



MAZAGON DOCK SHIPBUILDERS LIMITED

(Formerly known as Mazagon Dock Ltd.)

CIN: U35100MH1934GOI002079

(A Government of India Undertaking)

Dockyard Road, Mazagon,

Mumbai 400 010.

INDIA

Repairs & renovation works at Module Shop, SY, MDL

Specification for Civil work

TECHNICAL SPECIFICATIONS FOR CIVIL WORKS

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CIVIL WORK

1. LIST OF PREFERRED MAKE:

Following are the list of preferred makes to be used in execution of works, unless otherwise specified in Bill of Quantities.

S.N.	DESCRIPTION OF MATERIAL	MAKE OF MATERIALS
1.	Plywood	Anchor / Archid / Century / Kenwood / Garnet / Samrat / Green / Prince / Mayur (6mm, 9mm, 12mm, 19mm or any other thickness.
2.	Laminates	Formica / Greenlam / Century / Signature / Heritage / Archid / Bravia Newmica / Kitmica
3.	Block board	Anchor / Century / Archid / Green / Marino / Multiply
4.	Soft Board (pin up board)	Jolly board, Western India plywood.
5.	Gyp. Board	India gypsum
6.	Vertical blinds	Vista, Mac, Universal
7.	Screws	GKW / Mettle fold
8.	Brass hinges	Magnum, Reliance, Punit heavy duty.
9.	Hardware	Shalimar, Everite, Reliance(brass powder coated)
10.	Drawer shutter lock	Godrej / Vijayan - (3 set of keys).
11.	Ball catch	Magnetic (M-2) / Brass.
12.	Door lock / handles	4-C ACME, Golden, Godrej, Ultra.
13.	Veneer	Anchor / URO / Durian / Century.
14.	Adhesives	Fevicol (SH), Mowicoll, Mahacol, Araldite
15.	Wood preservatives	Woodguard, PCI, Black Japan.
16.	Door closure	Efficient gazets, Everite Hyper.
17.	Glass	Modi / Saint Gobain / Hindustan Palington / Asahi / Triveni
18.	Melamine Polish	Asian paint, MRF, Nerolac.
19.	Paint	Burger, Nerolac, Asian, Dulux, Tractor.
20.	Vitrified/ Ceramic/Glazed Tiles	Nitco, Kajaria, RAK, Bells, Johnson / Regency/Bells
21.	Aluminium sections	Jindal / Indal
22.	Floor springs	Everite / Hemco / Hyper / ozone
23.	Wood preservative	Asian paint / Pidilite / MRF
24.	Cement	Ultratech/ ACC / Ambuja / Birla
25.	White cement	Birla cement, JK cement
26.	Putty	Birla White Putty
27.	Sun control film	Garware, LG
28.	Stainless steel sink	Nirali / Diamond
29.	Steel (Thermo Mechanically Treated Steel) High strength deformed bars or mild steel reinforcement (TOR-Steel)	TATA, SAIL, JSW ,RINL, Jindal, Ispat
30.	Clay Bricks	Good quality locally available material approved by Engineer / Architect

S.N.	DESCRIPTION OF MATERIAL	MAKE OF MATERIALS
31.	Water proofing material / compound.	Sika / Roff / Sunanda / Krishna Conchem
32.	Panelled Doors	National / Century / Swastik / Kitply
33.	P.V.C. Doors	Sintex
34.	Red Oxide	Asian
35.	Acrylic Exterior paint	Asian Ultra/Nitcotex / Sandtex / Berger Weathershield
36.	Glazing	Saint Gobain/"Hindustan Pilkington"/ Tiveni, Modi/ Asahi
37.	Iron monjires and brass fittings	Enox, Archis, doorset, ozone, dorma,
38.	Vitreous sanitary ware (ISI mark)	Jaquar/Hindustan sanitary ware/parry ware/Bells/Cera
39.	Seats & Covers solid (W.C.)	Jaquar/Hindustan sanitary ware/parry ware/Bells / Cera
40.	PVC Low level flushing cisterns	Jaquar / Parryware / Hindustan /Sanitary Wall
41.	C P Fittings / Toilet Accessories ISI Marked	Jaquar / Plumber
42.	UPVC Pipes (S/W/R Pipes)	Supreme / Finolex / Prince
43.	G.I. Pipes (B-Class)	Tata / Zenith
44.	G.I. Fittings (ISI Brand)	Unik / AMCO
45.	S.W. Pipes / Fittings & Gully traps	Perfect / Trimurti
46.	Ball valves	Zoloto
47.	C.I. Manhole Cover	RIF / BIC / Neco
48.	R.C.C. Pipes	Indian Hume pipe
49.	Sanitary Fixture	Jaquar/Hindware / Parryware / Cera.
50.	PVC Fittings (Moulded)	Finolex / Prince
51.	Non-return valve	Intervalve
52.	Stoneware Pipe and fittings	Trimurti / Perfect Potters / Bharat
53.	Stoneware Pipe and fittings	Trimurti / Perfect Potters / Bharat

- Note** (i) Wherever make is specified in BOQ, the same shall prevail over list of preferred make.
(ii) Wherever specification of BOQ item is not mentioned; then CPWD specification shall be applicable.
(iii) Wherever make is specified in BOQ then manufacture's specifications & procedure shall be applicable.
(iv)Wherever no specifications or make is specified than work is to be carried out as per the written instruction of the Engineer-In-Charge

2. GENERAL:

2.1. Materials

All materials required to complete the works shall be procured by the contractor including steel and cement unless specified. All materials shall be of Indian origin of the best quality of their respective kinds as specified and shall conform strictly to the stipulations laid down by the latest Indian Standards. Standards issued elsewhere may be used only if approved by the Engineer-In-Charge and for those materials only for which appropriate Indian Standard does not exist.

2.2. Sampling and Testing

The Contractor shall submit adequate number of samples of materials to the Engineer-In-Charge for approval giving all relevant information like source of supply, availability, etc. The approved samples shall be deposited with the Engineer-In-Charge, whenever so instructed.

The Engineer-In-Charge may order such tests and analysis as per requirement and as considers necessary and the Contractor shall bear the cost of all sampling and testing which is in consonance with the Indian Standards.

If tests on materials lead to rejection of the particular consignment, notwithstanding the results of the tests at the manufacturer's works or elsewhere or of test certificates or of any approval given earlier, such materials shall be removed forthwith from the site by him at his own cost and replaced by other proper consignment. All charges in connection with of the new materials shall be borne by the Contractor.

Samples required for approval and testing must be supplied well in time to allow for testing and approval, due allowance being made for the fact that if the first samples are rejected, further samples may be required. Delay to the Works arising from the late submission of samples will not be acceptable as a reason for delay in the completion of the Works.

2.3. Storage of Materials

Generally stacking and storage of construction materials at site shall be as per recommendations in IS: 4082. All materials required to be incorporated in the Works shall be stored in racks in bins, under cover etc. as appropriate and as amplified in the succeeding clauses to prevent deterioration or damage from any cause whatsoever to the satisfaction of the Engineer-In-Charge.

2.4. Records & Usage of Materials

The Contractor shall maintain detailed records of all materials received at Site or in his workshop and also about the consumption, balance in stock etc. and shall make such records available to the Engineer-In-Charge, if asked for.

Depending on the types of materials the same should be used in the order in which they arrive at site and as directed by the Engineer-In-Charge.

2.5. Contractor's Responsibility

The Contractor shall be responsible for keeping the material in sound and acceptable condition from the time of consignment of any material is received at site and till its consumptions. Any material not approved for use shall be removed from the site at Contractor's cost.

2.6. Workmanship

In all cases the work shall be carried out in accordance with the latest Indian Standard Specifications and the best Engineering practice. In the absence of such specifications, work shall be executed in accordance with any other relevant standards issued elsewhere as approved by the Engineer-In-Charge or as per the instructions and directions of the Engineer-In-Charge.

2.7. Constructional Plant (s)

The Contractor shall be responsible for the supply, use and maintenance of all Constructional Plant and Equipment so as to ensure smooth and efficient working of the job at his own cost. The Engineer-In-Charge shall have access to the Plant at all times.

2.8. Workmen and Staff

The Contractor shall ensure that they employ only capable and experienced labour force, foremen, other tradesmen and supervisory staff on the job capable of handling the types of work assigned to them in a workmanlike and efficient manner to the satisfaction of the Engineer-In-Charge. They shall also ensure that his Sub-contractors or nominated Sub-contractors also employ all workmen and supervisory staff capable of delivering work of a high standard.

For all concrete work trained and experienced personnel at site shall be deployed.

2.9. Method of Measurement

Mode of measurement shall be in accordance with the relevant parts of IS: 1200 "Method of Measurement of Building and Civil Works" only, unless otherwise specified in various item wise specifications describes herein below.

2.10. Rates and Prices

Unless otherwise mentioned, the rates and prices set against items in the bill of quantities or which can be reasonably inferred there from complete as a functioning entity shall include all costs and expenses which may be required in and for the construction of the work such as- material to be incorporated in the works (permanent/ temporary), labour required for all operations, temporary works, tools and equipments as required, all operations required for the completion and or maintenance of the relevant items as per specifications, all leads and lifts unless otherwise specifically mentioned in the items, including all general risks, liabilities and obligations set forth or implied in the documents on which the tender is based.

2.11. List of Bureau of Indian Standard Codes (BIS)

Following is the consolidated list of various Indian Standards relevant to the civil works appearing in this specification.

S. No	IS Code No	Particulars
1	IS : 4082-1977	Carriage of materials. Recommendation of stacking and storage of construction materials at sites. (1st revision) (Reaffirmed-1990)
2	IS:1200 (Part 22)-1988	Method of Measurement of Building & Civil Engineering Works-Part 22-Materials
3	IS : 17293-1974	Safety code for working with construction machinery
4	IS : 7969-1975	Safety code for handling & storage of building materials
5	IS : 8989-1978	Safety code for erection of concrete framed structures
6	IS : 4014 (part 2) 1967	Code of practice for steel tubular scaffolding – Part 2 – Safety regulations for scaffolding
7	IS:13416 (Part 1) 1992	Preventive measures against hazards at work places – Part 1 – Falling material hazard prevention.
8	IS : 13416 (Part 2)1982	Preventive measures against hazards at work places recommendations – Fall prevention.
9	IS: 13416 (part 3) 1994	Preventive measures against hazards at work places – Recommendations – Part 3 – Disposal of debris (MULBA)
10	IS : 13416 (Part 5) 1994	Preventive measures against hazards at work places – Recommendations – Part 5 – Fire protection

GENERAL

EARTHWORK

S. No	IS Code No	Particulars
1	3764	Safety code for excavation work
2	6313 (Part-II)-1981	Code of Practice for Anti-termite measures in Buildings (Part-II) Pre-constructional Chemical Treatment measures (1 st Revision) (Amendments 3) (Reaffirmed-1991)

MORTARS

S. No	IS Code No	Particulars
1	650	Specification for standard sand for testing of cement
2	3025	Method of sampling and test for water
3	8112	Specification for 43 grade ordinary Portland cement
4	12269	Specification for 53 grade ordinary Portland cement.

CONCRETE WORK

S. No	IS Code No	Particulars
1	383	Specification for coarse & fine aggregate from Natural Source for Concrete.
2	456	Code of Practice for plain and reinforced concrete.
3	516	Method of test for strength of concrete
4	1199	Method of sampling and analysis of concrete
5	1200 (Part II)	Method of measurement of building and civil engineering work (concrete work)
6	1322	Specification for bitumen felt for waterproofing and damp proofing
7	1791	Specification for batch type concrete mixers
8	2386(Part I to IV)	Method of test for aggregate for concrete work
9	2505	General requirement for concrete vibrators immersion type
10	2506	General requirement for screed board concrete vibrators
11	3812	Specification for fly ash for use as Pozzolana and admix
12	4656	Specification for form vibrators for concrete

REINFORCED CEMENT CONCRETE WORK

S. No	IS Code No	Particulars
1	432 (Part I &II)	Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement Part-I mild steel and medium tensile steel bars
2	1200 (Part V)	Method of measurement of building and civil engineering work – concrete work (Part 5 – Form work)
3	2505	Code of Practice for bending and fixing of bars for concrete reinforcement
4	2751	Recommended practice for welding of mild steel plain and deformed bars for reinforced construction
5	4925	Batch plants specification for concrete batching and mixing plant
6	9103	For admixtures for concrete

BRICK WORK

S. No	IS Code No	Particulars
1	1200 (Part 3) 1976	Method of measurements of building and civil engineering works: Part 3 brick work (3 rd revision) Reaffirmed 1992
2	2212-1991	Code of practice for brick work (1 st revision)
3	1905-1980	Code of Practice for structural safety of buildings - Masonry wall
4	2116-1980	Specification for sand for masonry mortars (1 st revision)

MARBLE/GRANITE / STONE WORK

S. No	IS Code No	Particulars
1	3316 – 1974	Granite slabs

WOOD WORK

S. No	IS Code No	Particulars
1	287-1973	Recommendations for maximum permissible moisture content of timber used for different purposes (3 rd revision)
2	1200 (Part XII) 1973	Wood work and joinery (2 nd revision) (Amendment 1) (Reaffirmed 1992)
3	2202 (Part I &II) 1991	Specification for wooden flush door shutters (solid core type) plywood face panels (5 th revision) (Amendments 2)
4	3087-1985	Specification for wood particle boards (medium density) for general purposes (1 st revision) (Amendments 4) (Reaffirmed 1990)
5	4021-1995	Timber door, window and ventilator frames.
6	883	Defects permissible
7	1708 (Part – I)	Moisture Content
8	2095	Gypsum Board

STEEL WORK

S. No	IS Code No	Particulars
1	800-1984	Code of practice for use of structural steel in general in steel construction (2 nd revision) (Amendments 2) (Reaffirmed 1991)
2	806-1968	Code of practice for use of steel tubes in general building construction (1 st Revision) (Amendment 1) (Reaffirmed 1991)
3	812-1978	Glossary of terms relating to welding and cutting of metals (Reaffirmed 1991)
4	813-1986	Scheme of symbols for welding (revised) (Reaffirmed 1991)

5	816-1969	Code of practice for use of metal arc welding general construction in mild steel (1 st revision) (Amendments 2) (Reaffirmed 1992)
6	818-1968	Code of practice for safety and healthy requirements in electric and gas welding and cutting operations (1 st revision) (Reaffirmed 1991)
7	822-1970	Code of procedure for inspection of welds (Reaffirmed 1991)
8	1200-1993 (Part VIII)	Method of measurements of building and civil engineering works steel work and iron works (4 th revision)

FLOORING

S. No	IS Code No	Particulars
1	777-1988	Specification for glazed earthenware wall tiles (2 nd revision) (Superseded by IS 13753, 13754, 13755, 13756)
2	1130-1969	Specification for marble (Blocks, slabs and tiles) (Reaffirmed 1993)
3	1200-1977	Method of measurement of building and civil engineering work (Part XI) paving, floor finishes, dado and skirting) (3 rd revision) (Amendment 1) (Reaffirmed 1992)
4	2571-1970	Code of practice for laying in situ cement concrete flooring (1 st revision) (Reaffirmed 1991)
5	8042-1989	Specification for white Portland cement (2 nd revision) (Amendments 4)
6	13755	Ceramic tiles
7	4457 – 1982	Ceramic unglazed vitreous acid resting tiles
8	3462	PVC flooring (Vinyl Tiles)

FINISHING

S. No	IS Code No	Particulars
1	104-1979	Specification for ready mixed paint, brushing, zinc chrome, priming (Reaffirmed 1993) (2 nd Revision)
2	109-1968	Ready mixed paint, brushing, priming plaster to Indian Standard colour No.361.631 white and off white (Reaffirmed 1993) (1 st Revision)
3	290-1961	Coal tar black paint (Reaffirmed 1991) Revised
4	419-1967	Putty for use on window frames (Reaffirmed 1992) (Revised)
5	428-1969	Distemper, oil emulsion, colour as required (Reaffirmed 1993) (1 st Revision)
6	1200-1976 (Part XII)	Method of measurements of building and civil engineering works: Part XII – Plastering and pointing (Reaffirmed 1992) (3 rd Revision)
7	1200-1994 (Part XIII)	Method of measurements of building and civil engineering works: Part XIII – white washing, colour washing, distempering and painting of building surfaces (5 th Revision)
8	1200-1987 (Part XV)	Methods of measurements of building and civil engineering works: Part XV – Painting, polishing, varnishing etc. (Reaffirmed 1992) (4 th Revision)
9	2932-1994	Enamel, synthetic, exterior (a) undercoating (b) Finishing (2 nd Revision)
10	5410-1992	Cement paint (1 st Revision)
11	1661	Application of plaster
12	1542	Plaster for sand
13	2645	Integral waterproofing compound
14	2395 (Part I & II)	Painting workmanship

DISMANTLING AND DEMOLITION

S. No	IS Code No	Particulars
1	1200-1974	Method of measurements of building and civil engineering works: Part XVII: Demolition and dismantling (Reaffirmed 1992) (3 rd Revision)

MISCELLANEOUS

S. No	IS Code No	Particulars
1	2721	G.I. chain link fencing

ALUMINIUM WORK

S. No	IS Code No	Particulars
1	1285-1975	Specification for wrought aluminium and aluminium alloy, extruded round tube and hollow sections (for general engineering purposes)
2	1868-1996	Anodic coatings on aluminium and its alloys – Specification
3	1948-1961	Specification for aluminium doors, windows and ventilators (Reaffirmed 2001)

WATER PROOFING

S. No	IS Code No	Particulars
1	2645-1975	Specification for integral cement water proofing compounds.
2	1077	Brick bats

3. EARTH WORKS:

3.1. Earthwork in Excavation & Backfilling

General

Any excavation shall be started only after recording the existing ground levels jointly with the Engineer-In-Charge.

Classifications

All materials to be excavated shall be classified by Engineer-In-Charge, into one of the following classes and shall be paid for at the rate tendered for that particular class of material. No distinction shall be made whether the material is dry, moist or wet. The decision of Engineer-In-Charge regarding the classification of the materials shall be final and binding on Contractor.

Earthwork will be classified under any of the following categories –

(a) Ordinary / soft Soils

These shall include all kinds of soils containing kankar, sand, silt, moorum and / or shingle, gravel, clay, loam, peat, ash, shale etc. which can generally be excavated by spade, pick axes and shovel. This shall also include embedded rock boulders not longer than 0.5 metre in any direction and not more than 200mm. in any one of the other two directions.

(b) Hard soil / Rock

This shall include rock, boulders, slag, chalk, slate, hard mica schist, laterite and all other materials which in the opinion of Engineer-In-Charge is rock, and could be removed with picks, hammer, crow bars, wedges and pneumatic breaking equipment.

This shall also include excavation in macadam and tarred roads and pavements and masonry to be dismantled as also rock boulders not longer than 0.5 metre in any direction and not more than 200 mm. in any one of the other two directions.

Method of Excavation

Depending on the type of material, quantum of excavation and time for construction, the Contractor may carry out the work manually or by use of appropriate mechanical equipment.

Details of Works

Dimensions / Levels

Excavation for permanent work shall be carried out to the correct dimensions, lines and levels and profiles shown on the drawings or as directed by the Engineer-In-Charge. Rough excavation shall be carried out to a depth 150 mm. above the final level. The balance shall be excavated with special care. Soft pockets shall be removed even below the final level and extra excavation filled up as directed by the Engineer-In-Charge.

Shoring and strutting

The Contractor shall provide and maintain all planking and strutting as may be necessary to prevent any ground movement.

Excavation to be kept dry

The Contractor shall keep all excavation free from water, whether from sub-soil or from rains or from any other source, by pumping or other approved means.

Sides and bottom of excavation

Excavation shall be left open for as short period as practicable and necessary. Immediately before foundations or other work be constructed therein, the sides of excavation shall be trimmed, if necessary and the bottom shall be cleaned, free of loose or disturbed ground, dry well rammed and approved by the Engineer-In-Charge.

Stacking / Removal of excavated material

Stacking, dumping, spreading at site or removal from site of excavated material shall be strictly as approved by the Engineer-In-Charge.

Excavated material suitable for filling shall be dumped in an orderly manner to required levels / grades as directed. All surplus material or material not suitable for filling shall be carried away from site to approved dumping ground.

Backfilling

All return fill in excavated trenches, pits etc. shall consist of materials selected from excavation or elsewhere and shall be dry, friable and free from clay and plastic material, mud, vegetable, salts, sulphates and organic matter likely to decay and shall be subject to the Engineer-In-Charge's approval before use. All clods of earth shall be removed or broken. Where excavated material is mostly rock, it shall be broken to pieces not larger than 150mm size and mixed with properly graded murum or equivalent approved material. Filling shall be placed in layers not exceeding 150mm well watered & consolidated by mechanical compaction machines or manually to achieve 95% proctor density if permitted by the Engineer-In-Charge and to the satisfaction of the Engineer-In-Charge.

4. MORTARS:

4.1. Cement

Standard

Cement to be used in the Works shall be conforming to the following IS standards codes-

- 43 Grade Ordinary Portland Cement : IS 8112
- Portland Pozzolana Cement (fly ash based) : IS 1489 (part-I)

Supply & Storage

The cement to be used on works shall be OPC or PPC (fly ash based) as specified. Unless otherwise specified, Ordinary Portland Cement or PPC shall be supplied in bags containing 50 Kg. each. Stacking of cement rejected due to aging or not fulfilling IS requirements shall be at the cost of the Contractor. Cement held in storage for a long period shall be re-tested before its use, if directed by Engineer in charge.

Tests

A certified report, attesting the conformance of the cement to IS Specifications by the cement manufacturer shall be furnished to the Engineer-In-Charge, by the contractor.

Samples of cement shall be taken immediately on receipt of cement at site. The methods and procedure of sampling shall be as per **IS 3535**. Tests shall be carried out for fineness, initial and final setting time and compressive strength as per **IS 4031**.

Supplier of cement shall furnish the following documents before the cement is delivered to site
-

Certificate conforming that chemical composition and physical characteristics are within the stipulated values for types of cement supplied as per relevant codes.

Certificate conforming that the chloride content in the cement is not in excess of 0.05 per cent of mass of cement.

If during subsequent testing of cement supplied in lots any of the properties are found to be outside the acceptable limits, the lot of cement shall be rejected.

Each 1000 bags or part thereof of cement or each wagon load of cement shall constitute one lot of cement for the purpose of conducting tests at site.

Samples for testing at site shall be taken at random from 2% of the total quantity supplied in one lot. For cement supplied in bags, samples shall be drawn from minimum of 5 bags and the 2% value shall be rounded to the next higher integer. For bulk cement, sampling shall be done with the help of slotted sampler to be as per IS 3535.

Results of test conducted on samples drawn shall be submitted to the Engineer-In-Charge for his approval. If in the opinion of the Engineer-In-Charge, the test results are not within permissible limits, the lot of cement from which samples have been obtained for testing shall stand rejected and the material shall be removed from site.

Following tests shall be conducted at site on each lot of cement delivered if required as per the instructions of Engineer – In – Charge.

TABLE 1

Mandatory tests	Number of test/lot
1 Consistency of standard cement paste	5
2. Initial and final setting time	5 each
3. Compressive strength test	10

Mean values of the results from the above results shall be taken as the representative value and the acceptance criteria shall be based on these test. All test procedures and computation of test results shall be as per IS 4031.

Apart from mandatory tests specified as above, the Engineer-In-Charge may at his discretion, call for any additional tests that he may consider necessary. All such tests shall be done on representative samples taken from each lot described above para and testing and computation of test results shall be done as per IS 4031. Charges for such testing shall be born by the contractor.

4.2. Fine Aggregate

Standard

Fine aggregate for different end uses (other than lightweight concrete) shall conform to the following standards:

For Structural Concrete - IS: 383 (between Grading Zones I & II)
For Mortar & Grout - IS: 2116
For Plastering - IS: 1542 (Class A grading)

Fine aggregate shall consist of natural sands or machine crushed rock/gravel. It shall be clean, sharp, hard, strong and durable and free from dust, vegetable substances, adherent coating, clay, loam, alkali, organic matter, mica, soluble sulphate, gypsum or any other deleterious substances which can be injurious to the setting qualities / strength / durability of concrete. **Use of sea sand is prohibited.**

Source

Once a specific source of supply of fine aggregate is accepted, the source shall not be changed without prior approval of the Engineer-In-Charge.

Storage

Fine aggregates shall be stored at site in adequate quantity on clean and well maintained hard floor and areas not liable to flooding. Contamination with foreign matter and earth shall be avoided during storage and while heaping the materials.

Usage

Fine aggregate shall be thoroughly washed at site with clean fresh water such that the percentage of all deleterious matter is within the permissible limits as laid down in IS 2386 (Part-II).

Screening of sand shall be done if necessary, and as and when directed by the Engineer-In-Charge to remove all objectionable foreign matter and effecting any grading.

4.3. Water

Standard

Water supplied shall conform to the various provisions detailed under Clause 5.4 of IS 456:2000. Broadly stated water used for mixing and curing as also for cooling / washing of aggregates shall be clean and fresh, free from oils, acids, alkalises, salts, sugar, organic materials or other substances that may be deleterious to concrete or steel. Sea water or water from excavation shall not be used.

Potable water is generally considered satisfactory for mixing concrete. As a guide the following concentration represent the maximum permissible values:

To neutralize 100 ml sample of water, using phenolphthalein as an indicator, it should not require more than 5ml of 0.02 normal NaOH. The test shall be conducted as detailed in 8.1 of IS 3025 (Part 22).

To neutralize 100ml sample of water, using mixed indicator, it should not require more than 25ml of 0.02 normal H₂SO₄. The test shall be conducted as detailed in 8 of IS 3025 (Part 23).

Permissible limits for solid content shall be as given in the table below:

TABLE 2

SI. No.	Particulars	Tested as per	Permissible limits Max
i)	Organic	IS 3025 (Part 18)	200 mg/l
ii)	Inorganic	IS 3025 (Part 18)	3000 mg/l
iii)	Sulphates (as SO ₃)	IS 3025 (Part 24)	400 mg/l
iv)	Chlorides(as Cl)	IS 3025 (Part 32)	2000 mg/l for concrete not consisting embedded steel & 500 mg/l for reinforced concrete work
v)	Suspended matters	IS 3025 (Part 17)	2000 mg/l

Storage

Water shall be so stored that it remains free from all deleterious materials as mentioned above.

Tests

No water shall be used until tested for its chemical and other impurities in accordance with IS 3025 to ascertain its suitability. Tests shall be conducted whenever the source is changed or during seasonal variation.

4.4. Fly Ash

Material

Fly ash is a finely crushed residue resulting from the combustion of pulverised coal in boilers. Fly ash used shall be as per IS: 3812-1981. It shall be clean and free from any contamination of bottom ash, grit or small pieces of pebbles. Fly ash adding is meant for use to improve grading of its pozzolanic properties. Grades and proportion of fly ash shall be as specified in the item description in accordance with relevant IS provision. It is obligatory on the part of supplier/ manufacturer that the fly ash conforms to the requirement if mutually agreed & shall furnish a certificate to this effect to the purchaser or his representative.

Fly ash shall be protected from dirt collecting on it.

4.5. Mortar Mixing

Cement and sand in the specified proportion shall be mixed in dry thoroughly by using mechanical mixer or by hand mixing, if permitted. Composition (cement and sand mortar, or lime and sand mortar or cement, lime and sand mortar) and proportions of mortars shall be as specified in the respective items of work. The ingredients of the mortar shall be accurately gauged by measure.

Precaution

Mortar shall be used as soon as possible after mixing and before it begins to set, and in any case within half hour, after the water is added to the dry mixture.

PLAIN CEMENT CONCRETE (PCC) WORKS:

4.6. Cement

Cement shall be as specified under –Mortars specifications.

4.7. Aggregate

4.7.1. Coarse Aggregates

Standard

Coarse aggregate for use in concrete (other than light weight concrete) shall conform to IS 383.

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

Coarse aggregate shall consist of natural or crushed stone, angular in shape with granular or crystalline surfaces or approved river shingle or gravel, rounded in shape. All aggregate shall be clean and free from elongated, friable, flaky or laminated pieces, adherent coatings, clay lumps, mica, organic matter and any other deleterious matter that may cause corrosion of reinforcement or impair the strength and / or durability of concrete. It shall be chemically inert, hard, strong, dense, and durable against weathering.

The maximum quantities of deleterious materials in the coarse aggregate shall not exceed the limits indicated in the IS 383 when tested as per IS 2386 Part-I & Part-II “Method of Tests for Aggregate for Concrete”.

Source

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

Supplier of aggregates shall furnish the following information before the material is delivered to site:

Precise location of source from where the material is to be supplied

Trade group of principal rock type as per table given below

Presence or reactive minerals.

TABLE 3

Trade group names of aggregates	Granite, Gabbro, Dolerite, Rhyolite,
To be used for concrete	Basalt, Quartzite, Gneiss

The supplier shall also furnish reports of test results giving the following information for approval to Engineer-In-Charge before delivery of material at site:

- Specific gravity
- Bulk density
- Moisture content
- Absorption value
- Aggregate crushing strength
- Aggregate impact value
- Abrasion value
- Flakiness index
- Elongation index
- Limits of deleterious substances in the aggregate
- Soundness of aggregate
- Potential reactivity of aggregates

Storage

Coarse aggregate of available sizes shall be stored at site as separate stacks over clean and well maintained hard floor and areas not liable to flooding. Alternatively they will be stored in bins.

Contamination with foreign materials and earth during storage and while heaping the materials shall be avoided. It shall be kept in layers not exceeding 1.2 m in height to prevent coning or segregation.

Usage

Coarse aggregate, which is not clean, shall be washed with clear fresh water before use in the job. Screening would be done if considered necessary by the Engineer-In-Charge without extra cost.

Tests

All test shall be conducted in accordance with IS 2386 (Part I to VIII).

In addition to above, the following tests shall be carried out on representative samples from every lot of aggregates after delivery at site. These test results are to be submitted to the Engineer-In-Charge for his approval. Acceptance criteria for aggregates shall be based on the results of this set of tests only. If in the opinion of the Engineer-In-Charge, the test results are not within permissible limits, the lot of aggregates from which the samples have been obtained for testing shall stand rejected and the material shall be removed from the site.

Mandatory Tests on Aggregates at site shall be min. 3 on each 10 cub.m or part there of as per IS: 2386. Mean value of the results from site test shall be taken as the representative value and the acceptance criteria shall be based on these. All test procedures & computations for test results shall be as per IS 2386.

Apart from above, the Engineer-In-Charge may at his discretion, call for any additional tests that he may consider necessary. Sampling, procedure and computations for such test shall be done in accordance with IS 2430 and IS 2386 as applicable.

4.7.2. Fine Aggregates

Fine aggregates shall be as specified under –Mortars specifications.

4.7.3. Water

Water shall be as specified under –Mortars specifications.

4.7.4. Fly Ash:

Fly ash shall be as specified under -Mortars specifications.

4.7.5. Admixtures:

Admixtures if required shall be as specified under RC Concrete specifications.

4.7.6. Placing of Cement Concrete

Placing of cement concrete shall be as specified under- Reinforce Cement Concrete specifications (relevant as applicable). All concrete shall be protected against damage until final acceptance by the Engineer-In-Charge.

4.8. Formwork

Formwork may be of timber, plywood, steel or other metal, plastic or concrete or any suitable material as per the direction of Engineer-In-Charge.

Formwork (or shuttering) comprises all forms and moulds made up of planks and sheeting etc., shores, bracings and struts, ties, anchors and hangers, steel rods, bolts and allied inserts, uprights, walling, wedges and all other temporary supports for concrete work during the process of concreting and setting.

Form work design parameters and specifications shall be as specified under- Reinforce Cement Concrete (relevant as applicable).

4.9. Measurement

All measurements shall be as per relevant part of IS 1200. Any work done in excess over the specified dimensions or sections shown in the drawing shall be ignored.

Concrete work executed under water, in liquid mud or under foul positions shall be measured separately as instructed by the Engineer-In-Charge.

No deductions shall be made for- Opening up to 0.1 sq.m, volume occupied by pipes, conduits, sheathing, small voids etc.

4.10. Steel Reinforcement

Standard

Steel reinforcing bars shall conform to the following standards –

- Mild steel & medium tensile steel bars - IS: 432 (Part-I)
- High yield strength deformed steel bars - IS: 1786
- Hard- drawn steel wire fabric - IS: 1566
- Structural steel, Grade A - IS: 2062

Binding wire shall conform to IS 280 and shall be soft drawn mild steel wire of size not less than 1.5 mm. in dia. (16 g.)

All reinforcement shall be free from loose mill scales, loose rust and coats of paints, oil, mud or any other substances, which may destroy or reduce bond.

Supply

Supply of reinforcement for the Works shall be arranged by the Contractor as per the provisions of the tender.

Storage

Reinforcement bars shall be kept in a clean condition out of direct contact with soil, mud, oil, water, etc. They shall be coated with cement wash before stacking to prevent formation of scale and rust. Fabricated reinforcement shall be carefully stored on timber planks / bellies, ends protected; no water shall be allowed to accumulate in the stored area, to prevent damage, distortion, corrosion and deterioration. Storage of materials shall be as described in IS 4082. The areas under storing shall be properly demarcated.

