than 6oC per minute.

iv) Open flash point is taken as that temperature when a flash first appears at any point on the surface of the material in the cup. Take care that the bluish halo that sometimes surrounds the test flame is not confused with the true flash. Discontinue the stirring during the application of the test flame.

v) Flash point should be taken as the temperature read on the thermometer at the time the flash occurs.

B) FIRE POINT

i) After flash point, heating should be continued at such a rate that the increase in temperature recorded by the thermometer is neither less than 5oC nor more than 6oC per minute.

ii) The test flame should be lighted and adjusted so that it is of the size of a bead 4mm in dia.

REPORTING OF RESULTS

i) The flash point should be taken as the temperature read on the thermometer at the time of the flame application that causes a distinct flash in the interior of the cup.

ii) The fire point should be taken as the temperature read on the thermometer at which the application of test flame causes the material to ignite and burn for at least 5 seconds.

1.30 MARSHALL STABILITY

AIM

To determine the Marshall stability of bituminous mixture as per ASTM D 1559.

PRINCIPLE

Marshall stability is the resistance to plastic flow of cylindrical specimens of a bituminous mixture loaded on the lateral surface.
It is the load carrying capacity of the mix at 60oC and is measured in kg.

APPARATUS

FIG. 30.1 MARSHALL STABILITY APPARATUS

i) Marshall stability apparatus
ii) Balance and water bath

SAMPLE

From Marshall stability graph, select proportions of coarse aggregates, fine aggregates and filler in such a way, so as to fulfil the required specification. The total weight of the mix should be 1200g.

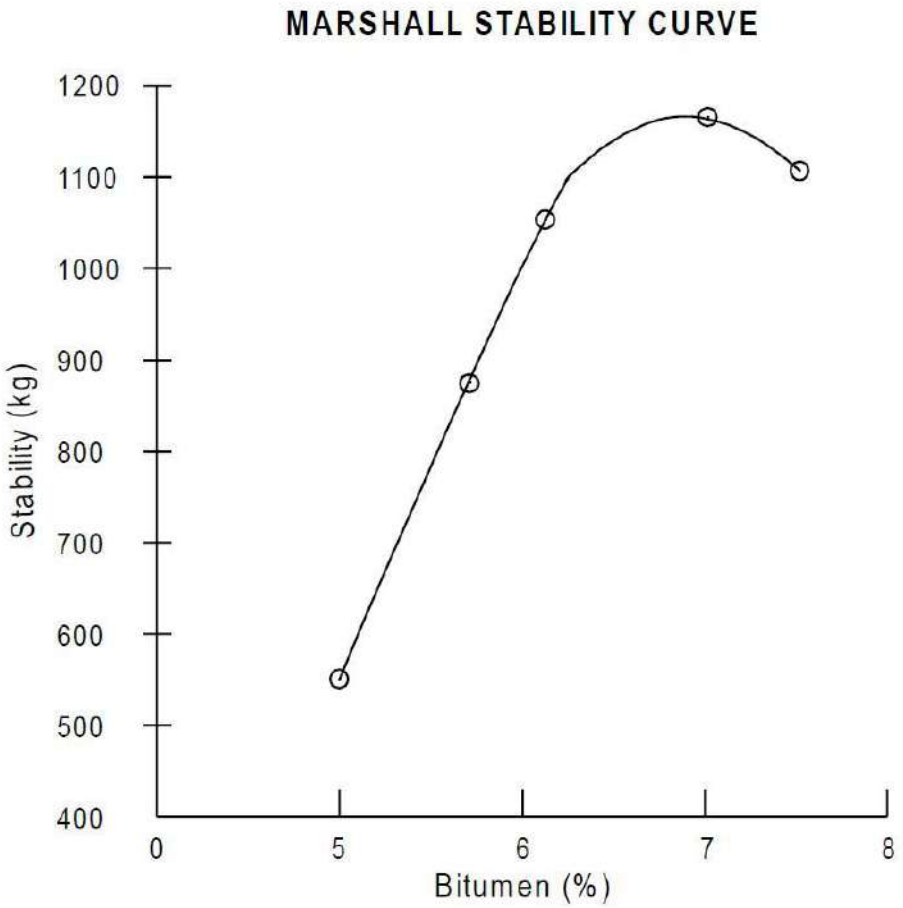
PROCEDURE

i) Heat the weighed aggregates and the bitumen separately upto 170oC and 163oC respectively.
ii) Mix them thoroughly, transfer the mixed material to the compaction mould arranged on the compaction pedestal.
iii) Give 75 blows on the top side of the specimen mix with a standard hammer (45cm, 4.86kg). Reverse the specimen and give 75 blows again. Take the mould with the specimen and cool it for a few minutes.
iv) Remove the specimen from the mould by gentle pushing. Mark the specimen and cure it at room temperature, overnight.
v) A series of specimens are prepared by a similar method with varying quantities of bitumen content, with an increment of 0.5% (3 specimens) or 1 bitumen content.
vi) Before testing of the mould, keep the mould in the water bath having a temperature of 60oC for half an hour.
vii) Check the stability of the mould on the Marshall stability apparatus.

