MAZAGON DOCK SHIPBUILDERS LIMITED
(Formerly known as Mazagon Dock Ltd.)
CIN : U35100MH1934GOI002079
(A Government of India Undertaking)
Dockyard Road, Mazagon,
Mumbai 400 010.
INDIA

Biennial Rate Contract (2025-2027) for Major Civil Works in Various buildings / Workshops in MDL Yards at Dockyard Road, Anik Chembur, Nhava, Gavhan, South Yard Annexe, Residential quarters at Dockyard Road, Vashi and Belapur

Preferred Make, General Instruction & Technical Specification

FOR CIVIL WORKS

SECTION	PERTICULARS
1.	LIST OF PREFERRED MAKE
2.	SCOPE OF WORKS
3.	GENERAL INSTRUCTIONS & CONDITIONS
4.	GENERAL
5.	EARTH WORKS
6.	MORTARS
7.	PLAIN CEMENT CONCRETE (PCC) WORKS
8.	REINFORCED CEMENT CONCRETE
9.	BRICKWORK
10.	STONE WORKS
11.	MARBLE/ GRANITE STONE WORKS
12.	WOOD WORK
13.	STEEL WORKS
14.	FINISHING WORKS
15.	FLOORING
16.	ROOFING
17.	DISMANTLING & DEMOLISHING
18.	MISCELLANEOUS
19.	ROAD WORK
20.	PILE WORK
21.	SERVICES MISCELLANEOUS WORKS
22.	ALUMINIUM WORKS
23.	WATERPROOFING WORKS
24.	SNITARY APPLICIANCES AND FITTINGS
25.	EXTERNAL DRAINAGE & SEWAGE DISPOSAL
	CONTRACTOR TO PROVIDE
	APPENDIX: GUIDELINES FOR STORAGE AND INSTALLATION OF CPVC PIPES

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.	Cement 53 Grade / 43 Grade	Gujarat Ambuja (Silicate), ACC (Suraksha), Ultra-tech, Birla Plus (Grasim), Vasavadatta (Birla Shakti)
2.	White Cement	Birla cement, JK cement, Orient
3.	Ready Mix Concrete	Ultra tech, Hella, Indiacrete , Procon
4.	AAC blocks	Ultratech, Ascolite, Siporex, Godrej & Boycee
5.	Synthetic plaster	Renovo, Ruff & Tuff, Spectrum, Oikos
6.	Putty	Birla White Putty, JK, Dr FIXIT, Asian
7.	Steel (Thermo Mechanically Treated Steel) High strength deformed bars or mild steel reinforcement (TOR-Steel)	TATA, SAIL, JSW ,RINL, Jindal, Ispat, Vizag
8.	Structural Steel sections/members/Chequered plate	TATA, SAIL, JSW ,RINL, Jindal, Ispat, Vizag
9.	Clay Bricks	Good quality locally available material approved by Engineer / Architect
10.	Vitrified/ Ceramic/Glazed Tiles/ Anti skid/Acid and alkali resistant tiles	Nitco, Kajaria, RAK, Bells, Johnson /Regency/Bells. Euro, Asian Granito, AGL
11.	Stainless Steel	Jindal/SAIL
12.	Aluminium sections	Jindal , HINDALCO, NALCO, BALCO
13.	Aluminium Composite Panels (ACP)	Alutech india, E3 panels, Aludecor, Alstone, Alex, Altobond
14.	DGU Glass	Saint gobain/Asahi
15.	Glass	Modi, Saint Gobain, Hindustan Palington, Asahi, Triveni
16.	Wood preservatives	Woodguard, PCI, Black Japan, Asian paint, Pidilite
17.	Sun control film or Frosted film	Garware, LG, 3M
18.	Stainless steel sink	Nirali , Diamond, Jindal
19.	Rubber flooring	Sandick, NORA, Responsive
20.	Modular doors & partitions	Greenlam, Merino
21.	Flush doors	Century/Anchor or equivalent
22.	Melamine polish	Asian paint, ICI, NEROLAC
23.	Panelled Doors	National, Century, Swastik, Kitply
24.	P.V.C. Doors	Sintex, Supreme, Eurostar, Ozone
25.	Fibre Reinforced Plastic (FRP) Door	Astral, Durian, Everest
26.	Gyp. board	India gypsum, National gypsum, Gypsonite

S.N.	DESCRIPTION OF MATERIAL	MAKE OF MATERIALS
27.	Vertical blinds	Vista, Mac, Universal
28.	Rockwool	Rockwool/Twiga
29.	Blinds	Hunter Douglas, Mac, Vista, Technifab, Ferrari
30.	Roller Blinds fabric	Vista, Mac, Universal
31.	Wallpaper	Arte, Marshall ,Ego ,softek, Elemento
32.	Plywoods (commercial and Marine)	Anchor , Archid , Century , Kenwood , Garnet , Samrat , Greenlam, Prince, Mayur (6mm, 9mm, 12mm, 19mm or any other thickness.
33.	Laminates (Interior works)	Formica , Greenlam , Century , Signature, Heritage , Archid , Bravia Newmica, Kitmica
34.	Laminates (Exterior works)	Greenlam , Stylam, Merinon EWC, Fundermax
35.	Block board	Anchor, Century, Archid, Green, Marino, Multiply
36.	Soft Board (pin up board)	Jolly board, Western India plywood.
37.	Pre-Laminated Particle boards	SRB boards, Bison, Elite, Action TESA, Century. Krifor (12mm, 19mm or any other thickness.
38.	Veneer	Anchor , URO, Century, Greenlam
39.	Adhesives	Fevicol (SH), Mowicoll, Mahacol, Araldite , Astral, Super bond
40.	Screws	GKW, Mettle fold
41.	Brass hinges	Magnum, Reliance, Punit heavy duty, Ace Hardware.
42.	Hardware	DORMA, Hafele, Hettich, Blum, Shalimar, Everite, Reliance, Ace Hardware, Kich
a)	Stainless Steel powder coated hinges	Palladium/Haffle/Kich/DORMA/Hettich
b)	Mortise lock - Brass or Stainless steel mortise lock of 6 lever	Hafele , DORMA, Hettich, Kich, Godrej, Ultra, Atomberg, QUBO, Kich
c)	Tower bolts - Stainless steel and brass	Hafele / DORMA/Hettich/Kich
d)	Door closers	Hafele / DORMA/Hettich/Kich, Efficient gazets, Everite Hyper.
e)	Floor spring	Hafele / DORMA/Hettich
f)	Drawer shutter lock	Godrej /Vijayan - (3 set of keys).
g)	Ball catch	Magnetic (M-2) / Brass.
h)	Door lock / handles	4-C ACME, Golden, Godrej, Ultra, Atomberg, QUBO, Kich
43.	Wood preservatives	Woodguard, PCI, Black Japan, Asian paint, Pidilite
44.	Sun control film or Frosted film	Garware, LG, 3M
45.	Stainless steel sink	Nirali , Diamond, Jindal
46.	Paint (luster, emulsion)	Burger, Nerolac, Asian, Dulux, Tractor.
47.	PU paint	Nerolac/ ICI/ Asian make.
48.	Epoxy paint	Epoxy/Dulux/Berger
49.	Texture Paint	Vista, Asian, Oikos, Acro , Surfa
50.	Water proofing material / solution/compound.	Fosroc, Dr, Fixit, Sika. Roff , Sunanda, Krishna Conchem, Asian, Mapei, MYK arment
51.	Red Oxide	Asian, Berger, Nerolac
52.	Polymer, PMM. & Polymer	Fosroc, Dr, Fixit, Sika. Roff , Sunanda, Krishna

S.N.	DESCRIPTION OF MATERIAL	MAKE OF MATERIALS
	Modified Crack filler	Conchem, Asian, Mapei, acro- chem, MYK arment
53.	Composite marble	Kalinga stone, AGL Classic Marbles, Johnson
54.	Calcium Silicate board / tile	Ramco Hilux, wedge india, Galaxy Refractories
55.	High density cement fibre board/ Cement board	Everest, Visaka
56.	Acrylic Exterior paint	Asian Ultra/Nitcotex / Sandtex / Berger Weathershield
57.	Iron monjires and brass fittings	Enox, Archis, doorset, ozone, dorma,
58.	C P plumbing Fittings / Toilet Accessories	Jaquar, Hindustan, Plumber, Asian Essess, parry ware, Bells, Cera
59.	Vitreous sanitary ware (ISI mark)	Jaquar, Hindustan, Plumber, Asian Essess, parry ware, Bells, Cera
60.	Seats & Covers solid (W.C.)	Jaquar, Hindustan, Plumber, Asian Essess, parry ware, Bells, Cera
61.	PVC Low level flushing cisterns	Jaquar , Parry ware, Hindustan, Cera
62.	Concealed Cistern with flush plate	Jaquar, Hindustan, Plumber, Asian Essess, parry ware
63.	Sanitary Fixture	Jaquar, Hindustan, Plumber, Asian Essess, parry ware
64.	Ball & wheel valves	Zoloto, LEADER, AUDCO
65.	UPVC Pipes (S/W/R Pipes)	Supreme, Finolex, Prince
66.	G.I. Pipes & fittings	Tata, Zenith, JINDAL, SWASTIK
67.	S.W. Pipes / Fittings & Gully traps	Perfect, Trimurti
68.	C.I. Manhole Cover	RIF, BIC, Neco
69.	R.C.C. Pipes	Indian Hume pipe
70.	PVC Fittings (Moulded)	Supreme, Finolex, Prince
71.	Non-return valve	Intervalve
72.	Stoneware Pipe and fittings	Trimurti, Perfect Potters, Bharat
73.	Stoneware Pipe and fittings	Trimurti. Perfect Potters, Bharat
74.	For Structural Repair works	Fosroc, Sunanda, BSF, Krishna conchem or Dr F, Fixit, Equivalent as approved by MDL
75.	FRP Manhole cover with frame	Everlast, Fibrocast
76.	NP 2 Class Hume Pipe	Locally available (Vishwa/Bharat/Indian pipes/Arihant)
77.	CPVC pipes	Astral, Supreme, Finolex , Prince
78.	Anchor fastener	Hilti, Fisher
79.	Polyethylene tank	Sintex, Prince, Astral
80.	Furniture	Godrej, Burosys, Space wood, Danco, Monarch, Duri
81.	Galvalume/GI roof/cladding shee	PHENIX Infra, Kingspan, LLOYD Insulations (I) Ltd, JSW, Jindal, tata
82.	Polycarbonate sheets	GE, Lexan, Danpalon, polygala

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 INSTRUCTIONS, CONDITIONS & SCOPE OF WORKS APPLICABLE FOR BRC RATE CONTRACT (2025- 27) FOR CIVIL WORKS.

1) Scope of work

1.1. Mazagon Dock Shipbuilder's Limited has office buildings/workshops/store sheds / marine structures/internal roads and other infrastructure located in the various yard viz. North Yard, South Yard, East Yard, Alcock Yard, Anik Chembur Yard, Sewree Yard, Gavan Yard, Nhava Yard, Naval Yard at Colaba and Residential quarters in Mumbai/Navi Mumbai.

1.2. Various works of new construction/repair/renovation/maintenance nature needs to be carried out in the above structures in order to maintain a high level of working efficiency and aesthetic appearance in the yard.

1.3. The Scope of work required to be carried out have been broadly categorized in to Civil, Structural repair, Renovation and interior work, comprising of excavation and disposal, concrete work, brick/stone masonry work, plastering work, restorative repair work, wood work, external/internal painting work, roofing and sheeting work, plumbing/sanitary and pipeline work, waterproofing and flooring work, structural steel work, structural repair work, partition work, glazing work, false ceiling work, Bituminous/concrete road work etc.

2) GENERAL INSTRUCTIONS

2.1. The Bill of Quantities must be read with the Conditions of Contract, Drawings and the Specifications and the Contractor shall be deemed to have examined the Drawings, Specifications, Conditions of Contract and to have visited the Site and acquainted himself with the Works to be done and the way in which they are to be carried out and all factors affecting the execution of the Works and the Costs thereof including temporary works if required to complete the works.

2.2. Notwithstanding that the work has been sectionalised, every part of it shall be deemed to be supplementary to and complementary of every other part and shall be read with it or into it so far as it may be practicable to do so.

2.3. General directions and descriptions of work and materials given in the Specification are not necessarily repeated in the Bill of Quantities. The Specification shall therefore be referred to for the true intent of the Bill of Quantities.

2.4. All work shall be measured net as it is finished and/or fixed in the Works and no allowance shall be made for wastage notwithstanding any general or local custom. Any items of work not covered in the Preamble shall be measured as per specifications for works methods laid down in IS-1200 and/or other Indian Standards or as decided by the Engineer.

2.5. The rates set down against the items are to be the full inclusive value of the finished work excluding GST, shown on the Drawing and/or described in the Specifications or which can reasonably be inferred there from and to cover the cost of every description of Temporary Works executed or used in connection therewith (except those items in respect of which specific provision has been separately made in this Bill of Quantities) and all the Contractor's obligations

under the Contract including testing, giving samples and all matters and things necessary for the proper execution, completion and maintenance of the Works. No claim for additional payment shall be allowed for any error or misunderstanding by the Contractor of the work involved.

2.6. The rates shall include (except where separate items are given) for the provision and operation of the following items, for compliance with the Condition of Contracts and specifications:

a. Supervision and labour for the Works;
b. All materials, installation/erection, handling and transportation;
c. All Contractor's Equipment;
d. All testing, commissioning, insurance, maintenance, security, welfare facilities, overheads and profit and every incidental and contingent costs and charges whatsoever including;
e. All temporary fencing, watching, lighting, sanitary accommodation, general security arrangements, welfare facilities and first aid provision;
f. Provision and maintenance of Contractor's Site offices, cabins, maintenance and storage areas;
g. All necessary temporary services including fresh water, compressed air lines, electrical cabling and switchgear, telephone.
h. The maintenance of all Contractor's services;
i. All insurances for the Works;
j. Maintenance & restoration of all permanent roadways, access roads etc utilised by the Contractor, including all necessary traffic management, if damaged or spoilt by the Contractor
k. The protection from damage and making good any damage to existing shipyard services of any description;
l. Allow for complying with all environmental aspects as specified

2.7. The Specifications and the various Sections in the Bill of Quantities are intended to cover the supply of all Materials and Plant and the execution of all works necessary to complete the Works. Should there be any details of Construction or Materials or Plant which have not been referred to in the Specifications or in the Bill of Quantities, but the necessity for which may reasonably be implied or inferred there from, or which are usual, or essential to the completion of all works in all trades, the same shall be deemed to be included in the rates in the Bill of Quantities. The rates shall cover the items as described in the Bill of Quantities and if there is inconsistency between the Bill of Quantities or Specifications, the description in the Bill of quantities shall prevail.

2.8. Contractor shall provide lifting arrangement for carrying construction materials at any height of the buildings/ sheds/ workshops at their own cost.