Fabrication

Bending of reinforcement shall be in accordance with IS 2502-1963 and as shown in the Drawings and sketches and any written instructions if any. Bars shall not be bent or straightened in a manner injurious to the materials. All bars shall be bent cold except for bars over 25 mm. dia. which may be bent hot if specifically approved by the Engineer-In-Charge. Bars which depend on their strength on cold working shall not be bent hot. Bars bent hot shall not be heated beyond cherry red colour (not exceeding 645 Degree C) and after bending shall be allowed to cool slowly without quenching.

No reinforcement bar shall be bent when in position without the Engineer-In-Charge's approval, whether or not it is partly embedded in hard concrete. Spiral reinforcement shall have 1½ finishing turns at both top and bottom unless shown otherwise.

Where reinforcement bars are bent aside at construction joints and afterwards bent back into their original position, care shall be taken to ensure that at no time is the radius of the bend less than 4 bar diameters for plain M.S. bars and 6 bar diameters for deformed bars. Care shall also be taken when bending back bars, to ensure that concrete around the bar is not damaged.

Cut ends of treated rods shall be given a protective coat of approved zinc paint immediately after cutting.

Binding

All bars shall be bound tightly together where they cross, with black annealed steel binding wire. The free ends of the binding wire shall be bent inwards. The binding wire shall satisfy provisions of IS: 280.

Placing & Fixing

The reinforcement as per the Drawings and instructions shall be placed, fixed and maintained in the forms within a tolerance of ± 10 mm. for effective depth 200 mm. or less and ± 15 mm tolerance for effective depth over 200 mm. during the placing and compaction of concrete.

Precast concrete blocks, MS chairs and spacers as required shall be provided to maintain the steel in position. In fair faces of concrete temporary spacers only shall be used and withdrawn as compaction of concrete proceeds.

Tack welding of crossing bars shall be done without any extra cost and only if permitted by the Engineer-In-Charge.

Cover

Spacing of reinforcement shall be governed by Clause 25.3 and cover to reinforcement by Clause 25.4 of IS 456-2000. Increased covers, if shown on the drawings or instructed by the Engineer-In-Charge shall be provided at the respective locations. Cover to reinforcement shall be as per IS 456-2000. Fully cured cement mortar blocks of 1:2 mix shall be used as cover blocks where no grade of concrete is specified and where grade of concrete is specified it shall be as per the same strength as that of the structural member. Any other cover blocks shall be used only on approval by the Engineer-In-Charge. However, use of pebbles or stones shall not be permitted. Where the bars cross, the outer one shall have the minimum cover.

Splicing & Lapping

Where splicing and / or overlapping in reinforcement are required, the bars shall be provided with such splices or overlaps as are shown on the drawings or directed by the Engineer-In-Charge. Laps shall be staggered only as shown on the drawings and approved by the Engineer-In-Charge.

Welded Laps

Butt welding of reinforcing steel bars shall be used only when specified or shown on the drawings or approved by the Engineer-In-Charge. When butt-welding is carried out, the ends of the bars shall be prepared with single 45° C and a backing plate shall be used. The minimum root face will be one quarter of the bar diameter. Welding shall be done in accordance with the recommendations of IS 2751 & 816. Electrodes shall comply with IS 814. The maximum size of electrodes shall be based on following table:

TABLE - 12

Diameters of Bars in mm.	Diameters of Bars in inches	Maximum size of Electrodes	Amperage corresponding to maximum size of mm. Electrodes
12 to 25	½" to 1"	10 3.25 mm.	} As specified by the manufacture of Electrodes
25 to 32	1" to 1 ¼" Double bevel	8 4.06 mm. (0.160)	
32 to 50	1 ¼" to 2" Double bevel	10 3.25 mm. (0.160)	
25 to 50	1" to 2"	6 4.06 (0.160)	

Before doing the welding of bars at site, the Contractor shall make minimum 3 No. joints and get them tested in an approved laboratory (including X-ray testing of welds if necessary). Only on these tests proving satisfactory, the Contractor would be permitted to weld at site.

The following precautions shall be taken while providing welded laps:

If the cold twisted deformed bar has an untwisted end at the lapping point, the said portion shall be cut off for a minimum length of 10 cm. from such end prior to welding.

Bars shall be aligned on a proper axis to avoid crookedness after welding.

The joints to be welded shall be rust free.

Weld slag shall be chipped off and removed by brush.

Welding Contract

The welding work shall not be given to a sub contractor who does not produce satisfactory evidence of his ability to handle the work in a competent manner. The Contractor shall also prove the ability of the operators employed by him to produce welding connection of the required strength.

The Contractor shall employ a competent welding supervisor or charge-hand to ensure that the standard of workmanship is satisfactory.

The Engineer-In-Charge shall have free access to the work being carried out by the Contractor at all reasonable times and facility shall be provided so that during the course of welding he may be able to inspect any layer of weld metal. Engineer-In-Charge shall be at liberty to reject any work not conforming to the relevant specifications, IS codes . Defective welds shall be cut out and re-welded.

Safety requirement and health provisions

The Contractor shall make all safety and health provisions for his welders as laid in IS : 818 - 1968 i.e. Code of Practice of safety and health requirements in electric and gas welding and cutting operation.

Reinforcement to be clean

All steel reinforcement before the concrete is deposited shall be clean, free of dust, loose scales, oils, rust, grease or any other deleterious materials. Particular care shall be taken to avoid contamination of reinforcement with mould oil.

Checking Reinforcement

No concrete shall be deposited until all formwork and reinforcement have been inspected and approved by the Engineer-In-Charge. There shall be in attendance on each concreting gang a competent steel fixer who shall ensure that the reinforcement and other embedded fittings are kept in position during placing and compaction of concrete.

The Contractor shall provide temporary gangways, platforms and other means of access to prevent men from walking on the reinforcement bats. These shall be independent of the reinforcement.

Measurement

- a) Steel reinforcement shall be measured in lengths of different diameters as actually used in the work and their weight calculated on the basis of Bureau of Indian Standard's Structural Engineer's Handbook No. 1 latest issue without any allowance for rolling margin. All authorised spacer bars on supports on any saddles, forks, chairs, laps, etc. shall be measured on the actual quantity consumed in the job.
- b) Wastage and unauthorised laps etc. shall not be measured for payment purpose.
- c) Annealed steel wire required for binding or tack welding shall not be measured, its cost being included in the rate of reinforcement.
- d) Wherever lap joints are provided by welding, the measurement shall be on linear meter of the actually welded seam length.

Rate

The rate for reinforcement shall include the cost of labour and materials required for all the operations described above such as cleaning of reinforcement bars, straightening, cutting, hooking, bending, binding, placing in position etc. as required or as directed including tack welding on crossing of bars in lieu of binding with wires, wastages etc.

4.11. Encasing Rolled Steel Section

Before concrete work is started, the Engineer-In-Charge shall check that all rolled steel sections to be encased, have been erected truly in position. The sections shall be unpainted and shall be wire brushed to remove the loose rust/scales etc. Encased steel sections shall be jointed with M.S. reinforced bars / links as shown on the drawings and as directed by the Engineer-In-Charge. The reinforced bars / links shall be in conformation with the specifications as described under Clause 3005.9 above.

Concreting

Concrete shall be of specified grade in the item description. Consistency of concrete, placing of concrete and its compaction, curing, finishing and strength of concrete shall be in accordance with the specification as specified of this Section under relevant clauses as applicable. The mix shall be poured around the steel sections and around the wrapping by vibrating the concrete into position.

Measurement

The length shall be measured correct to one cm and other dimensions correct to 0.5 cm. The cement concrete shall be measured as per gross dimensions of the encasing exclusive of the thickness of plaster. No deductions shall be made for the volume of steel sections, expanded metal, mesh or any other reinforcement used therein. However, in case of boxed stanchions or girders, the boxed portion only shall be deducted.

Reinforcement shall be measured and paid separately. The description shall include the bending of the fabric as necessary, raking or circular cutting and waste shall be included in the description.

Rate

The rate shall include the cost of materials and labour required for all the operations described above except the cost of reinforcement. The cost of providing and erecting steel section and wire hangers reinforcement shall be paid for separately.

5. BRICKWORK:

Materials

Bricks used for masonry work shall conform to IS 1077 except that sizes shall be as per the approved local bricks. The crushing strength shall be as specified in IS 3495.

Bricks shall be of uniform size shape and colour. They shall be well burnt and free from cracks, twists, stones, floats or nodules of lime and other defects. They shall have sharp and square edges and parallel faces, sound texture, uniform colour and they shall give a ringing sound when struck with a mallet. No brick shall absorb on average water more than 20% of its dry weight in 24 hours.

Brick shall be procured from source/s to be approved by the Engineer-In-Charge.

It shall not break when struck against each other and dropped flat from a height of one meter on ground.

Mortar- The mortar for the work shall be as specified under - Mortars specifications.

Laying

All the masonry work shall be carried out to specified dimension, lines and levels indicated on the drawings or as directed by the Engineer-In-Charge and a good bond shall be provided throughout the work both longitudinally and transversely.

Double scaffolding of adequate strength shall be provided for all types of loads likely to come on them during construction. No holes allowed in masonry for scaffolding.

During rains and frosty weather, the work shall be carefully covered so as to prevent any mortar being washed away.

Any anchors, wall plugs, accessories, flashings and other items required to be built in with masonry shall be provided in their correct position as the masonry work progresses.

Before new work is started, all loose mortar shall be removed and the exposed joints shall be thoroughly cleaned before laying new work.

Brick Work Proper

Every brick shall be thoroughly soaked in water before using in work. Before starting the brick masonry the concrete surfaces e.g. plinth beams, columns, slabs, chajjas, lofts etc. shall be thoroughly hacked and washed to remove all mud, dirt, loose particles etc. and a thin coat of cement slurry shall be applied over concrete surfaces when fresh masonry is to be started on or against old masonry, the surface of the old masonry shall be thoroughly cleaned and washed to remove all moss deposits loose mortar mud and dirt etc.

Brickwork shall be laid in English Bond with frog upwards unless otherwise specified. In exposed brickwork, selected bricks of the specified class shall be used for the face work. No half or quarter brick shall be used except as closures. Nor more than ten courses shall be raised in a day and no part of the work shall be raised more than 1 m. above another at any time.

The size of the brick shall be 22.5 x 11.5 x 7.5 cm. unless otherwise specified; but tolerance upto ± 3 mm. in each direction shall be permitted, However, bricks conforming in size to IS 1077 could be used. Bricks shall be provided with frogs. Only full size bricks shall be used for masonry work. Brick bats shall be used only with permission of the Engineer-In-Charge to make up required wall length or for bonding. Sample bricks shall be submitted to the Engineer-In-Charge for approval and brick supplied shall conform to approved samples. If demanded by Engineer-In-Charge, brick sample shall be tested as per IS 3495 by the

Contractor at no extra cost to Employer. Brick rejected by Engineer-In-Charge shall be removed from the site of works within 24 hours.

Each brick shall be set with both bed and vertical joints filled with mortar as per IS 2250. Joints shall not be less than 6 mm. and not more than 10 mm. in thickness and are to be full of mortar, close, well finished and neatly struck. All joints shall be adjusted to their final position in the wall while the mortar is still soft and plastic. All joints shall be raked out by raking tools when mortar is still green to a depth of 12 mm. to ensure good key to plaster or pointing. Where plastering or pointing is not required to be done, the joints shall be uniform in thickness, struck flush and finished at the time of laying.

The face of brick work 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. If the mortar in the lower course has begun to set, the joints shall be raked out to a depth of 12 mm. before another course is laid.

Miscellaneous inserts in masonry e.g. sleeves, wall ties, anchors, conduits, structural steel, steel lintels etc. shall be installed by the Contractor. Openings etc. shall be provided as shown on the drawings. Chases, pockets etc. shall be provided as shown on the drawing to receive windows, louvers, doorframes, circular openings for exhaust fans etc.

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

5.1. Half Brick Work

Material

Bricks and mortar shall be as specified under -Brick work specifications.

The reinforcement used for the half brick work shall be as specified under- Reinforced Cement Concrete specifications. All steel reinforcement before the concrete for RC stiffeners / patli is deposited shall be clean, free from dust, loose scales, oils, rust, grease or any other deleterious materials. Particular care shall be taken to avoid contamination of reinforcement with mould oil.

Cement concrete – The cement concrete work for RC stiffeners/ patli of specified grade shall be as specified under - Reinforced Cement Concrete specifications.

Laying- Generally shall be laid in the same manner as described under- Brick work specifications.

Half-brick work shall be carried out in panels and with horizontal stiffeners of 75 mm. thick unless otherwise specified 900mm at vertical intervals, with MS 2 No. 6mm. dia. Reinforcements laid in 1:2:4 nominal mix concrete properly filled as per specifications. These shall be securely anchored at their end where the partitions end. The free ends of the reinforced 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 .Over laps in reinforcement, if any shall not be less than 30cm The mortar interposed between the reinforcement bars and bricks shall not be less than 5mm. The mortar covering in the direction of joints shall not be less than 15mm

Measurement

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 one brick greater thickness and measurements for half brick wall shall be taken for its clear length from the face of the thicker wall.

In case of half brick masonry with RC stiffeners / patlis etc., stiffeners including reinforcement, shuttering etc. shall not be measured for separately.

Deductions shall be as described under -Brick work specifications.

Rate

The rate includes the cost of the materials & labour involved in all the operations described above including RC stiffeners & reinforcement, double scaffolding, curing etc.

MARBLE/ GRANITE STONE WORKS:

5.2. Materials

Marble slabs / Granite slabs shall be of the best quality and in sizes and thickness as approved by the Engineer-In-Charge. The specified thickness shall be taken at the thinnest part.

They shall be hard, dense, uniform and homogenous in texture having clean crystallizing grain and free from all defects and cracks. The edges shall be machine cut true and square and surface shall be machine polished to an even and perfectly plain surface.

Marble slabs shall confirm to IS 1130 – 1969.
Granite slabs shall confirm to IS 3316 – 1974.

Before starting the work, the Contractor shall get approval of samples of marble/ granite stones from the Engineer-In-Charge. Approved samples shall be kept in the custody of the Engineer-In-Charge and marble/ granite supplied / used on the work shall strictly conform to the samples approved by the Engineer-In-Charge with regard to soundness, colour, veining and general texture.

Stones to be used for skirting and dado shall be from the same stock and shade as used for floors. Tolerance in thickness of stone shall be ± 3 mm.

5.3. Flooring/ dado/ skirting

General

The surfaces to be laid with flooring or dado shall be thoroughly hacked, joints of masonry racked, cleaned of all mortar scales and concrete lumps and loose materials etc. and washed to remove mud, dirt, oil, grease etc. from the surface and shall be thoroughly wetted.

All stones shall be laid in a pattern given on the drawings or directed by the Engineer-In-Charge.

All stones in floor shall be truly and evenly set and pressed in position to obtain uniform plane surface. The skirting tiles shall be in true plane, level and plumb.

Flooring /dado work shall not be started unless and until the surface is approved by the Engineer-In-Charge.

5.4. Marble / Granite Stone work in steps / platforms / frames etc.

Materials

Material and general specifications shall be as described under –granite/ Marble flooring specifications except joint shall be permitted only at curvature or when width / length is more than 0.6 / 2 metres respectively. No of joints in each direction shall not be more than one for every 2 metres. Additional joints shall be provided as shown in the drawing subject to approval of Engineer-In-Charge. Finishing/ polishing if not possible with machine can be done by standard practices, so as to give a plane true and highly smooth surface. It shall then be cleaned with a solution of oxalic acid, washed and finished clean.

5.5. Cudappa/ Granite/ Marble stone window framing

Materials

Cudappa/Granite/ Marble stones / strips shall be of the best quality, sizes and thickness as specified and approved by the Engineer-In-Charge. The specified thickness shall be taken at the thinnest part. General specifications shall be as described under –Flooring specifications.

As sample of window framing shall be prepared and it shall be kept on worksite after being approved by the Engineer-In-Charge.

Mortar

The mortar used for jointing shall be as described under –Marble/ Granite Flooring specifications.

Laying

The stone shall be wetted before laying. The framing (about 200mm wide) shall be made by using 2 No. strips of suitable size stuck together with adhesive chemical to form a rebate of minimum 100mm for sliding and openable windows while one strip for Fixed ventilators/ Louvered windows. Laying / fixing of window framing shall be as described under - Marbles/ Granite flooring specifications. In case spans are more, where so desired the stones shall be secured to each other by means of copper pins 75mm long and 6mm diameter or as specified or as directed.

Joints

All joints shall be full of mortar. If any hollow groundings are detected by tapping the face stones, these shall be taken out and re-laid. No joints in between are permitted unless otherwise specifically approved by the Engineer-In-Charge the framing stone shall be in single piece. The thickness of the face joints shall be uniform, straight and as fine as possible, not more than 1.5mm in the face joint the top 6mm depth shall be filled with mortar.

Curing

The work shall be kept constantly moist on all faces for a period of at least seven days.

Finishing

Finishing shall be as described in the item description. Unless other wise exposed edges to be rounded off / chamfered and polished as specified or directed. When factory made finished slabs are used, no further polishing is required.

Protection and scaffolding

Double scaffolding having two sets of vertical supports shall be provided where necessary. The supports shall be sound and strong, tied together by horizontal pieces over which the scaffolding plank shall be fixed. Green work shall be protected from rain by suitable coverings. The work shall also be suitably protected from damage during construction.

6. WOOD WORK:

6.1. Scope

This section shall cover all woodwork, joinery and similar work in the Building. All wood work associated with work of all other sections shall also be done generally according to these specifications unless specified otherwise. Unless otherwise specified, Timber used in the work shall be approved quality.

6.2. General

No woodwork shall be painted, varnished waxed or otherwise finished before specifically approved by the Engineer-In-Charge.

6.3. Fixing Generally

All wood shall be fixed in the manner as shown in the drawings. If not shown, fixing with masonry or concrete shall be done with expansion plugs and screws of approved size, under no circumstances they shall be fixed by wooden plugs.

6.4. Workmanship

All work shall be done in workmanlike manner as per best trade practices by skilled workmen.

6.5. Starting of Work

Unless otherwise instructed, finishing of woodwork on trims, finished frames, etc. shall not be commenced until all interior plastering and flooring is completed and cured and area cleared of all rubbish. Whenever so required samples of actual work shall be installed at the site and got approved by the Engineer-In-Charge.

6.6. Timber

All wood shall be of best quality kiln seasoned timber of its kind specified. Unless otherwise stated all wood shall be approved CP teak wood. All timber shall be treated with approved anti-termite treatment. All wood in contact with masonry or concrete shall be painted with hot bitumen before placing in position taking care to ensure that exposed parts of the timber are completely free from any bitumen. Samples of all wood shall be got approved before ordering. Moisture content of wood shall be in accordance to IS:287-1993. CP Teak wood shall not possess any individual hard and sound knot exceeding 40 mm in diameter and the aggregate area of all the knots shall not exceed one percent of the area of the piece.

6.7. Sawing

All scantlings, planks, battens, etc. shall be sawn in straight lines, planes, uniform thickness, of full measurements from end to end and shall be sawn in the direction of grain. They shall be procured with sufficient margins in as to secure the specified dimensions, lines and planes after being wrought.

6.8. DOOR, WINDOW AND VENTILATOR FRAMES

6.8.1. Timber for door, window and ventilators frames shall be as specified. Timber shall be sawn in the direction of the grains. All members of a frame shall be of the same species of timber and shall be straight without any warp or bow. Frames shall have smooth, well-planed (wrought) surfaces except the surfaces touching the walls, lintels, sill etc., which may be left clean sawn. Rebates, rounding or moulding shall be done before the members are jointed into frames. The depth of the rebate for housing the shutters shall be 15 mm, and the width of the rebates shall be equal to the thickness of the shutters. A tolerance of ± 2 mm shall be permitted in the specified finished dimensions of timber sections in frames.

6.8.2. Joints

The Jamb posts shall be through tenoned in to the mortise of the transoms to the full thickness of the transoms and the thickness of the tenon shall be not less than 2.5 cm. The tenons shall closely

fit into the mortise without any wedging or filling. The contact surface of tenon and mortise before putting together shall be glued with polyvinyl acetate dispersion based adhesive conforming to IS 4835 or adhesive conforming IS 851 and pinned with 10 mm dia hard wood dowels, or bamboo pins or star shaped metal pins. The joints shall be at right angles when checked from the inside surfaces of the respective members. The joints shall be pressed in position. Each assembled door frame shall be fitted with a temporary stretcher and a temporary diagonal brace on the rebated faces.

6.8.3. Fixing of Frames

The frames shall be got approved by the Engineer-in-Charge before being painted, oiled or otherwise treated and before fixing in position. The surface of the frames abutting masonry or concrete and the portions of the frames embedded in floors shall be given a coating of coal tar. Frames shall be fixed to the abutting masonry or concrete with holdfasts or metallic fasteners as specified. After fixing, the jamb posts of the frames shall be plugged suitably and finished neat. Vertical members of the door frames shall be embedded in the floor for the full thickness of the floor finish and shall be suitably strutted and wedged in order to prevent warping during construction. A minimum of three hold fasts shall be fixed on each side of door and window frames one at centre point and other two at 30 cm from the top and bottom of the frames. In case of window and ventilator frames of less than 1 m in height two hold fasts shall be fixed on each side at quarter point of the frames. Hold fasts and metallic fasteners shall be measured and paid for separately.

6.9. Measurements

Wood work wrought, framed and fixed shall be measured for finished dimension without any allowance for the wastage or for dimensions beyond specified dimension. However, in case of members having mouldings, roundings or rebates and members of circular or varying sections, finished dimensions shall be taken as the sides of the smallest square or rectangle from which such a section can be cut. Length of each member shall be measured over all to the nearest cm so as to include projection for tenons. Width and thickness shall be measured to the nearest mm and the quantity shall be worked out in unit of upto three places of decimal.

6.10. Rate

The rate shall include the cost of material and labour involved in all the operations described above except the hold fasts or metallic fasteners which will be paid for separately.

6.11. FLUSH DOOR SHUTTERS

6.11.1. Flush door shutters shall have a solid core and may be of the decorative or non-decorative (Paintable type as per IS 2202 (Part I). Nominal thickness of shutters may be 25, 30 or 35 mm. Thickness and type of shutters shall be as specified.

6.11.2. Width and height of the shutters shall be as shown in the drawings or as indicated by the Engineer in-Charge. All four edges of the shutters shall be square. The shutter shall be free from twist or warp in its plane. The moisture content in timbers used in the manufacture of flush door shutters shall be not more than 12 per cent when tested according to IS 1708.

6.11.3. Core

The core of the flush door shutters 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 including lapping, where provided shall not be less than 45 mm and not more than 75 mm. The width of each wooden strip shall not exceed 30 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 of one species only but it may not be of the same species as that of the stiles and rails. Any species of timber may be used for core of flush door. However, any non-coniferous (Hard wood) timber shall be used for stiles, rails and lipping.

6.11.4. Face Panel

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 be between 0.5 mm and 1.5 mm for commercial veneers and between 0.4 mm and 1.0 mm for decorative veneers, provided that the combined thickness of both is not less than 2.2 mm. The direction of the veneers 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. Commercial face veneers shall conform to marine grade plywood and decorative face veneers shall conform to type I decorative plywood in IS 1328.

6.11.5. Lipping

Lipping, where specified, shall be provided internally on all edges of the shutters. Lipping shall be done with battens of first class hardwood or as specified of depth not less than 25 mm. For double leaved shutters, depth of the lipping at meeting of stiles shall be not less than 35 mm. Joints shall not be permitted in the lipping.

6.11.6. Rebating

In the case of double leaves shutters the meeting of stiles shall be rebated by 8 mm to 10 mm. The rebating shall be either splayed or square type as shown in drawing where lipping is provided. The depth of lipping at the meeting of stiles shall not be less than 30 mm.

6.11.7. Opening for Glazing

When required by the purchaser opening for glazing shall be provided and unless otherwise specified the opening for glazing shall be 250 mm in height and 150 mm or 200 mm in width unless directed otherwise. The bottom of the opening shall be at a height of 1.4 m from the bottom of the shutter. Opening for glazing shall be lipped internally with wooden batten of width not less than 25 mm. Opening for glazing shall be provided where specified or shown in the drawing.

6.11.8. Venetian Opening

Where specified the height of the venetian opening shall be 350 mm from the bottom of the shutter. The width of the opening shall be as directed but shall provide for a clear space of 75 mm between the edge of the door and venetian opening but in no case the opening shall extend beyond the stiles of the shutter. The top edge of the opening shall be lipped internally with wooden battens of width not less than 25 mm. Venetian opening shall be provided where specified or shown in the drawing.

6.11.9. Tolerance

Tolerance on width and height shall be + 3 mm and tolerance on nominal thickness shall be ± 1.2 mm. The thickness of the door shutter shall be uniform throughout with a permissible variation of not more than 0.8 mm when measured at any two points.

6.11.10. Adhesive

Adhesive used for bonding various components of flush door shutters namely, core, core frame, lipping, cross-bands, face veneers, plywood etc. and for bonding plywood shall conform to BWP type, phenol formaldehyde synthetic resin adhesive conforming to IS 848.

6.11.11. Tests

Samples of flush door shutters shall be subjected to the following tests:

- (a) End Immersion Test
- (b) Knife Test
- (c) Glue Adhesion Test

One end of each sample shutter shall be tested for End Immersion Test. Two specimens of 150 x 150 mm size shall be cut from the two corners at the other end of each sample shutter for carrying out Glue Adhesion Test. Knife Test shall be done on the remaining portion of each sample shutter.

6.11.12. Sample Size

Shutters of decorative and non-decorative type from each manufacturer, irrespective, of their thickness, shall be grouped separately and each group shall constitute a lot. The number of

shutters (sample size) to be selected at random from each lot for testing shall be as specified in following Table. If the total number of shutters of each type in a work (and not the lot) is less than twenty five, testing may be done at the discretion of the Engineer-in-Charge and in such cases extra payment shall be made for the sample shutter provided the sample does not fail in any of the test specified in CPWD Specification Manual.

For knife test, glue adhesive test, slamming test, the end immersion test, the number of shutters shall be as per col. 4 of following Table.

TABLE 13

Sample Size and Criteria for Conformity

Lot Size	Sample Size	Permissible no. of defective	Sub. Sample size
(1)	(2)	(3)	(4)
Upto 26 to 50	8	0	1
51 - 100	13	1	2
101 - 150	20	1	2
151 - 300	32	1	3
301 - 500	50	2	4
501 and above	80	2	5

6.11.13. Criteria for Conformity

All the sample shutters when tested shall satisfy the requirements of the tests. The lot shall be declared as conforming to the requirements when numbers of defective sample does not exceed the permissible number given in col. 3 of above Table. If the number of sample shutters found unsatisfactory for a test is one, twice the number of samples initially tested shall be selected and tested for the test. All sample shutters so tested shall satisfy the requirement of the test. If the number of samples found unsatisfactory for a test is two or more, the entire lot shall be considered unsatisfactory.

6.11.14. Fixing

This shall be as specified in CPWD Specifications.

6.11.15. 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. Overlap of two shutters shall not be measured.

All work shall be measured net as fixed and area calculated in square metres to nearest two places of decimal. No deduction shall be made for providing Venetian opening and opening for glazing.

6.11.16. Rates

The rate includes the cost of material and labour involved in all the operations described above. Extra rate shall be payable for providing rebates in double leaved shutters. Glazing when provided shall be measured & paid for separately as specified in BOQ.

6.12. HOLD FASTS

6.12.1. These shall be made from mild steel flat 40 x 5 mm size conforming to IS 7196 without any burns or dents. 5 cm length of M.S. flat at one end shall be bent at right angle and one hole 11 mm dia shall be made in it for fixing to wooden frame with 10 mm dia nut bolt. The bolt head shall be sunk into the wooden frame, 10 mm deep and plugged with wooden plug. At the other end 10 cm length of the hold fast flat shall be forked and bent of length as specified at right angle in opposite direction and embedded in cement concrete block of size 30 x 10 x 15 cm of mix 1 :3:6 (1

cement: 3 coarse sand: 6 graded stone aggregate, 20 mm nominal size) or as specified in CPWD specification.

6.12.2. Measurements

Measurements for the hold fasts shall be in number.

6.12.3. Rate

It includes the cost of labour and material involved in all the operations described above including fixing bolt and cement concrete blocks.

6.13. FITTINGS

6.13.1. 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 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 CPWD specifications. 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 CPWD specifications or directed by Engineer-In-Charge.

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.

6.13.2. Butt Hinges

These shall be of the following types according to the material used.

- (a) Mild steel butt hinges (Medium).
- (b) Cast brass butt hinges light or heavy.
- (c) Extruded aluminium alloy butt hinges.

Mild Steel (Medium): These shall be medium type manufactured from M.S. sheet. These shall be well made and shall be free from flaws and defects of all kinds. All hinges shall be cut clean and square and all sharp edges and corners shall be removed. These shall generally conform to IS 1341.

Hinge Pin: Hinge pin shall be made of mild steel wire. It shall fit inside the knuckles firmly and rivetted head shall be well formed so as not to allow any play or shake, and shall allow easy movement of the hinge, but shall not cause looseness.

Knuckles: The number of knuckles in the hinges of different sizes shall be as per IS 1341. The size of knuckles shall be straight and at right angle to the flap. The movement of the hinges shall be free and easy and working shall not have any play or shake.

Screw Holes: The screw holes shall be clean and counter sunk. These shall be suitable for counter sunk head wood screws and of the specified size for different types, and sizes 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 the wood screws. The nos. of screw holes shall as specified in IS 1341.

- 6.13.2.1. Cast Brass: 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.

Hinge Pin: Hinge pin shall be made of brass or of stainless steel. 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.

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.

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.

- 6.13.2.2. Extruded Aluminium Alloy: These shall be manufactured from extruded sections. These shall be well made and free from flaws and defects of all kinds. These shall generally conform to IS 205.

Hinge Pin: Hinge pin shall be made of mild steel (galvanised or aluminium alloy). The aluminium alloy hinge pin shall be anodised. The hinge pin shall be finally rivetted and shall be properly finished. The movement of hinges shall be free easy and square and shall not have any play or shake.

Knuckles: Number of knuckles in each hinge pin shall not be less than 5. The number of knuckles in case of sizes less than 40 mm 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.

Screw Holes: The screw holes shall be suitable for counter sunk head wood screws and of specified sizes for different type 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.

- 6.13.2.3. M.S. Sliding Door Bolts: These shall be made of M.S. sheets and M.S. rods and shall generally conform to IS 281. M.S. sliding door bolts shall be copper oxidised (black finish) or as specified.

- 6.13.2.4. Cast Brass Sliding Door Bolts: These shall be made from rolled brass and shall generally conform to IS 2681. The hasp shall be of cast brass and secured to the bolt as or as specified in CPWD specification. Alternatively, the hasp and the bolt may be cast in one piece. The fixing and staple bolts shall be cast with 6 mm studs. Bolts shall be finished to shape and have threaded ends and provided with washers and nuts of square or hexagon type. All components shall be finished smooth and polished before assembly. Cast brass sliding bolts shall be finished bright or chromium plated or oxidised or as specified.

6.13.2.5. Aluminium Sliding Door Bolts: These shall be made of aluminium alloy and shall generally conform to IS 2681. Aluminium sliding door bolts shall be anodized. All screw holes shall be counter sunk to suit the counter sunk head of screws of specified sizes. All edges and corners shall be finished smooth. In case of single leaf door, when iron socket plate or a brass or aluminium fixing bolts (or sliding door bolt) cannot be fixed, hole of suitable size shall be drilled in the door frame and an iron or brass ~ plate cut to shape shall be fixed at the face of the hole. The leading dimensions of the sliding door bolts shall be as per CPWD Specification.

6.13.3. Tower Bolts

6.13.3.1. These shall generally conform to IS 204 (Part. I) & IS 204 (Part. II). Tower bolts shall be well made and shall be free from defects. The bolts shall be finished to the correct shape and shall have a smooth action. All tower bolts made with sheet of 1.2 mm thickness and above shall have counter sunk screw holes to suit counter sunk head of wood screws. All sharp edges and corners shall be removed and finished smooth.

The height of knob of tower bolt when the door, window etc. is in closed position from the floor level shall be not more than 1.9 metre.

(a) Aluminium barrel tower bolts with barrel and bolt of extruded sections of aluminium alloy. The knob shall be properly screwed to the bolt and rivetted at the back.

(b) Brass tower bolts with cast brass barrel and rolled or cast brass bolt. or Brass tower bolts with barrel of extruded sections of brass and rolled or drawn brass bolt. The knobs of brass tower bolts shall be cast and the bolt fixed with knob, steel spring and ball shall be provided between the bolt and the barrel.

(c) Mild steel barrel tower bolts with mild steel barrel and mild steel bolt. or Mild steel tower bolts with mild steel barrel and cast iron bolts.

The plates and straps after assembly shall be firmly rivetted or spot welded. The rivet head shall be properly formed and the rivet back shall be flush with the plate. These shall be made in one piece.

6.13.3.2. Unless otherwise specified bolt shall have finish as given below:

(a) Mild steel tower bolts (Types 1 and 2) Bolts bright finished or plated as specified and barrel and socket stove enamelled black.

(b) Brass tower bolts (type 3 to 5) Bolt and barrel polished or plated as specified. (c) Aluminium alloy tower bolts (type 6) Bolt and barrel anodized.

The anodic film may be either transparent or dyed as specified. The quality of anodized finish shall not be less than grade AC-10 of IS 1868.

6.13.3.3. This shall be of mild steel polished bright or copper oxidised batch electrogalvanised or stove enamelled. In case of stove enamelled locking bolts, the bolt may be finished bright.