REPORTING OF RESULTS

Plot % of bitumen content on the X-axis and stability in kg on
the Y-axis to get maximum Marshall stability of the bitumen mix.

A sample plot is given below.



1.31 PENETRATION

AIM

To determine the penetration of bitumen as per IS: 1203 - 1978.

PRINCIPLE

The penetration of a bituminous material is the distance in tenths of a mm, that a standard needle would penetrate vertically, into a sample of the material under standard conditions of temperature,
load and time.

APPARATUS

FIG. 31.1 : PENETROMETER

i) Penetrometer

ii) Water bath

iii) Bath thermometer - Range 0 to 44oC, Graduation 0.2oC

SAMPLE

Bitumen should be just sufficient to fill the container to a depth of at least 15mm in excess of the expected penetration.

PROCEDURE

i) Soften the bitumen above the softening point (between 75 and 100oC). Stir it thoroughly to remove air bubbles and water.

ii) Pour it into a container to a depth of at least 15mm in excess of the expected penetration.

iii) Cool it at an atmospheric temperature of 15 to 30oC for 1 ½ hrs. Then place it in a transfer dish in the water bath at 25.0 + 0.1oC for 1 ½ hrs.

iv) Keep the container on the stand of the penetration apparatus.

v) Adjust the needle to make contact with the surface of the sample.

vi) Adjust the dial reading to zero.

vii) With the help of the timer, release the needle for exactly 5 seconds.

viii) Record the dial reading.

ix) Repeat the above procedure thrice.

REPORTING OF RESULTS

The value of penetration reported should be the mean of not less than three determinations expressed in tenths of a mm.

1.32 SPECIFIC GRAVITY

AIM

To determine the specific gravity of semi-solid bitumen road tars, creosote and anthracene oil as per IS: 1202 - 1978.

PRINCIPLE

It is the ratio of mass of a given volume of bitumen to the mass of an equal volume of water, both taken at a recorded/specified temperature.

APPARATUS

FIG. 32.1 : SPECIFIC GRAVITY BOTTLES

i) Specific gravity bottles of 50ml capacity

ii) Water bath

iii) Bath thermometer - Range 0 to 44oC, Graduation 0.2oC

SAMPLE

Take the sample (half the volume of the specific gravity bottles).

PROCEDURE

i) Clean, dry and weigh the specific gravity bottle alongwith the stopper (Weight 'A').

ii) Fill the specific gravity bottle with freshly boiled distilled water and insert the stopper firmly. Keep it in the water bath having a temperature of 27.0 + 1oC for not less than half an hour and weigh it (Weight 'B').

iii) Weigh the specific gravity bottle about half-filled with the material (Weight 'C').

iv) Weigh the specific gravity bottle about half-filled with the material and the other half

with distilled water (Weight 'D').

v) Weigh the specific gravity bottle completely filled with the material (Weight 'E').

REPORTING OF RESULTS

i) specific gravity (Solids and semi-solids) $= \frac{C-A}{(B-A)-(D-C)}$

ii) specific gravity (Solids and semi-solids) $= \frac{C-A}{(B-A)-(D-C)}$

The average of the two results should be reported.

1.33 SOFTENING POINT

AIM

To determine the softening point of asphaltic bitumen and fluxed native asphalt, road tar, coal tar pitch and blown type bitumen as
per IS: 1205 - 1978.

PRINCIPLE

It is the temperature at which the substance attains a particular degree of softening under specified condition of the test.

APPARATUS

FIG. 33.1 : RING AND BALL APPARATUS

i) Ring and ball apparatus

ii) Thermometer - Low Range : -2 to 80^{o}C, Graduation 0.2^{o}C- High Range : 30 to 200^{o}C, Graduation 0.5^{o}C 83

PREPARATION OF SAMPLE

i) The sample should be just sufficient to fill the ring. The excess sample should be cut off by a knife.

ii) Heat the material between 75 and 100^{o}C. Stir it to remove air bubbles and water, and filter it through IS Sieve 30, if necessary.

iii) Heat the rings and apply glycerine. Fill the material in it and cool it for 30 minutes.

iv) Remove excess material with the help of a warmed, sharp knife.

PROCEDURE

A) Materials of softening point below 80^{o}C:

i) Assemble the apparatus with the rings, thermometer and ball guides in position.

ii) Fill the beaker with boiled distilled water at a temperature 5.0 ± 0.5^{o}C per minute.

iii) With the help of a stirrer, stir the liquid and apply heat to the beaker at a temperature of 5.0 ± 0.5^{o}C per minute.

iv) Apply heat until the material softens and allow the ball to pass through the ring.

v) Record the temperature at which the ball touches the bottom, which is nothing but the softening point of that material.

B) Materials of softening point above 80^{o}C: The procedure is the same as described above. The only difference is that instead of water, glycerine is used and the starting temperature of the test is 35^{o}C.

REPORTING OF RESULTS

Record the temperature at which the ball touches the bottom.