2.9. The rates of all the items are inclusive of any lead and lift within MDL premises even if specified in bill of quantities.

2.10. DISMANTLING AND DEMOLITION

a) The rates for dismantling /demolition shall include dismantling / breaking of super structure work such as Brick walls, wooden truss with roofing above, Structural steel supports in length of 1m, such as columns /beams, RC members with reinforcement, staircases, railing , doors, windows, grills. Wire mesh grills services pipe networking, PVC storage tanks etc. and foundation work with pneumatic jack hammers or any other approved method, and

removing from Site by carting away to disposal outside MDL's premises to Municipal approved dumping grounds.

b) The rates for demolition and dismantling shall include all necessary excavation, breaking of foundation etc. dewatering of excavation if necessary, loading all dismantled / demolished materials and removing from Site by carting away to disposal.

c) Dismantled wooden & ferrous and non ferrous material shall be stacked properly at the designated scrap bins in MDL yards. No separate payment for this work will be made but the cost of the same is deemed to be included in the rates of work.

d) In case of Dismantling of steel or reinforcement which are embedded in RCC, the Contractor has to remove the concrete from the steel or reinforcement and the cost towards the same are included in the rates. Dismantled concrete to be disposed-off and separated reinforcement bars or steel to be stacked at designated MS Scrap bins in MDL yard. MS Structures to be cut in 1m parts and shall be stacked at designated MS Scrap bins in MDL yard.

2.11. TEMPORARY WORKS- Normal **dewatering** if required for area under construction to enable excavation in the dry condition is inclusive under excavation item of work. If, heavy dewatering is to be done then shall be paid separately and the rate shall include for mobilization and fixing in position of all pumps, pipelines, all supporting arrangements, excavation of any sumps and drains for final stage of dewatering, electrical connections.

3) General Conditions:

3.1. Rate Contract is only an agreement between MDL and Contractor for works at specified prices and terms and conditions (as incorporated in the agreement) during the period covered by the Rate contract.

3.2. The period of Rate contract is Biennial effective from the dates mentioned in the contract.

3.3. No Quantity is mentioned, nor is any minimum drawable quantity guaranteed in the Rate Contract.

3.4. The rates are finalized for the various items to be executed during the contractual period.

3.5. The Rate contract shall be just a standing order and will come into effect when a Confirmatory order for any specific work is placed by MDL during the currency of the Rate contract.

3.6. Work requirements may be placed upto the last date of the Currency of the Rate contract but not after expiry of the Rate Contract.

3.7. The Rate contract will remain alive for purpose of delivery for all confirmatory orders issued during the currency of the Rate Contract until they have been completed.

3.8. On finalization of the Rate Contract, the Successful bidder (s) shall have to mobilise their resources including police verification report of adequate number of their employees & key personnel.

3.9. When individual Confirmatory Purchase Order (s) are released by MDL under the Rate Contract from time-to-time irrespective of number of orders and value of the orders, the Contractor (s) shall mobilise and commence the work at site on priority and not more than 2 weeks from the date of placement of such order (s).

3.10. The anticipated Cumulative Limiting Value of works to be ordered under the Biennial Parallel Rate Contract is about Rs. 20cr+GST during the tenure of 2 years of the Rate contract. The amount indicated is just to give an idea to the bidders about the likely volume of works to be executed under this BRC and not a guarantee of work to be awarded for the total volume by MDL. Bidder shall not be entitled to any compensation on account of variation in the volume of work.

3.11. Site Logistics:

a) Contractor shall make his own arrangement if necessary for Porta-cabin for their site personnel along with necessary furniture, COMPUTER, PRINTERS, storage cupboards etc. at his own cost.
b) Contractor shall make godown for if necessary storage of cement and construction material at his own cost.

The materials at a) and b) above should be dismantled and taken back by the Contractor on completion of the work at his own cost.

3.12. Contractor's Barricades:

a) Contractor shall arrange to barricade the area where debris and construction materials are stored with relevant board indicating name of Contractor, work and its duration. Contractor shall arrange to clear the debris on regular basis and keep the surrounding clean at all times.
b) Contractor shall erect and maintain at his own cost barricades required in connection with his operation to guard or protect the storage and site offices etc.
c) The Contractor has to provide Sign board at site with detailed name of project, name of client and name of Contractor at the entrance of the site and shall be clearly visible without any extra cost to MDL.
d) The Contractor shall also comply with the provisions of Environment Protection Act with regard to air, water & noise pollution without any extra cost to MDL.

3. GENERAL:

3.1. 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.

3.2. 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.

3.3. 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.

3.4. 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.

3.5. 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.

3.6. 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.

3.7. 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.

3.8. Workmen and Staff

The Contractor shall ensure that they employs 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.

3.9. 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.

3.10. 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.

3.11. 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 (1st 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

PILE WORK

S. No	IS Code No	Particulars
1	2911	Code of practice for design and construction of pile foundation (Part-I & IV). .

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 (3rd revision) Reaffirmed 1992
2	2212-1991	Code of practice for brick work (1st revision)
3	1905-1980	Code of Practice for structural safety of buildings - Masonry wall
4	2116-1980	Specification for sand for masonry mortars (1st 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 (3rd revision)
2	1200 (Part XII)1973	Wood work and joinery (2nd revision) (Amendment 1) (Reaffirmed 1992)
3	2202 (Part I &II) 1991	Specification for wooden flush door shutters (solid core type) plywood face panels (5th revision) (Amendments 2)
4	3087-1985	Specification for wood particle boards (medium density) for general purposes (1st 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 (2nd revision) (Amendments 2) (Reaffirmed 1991)
2	806-1968	Code of practice for use of steel tubes in general building construction (1st 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 (1st revision) (Amendments 2) (Reaffirmed 1992)
6	818-1968	Code of practice for safety and healthy requirements in electric and gas welding and cutting operations (1st 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 (4th revision)

FLOORING

S. No	IS Code No	Particulars
1	777-1988	Specification for glazed earthenware wall tiles (2nd 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) (3rd revision) (Amendment 1) (Reaffirmed 1992)
4	2571-1970	Code of practice for laying in situ cement concrete flooring (1st revision) (Reaffirmed 1991)
5	8042-1989	Specification for white Portland cement (2nd 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) (2nd Revision)
2	109-1968	Ready mixed paint, brushing, priming plaster to Indian Standard colour No.361.631 white and off white (Reaffirmed 1993) (1st 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) (1st Revision)
6	1200-1976 (Part XII)	Method of measurements of building and civil engineering works: Part XII – Plastering and pointing (Reaffirmed 1992) (3rd 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 (5th Revision)
8	1200-1987	Methods of measurements of building and civil engineering

	(Part XV)	works: Part XV – Painting, polishing, varnishing etc. (Reaffirmed 1992) (4th Revision)
9	2932-1994	Enamel, synthetic, exterior (a) undercoating (b) Finishing (2nd Revision)
10	5410-1992	Cement paint (1st 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) (3rd 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

4. EARTH WORKS:

4.1. 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.

4.2. Earthwork in Filling

Material

All fill material, whether out of surplus material from excavations or brought from any other source outside shall be subject to prior approval of the Engineer-In-Charge. The source of outside material shall also be approved by the Engineer-In-Charge.

All fill material shall be free from vegetable refuse and other organic matter, marine clay, black cotton soil, injurious salt and other material considered unsuitable by the Engineer-In-Charge.

All large clods shall be broken. Where the material is mostly rock, boulders shall be broken into pieces not larger than 15 cm. size, mixed with properly graded fine material like murum etc.

Filling over areas (site gradation) / roads /pathways

Any filling work shall be started by the Contractor only after recording existing ground levels jointly with the Engineer-In-Charge.

Formation width and side slopes shall be as per drawings or as directed by the Engineer-In-Charge.

All banks shall be thrown up in layers of not more than 200 mm. in depth over the whole width between the surfaces of side slopes slightly concave in section, so as to retain water for subsidence. When on side long ground, the whole area of the bank of the slope shall be benched out or stepped so as to prevent material from slipping.

Each layer of filling shall be watered, rammed and thoroughly consolidated to the satisfaction of the Engineer-In-Charge and to obtain the density stipulated in the item. Compaction shall be done by mechanical compaction machines unless otherwise allowed by the Engineer-In-Charge. The normal allowance for subsidence or settlement shall be 5 cm. per 30 cm. depth of bank. This may be increased or decreased by the Engineer-In-Charge depending on the nature of the filling material used. Necessary field and laboratory tests shall be carried out by the Contractor to demonstrate that the specified density at moisture content is obtained in the fill at different stages of filling and after the fill to the entire height is completed, if so specifically called for.

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

If rock obtained from excavation (which may be used for filling and levelling to indicated grades without further breaking) is permitted for filling by the Engineer-In-Charge, filling shall be done in layers not exceeding 50cm approximately. After rock filling to the approximate level, the voids in the rocks shall be filled with finer materials such as earth, broken stone etc. and the area shall be flooded with water so that the finer materials fill up the voids. Care shall be taken to ensure that the finer fill material does not get washed out. Over the layer so filled, a 100 mm. thick mixed layer of broken material and earth shall be laid and consolidation carried out by a 10 -12 tonne roller. No less than twelve passes of the roller shall be accepted before subsequent similar operations are taken-up.

After the filling layers are consolidated, the surface and slopes shall be trimmed to the levels, formation width and to even and uniform gradient as per requirement.

Plinth filling

Plinth filling shall be carried out with approved material in layers not exceeding 15cm. watered and compacted with mechanical compaction machines such as pneumatic tampers, rammers etc. The Engineer-In-Charge may, however, permit manual compaction by hand tampers in case he is satisfied that mechanical compaction is not possible. When filling reaches the finished level, the surface shall be flooded with water, unless otherwise directed, for at least 24 hours, allowed to dry and then the surface again compacted as specified above to avoid settlements at a later stage. The finalised level of the filling shall be trimmed to the level/slope as directed / specified.

Where specifically specified, compaction of the plinth fill shall be carried out by means of 8 -10 tonne approved type of roller. In this case fill layers can be upto a maximum of 300 mm. As rolling proceeds water sprinkling shall be done to assist consolidation. Water shall not be sprinkled in case of sandy fill. Rolling shall commence from the outer edge and progress towards the centre and continue until compaction to the satisfaction of the Engineer-In-Charge or provides density not less than that specified in the item but in no case less than 10 passes of the roller shall be accepted for each layer. The compacted surface shall be properly shaped, trimmed and consolidated to an even and uniform gradient. All soft spots shall be excavated and filled and consolidated.

At places back filling shall be carried out with local sand if directed by the Engineer-In-Charge. The sand used shall be clean, medium grained and free from impurities. The filled-in-sand shall be kept flooded with water for 24 hours to ensure maximum consolidation. The surface of the consolidated sand shall be dressed to required level or slope. Construction of floors or other structures on sand fill shall not be started until the Engineer-In-Charge has inspected and approved the fill.

4.3. Anti-termite Treatment:

Material

Chemical to be used for treatment shall be from the approved specialised agencies, proportion in accordance with IS 6313 (Part-II) subject to confirmation of the Engineer-In-Charge. Graduated containers shall be used for dilution of chemicals with water in the required proportion to achieve the desired percentages of concentration.

Safety Precaution

All chemical used for treatment shall be clearly labelled in properly sealed form, and kept securely closed in stores. Mixing is to be done with utmost care as per manufacturer's instructions. Chemicals are not allowed to contaminate with drinking water.

Application

Chemical treatment of soils for the protection of buildings from attack of subterranean termites shall be done as per IS:6313 (Part-II). Proper check should be kept to ensure that the specified quantity of chemical is used for the required area during the operations.

Time of application of Soil treatment should start when foundation trenches and pits are ready to take bed concrete/ levelling course in foundations. Laying of bed concrete / levelling course should start when the chemical emulsion has been absorbed by the soil and the surface is quite dry. Treatment should not be carried out when it is raining or soil is wet with rain or sub- soil water. Treatment to the surface of earth filling within plinth shall also be done in the same manner before laying sub-grade for flooring. Treatment along the external perimeter of building shall be carried out after completion of the building by providing 30 mm deep holes in the soil with iron rods at intervals of about 15 cm unless otherwise specified by the manufacturer.

Disturbance

The treated soil barrier shall not be disturbed. If for some reasons the treated soil barriers are disturbed, immediate steps shall be taken to restore the continuity and completeness of the barrier system.

The contractor shall provide 10 years guarantee bond to cover defects liability period.

4.4. Dry rubble soling

Materials

Supply of rubble stone of the specified type and size and shall be obtained from approved sources only and transporting to the site of work including all loads, lifts, handling, transportation etc.

The rubble of the specified type of stones shall be hard, tough, sound, durable, dense, clean of close texture and free from unsound material, cracks, decay and weathering. Their water absorption shall be as low as possible but not more than 5 percent.

The shape of the stones shall be as regular as can be obtained by quarrying without attempt at shaping or dressing. They shall be sufficiently flat bedded. The stone shall be broken with the smallest dimensions equal to the specified thickness of soling. The length and breadth should not generally exceed twice its thickness. Before starting collection, the contractor shall get a sample conforming to the required quality, shape and size approved by the Engineer-In-Charge.

Laying Soling

The item provides for the labour for laying soling of specified type of stones in the specified thickness including preparing the sub-grade to proper sections by scrapping, dressing, compaction, etc. and hand packing the rubble chips to the required line, curve and grade and section.

The rubble supplied shall be laid with the largest face downwards and in contact with each other. The stones shall break joint as far as possible. The full thickness of the soling shall generally be made with one stone only. Unless otherwise provided in the plans or directed by the Engineer-In-Charge, the width of the soling shall be 30cm more than that of the metal above.

As the laying of rubble advances the soling shall be hand packed by wedging and packing with 80mm metal collected for the purpose in the joints of the soling and driving them by hammers in place so as to fill the voids as completely as possible. This operation of hand packing shall follow the rubble laying closely. The soling shall be laid and hand packed true to grade and section and these shall be often checked by boning rods, template boards and fish lines, etc. The grades sections etc. of the soling shall correspond to those of the surfacing coming on it.

The soling thus laid shall be finished by knocking out projecting stones and filling depressions by chips to come up to the grade and camber.

4.5. Low density polyethylene (LDPE) sheets:

Materials

LDPE Sheets of approved quality and thickness as mentioned in the item description or as shown on the drawing shall be used.

Laying

A separation membrane to be used between the concrete floor and the sub-base shall be unless otherwise specified impermeable plastic sheeting of 150 micron thick laid in flat without creases. Before placing the LDPE sheet, the sub-base shall be prepared to the correct line and level, swept clean of all the extraneous material using air compressor. Whenever overlap of LDPE sheet is necessary the same shall be at least 300mm and any damaged sheeting shall be replaced at Contractor's expense.