6.13.3.4. These shall be of M.S. cast brass or aluminium as specified. M.S. pull bolt locks shall be copper oxidized (black finish) or as specified.

6.13.3.5. Brass pull bolt locks shall be finished bright, chromium plated or oxidised as specified. Aluminium pull bolt locks shall be anodised and the anodic Coating shall not be less than grade. A.C. 10 of IS 1868. The bolt shall be 10 mm in diameter and the fixing plate 3 mm thick. The stop block shall be screwed to the fixing plate by a small ball and spring over which the bolt shall slide.

6.13.3.6. The fixing plate shall have four holes for fixing it to the door leaf, two of which shall be square to receive 6 mm dia. bolts with round heads, the remaining two shall receive machine screwed with lock nuts. The receiving plate shall be of the same width and thickness as the fixing plate and shall have 3 counter sunk holes.

Where the bolt slides into wooden members, like the chowkhat, which have a rebate, the receiving plate shall also be correspondingly shaped so as to fit into the rebate. The screws and bolts shall have the same finish as the main bolt. The leading dimensions of pull bolt locks are given in the drawing. The denominating size of the pull bolt locks shall be length of the fixing plate between guides plus the thickness of the guides.

6.14. Door Latch

6.14.1. This shall be of mild steel, cast brass, or as specified and shall be capable of smooth sliding action. In case, of mild steel latch, it shall be copper oxidized (black finish) or as specified and in case of brass, it shall be finished bright, chromium plated or oxidized or as specified. The size of door latch shall be taken as the length of the latch.

6.14.2. Door handles shall be of the following types according to the material used:

(a) Cast or Sheet Aluminium Alloy Handles: These shall be of aluminium of specified size, and of shape and pattern as approved by the Engineer-in-Charge. The size of the handle shall be determined by the inside grip of the handle. Door handles shall be of 100 mm size and window handles of 75 mm size unless, otherwise specified. These shall be fixed with 25 mm long wood screws of designation No. 6. Aluminium handles, shall be anodized and the anodic coating shall not be less than grade AC 15 - IS 1868 as specified. The finish can be bright natural, matt or satin or dyed as specified.

(b) Cast Brass Handles: These shall be of cast brass of specified size and of the shape and pattern as approved by the Engineer-in-Charge. The size of the handle shall be determined by the inside grip of the handle. Door handles shall be of 100 mm size and window handles of 75 mm size, unless otherwise specified. These shall be fixed with 25 mm long wood screws of designation No 6. Brass handles shall be finished bright satin or nickel chromium plated or copper oxidised or as specified.

(c) Mild Steel Handles: These shall be of mild steel sheet, pressed into oval section. The size of the handles will be determined by the inside grip of the handle. Door handles shall be 10 mm size and window handles of 75 mm size unless otherwise specified. These shall be fixed with 25 mm long wood screws of designation No.6., Iron handles shall be copper oxidised (black finish) or stove enamelled black or as specified.

6.14.3. PTMT (Polytetra Methylene Tetraphthalate) is an engineering plastic (raw material imported) and have following physical properties:(i) Tensile Strength (ii) Compressive Strength (iii) Rockwell hardness L-scale (iv) Working temperature (v) E Value (vi) Density (vii)Impact Strength

P.T.M.T. fitting shall be in different colours like White, Green, Blue, Derby Brown, Mushroom, Black, Gold, Silver & Bronz or any colours agreed by the manufactures and purchaser.

P.T.M.T. fittings are suitable for internal doors shutters kitchen, bath w.c. & cabinet etc. These shall not be used in external door and where security is concern.

Screws used for fittings shall be counter sunk cross head of chromium plated brass or stainless steel. Sizes of screws shall .be of same size as used in case non ferrous material door/window fittings.

6.14.4. P. T. M. T. Butt Hinges: These shall be of required colour/shade ceramic look, glassy smooth surface. These shall be of required size and thickness.

6.14.5. PTMT Tower Bolt: The tower bolt shall be generally barrel type moulded to required shape and size. Size (length, dia, length of rod, number of holes) shall generally confirm to IS 204 PI & P-II. The rod shall be solid. If it in hollow it shall be provided with stainless steel rod of required dia. for its strength protective coat of wood primer, polish or varnish.

6.15. Universal Hydraulic Door Closer (Exposed Type)

6.15.1. These shall be made of cast iron/aluminium alloy/zinc alloy and of shape and pattern as approved by the Engineer-in-Charge.

6.15.2. These shall generally conform to IS Specifications for door closers (Hydraulically regulated) IS 3564.

6.15.3. The door closers may be polished or painted and finished with lacquer to desired colour. Aluminium alloy door closer shall be anodized and the anodic coating shall not be less than grade AC 15 of IS 1868. All dents, burrs and sharp edges shall be removed from various components and they shall be pickled, scrubbed and rinsed to remove greese, rust, scale or any other foreign elements. After pickling, all the M.S. parts shall be given phosphating treatment in accordance with IS 3618.

6.16. PARTITIONS

Tapered Edge Calcium Silicate Board are manufactured from Siliceous and Calcareous materials '- reinforced with fibers. The boards are made in a laminar process and then autoclaved to give a stable crystalline structure. It is lightweight and can be fixed to either side of timber, aluminum or lightweight galvanized metal sections. The partitions are non-load bearing and can easily be assembled at site.

6.16.1. Installation

The G.I. frame and board partitions shall be fixed as per nomenclature of the item and directions of Engineer-in-Charge or as specified in CPWD specification.

6.16.2. Jointing & Finishing

Joints of the boards are finished with specially formulated Jointing compound and fibre tape to provide seamless finish. Board surface can be decorated with any type of paint, wall paper, wood veneer & hard laminates. Services should be incorporated before commencement of board fixing.

6.16.3. Fitting and Fixtures

It is easy and simple to attach different fittings to wall paneling boards. Inclined nails can be fixed to the boards itself for light materials. For heavier materials the fastening should be centered on internal stud work or steel or wood frame behind the boards, fixed before boarding. Services should be incorporated before commencement of board fixing.

6.16.4. Tolerance

Tolerance in dimensions shall be. ± 5 mm.

6.16.5. Measurement

6.16.5.1. Length and breadth of superficial area of the finished work shall be measured correct to a cm. Area shall be calculated in square meter correct to two places of decimal. No deduction will be made of openings of areas upto 0.40 sqm nor shall extra payment be made either for any extra material or labour involved in forming such openings.

6.16.5.2. For openings exceeding 0.40 sqm in area, deduction in measurements shall be made but extra will be payable for any extra material or labour involved in making such openings.

6.16.6. Rate The rate shall include the cost of all materials and labour involved in all the operations described above including all scaffolding, staging etc.

6.17. DOOR, WINDOW, VENTILATOR AND PARTITION FRAMES

6.17.1. Frame Work

First of all the shop drawings for each type of doors/windows/ventilators etc. shall be prepared by using suitable sections based on architectural drawings, adequate to meet the requirement/

specifications and by taking into consideration varying profiles of aluminium sections being extruded by approved manufacturers. The shop drawings shall show full size sections of glazed doors, windows, ventilators etc. The shop drawings shall also show the details of fittings and joints. Before start of the work, all the shop drawings shall be got approved from the Engineer-in-Charge.

Actual measurement of openings left at site for different type of door/window etc. shall be taken. The fabrication of the individual door/windows/ventilators etc. shall be done as per the actual sizes of the opening left at site. The frames shall be truly rectangular and flat with regular shape corners fabricated to true right angles. The frames shall be fabricated out of section which have been cut to length, mitered and jointed mechanically using appropriate machines. Mitered joints shall be corner crimped or fixed with self tapping stainless steel screws using extruded aluminium cleats of required length and profile. All aluminium work shall provide for replacing damaged/broken glass panes without having to remove or damage any member of exterior finishing material.

6.17.2. Fixing of Frames

The holes in concrete/masonry/wood/any other members for fixing anchor bolts/fasteners/screws shall be drilled with an appropriate electric drill. Windows/doors/ventilators etc. shall be placed in correct final position in the opening and fixed to Sal wood backing using stainless steel screws of star headed, counter sunk and matching size groove. of required size at spacing not more than 250 mm c/c or dash fastener. All joints shall be sealed with approved silicone sealants.

In the case of composite windows and doors, the different units are to be assembled first. The assembled composite units shall be checked for line, level and plumb before final fixing is done. Engineer-in-Charge in his sole discretion may allow the units to be assembled in their final location if the situation so warrants. Snap beadings and EPDM gasket shall be fixed as per the detail shown in the shop drawings.

Where aluminium comes into contact with stone masonry, brick work, concrete, plaster or dissimilar metal, it shall be coated with an approved insulation lacquer, paint or plastic tape to ensure that electrochemical corrosion is avoided. Insulation material shall be trimmed off to a clean flush line on completion.

The contractor shall be responsible for the doors, windows' etc. being set straight, plumb, level and for their satisfactory operation after fixing is complete.

6.17.3. Rate for the work

6.17.4. Rate

The rate shall include the cost of all the materials, labour involved in all the operations as described in nomenclature of item and particular specification.

6.18. DOOR, WINDOWS AND VENTILATOR SHUTTERS

Material, fabrication and dimensions of aluminium doors, windows and ventilators manufactured from extruded aluminium alloy sections of standard sizes and designs complete with fittings, ready for being fixed into the building shall be as per IS 1948.

6.18.1. Glass Panes

Glass panes shall weigh at least 13.5 kg/m² and shall be free from flaws, specks or bubbles. All panes shall have properly squared corners and straight edges.

7. STEEL WORKS:

7.1. Structural Work in built-up section (Welded/ bolted)

Although Broad Specifications for Structural Steel Works are as indicated below, the entire work shall be executed strictly in keeping with the working methodology, sequence of operations, safety and security etc. as approved by the Engineer-In-Charge, in best workmanship in conformity with relevant IS codes and the specifications of this tender document.

The Tenderer shall submit his own fabrication / erection methodology comprising sequence of operations to suit the works requirement such as –

- Material movement / storage of material
- Fabrication scheme considering space constraints
- Scheme for erection to be done at about 30 mtr. height for trusses
- Retractable Roof work
- Sliding Motorized Doors work
- Structural steel work of Blasting Chamber.
- Necessary Safety precautions as per prevailing rules.
- Security formalities to be maintained being a MDL area.

General

In addition to the requirements contained in this Specification, all materials shall conform to the latest edition of the relevant Indian Standard or its equivalent standard approved by the Engineer-In-Charge and shall, if required, be tested as prescribed therein.

In the event of conflict between this Specification and recognised standards, then the requirement of this Specification shall govern.

The work shall be carried out by competent personnel skilled in their various trades. All work shall be of the highest quality and the work shall be the subject of inspection and approval of the Engineer-In-Charge and the Employer.

All material shall be obtained from an approved supplier and manufacturer's appropriate test certificates shall be available upon request by the Engineer-In-Charge or the Employer.

All Steelwork shall be straightened or curved as necessary by pressure and not by hammering.

When bolt heads or nuts bear upon bevelled surfaces they shall be provided with square tapered washers to afford seating for the nut square with the axis of the bolt.

All nuts and bolts specified on the Drawings shall be to the required size with correct threaded length, and be supplied with matching nuts and washers also of the same material, except where electrolytic action is to be avoided.

Where small parts such as bolts and nuts etc. are to be sherardised, they shall be treated to receive a coating of finished thickness not less than 30 microns.

Where bolts, nuts and washers etc. are to be hot dip galvanised, they shall be treated to receive a finished thickness of zinc coating of not less than 80 microns thickness.

The Contractor shall give due notice to the Engineer-In-Charge in advance of the materials or workmanship getting ready for inspection.

The Engineer-In-Charge shall have free access at all reasonable times to those parts of the contractor's work which are concerned with the fabrication of the steel work and those portions of the site where assembly or erection is being carried out. The contractor shall give all reasonable assistance required in connection with the inspection and testing of the work.

No part of the work shall be treated as approved unless so informed by the Engineer-In-Charge in writing. However, approval of any material fabricated at shop / field shall not invalidate final rejection at site by the Engineer-In-Charge if it fails to be in proper condition or has fabrication inaccuracies, which prevents proper assembly. Similarly any approval of the fabrication and / or erection by the Engineer-In-Charge shall not relieve the Contractor of his responsibility for furnishing material and / or workmanship conforming to the requirements of the specifications.

All sections shall be free from surface defects such as pitting, cracks, laminations, twists, bends etc. The use of defective sections shall not be permitted and all such rejected material shall be immediately removed away from the store / site at contractor's cost.

All sections shall be marked for identifications and each lot shall be accompanied by manufacturers quality certificate, chemical analysis and mechanical characteristics as specified in relevant IS Codes.

Each lot of electrodes, bolts, nuts etc. shall be accompanied by manufacturer's quality test certificate conforming to relevant IS codes.

Materials at the shops shall be kept clean and protected from weather.

All members likely to collect rain water shall have drain holes.

Not more than one shop shall be provided to make the full length of a member.

All bolts, nuts, washers, rivets, electrodes, screws, etc. shall be supplied 10% in excess of the requirement in each category and size.

Materials -

Unless specified other wise various materials shall conform to the following IS Codes and Standards –

- Structural steel (Standard quality) : IS:226
- Rolled steel sections : IS: 808
- Steel tubes for structural purpose : IS: 1161
- Structural steel (for walkways, ladder, hand rails) : IS: 1977
- Welded Electrodes : IS: 811
- Threaded fasteners : IS 1367

Supply

Supply of structural steel and all required material for the works shall be arranged by the Contractor.

Receipts and storing of materials

All steel shall be carefully off-loaded and stacked on timber or concrete supports suitably spaced on a firm level surface, and of sufficient height to keep steel clear of the ground and water. The steel shall be stored separately, by section size or thickness.

All sections shall be checked, sorted out and arranged by grade and quality in the store as per instructions of the Engineer-In-Charge.

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

All materials shall be kept protected from corrosion. Storing shall be generally in accordance with IS: 4082.

Welding electrodes and welding wires if used shall be stored separately in their original bundles or cartons, in a dry place adequately protected from weather and other effects as per IS :9595 and as per instructions given by Engineer-In-Charge. Electrodes shall be kept dry.

Shop Drawings

If instructed by Engineer – In – Charge, the Contractor shall prepare all the fabrication and erection drawings for the structural steel work. These shall be prepared on the basis of the Engineer's design drawings 'released for preparation of shop drawings or approved for construction (AFC) drawings and shall be used for further work on the written approval to these drawings by the Engineer-In-Charge to the Contractor. Such 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. Furthermore any approval shall not relieve the Contractor from the responsibility for correctness of engineering, design of connections, workmanship, fit of parts, details, materials, errors or omissions of any and all work shown thereon.

The Contractor should check for erection clearance and ensure that detailing of connections is carefully planned to obtain ease in erection of structures, including field welded connections and bolting. Particular care is required when detailing joints with the use of high strength friction grip bolts as this involves clearances for use of sockets with torque wrench.

The contractor shall submit design calculations for substitution, if any and for the connection details proposed by him.

The fabrication drawings shall be revised by Contractor to reflect all revisions in design drawings as and when such revisions are made by the Engineer-In-Charge. The revised fabrication drawings shall be submitted to the Engineer-In-Charge for approval. Only approved and marked for construction drawings with appropriate revisions marking drawings shall be used for carrying out the fabrication work. Unchecked, unsigned and drawings without any stamp of (AFC) shall not be used for the purpose of proceeding with the work. If it is found that the contractor has not adhered to these stipulations, the fabrication work shall be liable for rejection.

The details regarding the reproducible, number of prints to be furnished etc. shall be as per the tender provisions.

Laying Out

As shown on drawings or as directed by the Engineer-In-Charge.

Fabrication

Standard

All fabrication shall be done strictly as per the (AFC) drawings with latest revision in accordance with IS: 800 (Code of Practice for use of Structural Steel in general Building Construction) and IS: 1915 (Code of Practice for Steel Bridges) and also in accordance with IS: 9595 and other relevant IS Codes and ISI Hand book SP-6 (1), subject to approval of the Engineer-In-Charge.

No holes or notches shall be made in the steel work other than those shown on the drawings without approval of the Engineer-In-Charge. Similar approval must be obtained prior to the enlargement of any hole.

The butting end of members shall be faced in a milling or ending machine after the members have been completely fabricated so as to butt in close contact over the entire surface.

Templates

Extensive use of templates shall be made. The templates shall be steel bushed where considered necessary by the Engineer-In-Charge. In case actual members are used as templates for drilling similar pieces it will be at the discretion of the Engineer-In-Charge to decide whether such pieces are fit to be incorporated in the finished structure. The Contractor shall arrange for corresponding parts of each unit manufactured from the same drawings, to be interchangeable, as far as economic manufacturing conditions permit and shall advise the Engineer-In-Charge of the precise arrangements made in this respect.

Connections

Shop/field connections shall be effected either by welding or by high strength friction grip bolts as specified. High tensile bolts shall be used for field connections and standard MS bolts conforming to IS: 1363 may be used for field connections for light members such as purlins, girths, staircase stringers and landing beams or for other connections also, if permitted by the Engineer-In-Charge.

Where necessary, tapered washers or flat washers or spring washers shall be used with bolts. In case of high strength friction grip bolts, hardened washers shall be used under the nuts or the heads depending upon whether the nuts or the heads are turned to tighten the bolts. The length of the bolts shall be such that at least one thread of the bolt projections beyond the nut except in case of high strength friction grip bolts where this projection shall be at least three times the thread pitch.

All connections and splices shall be designed for full strength of members or loads indicated unless otherwise approved.

All connections shall be precisely shown on the drawings and shall be strong enough to develop the full strength of the member and shall be subject to the approval of the Engineer-In-Charge.

All field connections shall be made with black steel bolts. All surfaces of steel and bolts shall be entirely free of paint, lacquer or other protective substance. All shop connections shall be welded as approved by the Engineer-In-Charge. As far as possible, it should be ensured to have down hand welding for all shop joints.

In all cases where bearing is critical, the unthreaded bolt shall bear on the members assembled. A washer of adequate thickness may be provided to exclude the threads from the bearing thickness, if no longer grip bolt has to be used for this purpose. Column splices shall be designed for the full tensile strength of the minimum cross section at the splice. Unless otherwise noted, beam end connections shall be designed for 60% of the shear capacity of the beam section plus additional axial forces, if any, shown on the Engineer's design drawings.

Materials at the shops shall be kept clean and protected from weather.

Not more than one shop splice shall be provided to make the full length of a member.

All bolts, nuts, washers, rivets, electrodes, screws etc. shall be supplied 10% in excess of the requirement in each category and size.

Straightening

All material shall be straight and if necessary shall be straightened and/or flattened by pressure, unless required to be of curvilinear form and shall be free from twists. Straightening will be done by methods that will not injure the materials. Long plates shall be straightened by passing through a mangle or levelling rolls and structural shapes by hydraulic or mechanical bar straightening machines. Heating of rolled sections and plates for purposes of straightening shall not be permitted. Limited applications of heat with a gas-torch shall be permitted on approval of Engineer-In-Charge in writing. Sharp kinks or bends shall be the cause for rejection.

Rolling and Forming

Plates for circular structural members 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.

Cutting

Rolled sections shall be sawed or milled to length. Small plate pieces like gussets may be sheared or cropped to size. Sawing, shearing and cropping shall be clean, reasonably square and free from any distortion. All re-entrant corners shall be shaped notch-free to a radius of at least 12mm.

Gas-cutting shall preferably be done by a mechanically guided torch. Hand flame cutting may, however, be permitted where the part being cut shall not be subjected to substantial tensile stresses and only when approved by the Engineer-In-Charge. Gas-cut edges shall be free of gouges. Any gauges that remain after cutting shall be removed by grinding.

Gas-cutting shall normally only be permitted for mild steel though gas cutting of high tensile steel may also be permitted, provided special care is taken to leave sufficient metal to be removed by machining so that all metal that has been hardened by flame is removed except where the material is subsequently joined by welding, no loading shall be transmitted into metal through a gas cut surface.

Edge planing of sheared, cropped or gas cut edges is not intended unless the edges warrant such planing or is specifically called for by the Engineer-In-Charge.

Punching shall not be resorted to unless previously approved by the Engineer-In-Charge. Where permitted in secondary members such as purlins, side sheeting runners, packing plates and lacing bars, holes may be punched full size through material not over 12 mm thick except where required for close tolerance bolts or barrel bolts. Holes must be clean cut, without burr or ragged edges. Holes through more than one thickness of material (e.g. compound stanchions and girder flanges) shall be drilled after assembling and tightly clamping or bolting the members together. The various thickness shall then be separated, burrs formed by the drill removed and the members reassembled.

Sub-punching may be permitted before assembly provided the holes are punched 3 mm less in diameter than the required size and reamed after assembly to the full diameter. The thickness of material punched shall not exceed 16 mm.

Holes for all other connections shall be drilled accurately and burrs removed effectively.

Punching shall not be adopted for dynamically loaded structure or its part.

Holes for bolts shall not be more than 1.5 mm larger in diameter than the nominal diameter of the bolt. Holes for turned and fitted bolts shall be drilled to a slightly smaller diameter and remade to a diameter equal to the nominal diameter of the shank or barrel. This shall be subject to tolerance specified in IS 919. Parts to be connected with close tolerance or barrel bolts shall be firmly held together by tacking bolts or clamps and the holes drilled through one operation shall be drilled to a smaller size and reamed out after assembly. Where this is not possible the parts shall be drilled and reamed separately.

Where reamed members are taken apart for stripping or handling, the respective pieces reamed together shall be so marked that they may be reassembled in the same position in the final setting up. No interchange of reamed parts will be permitted.

Gas-cutting of holes shall be strictly prohibited. Poor matching, over drilling and ovality in holes shall be a cause for rejection.

When batch-drilling is carried out in the operation through two or more separable parts, these parts shall be separated after drilling and the burrs removed.

Machining

Column splices and butt joints of struts and compression members depending on contact for load transmission shall be accurately machined and close butted over the whole section with a tolerance not exceeding 0.2mm locally at any place.

In column caps and bases, the ends of shafts together with attached gussets, angles, channels, etc. after welding together shall be accurately machined so that the parts connected, butt over the entire surfaces of contact. In no case the parts connected butt less than 90% of the surface of contact. Care shall be taken that these connecting angles or channels are fixed with such accuracy that they are not reduced unduly in thickness in machining.

Ends of all bearing stiffeners shall be machined or ground to fit tightly at both top and bottom.

Where sufficient gussets or welding are provided to transmit the entire loading, the column ends need not be machined.

Splicing

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

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

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

Where a cover plate is used over a joist/channel section the splicing of the cover plate and channel/joist sections shall be staggered by minimum 500 mm. Extra splice plate shall be used for the cover plate and joist/channel section as per provision of relevant IS Codes.

Bolting

All turned and fitted bolts shall be parallel throughout the barrel and within the tolerance of only minus (-1/8) mm. unless otherwise specified and faces of heads and nuts bearing on steel work shall be machined. All such bolts shall be provided with washers not less than 6 mm thick so that when the nut is tightened, it shall not bear on the unthreaded body of the bolt. In all cases, where the full bearing area of the bolt is to be developed, the threaded portion of the bolt should not be within the thickness of the parts bolted together. The threaded portion of each bolt shall project through the nut by at least one thread. Tapered washers of suitable thickness shall be provided for all heads and nuts to afford a seating square with the axis of the bolt.

7.2. Welding

Welding shall generally be done by electric arc process and shall conform to the respective IS Codes and Standards as listed above.

Welding Procedures

The Contractor shall make necessary arrangement for providing sufficient number of welding sets of required capacity, all consumables, cutting & grinding equipment with requisite accessories/auxiliaries, equipment etc.

The Contractor shall submit the welding procedure for each type of joint for the approval of the Engineer-In-Charge and shall ensure that copies of the same are at all times, readily available

to the welders employed on the Works. The procedure shall include all details with reference to provisions of IS 823 and IS 4353. It should be specifically ensured that filter glass used in welding helmets shall be of internationally accepted quality and make.

The welding procedure shall be such as to ensure that the weld metal can be fully and satisfactorily deposited throughout the length and thickness of all joints and that distortion and shrinkage stresses are reduced to a minimum and that the welds meet the requirements of quality specified.

Welding plant and accessories shall have capacity adequate for the welding procedure laid down and shall satisfy appropriate standards and be of approved make and quality. The Contractor shall maintain all welding plants in good working order. All the electrical plant in connection with the welding operation shall be properly and adequately earthed and adequate means of measuring the current shall be provided.

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

- a) Manual metal arc welding process (MMAW)
- b) Submerged arc welding process (SAW)

Submerged arc, automatic or semi-automatic welding shall be generally be employed. Only where it is not practicable to use submerged arc welding, manual arc welding maybe resorted to.

Voltage and current (and polarity if direct current is used) shall be set according to the recommendations of the manufacturer of the electrode being used and suitability to thickness of material, joint form etc. Adequate means of measuring the current shall be available either as part of the welding plant or by the provision of a portable ammeter. In checking the welding current, a tolerance of 10% or 30 Amperes from the specified value whichever is less shall be permitted.

The welding procedure adopted and the consumables used shall be specifically approved by Engineer-In-Charge. Welding electrodes used shall conform to IS : 814 (latest) and shall be supplied by manufacturer approved by the Engineer-In-Charge. Any electrode which has part of its flux coating broken or is damaged shall be rejected.

No welding shall be done on base metal at a temperature below 5 Deg. C. Base metal shall be preheated as required to the temperature given in the table below prior to tack welding or welding. When base metal not otherwise required to be preheated is at a temperature below 0 deg. C, it shall be preheated to at least 20 Deg. C prior to tack welding or welding. Preheating shall be done of the surface of the base metal on which the weld metal is being deposited within 75 mm on each side of the point of welding to the specified preheated temperature and this temperature shall be maintained as minimum inter-pass temperature while welding is in progress. The temperature shall be measured on the face opposite to that heated. However there is access to only one face, the heat source shall be removed to allow for temperature equalization (one minute for each 25 mm of plate thickness) before measuring the temperature.

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Thickness of thickest part at point of welding	Minimum preheat and inter-pass temperature			
	Other than low hydrogen welding electrodes	Low hydrogen welding electrodes		
		IS:226 steel or IS:2062 steel	IS: 961 steel	IS:226 steel, IS 2062 steel
Upto 20 mm.	None	Welding with this	None	10 Deg. C
Over 20 mm. to 40 mm. incl.	65 Deg. C		10 Deg. C	65 Deg. C
			95 Deg. C	110 Deg. C

63 mm. incl.		process not allowed	110 Deg. C	65 Deg. C
Over 63 mm	150 Deg. C			

Welding shall be done with the structural in flat position in a down hand manner wherever possible. Adequate care shall be taken to maintain the current and polarity for the type of electrode used and nature of work.

No welding shall be done when the surface of the members is wet nor during periods of high wind unless the welding operation and the work are properly protected.

Before commencing fabrication of member or structure in which welding is likely to result in distortion and/or locked up stresses, a complete programme of fabrication, assembly and welding shall be made and submitted to the Engineer-In-Charge for approval. Such a programme shall include besides other appropriate details, full particulars in regard to the following:

- a) Proposed pre bending in components such as flanges and presetting of joints to offset expected distortion.
- b) Make up of sub-assemblies proposed to be welded before incorporation in the final assembly.
- c) Proposed joint forms, classification of wire and flux or covered electrodes, welding process including fitting and welding sequence with directions in which freedom of movement is to be allowed.
- d) Proposed number, spacing and type of strong backs and details of jigs and fixtures for maintaining proper fit up and alignment during welding.
- e) Any other special features like assembling similar members back to back or stress relief.

Sequencing of welding

- a) The contractor shall choose the welding sequence after carefully studying each case such as to minimize distortion and shrinkage and submit the same to the Engineer-In-Charge for comments and approval.
- b) As far as practicable, all welds shall be made in sequence that will balance the applied heat of welding while the welding progresses.
- c) The direction of the general progression in welding on a member shall be from points where the parts relatively fixed in position with respect to each other towards points where they have a greater relative freedom of movement.
- d) All splices in each component part of a cover-plated beam or built up member shall be made before the component part is welded to other component parts of the member.
- e) Joints expected to have significant shrinkage shall be welded before joints expected to have lesser shrinkage.
- f) Welding shall be carried continuously to completion with correct number of runs.

Preparation of fusion faces

Preparation of fusion faces shall be done in accordance with the approved fabrication drawings by shearing, chipping, machining or gas cutting (except that shearing shall not be used for thickness over 8 mm). The faces shall be smooth, uniform and free from irregularities such as fins, tears, laminations etc. as would interfere with the deposition of the specified size of weld to be the cause of defects.

Surfaces to be welded shall be free from loose scale, slag, rust, grease, paint, moisture and any other foreign material, which might affect the quality of weld. Surfaces shall be wire-brushed vigorously or machined/ground, if found necessary by the Engineer-In-Charge.

Welding of joints shall be undertaken only on approval by the Engineer-In-Charge of the alignment, levels etc. of the members to be jointed.

Gaps for Joints

Parts to be fillet welded shall be brought in as close contact as possible and in no event shall they be separated by more than 1.5 mm. In case of a gap of more than 1.5 mm the size of the fillet weld shall be increased by the amount of the gap. A gap greater than 3 mm. wide shall be packed with MS shims and the weld increased by the amount of the gap.

Abutting parts to be butt welded shall be carefully aligned together within a gap of 3 mm and correct root gap shall be maintained throughout the welding operation.

Gaps shall be set by means of suitable jigs and the steel work held firmly in position by clamps or bolts until the welded joint is sufficiently rigid to be freed of clamps without causing strain or distortion.

Misalignment greater than 25 percent of the thickness of the thinner plate or 3 mm. whichever is smaller shall be corrected and in making the correction the parts shall not be drawn into a slope sharper than 2 Deg. (1 in 27.5)

Fillet Welds

The minimum leg length of a fillet weld as deposited should not be less than the specified size and the throat thickness as deposited should not be less than that tabulated below –

<u>Angle between fusion faces</u>		<u>Throat thickness</u>
60 Deg. C	90 Deg. C	48 mm
91 Deg. C	100 Deg. C	16.5 mm
101 Deg. C	106 Deg. C	15 mm.
107 Deg. C	113 Deg. C	14 mm
114 Deg. C	120 Deg. C	12.5 mm.

In no case should a concave weld be deposited without the specific approval of the Engineer-In-Charge unless the leg length is increased from the above specified so that the resultant throat thickness is as great as would have been obtained by the deposition of a flat. Welding sequence should be such as to have minimized shrinkage stresses. After each run of weld, all slag shall be removed and final run shall be protected by clean boiled linseed oil till approved.

Butt Welds

All main butt welds shall be full penetration butt welds, unless otherwise specified with complete fusion of the root edges. The ends of the welds shall have full throat thickness. This shall be obtained on all main welds by use of extension pieces adequately secured on either side of the main plates. Additional metal remaining after the removal of the extension pieces shall be removed by machining or by other approved means and the ends and surfaces of the weld shall be smoothly finished by machining or other approved means. Where the abutting parts are thinner than 20 mm, the extension pieces may be omitted but the ends of butt welds shall then be chipped or gouged out to sound metal and side welded to fill up the ends to the required reinforcement.

Quality of Weld

The weld metal as deposited shall be free from blow holes, cracks, slag inclusions, excessive porosity, cavities and other faults. It shall be properly fused with the parent material without overlapping or serious under-cutting at the toes of the weld. The weld surfaces shall be cleaned of slag or flux and show a uniform and consistent contour and regular appearance.

Faulty Works

In the event of excessive convexity, weld size is to be reduced by removing the excess weld metal. In the event of faulty work the defective portions shall be cut out and re-welded. Where serious under-cutting occurs, additional weld metal shall be deposited to make good the reduction. In case of members getting distorted due to heat of welding, the members are to be straightened out by mechanical means or by careful applications of limited amount of heat when temperature of the areas affected more than 65^o C.

Protection

Immediately after dislodging, inspection and approval, all site welds and the surrounding surfaces shall be painted to protect the metal.

Tolerances

The dimensional and weight tolerance for rolled shapes shall be in accordance with IS: 1852 and/or ASTM A6.

No rolled or fabricated member shall deviate from straightness by more than 1/1000 of the axial length or 100 mm whichever is smaller.

The length of members with both ends finished for contact shall have a tolerance of ± 1 mm.

Members without ends finished for contact bearing shall have a tolerance of ± 1.5 mm for members up to 10 meters long and a tolerance of ± 3 mm for members over 10 meters in length.

Lateral deviation between centre line of web plate and centre line of flange plate at contact surface in the case of built up sections shall not exceed 3mm.

The combined warp age and tilt of flanges in welded built up sections shall not exceed 1/200th of the flange width or 3 mm whichever is smaller.

The deviation from flatness of welded plate girder web in the length between stiffeners or a length equal to the depth of the girder shall not exceed 1/150th of such length.

Deviations from the specified depth of welded girders measured at the centre line of the web shall not exceed ± 3 mm up to a depth of 1000 mm, ± 5 mm for depths above 1000mm, upto 2000mm and + 8mm and - 5mm for depths over 2000mm.

7.3. Inspection and testing of weld:

The Contractor shall carry out procedure tests in accordance with IS: 7307 to demonstrate by means of a specimen weld of adequate length on steel sample of that to be used that he can make welds with the welding procedure to be used for the work for the complete satisfaction of the Engineer-In-Charge. The test weld shall include weld details from the actual construction and it shall be welded in a manner simulating the most unfavourable instances of fit-up, electrode condition etc. which are anticipated to occur on the particular fabrication. Where material analysis are available, the welding procedure shall be carried out on material with the highest carbon equivalent value.