4.6. Damp Proof Course

Material

Cement concrete shall consist of specified proportion and thickness. Cement, sand, aggregate and water etc. shall be as specified under Mortars- under relevant clauses as applicable. Hot bitumen shall be of approved quality and conforming to IS: 3117 / IS: 3037. Integral cement waterproofing compound or its equivalent to be used shall conform to IS 2645. It shall be from approved standard manufacturers and shall be approved by the Engineer-In-Charge.

Laying

Cement concrete layer of specified proportion and thickness shall be laid. The surface of brick / concrete shall be levelled and prepared before laying the cement concrete. Edge of damp proof course shall be straight, even and vertical. Side shuttering shall be strong and properly fixed. The concrete mix shall be of workable consistency and shall be tamped thoroughly to make a dense mix. There shall be no construction joint in the damp proof course.

Curing

Damp proof course shall be cured for at least seven days, after which it shall be allowed to dry.

Application of Hot Bitumen

Hot bitumen in specified quantity shall be applied over the dried up surface of cement concrete properly cleaned with brushes and finally with a piece of cloth soaked in kerosene oil. The hot bitumen shall be applied uniformly all over, so that no blank spaces are left anywhere.

Waterproofing Agent / Ingredients

Waterproofing agent / ingredients of approved quality shall be added to the concrete mix in accordance with the manufacturer's specification subject to approval of the Engineer-In-Charge.

5. MORTARS:

5.1. 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.

5.2. 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.

5.3. 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 H_2So_4. 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/1
ii)	Inorganic	IS 3025 (Part 18)	3000 mg/1
iii)	Sulphates (as SO3)	IS 3025 (Part 24)	400 mg/1
iv)	Chlorides(as Cl)	IS 3025 (Part 32)	2000 mg/1 for concrete not consisting embedded steel & 500 mg/1 for reinforced concrete work
v)	Suspended matters	IS 3025 (Part 17)	2000 mg/1

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.

5.4. 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.

5.5. 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.

5.6. POLYMER MODIFIED MORTAR

The surface shall be cleaned of all dust and loose material with the help of vacuum cleaner and made wet to receive the bond coat .The bonding coat shall be in the proportion of 1:1 or 1:1.5 of cement and polymer.

The quantity by weight of polymer, cement and sand for preparation of polymer mortar shall be checked

Acrylic Polymer	:	1Kg
Cement	:	5Kg
Quartz	:	15Kg
Water	:	1 to 1.5 litres depending on the consistency

(Design mixed quartz sand shall be used).Polymer to be used shall be tested for physical and chemical properties)

The mortar shall be mixed in a mixer and the bonding coat shall be applied only when the mix is ready. The mortar shall be applied by pressing hard and each layer of 10mm shall be compacted with hand vibrator. The mortar shall be applied to match the existing surface and refuse material should not be used again unless mixed with additional quantity of polymer.

No bonding coat is needed if the 2nd layer of mortar is applied within 4 hours. Curing shall be done by sprinkling after 48 hours. No direct splashing of water shall be permitted.

5.7. The material used shall be as per specification and the contractor shall use only the material so approved.

5.8. The items to be used shall comply with all requirements as specified in and the material purchased shall be in the original manufacturer's sealed manner.

5.9. Mortar mixes

5.10. Mix polymer components in clean container free of harmful residue of foreign particles.

5.11. Temperature from preparation of polymer mortar to application should be between 0 to 40 degree centigrade, otherwise as recommended by manufacturer.

5.12. Thoroughly blend polymer with a mechanical mixer to uniform and homogeneous mixture.

5.13. The proportion of mixing the polymer for modification shall be decided by the use of the modified mortar. For use in cover core replacement or incase of sections replacement the percent of polymer can be limited to 15%. In case sand used for polymer modification contain silt or clay beyond 3%, then to be checked for silt content.

5.14. Polymer Modified Mortar application:- Modified mortar shall be prepared by first mixing all dry components in dry state. Mix required quantity of polymer with water as per manufacturer's specification. Mix the dry system and polymer and water mixture. Mix thoroughly by workable mix. For 1 bag of cement required quantity of polymer shall be used given in table and 3 part of river sand by volumetric.

5.15. Apply polymer -modified mortar to concrete surface by hand packing. Thickness shall be within the limits instructed by the Engineer-Incharge. Additional layers shall be applied to build up the damaged concrete section complete in line and level.

5.16. Work polymer modified mortar into place and consolidate thoroughly so that all contact surfaces are wet by the mortar and entrained air is reduced to the level recommended by manufacturer.

5.17. Finish surface of polymer modified mortar to texture, color, and smoothness required for the specific application. This mortar coat should be finished by application of plain cement mortar in 1:3 using 53-grade cement. No water curing shall be applied to polymer modified mortar surface. However over coat of plain cement mortar shall be cured with water as required after 12 Hrs.

5.18. Upon completion of finishing operations, allow mortar to cure in accordance with normal curing practices for polymer modified mortars.

5.19. Cleanup

5.20. Protect concrete surfaces, beyond limits of surface receiving polymer-modified mortar, against spillage.

5.21. Safety - Polymer materials may be skin irritants or sensitizes to many people. Accordingly, advise applicators to avoid contact with eyes and skin, inhalation of vapours, and ingestion. Make protective and safety equipments available on site. Read all label warnings by manufacturer. Make application in accordance with applicable safety laws.

5.22. CURING

5.23. All polymer treated surfaces can either be immediately covered with plain cement mortar and then cured after 12 hours or the surfaces can be left to naturally cure without sprinkling water for two days and then covered with plaster.

5.24. All plastered surfaces shall be water cured for seven days with the first two days the curing being done every five to six hours. When the atmospheric temperature of the site exceeds 40 degree Celsius then curing shall be resorted to as many times as required to keep the surface moist or to ensure the mortar temperature does not rise.

5.25. Measurement of PMM work

5.26. All polymer Modified Mortar works shall be measured in Kg

5.27. Testing procedure for adequacy for infrastructure works / projects

5.28. For all projects this testing is mandatory testing of P.M.M used for the contractor shall test this work at site for air entrainment. Mix should be tested the first time before usage to ensure that air entrained is below 5%. If the value is above 5%, proper modification in the mix design shall be incorporated. Subsequently Air entrainment test shall be done for every 50sqmt of PMM work.

5.29. 1Post repair performance testing shall include
(i) Integrity testing for repaired surface.
(ii) Surface strength
(iii) Corrosion Potential Test

Testing shall be done at the rate of 1 location for every 10 location except CP, which shall be max 4 tests for every project.

5.30. Testing shall be done free of cost by the contractor and shall not raise any bill to the client. The test result if unacceptable shall mean rejection of the area repaired and will require repairs again.

6. PLAIN CEMENT CONCRETE (PCC) WORKS:

6.1. Cement

Cement shall be as specified under –Mortars specifications.

6.2. Aggregate

6.2.1. 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.

6.2.2. Fine Aggregates

Fine aggregates shall be as specified under –Mortars specifications.

6.2.3. Water

Water shall be as specified under –Mortars specifications.

6.2.4. Fly Ash :

Fly ash shall be as specified under -Mortars specifications.

6.2.5. Admixtures :

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

6.2.6. 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.

6.3. 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).

6.4. 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 upto 0.1 sq.m, volume occupied by pipes, conduits, sheathing, small voids etc.

7. REINFORCED CEMENT CONCRETE:

7.1. Cement

Cement shall be as specified under - Mortars specifications.

7.2. Coarse Aggregate

Coarse Aggregates shall be as specified under- Mortars specifications.

7.3. Fine Aggregate

Fine aggregates shall be as specified under- Mortars specifications.

7.4. Water

Water shall be as specified under –Mortars specifications.

7.5. Fly Ash :

Fly ash shall be as specified under –Mortars specifications.

7.6. Admixtures

7.6.1. General :

Admixtures if permitted shall comply with IS 9108 Concrete admixtures are proprietary items of manufacturer and shall be obtained from established /approved manufacturers.

Admixtures should not impair durability of concrete nor combine with the constituent to form harmful compounds nor increase the risk of corrosion of reinforcement.

The workability, compressive strength and slump with and without use of admixtures shall be established during the trial mixes prior to use of admixtures.

The relative density of liquid admixture shall be checked for each drum containing admixtures and compared with the specified value before acceptance.

The chloride content of admixtures shall be independently tested for each batch before acceptance.

If two or more admixtures are used simultaneously in the same concrete mix, data shall be obtained to assess their interaction and to ensure their compatibility.

The Contractor shall provide the following information concerning each admixture after using the same from the manufacturer:

Normal dosage and detrimental effects, if any, of under dosage and over dosage.
The chemical names of the main ingredients in the admixtures.
The chloride content, if any, expressed as a percentage by the weight of the admixture.
Values of dry material content, ash content and relative density of the admixture which can be used for uniformity tests.
Whether or not the admixture leads to the entrainment of air when used as per the manufacturer's recommended dosage and of so to required extent.
Where two or more admixtures are proposed to be used on any one mix, confirmation as to their compatibility.

Assurance with documentary evidence to show that there would be no increase in risks of corrosion of the reinforcement or other embedment as a result of using the admixture.

In addition the following conditions also shall be satisfied:

"Plasticizers" and "super-plasticizers" shall meet the requirements indicated for "water reducing admixtures".

Except where resistance to freezing and thawing and to disruptive action of de-icing salts is necessary, the air content of freshly mixed concrete in accordance with the pressure method given in IS 1199 shall be not more than 2% higher than that of the corresponding control mix and in any case not more than 3% of the test mix.

The chloride content of the admixture shall not exceed 0.2% when tested in accordance with IS 6925. In addition, the maximum permissible limit of chloride content of all the constituents of concrete as indicated in IS 456:2000 shall also be observed.

Uniformity tests on the admixtures are essential to compare qualitatively the composition of different samples taken from batch to batch or from the same batch of different items.

The tests that shall be performed with permissible variations in the same are indicated below:

Dry material content : to be within 3% and 5% of liquid and solid admixtures respectively of the value stated by the manufacturer.

Ash content: to be within 1% of the value stated by the manufacturer.

Relative density (liquid admixtures) : to be within 2% of the value stated by the manufacturer.

All tests relating to the admixtures shall be conducted periodically as decided by the Engineer-In-Charge at an independent laboratory and compared with the data given by the manufacturer.

7.6.2. Material Admixtures

Pozzolana

Pozzolonic materials conforming to IS 3812 may be used with the permission of the Engineer-In-Charge provided uniform blending with cement is ensured.

Fly ash (Pulverized fuel ash)

Fly ash conforming to Grade 1 of IS 3812 may be used as part of replacement of Ordinary Portland cement provided uniform blending with cement is ensured.

Silica fume

Silica fume conforming to standard acceptable to the Engineer-In-Charge may be used as part replacement of cement provided uniform blending with cement is ensured.

Rice husk ash

Rice husk ash giving required performance and uniformity characteristics may be used with the approval of the Engineer-In-Charge.

Metakoline

Metakoline having fineness between 700 to 900sq.m per kg may be used as Pozzolonic material in concrete.

Ground granulated blast furnace slag (GBSS)

Ground granulated blast furnace slag obtained by grinding granulated blast furnace slag conforming to IS 12089 may be used as part replacement of Ordinary Portland cement provided uniform blending with cement is ensured.

7.7. Placing of Concrete – (Plain & Reinforced)

Grades of Concrete

Various grades of concrete shall be as per **IS 456 - 2000 (latest)** with specified characteristic compressive strength against these grades in accordance with Table 2 in the said IS. In the grade designation, letter **'M'** refers to the mix and the number to the specified characteristic compressive strength of 15 cm. cube at 28 days expressed in N/mm^2. The characteristic strength is defined as the strength of material below which not more than 5 percent of the test results are expected to fall.

The mix shall be designed to produce the grade of concrete having the required workability and a characteristic strength not less than appropriate values given in Table 2 of IS 456:2000. The target mean strength of concrete mix should be equal to the characteristic strength plus 1.65 times the standard deviation.

Design Mix Concrete

All RC work shall be in "Design Mix Concrete" only. The Contractor shall make all the necessary tests from approved authorized laboratories like VJTI, IIT, Sardar Patel College, etc. to determine for each grade of concrete, the proportions of various ingredients by weight to arrive at the desired design mix to the satisfaction of the Engineer-In-Charge. Such mix will be known as the "declared mix". No deviation from the "declared mix" will be permitted without the approval of the Engineer-In-Charge. Approval by the Engineer-In-Charge to such "declared mix" shall not relieve the Contractor of his responsibility to use in the Works at all times only concrete as specified in the relevant drawings.
The Contractor shall be entirely responsible for design of concrete mixes of the specified performance to suit the degree of workability and characteristic strengths required for the various parts of the Works.
Concrete shall meet with the strength requirements and minimum cementations material, maximum w/c ratio as indicated in TABLE 5 of IS 456:2000 hereinafter unless specifically stated otherwise.
Alternative mixes may be designed by the Contractor for use in both thin and narrow sections and thick sections. Special mixes using finer aggregates may be designed by him for in filling pockets and narrow spaces and for regions of congested reinforcement.

Nominal Mix Concrete

Nominal mix concrete may be allowed by the Engineer-In-Charge at his discretion. The proportions of materials shall be in accordance with Table 9 of IS 456-2000. The relevant details at a glance are indicated in given below in Table 4.

TABLE - 4

Grade of Concrete	Total quantity of dry aggregates by Mass per 50kg of Cement, to be taken as the sum of the individual Masses of Fine & Coarse Aggregate, Kg, Max.	Quality of water per 50Kg. of cement, Max.
M 10	480 Kg.	34 Litres
M 15	350 Kg.	32 Litres
M 20	250 Kg.	30 Litres

The proportion of fine aggregate to coarse aggregate by mass shall generally be 1:2 subject to an upper limit of 1:1 ½ and lower limit of 1:2 ½.

TABLE - 5

I.S. Sieve Designation	Percentage passing for single sized aggregate of nominal size					Percentage passing for graded aggregate of nominal size			
	40 mm.	20 mm.	16 mm.	12.5 mm.	10 mm.	40 mm.	20 mm.	16 mm.	12.5 mm.
63 mm.	100	-	-	-	-	-	-	-	-
40 mm.	85-100	100	-	-	-	95-100	100	-	-
20 mm.	0-20	85-100	100	-	-	30-70	95-100	100	100
16 mm.	-	-	85-100	100	-	-	-	90-100	-
12.5 mm.	-	-	-	85-100	100	-	-	-	90-100
10 mm.	0-5	0-20	0-30	0-45	85-100	10-35	25-55	30-70	40-85
4.75 mm.	-	0-5	0-5	0-10	0-20	0-5	0-10	0-10	0-10
2.36 mm.	-	-	-	-	0-5	-	-	-	-

Mix Design & Proportioning

Mix proportions shall be designed to ensure that the workability of fresh concrete is suitable for conditions of handling and placing, so that after compaction it surrounds all reinforcements and completely fills the formwork. When concrete is hardened, it shall have the stipulated strength, durability and impartibility.

Determination of the proportions by weight of cement, aggregates and water shall be based on design of the mix.