After welding, but before the relevant tests given in IS: 7307 are carried out, the test weld shall be held as long as possible at room temperature, but in any case not less than 72 hours and

shall then be examined for cracking. The examination procedure shall be sufficiently rigorous to be capable of revealing significant defects in both parent metal and weld metal.

After establishing the welding method, the Contractor shall finally submit to the Engineer-In-Charge for his approval the welding procedure specification in standard format given in IS: 9595 before starting the fabrication.

Approval to the welding procedure by the Engineer-In-Charge shall not relieve the Contractor of his responsibility for correct and sound welding without undue distortion in the finished structure.

The Contractor shall satisfy the Engineer-In-Charge that the welders are suitable for the work upon which they shall be employed. For this purpose welders shall have satisfied the relevant requirements of IS 7318. If the welders shall be working to approved welding procedures, they shall have satisfied the relevant requirements of IS 7310.

Unless specified otherwise, inspection of steel work shall be made at the place of manufacture prior to dispatch and shall be conducted so as not to interfere unnecessarily with the operation of the work. Stage inspection during the progress of the work shall be carried out during final assembly and erection at the Site.

The method of inspection shall be according to IS: 822 and extent of inspection and testing shall be in accordance with the relevant application standard or in the absence of such a standard as specified by the Engineer-In-Charge. Welds shall not be painted or otherwise obscured until they have been inspected, approved and accepted.

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

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

All welding shall be subject to inspection and tests as specified by the Engineer-In-Charge.

The Engineer-In-Charge may require test plates to be prepared in accordance with IS: 1181 "Qualifying Test for Metal Arc Welding (Engaged in welding structures other than pipes)". At main butt welds, these may be taken from plates cut from extensions of the main plates and fixed as extensions at the butt joints, so that the direction of rolling is parallel to that of the main plates and the welds continuous with the main welds.

The Engineer-In-Charge may require radiographic tests and ultrasonic tests to be carried out to check full strength butt welds at contractor's cost. These shall be in accordance with the recommended U.W. 51 of ASME Code Section VIII. Other non-destructive tests could be as follows –

Magnetic Particle Test

This is carried out to examine the root and intermediate passes of weld in accordance with the following as decided by the Engineer-In-Charge –

- ASTM Specification. E-109
- ASTM Specification E-138

If heat treatment is performed, the completed weld shall be examined after the heat treatment. Magnetic particle test shall be carried out using alternating current. Direct current may be used with the permission of the Engineer-In-Charge.

Liquid Penetrate Inspection

In the case of welds examined by Liquid Penetrate Inspection, such tests shall be carried out in accordance with ASTM-E-165 or IS: 3658.

The above tests are generally not required to be carried out but if and when required, they shall be paid done as specified at contractor's cost.

Radiography Test

Ultrasonic Testing

- (a) Testing of welds shall be undertaken by an independent accredited testing authority selected by the Contractor and approved by Engineer-In-Charge. The Contractor shall be responsible for all costs of such testing. All welds shall be tested as specified.
- (b) The Contractor shall inspect each welded joint & they shall be inspected for edge fusion and the possibility of cracking. Testing of welds shall be by ultrasonic examination and they shall be carried out by the Contractor in accordance with standards to the approval of the Engineer-In-Charge. The Engineer-In-Charge shall have the opportunity to witness any or all of the tests. The Contractor shall give adequate prior notice before the commencement of any tests. All ultrasonic operators shall be fully qualified, and each weld shall be examined with sufficient probe angles to guarantee full coverage of the joint.
- (c) The Contractor shall produce a test report for each weld joint or weld repair examined, comprising:
 - a sketch of all flaws
 - the location and size of each flaw
 - dB level used
 - conclusions as to acceptance or rejection of the flaw with reference to these requirements
- (d) The Engineer-In-Charge along with the Contractor shall make an initial assessment of defects against acceptance criteria. All ultrasonic reports including recommendations shall be reviewed by the Engineer-In-Charge. Acceptance criteria shall be in accordance with the approved standard. The standard on which the slag indication acceptability is to be finally determined and this is to be agreed and confirmed prior to any ultrasonic testing. When positive flaw type interpretations cannot be ascertained in any instance, the flaw shall be considered planar and in need of repair.

7.4. Assembly

Steel work shall be temporarily shop-erected completely or as directed by the Engineer-In-Charge, so that the accuracy of fit may be checked before dispatch. Due notice shall be given to the Engineer-In-Charge in all cases when the work is ready for inspection and the assembly shall not be dismantled until it has been inspected and approved by the Engineer-In-Charge. However, such approval shall not relieve the Contractor of his responsibility for carrying out a precise job in a workmanlike manner. The parts shall be assembled with a sufficient number of parallel drifts to bring and keep the components in place. In the case of parts drilled or punched through steel jigs with bushes resulting in similar parts being interchangeable for portions of the steel work, trial assembly shall be carried out to the extent required by IS: 1915.

All steel work, which is bolted together, shall be in perfect contact over the whole surface. All bearing stiffeners shall bear tightly at top and bottom without being drawn or caulked. When two bolted surfaces are to be in permanent contact after assembly, each shall be thoroughly scraped to remove loose scales, dirt, burrs and any foreign matter and cleaned and dried and a

coat of yellow zinc chromate or other approved primer paint shall be applied after cleaning and drying. The surfaces shall be brought together while the paint is still wet.

Drilling done during assembly shall not distort the metal or enlarge the holes. Holes that must be enlarged due to miss-matching shall be reamed. Poor matching of holes shall be cause for rejection. Enlarging of holes with gas trench shall not be allowed. Enlargement of holes by gas trench shall be cause for rejection.

Erection

All structural steel work shall be erected in accordance with IS: 800 and IS: 1915.

Detailed Scheme

The Contractor shall furnish a detailed scheme for erection of structural steel work for the approval of the Engineer-In-Charge. Such scheme shall indicate the type, capacity and the quality of equipment that the Contractor proposes to deploy for handling, hoisting and erecting the steel work including staging, temporary bracing, guying etc. The scheme shall also indicate the strength and trade-wise composition of the work force and supervising personnel that the Contractor would deploy on the job.

The scheme 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 materials between the storage and work areas. The layout shall clearly indicate the points at which proposed erection begins, the directions in which it is proposed to progress, the deployment of equipments etc. The locations and extent of site offices and stores, labour quarters if any, layout of electrical cables and water pipes from the tap-off points indicated on drawings shall also be indicted in detail on the above layout.

Any modifications to the erection programme directed by Engineer-In-Charge for the reasons of inadequacy of the quality and/or capacity of the erection equipment, 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 shall be incorporated by the Contractor and the work shall be carried out in accordance with the revised programme. The approval by Engineer-In-Charge shall not relieve Contractor from his responsibility for the safe, sound, accurate and timely erection of structural steel work as required by the Engineer-In-Charge. The Contractor shall be deemed to have visualized all erection problems prior to submission of bid documents for the work and no additional compensation shall be claimed on this account.

The Contractor shall fully mobilize at site prior to the actual operation of erection commences at site. Such mobilization shall include items like establishment of offices, stores, unloading gantry / handling equipments, labour quarters if any, electrical and water connections, compressors, all tools and tackle, rivet guns, welding sets, torque wrenches, spud wrenches, non-inflammable staging as a part of his contract and any other work that may be necessary to start the erection work. The passageways, fences, safety belts, helmets, lights and other fittings to be to the satisfaction of Engineer-In-Charge and to meet the rules of local authorities and for protection of his men and materials. A licensed electrician shall be kept on the job for full period to maintain the Contractor's electrical equipment and connection.

The Contractor shall protect all existing plant structures, piping, conduits, equipment and facilities against any damage during erection. Any damage caused by the Contractor shall be rectified entirely at the Contractor's cost to the satisfaction of Engineer-In-Charge.

When lifting and fitting steel work in position, care shall be taken that the parts thereof are not strained, twisted, bent or damaged in any manner whatsoever. Should any part be strained, twisted, bent or damaged, it shall be reinstated in a manner approved by the Engineer-In-Charge by gentle heating & bending & not by hammering. Any parts that are badly damaged shall be replaced with new materials at the Contractor's expense.

No permanent bolting or welding shall be done until proper alignment has been obtained and approved by the Engineer-In-Charge.

Any errors in the fabrication, which prevent the proper assembling and erection of the parts with moderate amount of reaming, chipping or cutting is likely to render the steel work for rejection unless corrective action, only if permitted by the Engineer-In-Charge, is taken. Any expenditure involved in executing the corrective measures shall be borne by the Contractor.

All erection holes shall be plugged either by weld or bolts, nuts, washers shall be provided as directed by the Engineer-In-Charge, without extra cost.

The Contractor shall be responsible for accurately positioning, levelling and plumbing of all steel work and placing of every part of the structure in accordance with the approved fabrications drawings to the entire satisfaction of Engineer-In-Charge.

Dispatch of materials stacking and handling

Each structural member either knocked down or a single composite each loose item (like splices pack plates etc.) shall have "Mark number" painted on each item before it is dispatched from the SHOP.

The Contractor shall deliver the fabricated steel work to the site as far as possible in the same sequence as that which he wishes to allow for the erection. Dispatches should be scheduled to avoid clustering up of the site.

Transportation

Loading & transportation shall be done in compliance with transportation rules. In case certain parts can not be transported in the lengths stipulated in the drawings the position and type of additional splice joints shall be got approved by the Engineer-In-Charge.

The bolts required for erection shall be bagged according to size prior to dispatch.

The Contractor shall ensure that steel work is not damaged due to careless or haphazard stacking. The steel work shall be stacked at site in such a manner that it shall be free from dirt, oil and other injurious elements and erection marks remain visible. Stacking shall, as far as practicable be done in the sequence of erection but heavy members shall not be stacked on top of light ones. Material shall also not be stacked in the vicinity of excavations for pits, foundations etc. already done or proposed to be done.

Arrangement shall always be made at the time of handling to make sure that damage to steel work is avoided. No dragging of steel shall be permitted.

Scratched or abraded steel shall be given a coat of yellow zinc chromate primer prior to erection. All milled and machined surfaces shall be properly protected from rust/corrosion by suitable coating and also from getting damaged. In the event of damage due to improper stacking and careless handling, the damaged piece will be rejected and shall be replaced by the Contractor at his own expense.

Precautions

All operations connected with welding and cutting equipment shall conform to the safety requirements and Health Provisions in Electric and Gas welding and cutting operations.

Safety & Security during erection

The Contractor is entirely responsible for the safety and stability of the structure during erection.

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

During erection, the steel work shall be securely bolted or otherwise fastened and when necessary temporarily braced/guyed till the completion including those due to the wind, erection equipment and its operation etc. For the purpose of guying, the Contractor shall not use other structure in the vicinity.

No permanent bolting or welding shall be done until proper alignment has been achieved.

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

Erection Clearance and Tolerances

Unless otherwise specified, the underside of base plates shall be within ± 3 mm from the elevations shown on the drawing. The lateral deviations of the base plates shall not exceed 5 mm from the theoretical centre line.

Maximum permissible erection tolerance

A) Columns

1	Deviation of column axes at foundation top level with respect to true axes. i) In longitudinal direction ii) In lateral direction	± 5 mm ± 5 mm
2	Deviation in the level of bearing surface of columns at foundation top with respect to true level	± 5 mm
3	Out of plumbness (verticality) of column axis from true vertical axis as measured at top i) Upto and including 30 m. height ii) Over 30 m. height	$\pm \frac{H}{1000}$ or ± 25 mm whichever is less $\pm \frac{H}{1200}$ or ± 35 mm whichever is less
4	Deviation in straightness in longitudinal & transverse planes of column at any point along the height.	$\pm \frac{H}{1000}$ or ± 10 mm whichever is less
5	Difference in the erection positions of adjacent pairs of columns along length or across width of building prior to connecting trusses/beams with respect to true distance.	± 5 mm
6	Deviation in any bearing or seating level with respect to true level.	± 5 mm
7	Deviation in difference in bearing levels of a member on adjacent pair of columns both across and along the building.	± 5 mm
	Note 1 : Tolerance specified under 3 should be read in conjunction with 4 & 5	
	Notes 2 : 'H' is the column height in mms	

B) Trusses

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

C) Gantry girders and rails

1	Shift in the centre line of crane rail with respect to centre line of web of gantry girder.	\pm (Web thickness of girder(mm) ± 2 mm)
2	Shift of alignment of crane rail (in plan) with respect to true axis of crane rail at any point.	± 5 mm
3	Deviation in crane track gauge with respect to true gauge.	
	i) For track gauge up to & including 15 mm	± 5 mm
	ii) For track gauge more than 15 mm	$\pm (5+0.25 (S-15))$ subject to maximum ± 10 mm where S in metres is true gauge.
4	Deviation in the crane rail level at any point from true level.	± 10 mm
5	Difference in levels between crane track rails (across the bay) at	
	i) Supports of gantry girders.	15 mm
	ii) Mid span of gantry girders.	20 mm
6	Relative shift of crane rail surfaces (at a joining) in plan and elevation.	2 mm

Alignment of individual beams, girders etc. shall not deviate more than ± 5 mm from the location given on the drawings.

The actual levels of trusses, collar beams, roofing beams, purlins etc. shall not vary more than 20mm. from their marked levels. The sweep of trusses, beams etc. in the horizontal plane shall not exceed $1/1500$ of their span, subject to a maximum of 10mm. The deviation of the upper chords of trusses from vertical plane through centres of supports shall be within $1/250^{\text{th}}$ of the truss height. Deviation in spacing of purlins shall be within 5mm.

For Crane rail alignment, the maximum vertical and horizontal deviations permitted shall be ± 2 mm gauge variation shall also be ± 2 mm.

Anchor Bolts & Foundations

The holding down and anchor bolts shall conform to the requirements laid down in IS : 5624 or as directed by Engineer-In-Charge. The Contractor shall carefully check the location and layout of anchor bolts / HD 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/foundations shall be reported to the Engineer-In-Charge.

All tolerance shall be as per IS: 7215 unless stated otherwise.

Anchor bolts / HD bolts may be provided with three nuts on upper threaded portion, one of which may be used for levelling the column base to the required elevation and one will be a lock nut. All shims shall be supplied by the Contractor at his own cost.

During casting of concrete Contractor shall ensure that space between the bolts or bolts and sleeves is kept clean after removal of shuttering. Contractor shall fix timber plugs to maintain this space in a clean condition. The projecting threads of bolts shall be protected by approved wrapping materials. A certain amount of cleaning of foundations and preparing the area is considered normal and shall be carried out by the Contractor at no extra cost.

Grouting under base plates

Grouting shall be done after erection and making proper alignment of the structural steel, unless otherwise approved by the Engineer-In-Charge. The Contractor shall furnish all shims/pack plates/wedges etc. and level all base plates to the proper elevations as shown on the fabrication drawings before grouting as specified.

Contractor shall keep holes on the stanchion bases for escape of air. Unless specified the grout to be used in bases shall be proportioned to 1:2 cement / sand along with non-shrinkage agents of approved quality and dosage as recommended by the manufacturers & as approved by Engineer-In-Charge & shall have a 28 days compressive strength of at least 300 kg/sq.cm. The grout mixture shall be poured continuously (without any interruption till completion) by grouting pumps from one side of the base plate. The pedestal/column surfaces, which are to receive the grout shall be thoroughly cleaned of all dirt, mud, water, oil or other extraneous matter using compressed air immediately prior to the grouting operation. The grout shall be carefully worked under the base plates and shall completely fill the space between the underside of the base plate and the concrete pedestal including voids around anchor bolts. If the bolt sleeves have been provided for the flexible positioning of bolts, neat cement grout of heavy consistency along with non shrink additives of approved make shall be poured in the sleeves so as to completely fill the sleeve hole. After the grout has had its initial set, the grout shall be cut back flush with the base plate and the surplus grout shall be removed. Before leaving the site, the Contractor shall re-tighten the nuts of all anchor bolts / H.D. bolts. The alignment of the structure shall now be rechecked and if found correct, the voids left by removal of shims/wedges/pack plates (if removed) shall be filled up with the same grout. If serious misalignment is found after checking the alignment, the grout shall be removed completely and fresh grouting to be done as explained above after carrying out appropriate corrections to the alignment. All the form work should be made water tight to prevent the leakage from the joints.

7.5. Painting

Painting work shall be carried out in accordance with IS: 8629 (Parts I to III)

- All preparation, priming and painting, in colours selected by the Employer, shall be deemed to be included in the Contract price.
- Painting shall generally be in accordance with IS : 1477
- All items of equipment shall be suitably protected and packed to resist corrosion and impact damage. Machined surfaces are to be treated with a proprietary sealing agent for transportation and storage.
- Paint materials shall be in accordance with the appropriate Indian Standard and shall be obtained from approved manufacturers and applied in accordance with the manufacturers' instructions or as ordered by the Engineer-In-Charge. All materials shall be delivered to the Site in sealed and labelled containers.

- The paint for each coat shall be from the same manufacturer, compatible with the underlying coat and shall be a different colour for ease of identification.
- Particular regard shall be paid to the maintenance of the recommended temperature and humidity during application and curing. Painted steelwork shall not be over coated or handled until the recommended curing period has elapsed. No finished paint coating will be accepted until the specified dry film thickness has been achieved to the entire surface including edges.
- All steel surfaces shall be completely dry and free from oil and grease and all welds ground smooth and weld spatter removed. All fins at saw cuts, burrs and sharp edges shall be removed, and the edges shall be rounded off.
- For all painted items, the Contractor shall submit for approval a 'Paint System Sheet' stating full details of each paint system proposed indicating the following information, with reference to IS : 1477
 - surface preparation
 - system reference together with manufacturer's brand name and product reference
 - dry film thickness
 - colour
 - time to repaint

Items to be painted

All structural steel work and metals including floor plates, floor gratings, stair treads, hand rails, brackets and steel inserts shall be painted except if otherwise specified.

No black bolts, nuts, washers and welds shall be painted before assembly or erection and approved by Engineer-In-Charge. They shall be thoroughly cleaned and dipped into boiling linseed oil and after erection, painted as specified herein.

Standard

The operations, workmanship, schedules and equipment for painting shall be generally comply with the requirement to IS: 1477 (Parts I & II) "Code of Practice for Finishing of Iron and Steel in Building – Painting and Allied Finishes".

All painting shall be carried out by brushing, spraying and roller application of paint shall not be allowed without the written permission of the Engineer-In-Charge.

No painting shall commence until the cleaned surfaces are approved by the Engineer-In-Charge.

No exterior or exposed painting shall be carried out under adverse weather conditions such as rain, extreme humidity, dust storms etc.

Shop Painting

After inspection of the fabricated work and before leaving the shop, all steel work shall be thoroughly cleaned by approved means to remove all rust, loose mill scales, drift and other foreign material by hand tool cleaning, power tool cleaning, frame cleaning or sand blasting as found appropriate and approved by Engineer-In-Charge. Greasy and oily surfaces shall be cleaned with solvent and dry rags. Unless otherwise specified, the Contractor shall not flame, clean or pickle the steel work prior to painting. Painting shall generally be done immediately after the cleaning and to thorough dry surfaces as per IS: 1477.

All steel work shall be given one shop coat of approved metal primer as specified unless otherwise it shall be yellow Zinc Chromate primer conforming to IS: 2074 in two coats and shall be applied before any member of steel structure are placed on position or taken out of workshop. A primer coat shall be applied thoroughly and evenly and well worked into joints

and other open spaces in order to ensure a continuous and uniform film without 'holidaying'. The primer coat shall be air dried and shall have a minimum thickness of 25 microns (tolerance $\pm 10\%$ after drying), unless specified.

Surfaces which are inaccessible or not easily accessible after shop assembly shall receive the full specified protective treatment before assembly (This shall not apply to the interior of tube/pipe sealed hollow sections).

All rivets, bolts (except high strength bolts), nuts, washers etc. shall be thoroughly cleaned and dipped in boiled linseed oil.

Parts to be encased in concrete and edges and surface areas adjacent to edges to be field-welded shall be thoroughly cleaned but shall not be painted or oiled.

Parts inaccessible after assembly shall be given two coats of shop paints of approved epoxy paint of approved shades, unless specified..

Machine finished surfaces shall be protected against corrosion by a suitable coating.

Where galvanized surfaces are to be painted, they shall be cleaned and washed with a solution of copper sulphate before the application of the first coat of primer.

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

Welds and adjacent parent metal shall not be painted prior to dislagging inspection and approval by Engineer-In-Charge.

Site Painting

After erection, the whole of the steel work shall be thoroughly cleaned and all dirt, marks, grease over spills of primer paint and other foreign matter shall be removed by hand, cleaning tool (power tool cleaning) using compressed water jet etc. Areas, where the shop coat has suffered damage or deterioration, shall be cut back and repainted with primer in the same manner as in the shop. All exposed surfaces of metal bolt heads and connections left unpainted in the shop shall be similarly treated. After this preliminary work of making good has been approved by the Engineer-In-Charge, all surfaces shall be thoroughly cleaned and when dry two finishing coats of approved paint shall be applied. Each coat shall be allowed to dry and harden thoroughly before the next coat is applied. The paint manufacturer's instructions shall be followed strictly. Also proper attention shall be paid to the following:

- Proper storage to avoid exposure and extremes of temperature
- Surface preparation prior to painting.
- Mixing and thinning.
- Application of paint and the recommended limit on time intervals between consecutive coats.

Primers and finish coat paints shall be from the same manufacture in order to ensure compatibility. Unless specified and approved, painting colour code shall be tentatively as follows:

1.	Gantry girders and monorail	Dark green
2.	Gantry girder and monorail stopper	Signal red
3.	Building structural steel - columns, brackets, beams, bracings, roof truss, purlins, side girths, louvers, stringers	Dark admiralty grey
4.	Pipe rack structure and trestle	Dark admiralty grey
5.	Chequered plate (plain face)	Black
6.	Grating	Black
7.	Ladder	Rungs - black Vertical and cage red

8.	Hand railing Hand rail middle rail toe plate	Signal red
9.	Vertical post	Black

Rub down and primer application

The shop coated surfaces shall be rubbed down thoroughly with emery/abrasive paper to remove dust, rust, other foreign matters and degreased, if required, in accordance with IS: 1477, cleaned with warm fresh water and air dried. The portions, from where the shop coat has peeled off, shall be touched up and allowed to dry. Primer coat of yellow zinc chromate primer (conforming to IS: 2074) shall be applied by brushing/spraying in a manner so as to ensure a continuous and uniform film throughout. Special care shall be taken to cover all the crevices, corners, edges etc. The each primer coat shall be air dried and shall have a minimum film thickness of 25 microns (tolerance $\pm 10\%$) after drying, unless specified.

Final paint application

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

Inspection & testing of painting material

All painting materials including primer and thinners brought to site by the Contractor for application shall be procured directly from reputed and approved manufacturers as per specifications and shall be accompanied by manufacturer's test certificates. Paint formulations without certificates shall not be accepted.

Guarantee

The Contractor shall guarantee that the chemical & physical properties of paint materials used are in accordance with the requisite specifications.

7.6. Mode of Measurement

Generally Structural steel painting is included in structural steel fabrication work. If specified separately the same will be measured as per IS 1200.

7.7. Rate

As specified in structural steel work.

7.8. M.S. land ties

General

All general specifications shall be as described under –Steel work specifications.

Materials

Structural steel work for fabrication of items shall comply with IS: 2062, Grade A.

All bolts and nuts shall comply with I.S. 1367, for Mild steel, high tensile steel structural quality and high tensile steel special quality bolts, and nuts shall comply with the provisions of Clause 3.5 of I.S. 800.

When bolt heads or nuts bear upon bevelled surfaces they shall be provided with square tapered washers to afford seating for the nut square with the axis of the bolt.

All nuts and bolts specified on the Drawings shall be to the required size with correct threaded length, and be supplied with matching nuts and washers also of the same material, except where electrolytic action is to be avoided.

Where small parts such as bolts and nuts etc. are to be sherries, they shall be treated to receive a coating of finished thickness not less than 30 microns.

Where bolts, nuts and washers etc. are to be hot dip galvanised, they shall be treated to receive a finished thickness of zinc coating of not less than 80 microns thickness.

Fabrication and Laying / Fixing in position

Fabrication and laying, fixing in position of land ties shall be done strictly as per the approved fabrication drawings subject to approval of Engineer-In-Charge.

Workmanship

It shall be of the highest quality in relation to the class of work. Care shall be taken in all preparation of the work, the selection of the finest materials and in the employment of fully qualified and tested workmen.

Painting

Exposed / top surface of land ties shall have 2 coats of zinc chromate primer coats (50 micron DFT each), unless specified, embedded portion shall not be painted.

Measurement

Mode of measurement shall be actual structural member fixed in place and measured in running metres correct to a millimetre in case of channels / beams / angels cleats, etc while MS plates shall be measured in square meter nearest to two place of decimal and weights calculated on the basis of Bureau of Indian Standard's Structural Engineer's Handbook No. 1 latest issue correct to the nearest kilogram.

- a) Unless otherwise specified, weight of cleats, brackets, placing pieces, bolts, nuts, washers, distance pieces, separators, diaphragm gussets, fish plates, etc. shall be added to the weight of respective items.
- b) No deductions shall be made for rivet / or bolt holes paints or finishes.
- c) The weight of steel sheets, plates and strips shall be taken from relevant Indian Standards. For rolled sections, steel rods and steel strips, weight given in relevant Indian Standards shall be used.
- d) Unless other wise specified weight of welding material shall not be added in the weight of members for payment and nothing extra shall be paid for making and filling holes for temporary fastening of members during erection before welding.

Rate

Rate includes the cost of labour, materials, handling, cutting, welding etc, use of equipments for all the operations, as described above including painting as described above.

7.9. CRS steel in crane rail with clamps

Materials

Rails shall comply with the specification of IS: 3443 - 1966.

Rails shall be free from all paint, oil, grease, dirt, loose rust and loose mill scale. Rail clamps shall be adjustable type rubber nosed crane rail clamps shall be used in accordance with the supplier's recommendations or as specified.

Fixing

The rail shall be laid straight and levelled to the requirements as per specifications. The location of rail on girders shall be such that the centre line of the rail is aligned on a vertical plane with centre line of web of girder within a tolerance of half the thickness of the girder web. If tighter tolerances are required the alignment of the girder should be corrected to bring the position of the rail within the tolerances limit.

Tolerances

Tolerances of $\pm 1\text{mm}$ in 2 metres, cumulative to 5m and $\pm 3\text{mm}$ over the track span. All these shall be with respect to approved datum line.

Joint Assembly

All joints shall be assembled on site and held together by the clipping of track to the rail support. The rail clamps should have 2 bolt each and shall be provided at 500mm c/c unless specified. Rail joint should have fish plate, as per standard good Engineering practices.

Painting

The rails shall be sand blasted and given one coat of epoxy primer with 25 micron DFT (Dry Film Thickness), unless specified. The top surface of rail head shall not be painted.

Measurement

The rail shall be measured for actual fixed length and measured correct nearest to centimetre (cm.)

Rate

Rate shall be for supply and fixing in position and involved all operations, material, labour, testing, etc. No separate payment shall be made for clamps, fittings and fixtures, etc.

7.10. Structural steel work in motorized doors

i) Horizontal moving panel sliding door

Materials

Structural steel shall be as described under-Steel work specifications.

Fabrication and Erection

Fabrication and erection shall be as described under –Steel work specifications and in accordance with approved fabrication drawing.

Moving Panel

The horizontal moving panel of the door shall be suspended from 2 Nos. '4' wheel trolleys, unless specified. The trolley shall have single flanged wheels capable of moving on bottom flange of rolled steel beam. The size of beam will be ISMB 200 to ISMB 400 unless otherwise shown on the drawing or specified elsewhere.

One of the trolleys shall have all the '4' wheels driven by Electric motor through gear reduction to get travel speed of '8 to 10' mtrs. per min. the other trolley shall be idler / follower type.

Panel of the trolley drive motor shall be wall mounted with pushbuttons for selecting the direction of movement e.g. open / close. These pushbuttons shall have identification on it. In case of '2' panel door the control panel shall be one for both the motors with separate switches for moving the door panels.

Limit switches to avoid excess travel shall control the travel of door. The travel motor shall have DC disc brake to stop the travel in case of power shutoff. The drive shall have facility for manual operation in case of power failure.

Power supply to the travel drive motor shall be through festoon cable arrangement depending upon travel distance.

Painting

Doors shall be sand blasted and primer coat and final coat shall be as specified in the item described and in accordance with specifications as described under –Steel work specifications.

Measurement

Mode of measurement shall be actual structural member fixed in place and measured in running metres correct to a millimetre in case of channels / beams / channels / angels, etc while MS plates shall be measured in square meter nearest to two place of decimal and weights calculated on the basis of Bureau of Indian Standard's Structural Engineer's Handbook No. 1 latest issue correct to the nearest kilogram.

Mechanical equipment and accessories such as wheels, motors, brakes, electrical supply, power, etc. shall be measured and paid separately as described under Section – Cranes & Rails.

- a) Unless otherwise specified, weight of cleats, brackets, placing pieces, bolts, nuts, washers, distance pieces, separators, diaphragm gussets, fish plates, etc. shall be added to the weight of respective items.
- b) No deductions shall be made for rivet / or bolt holes paints or finishes.
- c) The weight of steel sheets, plates and strips shall be taken from relevant Indian Standards. For rolled sections, steel rods and steel strips, weight given in relevant Indian Standards shall be used.
- d) Unless other wise specified weight of welding material shall not be added in the weight of members for payment and nothing extra shall be paid for making and filling holes for temporary fastening of members during erection before welding.

Rate

Rate includes the cost of labour, materials, use of equipments for all the operations, as described above including painting as described above but excluding mechanical / electrical equipment and mechanical / electrical accessories, which shall be measured and paid separately.

7.11. MS Anchor bolts

Materials

Anchor bolts shall be tuned from plain mild steel rounds conforming to IS: 432 Grade I.

Nuts and lock nuts (hexagonal type) shall be of grade 'B' as per IS: 1367 and conform to IS : 1363 and IS : 3138

Punched washers shall be of mild steel as per IS: 226 and conform to IS: 2016.

Pipe sleeves shall be of mild steel tubes (medium duty) conforming to IS: 1239

Anchor plates and ribs shall conform to IS: 226

Fabrication

Fabrication of anchor bolts (diameter and length as specified in the item description) and their complete assemblies shall be strictly in compliance with the specifications and drawings / standards. Anchor bolts shall have coarse type threads conforming to IS : 4218.

Placement

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

Tolerances

Tolerances allowed for anchor bolts positioning shall be:

- a) For sleeved bolts, one tenth of the bolt nominal diameter.
- b) For bolts without sleeves, one twentieth of the bolt nominal diameter.

Protection

The exposed surface of bolts shall be properly covered (after greasing of bolts and packing of sleeves) with jute cloth so as to protect them from damage.

Measurement

Anchor bolt shall be measured on the basis of actual weight in metric tons of the anchor bolt assembly correct up to two decimal.

Rate

The rate shall include supply of all material and labour involved in above operations including handling, transporting, fixing in position, welding if required, providing necessary templates, greasing, packing of sleeves, covering with jute cloth etc. all complete.

7.12. M.S. foundation bolt

Specifications for M.S. foundation bolt shall be generally as described under –MS Anchor bolt specifications.

7.13. M.S. Inserts

Materials

Metal inserts shall be of mild steel conforming to IS: 226 and IS: 2062

Lugs shall be of either mild steel bars / flats.

Mild steel rounds shall conform to IS: 432 (Grade I)

High yield deformed bars shall conform to IS: 1786

Mild steel flats shall conform to IS: 226

Fabrication

Fabrication of inserts shall be done strictly as per drawings / standards and in compliance with the requirements given in relevant specifications.

Placement

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

Painting

The exposed surfaces of inserts shall be cleaned (all the surfaces) with wire brush and application of two coats of yellow zinc chromate primer on the plain surface after fabrication conforming to IS: 2074 shall be given as described under- Steel work specifications.

Measurement

MS inserts shall be measured on the basis of actual weight in metric tones of the metal inserts correct up to two decimal.

Rate

The rate shall include supply of all materials handling, transporting, fabrication, welding, fixing in position, providing necessary templates, spacers, dummy structures, adjusting the formwork & reinforcement, staging, applying two coat of yellow zinc chromate primer, etc. all complete.

7.14. M.S. Chequered Plate**Materials**

Chequered plates shall be of mild steel (Grade I unless otherwise specified) and conforming to IS: 3502.

Shop Drawings

Shop drawings shall be prepared by the Contractor on the basis of "Approved for Construction" (AFC) design / drawing issued to the Contractor.

Fabrication

Chequered plates shall be fabricated as per the "Approved for Construction" Shop drawings (prepared by the Contractor based on design drawings and duly approved by Engineer-In-Charge). These shall be perfectly flat and without any dents / deformations and shall be cut to the required size and shape. Holes / notches / openings of the required size, if any shown in the drawings shall be made. If used for staircase treads, nosing shall be made by cold bending of chequered plates. All edges shall be made smooth and even. All chequered plate units shall be given distinct erection marks in accordance with the marking drawings.

Erection / Fixing

Chequered plates shall be fixed to the bearing members by welding / bolting / screwing as shown in the drawings.

Painting

Chequered plates shall be cleaned (both side) with wire brush and shall be given unless otherwise specified in the item description two coats of yellow zinc chromate primer on the plain surface after fabrication conforming to IS:2074 and specifications as described under – Steel work specifications.