As a trial the manufacturer of concrete may prepare a preliminary mix according to provisions of SP: 23-1982.

All concrete proportions for various grades of concrete shall be designed separately and the mix proportions established keeping in view the workability for various structural elements, methods of placing & compacting.

Standard Deviation

Standard deviation calculations of test results based on tests conducted on the same mix design for a particular grade designation shall be done in accordance with clause 9.2.4 of IS 456.

Acceptance Criteria

Compressive strength: The concrete shall be deemed to comply with the strength requirements when both the following conditions are met –

a. The mean strength determined from any group of four consecutive test results complies with the appropriate limits in col. 2 of Table 6 pf IS 456 - 2000.

b. Any individual test result complies with the appropriate limits in column 3 of Table 6.

Flexural strength: When both the following conditions are met, the concrete complies with the specified flexural strength.

i. The mean strength determined from any group of four consecutive test results exceeds the specified characteristic strength by at least 0.3 N/mm^2

ii. The strength determined from any test results is not less than the specified characteristic strength less 0.3 N/mm^2

Quantity of concrete represented by strength test results – The quantity of concrete represented by a group of four consecutive test results shall include the batches from which the first and last samples were taken together with all intervening batches.

For the individual test result requirements given in col. 3 of Table 6 or in item (b) of above only the particular batch from which the sample was taken shall be at risk.

Where the mean rate of sampling is not specified the maximum quantity of concrete that four consecutive test results represent shall be limited to 60 cub. m

If the concrete is deemed not to comply pursuant to quality of concrete represented by strength Test result as above, the structural adequacy of the parts affected shall be investigated and any consequential action as needed shall be taken.

Cement content of concrete

For all grades of concrete manufactured / produced, minimum cement content in the concrete shall be 310 kg per cubic metre of concrete. Also, irrespective of the grade of concrete, the maximum cement content shall not be more than 500 kg per cub. m of concrete. These limitations shall apply for all types of cements of all strengths.

Actual cement content in each grade of concrete for various conditions of variables shall be established by design mixes and approved by the Engineer-In-Charge.

Approval of Design Mix

The contractor shall submit details of each trial mix of each grade of concrete designed for various workability conditions to the Engineer-In-Charge for approval. Concrete of any particular design mix and grade shall be produced / manufactured for works only on obtaining approval of the Engineer-In-Charge.

For any change in quality/quantity in the ingredients of a particular concrete for which mix has been designed earlier and approved by the Engineer-In-Charge, the mix has to be redesigned and approval shall be obtained again.

Quality Assurances Measures

In order that properties of the completed structure be consistent with the requirements and the assumptions made during planning and design adequate quality assurance measures shall be taken. Quality Assurance procedures be developed and submitted to the approval of Engineer-In-Charge. The said Quality Assurance plan shall fulfil the requirements detailed under clause no. 10.1 of IS : 456 - 2000.

Proportioning & Batching

Preliminary tests shall be carried out to determine the proportions by weight of cement, coarse and fine aggregate to produce the desired grade of concrete. These proportions shall be maintained during subsequent concrete batching by means of weight batchers conforming to IS 2722.

The accuracy of the measuring equipment shall be within ± 2 percent of the quantity of cement being measured and within +/- 3 percent of the quantity of aggregate, admixtures and water being measured.

The batcher shall be tested for accuracy of calibration before commencement of the work and at least once a week thereafter or more frequently, if so required by the Engineer-In-Charge.

All measuring equipment shall be maintained in a clean serviceable condition and their accuracy periodically checked.

Grading of Aggregate & Foreign Material Limitations

Coarse Aggregate

- Coarse aggregates shall be either in single size or graded; in both cases, the grading shall be within acceptable limits .

- The percentages of deleterious substances in the coarse aggregate delivered to the mixer shall not exceed the volumes given in table here below.

TABLE - 6

Deleterious Substance		PERCENT BY WEIGHT	
		Uncrushed	Crushed
i)	Coal & Lignite	1.00	1.00
ii)	Clay lumps	1.00	1.00
iii)	Material finer than 75 micron	3.00	3.00
iv)	Soft fragments	3.00	--
v)	Shale	--	--
vi)	Total of percentages of all the deleterious materials (except mica) including SI no. (i) to (v)	5.00	5.00

Fine Aggregate

- Unless otherwise directed or approved, the grading of sand shall be within the limits indicated in table here below.

TABLE - 7

I.S. Sieve Designation	Grading Zone-I % passing	Grading Zone - II % passing	Grading Zone - III % passing	Grading Zone - IV % passing
10 mm.	100	100	100	100
4.75 mm.	90-100	90-100	90-100	95-100
2.36 mm.	60-95	75-100	85-100	95-100
1.18 mm.	30-70	55-90	75-100	90-100
600 micron	15-34	35-59	60-79	80-100
300 micron	5-20	8-30	12-40	15-50
150 micron	0-10	0-10	0-10	0-15

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

Fine aggregate shall have a fineness modulus of not less than 2.2 or more than 3.2. The fineness modulus is determined by adding the cumulative percentages retained on I.S.

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

- The percentage of deleterious substances in sand delivered to the mixer shall not exceed the values given in table here below:

TABLE - 8

Deleterious Substance		PERCENT BY WEIGHT	
		Uncrushed	Crushed
i)	Coal & Lignite	1.00	1.00
ii)	Clay lumps	1.00	1.00
iii)	Material finer than 75 micron	3.00	15.00
iv)	Soft fragments	--	--
v)	Shale	1.00	--
vi)	Total of percentages of all the deleterious materials (except mica) including SI no. (i) to (v) for uncrushed and SI. No. (i) & (ii) for crushed fine aggregate.	5.00	2.00

Water Cement Ration (W/C Ratio)

- The water-cement ratio is defined as the weight of water in the mix (including the surface moisture of the aggregates) divided by the weight of cement in the mix. Free water-cement ratio should not exceed 0.40 for substructure and 0.45 for superstructure unless otherwise specified.

- Only such quantity of water shall be added to the cement / cementations material and aggregates in the concrete mix as to ensure dense concrete, specified surface finish, satisfactory workability, consistent with the strength stipulated for each class of concrete. Water added to the mix shall be such as not to cause segregation of materials or the collection of excessive free water on the surface of the concrete.

- The actual water-cement ratio to be adopted shall be determined in each instance by the Contractor & approved by the Engineer-In-Charge.

The W/C ratio determined and approved for use by the Engineer-In-Charge shall be maintained throughout the corresponding part of the Works. Approved tests conforming to relevant IS Codes subject to approval of Engineer-In-Charge shall be undertaken periodically by the Contractor for maintaining the consistency. Such ones comprise frequent determination of the water content of the aggregate during the progress of work as specified in IS 2386 (Part-III). To allow for the variation in weight of aggregates due to variation in their moisture content, suitable adjustments in the weights of aggregates shall also be made.

- The Contractor shall exercise special precautions on the water content for concrete work since the colour of such concrete is sensitive to small variations of water in the mix.

Volumetric mixing may be allowed by the Engineer-In-Charge at his discretion by converting the “declared mix” to corresponding mix by volume. Allowance for bulkage shall be made in accordance with IS 2386(Part 3). Periodic checks shall be made on mass /

column relationship of the materials. Similarly where cement is measured by bags directly reasonable number of cement bags should be weighed periodically to check the net mass as directed by the Engineer-In-Charge.

Workability

- Workability of concrete should be checked at frequent intervals. It shall be checked at frequent intervals by approved tests such as slump tests, compacting factor tests etc. in accordance with IS 1199. If required the same shall be controlled by adjusting the dosage of the admixtures if permitted by the Engineer-In-Charge.

- The range of slumps for various types of work shall generally be as follows subject to approval by the Engineer-In-Charge unless stated otherwise. Slump required for workability shall be achieved, if necessary by using approved super plasticizer without any extra cost.

TABLE - 9

Placing condition	SLUMP (in mm.)	
	Maximum	Minimum
Blinding concrete; shallow sections; Pavement using Pavers	75	25
Mass concrete; Lightly reinforced sections in slabs, beams, walls, columns, Floors, hand placed pavements, Strip footings	75	25
Heavily reinforced sections in slabs, beams, walls, columns;	100	50
Slip formwork, Pumped concrete	100	75
Trench fill; In-situ piling	150	100
Note: For most of the placing conditions, internal vibrators (needle vibrator) are suitable. The diameter of the needle shall be determined based on the density and the spacing of reinforcement bars and thickness of the sections. For trieme concrete, vibrators are not required to be used and clause 7.1.2 of IS : 456 - 2000 shall be followed in such case.		

a) Mixing of Concrete

All concrete whether design mix or nominal mix shall be mixed in an approved mechanical mixer. The mixer shall comply with IS : 1791 & IS : 12119. The mixer shall be fitted with water measuring (metering) devices.

Material for concrete shall be deposited into the mixer drum while it is in rotation in the following order.

Coarse aggregate, cement, fine aggregate and water

The mixing shall be continued until there is a uniform distribution of the materials and the mass is uniform in colour and consistency. If there is segregation after unloading from the mixer, the concrete should not be remixed.

For guidance, the mixing time shall be at least 2 minutes .For other types of more efficient mixers, manufacturers recommendations shall be followed; for hydrophobic cement it may be decided by the Engineer-In-Charge.

The volume of mixed material shall not exceed the manufacturer's rated mixer capacity.

Temperature of aggregate, water and cement when added to the mixer shall be such that the temperature (minimum & maximum) of the concrete at the time of placement shall be as specified in IS 456 : 2000

The mixer shall be thoroughly cleaned of all hardened sticking concrete and foreign materials before beginning the concreting operations and also at frequent intervals between batches and at the end of concreting work by spraying the drum with cool water.

Concrete shall be discharged from the mixer on to a level, clean and water-tight surface. The area surrounding the mixer and the aggregate stacks shall be kept clean.

Subject to the approval of the Engineer-In-Charge, the Contractor may use waterproofing admixtures and / or other chemical admixtures and additives in concrete. The proportions and the mode of use shall be as per the manufacturers' instructions. The Contractor shall furnish complete literature in regard to such admixtures / additives to the Engineer-In-Charge.

Dosage of retarders, plasticizers and super-plasticizers shall be as per manufacturer's requirement and subject to approval of the Engineer-In-Charge. Unless otherwise specified. It shall be restricted to 0.5, 1.0 and 2.0 percent respectively by weight of cementations materials unless a higher value is permitted by the Engineer-In-Charge. Approval of mix design shall be by the Engineer-In-Charge prior to actual executions.

Mixing of cement mortar or concrete which has partially set shall not be permitted under any circumstances.

b) Transporting and Placing of Concrete

Concrete shall be handled from the place of mixing to the place of final placing as rapidly as practicable by methods which will prevent the segregation or loss of any of the ingredients and maintaining the required workability. Entire operation shall not take time more than the initial setting time of concrete under the prevailing site conditions.

During hot or cold weather, concrete shall be transported in deep containers. Other suitable methods to reduce the loss of water by evaporation in hot weather and heat loss in cold weather may also be adopted.

The concrete shall be deposited as nearly as practicable in its final position to avoid re-handling. No concrete shall be permitted to be used in the Works after initial set has taken place. Concreting of beams, slabs and similar members shall be carried out in one continuous operation to the full depth of the member and the sequence of placing shall be so arranged as to avoid disturbance of partially set concrete.

Method of placing of concrete should be such that no segregation occurs during placing. Generally concrete shall not be dropped freely from a height of more than 1.2 meters in the works of watertight structures and 1.6 m. in all other works. When required to be deposited from a greater height, it shall be done through a metal-lined chute with slope no flatter than 1:3 (vertical : horizontal) and not steeper than 1:2. The discharge end of the chute will be provided with a baffle plate to prevent segregation. The discharge end of the chute shall be maintained above the surface of the concrete in forms and concrete shall not be permitted to fall from the end of chute by more than 1 m. During cleaning a chute, the waste water shall be kept clear of the forms.

c) Compaction of Concrete

Except for thin layer of plain concrete (for which tamping may be allowed), each layer of all grades / mixes of concrete shall be thoroughly compacted with approved mechanical vibrators of adequate power or as per IS 2505, IS 2506, IS 2514 supplemented by hand spreading, rodding and tamping as directed so that concrete works around the reinforcement, around entrapped fixtures and into corners of the formwork, embedded air

is expelled, dense concrete is obtained and the exposed surfaces are free from air pockets, honey-combing and other defects.

Type of vibrators (immersion vibrators, shutter vibrators, surface vibrators etc.) to be used shall depend on the type of structure for which concreting is done and shall have the approval of the Engineer-In-Charge. The size and number to be provided shall be such as to ensure proper consolidation.

General precautions to be taken in vibration work shall be as follows-

- Concrete once vibrated shall not be vibrated again.
- Partially hardened concrete or mortar shall not be re-tamped.
- Over-vibration, under-vibration or vibration of very wet mixes should be avoided.
- Tapping or external vibration of forms by hand tools or immersion vibrators shall not be permitted.
- Care shall be taken to prevent contact of immersion vibrators against reinforcement steel. These vibrators shall not be allowed to come in contact with the reinforcement steel after start of initial set. They shall also not be allowed to come in contact with forms or finished surfaces.
- Whenever external vibrators are used, the design of formwork & the disposition of vibrators should be given special consideration to ensure sufficient compaction and surface blemishes.

d) Concreting in Inclement Weather

During heavy rains, concreting shall be stopped keeping appropriate temporary stop ends and newly cast concrete shall be instantly covered by suitable protective means. Any concrete damaged due to rainstorms etc. shall be replaced appropriately as directed by the Engineer-In-Charge at the expense of the Contractor.

e) Concreting under water

When it is necessary to deposit concrete under water, the Contractor shall submit to the Engineer-In-Charge for his approval the method of carrying out the work together with the materials and proportions thereof he propose to use. In no case such concrete be considered as "Design Mix Concrete"

f) Curing

All concrete shall be protected during hardening from the harmful effects of sunshine and drying winds. All exposed surfaces of newly placed concrete shall be kept continuously in a damp or wet condition by water ponding or by covering with a canvas, hessian or similar other water absorbent materials and kept continuously wet for at least seven days from the date of placing of concrete. Likewise all formwork directly in contact with concrete shall be kept dry. Curing compounds to provide surface coating with specking equipment may also be used if permitted by the Engineer-In-Charge. The necessary literature shall be furnished by the Contractor for the purpose.

For in-situ slabs (whether for flat roofs or other level surfaces, floors, pavements, side walks etc.), curing shall be by pounding only.

The curing period for water-tight structure shall be 10 days. In the case of concrete where mineral admixtures or blended cements are used the curing period shall be extended to 14 days.

The Contractor shall take good care in the arrangement (whether by continuous fine mist spraying or sprinkling or by covering with clean sand or wet gunny bags or by any curing compounds) and execution of curing so that curing will be carried out without interruption during the nights, Sundays and holidays.