Measurement

Measurement shall be made on the basis of admissible weight in metric tons of the chequered plates accepted by the Engineer-In-Charge. The weight shall be calculated on the basis of IS Hand Book. No allowance in weight shall be made for rolling tolerances.

Rate

The rate shall include supplying, fabricating, erecting M.S. chequered plate including transporting, handling, straightening, if required, cutting to required size and shape, making holes / notches / opening of required size and nosing, smoothing the edges, fixing by welding / bolting / screwing, preparing detailed fabrication drawings, surface cleaning, removal of rust, scale, grease and applying two coat of yellow zinc chromate primer etc. all complete as specified.

7.15. M.S. Gratings

Categories

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

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

Material

Gratings shall be of mild steel flats with mild steel rounds as per detailed drawings forwarded to Contractor.

Mild steel flats shall conform to IS: 226

Mild steel rounds shall conform to IS: 432 - Grade I

Fabrication Drawings

Fabrication and erection drawings shall be prepared by the Contractor on the basis of "Approved for Construction" (AFC) design drawing issued to the Contractor. These drawings shall be prepared by Contractor or by an agency approved by the Engineer-In-Charge.

Fabrication of Category 'A' Gratings

These shall be fabricated strictly as per the "Approved for Construction" fabrication drawings prepared by the Contractor based on design drawings and standards. All units shall be given distinct erection marks in accordance with the marking drawing.

Fabrication of Category 'B' Gratings

These shall be as per manufacturer's details designed to carry loads as specified in the design drawing supplied to the contractor. The deflection shall not exceed span / 200 or 6mm whichever is minimum. The maximum clear size of voids in the grating be limited to 30mm x 55mm. The contractor shall make necessary notches / opening in the gratings as shown in the drawings. All edges affected by such notches / openings shall be suitably stiffened by welding additional flats of the requisite size. All units shall be given distinct erection marks in accordance with the marking drawings. Before procurement the contractor shall submit the

design calculations, drawings and manufacturer's literature / catalogues and get the same approved by the Engineer-In-Charge.

Erection / Fixing

Gratings shall be fixed to the bearing members by welding / clamping / bolting as indicated in the drawings.

Painting

MS inserts shall be cleaned (both the surfaces) with wire brush and given two coats of yellow zinc chromate primer on the plain surface after fabrication conforming to IS:2074 and specifications as described under above under –Steel work specifications.

Measurement

Payment shall be made on the basis of admissible weight in metric tons of the gratings accepted by the Engineer-In-Charge. The weight shall be calculated on the basis of IS Hand Book. Manufacturer's catalogues / charts shall be adopted in case of gratings of category 'B'. No allowance in weight shall be made for rolling tolerances

Rate

The rate shall include supplying, fabricating, erecting MS gratings (of the specified category) including transporting, handling, cutting to required size and shape, making holes/notches / opening of required size and nosing, smoothening the edges, fixing by welding / bolting / screwing, preparing detailed fabrication drawings, surface cleaning, removal of rust, scale, grease and applying two coats of yellow zinc chromate primer etc. all complete as specified.

7.16. M.S. Tubular Hand Railing

Material

M.S. tubes for hand railing shall be 25mm and 32 mm nominal diameter, unless specified of mild steel medium grade conforming to IS: 1239, vertical rolled steel angles etc. conforming to IS-808.

Toe/Base plates shall be of mild steel conforming to IS: 226

Fabrication Drawings

Fabrication and erection drawings shall be prepared by the Contractor on the basis of "Approved for Construction" (AFC) design drawing issued to the Contractor. These drawings shall be prepared by Contractor or by an agency approved by the Engineer-In-Charge.

Fabrication

Hand railing shall be fabricated strictly as per the "Approved for Construction" fabrication drawings prepared by the Contractor based on design drawings and standards. All tubes shall be straight and without any dents / deformations. Tubes shall be cut and ends shall be prepared to a neat and workman like finish. All elements shall be directly welded. Tubes shall be cold bent to shape and curvature in case of discontinuous ends of handrails. Lower ends of vertical posts shall be cut and splayed (for grouting in pockets provided in the concrete members). For removable type of hand railing, suitable base plates (with provision for bolting) shall be welded to the lower end of vertical posts.

Erection / Fixing

Hand railing shall be fixed to the bearing members by welding / bolting / grouting as indicated in the drawings or as directed by the Engineer-In-Charge.

Painting

MS tubes shall be cleaned (both the surfaces) with wire brush and given two coats of yellow zinc chromate primer on the plain surface after fabrication conforming to IS:2074 and 2 coats of approved synthetic enamel paint as per specifications described under-Steel work specifications.

Measurement

Actual length of structural steel tubes/ angles etc. fixed in place for railing as per design shall measured in running metres correct to a millimetre, while M.S. Plates shall be measured in square meter nearest to two decimals and weights shall be calculated on the basis of Bureau of Indian Standard's Structural Engineer's Handbook No. 1 latest issue correct to the nearest kilogram.

Rate

The rate shall include preparation of fabrication drawings, supply of all materials handling, transporting, straightening if required, cutting to required size, bending, welding, bolting, grouting, surface cleaning, removal of rust, scale, grease and applying two coat of yellow zinc chromate primer after fabrication etc. all complete as specified.

7.17. Non Shrink High strength Grout

Materials

Grouting shall be carried out with ordinary cement in the proportion of (1:2) with non-shrinkage grouts of approved manufacturers dosage as recommended by the manufacturer and approved by the Engineer-In-Charge. Cement and aggregate shall be as described under – Mortars specifications.

Non-shrinkage high strength grout shall be of M/s. MC-Bauchemie (I) Pvt. Ltd., M/s. FOSROCK, M/s. ROFEE, etc. or other approved equivalent .The dosage, proportions and mixing procedures as per manufacturers details subject to Engineer-In-Charge's approval. The compressive strength after 28 days shall be at least 300 Kg./Sq.cm.

Grouting shall be done after erection and making proper alignment of the structural steel, unless otherwise approved by the Engineer-In-Charge. The surface which are to receive the grout shall be thoroughly cleaned using compressed air immediately prior to the grouting operations. The grout mixture shall be poured continuously by grouting pumps from one side of the base plate. The grout shall be carefully worked under the base plates and shall completely fill the space between the under side of the plates and concrete pedestal including voids around anchor bolts. The procedure for laying grout shall be strictly as per manufacturer's procedure under expert's supervision taking care to avoid air locks. Edges shall be finished properly. After the grout has its initial set, the grout shall be removed.

Measurement

The grout laid in place shall be measured in Kilograms nearest to the two decimal.

Rate

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

M.S. Rolling Grills

Material

Rolling grills are similar in design, construction and operation to rolling shutters and all the provisions as described under Section Clause 3010.22 above shall be applicable to rolling grills except in respect of the shutter portion, and shall conform to IS: 6248.

Shutters

Unless specified rolling grill shutter and the rolling grill portion of the rolling shutter-cum-grill shall be fabricated with 8mm diameter mild steel round bars. Straight bars and bars bent to the required profile are placed alternatively and held in position with 20mm wide and 5mm thick mild steel flat links. Straight bars shall be spaced not exceeding 150mm centre to centre and the bars bent to required profile shall be placed symmetrically between two consecutive straight bars shall be bent to form a corrugated profile such that the pitch of the corrugation is 100 to 120mm and the depth of corrugation is 80 to 100mm. All the bent bars shall have uniform profile. Straight bar along with the adjoining bent bars on both sides shall be held in position by passing the bars through holes in the links. Each link shall have three holes and the length of the links shall be such that the distance from centre of the hole to the nearest edge of the flat is not less than the diameter of the hole. The corner of the links shall be rounded. All links shall be of uniform size and shape. The spacing of the links measured along the straight bar shall be uniform in size and shape. The spacing of the links measured along the straight bar shall be the same as to the centre to centre distance between two consecutive crests / troughs of the bars bent to the required profile. Each bar and link shall be a continuous single piece without any joint.

Measurement

The measurements shall be as specified in 3010.22 above. In case of Rolling shutter-cum-grill, where the area of the grill portion is half or less than half the area of opening, it shall be measured and paid as rolling shutter and where the area of grill portion is more than half the area of opening, it shall be measured as rolling grill.

M.S. Bars and M.S. Grills in Steel Frames:

M.S. round or square bars, with or without M.S. flats, M.S. grills of different patterns with flats with M.S. or without M.S. bars, round or square, fixed in wooden or steel windows or clerestory windows etc. are described in this clause.

Fabrication

When M.S. bars round or square are to be fixed in wooden or steel frame these are cut into required length to form the required pattern, then fixed as per drawing. In the case of wooden frames the length will be for fixing in the hole 5cm deep in one frame and right through and flush with outer side of the frame.

When M.S. round or square bars are to be fixed to steel frames or in combination with M.S. flats there are to be cut to proper size welded to steel frames or M.S. flats to form the required pattern. In case of M.S. flats they should have counter sunk holes to facilitate fixing them to wooden frames with wood screws. Welding shall be done in an approved workshop and not at site.

When the grill is to be fabricated mainly with M.S. flats with or without M.S. round or square bars, the flats of required size are cut and bent to form the required pattern and design as per drawing or all around the width of the flats or circumference of bars which are joined. At corners of flats proper mitred joint forming a right angle shall be provided with welding for full width. Welding shall be done in approved workshop and not at site.

Fixing

When M.S. round or square bars are to be fixed to wooden frames the bars shall be passed into the wooden frame, from the end having a through hole and fixed flush with that end while at the other end it will be 5cm deep in the hole drilled in the frame. In case of steel frames, the bars will be welded to the steel frame by fillet weld all along the circumference of the bars in an approved workshop and not at site.

In case of grill of bars welded to M.S. Flat forming the required pattern, the outer frame of M.S. flats shall be fixed to the wooden frame with wood screws in the counter sunk holes drilled in

M.S. flats ensuring that screws are driven with some screw driver (not hammered) till the screws are embedded fully inside flush with the M.S. flats.

In case of fixing to the steel frames, M.S. flats of required pattern with or without M.S. round or square bars, the method of fixing will be similar to what is described above.

Any kind of welding at site shall be allowed only under written instructions of the Engineer-In-Charge.

Measurements

The different types of M.S. grills as described in fabrication will be measured separately. The length of bars and flats used in grills will be measured correct to cm and then weights calculated in kg by using Bureau of Indian Standard's Structural Engineer's Handbook No. 1 latest issue.

Rate

The rate shall include the cost of materials and labour required for all the operations described above. Grill of different types mentioned in fabrication shall be paid for separately.

7.18. M.S. Gutters:

i) Material -

Gutters shall be fabricated from plain M.S. sheets of 6mm thick unless otherwise shown on the drawing or specified in the item description.

Structural steel sheets / strips shall conform to IS : 1079

Gutters shall be of the shape and section specified in the description of the item. The overall width of the sheet referred to there in shall mean the peripheral width of the gutter including the rounded edges. The longitudinal edges shall be turned back to the extent of 12mm and beaten to form a rounded edge. The ends of the sheets at the junctions of pieces shall be hooked into each other and beaten finish to avoid leakage.

ii) Slope:

Gutter shall be laid with a minimum slope of 1 in 120, unless specified.

iii) Laying and fixing :

Gutter shall be supported on and fixed to M.S. flat iron brackets bent to shape and fixed to the requisite slope. The maximum spacing of brackets shall be as shown on the approved drawings or unless otherwise specified shall be 1.20 meters.

Where the brackets are to be fixed to the sides of rafters, they shall be of 40 x 3mm section bent to shape and fixed rigidly to the sides of rafters with 3 Nos. 10mm dia. bolts, nuts and washers. The brackets shall overlap the rafter not less than 30cm and the connecting bolts shall be at 12 cm centers.

Where the brackets are to be fixed to the purlins, it shall be as shown on the drawing approved for construction or unless otherwise specified, the brackets shall consist of 50 x 3mm M.S. flat iron bent to shape with one end turned at right angle and fixed to the purlin face with 2 Nos. 10mm dia. bolts, nuts and washers. The brackets will be stiffened by provision of 50 x 3mm M.S. flat whose over hung portion bent to right angle shape with its longer leg connected to the bracket with 2 Nos. 6mm dia. M.S. bolts, nuts, and washers and its shorter leg fixed to face of purlin with 1 No. 10mm dia. bolt, nut and washers. The over hang of the vertical portion of the bracket from the face of the purlin shall not exceed 22.5cm with this arrangement. The spacing of the brackets shall not exceed 1.20 meters unless otherwise shown on the drawing.

The gutter shall be fixed to the brackets with 2 Nos. G.I. bolts and nuts 6mm dia. each fitted with a pair of G.I. and bitumen washers. The connecting bolts shall be above the waterline of the gutters.

For connection to down take pipes, a proper drop end or funnel shaped connecting piece shall be made out of Galv. sheet of the same thickness as the gutter and riveted to the gutter, the other end tailing into the socket of the rain water pipe. Wherever, necessary stop ends, angles, etc. shall be provided.

iv) Finish

The gutters when fixed shall be true to line and slope and shall be leak proof.

v) Painting

Gutters of internal surfaces shall be cleaned thoroughly and given two coats of approved primer to suit polyurethane coating as per manufacturer's instructions, unless otherwise specified and shall be applied before laying in position finish coat shall be of approved brand Polyurethane coat paint. External surface shall be painted with two coats of approved primer i.e. Yellow zinc chrome primer conforming to IS : 2074 and approved two coats of synthetic enamel paints as specified under painting item or directed by the Engineer-In-Charge

vi) Measurement

Measurement shall be taken for the finished work along the centre line of the top width of the gutter connection to a cm. The hooked lap portion in the junctions and gutter length shall not be measured. The effective area for payment shall be calculated in square meter. The weight for M.S. sheet shall be calculated on the basis of Bureau of Indian Standard's Structural Engineer's Handbook No. 1 latest issue. No allowance in weight shall be made for rolling tolerances. The number of brackets which are fixed to purlins with stiffeners flats shall be measured.

Welds, bolts, nuts, screw, and washers shall not be measured. The quoted rate shall be deemed to be inclusive of the same.

vii) Rate

The rate shall include the cost of all labour and materials specified above, including all special such as angles, junctions, drop ends or funnel shaped connecting pieces, stop ends etc. flat iron brackets and bolts and nuts required for fixing the latter to the roof members including handling, painting etc. Brackets with stiffener flats shall be measured separately.

7.19. Polyurethane Coating Structural Surface

Material

Polyurethane coatings shall be in confirmation with relevant BIS / BS code or otherwise by renowned manufacturers subject to inspection and approval of Engineer-In-Charge. The contractor shall submit necessary supporting technical documents of manufacturer in regards to heat, Ultra violet rays, metal expansion and contraction, abrasion resistance, life of coating, special precautions to be taken care while application, its maintenance and guarantee etc. The contractor should get approval before using the paint.

Key Properties of Coating

It shall be fast drying at room temperature. It shall withstand temperature around 100° C. Broad details of coatings are described as below:

- | | | | |
|----|--------------------|---|--|
| a) | Weather Resistance | : | Excellent colour & gloss retention even in sunlight exposure |
| b) | Alcohol Resistance | : | Unaffected by splash and spillage |
| c) | Salts | : | Unaffected |

- d) Water Resistance : Excellent water and salty water resistance (not recommended for immersion)
- e) Oil & Grease : Unaffected.

Application

Before application of Topcoat PU-101 enamel or other approved coat, contractor shall carry out all necessary pre-treatment preparation. For M.S. surface remove grease, oil and other contamination by using proper de-rusting and phosphating chemicals to clean surface. Apply properly TUFF COAT PU - 102 - primer coat / EP 102 Epoxy Primer / Grey Primer / Zinc Rich Primer or Hi-Build wash primer.

After proper drying of primer coat apply PU-102 Enamel in the proportion and manner strictly as per manufacturer's specifications. Stir the base component thoroughly and mix four parts of base and one part of hardener by volume to uniform consistency. Keep it for 15-30 min. for stabilization and stir again before use. Make required viscosity as per application method with TC / PU 101 Thinner. Mix the above material as per requirement.

Pot life: Close the containers immediately to avoid the chances of the moisture absorption in material. Do not apply in humid condition during the raining, fog or mist or at very low temperature i.e. below 7°C.

Stability of Hardener: Once the hardener container is opened, try to consume it immediately because it reacts with Hydroxyl groups present in atmosphere and it results in to deterioration.

Necessary scaffolding and safety precautions shall be as recommended by the Manufacturer or as directed by the Engineer-In-Charge.

Measurements

Length shall be taken for the finished work along the centre line of the top width of the gutter connection to a cm. The hooked lap portion in the junctions and gutter length shall not be measured. The effective area for painting shall be measured for its gross superficial area and shall be calculated in square meter.

8. FINISHING WORKS:

8.1. Cement Plastering

Cement plaster shall be of 6, 12, or 20 mm thick as specified in the respective item.

Materials

Cement mortar shall be as described under- Mortar specifications. However, cement used in the plaster shall be Portland Pozzolana Cement (PPC) Fly ash based conforming to IS: 1489 (Part-I.) unless otherwise specified. Only river washed sand shall be used. Pan type mixer for mortar should preferably be used.

Application

Unless otherwise specified all plaster work shall be carried out in accordance with IS 1661.

The thickness and proportion of cement mortar shall be as specified or directed.

Unless permitted otherwise by the Engineer-In-Charge, only double scaffolding of adequate strength shall be provided by the Contractor. No holes shall be made in the masonry for supporting the scaffolding. Scaffolding members shall not be tied to windows, doors, other members provided in the walls.

No plastering work shall commence until the surface preparatory work is approved by the Engineer-In-Charge.

The sand shall be as approved by Engineer-In-Charge and in accordance with IS 1542 specification for plaster.

Preparation of Surface

Joints of all masonry work shall be carefully raked out for a depth of about 12 mm. without causing any damage to the masonry. Surfaces of concrete work shall be thoroughly roughened with chisel by pricks prior to application of plaster. For materials, which are not able to receive plaster directly, the necessary procedures shall be carried out as per the directions of the Engineer-In-Charge

All surfaces shall be thoroughly cleaned of all dirt, soot, oil, grease and any other material preventing proper bonding etc. and any efflorescence shall be removed by brushing and scraping. The surface shall then be soaked with water for at-least 6 hours prior to application of plaster to ensure proper adhesion between the surface and plaster. If any surfaces become dry in spots, such area shall be moistened again to restore uniform suction.

Procedures / Precautions Applicable to Workmanship

Plaster work shall proceed from top to bottom in one operation on an entirely unobstructed surface or on areas up to break against openings.

Long straight edge shall be used to ensure perfectly even surface. All corners, angles and junctions shall be truly vertical and horizontal as the case may be and shall be carefully and neatly finished. All soffits, exposed angles with door and window frames shall be carefully finished. Internal angles shall be rounded if so directed and arises shall be rounded, splayed or beaded as directed. The mortar shall adhere to the surface intimately when set and there should be no hollow sound when struck.

All plaster work shall be kept cured for a minimum period of 10 days after the application of finishing coat to prevent excessive evaporation. Matting of gunny bags should be hung over the outside of the plaster in a hot dry weather.

1st Coat

The thickness shall be about 12 mm. thick in case of brick walls, RC walls and columns and 6 mm. thick for ceiling, soffit of beams etc. Before this coat hardens, the surface shall be cross scratched to provide a mechanical key for the 1st coat. The cross-scratch shall be horizontal as far as possible to aid curing which will be done for at least 2 days immediately following the application.

Chicken Mesh

Chicken wire mesh of 22 gauge unless specified at junction of RCC and masonry work 15 cm. (at 6") overlap on either side shall be fixed with nails.

Finish Coat

At least a period of 3 days should elapse between the application of the first coat and the finish coat. Finish coat shall be applied as specified in the item description unless other wise, stated neeru finish shall apply as described under the neeru finish specifications given below.

Curing

Curing shall be started as soon as the plaster has hardened sufficiently not to be damaged when watered.

The plaster shall be kept wet for a period of at least 7 days. During this period, it shall be suitably protected from all damages at the contractor's expenses by such means as the Engineer-In-Charge may approve. The Dates on which the plastering is done shall be legibly marked on the various sections so that for the specified period it can be watched.

Measurement

For plastering, the measurement shall be on area superficial for the unfinished surfaces as actually covered. Length and breadth shall be measured correct to a cm and its area shall be calculated in Sq.m. correct to two places of decimal. Dimensions before plastering shall be taken.

The areas shall include (all the actual pointed / plastered areas for jambs, sills, soffits of openings etc.

No deductions shall be made for ends of joints, beams etc.

No extra shall be allowed for beaded, chamfered or rounded arrises or curved angles.

Rate

The rate shall include the cost of all labour and materials involved in all the operations described above excluding chicken mesh, which shall be measured separately.

8.2. Neeru Finishing:

Materials

Lime shall be of best quality hydraulic lime properly burnt and from approved sources and shall be slaked with fresh water on site. It shall be free from un-burnt kankar, ashes and other impurities including salt. Lime shall be stored safely in weatherproof sheds, filled in bags. It shall not be stacked against the walls of the shed. It should be used as soon as possible.

Instant Neeru

Instant neeru shall conforming to IS 712 and mix /slurry shall be prepared as per the recommendation of the manufacturer's specification subject to approval of the Engineer-In-Charge.

Application

The 'Neeru' as prepared above shall be applied to the prepared surface with a steel trowel to a thickness not exceeding 3mm and rubbed and polished to a perfectly smooth and even finish working from top to bottom. While trowelling is going on soap stone powder contained in thin muslin bags shall be dusted over the surface and worked in.

The surface of the under coat on which the punning is to be done shall be left rough. The punning shall be applied, when the under coat is still green. The mortar for punning shall be applied in a uniform layer slightly more than 3mm thick between gauged pads, with which to ensure an even and uniformly thick surface by frequent checking with a wooden straight edge. It shall be finished to an even and smooth surface with trowels.

All corners, arises, angles and junctions shall be truly vertical and horizontal as the case may be and shall be carefully and neatly finished. Rounding or chamfering corners, arises, junctions etc. where required, shall be punned without any extra payment. Such rounding, chamfering or grooving shall be carried out with proper templates or battens to the size required.

No portion of the surface shall be left out initially to be patched up later on.

Thickness

The thickness of the finished punning shall not be less than 3mm thick.

Scaffolding, Finishing, Precaution and Curing

Specifications for these shall be as described under-Plastering specifications.

Measurement

Included in plastering work wherever specified.

Rates

Included in plastering work wherever specified.

8.3. Chicken mesh 22 SWG:**Materials**

Chicken wire mesh shall be 22 gauge of approved manufacturers, unless specified.

Fixing

The chicken wire mesh shall be provided at the junction of RCC and masonry work 150mm over lap on either side fixed with 'U' nails. 150mm centre to centre before plastering the junction.

Measurement

Length and breadth shall be measured correct to a centimetre (cm) and its area shall be calculated in Square metres (Sq.m.) correct to two place of decimal.

8.4. Plaster of Paris Finishing (POP):**Material**

The Plaster of Paris shall be of calcium-sulphate semi-hydrate variety. Its fineness shall be such that when sieved through a sieve of IS sieve designation 3.35 mm for 5 minutes after drying the residue left on it shall not be more than by 1% by weight. It shall not be too quick

setting. Initial setting time shall not be less than 13 minutes. The average compressive strength of material determined by testing 5 cm cubes after removal from moulds, after 24 hours and drying in an oven at 40° C till weight of the cubes is constant & shall not be less than 84 kg per square metre.

Application

The 'POP' as prepared above shall be applied to the prepared surface with a steel trowel to a thickness not exceeding 6mm and rubbed and polished to a perfectly smooth and even finish working from top to bottom. While towelling is going on soap stone powder contained in thin muslin bags shall be dusted over the surface and worked in.

The surface of the under coat on which the punning is to be done shall be left rough. The punning shall be applied, when the under coat is still green. The mortar for punning shall be applied in a uniform layer slightly more than 6mm thick between gauged pads, with which to ensure an even and uniformly thick surface by frequent checking with a wooden straight edge. It shall be finished to an even and smooth surface with trowels.

All corners, arrises, angles and junctions shall be truly vertical and horizontal as the case may be and shall be carefully and neatly finished. Rounding or chamfering corners, arrises, junctions etc. where required, shall be punned without any extra payment. Such rounding, chamfering or grooving shall be carried out with proper templates or battens to the size required. No portion of the surface shall be left out initially to be patched up later on.

Thickness

The thickness of the finished punning shall not be less than 6mm thick, unless specified.

Scaffolding, Finishing, Precaution and Curing

Specifications for these shall be as described under- Plaster specifications.

8.5. Sand Faced Cement Plaster:

General

This shall be done in two coats. Backing coat shall be 12 mm. thick in 1:4 cement mortar with 2% by weight of cement of approved integral cement waterproofing admixture added to it, unless specified. The second and finishing coat shall be 8 mm. thick in 1:3 CM, unless specified.

Materials

Cement mortar shall be as described under- Mortar specifications. However, cement used in the plaster shall be Portland Pozzolana Cement (Fly ash based) conforming to IS: 1489 (Part - I) unless otherwise specified Only river washed sand shall be used. Pan type mixer for mortar shall preferably be used.

Integral waterproofing compound conforming to IS: 2645 and of approved brand and manufactured, enlisted by the Engineer-In-Charge from time to time shall be used. The Contractor shall bring the materials to the site in their original packing. The containers will be opened and the material mixed with dry cement in the proportion by weight, recommended by the manufacturers or as specifically described in the description of the item. Care shall be taken in mixing, to see that the water proofing material gets well and integrally mixed with the cement that does not run out separately when water is added.

Chicken wire mesh 22 gauge at junction of RCC and masonry work 150 mm. (at 6") overlap on either side shall be fixed with nails. *(Chicken wire shall be measured separately under relevant item)*

Application

This shall be applied in 2 coats. The first coat or the base coat shall be approximately 12 mm and shall be continuously carried out without break to the full length of wall or natural breaking points such as doors, windows etc. The base coat shall be splashed on to the prepared surface with heavy pressures, brought to true and even surface and then lightly roughened by cross scratch lines, to provide bond for the finishing coat. The base coat shall be cured for at least seven days.

For backing coat about 15 cm. x 15 cm. plaster patches shall be prepared as gauges at convenient distance apart to ensure even plastering in one plane. The mortar shall be firmly applied with somewhat more than the required thickness and well pressed into the joint and on the surface by wooden floats to produce an even and uniform surface. The surface shall be roughened with wire brushes to give a good bond to the finishing coat. The backing coat shall be cured for 4-5 day.

For the finishing coat, sand used shall be screened to pass through 3 mm. mesh sieve (all material passing through 1.5 mm. mesh sieve shall be eliminated). The coat shall be applied uniformly with wooden float and the entire surface shall be rubbed with approved sponges (e.g. wooden float lined with cork) to expose the sand grains uniformly and predominantly, while finishing steel trowel shall not be used and overworking shall be avoided.

Measurement

Measurement shall be as described under- Plastering specifications.

Rate

The rate shall include the cost of all labour and materials involved in all the operations described above including integral waterproofing compound but excluding chicken mesh which shall be measured separately.

8.6. Rough Cast Cement Plaster:

Materials

Cement mortar shall be as described under – Sand faced plaster specifications.

Application

This shall be done in two operations; backing coat of 12 mm. thick in 1:4 CM is done in an identical manner as for sand-faced cement plaster. As soon as the backing coat is only slightly set (i.e. when it is still essentially in a plastic state), the finishing coat 13 mm. thick in 1:1:2 proportion (1 cement: 1 of graded sand:2 of gravel generally 8 mm. to 12 mm. in size) shall be dashed by means of trowels against the backing coat such that the dispersion of gravel shall be uniform and it shall be seen predominantly on the surface.

8.7. Waterproof Cement Plaster:

Materials

Cement mortar shall be as described under – Sand faced plaster specifications.

Application

Application shall be as described under- Sand faced plaster specifications.

Finish coat

When the plaster has been brought to a true surface with wooden straight edge it shall be uniformly treated over its entire area with paste of neat cement and rubbed smooth, so that the

whole for surface is covered with neat cement coating. The quantity of cement applied for floating coat shall be 1 kg per sq. m. Smooth finishing shall be completed with trowel immediately and in no, case later than half an hour of adding water to plaster mix.

The first coat shall be evenly dampened and 5 mm thick finish coat shall be well smooth after floating it with a coat of Portland Cement. The use of dry cement shall not be permitted.

Integral waterproofing compound conforming to IS: 2645 and of approved brand and manufactured, enlisted by the Engineer-In-Charge from time to time shall be used. Applications shall be as described under sand faced plaster specifications.

8.8. Grooves in Plaster:

Materials/mortars

Materials / mortar shall be as described under –Plastering specifications.

Application

The horizontal and vertical grooves shall be exactly to the required depth and width as shown in the drawings and shall be in perfect lines without any break in continuity. The grooves shall be neatly finished with extreme care.

Plasterwork shall follow following steps and work shall commence only after approval of the Engineer-In-Charge. .

- Surface shall be properly cleaned.
- Plaster area shall be provided with level pads or spots allowing working & checking with 2 - 3m. Straight edge. Depth of plaster shall not be less than 8mm. at any point.
- Required concealing services work shall be completed and tested prior to start of plasterwork.
- No further cutting of masonry shall be allowed.
- Repairs carried out to masonry or concealing work shall be cured and dry.
- Surface shall be sufficiently damp / wet.
- Plaster pads shall be checked for plumb & level and approved by Engineer-In-Charge.

Corners, external or internal shall be finished along with finished coat. It is advisable to have rounded corners.

Plaster shall be cured for 14 days by wet curing except in neeru finish plaster.

Plaster shall be levelled and lined by Aluminium hollow section of 2-3 m. long. (This will give even and levelled surface). There shall not be more than 2 mm. difference in level when checked with 3 m. straight edge. It is important enough pressing and beating is done to achieve compact filling of joints and area shall be fully compacted.

Finishing of plaster may be carried out with wooden float (randhaas) or trowelled smooth with sheet metal trowels as specified. Care shall be taken to avoid excessive trowelling and overworking the wooden float.

All corners, internal or external, shall be truly vertical or horizontal. These shall be finished with a proper template to achieve best workmanship for rounding and chamfering as specified or directed.

Plaster shall be cut to correct horizontal or vertical line at the end of the day or if work required to be suspended for any reason.

Area of plaster is advisable to be limited to 15 Sq.m. To avoid cracks due to thermal movements of dissimilar material in contact, it is advisable to provide joints, treated with

groove or any other detail suggested by the Engineer-In-Charge. These joints if not specified shall be treated with 100 mm. wide reinforcing chicken mesh fixed over joints by G.I. nails and area plastered.

8.9. Cement Pointing

Materials

Materials shall be as described under-Mortar specifications.

Mortar

Cement & fine sand (washed, if necessary) are mixed in the specified proportion using sufficient water to produce a smooth paste of homogeneous mix and uniform colour. Waterproofing compound, as approved by the Engineer-In-Charge, shall be added as per manufacturers specifications. Mixing platform shall be clean and impervious and shall be so arranged that no deleterious extraneous material shall get mixed with mortar nor the mixing water of the mortar shall flow out.

Preparation of Surface

All joints to be pointed shall be raked out to a depth not less than the width of the joint, preferably when the mortar is green. Projections of stones shall be chiselled, if necessary. The raked surfaces shall be thoroughly cleaned of all dust, loose particles and efflorescence materials with stiff wire brushes and washed with water and kept well wetted before pointing. The entire area shall be protected by a removable / non-staining coating of suitable approved material.

Pointing

Mortar prepared as above shall be well pressed into the joints with a pointed trowel and rubbed smooth either flush sunk or raised, according to the type of pointing required. The mortar shall not be spread over the corner, edges or surface of the masonry. All superficial mortar shall be removed with a trowel. The surface of the masonry shall be cleaned and no stain shall be allowed to remain. Pointing shall be of uniform appearance with sharp, clear and regular lines.

Curing

Pointed surfaces shall be kept wet continuously for a minimum period of seven days, during which period it shall be suitably protected from all damage.

Bad Workmanship

Should the mortar perish or deteriorate through neglect of watering or any other default and if the work is not done neatly and as specified above, the pointing shall be removed and redone by the Contractor at his own cost when instructed by the Engineer-In-Charge.

Measurements

For pointing, the area of masonry surface actually pointed shall be measured net.

8.10. White / Colour Washing:

Materials

The materials for preparing lime wash shall be freshly burnt fat lime of good quality free from unburnt stone or other foreign matter. Lime shall be of "C" type as mentioned in IS 712.

Lime shall be slaked on the spot, mixed and stirred thoroughly with sufficient quantity of water (about 4.5 litres per Kg. of lime) to make a thin cream. This shall be allowed to stand for a period of 24 hours and then strained through a clean coarse cloth. Clean gum dissolved in hot

water shall then be added in the proportion of 4 gm. of gum Arabic to one litre of lime cream to prevent lime wash coming off easily when rubbed.

Indigo (Neel) up to 3 gm per Kg of lime dissolved in water shall be added and stirred well. Water at 5 litres per Kg. of lime is then added to produce a milky solution.

Alternatively ready made whiting (ground white chalk) complying to IS 63 can be used. In this case whiting shall be dissolved in sufficient quality of warm water to form thin slurry, which shall then be screened through a clean coarse cloth. 2 gm. of gum and 0.4 gm. of copper sulphate dissolved separately in hot water shall be added for every litre of the slurry, which shall then be diluted with water to the consistency of milk for use. Rice size may be allowed instead of gum.