Water for curing shall be of the same quality as used for concrete.

g) Expansion Joints

Expansion joints in the watertight structures shall always be provided with water-stop for the entire length of joints unless otherwise specified or as specified in the item description. The work shall be carried out in strict accordance with the manufacturer's instructions.

h) Construction Joints & Keys

Concrete shall be placed without interruption until completion of the part of the work between predetermined construction joints as specified hereinafter. Time lapse between the pouring of adjoining units shall be as specified on the drawings or as directed by Engineer-In-Charge.

If stopping of concreting becomes unavoidable anywhere, properly formed construction joints shall be made along where the work is stopped. These joints shall be either vertical or horizontal, unless shown otherwise on drawings. In case of an inclined or curved member, the joint shall be at right angles to the longitudinal axis of the member. Vertical joints in walls shall be kept to a minimum. Vertical joints shall be formed against a stop board. Horizontal joints shall be level and wherever possible, arranged so that the joint lines coincide with the architectural features of the finished work. Battens shall be nailed to the formwork to ensure a horizontal line and if directed shall also be used to form a grooved joint. For tank walls and similar work joints shall be formed as per IS 3370. Concrete that is in the process of setting shall not be disturbed or shaken by traffic either on the concrete itself or upon the shuttering. Horizontal and vertical construction joints and shear keys shall be located and shall conform in detail to the requirements of the plans unless otherwise directed by Engineer-In-Charge. Where not described, the joint shall be in accordance with the following.

Column Joint

In a column, the joints shall be formed 75 mm. below the lowest soffit of the beams including haunches if any. In flat slab construction, the joint shall be 75 mm. below the soffit of column capital. At least 2 hours shall elapse after depositing concrete in columns, piers or walls, before depositing in beams, girders or slabs supported thereon.

Beam & Slab Joint

Concrete in a beam shall be placed throughout without a joint but if the provision of a joint is unavoidable the joint shall be vertical and at the centre or within the middle third of the span unless otherwise shown on drawings. Where a beam intersects a girder, the joints in the girder shall be offset a distance equal to twice the width of the beam and additional reinforcement provided for shear. The joints shall be vertical throughout the full thickness of the concrete member. A joint in a slab shall be vertical and parallel to the principal reinforcement. Where it is unavoidably at right angles to the principal reinforcement, the joint shall be vertical and at the middle of the span.

Joints in Liquid Retaining Structures

Vertical construction joints in watertight construction will not be permitted unless indicated on the drawings. Where a horizontal construction joint is required to resist water pressure, special care shall be taken in all phases of its construction to ensure maximum water tightness.

Where the work has to be resumed on a surface which has hardened, any skin or laitance shall be removed and the surface roughened by hammering with an approved power-operated "bush" hammer followed by wire brushing to remove all loose practices. When using this procedure, great care shall be taken to avoid disturbing concrete matrix . The surface is then thoroughly wetted. Fresh concrete should thoroughly be vibrated near the

construction joint so that mortar from the new concrete flows between large aggregates and develop proper bond with old concrete.

Where high shear resistance is required at the construction joints, shear key may be provided. Sprayed curing membranes and release agents should be thoroughly removed from joint surfaces.

Where the concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire on bristle brushes or by using water jets, care being taken to avoid dislodgment of particles of aggregate. The prepared surface should be in a clean saturated surface dry condition when fresh concrete is placed, against it. Fresh concrete shall be thoroughly vibrated near construction joint so that mortar from new concrete flows between large aggregates and develop proper bond with old concrete.

i) Sampling & Testing of Concrete

For preliminary tests(initial trial mix), test specimen shall be prepared with at least two different water / cement ratio for each class of concrete consistent with the workability required for the nature of the work. The materials and proportions used in making preliminary tests shall be similar in tall respects to those to be actually employed in the works. All the cubes shall be made, cured and tested in accordance with IS : 516

Facilities required for sampling materials and concrete in the field, if Engineer-In-Charge so desires, shall be provided by Contractor at no extra cost. The following equipment with operator shall be made available at Engineer-In-Charge's request (all must be in serviceable conditions) –

Concrete cube-testing machine suitable for 15 cm. cubes of 100 Tonnes capacity with providing calibration ring	1 No
Cast Iron cube moulds 15 cm. size 18 Nos. (minimum)	18 No
Slump cone complete with temping rod	1 Set
Laboratory balance to weight upto 5 Kg.with sensitivity of 10 gm	1 No
IS sieves for coarse & fine aggregates	1 Set
A set of measuring cylinder from 5 ltr. to 0.1 ltr.	1 Set
Laboratory balance of 2 Kg. capacity with sensitivity of 1 gm	1 No

Note: Arrangement shall be made by Contractor to have the cubes tested in an approved laboratory in lieu of a testing machine at site at his expense, with the prior consent of the Engineer-In-Charge.

Three test specimens unless otherwise specified shall be made from each sample for testing at 28 days. Additional samples shall be taken for determining the strength of concrete at 7 days or at the time of striking the formwork, or to determine the duration of curing or to check the testing error. Additional samples shall also be required for testing samples cured by accelerated methods as described in IS 9103. The specimen shall be tested as described in IS 516.

For works test, samples from fresh concrete shall be taken as per IS 1199 and cubes shall be made, cured and tested in accordance with IS 516 unless specified or instructed otherwise by the Engineer-In-Charge. Minimum frequency for sampling of concrete of each grade shall be in accordance will the following:

TABLE 10

Quality of concrete in the work m^3	Number of samples
1 - 5	1
6 - 15	2

16 – 30	3
31 – 50	4
51 and above	4 plus one additional sample for each additional 50 m^3 as part thereof

Note : At-least one sample shall be taken from each shift when concrete is produced at continuous production unit, such as ready-mixed concrete plant, frequency of sampling shall be subject to the approval of Engineer-In-Charge.

The acceptance criteria of concrete tests shall be as per Clause 16.1, 16.2, 16.3, 16.4, 16.5 & 16.6 of IS 456-2000.

j) Concrete Below Specified Strength

Should the concrete tests fail to meet the minimum specified strength requirements for the respective grades of concrete, the Engineer-In-Charge may take one of the following decisions –

Instruct the Contractor to carry out such additional tests (e.g. NDT test, core test, load-test etc.) and/or remedial measures to ensure the soundness of the structure at the Contractor's expense.

The Engineer-In-Charge may accept the work provided it meets the relevant acceptance criteria as stipulated in IS 456-2000. Any decision to accept the work shall be entirely at the discretion of the Engineer-In-Charge who may make a reduction in the rate of the appropriate item.

The work will be rejected and any consequential action as needed shall be taken at the Contractor's expenses including cutting out and replacing a part or whole of the work.

k) Repair & Replacement of unsatisfactory Concrete

Immediately after the shuttering is removed, the surface of concrete shall be carefully inspected and all defective areas called to the attention of Engineer-In-Charge who may permit patching of the defective areas or also reject the concrete unit either partially or fully shall be attended. Rejected concrete shall be removed and replaced by Contractor at No additional expense. Holes left by bolts etc. shall be filled up and made good with mortar composed of one part of cement to one and half parts of sand passing 2.36 mm. IS sieve after removing loose stones adhering to the concrete. Mortar filling shall be struck off flush at the face of the concrete. Concrete surfaces shall be finished as described under the particular items of work.

Superficial honey combed surfaces and rough patches shall be similarly made good immediately after removal of shuttering, in the presence of Engineer-In-Charge and superficial pores shall be filled in. The mortar shall be well worked into the surface with a wooden float Excess water shall be avoided. Unless instructed otherwise by Engineer-In-Charge, the surface of the exposed concrete placed against shuttering shall be rubbed down immediately on removal of shuttering to remove fine or other Irregularities, care being taken to avoid damaging the surface. Surface irregularities shall be removed by grinding.

Use of Epoxy

The use of epoxy for bonding fresh concrete used for repairs will be permitted upon written approval of Engineer-In-Charge. Epoxies shall be applied in strict accordance with the instructions of the manufacturer. Only flexible epoxy shall be permitted with certain minimum solid contents as recommended by the Engineer-In-Charge. The use of epoxy if any shall be at no extra cost to the Employer.

Method of Repair

Small size holes having surface dimensions about equal to the depth of the hole, holes left after removal of bolts, grout insert holes and slots cut for repair of cracks shall be repaired as follows. The holes to be patched shall be roughened and thoroughly soaked with clean water until absorption stops.

Before surface treatment, grouting may have to be done by equal strength shrinkable grout. Unless otherwise specified, 5 mm. thick layer of grout of equal parts of cement and sand shall be well brushed into the surface to be patched, followed immediately by the patching concrete which shall be well consolidated with a wooden float and left slightly prod of the surrounding surface. The concrete patch shall be built up in 10 mm. thick layers. After an hour or more, depending upon weather conditions, it shall be worked off flush with a wooden flat and a smooth finish obtained by wiping with hessian, a steel trowel shall be used for this purpose. The mix for patching shall be of the same materials and in the same proportions as that used in the concrete being repaired, although some reduction in the maximum size of the coarse aggregates may be necessary and the mix shall be kept as dry as possible.

Mortar filling by air pressure (guniting) shall be used for repair of areas too large and / or too shallow for patching with mortar. Patched surfaces shall be given a final treatment to match the colour and texture of the surrounding concrete. White cement shall be substituted for ordinary cement, if so directed by Engineer-In-Charge, to match the shade of the patch with the original concrete.

Curing of patched work

The patched area shall be covered immediately with an approved water retaining, water saturated material such as gunny bags which shall be kept continuously wet and protected against sun and wind for a period of 24 hours. Thereafter, the patched area shall be kept wet continuously by a fine spray or sprinkling for not less than 10 days.

Approval by Engineer-In-Charge

All materials, procedures and operations used in the repair of concrete and also the finished repair work shall be subject to the approval of Engineer-In-Charge. All fillings shall be tightly bonded to the concrete and shall be sound, free from cracks after the fillings have been cured and dried.

l) Finishing

This specification is intended to cover the treatment of concrete surfaces of all structures. Areas requiring special finish not covered by this specification shall be clearly indicated on the drawings and special specifications, if any shall be furnished by the contractor for approval.

Finish for Formed Surfaces

The type of finish for formed concrete surfaces shall be as follows, unless otherwise specified.

For surface against which backfill or concrete is to be placed, no treatment is required except repair of defective areas.

For surfaces below grade, which will receive, waterproofing treatment the concrete shall be free of surface irregularities, which would interfere with proper application of the waterproofing material, which is specified for use.

Unless specified, surfaces which will be exposed when the structure is in service shall receive no special finish, except repair of damaged or defective concrete, removal of fins and

abrupt irregularities, filling of holes left by form ties and rods and clean up of loose or adhering debris.

Surfaces which will be exposed to the weather and which would normally be level, shall be sloped for drainage. Unless the drawing specifies a horizontal surface or shows the slope required, the tops of narrow surface such as stair treads, walls, curbs and parapets shall be sloped across the width approximately 1 in 30. Broader surface such as walkways, roads, parking areas and platforms shall be sloped about 1 in 50. Surfaces that will be covered by backfill or concrete, sub-floors to be covered with concrete topping, terrazzo or quarry tile and similar surfaces shall be smoothing screened and levelled to produce even surfaces. Surface irregularities shall not exceed 6 mm. Surfaces which will not be covered by backfill, concrete or tiles toppings such as outside decks, floors of galleries and sumps, parapets, gutters, side walks, floors and slabs, shall be consolidated, screened and floated. Excess water and laitance shall be removed before final finishing. Floating may be done with hand or power tools and started as soon as the screened surface has attained the stiffness to permit finishing operations and these shall be the minimum required to produce a surface uniform in texture and free from screed marks or other imperfections. Joints and edges shall be tooled as called for on the drawings or as directed by the Engineer-In-Charge.

Standard finish for exposed concrete

Exposed concrete shall mean any concrete, other than floors or slabs, exposed to view upon completion of the job.

Unless otherwise specified on the drawings, the standard finish for exposed concrete shall be a smooth finish.

A smooth finish shall be obtained with the use of lined or plywood forms having smooth and even surfaces and edges. Panels and form linings shall be of uniform size and be as large as practicable and installed with closed joints. Upon removal of forms the joint marks shall be smoothed off by grinding etc. and all blemishes, projections etc. removed leaving the surfaces reasonably smooth and unmarred.

Integral cement concrete finish

When specified on the drawings an integral cement concrete finish or specified thickness for floors and slabs shall be applied either monolithic or bonded, as specified on the drawings, as per IS 2571. The surface shall be compacted and then floated with a wood float or power floating machine. The surface shall be tested with a straight edge and any high and low spots eliminated. Floating or trowelling of the finish shall be permitted only after all surface water has evaporated. Dry cement or a mixture of dry cement and sand shall not be sprinkled directly on the surface of the cement finish to absorb moisture or to stiffen the mix.

Protection

All concrete shall be protected against damage until final acceptance by Engineer-In-Charge.

Measurement

Dimensions shall be measured to a cm except for the thickness of slab which shall be measured correct to 0.50cm. The areas shall be worked out nearest to 0.01 sq.m.

The cubical contents shall be worked out to nearest 0.01 cubic meter. Reinforced cement concrete shall be classified under different category and measured as categorized in the item description.

No deductions shall be made for-

i) Ends of dissimilar material(e.g. joist, beams, post girders, rafters, purlins, corbels, steps etc.),

ii) volume occupied by water pipes, conduits etc. Nothing extra shall be paid for leaving and finishing such cavities and holes.

iii) The concrete displaced by the reinforcement, inserts shall not be deducted.

iv) No deduction shall be made for openings less than 0.10 Sq.m. in area where concrete is measured in Sq.m. and 0.02 Cu.m. where concrete is measured in Cu.m.

The measurement of RCC work between various units shall be regulated as below-

a) Footings (sloped) –

Volume = $h/3\ (A1 + A2 + \sqrt{A1 \times A2})$

where A1 & A2 are areas at top and bottom respectively and h = perpendicular height of the trapezoidal portion.

b) Slabs -

They shall be measured full on superficial areas in the plane of the slab.

c) Columns -

When in junction with slab, the thickness of slab shall be deducted in computing the column height.

d) Beams -

They shall be measured as clear length between supporting beams and columns. Depth shall be measured clear below slab.

e) Lintels

The length shall be measured including the bearing lengths.

f) Chajja's

Measurement of chajjas shall be inclusive of bearings.

Rate

The rate includes the cost of material and labour involved in all the operations described above except for the cost of centering and shuttering unless specified. Reinforcement shall be measured separately .

Unless otherwise specified the rates of concrete work shall allow for-

i) Use of metal 12mm and below in size well-graded in thin members or where reinforcement is crowded,

ii) any shapes and sizes of various members,

iii) all architectural effects like chases, ledges, moulds, grooves, chamfers etc.

iv) provision of any openings, pockets, channels, holes, wooden blocks etc

v) provision of cover blocks (made out of precast cubes in CM of the same strength as that of concrete of the member or equivalent approved material) to maintain the specified cover to reinforcement

vi) work at all depths and heights and levels and locations

vii) taking out and testing of cubes as per IS specifications

viii) For machine mixing and through vibrating.

ix) The rates for all concrete work shall be for unfinished work only. (It may be noted that all concrete surfaces need not be plastered and all unplastered surfaces are not necessarily form-finished)

x) Cost towards Design Mix and approval.