Colour wash shall be lime wash as above to which a solution of water and lime fast pigment, boiled if directed, shall be gradually added and stirred until the required tinge is available.

Preparation of surface

The surface shall be prepared by removing all mortar dropping and foreign matter and thoroughly cleaned with wire or fibre brush or other means to be approved by the Engineer-In-Charge. All loose pieces and scales shall be stuffed with mortar and cured.

Application

Lime wash shall be applied with a brush. Each coat must be allowed to dry and shall be subject to an inspection before the next coat is applied. When dry, the surface shall not show any signs of cracking and shall present a smooth and uniform finish easily when rubbed with a finger. Patchy or streaky work will be rejected. No colour wash shall be done with a sample of the colour wash to the required tint or shade unless it is approved by the Engineer-In-Charge.

Precautions

Doors, Windows, floors etc., shall be protected from being splashed upon. Any splashing and droppings shall be removed and surfaces cleaned.

Scaffolding

Single or double scaffolding shall be provided by the Contractor as and when required.

Measurements

Cornices and other such wall or ceiling features shall be measured along the girth and included in the measurements.

The number of coats shall be 3 coats unless otherwise specified. The item to include removing nails making good holes, cracks, patches etc. not exceeding 50 sq.m. each with material similar in composition to the surface to be prepared.

8.11. Painting

All the water base and oil base paints such as distemper, cement paint, enamel paint, flat oil paint etc. shall be of approved manufacturers and shall conform to the respective IS Codes and Standards.

Colour and Shade shall be as approved by the Engineer-In-Charge.

Supply

All paint materials shall be supplied to the Site in the manufacturer's sealed and branded containers. Any containers reaching site with broken seals are liable for instant rejection by the Engineer-In-Charge.

Storage

All paint materials shall be stored in cool dry conditions clear of other stores to the satisfaction of the Engineer-In-Charge.

Usage

The mixing of materials of different brands before or during application shall not be permitted.

Brushes, pails, kettles and other implements and tools used in painting or preparation of the work shall be clean and free from foreign matter.

The instructions of the manufacturer shall be followed regarding preparation of surface and application of priming and finishing coats. In any event the following engineering practices shall always be followed while carrying out work as specified in IS 2395 Part-I & Part-II.

- a) No exterior or exposed painting shall be carried out under adverse weather conditions such as rains, extreme humidity, dust storms etc.,
- b) The work shall preferably be carried out in shade to avoid blistering or wrinkling due to direct sunlight.
- c) All surfaces to be painted shall be free of loose matter, efflorescence, dust etc. before application of each coat.
- d) No paint shall be applied to works, which are internally or superficially damp.

Preparation of Surfaces

General

All surfaces requiring paint shall be thoroughly cleaned of all dirt, dust, grease or oil before spotting or priming. Oil or grease film shall be washed off with an acid that is non-injurious to the surface or shop primers and rinsed off completely with plain or soapy water. Surfaces shall be dry unless dampening is required for a particular finished material.

Before starting the work, the Contractor shall obtain the approval of the Engineer-In-Charge regarding the soundness and readiness of the surface to be painted on.

Masonry, Concrete and Plastered Surfaces

Surface shall be free from all efflorescence, mildew, loose paint or other foreign and loose materials. Surface with mildew or efflorescence shall be treated as follows:

- All mildewed surfaces shall be treated with an approved fungicide such as ammonical wash consisting of 7 gm. of copper carbonate dissolved in 80 ml. liquor ammonia and silica fluoride solution and allowed to dry thoroughly before paint is applied.
- All efflorescence shall be removed by scrubbing and affected surfaces shall be treated with a solution of muriatic acid in water (1:6 to 1:8) and washed fully with clean water and allowed to dry thoroughly.

Masonry cracks shall be cleaned out and patch filled with mortar similar to the original surfaces uniformly textured. Where this type of re-surfacing may lead to the finishing paint being different in shade from the original surface, the surfaced area shall be treated with minimum one coat of cement primer, which shall be continued to the surrounding area from a distance of 100mm.

The plastered surface shall be carefully rubbed smooth and thoroughly cleaned with clean fresh water.

Metal

All metal surfaces shall be absolutely clean, dry and free from wax, grease or dried soap films. Grease shall be removed by proprietary brands of approved solvent cleaner or other solutions or detergents. In addition all steel and iron surfaces shall be free from dust, rust and scales. This shall be done by wire brushing and scraping. All galvanised surface shall be pre-treated with a compatible primer according to the manufacturer's direction. Any abrasion in ship coats shall be touched with the same quality of paint as the original coat. The cleaning and operation of priming paint at site shall be carried out after the erection of steelwork.

As required single or double scaffolding or ladder shall be used without damaging or scratching the surfaces to be painted.

Woodwork

Surfaces to be painted shall be thoroughly dry, clean and smooth, properly sand papered to a fresh surface. Resinous exudation and large knots shall be removed and replaced with filler (sound wood). Small knots that do not justify cutting and sap tracks shall be covered with minimum two coats of pure shellac coating applied thinly and extended 25 mm. beyond the area.

Parts of timber to be enclosed shall always be primed unless already impregnated. When the priming is hard, all cracks, holes, open joints etc. shall be made good with hard stopping and rubbed down with fine abrasive paper.

Primer of joinery shall be applied only on site after the Engineer-In-Charge has approved the joinery.

Application

The method of application shall be as per the recommendations of the manufacturer, wherever relevant. Applications shall be by hand brushing, rolling or air spray. All priming undercoats shall be applied by brush only. Rollers and spray equipments shall not be used for the purpose.

All materials shall be evenly applied, shall be free of sags, runs crawls or other defects. All coats shall be of proper consistency. All primer and undercoats shall be tinted to approximate the colour of the finishing coats. Finished coats shall be of exact colour and shade as per approved samples and all finish shall be uniform in colour and texture. All parts of mouldings and ornaments shall be left clean and true to finish.

All coats shall be thoroughly dry before being papered or before the succeeding coat is applied. Coats of paint as specified are intended to cover surfaces perfectly. In case the surface is not covered properly by applying the specifying number of coats, further coats shall be applied by the Contractor when so directed by the Engineer-In-Charge.

In case of selection of special shades and colour (not available in standard shades) the contractor shall mix different shades and prepare test panels of minimum size 1 metre square as per instructions of the Engineer-In-Charge and obtain his approval prior to application of finishing paints.

Equipment and Protection

All brushes used for the job shall be clean and in good condition.

Spray painting equipment shall be a type that will produce full, even coatings, shall be equipped with grease and water separators and kept properly clean and well maintained at all times.

Sufficient drop cloths, shields and other protective equipment shall be used to prevent sprays or droppings from fouling surfaces not being painted. Empty containers, saturated rags and

waste shall not be allowed to accumulate. Any required ventilating or isolating measures for protecting his workmen and others from toxic or unhealthy conditions due to painting shall be provided by the Contractor.

Cleaning up

Cleaning of paint droppings and spilling, splashed or splattered, films and smudges from finished surfaces and areas not to be painted shall be carried out concurrently with the work to the satisfaction of the Engineer-In-Charge. At completion, all equipments, excess materials and containers shall be removed and the premises shall be cleaned of all painting waste and debris.

Measurements

Length and breadth shall be measured correct to a cm and area shall be calculated in sq.m. correct to two places of decimals.

Corrugated surfaces shall be measured flat as fixed and the area so measured shall be increased by the percentage as described in above para to allow for girthed area.

Cornices and other such wall or ceiling features shall be measured along the girth and included in the measurements.

The number of coats shall be 3 coats unless otherwise specified. The item to include removing nails making good holes, cracks, patches etc. not exceeding 50 sq.m each material similar in composition to the surface to be prepared.

- Timber doors, windows etc. shall be measured flat (not girthed) overall including frames and all edges, cleats etc. shall be deemed to be included in the item.
- Steel doors, windows, etc. shall be measured flat (not girthed) including frames, edges, etc.
- All pipes shall be measured in running meters and shall allow for all specials, brackets, clamps, etc. which shall not be measured separately.
- Multiplying co-efficient for EACH SIDE for the various items shall be as follows:

TABLE 15

	Multiplying Co-efficient	
Timber Doors, Windows etc		
Panelled doors, windows etc.	1.00	1.30
Flush doors	0.80	1.20
Partly panelled & partly glazed doors, windows etc.	1.50	1.00
Fully glazed doors, windows etc.		0.80
Fully timber louvered doors, windows etc		1.80
Steel Doors, Windows, etc		
Plain sheeted doors, windows	1.10	1.10
Fully glazed doors, windows	0.50	0.50
Partly panelled, partly glazed doors, windows		0.80
Collapsible gates	1.50	1.50
Rolling shutters	1.10	1.10
General		
Expanded metal, grill work, railings, gates		1.00
Corrugated iron sheeting	1.14	1.14
AC corrugated sheeting	1.20	1.20
AC semi corrugated sheeting	1.10	1.10

8.12. Oil bound Distemper

In regards to materials, surface preparation, application, equipment & protection, cleaning etc. shall be as described above.

Application

Priming coat

The priming coat shall be with distemper conforming to IS: 428 in one coat. After the surface defects are treated with gypsum which is allowed to set hard and wiped clean, the priming coat is applied with distemper primer (when wall surface has not dried completely).

Newly plastered 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.

Distemper coat

After the primer coat has dried at least for 48 hours, the surface shall be lightly sand papered to make it smooth. Distemper is then applied in dry weather with a broad stiff brush in long paralleled strokes, each coat being allowed to dry before the next coat is applied. The subsequent coats shall be applied in the same way. Two coats of distemper shall be applied over 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 preceding coat. For old work the distemper shall be applied over the prepared surface in the same manner as in new work. 15 cm double bristled distemper brushes shall be used. After each days work, brushes 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.

8.13. Plastic Emulsion Paint:

Materials, surface preparation, Application, Equipment and protection, cleaning etc. shall be as described under- Painting specifications. The plastic emulsion paints is not suitable for application on external, wood, and iron surface, which are liable to heavy condensation. These paints are to be used on internal surfaces except wooden and steel. Plastic emulsion paints as per IS: 5411 of approved brand and manufacture and of the required shade shall be used.

Application

The paint is mixed thoroughly adding about 50% water and then strained through a cloth. The paint is then applied on wall and allowed to dry thoroughly. A putty is prepared by mixing whiting and paint and is filled wherever necessary in holes depressions etc.

For the second coat only about 15 to 20% water is added.

(The correct quantity of water to be added shall be as per manufacturer's instructions)

The number of coat shall be two unless otherwise specified 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 surface on finishing shall present a flat velvety smooth finish. If necessary more coats will be applied till the surface presents a uniform appearance. Painting on old surface shall be as described for new work except that the surface before application of paint shall be flattened well to get the proper flat velvety finish after painting.

8.14. Oil Paint:

Materials, surface preparation, application, equipment & protection, cleaning etc. shall be as described under-Painting specifications.

Application

Unless otherwise specified, paint shall be applied with brushes. The contents of the drum and tins shall be well stirred before using and occasionally during the use to prevent sedimentation at the bottom.

Priming coat

The priming coat shall be made up of materials depending on the surfaces to be plastered and specified or recommended by the manufacturer.

The primer shall be ready mixed primer of approved brand and manufacture and shall be compatible with finished painting scheme.

Where primer for wood work is specified it shall be prepared as per manufacturers specifications. The wood work to be painted shall be dry and free from moisture. The surface shall be thoroughly cleaned. All unevenness surface shall be rubbed down smooth with sand paper and shall be well dusted. Appropriate filler material conforming to IS: 345 with same shade as paint shall be applied.

Finishing coat

Unless otherwise specified, the finishing shall be done in at least two coats of paint. The last coat shall give a flat, semi glossy or glossy finish as directed by the Engineer-In-Charge.

8.15. Synthetic Enamel Paint:

In regards to materials, surface preparation, application, equipment & protection, cleaning etc. shall be as described above. Synthetic enamel paint conforming to IS:2932 shall be of approved brand and manufacture and of required shade.

Application

Priming coat

Primary coat shall be of ordinary paint of shade to match with the top coat as recommended by the same manufacture. As top coat shall be used. Under coat shall be allowed to dry overnight. It shall be rubbed next day with the finest grade of wet abrasive paper to ensure smooth and even surface, free from brush marks and all loose particles brushed off.

Finishing coat

It shall be applied on properly primed surface. Subsequent coat shall not be applied till the previous coat is dry. The previous coat shall be lightly sand prepared for better adhesion of subsequent coats.

Top coats of synthetic enamel paint of desired shade shall be applied after the under coat is thoroughly dry. Additional finishing coats shall be applied if found necessary to ensure properly uniform glossy surface.

Unless otherwise specified, the finishing shall be done in at least two coats of paint. The last coat shall give a flat, semi glossy or glossy finish as directed by the Engineer-In-Charge. If, however, the surface is not satisfactory additional coats as required shall be applied to get correct finish.

8.16. Waterproof Cement Paint:

In regards to materials, surface preparation, application, equipment & protection, cleaning etc. shall be as described above. The cement paint shall be conforming to IS: 5410 of approved brand and manufacture and of required shade.

Application

Priming coat

Cement primer coat is used as a base coat on wall finish. The cement primer is composed of a medium and pigments which are resistant to alkalies present in the cement in wall finish and provides a barrier for the protection of subsequent coats. Primer coat material shall be as per recommendation of finish coat material. Primer coat shall be preferably applied by brushing and not by spraying on the clean dry and smooth surface. The surface shall be finished as uniformly as possible leaving no brush marks. It shall be allowed to dry for at least 48 hours, before subsequent coat.

Finishing coat

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. Cement paint shall be mixed with water in two stages and strictly as per manufacturer's instructions.

The surfaces shall be given one coat of paint. Care shall be taken so that the paint does not dry out too rapidly. After 4 to 6 hours, the water shall be sprinkled over the surface to assist curing and prevent cracking. After the first coat has dried (24 to 48 hours), the second coat shall be applied in a similar manner. The finished surface shall be kept moist by occasional sprinkling with water for seven days after painting.

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.

Rate

The rate shall include the cost of all labour and materials involved in all the operations described above including scaffolding, unless specified. **Quoted rate shall be inclusive of Cement primer coat unless separate item is specifically provided for.**

8.17. Acid Proof Paint

Material- Acid proof paint of approved brand and manufacturer and of required shade shall be used.

Standards- In regards to materials, surface preparation, application, equipment and protection, cleaning etc. shall be as described above.

9. FLOORING:

Material

All tiles shall be of first quality of Indian make and shall be uniform in size, true and square with sharp arises, perfectly flat, flawless without twist, cracks and other defects. They shall be procured from approved sources. The Contractor shall furnish to the Engineer-In-Charge samples of different varieties he proposes to incorporate in the work. The Contractor shall strictly conform only to the samples approved by the Engineer-In-Charge.

Tiles to be used for skirting and dado shall be of the same manufacture and shade as that for floors.

9.1. Workmanship

The surfaces to be laid with flooring or dado shall be thoroughly hacked, joints of masonry racked, cleaned of all mortar scales and concrete lumps and loose materials etc. and washed to remove mud, dirt, oil, grease etc. from the surface and shall be thoroughly wetted.

All tiles shall be laid in a pattern given on the drawings or directed by the Engineer-In-Charge.

All tiles in floor shall be truly and evenly set and pressed in position to obtain uniform plane surface. The skirting tiles shall be in true plane, level and plumb.

Flooring/dado work shall not be started unless and until the surface is approved by the Engineer-In-Charge.

9.2. Indian Patent Stone (IPS) Flooring

Material

Material such as cement, sand, fine aggregate water etc. shall be as described under Mortars specifications.

Laying

IPS shall be in concrete of specified proportion and thickness with metal size 12mm & below well-graded. When used for terraces, an approved waterproofing compound shall be added to the mix as per the specification of the manufacturer.

The surface of the sub-grade shall be thoroughly wetted and cement slurry shall be thoroughly brushed into the surface just ahead of the finish.

The laying shall be done in alternative bays of 1.5 m x 1.5 m or other approved dimensions with glass dividing strips of 25 mm. x 3 mm thick wherever specified. Only minimum quantity of workable shall be used and the paving consolidated thoroughly by compacting with heavy wooden battens.

Finishing operations shall follow shortly after compaction of concrete by trowelling three times at intervals so as to produce uniform hard surface. Only just sufficient trowelling shall be done to give a level surface. Successive trowelling shall be done till the moisture ceases to exude from the mass. No dry cement shall be used directly on the surface to absorb moisture or to stiffen the mix. The final trowelling shall be done well before concrete becomes too hard but at such a time that considerable pressure is required to make any impression on the surface.

The paving shall be cured for at least 15 days and it shall be protected during this period with hessian or other suitable material, which will not stain the surface. The laying and finishing shall conform to IS: 2571.

Topping with a hardener

If a floor hardener is specified, the cement concrete flooring shall be laid as described above and the top finished with an approved hardener such as 'Ironite' or its equivalent. Ironite shall be first mixed dry with cement in a proportion 1:4 by weight (one Ironite to 4 part of cement) and this mix shall be sprinkled uniformly on the top of green cement concrete flooring after the concrete is consolidated with wooden battens and before trowelling commences. The Ironite to be used shall be such that 1.5 Kg. of Ironite is utilised for 1 Sq.m of area of cement concrete flooring, unless specified.

Curing

The curing shall be done for a period of ten days. Curing shall not be commenced until the top has hardened. Covering with empty cement gunnies shall be avoided as the colour is likely to be bleached with the remnants of cement matter from the bags.

Measurements

Length and breadth shall be measured before laying skirting dado on wall plaster. No deductions shall be made nor be extra paid for voids not exceeding 0.20 sq.m. Deductions for ends of similar materials or other articles embedded shall not be for areas not exceeding 0.10 sq.m.

Rate

The rate shall include the cost of all materials and labour involved in all the operations described above including application of cement slurry on base concrete, extra water proofing compound including roughening and cleaning the surface of base concrete. The base concrete shall be paid for separately.

9.3. Glazed tile work

Material

Material shall be generally as described under- Flooring specifications. Glazed tiles shall conform to IS 777.

Tiles shall be evenly and well glazed over the top surface and shall be grooved and recessed in parts on the rear face to provide the necessary key for mortar. They shall be of specified sizes and thickness. The tolerance on facial dimension shall be ± 1.0 mm. and ± 0.5 mm. in thickness.

For coloured tiles, only the glaze shall be coloured as specified.

Mortar

Cement mortars shall be as described as under –Mortar specifications and the proportion of mortar shall be as specified in the respective items of BOQ.

Laying

Tiles shall be soaked in water for at least 6 hours prior to their use in the job.

Tiles shall be laid on cement and sand mortar (1:3) bedding of average thickness of 20mm and shall be spread, tamped and corrected to proper levels and allowed to harden for a day before the tiles are set. Over this bedding neat grey cement slurry (1:3) mix of honey like consistency shall be spread at a rate of 3.3 Kg of cement per Sq.m. Tiles shall be washed clean and fixed in this grout one after another, each tile being gently tapped with a wooden mallet till it is properly bedded and in true level and line with the adjoining tile. Cement slurry oozing out through the joints shall be immediately wiped clean. Joints shall be fine (width 1.5mm) and nearly undistinguishable. Joints shall be pointed with white cement and matching pigment and finished neatly. The flooring shall be thoroughly cleaned with suitable hydrochloric acid

before handing over. Joints shall be of straight fit joints as shown on the drawing or as directed by the Engineer-In-Charge.

Pointing and Finishing

The joints shall be cleaned off the grey cement slurry with wire / coir brush or trowel to a depth of 2 mm to 3 mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement added with pigment if required to match the colour of tiles. After curing, the surface shall be washed and finished clean. The finished floor shall not sound hollow when tapped with a wooden mallet.

Curing

Work shall be properly cured for at least 7 days and kept well protected.

Measurement

Measurement shall be as described under –IPS flooring specifications.

Rate

The rate shall include the cost of all materials and labour involved in all the operations described above including wastage and application of cement slurry on base concrete / surface, filling of joints as specified above etc.

9.4. Glazed Ceramic Tiles Work

Material

Material shall be generally as described under- Flooring specifications. Ceramic tiles shall confirm to IS 13755 of 1st quality.

The finished tiles, when fractured will appear fine grained in texture, dense and homogeneous. Tiles shall be sound, true to shape, flat and free from flaws and other manufacturing defects.

Mortar

Cement mortars shall be as described under –Mortar specifications and the proportion of mortar shall be as specified in the BOQ.

Laying

Laying of ceramic tiles shall be as described under –Glazed tiles specifications.

Pointing and Finishing

Pointing and Finishing shall be as described under-Glazed tiles specifications.

Curing

Work shall be properly cured for at least 7 days and kept well protected.

Measurement

Measurement shall be as described under- IPS flooring specifications.

Rate

The rate shall include the cost of all materials and labour involved in all the operations described above including application of cement slurry on base concrete/ surface.

9.5. Polished Kotah, Cuddappa, Flooring, Skirting and Dado

Material

These shall be of first quality procured from approved sources. They shall be sound, durable, uniform in size & colour, free from soft veins, cracks or other flaws, with their edges true & square. These natural stones shall be of thickness not less than 20mm, unless specified. They shall be machine cut with top surface double machine polished.

The Contractor shall furnish to the Engineer-In-Charge two samples each of the different stones, he proposes to incorporate in the work together with the relevant literature from the suppliers. The Contractor shall strictly conform only to the samples approved by the Engineer-In-Charge.

Stones to be used for skirtings and dado shall be from the same stock and shade as used for floors.

The surfaces on which the stone slabs are to be laid shall be cleaned of all dust and saturated with water.

Dressing

The edges of stones to be pointed shall be true to line and dressed to the required depth all round. All the exposed edge shall be neatly polished to give a neat appearance.

Every slab shall be cut to the required size and shape and fine chisel dressed on the sides to the full depth so that a straight edge laid along the side of the stone shall be in full contact with it. The sides (edges) shall be table rubbed with coarse sand or machine rubbed before paving. All angles and edges of the slabs shall be true, square and free from chipping and surface shall true and plane.

Tolerance in thickness of stone shall be ± 3 mm.

The slabs shall be set in cement slurry (thin paste of neat cement shall be applied to sides, bottom and the prepared base) over 20 mm. thick lime mortar (1:2) bedding and tamped with wooden mallet. The joints shall be flushed with cement. The details of operations are similar as for marble mosaic tile work.

Work shall be properly cured for at least 7 days and kept well protected.

Pointing and Finishing

The joints shall be cleaned off the grey cement slurry with wire / coir brush or trowel to a depth of 2 mm to 3 mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement added with pigment if required to match the colour of tiles. After curing, the surface shall be washed and finished clean. The finished floor shall not sound hollow when tapped with a wooden mallet.

Polishing and finishing

Polishing and finishing shall be machine polished in three stages with different grades of polishing stones in the machine. After the first stage of polishing ,a grouting coat with matching cement is given. After the final coat oxalic acid crystals ground into powder shall be dusted over the surface at the rate of 32.5 gm/Sq.m sprinkled with water and rubbed hard with a pad of woollen rags by means of the polishing machine.

Measurement

Measurement shall be as described under-IPS flooring specifications.

The measurement of treads and risers shall be in linear meter or in Sq. m. as specified in the Bill of Quantities. Only clear visible dimensions shall be considered ignoring bearing in plaster, masonry etc.

Length shall be measured along the finished face of riser, skirting or dado correct to a cm. Height shall be measured from the finished level of tread of floor to the top. This shall be measured correct to a mm in the case of risers of steps and skirting and correct to two places of decimal. Lining of pillars etc. shall also be measured under this item.

Rate

The rate shall include the cost of all materials and labour involved in all the operations described above including application of cement slurry on base concrete/ surface, polishing etc.

9.6. Marble Mosaic Tiles Flooring/Skirting/Dado

Material Marble mosaic tiles shall be first quality, hydraulic pressed and shall conform to IS 1237. They shall be with white cement and pigments and marble chips of sizes as required.

Tiles shall be 250 x 250 square and not less than 20 mm. thick unless otherwise specified. Tolerances allowed are:

- Length and breadth ± 1 mm.
- Thickness ± 5 mm.

The top surface shall be smooth and polished with upper wearing layer of minimum 5 mm. thickness consisting of a mixture of marble chips of approved sizes and colour and white cement.

Mortar

Cement mortars shall be as described under –Mortar specifications and the proportion of mortar shall be as specified in the BOQ.

Laying

Tiles shall be soaked in water for at least 6 hours prior to their use in the job.

Cement mortar (1:3) bedding of average thickness of 20 mm. (thickness at any place being not less than 10 mm.) shall be spread, tamped and corrected to proper levels and allowed to harden for a day before the tiles are set. Over this bedding, neat gray cement slurry (1:3 mix) of honey like consistency shall be spread at a rate of 4.4. Kg. of cement per Sq.m. over such an area as would accommodate about 20 tiles. Tiles shall be washed clean and fixed in this grout one after another, each tile being gently tapped with a wooden mallet till it is properly bedded and in true level and line with the adjoining tile. Cement slurry oozing out through the joints shall be immediately wiped clean. Joints shall be fine (width 1.5 mm) and nearly undistinguishable. Joints shall be pointed with matching cement and finished neatly.

For skirting and dado work, the brick or concrete wall surface to which the tiles are to be fixed shall first be wetted with clean water and later covered with 16 mm. cement mortar (1:3). Before this is hardened, tiles with cement slurry shall be laid and gently tapped with a wooden mallet in a true plane and level. The fixing shall be done from bottom upwards.

Curing

Work shall be properly cured for at least 10 days and kept well - protected.

Polishing

When the flooring is ready for polishing, the joints shall be rubbed with Carborundum stones to effect proper levelling. The flooring shall then be machine polished in three stages with different grades of polishing stones in the machine. After the first stage of polishing, a grouting coat with matching cement is given. After the final coat, oxalic acid crystals ground into powder shall be dusted over the surface at the rate of 32.5 gm/Sq.m sprinkled with water and rubbed hard with a pad of woollen rags by means of the polishing machine.

Skirting / dado shall be hand polished with Carborundum stones.

The finished floor and skirting / dado shall give a uniform shade of tiles. Any defective tiles shall be removed by the Contractor and suitably replaced at his own cost.

Measurement

Measurement shall be as described under- IPS flooring specifications. Length shall be measured along the finished face of skirting or dado correct to a cm.

Rate The rate shall include the cost of all materials and labour involved in all the operations described above including application of cement slurry on base concrete/ surface, polishing etc.

10. ROOFING

10.1. Corrugated Colour coated steel sheet single skin for roofing/ Cladding:

Material

- Manufacturer – Product reference here below given are of M/s. Interarch Building Products Private Limited. However, other similar approved manufacturer's product reference can be used subject to prior approval of Engineer-In-Charge.
- Product Reference - TRACDEK, HI-RIB AZ 150 GSM SMP Galvalume
- 0.50 mm (including metallic coating) cold rolled galvalume steel, 550 MPa yield stress (ASTM A 446 Grade-E) with hot dip metallic coating of AZ 150 (150 gm / sq.m, zinc / aluminium alloy coating of 55% and 45% respectively conforming to ASTM 792/AS 1397).

Storage on Site

Storage /stacking of the material shall generally in confirmation with IS 4082 unless otherwise specified by the manufacturer. Material shall be protected from damage while stored on site. When they are stacked for any length of time, it is recommended that cover be provided.

Packs of sheets shall be kept dry in transit and on site to prevent water and / or condensation being trapped between adjacent surfaces. Packs of sheets standing on site shall be stored clear off the ground. Sheets shall be handled using clean dry gloves.

Paint

20 microns exterior coat of silicon modified polyester (SMP) paint system over 5 micron polyester back coat over 5 micron approved primer. Colour of the roofing and cladding sheet shall be as approved by the Employer

Laying and fixing

Roofing sheets shall be factory cut and supplied in required lengths (upto 12m) to suit shop drawings. Sheets shall be crest fixed to purlins with 12 x 14 x 55 mm mechanically galvanized self drilling fasteners with EPDM seals (one fastener on each crest, unless specified). Colour caps same as that of roofing to be supplied along with fasteners. End laps of roofing to be minimum 200 mm.

Cladding sheets shall be supplied in required lengths (upto 12 m) to suit shop drawings. Sheets shall be valley fixed with 12 x 14 x 20 mm mechanically galvanized Self drilling fasteners with EPDM seals (one fasteners in each valley, unless specified). Colour caps same as that of cladding to be supplied along with fasteners. End laps of cladding to be minimum 100 mm.

Roofing and cladding shall generally comply with the following:

- Slope of roofing shall be as shown on approved fabrication drawing.
- Cut panels, sheets and flashings shall give clean true lines with no burrs.
- Cut openings to minimum size necessary.
- Lay panels and sheets with exposed joints of side laps away from prevailing wind unless shown otherwise on drawings.
- Panel and sheet ends, laps and raking cut edges fully supported and with fixings at top of lap unless otherwise specified.
- Drill holes, position at regular intervals in straight lines, centred on support bearings or as shown on the drawing.

- Remove dust and other foreign matter before finally fixing panels and sheets.
- After completion check fixings to ensure water tightness .
- Cut edges paint to match face finish.

Foam fillers for roofing

Self adhesive PU form (polyurethane) fillers shall be supplied as per manufacturer's instructions matching to the shape of roof profile and to be fixed along the ridge and eaves end of roofing.

Finish

The roof when completed shall be true to lines and slopes and shall be leak proof. The ridge should be notched at the crest & turned down, at the ridge the valley of the roof to be turned up to prevent entry of water & dust.

Safety Precautions

No person other than workmen employed by the roofing contractor shall be permitted access to any area over which the sheeting is being laid. Cat ladders or roof boards should in variably be used by men working on the roofs. The observations of this rule which is advocated primarily on the grounds of safety, will also avoid damage to the roofing materials.

All personnel on roof top shall have safety belts tied to life-line attached from the ridge to the eaves and also any other safety as per requirement of the manufacturer's instructions.

Scaffolding for cladding

Only steel 'H' frames shall be used for scaffolding. The scaffolding shall be design to execute the work at 30 meters height and same shall be checked from the Engineer-In-Charge.

Material warranty

At least minimum 10 years warranty against corrosion of material shall be given.

Leakages

Leakages if any, observed during contract period, including 2 years after expiry of defects liability period rectification and maintenance shall be the responsibility of the contractor at his own cost.

Measurements

The length and breadth shall be measured correct to a cm. Area shall be worked in sq.m. correct to two places of decimal.

The superficial area of roof / cladding shall be measured net 'as laid' and paid for accordingly. Laps shall not be paid for separately. Measurement shall be taken on the flat and not girthed.

Roof with curved sheets shall be measured and paid for separately.

No deduction in measurement shall be made for opening up to 0.4 sq.m and nothing extra shall be allowed for forming such openings. For any opening exceeding 0.4 sq.m in area, deduction in measurements for the full opening shall be made.

Cutting across corrugation shall be measured on the flat and not girthed. No additions shall be made for laps cut through.

10.2. Colour coated sheet for flashing, capping & trims, etc. :

Material

These shall be formed out of same substrates and corresponding thickness as that of the roofing / cladding sheets and shall be supplied in standard lengths of 2.5 m, unless specified in the required shapes and girths.

Fixing

These shall be supplied in required lengths (upto 2.5 m) to suit shop drawings and shall laid / fixed as per approved fabrication drawing. These shall be stitched to the roofing / cladding with 10x12x20 mm hex-head mechanically galvanised self drilling fasteners with EPDM seals at every 500 mm c/c, unless specified. The end laps shall be stitched at minimum every 50 mm c/c unless otherwise specifically instructed by the manufacturer.

Finish

The edges of the flashing / capping and Trims shall be straight from end to end and their surfaces should be plane and parallel to the general plane of the roof. The ridges and hips shall fit in squarely on the sheets.

Storage, paint, safety precautions, warrantee etc. shall be as described under roofing and cladding specifications.

Measurement

The measurements shall be taken for net 'as laid' length along the centre line of flashing capping or Trims, correct to a cm. Laps provided in between shall not be measured.

10.3. 2mm thick Fibre Reinforced Plastic corrugated transparent sheet

Materials

Manufacturer – Product reference here below given are of M/s. Interarch Building Products Private Limited. However, other similar approved manufacturer's product reference can be used subject to prior approval of Engineer-In-Charge.

Product Reference

FRP sheets shall be supplied in 2mm thick matching to the roof profile in required length to suit approved fabrication drawing.

Storage of materials, safety precautions, warrantee, leakages etc. shall be as described under roofing/ cladding specifications.

Fixing

FRP sheets shall be fixed to purlins with 12 x 14 x 55 mm fasteners with EPDM seal and having cyclonic washers. Butyl tape shall be applied on the side/ end lap of FRP sheets and near about roofing sheets.

Fix in profile, in accordance with manufacturer's day light system recommendations, technical manual. Fixing should not be over tightened. Overlap (side and end) as per approved drawing.

Measurement

The length & breadth shall be measured correct to a cm up to two places of decimal. The superficial area of roofing shall be measured net 'as laid'. Laps shall not be measured separately. Measurement shall be taken on the flat and not girthed.

Rates

The rate shall include the cost of all the materials and labour involved in all the operations described above including necessary fittings and accessories scaffolding for cladding, laps as per drawing, safety precautions, overlaps etc.,

10.4. Colour coated steel sheet for gutters

Material

These shall be formed out of same substrates and corresponding thickness as that of the roofing / cladding sheets and shall be supplied in standard lengths of 2.5 m. in the required shapes and girths.