7.8. Formwork

Formwork (or shuttering) comprises of all forms and moulds made up of planks and steel 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.

Material

Formwork may be of timber, plywood, steel or other metal, plastic or concrete or any suitable material. For special finishes the formwork may be lined with plywood, steel sheets, oil tempered hard board etc. Dented steel plates will not be allowed and shall not be used at all.

Timber shall be easily workable without splitting and shall not warp when exposed to sun or rain or wetted during concreting. Plywood shall be 12 mm. thick complying with IS 4990 and steel shall be 3 mm. black sheets suitably stiffened with angles or appropriate equivalent.

Sliding forms and slip forms may be used for special purpose construction with the approval of the Engineer-In-Charge.

Design

Formwork shall be adequately designed to cater for all the vertical (dead load of wet concrete, superimposed live loads during construction, materials, equipment etc.) and lateral loads without causing displacement, deflection or movement of any kind. The Contractor shall be entirely responsible for the design and stability of formwork regardless of whether he is instructed to furnish the design calculations, drawings and other particulars of his proposal or not, and regardless of whether his proposal has been approved by the Engineer-In-Charge or not. All the expenses arising out of defective shuttering & centering resulting in dismantling / redoing the work etc. shall be to the Contractor's account. For details regarding design, detailing etc. reference may be made to IS 14687. Contractor shall submit formwork design & methodology for the approval of Engineer-In-Charge prior to execution.

Erection of Formwork

Forms shall be true to shape, lines, levels and dimensions of the concrete work as shown on the drawings and shall be rigidly constructed using adequate number of props, struts, ties, braces etc. Where props rest on natural or filled-up ground, the soil shall be thoroughly compacted to avoid any settlement. False-work shall be so constructed that vertical adjustments can be made to compensate the settlements. Wedges may be used at the top or bottom of timber shores, but not at both ends to facilitate vertical adjustments or dismantling of the formwork. No bamboos and wooden bullies shall be permitted to be used for props or cross bearers/bracings.

Proper precautions shall be taken to see that all joints in the formwork are watertight to prevent escape of slurry.

Connections in formwork shall be constructed to permit easy removal of the shuttering and shall be adequately secured by screws, bolts, clamps, wire etc. so as to be strong enough to retain the correct shape during consolidation.

Faces in contact with concrete shall be free from adhering ground, projecting nails, splits or any defects so that when stripped, any formation of blemishes is avoided. All formwork shall be carefully cleaned and thoroughly wetted or treated with an approved chemical compound. Care being taken to keep all reinforcement away from contact from such composition.

Unless specifically permitted, wire ties passing through the walls and through bolts are not permitted. For fixing of formwork, alternative arrangements such as coil nuts shall be adopted at the Contractor's cost.

Plywood shall be used for Exposed Concrete surfaces; where called for. Sawn and wrought timber may be used for unexposed surfaces. Inside faces of forms for concrete surfaces which are to be roughed finished shall be planed to remove irregularities or unevenness in the face. Formwork with linings will be permitted.

All new and used form timber shall be maintained in a good condition with respect to shape, strength, rigidity, water tightness.

Excessive construction camber to compensate for shrinkage, settlement etc. that may impair the structural strength of members will not be permitted.

Forms for substructure concrete may be omitted when, in the opinion of Engineer-In-Charge the open excavation is firm enough to act as the form. Such excavations shall be slightly larger than required by the drawings to compensate for irregularities in the excavation and to ensure the design requirements. No extra payments on this account will be made in any item of work.

Forms shall be so designed and constructed that their removal will not damage the concrete. Face formwork shall provide true vertical and horizontal joints, conform to the architectural features of the structure as to location of joints and as directed by Engineer-In-Charge.

Where exposed smooth or rubbed concrete finishes are required the forms shall be constructed with special care so that the resulting concrete surface requires a minimum finish.

Bracings, Struts & Props

Shuttering shall be braced, strutted, propped and so supported that it shall not deform under weight and pressure of the concrete and also due to the movement of men & other materials. Bamboo's shall not be used as props or cross bracings.

The shuttering / forms for beams and slabs shall be so erected that the shuttering / forms on the sides of the beams and under the soffit of slabs can be removed without disturbing the beam bottoms. Re-propping of beams bottom forms shall not be done except when props have to be reinstated to take care of construction loads anticipated to be in excess of the design load. Vertical props shall be supported on wedges or other measures shall be taken whereby the props can be gently lowered vertically while striking the shuttering.

Mould Oil

Care shall be taken to see that the faces of formwork coming in contact with concrete are perfectly cleaned and two coats of mould oil or any other approved material applied before fixing reinforcement and placing concrete. Such coating shall be insoluble in water, non-staining and not injurious to the concrete. It shall not become flaky or be removed by rain or wash water. Reinforcement and/or other items to be cast in the concrete shall not be placed until coating of the forms is complete. Adjoining concrete surfaces shall also be protected against contamination from the coating material.

Chamfers and fillets

All concrete and angles exposed in the finished structure shall be formed with mouldings to form chamfers or fillets on the finished concrete. The standard dimensions of chamfers and fillets, unless otherwise specified, shall be 2cm x 2cm. Care shall be exercised to ensure accurate mouldings. The diagonal face of the moulding shall be planed or surfaced to the same texture as the forms to which it is attached.

Vertical Construction Joint Chamfered

Vertical construction joints on faces which will be exposed at the completion of the work shall be chamfered as above except where not permitted by Engineer-In-Charge for structural or hydraulic reasons.

Wall Ties

Wire ties passing through the walls shall not be allowed. In their place bolts passing through sleeves shall be used.

Reuse of Forms

Before reuse, all forms shall be thoroughly scraped, cleaned, nails removed, holes that may leak suitably plugged and joints examined and when necessary repaired and the inside retracted to prevent adhesion, to the satisfaction of Engineer-In-Charge. Warped timber shall be resized.

Removal of Forms

Contractor shall record on the drawing or in a register the date upon which the concrete is placed in each part of the work and the date on which the shuttering is removed there from.

In no circumstance shall forms be struck until the concrete reaches a strength of at least twice the stress due to self weight and any construction/erection loading to which the concrete may be subjected at the time of striking formwork.

Nor formwork shall be removed or otherwise allowed to move until concrete attains sufficient strength against own weight and external load as per the stipulations of Clause 11.3 of IS 456-2000.

The stripping of formwork shall be done without shock or vibration so that no damage is caused to newly cast concrete. Any damage resulting from premature removal of shutters or from any other cause whatsoever shall be made good by the Contractor at his own expense as directed by the Engineer-In-Charge.

In normal circumstances generally where ambient temperatures are above 15^{o}C and ordinary port land cement is used forms may be struck after expiry of the following periods:

TABLE - 11

Type of formwork	Ordinary Portland Cement Concrete

a)	Vertical formwork to columns, walls, beams	16-24 hrs
b)	Soffit formwork to slabs (Props to be refixed immediately after removal of formwork)	3 days
c)	Soffit formwork to beams (Props to be refixed immediately after removal of formwork)	7 days
d)	Props to slabs 1) Spanning up to 4.5 m 2) Spanning over 4.5 m	 7 days 14 days
e)	Props to beams and arches: 1) Spanning up to 6 m 2) Spanning over 6 m	 14 days 21 days

For other cements and or lower or higher temperature, the stripping time as above may be suitably modified with prior approval of the Engineer-In-Charge.

Oiling of forms

Use of form / mould oil will not be permitted on the surfaces which require painting.

Tolerances

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

Tolerances for RC buildings

- Variation from the plumb

- In the lines and surfaces of columns, piers, walls and in arises 5 mm. per 2.5 m. but not more than 25 mm.

- For exposed corner columns and other conspicuous lines.

In any bay or 5 m. maximum - 5 mm
In 10 m. or more - 10 mm

- Variation from the level or from the grades indicated on the drawings –

- In slab soffits, ceilings, beam soffits and in arises.

In 2.3m - 5 mm
In any bay or 5 m. maximum - 8 mm
In 10m or more - 15 mm

- For exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines.

In any bay or 5 m. maximum - 5 mm
In 10m or more - 10 mm

- Variation of the linear building lines from established position in plan and related position of columns, wall and partitions.

- In any bay or 5 m. maximum - 10 mm
- In 10 m. or more - 20 mm.

- Variation in the sizes and location of sleeves, openings in walls and floors 5 mm. (except in the case of and for anchor bolts).

- Variation in cross sectional dimensions of columns and beams and in the thickness of slabs and walls **(- 5 mm. + 10 mm.)**

- Footings

- Variation in dimension in plan **(- 5 mm. + 50 mm.)**

- Misplacement or eccentricity

2% of footing width in the direction of misplacement but not more than 50 mm.

- Reduction in thickness

5% of specified thickness subject to a maximum of 50 mm.

- Variation in Steps

	RISE	**TREAD**
a) In a flight of stairs	3 mm.	5 mm.
b) In consecutive steps	1.5 mm.	3 mm.

i) Tolerances in other concrete structures

Variation of the constructed linear out line from established position in plan.

In 5 m.	10 mm.
In 10 m. or more	15 mm.

ii) Variations of dimensions to individual structure features from established positions

In 20 mm. or more	25 mm.
In buried construction	50 mm.

iii) Variation from plumb, from specified better or from curved surfaces of all structures.

In 2.5 m.	10 mm.
In 5 m.	15 mm.
In 10 m. or more	25 mm.
In buried construction	Twice the above

iv) Variation from level or grade indicated on drawings in slabs, beams, soffits, horizontal grooves and visible arises.

In 2.5 m.	5 mm.
In 7.5 m.	10 mm.
In buried construction	Twice the above

v) Variation in cross sectional dimensions of columns, beams buttresses, piers and similar member **(- 5mm + 10 mm)**

vi) Variation in the thickness of slabs, walls, arch sections and similar members.
(- 5mm + 10 mm)

Footings for columns, piers, walls, buttresses and similar members

Variation of dimensions in plan **(-10mm + 50mm)**

Misplacement or eccentricity

2% of footing width in the direction of misplacement but not more than 50mm

Reduction in thickness

5% of specified thickness subject to a mix of 50mm

Tolerances in other types of structures shall generally conform to those given in Clause 2.4 of Recommended Practice for Concrete Form-work (ACI-347).

Special Provision

Where exposed smooth or rubbed concrete finishes are required, the forms shall be constructed with special care so that the resulting concrete surfaces will required a minimum finish.

Wherever the concreting of narrow members is required to be carried out within shutters of considerable depth, temporary openings (windows) in the sides of the shutters shall, if so directed by the Engineer-In-Charge, be provided to facilitate the pouring and consolidation of the concrete. Small temporary openings shall be provided as necessary at the bottom of shutters of columns, walls and deep beams to permit the expulsion of rubbish etc.

Measurement

a) Unless otherwise stated, shuttering shall be measured as the area of the finished structure which is required to be supported during the deposition of the concrete but no deduction shall be made for holes less than 0.10 Sq.m.

b) Shuttering to secondary beams shall be measured upto the sides of main beams but no deduction shall be made from the shuttering of the main beam where the secondary beam intersects it.

c) Shuttering to beams which intersect with stanchion casings or columns shall be measured upto them on all sides. No deduction shall be made from shuttering to stanchion or column casings at these intersections.

d) Shuttering at construction joint shall not be measured.

e) Shuttering for the cover blocks shall not be paid for separately but is included in the respective items of formwork items.

Rate

The rate of the form work includes the cost of labour and materials required for all the operations described above.

Unless otherwise specified the rate of form work shall allow for-

i) provision of required well supported false work such as staging, access and working platforms for concreting etc.

ii) provision of any dowels and inserts etc. to be left out from shuttering (dowels, inserts etc. themselves shall be paid for under respective items), provision of any holes, pockets, channels etc.

iii) removing the shuttering carefully after specified time limit or as directed.

iv) work at all depths and heights as specified in the item descriptions.

The formwork generally shall include-

i) Splayed edges, notching, allowance for overlaps and passing at angles, sheathing battens, strutting, bolting, nailing, wedging, easing etc.

ii) All supports, struts, braces, wedges as well as mud sills, foundation pads, ground improvement, temporary piles or other suitable arrangements to support the form work.

iii) Bolts, wire ties, clamps, spreaders, nails or any other to hold the sheathing together.

iv) Filleting to form stop chamfered edges of splayed external angles not exceeding 20 mm wide to beam, columns and the like.

v) Where required, the temporary openings provided in the forms for pouring concrete, inserting vibrators, and cleaning holes for removing rubbish from the interior of the sheathing before pouring concrete.

vi) Dressing with oil to prevent adhesion and

vii) Raking or circular cutting.

Inspection of forms

Temporary openings shall be provided at the base of columns and wall forms and other places necessary to facilitate cleaning and inspection. Immediately before concrete is placed all forms shall be carefully inspected to ensure that they are properly placed, sufficiently rigid and tight, thoroughly cleaned, properly treated and free from foreign material.

When forms appear to be unsatisfactory in any way, either before or during the placing of concrete, the Engineer-In-Charge shall order all work stopped until the defects have been corrected.

7.9. 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 45^0 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.	}
25 to 32	1" to 1 ¼" Double bevel	8 (0.160)	4.06	mm.	} **As specified by the**
32 to 50	1 ¼" to 2" Double bevel	10 (0.160)	3.25	mm.	} **manufacture of** } **Electrodes**
25 to 50	1" to 2"	6 (0.160)		4.06	} }

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.

7.10. Ready Mix Concrete

General specifications shall be as described under- Reinforced cement concrete specifications & shall generally comply with the requirements of IS : 456 - 2000.

Ready mixed concrete is the concrete delivered at site from a Central Plant. The delivery is made by either agitator truck or truck mixer in a plastic condition requiring no further treatment before being placed in position in which it is to set and harden. The ready mix concrete shall conform to IS 4926, Specification for Ready Mixed Concrete is subject to the following:

- The ready mixed concrete shall be Centrally Mixed Concrete unless otherwise specifically mentioned.

- Batching plant : The batching plant shall be of fully automatic central batching and mixing type conforming to the provisions of IS : 4925. The capacity of the plant shall not be less than 30 cu.m./ hour.

- The ready mixed concrete shall be manufactured strictly as per the approved mix design by Engineer-In-Charge and supplied on the basis of specified strength based on 28 day compressive strength of 15 cm cube tested in accordance with IS : 456 - 2000. For any

change in quality / quantity in the ingredients of a particular concrete for which mix has been designed earlier and approved by the Engineer-In-Charge, the mix has to be redesigned and accordingly approval shall be obtained prior to use.

- Since the ready mixed concrete is a tailor made concrete, certain precautions are necessary for the concrete mix. Some of these are as listed below :

- Minimum quantity of cement and the details regarding proportioning and works control shall be in accordance with IS : 456-2000.

- The air content of the concrete shall not be more than 2% in any case. This shall be established by necessary testing at worksite.

- The dosage of the admixture shall be given at the batching plant only. Subsequent dosage of admixture shall not be permitted thereafter unless otherwise permitted by the Engineer-In-Charge.

Water shall not be added to ready-mixed concrete to restore the workability of concrete. However the workability can be restored to the design slump by use of proper admixture (without retarding effect) with prior approval of the Engineer-In-Charge provided the slump has not dropped below 50 mm. For the concrete with slump less than 50 mm and more than zero mm, the slump shall not be revised after the initial setting of the concrete. The initial setting of the concrete shall be established at worksite by the procedure in accordance with IS: 8412 -Method of test for determining setting time of concrete by penetration resistance.

When a truck mixer or agitator truck is used for transporting concrete, the concrete shall be delivered to the site for work the exact location as approved by the Engineer-In-Charge. Discharge of the concrete to be done by chute only to avoid segregation. The slump shall be checked at this delivery point. Further transport and placing of concrete along with compaction shall be completed prior to initial setting of concrete. In any case total transport time not to exceed 1½ hours.

Placing of Concrete :

When placing of concrete by manually the following shall apply –

Method of placing of concrete shall be such that no segregation occurs during placing. In manual placing, contractor has to arrange proper paths for the free movement of wheel barrows. Contractor has to prepare method statement for placing operation and get the same approved from Engineer-in-charge prior to actual execution. Generally concrete shall not be dropped freely from a height of more than 1.5 meters in the works of watertight structures and 2 m. in all other works. When required to be deposited from a greater height, it shall be done through a metal-lined chute with slope no flatter than 1:2 (Vertical : Horizontal) and not steeper than 1:3. The discharge end of the chute will be provided with a baffle plate to prevent segregation. The discharge end of the chute shall be maintained above the surface of the concrete in forms and concrete shall not be permitted to fall from the end of chute by more than 1 m. During cleaning a chute, the waste water shall be kept clear of the forms.

When placing concrete by mechanical equipment, the following shall apply

Central-bottom-dump buckets which provide for positive regulation of the amount and rate of deposition of concrete in all dumping position shall be employed. Concrete shall be discharged by a vertical drop into the middle of bucket or hopper. In placing concrete in large open areas, the bucket shall be spotted directly over the position designated and then lowered for dumping. The open bucket shall clear the concrete already in place and shall be opened slowly to avoid high vertical bounce. The height of drop of concrete shall not exceed 1 m. Dumping in a manner which would result in segregation of concrete ingredients shall not be permitted.

If pumps & pneumatic placers are used for conveying and placing concrete

Concrete mix with desired slump shall be appropriately designed to suit pumping. Care shall be taken to avoid stoppages in work once pumping is started. Care shall be taken to minimize frictional losses.

Before commencing to pump concrete, the pipeline shall be "Lubricated" with two batches of 1:2 cement and sand mortar. If required, sponge balls to be placed in pipes before grouting. Adequate emergency for washing / cleaning of pumps and pipelines to be made for efficient working. Supports to the pipes should be firmly ensured.

Manufacturers' instructions regarding pipeline layout, concrete quantity etc. shall be taken to avoid problems as blockages and excessive wear etc.

Pipe dia to be adequate and minimum pipe dia. to be three times the maximum aggregate size of the concrete mix. The pipe should be as far as possible rigid to avoid increased frictional losses and cleaning problems. Aluminium pipes shall not be used under any circumstances.

Concrete shall be placed in successive horizontal layers of uniform thickness ranging from 15 cm to 90 cm such that the formation of cold joints, of planes of weaknesses between each succeeding layer within the pour are avoided. The bucket loads or other units of deposit shall be spotted progressively along the face of the layer with such overlap as will facilitate spreading the layer to uniform depth and texture with a minimum of shovelling.

Freshly laid concrete shall not be wheeled over or walked over or otherwise disturbed.

When depositing concrete adjacent to a construction joint, special care shall be taken not to disturb the dowels or other reinforcing bars projecting from the existing concrete.

In vertical members like walls, columns, pardis etc. where the full height is not being poured in one continuous operation, the surface of each lift shall be finished horizontal and any laitance removed between the period of initial and final set.

Admixtures

Contractor shall submit the following before any admixtures is approved by the Engineer-In-Charge for their use –

- Certificate conforming that the use of a particular brand of admixture shall not be harmful to concrete in any way.
- Certificate conforming the exact dosage of admixture of a particular brand
- Certificate stating the specific purpose for which the admixture is to be sued.
- Special precautionary measures to be taken in the manufacturer of concrete when using the particular brand of admixture.
- Certificate conforming that the admixture conforms to specifications of IS 9103 or to ASTM – C 260, ASTM – C 10, ASTM – C 595 or to ASTM-C 618.

Engineer-In-Charge at his discretion may require tests to be performed to reconfirm the characteristic properties of any admixture. All such tests shall be done in accordance with IS 9103.

All tests described above shall be done at the site laboratory or at a laboratory to be identified by the Engineer-In-Charge depending on the test to be conducted.

All test shall be done in the presence of a representative nominated by the Engineer-In-Charge and a representative of the concrete manufacturer / Contractor when tests are performed at the site laboratory. All observations and reports of test shall be jointly signed

by the two representatives before the test results are submitted to the Engineer-In-Charge for approval.

Expenses for all materials used for testing, sampling procedures and testing including preparing reports shall be borne by the Contractor.

Sampling & testing for quality control of concrete

Fresh concrete

Fresh concrete shall be tested for

- Slump
- Compacting factor/workability
- Consistency
- Weight per cubic metre, cement factor and air content.

Slump

For concrete totally mixed in a central plant, slump shall be checked at

- immediately during loading of trucks
- Point of discharge from the delivery truck
- Final placement location

At placement location the slump measured shall conform to the design slump. Manufacturer of concrete shall adjust for loss of slump in transit and establish the requirements of design mix. All slump measurements shall be done within a period of 20 minutes from the time cement is added to the mixer. Placement contractor shall transport concrete from truck discharge point to actual placement location within 10 minutes of delivery before the final slump reading is taken at placement location.

For concrete entirely mixed in transit or for shrink mix concrete, slump readings shall be taken at

- point of discharge from delivery trucks
- final placement location

For measuring concrete slump at point of discharge from delivery trucks, samples shall be taken from concrete omitting the first and the last 15 % of the load. For concrete delivery or placed by pumping, sampling shall be similar to those specified for delivery trucks.

Slump measurement of ready mix concrete transported by buckets shall be at locations specified in above para with some limits of time. Sampling from buckets shall be such that the buckets containing discharge from mixer for the and last 15% are omitted.

At placement locations, samples for checking slump shall be collected from every 20 cum of concrete or part thereof placed at location for each type of concrete.

For all slump checks in the field at least two recordings shall be made and the average value taken as the recorded slump.

Slump checks for concrete in the laboratory shall be carried out as and when required by the manufacturer of concrete during the mix design stage and during the progress of work for control on field results.

Slump readings shall only be a guideline for concrete consistency and shall not be taken as the acceptability criteria for concrete placed at location. All slump tests shall be carried out in accordance with IS : 1199.

For quality control of strict check on the strength of concrete shall be maintained along with other field requirements such as workability, consistency, slump etc. mentioned in para above.

Acceptability criterion for concrete as specified in para above shall only be applicable.

Test on cube crushing strength of concrete in accordance and compliance with IS 456-2000 and IS 516 shall be done as under –

- Samples of fresh concrete shall be taken from concrete at central batch plant mixer while loading delivery trucks or other transport and also from concrete transported to placement location.

- Test on specimens made from samples collected at placement location shall be considered as field test specimens and results therefrom shall be the criterion of concrete strength. Test in specimens made from samples at the batch plant shall only be taken as guide lines test. Only in the case of doubtful result, the Engineer-In-Charge may refer to such guide line results for deciding on the quality of concrete

- For truck mix concrete and shrunk mix concrete guide line test specimens shall be made from samples collected at discharge location from mixing trucks. For this purpose first and last 15% of the load shall be omitted while collecting samples.

The contractor shall set up a laboratory at this own expense which shall have facilities for conducting all necessary field test on materials and field and laboratory test on concrete. The laboratory shall be staffed with qualified and experienced scientists and technicians.

7.11. Industrial Vacuum Dewatered Flooring

General specifications for RCC grade slab/ structural slab shall be as described under-Reinforced cement concrete specifications & shall generally comply with the requirements of IS : 456 - 2000.

Laying of Concrete

Laying of concrete for Grade slab/ structural slab shall be generally as described under-Reinforce cement concrete specifications and laid to the required slope and level as shown on the drawing subject to prior approval of Engineer-In-Charge. Vibrating of the laid concrete with double beam screed vibrator till its setting unless other wise recommended by the process agency. Dewatering of the laid concrete shall be done by using suction pipe and pump after laying lower matt shall be laid on green concrete and excess water can be removed and optimum water cement ratio can be maintained by use of "TREMIX" or other approved process subject to approval of Engineer-In-Charge. The contractor shall execute the work strictly as per the process agency's specifications, methodology and instructions in regard to use of screed vibrators, channels, shuttering, dewatering unit, power floater, power trowel, etc. to get desired smooth finish over a levelling course etc. complete.

- Cutting and filling sealant of grooves / sawed joints / strips for placing land ties etc. shall be as shown on approved drawings, as instructed by the process agencies subject to prior approval of Engineer-In-Charge.

- Application of non-metallic floor hardener of approved makes / unless otherwise specified at 7 Kg/Sq.m. shall be sprinkled over green concrete in alternate bags and trowel simultaneously. Floor laid is to be trowel to acquire desired smooth finish with power trowel.

- When initial setting of concrete is reached, from next day onwards curing with water shall be carried out for minimum seven days.

7.12. Pre-cast Cement Concrete Jali

Material-

The jali shall be of cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 stone aggregate 6 mm nominal size) conforming to the specification as described under Clause No. 3005.1, reinforced with 1.6 mm thick mild steel wire, unless otherwise specified.

Fixing

The jali shall be set in position true to plumb and level before the joints sills and soffits of the openings are plastered. It shall then be properly grouted with cement mortar 1:3 (1 cement: 3 coarse sand) and rechecked for levels. Finally the jambs, sills and soffits shall be plastered embedding the jali uniformly on all sides.

Measurements

The jali shall be measured for its gross superficial area.

Rate

The rate shall be inclusive of materials and labour involved in all the operations described above except plastering of jambs, sills and soffits, which will be paid for under relevant items of plastering.

7.13. 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.

8. 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 ± 3mm. 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 confirm 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.

8.1. 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.

9. STONE WORKS:

9.1. Materials

Stones shall be the best available local stone from approved quarry. They shall be tough, hard, dense, sound and durable, free from cracks, veins, crystals, cavities and other flaws and defects and shall conform to IS 1567 (Part-I). They shall not absorb water more than 5% of their dry weight when immersed in water and tested as per IS 1124 and shall have uniform colour and texture.

Rubble

When used for soling, stones shall be flat bedded and the smallest size shall be equal to the specified thickness of soling with length and breadth generally not exceeding twice the thickness.

Stone metal (for Roads /path ways)

Rubble shall be broken or crushed to pieces to pass through the square mesh of about 65 mm. and all pieces shall be retained on a square mesh of about 10 mm. Not more than 20% of any sample shall exceed 75 mm. in its greatest dimensions. The metal shall roughly be cubical in shape and more or less or uniform size with sharp edges for proper interlocking. Rounded, flaky thin and elongated material shall not be acceptable.

9.2. Laying

The item to includes all labour , materials, tools, scaffolding unless specified etc. necessary to complete the works as per drawing or as directed by the Engineer-In-Charge. Rubble is placed vertical with broad based at bottom. The gaps shall be filled with smaller stones and compacted properly.

9.3. Pre-cast Block Masonry Work

Material

Solid concrete block shall confirm to IS 2185 (I) – latest grade D (5.0) but shall have minimum compressive strength of 5 N/mm² & density not less than 1800 Kg per cub.m. Water absorption average Value of min. 3 units shall not be more than 10% by mass. Mix design for the blocks shall be got prepared from approved lab & further got approved from the Engineer-In-Charge.

Only factory made properly cured concrete blocks shall be used. Manually compacted / hand compacted blocks shall not be permitted at any case. The face of masonry units shall be flat and rectangle, opposite face shall be parallel, and all arises shall be square. The bedding surface shall be at right angles to faces of the block. Storage and stacking as described under relevant IS codes or as directed.

Testing of blocks and frequency shall be as per IS codes. Standard deviation shall be worked out as periodically & mix design shall be reviewed accordingly. The maximum variation in the length of units shall not be more than ± 5 mm and maximum variation in height and width of unit ,not more than ± 3 mm.

Mortar shall be as described under - Mortars specifications. The mortar used for solid block masonry work shall be rich dense cement mortar of mix 1:4.

Work Procedure for block masonry:

Before commencement of work contractor shall ensure that the blocks are semi dry. They should not be soaked in water at the time of use.

Blocks in successive courses should be laid in such a manner that vertical joints are staggered uniformly. Precast half-length closers (cut from full size blocks) shall be used. For battered faces, bedding shall be at right angles to the face unless otherwise directed. Care shall be taken during construction to see that edges of blocks are not damaged.

Two top layers of masonry work shall be constructed after 8 days period from successive course of masonry work. After the construction of balance two layers, the gap between RC work & masonry work shall be filled with metal or grit with proper hammering / cement mortar.

For 10 cm thick Block masonry RC horizontal stiffeners 10 cm thick at every 1.0 meter height or as indicated in the drawing at vertical intervals, with MS 2 No. 6 mm. dia. reinforcements laid in 1:2:4 concrete properly filled as per specifications.

Racking should be done up to depth 12 mm., then remove all excess mortar from masonry wall surface.

In one day's work allow mason to do the masonry work up to 1.0 meter height only

The blocks shall be cast in full / half & quarter length to avoid breakage during construction.

Curing

Newly laid masonry shall be thoroughly cured for 10 days and shall be protected from the effects of sun, rain etc. by suitable covering.

Measurement

The length and height of the wall shall be measured correct to a cm. The area shall be calculated in sq.m where partition block wall is joined to the main walls one block greater thickness and measurements for 10 cm thick block wall shall be taken for its clear length from the face of the thicker wall.

In case of 10 cm thick block masonry, with RC stiffeners / patlis etc. Stiffeners including reinforcement, shuttering etc. shall not be measured separately.

Deductions in Block work shall be as described under –Brick work specifications.

Rate

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

10. MARBLE/ GRANITE STONE WORKS:

10.1. 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.

10.2. 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.

10.3. 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.

10.4. Kadappa/ Granite/ Marble stone window framing

Materials

Kadappa/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.