Profile

The depth, width and height should be as per the rainfall catchments area and as approved.

Fixing

Gutters shall be fixed as per profile and drawings approved for construction.

The gutter shall be fixed on MS brackets of size and location as shown on the drawings. The end laps of gutter shall be bolted with galvanized (175 gauge minimum) nuts and bolts with metallic washers to suit design

Finish

The edges of the gutters shall be straight from end to end and their surface should be plain of the roof. Storage, paint, safety precautions, warrantee etc. shall be as described under roofing and cladding specifications.

Measurement

The measurements shall be taken for net 'as laid' length along the centre line of gutters correct to a cm. Laps provided in between shall not be measured.

Rate

MS brackets shall be measured and paid for separately under relevant item.

11. DISMANTLING & DEMOLISHING:

The item wise detailed specifications are intended for the general description of quality, workmanship, etc. desired for the items covered in the Schedule of Items. The Specifications are not, however, intended to cover the minute details and the work shall be executed according to the relevant latest Indian Standard Codes. In absence of the later, the work shall be executed according to the prevailing local Public Works Department Practice or to the recommendations of American and British Standard Institution at the discretion of the Engineer-In-Charge.

11.1. Scaffolding

Single or double scaffolding shall be provided by the Contractor as and when required.

11.2. Objective

The desired technique to be adopted in carrying out the demolition and dismantling work of existing structure shall be such that the fragments falling out of such operation can be contained within the work area or taking suitable protection so as to prevent materials from going out. This would relieve the surrounding area from any uncertain or uncontrolled behaviour of dismantled materials.

The rubbish / materials after dismantling shall also be stored systematically and disposed off immediately outside the plant boundary in order to ensure no major formation of heaps inside / adjacent to the work site and not hamper in any way the normal business operation of the Employer.

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.

The term 'Dismantling' implies carefully removing without damage (up or down). This shall consist of dismantling one or more part of the structures / facilities as specified or shown on the drawings.

11.3. Precautions

All materials obtained from dismantling or demolition shall be the property of the Contractor once the materials are taken out of the boundary of MDL after completion of the necessary gate pass and other formalities. But till such time the materials shall be kept in safe custody as per the directives of the Engineer-In-Charge.

The demolition shall always be planned beforehand and shall be done in reverse order of the one in which the structure was constructed. The scheme shall be got approved from the Engineer-In-Charge before starting the work.

Necessary propping, shoring and / or underpinning shall be provided for 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 required, as per the opinion of the Engineer-In-Charge, temporary enclosures or partitions shall be provided at the Contractor's cost.

Necessary precautions shall be taken to keep down the dust nuisance.

Dismantling shall be done in a systematic manner. All materials which are likely to be damaged by dropping from a height or demolishing roofs, masonry, etc. shall be carefully removed first. The dismantled articles shall be passed by hand, where necessary, lowered to the ground (and not thrown) and then properly stacked as directed by the Engineer-In-Charge.

Where fixing is done by nails, screws, bolts, rivets, etc. dismantling shall be done by taking out the fixed items with proper tools and not by tearing or ripping of.

Any serviceable material, obtained during dismantling or demolition, shall be separated out and stacked properly as directed by the Engineer-In-Charge within work site for verification required for gate pass and other formalities for taking outside the boundary. All unserviceable materials, rubbish, etc. shall be disposed off immediately outside the Owner's premises as directed by the Engineer-In-Charge.

11.4. General

Necessary data such as building size, wall thickness, construction materials, etc. that may be required shall have to be collected by the Tenderer from MDL site at his own expenses.

11.5. Information to be supplied by the Tenderer along with Tender

The information to be provided for by the Tenderer, unless otherwise specified, shall include the following :

To submit his method of demolition duly supported by specifications and drawings and sequence of operation along with a list of equipment, plants and machineries to be employed during such operation, to meet the above mentioned objective.

11.6. Work to be provided by the Contractor

- a) To arrange all the formalities as per requirement of statutory rules, if his method involves use of explosives. He has to obtain permission from appropriate authority of buying, storing, handling & making use of explosives.
- b) To notify, the Employer for arranging to shut off all gas, water, electricity, steam and other service lines running over ground or underground. Any temporary service connections required for the demolition work shall be separately taken and arranged by the Contractor.
- c) Any preliminary work, necessary for Contractor's method of demolition.
- d) To furnish all materials, labour, tools and plant and all consumables required for this work and its related temporary work such as cordoning the area, staging etc.
- e) To furnish the details of safety measures for human life / property / structures, the Contractor proposes to take during the blasting operation of explosives, if he proposes to use on this demolition work. This should be strictly as per rules and regulations laid down by the concerned authority for explosives to be used in this work.

11.7. Work by Others

No work under this specification will be provided for by any agency other than the Contractor, unless specifically mentioned otherwise elsewhere in the Contract or approved by the Engineer-In-Charge / Employer.

11.8. Codes & Standards

The demolition work shall be carried out as per Indian Standard Code of Practice No. IS 4130 - 1970 (Safety Code for demolition of buildings) or any other relevant Indian Standard Specifications and Codes of Practice. If demolition by blasting is adopted IS 4081 (Safety Code for blasting and related drilling operations) shall be followed. However, if any, particular aspect of the work is not specifically covered by any Indian Standard Specifications or any other standard practices, Engineer-In-Charge's instruction shall be followed.

11.9. Execution

The materials available after dismantling and demolition will be deemed to be the property of the Contractor once the material are disposed off from the plant boundary and the amount offered by the Contractor against each of the facilities / buildings / structures are received by the Employer.

It is presumed that the Contractor will adopt the most suitable method of demolition and dismantling to protect the materials and its surroundings. While doing so the Contractor shall ensure the following, which should be considered as binding towards the method and specification adopted by the Contractor:

- Total safety of the people working in the area of the Employer, other agencies employed by the Employer as well as those employed by the Contractor.
- Safety and no damage to the adjoining properties, facilities or services.
- Disposal immediately after dismantling to keep the area clean after the days work and not more than one truckload being accumulated.
- No noise or dust nuisance around the area of working.
- No obstruction to vehicular / pedestrian traffic during dismantling and disposal inside the plant boundary as well as outside municipal areas.
- No hindrance in the Employer's day to day production work or other operation.
- No accidents or other hazards.

11.10. Blasting

In special cases, the Contractor may be allowed to resort to controlled blasting at the sole discretion of the Employer/Engineer-In-Charge. The blasting, if allowed, will normally be for underground and foundation works. The work shall strictly be carried out as per the guidelines given below.

General guidelines for use of explosives

In case use of explosive is adopted for demolition work, specific permission of Engineer-In-Charge will have to be taken by the Contractor for blasting and he shall also obtain a valid blasting license from the authorities concerned.

The contractor shall employ competent and experienced supervisors and licensed blaster in-charge of each set of operations of blasting as well as operations of loading, unloading and transporting of such explosives from the mezzanine, who shall be held personally responsible to ensure that all safety regulations are carried out before and during the progress of blasting and also during the transportation and handling of explosive materials.

Before any blasting is carried out, Contractor shall intimate the Engineer-In-Charge and obtain his approval in writing for resorting to such operations. He shall intimate the hours of firing charges, the nature of explosive to be used and the precautions taken for ensuring safety.

Contractor shall ensure that all workmen and the personnel at site are withdrawn from an area within 200 metre radius from the firing points, at least 15 minutes before firing time by sounding warning whistle. The area shall be encircled by red flags. Clearance signal shall also be even by sounding a distinguishing whistle / siren.

The blasting near any existing building, equipment or any other property shall be done under cover and Contractor has to make all such necessary muffling arrangements. Covering may preferably be done by M.S. plates with adequate dead weight over them. Blasting shall be done with small charges only and where directed by Engineer-In-Charge; a trench shall have to be cut by chiselling prior to the blasting operation separating the area under blasting from the existing structures.

The firing shall be supervised by a experienced Supervisor. If the blasts do not tally with the number fired, the misfired holes shall be carefully located after half an hour and when located, shall be exploded by drilling a fresh hole near the misfired hole (but not nearer than 600mm from it) and by exploding a new charge.

A wooden tamping rod with a flat end shall be used to push cartridges home by metal rod or hammer shall not be permitted. The charges shall be placed firmly into place and not rammed or pounded. After a hole is filled to the required depth, the balance of the hole shall be filled with stemming, which may consist of sand or stone dust or similar inert material.

In no case shall blasting be allowed closer than 30 meters to any structures or to locations where concrete has just been placed. In the later case the concrete must be at least 7 (seven) days old.

Contractor shall preferably detonate the explosives electrically.

The explosive shall be exploded by means of primer, which shall be fired by detonating a fuse instantaneous detonator (F.I.D) or other approved cables. The detonators with F.I.D. shall be connected by special nippers.

In dry weather, ordinary low explosive gunpowder may be used. In damp weather, high explosive like gelatine with detonator and fuse wire may be used.

The quantity and strength of explosive used shall be such as will neither damage nor crack the other structures outside the limits of execution. All precautions, as directed by Engineer-In-Charge, shall be taken during the blasting operations and care shall be taken that no damage is caused to adjoining buildings or structures as a result of blasting operations. In case of any damage done due to negligence, the same shall be rectified by the Contractor to the satisfaction of Engineer-In-Charge at his own cost.

The Contractor shall observe rules and regulations controlling the storage and handling of explosives as exercised by the Inspector of explosives or licensing authority. The fees if any required for obtaining such license shall be borne by Contractor. Contractor shall have to make necessary storage facilities for the explosives etc. as per rules of local, State or Central Government authorities and statutory bodies / regulations. Explosives shall be kept dry and shall not be exposed to direct rays of sun or be stored in the vicinity of fire, stoves, steam pipes or heated metal, etc. No explosives shall be brought near the work in excess of quantity required for a particular amount of firing to be done; and surplus left after filling the holes shall be removed to the magazine. The magazine shall be built as far away as possible from the area to be blasted. The Engineer-In-Charge's prior approval shall be taken for the proposed location of the magazine and the structure of magazine shall be constructed as specified in the rules and regulations laid down by the concerned authorities. The Contractor shall build the magazine at his own cost. The contractor shall make this own arrangement for the site of this structure.

Contractor shall be responsible for any accident to workmen, public or Employer's property due to blasting operations. Contractor shall also be responsible for strict observances of rules, laid by Inspector of Explosives, or any other authority duly constituted under the State and / or Union Government.

Proper account of the explosive materials shall be kept at site as well as in the magazine as per the rules and regulations of the concerned authority. For this purpose, registers shall be kept by the Contractor and shall be filled and signed daily by his authorized and licensed blaster in-charge indicating therein the proper and correct account of the stock of explosive material brought in. For this purpose day to day operation-wise entry shall be made in the registers. Misfired and unfired charges of explosive shall also be noted in the register indicating the place, for safety.

Twenty four hours guards on duty shall be engaged by the Contractor to safeguard all kinds of explosive materials and equipment at the place of magazine as well as during the transportation period and on site when brought for using the same. Any theft, misuse or mishandling of the explosive materials shall be the responsibility of the Contractor and the Contractor shall indemnify the owner for this purpose and for the damages of any kind which may occur due to blasting of explosive in the magazine, during transportation, during handling in the work or due to any accidental cause.

The Contractor shall make his own arrangement of transportation of required quantities of explosive materials from the magazine to the work site as per the rules and regulations of the concerned authorities.

The Contractor shall have to note that live electrical circuits of high voltage may be passing overhead / underground and shall be likely to remain live at the time of operation of demolition work. The Contractor shall take all safety measures in this regard.

11.11. 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 outside the premises into approved dumping grounds.

12. MISCELLANEOUS:

12.1. Brickbat *Coba*

Brickbat *coba* shall be prepared from well-burnt hard broken bricks 5 mm. to 30 mm. in size proportioned as 1 Cu.m. of brick aggregate to 0.35 Cu.m. of slaked lime.

Brick aggregate shall be soaked in water for a sufficiently long time prior to its mixing with lime.

12.2. Putty

Putty shall be made by mixing and kneading whiting with sufficient linseed oil to render it into a stiff paste.

Putty used for fixing glass in wooden frames shall conform to IS 419 and that used for fixing in metal sashes to IS 420. Putty shall be free from impurities like dust, grit etc.

12.3. Bitumen: Bitumen for filling joints shall conform to IS 3117 / IS 3037.

12.4. Jointing Materials

Joint Filler

Performed joint filler shall be of bituminous material, non-extruding and resilient type and conform to IS 1838.

Sealing Compound

Sealing compounds shall be of an approved brand and shall conform to Grade "A" of IS 1834. They shall have good adhesive properties free from any corrosive effect and shall not slump in vertical or inclined joint, nor shall they bleed into or corrode the materials with which they are in permanent contact.

12.5. Galvanised iron Chain link fencing

Materials

The material requirement shall conform to IS : 2721 latest edition. The chain link fencing shall be woven from 3.55mm dia. wire with mesh size of 50mm, unless specified. The mesh wire shall not vary from the specified dia. by more than 0.05mm

All steel wires shall be hot dipped galvanized wire and dia of the wire shall be 3.55mm. The dia. shall be measured over the galvanized coating.

The line wire shall be 4mm dia. mild steel.

The stirrup wire for securing the line wires to the intermediate posts shall be 2.5mm diameter mild steel and post of MS 75 x 75 x 6mm angle unless otherwise specified.

The tying wire for securing the chain link fencing to the line wire shall be 1.6mm diameter mild steel.

Hair pin staples for fastening down the bottom of galvanized chain line fencing to the concrete sill shall be of 3.55mm wire. The ends shall be bent outwards to secure anchorage.

Cleats for eye bolts shall be of uniform size and shall consist of mild steel angle of 75 x 50 x 6mm. Unless specified or otherwise shown on the drawing.

The eye bolt strainer shall consist of bolts with welded eye sufficiently threaded and fitted with a nut and washer.

Two way eye bolt strainer shall have suitable ring nuts fitted after wires have been strained on one side.

Stretcher bar shall consist of mild steel flats 25mm x 4.75mm, unless specified. they shall be secured to the cleats by steel bolts.

Fixing

The chain link fencing shall be strained between each pair of straining posts and secured to each straining post by means of a stretcher bar. On of the top line wires shall be threaded through the appropriate adjacent rows of mesh, care being taken that no meshes in the rows are by passed by the wire except where deviation is necessary at the straining posts. The second top line wire shall be strained in front of the fencing. The fencing shall be attached to the top and bottom line wires by wire ties spaced 150mm apart and to the other line wires by wire ties spaced 450mm apart.

Continuous sill 125mm wide x 225 mm high for full length between post shall be cast with the top 25mm above G.L. and 25mm below the chain link fencing. Hair pin staples shall be threaded through the bottom row of mesh at 0.75m c/c and set in the masonry to a depth of 150mm.

Rates

The rate shall also include supplying and fixing necessary galvanized line wires, stirrup wires, tying wires, hair pin staples for fixing the fence in masonry / sill, etc. tensioning the line wire and fencing, all materials and labour etc. required to complete the job as per drawings or as per direction of Engineer-In-Charge excluding structural steel work like MS post and flat bar which shall be measured separately.

12.6. Pipe Sleeves for conduits / pipe crossing etc.

Materials

Material of the pipe sleeves shall be as described in the item description(BOQ) conforming to the relevant IS Standard. Length and diameter of the pipe to be provided shall be as described in the item description of the BOQ.

Making holes / chases in the concrete / masonry

Holes / chases of required size shall be done carefully during construction as shown on the drawing or as specified in the item description or as directed by the Engineer-In-Charge. Any damage to the adjoining portion or to any other item shall be made good at contractor's cost as directed by the Engineer-In-Charge.

Embedding pipe sleeves

After insertion of pipe sleeves, the holes / chases shall be repaired with cement concrete 1:2:4 and the surface finished to match with existing surface. The top and bottom shall be finished properly to make the joint leak proof by cement grouting of areas around. Conduits, pipes etc. and provision of chicken mesh there on prior to plastering. The specifications for cement concrete work and finishing etc. shall be same as described under - Cement Concrete Work specification.

13. SERVICES MISCELLANEOUS WORKS:

13.1. Cutting Holes in walls up to 30 cm x 30 cm

Square holes of size as specified or as directed by the Engineer-In-Charge shall be cut in the masonry. Any damage to the adjoining portion or to any other item shall be made good as directed by the Engineer-In-Charge. All dismantled material shall be removed from the site.

Masonry Work:

Brick work etc. shall be made good by using the same class of brick, tile or stone masonry as was cut during the execution of work. The mortar to be used shall be cement mortar 1:4 (1 cement: 4 fine sand) or as directed by the Engineer-In-Charge.

Finishing

Cement mortar in 1:4 mix (1 cement: 4 sand) shall be used for plastering or pointing, as may be required. Sand shall be fine or coarse as used in the original work. The surface shall be finished with two or more coats of white wash, colour wash, distemper or painting as required but where the surface is not to be white washed, colour washed, distempered or painted, it shall be finished smooth with a floating coat of neat cement or as required to match with the surrounding surfaces.

13.2. Cutting holes in RCC floors (up to 15 cm x 15 cm):

Square holes of size as specified shall be cut in RCC floor and roofs for passing drain pipe etc. Any damage to the adjoining portion or to any other item shall be made good as directed by the Engineer-In-Charge. All the dismantled material shall be removed from the site.

Cement concrete:

After insertion of drain pipe etc. the hole shall be repaired with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) and the surface finished to match with the existing surface. The top and bottom shall be finished properly to make the joint leak proof. The specifications for cement concrete work and finishing etc. shall be the same as detailed under relevant sub-heads.

13.3. Cutting chases in masonry walls:

Making chases:

Chases are made in the walls for housing GI pipes etc.

Cutting of chases in one brick thick

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

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

When narrow stretches of masonry (or short lengths of walls) such as between doors and windows, can not 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 mortar or concrete walls provided, if required.

Horizontal chases when unavoidable should be located in the upper or lower one third of height of storey and note 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 & kept within the permissible limits.

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.

Masonry directly above a recess, if less than 30 cm. (Horizontal dimension) should be supported on lintel. Holes in masonry may be provided upto 30 cm. Width x 30 cm height without any lintel. In the case of circular holes in masonry, no lintel should be provided upto 40 cm in diameter.

Filling Chases

After G.I pipes etc. are fixed in chases, the chases shall be filled with cement concrete 1:3:6 (1 cement: 3 coarse sand : 6 graded stone aggregate 20mm nominal size) or cement mortar 1:4 (1 cement : 4 coarse sand) as may be specified or otherwise directed by the Engineer-In-Charge and made flush with the masonry surface. The concrete surface shall be roughened with wire brushes to provide a key for plastering.

Measurements:

Chases shall be measured in running meter correct to a cm.

13.4. Embedding pipes in masonry (up to 150 mm dia)

Pipe shall be embedded in masonry during construction of the building. A hole of size upto 20 cm x 20 cm as directed shall be kept in the masonry. The pipes shall be centrally placed in the hole and shall be fixed by filling the stacks with cement concrete around. The holes shall be provided at correct positions as shown in the drawing or as directed by the Engineer-In-Charge.

Embedding pipes:

Pipes shall be embedded in masonry with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size). Where the wall thickness is 20 cm the cement concrete shall be made flush with the masonry surface on both sides and the surface roughened with wire brushes to receive plaster. Where the thickness of wall is more than 20 cm, the other side shall be covered with the same class of brick, tile or stone masonry etc. as provided in the adjoining portion or the main building. This masonry shall be paid for separately, under the relevant item.

14. ALUMINIUM WORKS:

14.1. Aluminium glazed door

Materials

Aluminium alloy extruded sections used in the manufacture, dimensions, weight per meter run of extruded section shall be as recommended in IS : 1948 - 1961 and of fabricated form of approved / renowned companies.

Aluminium alloy used in the manufacture of extruded window sections shall correspond to IS Designation HE 9 WP of IS 733. Hollow aluminium alloy sections used shall conform to SI Designation HV9-WP of IS 1285. Machine screws used shall conform to the requirements of IS 1362. Also cadmium plated screws, nuts, washers, bolts, lugs of steel shall be used on direction of the Engineer-In-Charge.

Anodizing

Anodic coatings on aluminium and its alloys, shall be in confirmation with IS : 1868 - 1996. All aluminium material used shall be anodized for protection against corrosion in marine atmospheres. A thick coating of minimum 15- microns (on each face) from a sulphuric acid

bath shall improve its corrosion resistance. Further, anodized sections should be double sealed or alternatively, sealed by exposure to steam.

The extrusions are anodized in different colours like silver, champagne, bronze and black as approved by the Engineer-In-Charge. A fool proof scaling system ensures durable finish for long lasting applications.

Anodized material received at site shall be with a certificate conforming coating of aluminium sections as specified. The Engineer-In-Charge may get the same tested from outside at the cost of contractor as per IS 5523.

Powder coated aluminium, if specified shall be used as approved by the Engineer-In-Charge.

Glazing

Unless otherwise specified, the glazing shall be of patent flattened Float glass of best quality conforming to IS: 2835. Glass shall be free from cracks and of approved manufacture. It shall be transparent, ground or figured as specified.

Glass shall be transparent or ground as specified, uniform in appearance and shall be free from specks, bubbles, smoke, veins, air holes, blisters, stains, scratches and other flaws and defects of specified thickness. All the glass panels shall have proper square corners, true & straight edges.

Tolerance in length and width of Float glass shall be ± 2.0 mm. for glass thickness above 3 mm. and maximum up to 6.3 mm.

For panels larger than 900 mm. plate glass (minimum thickness 6 mm.) shall be used unless otherwise specified.

Roughcast wired glass shall be 6 mm. Thick, unless specified.

Float glass shall not have defects greater than those given in Table of IS 2835. Tests shall be conducted, if asked, as specified in IS 2835 Appendix A, B, C at Contractor's own cost.

Unless otherwise specified in BOQ, normal thickness of glass for window shall be 5.5 mm thk. Weight @13.5 kg/Sq.m and for doors 6.3mm thk weight at 15.5 Kg/Sq.m.

Standard Sizes of Aluminium sections, Tolerances etc.

Manufacturing tolerances: Dimensional extrusions are normally manufactured as per Indian Standard / British Standard Specifications. Special tolerances shall be mutually agreed upon.

Tolerance on Cut length: Tolerance on cut length shall be +5mm upto 6 metres and + 7mm above 6 metres.

Tolerance in Weight: Actual weight of section shall not vary by more than $\pm 10\%$.

Fixing sizes of Doors for fabrication: The type and the overall sizes of aluminium doors shall be as indicated in the drawings. The dimensions shown are overall heights and widths to the outside of frames of doors. These sizes are derived after allowing 12.50mm clearance on both sides breadth wise while 12.50mm sides in height. While manufacturing the aluminium doors to enable the fixing of the same easily in the openings provided in masonry correct to the specified sizes of doors.

Fixing of Glass panels

Glazing shall be provided on the outside of the frames unless otherwise specified.

Fixing of glass panes shall be done with aluminium beading. Beadings are to be fixed with screws, spaced not more than 10 cm from each corner and intermediate not more than 20cm apart. When the glass panes are fixed with aluminium beading having mitred joints, epoxy

resin or silicon sealant shall be applied between glass panes and sash bars and also between glass panes and the beading.

All glass panes shall be fixed within the aluminium framing by use of CP brass or stainless steel screws as specified in item and the joints sealed with epoxy resin or silicon sealant to make the unit completely waterproof. Glazing or Caulking compound around the perimeter of glass shall not be permitted. Fixed glass panes shall be supported by setting blocks. There shall be no whistling or rattling. For normal size glass panes glazing clips are not provided. Screw threads shall be of machine screws and conform to the requirements of IS : 1362. Dimensions for screw threads for general purpose diameter range should be 0.25mm to 3.5mm.

Four glazing clips may be provided per pane for a size larger than 30cm x 60cm for all types and panes size exceeding 80cm x 200cm, 6 glazing clips shall be used. In case of doors without horizontal glazing bars, the glazing clips may be spaced according to the slots provided in the vertical members only if the spacing does not exceed 30 cm otherwise minimum 30 cm spacing or as specified shall be maintained.

The aluminium anodized extruded glazing beads or snap beading to be used should also be the product from the manufacturer of aluminium extruded sections used for fabricating doors. No beading manufactured by local units shall be permitted.

Fabrication

Frames shall be square and flat, with the corners fabricated to a true right angle.

The fixed as well as openable frame shall be constructed by cutting sections to exact length, with corners mitred and welded. Mitred shutter frame joints must be cleated mechanically with aluminium cleats if approved by the Engineer-In-Charge. Where hollow sections are used with welded joints, argon-arc welding or flash butt welding shall be employed or, if approved, mechanical connection assembly.

Subdividing bars of units shall be tenoned and riveted into the frame.

Fittings and fixtures shall be as detailed or approved by the Engineer-In-Charge and conforming to IS 1948. Casement shutter shall have Peg stay, Handles, Locks. Samples of fittings shall be submitted prior to being used for final approval of the Engineer-In-Charge.

EDPM/Neoprene preformed profile shall be used for inserting into extruded pockets of sections. Glazing beads shall also be of EDPM/Neoprene preformed profiles to hold the glass in frame under pressure. Non metallic setting blocks shall be used to centralize the glass in frame. Stainless steel ball bearing of approved make, housed in nylon type nylon roller, shall be used.

All mechanical connection shall be sealed with silicon sealant. Around all windows, approved quality sealants shall be run down to make sure of total weather/water sealing. Fixing shall be carried out as per IS 1081.

Frames : Frames shall be square and flat both the fixed and openable frames shall be constructed of sections, which have been cut to length, mitred and mechanically jointed at the corners. Sub-dividing bar of units shall be tenoned and riveted into frames. All frames shall have corners welded to true right angles. For jointing hollow sections flash butt welding argon arc welding or mechanical jointing by inserts shall be used. (Gas welding or brazing shall not be done) Concealed screws shall be used for joining the sub-units.

Shutters: Doors shall be constructed with sections as detailed in drawings. Hinges shall be non projecting and of heavy type. If specified or directed by the Engineer-In-Charge for floor spring, closers, long grip handles and locks shall be provided. In normal course standard lock with lever handle of approved make shall be provided.

For double door the first closing shutter shall have a concealed aluminium alloy bolt at top and bottom so constructed as not to work loose or drop by its own height.

Standard projecting or butt hinges as specified or as directed by the Engineer-In-Charge shall be provided which shall be inserted into the frames and riveted. For anodized work suitable aluminium alloy pins shall be used. The Engineer-In-Charge may permit the use of mechanical jointing instead of welding.

Openable shutters shall be provided with approved neoprene weather strips.

Tolerance

The size for doors shall not vary by more than ± 1.5 mm.

Fittings

All fittings and fixtures shall be of high quality and as shown in the drawing / as specified. The samples of all fittings shall be got approved by the Engineer-In-Charge before fixing. The general details of fittings for doors shall be as prescribed in IS : 1948 unless otherwise specifically specified.

Hinges

Cast or extruded aluminium alloy hinges for doors shall be of same type as described under clause 3020.2, but of larger size. The type of hinges projecting or non projecting type shall be as specified in the item description or as directed by the Engineer-In-Charge.

Handles

Handles for the doors shall be of the design as shown in the drawing and as specified in the item description or as directed by the Engineer-In-Charge.

Bolts

In double shutter doors, the first closing shutter shall have a concealed aluminium alloy bolt at top and bottom and shall be so constructed as not to work loose or drop by its own weight.

Single and double shutter doors may be provided with a three way bolting device and in case of double shutter door, concealed aluminium bolts shall not be provided.

Position of holes and number of lugs per units-

Outer frames shall be provided with fixing holes centrally located in the web of the section in the position as indicated in the drawing. Number of lugs to be provided as indicated in the drawings or as directed by the Engineer-In-Charge.

Fixing of Aluminium doors in position

Aluminium doors shall be stacked as to keep them in true shape without damage. The sizes of opening in the masonry shall be larger in width by 1.25cm on both the side and larger in height of 1.25cm only on top face. This gap is to be filled up with mastic cement and plaster done after door is fixed in position.

Fixing with G.I Steel lugs

Slotted G.I steel adjustable lugs shall be of natural finish and of size 100 x 16 x 3 mm.

Number of lugs and their position of fixing for an aluminium alloy door shall be as specified or as directed.

Before the aluminium doors are fixed in position, a thick shop coat of clear transparent lacquer based on the methyrate or cellulose shall be applied on aluminium doors, windows, etc. to protect the surface from wet cement during installation. The lacquer coating shall be removed

carefully after plastering etc. to the satisfaction of the Engineer-In-Charge without any extra cost.

The size of the opening shall first be checked and cleared of obstruction if any. The position of the unit for fixing holes shall be marked on the jamb. Necessary holes shall be made in the masonry and lugs of size not less than 100mm long 15 x 3 mm size fixed in cement concrete blocks of size 150 x 100 x 100mm in 1:3:6 mix (1 cement : 3 coarse sand : 6 graded stone aggregate 20mm nominal size). The frame of units after treating with lacquer coating as explained in above para shall be set in opening by using wooden wedges at jambs head (wedges shall be preferably placed near the points where glazing bar or other members meet.)

The wedges should be fixed only when the doors / windows are kept in perfect position and plumb. Later the frames should be fixed with lugs with 20mm long and 6.3mm dia. G.I. counter sunk machine screws and nuts. Only after ascertaining that the doors are firmly fixed with lugs in the opening, the wedges should be removed very carefully and the gap should be filled with mastic cement and plaster taking particular care to see that the plaster done over jambs do not in any way abut the front surface of aluminium door.

After the gaps are filled with mastic cement and plaster and the filling is finally set still if any crack / gap is noticed / pointed out by the Engineer-In-Charge the same should be immediately filled with either epoxy resin or silicon sealant.

Fixing on concrete surface

Contrary to the method adopted as stated above in this case instead of using lugs to fix the doors the same is fixed with wood screws to the wooden plugs fixed in the concrete surface.

As in earlier case the opening is checked for size etc. the specified treatment is given to the surfaces of aluminium doors and the correct positions for fixing wooden plugs marked on the jamb with respect to the holes provided in the door for fixing screws.

Only duly marked points on the jambs required size of hole shall be made in the concrete and the wooden plug of teak wood of specified size shall be fixed in the hole with rich cement mortar. Units shall be erected after plugs are duly set.

Door should be fixed to the wooden plugs, with the help of galvanized wood screws of size 45 x 10mm

Later the 12.5mm wide gap between the concrete surface and the aluminium unit shall be filled neatly with mastic cement and mortar. Alternatively if approved by the Engineer-In-Charge instead of fixing the units of wooden plugs the same can be conveniently and firmly fixed with rawl plugs using little longer size screws of designation 10.

Measurement

Shall be as per the relevant part of IS 1200

Frame work: The length of each extruded section used for fabrication of the door shall be measured correct to 1mm. Length shall be measured by reducing the width by 2.5cm and height by 1.25cm than the specified size of doors in the drawings issued for construction.

The weight of material used shall be calculated on the basis of actual weight of extruded sections used for fabrication and shall be compared with the weights given in the manufacturer's catalogue, subject to the condition that the variation in actual weight given in the manufacturer's catalogue, and the actual weight should not exceed $\pm 10\%$ than the weights specified in manufacturer's catalogue, payment shall be made for the actual weight of the extruded section. The final weights shall be calculated in Kgs upto two place of decimal.

Glazing

Length and width of glazing louvers shall be measured correct to a cm and area shall be calculated in Sq.m. nearest to 0.01 Sq.m.

Fittings

All fittings and fixtures for doors shall be inclusive of the rate. However, weight of the same will be ignore while calculating the weight of aluminium sections.

Rate

The rate shall include the cost of material and labour for all operations described above including cost of glazing. The rate shall also allow finish of aluminium section to be supplied in mat finished and provided with 15 micron thick anodizing in approved colour as specified in the item description or otherwise as directed by the Engineer-In-Charge.

14.2. Aluminium glazed openable window

Material

Material shall be used as described under –Aluminium doors specifications relevant clauses as applicable.

Standard Sizes, tolerances

Standard sizes/ tolerances etc. shall be used as described under-Aluminium doors specifications relevant clauses as applicable.

Fixing sizes of windows for fabrication: The type and the overall sizes of aluminium windows shall be as indicated in the drawings and should be reduced in size by 1.25 cm from all four sides while manufacturing the aluminium alloy windows to enable the fixing of the units easily in the openings provided in the masonry correct to the specified size of windows.

Glazing

Glazing shall be used as described under –Aluminium doors specifications.

Fixing of Glass Panels

Fixing of glass shall be used as described under –Aluminium doors specifications

Fabrication

Frames: Frames shall be used as described under-Aluminium doors specifications.

Shutters: Openable windows shall be constructed to sections as detailed in drawings. The hinges, handles, peg stays etc. shall be provided as specified or as directed by the Engineer-In-Charge. Details of construction of aluminium alloy windows in accordance with IS : 1948

For double window shutter the first closing shall have a concealed aluminium alloy bolt at top and bottom so constructed as not to work loose or drop by its own weight.

Standard projecting type as specified or as directed by the Engineer-In-Charge shall be provided which shall be inserted into frames and reverted. For anodized work pins for hinges shall be of aluminium alloy HR30. The Engineer-In-Charge may permit the use of mechanical jointing instead of welding.

Openable shutters shall be provided with continuous neoprene weather strips.

Tolerances

The sizes for openable windows shall not vary by more than $\pm 1.5\text{mm}$

Fittings

Hinges of approved quality and size shall be used for fixing the shutters as per the direction of Engineer-In-Charge.

Handles - For Side Hung Shutters

The handles shall be of cast aluminium of specified quality, manufactured by reputed manufacturers.

The handles shall be mounted on a handle plate welded or riveted to the opening frame in such a way that it could be fixed before the shutter is glazed.

The handle should have anodized finish with minimum anodic film thickness of 15 micron. The handle shall have a two point nose, which shall engage with an aluminium striking plate on the fixed frame in a slightly open position as well as in a fast position.

The height of the handles, in each type of side hung shutters shall be fixed in approximate position as shown on the drawing specified or as directed by the Engineer-In-Charge.

Weather Bar

When a coupling member is fitted over an external opening shutter the coupling member should incorporate an integrally extruded weather bar as per IS : 1948, Section No. Al - HK12B.

Position of holes and number of lugs per unit – The position of holes and number of lugs to be provided for windows of different sizes in accordance with IS : 1948

Fixing Aluminium Windows in position

In opening of masonry: Aluminium windows shall be stacked as to keep them in true shape without damage. The sizes of openings in the masonry shall be larger in width / height by 1.2cm for all four sides. This gap is to be filled up with mastic cement and plaster after window is fixed in position.

Fixing with steel lugs

Fixing with steel lugs shall be used as described under-Aluminium doors specifications.

Fixing on Concrete surface

Fixing on concrete surface shall be used as described under- Aluminium doors specifications.

Measurement

Framework

The length of each extruded section used for fabrication of the window shall be measured correct to 1mm. Length shall be measured by reducing the width and height by 2.5cm than the specified size of window in the drawings issued for construction.

The weight of material used shall be calculated as described under Aluminium Doors specifications.

Glazing - Length and width of opening for glazing inserts shall be measured correct to a cm and area of payment shall be calculated in Sq.m. nearest to 0.01 Sq.m.

Fittings - All fittings and fixtures for windows shall be included in the relevant items. However, the weight of the same shall be ignore while calculated weight of aluminium sections.

Rate

The rate shall include the cost of material and labour for all operations described above except the cost of glazing and panelling. It shall include screws expansion hold fastener, snap beading including filling with necessary PVC / neoprene felt, cleats, etc. The rate shall also allow finish of aluminium section to be supplied in mat finish and provided with 15 micron thick anodizing in approved colour and shall allow for openings of all shapes including circular, segmental or other shapes and sizes.

14.3. Aluminium glazed sliding window**Material :**

Material shall be used as described under –Aluminium doors specifications.

Standard Sizes, tolerances, fixing sizes etc.

Standard sizes/ tolerances etc. shall be used as described under-Aluminium Doors specifications under relevant clauses as applicable.

Glazing

Glazing shall be used as described under –Aluminium Doors specifications.

Fixing of Glass Panels

Fixing of glass shall be used as described under- Aluminium Doors specifications.

Fabrication

Frames : Frames shall be used as described under –Aluminium Doors specifications.

Shutters : Panels and type of sliding windows shall be manufactured as specified in the drawing, specified in the item description or as directed by the Engineer-In-Charge.

Fittings shall be self closing latch (normally fixed to the shutters while manufacturing the knob fixed on the sliding glass panes), nylon rollers etc.

Tolerance

The size of sliding windows shall not vary by more than ± 1.5 mm.

Position of holes and number of lugs per units

In absence of any guidelines issued by IS code for sliding windows. The position of holes and number of lugs to be provided for windows of different sizes in accordance with IS : 1948 and can be followed with suitable modifications, wherever necessary.

Fixing Sliding Windows

In opening of masonry: Aluminium windows shall be stacked as to keep them in true shape without damage. The sizes of openings in the masonry shall be larger in width / height by 1.2cm for all four sides. This gap is to be filled up with mastic cement and plaster after window is fixed in position.

Fixing with steel lugs

As described under –Aluminium Doors specifications.

Fixing on Concrete surface

As described under –Aluminium Doors specifications.

Measurements

Frames shall be measured as described under –Aluminium Doors specifications.

Glazing: Length and width of opening for glazing inserts shall be measured correct to a cm and area of payment shall be calculated in Sq.m. nearest to 0.01 Sq.m. However, the cost of knob fixed in the glass of sliding window glass need not be paid separately.

Rate

The rate shall include the cost of material and labour for all operations described above except the cost of glazing and panelling. It shall include screws expansion hold fastener, snap beading including filling with necessary PVC / neoprene felt, cleats, nylon rollers, etc. The rate shall also allow finish of aluminium section to be supplied in mat finish and provided with 15 micron thick anodizing in approved colour and shall allow for openings of all shapes including circular, segmental or other shapes and sizes. The rate shall also include the cost of automatic closing latch provided in the sliding window while manufacturing.

The cost of glazing, panelling shall be paid under separate item, as described herein.

14.4. Aluminium glazed fixed / openable ventilators

Material:

Material shall be used as described under- Aluminium Doors specifications.

Standard Sizes, tolerances, fixing sizes etc.

Standard sizes/ tolerances etc. shall be used as described under-Aluminium Doors specifications under relevant clauses as applicable.

Glazing

Glazing shall be used as described under- Aluminium Doors specifications.

Fixing of Glass Panels

Fixing of glass shall be used as described under –Aluminium Doors specifications

Fabrication

Frames : Frames shall be used as described under-Aluminium Doors specifications under relevant clauses as applicable.

Shutters : Ventilators shall be constructed to sections as detailed in drawings. The hinges, handles, peg stays etc. shall be provided as specified or as directed by the Engineer-In-Charge. Details of construction of aluminium alloy windows in accordance with IS : 1948

Standard projecting type hinges as specified or as directed by the Engineer-In-Charge shall be provided which shall be inserted into frames and reverted. For anodized work pins for hinges shall be of aluminium alloy HR30. The Engineer-In-Charge may permit the use of mechanical jointing instead of welding.

Ventilators shall be provided with continuous neoprene weather strips.

Tolerances

The sizes for ventilators shall not vary by more than $\pm 1.5\text{mm}$

Fittings

Hinges – Top Hung Ventilators

Friction hinges of approved quality and size shall be used for fixing top hung ventilators as per the direction of Engineer-In-Charge.

Cup Pivots Centre Hung Ventilators

The centre hung ventilators shall be hung on two pairs of cup pivots or on brass or bronze cup pivots which should be either chromium or cadmium plated and reverted to the inner and outer frames of the ventilator to permit the ventilator to swing through an angle approximately 85° .

The opening portion of the ventilators shall be so balanced that it remains open at any desired angle under normal weather conditions.

Spring Catch – Centre Hung Ventilators

The spring catch shall be of specified make and type conforming to relevant IS specifications and shall be made of either chromium plated or cadmium plated.

The spring catch shall be fitted in the centre of the top bar of the ventilator, for its operation. This spring catch shall be secured (preferably screwed or reverted) to the frame and shall close into the aluminium catch plate reverted or welded to the outside of the outer ventilator frame.

Cord Eye and Pulley Arrangement – Centre Hung Ventilator

Cord pulley wheel shall be of aluminium or cadmium plated brass in an aluminium bracket.

This shall be fitted at the sill of the ventilator, with aluminium or galvanized or cadmium plated steel screws or alternatively welded together with aluminium cord eye reverted or welded to the bottom inner frame bar of the ventilator in a position corresponding to that of pulley.

Position of Holes and Number of Lugs per Unit

The position of holes and the number of lugs to be provided for the ventilators of different sizes as described under –Aluminium Doors specifications.

Fixing Aluminium Ventilators in position

Fixing of Aluminium Ventilators shall be as described under –Aluminium Window specifications.

Measurements

Frames shall be measured as described under –Aluminium Doors specifications .

Glazing: Length and width of opening for glazing inserts shall be measured correct to a cm and area of payment shall be calculated in Sq.m. nearest to 0.01 Sq.m. However, the cost of knob fixed in the glass of sliding window glass need not be paid separately.

Rate

The rate shall include the cost of material and labour for all operations described above except the cost of glazing and panelling. It shall include screws expansion hold fastener, snap beading including filling with necessary PVC / neoprene felt, cleats, etc. The rate shall also allow finish of aluminium section to be supplied in mat finish and provided with 15 micron thick anodizing

in approved colour and shall allow for openings of all shapes including circular, segmental or other shapes and sizes. The rate also includes the cost of fittings and fixtures.

The cost of glazing, panelling shall be paid under separate item, as described herein.

14.5. Aluminium glazed louvered window with adjustable louvers

Material

Material shall be used as described under-Aluminium Doors specifications.

Standard Sizes, tolerances

Standard sizes/ tolerances etc. shall generally as described under –Aluminium Doors specifications.

Tolerances in weight shall not vary by more than $\pm 10\%$

Sizes of Ventilators for fabrications -

Overall sizes of aluminium adjustable louvered type ventilators shall be as specified in the drawings should be reduced by 1.25cm from all four sides while manufacturing.

Glazing

Glazing shall be used as described under –Aluminium Doors specifications.

Fixing of Glass Panels

Fixing of glass shall be used as described under-Aluminium Window specifications.

Fabrication

Frames: Frames shall be used as described under –Aluminium Doors specifications.

Fixing of Glass panels

Glazing shall generally as described under-Aluminium window specifications.

Glazed louvers shall be inserted inside the louvered frames. The glazed louvers can be removable type as and when required.

Fittings

Adjustable louvered frames, locking arrangement etc. shall be as per relevant IS code or as per the manufacturers norms subject to confirmation to relevant IS codes, or manufacturers instruction or otherwise as directed by the Engineer-In-Charge.

Fixing of louvered ventilators

Louvered ventilators shall be stacked as to keep them in true shape without damage. Fixing shall be in confirmation to relevant IS codes, or manufacturer's instruction or otherwise as directed by the Engineer-In-Charge.

Measurements

Frame Work

Frames shall be measured as described under- Aluminium Window specifications under relevant clauses as applicable.

Glazing - Length and width of opening for glazing inserts shall be measured correct to a cm and area of payment shall be calculated in Sq.m. nearest to 0.01 Sq.m. .

Rate

The rate shall include the cost of material and labour for all operations described above except the cost of glazing (which shall be measured and paid separately) The rate shall also allow finish of aluminium section to be supplied in mat finish and provided with 15 micron thick anodizing in approved colour.

14.6. Plain anodized aluminium sheet weather shed

Material

General specifications and materials shall confirm to requirements as described under- Aluminium Doors specifications. Anodized Aluminium Sheet of required width as shown on the drawing and thickness shall be minimum 2.5mm thick (14 gauge) made out of wider sheet duly machine cut unless otherwise any other width / thickness specified in the description of item. Anodizing on aluminium sheet and washers to be 15 micron thick.

Fixing

Aluminium sheet shall be cut, shape, size as shown on the drawing or specified in the item description supported on steel angle frames (supports shall be measured and paid under respective items). The sheets shall be laid and fixed in the manner as specified or as directed by the Engineer-In-Charge or otherwise shown in the drawings. Sheets shall be fixed to supporting angles with aluminium or hook bolt, bolts, crank hook bolt, etc. as per requirement with aluminium and neoprene washers. Holes must be made by drilling and not punched. Hook bolts are used for fixing sheets to angle purlins, crank hook bolts are used to fasten sheeting to angle purlins. The sheets shall be laid with minimum lap of 15cm at the end. The slope of sheeting should not be greater than 1 vertical to 3 horizontal. The length of hook bolts shall be varied to suit the particular requirements

The weather shed when completed shall be true to lines and slope and shall be leak proof.

14.7. Aluminium framed and panels made up of 4mm thick Synthetic Resin Bonded paper laminate with decorative facing on both side conforming to IS: 2036-1995 for toilets / bath / WC etc.)

Materials

General specifications shall be as described under- Aluminium Doors specifications.

Frame:

Frames shall be as described under –Aluminium Doors specifications.

The sizes / sections of top, bottom lock rail and style shall be of the sizes as mentioned on the drawings or otherwise as specified or directed.

Panelling

Panelling shall have minimum thickness 4mm, it shall be synthetic resin bonded paper laminate with decorative facing conforming to IS : 2036 - 1995 and other technical data conforming to approved manufacturer specifications.

Workmanship

General specifications shall be as described under-Aluminium Doors specifications.

Frames shall be square, flat and have been cut to length, mitred and mechanically jointed at the corners. All frames shall have corners welded to true right angles.

The panel inserts shall be either framed into the grooves. The depth of the groove shall be 12mm 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 grooves of stilts and rails to the full depth of groove leaving on space 1.5mm.

Fixing of Shutters

Overall dimensions shall be within ± 1.5 mm of size shown on drawings. Actual weight of aluminium sections shall not vary by $\pm 10\%$.

Fixing of shutters shall be as described under Clause No. 3009.5 of under clause 3009 - Woodwork & Joinery.

Fittings

Fittings shall be as prescribed under Section 9 – Wood Work and general specifications shall confirm to IS: 1948 unless and otherwise specified. Fittings shall be measured and paid separately.

Measurement

Frame work and panelling shall be measured separately

Frame Work

Frames shall be measured as described under –Aluminium Doors specifications.

Panelling

For panelling length and width of opening for panels inserts shall be calculated to the nearest to 0.01 Sq.m. The portions of the panels inserts inside the groove shall not be measured for payment.

Rates

The rate shall include the cost of material and labour for all operations described above except the cost of panelling (which shall be measured and paid separately). The rate shall also allow finish of aluminium section to be supplied in mat finish and provided with 25 micron thick anodizing in approved colour. The frame work shall be paid in kg and panelling shall be paid in square meter separately.

15. WATERPROOFING WORKS:

15.1. Waterproofing Treatment

Patented waterproofing treatments shall be done strictly in accordance with the manufacturer's specifications and in conformity with the relevant IS codes.

Any leakage or defects during guarantee period shall be made good by the Contractor at this own cost. The responsibility for all rectifications shall solely rest with the Contractor irrespective of the fact whether the specialised sub-contractor, if any, has given any guarantee to the Contractor.

15.2. Cement based patented type waterproofing treatment to terrace, gutter beam etc and similar location

General specifications for waterproofing and laying of brick bat coba shall be as described below:

Materials

Cement: Cement shall be ordinary Portland cement conforming to the requirements of IS: 269

Fine Aggregate: The fine aggregate shall be conforming to the requirements of IS: 383

Brick Bats: Bricks shall be of class designation 35 conforming to the requirements of IS: 1077

Waterproofing Compound: Integral waterproofing compound shall conform to the requirements of IS: 2645

Water: Conforming to provisions of IS: 456

Procedure for Laying of Waterproofing Treatment over Terraces- (India Water Proofing Co. type)

The waterproofing procedure as outlined herein indicates the process in general. The details, however, recommended by specialised agency shall have, however, to be strictly followed for carrying out the work.

RC area to be waterproofed shall be cleaned off all dirt, dust, oil etc. Any honeycombs, cavities, cracks etc. shall then be scaled by injecting with the necessary 'damp-proof' compound with cement solution and the surface made rough. Over thoroughly cleaned slab surface, then unless otherwise specified average 15mm thick plaster in cm 1:4 with admixture of approved waterproofing compound shall be laid.

The cleaned terrace shall be watered properly and cement slurry shall be spread over the slab. Brick bat coba in 'damp-proof' cement mortar shall then be laid to the specified average thickness or as directed in CM 1:2 to provide necessary gradient in a special manner with brickbats partly projected above. Unless otherwise specified average 75mm thick graded brickbat coba in 1:4:8 mix (1 cement : 4 coarse sand : 8 brick bat coba with 40mm nominal size) impregnated with approved water repellent / waterproofing chemical compound properly consolidated to required grade and slope shall be laid.

The brick bat joints shall be filled in with 'damp-proof' cement mortar by joint less waterproof plaster finished smooth with trowel in thin layer of cement and marked into 300 mm. x 300 mm. false squares or left smooth if directed by the Engineer-In-Charge. Unless otherwise specified finishing the top surface, with 15mm thick plaster with an admixture of approved chemical compound.

The treatment shall be continued along the inner sides of parapets or adjoining wall upto a height of 300 mm. to 375 mm in the shape of round vata and over that drip mould.

The construction joints shall be taken at ridges and shall be made properly watertight and monolithic.

Care shall be taken to finish the rain water inlets etc. properly so that no leakage occurs. The terrace shall be tested for water tightness after treatment is completed and any defects shall be made good.

Testing

If leakage is observed wherever waterproofing treatment is carried out the source of leakage is to be detected and the same shall be stopped with the help of injection grouting (with cement slurry).

Measurement: The measurements shall be on the actual net area. No vatas shall be measured separately.

Rate

All labour, materials including waterproofing chemicals, use of equipments, tools and plant, installing and removal of scaffolding, false work and forms and bracing, curing & testing necessary for the satisfactory completion of the item.

Providing brick bat coba with waterproofing chemicals of specified proportion including transporting, placing & compacting, curing, finishing to the dimensions and shapes shown on the plans or as ordered by the Engineer-In-Charge.

Providing 'vata' at the junction of base and walls also for ponding

Grouting of areas wherever required.

15.3. Cement based patented type waterproofing treatment over Chajjas

Material and General specifications shall be as described under –Terrace water proofing specifications.

15.4. Procedure for Laying of Waterproofing Treatment Over chajja's - (India Water Proofing Co. type)

General specification for laying waterproofing treatment over chajja's shall be as described under- terrace water proofing specifications except graded brick bat coba in 1:4:8 mix (1 cement: 4 coarse sand : 8 brick bat coba with 40mm nominal size) impregnated with approved water repellent / waterproofing chemical compound properly consolidated to be laid at the junction of wall and chajja to the required size and slope or as directed by the Engineer-In-Charge.

The treatment shall be continued along the external sides of parapet / walls or adjoining chajjas upto a height of 300mm – 375mm in the shape of round vata and over the drip mould.

Finish : As specified in the item description or otherwise finishing the top surface with 15mm thick plaster with an admixture of approved chemical compound.

Testing

Testing shall be done as described under –Terrace water proofing specifications.

The chajja shall be tested for water tightness after treatment is completed and any defects shall be made good.

15.5. Cement based patented type treatment for sunken portion of WC / Bath / Toilet / etc. for horizontal surfaces .

Material and General specifications shall be as described under-terrace water proofing treatment specifications.

Procedure for laying of India Waterproofing Type Treatment for WC's & Toilets etc.

Horizontal Surface

The preliminary preparatory work shall be as described under –terrace water proofing specifications. After cleaning the surfaces and then laying 20mm thick waterproof cement plaster to surfaces of brick walls / concrete of sunken floors using graded sand and mixed with approved cement based integral waterproofing compound, finished smooth with a floating coat of neat cement.

Brickbat coba shall be laid in CM 1:2 as per specifications and shall be kept wet for at least 4-5 days period. Brick bat coba in the sunken 1:4:8 proportion shall be measured and paid separately.

The final treatment over the brickbat coba shall be carried out in one operations so that no construction joints are left. Finishing top surface with 15mm thick plaster in CM 1:6 with an admixture of approved chemical waterproofing compound.

The prepared surface shall be kept wet for at least 10 days period.

Testing

If leakage is observed wherever waterproofing treatment is carried out the source of leakage is to be detected and the same shall be stopped with the help of injection grouting (with cement slurry).

Measurement

The measurements shall be on the actual net area. For horizontal treatment the measurement shall be taken on plan area and measured only once. Brick bat laid shall be measured separately.

15.6. Cement based patented type treatment for sunken portion of WC / Bath / Toilet / etc. for vertical surfaces.

Material and General specifications shall be as described under –terrace water proofing specifications.

Procedure for laying of India Waterproofing Type Treatment for WC's & Toilets etc.

Vertical Surfaces

Surface above the **floor level** shall be treatment with 20mm thick waterproof cement plaster in CM 1:4 with an admixture of approved chemical waterproofing chemical or as per manufacturer's specifications up to the specified height and the surface shall be roughened.

The treated surface shall be kept wet for at least 7 days period.

Testing

If leakage is observed wherever waterproofing treatment is carried out the source of leakage is to be detected and the same shall be stopped with the help of injection grouting (with cement slurry).

Measurement

The measurements shall be on the actual net area. Brick bat laid shall be measured separately.

15.7. Cement based waterproof brick bat coba for filling in sunken portion of WC / Bath / Toilet / etc.

Material and General specifications shall be as described under –terrace water proofing specifications

Procedure for laying of Brickbat Coba as per India water Proofing Type Treatment

After the expiry of the curing period of RCC slab, the surfaces shall be brushed and cleaned of all dust and foreign matter to lay the brickbat. The brickbat coba shall be laid and consolidated to proper slopes as directed by the Engineer-In-Charge to facilitate easy drainage of storm water and shall be of average thickness as specified in the item. The specifications for the materials, laying and curing etc. of this concrete shall be as specified in IS 3038.

Consolidation shall be done the next day by beating the surface with wooden beaters and shall continue on subsequent days till brick bat coba is properly consolidated and beater rebound and do not make any impression on the surface. During the process of beating, the surface shall be constantly kept wet by sprinkling water.

Graded brick bat coba in 1:4:8 mix (1 cement: 4 coarse sand: 8 brick bat coba, with 40mm nominal size) impregnated with approved water repellent / water proofing chemical compound properly consolidated to required depth, grade and slope.

Testing

If leakage is observed wherever waterproofing treatment is carried out the source of leakage is to be detected and the same shall be stopped with the help of injection grouting (with cement slurry).

15.8. Patented type cement based Box type waterproofing treatment – for underground structures from outside

Preparing the surface

The water proofing treatment over the lean concrete / levelling course should be roughened when the concrete is still green or otherwise proper key is provided for the 25mm thick base layer.

The top surface of the RCC roof slab / Vertical shall be made rough by hacking the surface with a specifically made hacking tool when the concrete is just laid and the initial set starts taking place.

In order to arrest any leakage through junction of vertical / horizontal water proofing a proper haunch in cement concrete shall be provided.

Blending Cement / Water with Water Proofing Compound

Proportions, method of mixing water proofing compound in powder or liquid form, to be used in cement / cement slurry/ cement mortar shall be as per manufacturer's recommendations subject to approval of the Engineer-In-Charge.

Rough Kotah Stone

The slabs shall be of selected quality, hard, sound, dense and homogenous in texture free from cracks, decay, weathering and flaws. They shall be hand or machine cut to the requisite

thickness. They shall be of the colour indicated in the drawings or as instructed by the Engineer-In-Charge. The slab shall have the top (exposed) face polished before being brought to site, unless otherwise specified. The slabs shall conform to the size required. Before starting the work the contractor shall get the samples of slabs approved by the Engineer-In-Charge.

For the stone slabs that are used for arresting the leakages, while executing this type of water proofing treatment, the first and foremost mandatory condition is that the number of joints in the portion covered by the stone slabs shall be minimum and this condition can be achieved only by using the maximum possible size of stone slabs. Normally the size of stone slabs used for the purpose is 600 x 600mm or 600 x 900mm each stone slab weighing approximately 16 kg and 25 kg respectively.

The rough kotah stone slabs used for such works though are basically rough on the surface still that much roughness will not be sufficient for the stone slabs to remain in vertical position held by cement slurry.

Therefore the grip for the stone slabs has to be increased and this can easily be done by planting 12mm to 15mm nominal size stone aggregate fixed with araldite on the face of each stone slab.

A 20mm thick clear gap has to be formed between the masonry / concrete surface and the stone slabs erected in vertical position for pouring the cement slurry.

This gap can be maintained by fixing with araldite the 20mm x 20mm cover blocks made out of rich cement mortar on the four corners of the slabs and at centre.

Preparation of Cement Slurry

Cement slurry normally prepared and used on general building works with just 1½ Kgs to 2 Kgs of cement to cover an area of one sq.m. shall not be applicable for such works instead it should have thick honey like consistency. Each time only that much quantity of slurry shall be prepared which can be covered on the surface and the surface in turn would be covered with 25mm thick cement mortar base within half an hour. Slurry prepared and remained unused for more than half an hour shall be totally rejected.

Preparation of Cement Mortar

The cement mortar 1:4 (1 blended cement: 4 coarse sand) shall be prepared with cement / water duly blended as explained in above clause. Each time only that much quantity of cement mortar that can be consumed within half an hour, shall be prepared. Any quantity of cement mortar that is prepared and remains unused for more than half an hour shall be totally rejected.

Fixing Water Proofing Course

Erecting Rough Kotah Stone forming 20mm wide gap

The rough kotah stone slab duly fixed with 20mm x 20mm cover blocks and 12mm to 15mm size on the surface as explained in para (iii) above shall be erected against the masonry / concrete surface to be treated by abutting the 20mm thick cover block against the surface thus forming a clear gap of 20mm.

The stone slabs thus erected shall be supported with ballies / pipes to the scaffolding already / erected for the purpose.

The joints of stone slabs shall be temporarily closed from outside with cement mortar so that the cement slurry poured in the gap does not escape through the joints. The bottom portion of the stone slabs shall also be closed with cement mortar.

While erecting the stone slabs proper care shall be taken to see that stone slab are of uniform size. In case smaller width slabs are used it shall be ensured that these are not fixed at the corners but the same should be at the middle portion.

Another important point to noted is that one should be very careful in interlinking the Rough Kota Stone Slabs of horizontal layer of water proofing with this vertical layer of water proofing and the method of interlinking shall be strictly followed.

The Rough Kota Stone Slab shall be erected in perfect plumb and the stone slabs thus erected and fixed in position can be considered as 2nd layer of water proofing on completion.

Further lifts of Rough Kota Stone Slabs upto the full height of the masonry / concrete wall shall be erected only after filling the gap of each lift erected, with cement slurry.

Filling Cement Slurry in the gap formed by erecting Rough Kota Stone slabs.

When the first lift of stone slabs are erected and checked to be in perfect plumb, cement slurry prepared as detailed above shall be poured in the gap till the gap is filled completely.

The further filling of slurry in the second lift shall be done when the second lift of stone slabs are erected in position and thus the work on 2nd and 1st layer of the items shall be completed simultaneously till the cladding over the entire height of the wall is complete.

Thus on completion of filling cement slurry and erecting stone slabs for the entire height of the wall it can be considered that the first layer i.e. the layer of cement slurry and the second layer i.e. the layer of erecting Rough kota stone slabs is completed as per the item.

Plastering over 2nd layer with cement mortar 1:4 (1 Blended Cement: 4 Coarse Sand)

Immediately on completion of the work of cladding the entire masonry / concrete wall with Rough Kota Stone Slab the cement mortar applied over the joints shall be removed and the joints exposed.

The entire surface cladded with stone slabs shall be cleaned with water neatly to start the work of plastering.

Cement mortar 1:4 (1 blended cement: 4 coarse sand) prepared as per para (v) above for the purpose.

Care shall be taken to see that the 20mm thickness of cement plaster over the entire surface shall be maintained correctly.

The work of plastering shall be taken up immediately on completion of cladding the wall surface rather it should be a continuous process from the day of starting the erection of stone slabs till the finishing work of plastering is done.

The plastering shall be taken up from top to bottom without leaving any joint. As far as possible the joints in plaster shall be minimum, still in case a joint has to be left to continue the work on the subsequent day, cement slurry prepared as explained under para (iv) above shall be applied over the entire joint and then only the work of plastering shall be taken up.

Finishing with Neat Cement Punning

When the surface of plastering is still green, the cement slurry prepared as above shall be applied over the plastered surface and the surface shall be finished neatly to a smooth surface with specially made semi-round thapis.

The surface should show a smooth and neat finish without any undulations.

Curing & Testing

The exposed faces of the water proofing course shall be kept wet for 14 days. No back filling shall be done before expiry of 14 days from the date of completing the water proofing course from outside.

Water tank shall be filled with water to full capacity and kept under observations for at least one week to detect leakage. In addition to that the same shall be completely emptied and shall be kept in dry condition to check the leakages, seepages from external surfaces.

Water Stops

Water stops shall be in confirmation with IS -3370 Part I.

Water bars are performed strips of impermeable material which are embedded in the concrete during construction so as to span across the joint and provide a permanent watertight seal during the whole range of joint movement.

The most usual forms of water bars are strip with a longitudinal corrugation. Water bars of polyvinyl chloride (PVC) are to be used.

Fixing Water Bar

The water bar should have such shape and width that the water path through the concrete around the bar shall not be unduly short. It is important to ensure proper compaction of concrete around the water bar

Proper cover to all the reinforcements shall be maintained.

Water bars should be placed at the centre of the wall or if it is to be provided away from the centre its distance from either face of the wall shall not be less than half the width of water bar.

Contractor to provide:

The Contractor shall provide and maintain at site throughout the period of works the following at his own cost and without extra charge, the cost being held to be included in the Contract Rates :

- 1) All labour, materials, plant, equipment and temporary works required to complete and maintain the works to the satisfaction of the Engineer-In-Charge.
- 2) Lighting for night work, and also whenever and wherever required by the Engineer-In-Charge.
- 3) Temporary fences, guards, lights and protective work necessary for protection of workmen, supervisors, engineers or any other persons permitted access to the site.
- 4) All equipment, instruments and labour required by the Engineer-In-Charge for measurement of the works.
- 5) A testing room of not less than 20m² equipped with the following, and labour and materials required for carrying out tests therein :
 - i) Set of standard sieves for testing, grading of sand.
 - ii) Sieves with opening respectively of 4.75 mm, 10 mm, 20 mm and 40 mm for testing grading of aggregates.
 - iii) Balance, capacity up to 10 kg, reading to 5 gm.
 - iv) Electric Thermostat controlled oven and pans for drying of sand and aggregates.
 - v) Glass measuring flasks of ½, 1 and 2 litre capacity and graduated cylinders for testing silt content.
 - vi) Flask for determining moisture content of sand.
 - vii) Slump cone with rod for slump test.
 - viii) Compressive testing Machine for cube test.
 - ix) Minimum 24 steel moulds for 150 mm x 150 mm x 150 mm concrete test cubes. It may be necessary to provide more steel cube moulds depending upon concreting programme.
 - x) Vibrator with 25 mm dia needle for compaction of concrete in test cubes and also vibrating table.
 - xi) Work benches, shelves, desks, sinks and any other furniture and lighting as required by the Engineer-In-Charge.
 - xii) Where concrete cube testing facilities from recognized institute near the site are not available or if the size of the project is large enough or if directed by the Engineer-In-Charge, the Contractor should provide at site concrete cube testing machine of adequate capacity to be able to test concrete cubes of grades M50 and below, at his own cost.
- 6) Any of equipment not specifically mentioned above which can reasonably be held necessary for the completion and maintenance of the works to the satisfaction of the Engineer-In-Charge.

APPENDIX
GUIDELINES FOR STORAGE AND INSTALLATION OF CPVC PIPES

1 STORAGE

CPVC pipes of all sizes are packed in polyethylene packing rolls and both the ends of the packed roll are sealed with air bubble film cap in order to provide protection during handling and transportation. After packing, the whole bunch of pipes is tightened with polypropylene/HOPE strapping. Each role is then marked with size/type of the pipe, lot number and quantity. The packed pipe rolls are stored in their respective racks in properly covered storage area. Apart from providing protection during handling and transportation, the packing rolls also protect the pipe from ultra violet rays.

2 INSTALLATION GUIDELINES

- 2.1** Visually inspect pipe ends before making the joint. Use of a chamfering tool will help identify and crakes, as it will catch on to any crack.
- 2.2** Pipe may be cut quickly and efficiently by several methods. Wheel type plastic tubing cutters are preferred. Ratchet type cutter or fine tooth saw are another options. However, when using the ratchet cutter be certain to score the exterior wall by rotating the cutter blade in circular motion around the pipe. Do this before applying significant downward pressure to finalize the cut. This step leads to a square cut. In addition, make sure ratchet cutter blades are sharp. Cutting tubing as squarely as possible provides optimal bonding area within a joint.
- 2.3** Burrs and filings can prevent proper contact between the tube and fittings during the assembly, and should be removed from the outside and inside of the tube. A chamfering tool is preferred, but a pocket knife or file is also suitable for this purpose.
- 2.4** Use only CPVC cement jointing. Use CPVC cement, which is fully recommended by the manufacturer.
- 2.5** When using adhesive solution/solvent cement be certain of proper ventilation.
- 2.6** When making a join, apply a heavy, even coat of cement to the pipe end. Use the same applicator without additional cement to apply a thin coat inside the fitting socket. Too much cement can cause clogged waterways. Do not allow excess cement to puddle in the fitting and pipe assembly. This could result in a weakening of the pipe wall and possible pipe failure when the system is pressurized.
- 2.7** Rotate pipe one-quarter to one-half turn while inserting it into the fitting socket and remove the excess adhesive solution/solvent cement from the joint with clean rag.
- 2.8** When making a transition connection to metal threads, use a special transition fitting or CPVC male threaded adapter whenever possible. Do not over-torque plastic threaded connections. Hand tight plus one-half turn should be adequate.
- 2.9** Hang or strap CPVC systems loosely to allow for thermal expansion. Do not use metal straps with sharp edges that might damage the tubing.
- 2.10** CPVC stub outs for lavatories, closets and sinks are appropriate. However, on areas where there is a likelihood that movement or impact abuse will occur, metal pipe nipples may be amore appropriate stub-out material. Showerheads, tub spouts and outside still cocks are examples.
- 2.11** When connected to a gas water heater, CPVC tubing should not be located within 50 cm of the flue. For water heaters lacking reliable temperature control, this distance may be increased up to 1 m a metal nipple or flexible appliance connector should be utilized. This measure eliminates the potential for damage to plastic piping that might result from excessive radiant heat from the flue.