11. WOOD WORK:

11.1. 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.

11.2. General

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

11.3. 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.

11.4. Workmanship

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

11.5. 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.

11.6. 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.

11.7. 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.

11.8. DOOR, WINDOW AND VENTILATOR FRAMES

11.8.1. 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.

11.8.2. 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.

11.8.3. 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.

11.9. 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.

11.10. 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.

11.11. FLUSH DOOR SHUTTERS

11.11.1. 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.

11.11.2. 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.

11.11.3. 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 mayor 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.

11.11.4. 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.

11.11.5. 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.

11.11.6. 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.

11.11.7. 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.

11.11.8. 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.

11.11.9. 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.

11.11.10. 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.

11.11.11. 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.

11.11.12. 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

11.11.13. 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. .

11.11.14. Fixing

This shall be as specified in CPWD Specifications.

11.11.15. 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.

11.11.16. 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.

11.12. HOLD FASTS

11.12.1. 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 pluged 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.

11.12.2. Measurements

Measurements for the hold fasts shall be in number.

11.12.3. Rate

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

11.13. FITTINGS

11.13.1. 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 lnetal, 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 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-inCharge. 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.

11.13.2. 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 IighUordinary or heavy.

(c) Extruded aluminium alloy butt hinges.

11.13.2.1. 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 tl)e 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.

11.13.2.2. 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.

11.13.2.3. Extruded Aluminium Alloy: These shall be manufactured fr('lM 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.

11.13.2.4. 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.

11.13.2.5. 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 robs 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.

11.13.2.6. 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.

11.13.3. Tower Bolts

11.13.3.1. 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.

11.13.3.2. 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.

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

11.13.3.4. 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.

11.13.3.5. Brass pull bolt locks shall be finished bright, chromium plated or oxidised as specified. Aluminium pull bolt locks shall be anodised and the anodic Goating 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.

11.13.3.6. 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.

11.14. Door Latch

11.14.1. 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.

11.14.2. 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.

11.14.3. 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)lmpact Strength

P.T.M.T. fitting shall be in different colours like White, Green, Blue, Derby Brown, Mushroom, Black, Gold, Silver & Broonze 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.

11.14.4. 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.

11.14.5. 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.

11.15. Universal Hydraulic Door Closer (Exposed Type)

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

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

11.15.3. 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.

11.16. 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.

11.16.1.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**.**

11.16.2.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.

11.16.3.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.

11.16.4.Tolerance

Tolerance in dimensions shall be. ± 5 mm.

11.16.5.Measurement

11.16.5.1. 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.

11.16.5.2. 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.

11.16.6. Rate

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

11.17. FIBRE GLASS REINFORCED PLASTIC (F.R.P.) SHUTTERS

11.17.1. F. R. P. Shutters shall be manufactured conforming to the specifications as per IS 14856 and nomenclature of item & direction of Engineer-in-Charge.

11.17.2. Blocks of any seasoned hardwood of bulk density not less than 450 kg.lm3 at 12 per cent moisture content or any other material of sufficient thickness and length shall be provided inside the shutter at suitable place to hold fittings and fixtures such as aldrops, tower bolt, handle, sliding door bolt, mortice lock etc. Blocks for hinges shall be provided at three locations, unless otherwise specified by the purchaser. One at the centre and other two at 200 mm from the top and the bottom of the shutter. Blocks shall be provided at predetermined places in the shutter so as to fix hinges mortice locks, tower bolts, aldrops, door closures, etc. The finished surface shall be buffed and polished with wax.

11.17.3. Location of Fittings and Accessories

The lock rail of door shutters shall be so placed that is centre line is at a height 850 + 5 mm from the bottom of the shutter. Door shutter shall be fixed to the frame with three hinges, unless otherwise specified by the purchaser, of the type specified. These locations shall be, one at centre and other two at 200 mm from the top and the bottom of the shutter, where blocks have already been provided and suitable indication by depressing the profile has been made. Screws for fixing the hinges shall be screwed in with screwdrivers & not hammered. The length of screw should be 8/30 mm. The hinges used shall be stainless steel or aluminium.

11.18. DOOR, WINDOW, VENTILATOR AND PARTITION FRAMES

11.18.1. 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.

11.18.2. 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.

11.18.3. Measurements

11.18.4. 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.

11.19. 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.

11.19.1. 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.

12. STEEL WORKS:

12.1. 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 plaining of sheared, cropped or gas cut edges is not intended unless the edges warrant such plaining 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 contract. In no case the parts connected butt less than 90% of the surface of contract. 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.

12.2. 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.

TABLE - 14

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	IS: 961 steel
Upto 20 mm.	None	Welding with this process not allowed	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
Over 40 mm. to 63 mm. incl.	110 Deg. C		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 then the specified size and the throat thickness as deposited should not be less than that tabulated below –

Angle between fusion faces		**Throat thickness**
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 65^0 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 tolerances 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 upto 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 upto a depth of 1000 mm, ± 5 mm for depths above 1000mm, upto 2000mm and + 8mm and – 5mm for depths over 2000mm.

12.3. 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.

12.4. 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	± 5 mm
	ii) In lateral direction	± 5 mm

2	Deviation in the level of bearing surface of columns at foundation top with respect to true level	± 5 mm
3	Out of plumbness (verticality) of column axis from true vertical axis as measured at top	
	i) Upto and including 30 m. height	± $\frac{H}{1000}$ or ± 25 mm whichever is less
	ii) Over 30 m. height	± $\frac{H}{1200}$ or ± 35 mm whichever is less
4	Deviation in straightness in longitudinal & transverse planes of column at any point along the height.	± $\frac{H}{1000}$ 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.	± $\frac{1}{250}$ of height of truss in mm. at centre of span or ± 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.	± $\frac{1}{1500}$ 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.	± $\frac{1}{1200}$ 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.	± (Web thickness of girder(mm) ± 2mm)
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 upto & including 15 mm	± 5 mm
	ii) For track gauge more than 15 mm	± (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 1/250th 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.

12.5. 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 ± 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 overspills 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 ± 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 (± 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 form 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.

12.6. 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.

12.7. Rate

As specified in structural steel work.

12.8. 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.

12.9. 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 ± 1mm in 2 metres, cumulative to 5m and ± 3mm 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.

12.10. 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.

ii) **Vertical Rolling Steel shutters**

Materials

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

Fabrication and Erection

Specifications for fabrication and erection of sliding doors shall be generally as described under- Horizontal moving panel sliding doors specifications.

Vertical Rolling Shutter

The drive for rolling shutter shall be through worm / bevel reduction gear. This will have facility for manual operation in case of power failure. The manual operation shall be done

from floor level. Universal coupling only shall be used to connect gearbox output shaft with rolling shutter pipe. Other coupling between motor and gearbox can be of geared type.

Limit switches shall be provided to control the open / close positions of shutter.

Tolerances

Tolerance shall be as described under – Assembly of steel work specifications.

Painting

Painting shall be as described under- Horizontal moving panel sliding door specifications.

12.11. M.S. sag rods with necessary threading

Materials

a) Sag rods shall be made up from mild steel rounds conforming to IS : 432 – Grade I

b) Nuts and lock nuts (hexagonal type) shall be of Grade B as per IS : 1367 and IS : 3138

c) Punched washers shall be of mild steel as per IS : 226 and confirm to IS : 2016

Fabrication

Fabrication of sag rods and their complete assemblies shall be strictly in compliance with the specifications & drawings / standards. Threads to sag rods shall confirm to IS : 4218

Placement

Sag rod assemblies shall be placed in position strictly as per drawings. The holes for sag rods and cleat bolts of appropriate size shall be drilled and all members / components shall be given distinct erection marks in accordance with the marking drawings. Holes shall not be formed by gas cutting process.

Tolerances

Tolerances in length allowed for sag rods shall allowed within ± 2mm

Galvanising

All hot dip galvanising shall be in accordance with I.S. 802 - Part 2.

Before galvanising, all components shall be grit blasted to give a clean roughened surface as a pre-treatment.

The minimum thickness of coating shall be 1000 grams per square metre, unless specified, and shall be measured in accordance with I.S 802 - Part2.

Samples of galvanised steelwork shall be tested at the galvaniser's works prior to despatch to ensure compliance with the coating requirements.

The items to be galvanised are included in the Drawings or otherwise as directed by the Engineer-In-Charge.

Measurement

The sag rods as fixed in place shall be measured in running metres correct to a centimetre and their weights calculated on the basis of Bureau of Indian Standard's Structural Engineer's Handbook No. 1 latest issue correct to the nearest kilogram unless otherwise specified. Weight of nuts, washers, shall be added unless otherwise specified.

Rate

The rate shall include the cost of labour and material involved in the operations described above including galvanising conforming to the specification as described above and as applicable.

12.12. CRS steel in track work

Specifications shall be as described under **Section- 9000: Track work** under relevant clauses as applicable for this item of work.

12.13. 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 assembles 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 upto 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.

12.14. M.S. foundation bolt

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

12.15. 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 upto 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.

12.16. 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, smoothening 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.

12.17. 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.

12.18. 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. confirming 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.

12.19. 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.

12.20. M.S. Steel Rolling Shutters

Material

Rolling shutters shall be of specified design and sizes and procured from approved manufacturers conforming to IS 6248,

Unless otherwise specified, rolling shutter

- shall be in 18 g. MS sheets and shall have 75 mm. Machine rolled lathes, interlocked with each other and ends locked with clips.
- shall have side guides of pressed steel channel 75 mm. Deep and 25mm wide fixed with necessary hold fasts etc.,
- shall be complete with necessary side guide brackets, suspension shafts, top rolling springs, locking haps and staples on both sides with the bottom lock plates, handles, top hood cover of 20 g. MS sheet with necessary stiffeners and frame work to prevent sagging.
- shall be complete with pulling hooks, gear mechanism, gear handles
- Lock plate must be of minimum 3.15 m. thickness with MS angle section of not less than 33 x 35 x 5 mm. at bottom.

Fixing

The arrangement for fixing in different situations in the opening shall be as per IS:6248 . Brackets shall be fixed on the lintel or under the lintel as specified with rawl, plugs and screws bolts, etc. The shaft along with the spring shall then be fixed on the brackets. The lap portion (shutter) shall be laid on ground and the side guide channels shall be bound with ropes etc. The shutters shall then be placed in position and top fixed with pipe shaft

with bolts and nuts. The side guide channels and cover frames shall then be fixed to the walls through the plate welded to the guides. These plates and brackets shall be fixed by means of steel screws bolts, and rawl plugs concealed in plaster to make their location invisible. Fixing shall be done accurately in a workman like manner that the operation of the shutter is easy and smooth.

Rolling shutter shall be of approved manufacture suitable for fixing in the position ordered i.e., outside, inside, on or below lintel or between Jambs. Shutters upto 12 sq.m. (130 Sq m. ft.) in area shall be manually operated or "Push up" type while bigger sizes shall be of reduction gear type mechanically operated by chain or handles.

These shall consist of an 18 gauge sheet or as specified with 75 mm (3") M.S. laths of best quality mild steel strip machine rolled and straightened with an effective bridge depth of 16 mm. (5/8") and shall have convex corrugation. These shall be interlocked together throughout their entire length with end locks. These shall be mounted on specially designed pipe shaft.

The springs shall be of approved make coiled type. These shall be manufactured from tested high tensile spring steel wire or strip of adequate strength to balance the shutters in position. The spring pipe shaft etc. shall be supported on strong M.S. or malleable cast iron brackets.

Top cover of shaft, spring etc. shall be of the same material as that of lath.

Both the side guides and bottom rail shall be joint less and of single piece of pressed steel.

For rolling shutter with wicket gate night latch shall be provided.

The complete shutter with cover shall be painted with one coat of zinc chromate primer and two coats of synthetic enamel paint of approved quality and shade.

Finish

All surfaces shall be cleared by sand blasting or chemically and immediately painting them with the coats of zinc chromate.

Painting

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

Measurement

Clear width and clear height of opening for rolling shutter shall be measured. The clear distance between the two jams of the opening shall be clear width and the clear distance between the sill and the soffit (bottom of lintel) of the opening shall be the clear height.

Measurements shall be in square meters for actual clear opening.

Rate

The rate shall include the cost of materials and labour involved in all operations described above including, cost of top cover, night latch if any and spring except ball bearing and mechanical device of chain and crank operation, which shall be paid for separately.

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.

12.21. Steel doors

Steel doors, shall be of specified design and sizes and procured form approved manufactures only and shall confirm to IS : 1038.

The actual sizes of units shall not vary by more than 1.5 mm. from those given in the drawings.

All fittings and fixtures shall be in oxidised brass as specified or as directed. Machine screws used shall confirm to IS : 1362 in residential buildings and IS : 4218 in industrial buildings, wood screws used shall confirm to IS : 451.

The framework for doors shall be strong and rigid, neat in appearance, free from any warping, buckling or any other flaws and defects. All frames shall be square and flat. Exposed welded joints shall be dressed smooth.

Fabrication / fixing

Steel Doors

All steel doors and frames shall be made of mild steel, welded without deposition of metal and properly reinforced. Corners shall be of welded construction with all joint faces welded and ground smooth.

Collapsible Steel Gate

It shall consist of vertical double channels at 10 cm. centres. The sizes of channels T-Section for top and bottom shall be as approved by Engineer-In-Charge and/or as per

drawing. The gate shall be provided with necessary bolts, buts, locking arrangement, stoppers and with brass handles on both sides. The gate shall be painted with one coat of anti-corrosive paint before erection and two coats of synthetic enamel paint of approved quality and shade.

Wrought Iron Grill

Grills shall be manufactured as per drawings and the welded joints shall be smooth.

Painting

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

Measurement

The measurement for collapsible gates / steel doors shall be in Sq.m. The height of the gate shall be measured as the length of the double channels and breadth from outside of the end fixed double channels in open position, of the gate.

12.22. Pressed Steel Door Frames :

Material

Steel door frames shall be manufactured from mild steel sheet of 1.25mm thickness, unless specified, conforming to IS : 226 and IS : 4351

Steel door frames with our without fan light shall be made in the profiles, which may be manufactured to suit doors of either type opening inwards or outwards as directed by the Engineer-In-Charge.

Construction

Each door frame shall consist of hinge jamb, lock jamb, head and if required angle threshold. These shall be welded or rigidly fixed together by mechanical means. Where no angle threshold is required, temporary base tie shall be screwed to the feet of frames in order to form a rigid unit. Where so specified base ties shall be pressed mild steel 1.25mm thick adjustable to suit floor thickness of 35 or 40mm and removable, or alternatively, threshold of mild steel angle of section 50 x 25mm minimum shall be provided for external doors frames.

Fabrication

The pressed door frames shall be got fabricated in an approved workshop as approved by the Engineer-In-Charge and shall be as per approved for construction drawing.

Hinges: 100mm mild steel butt hinges shall be used. For door frames upto 89cm wide three hinges shall be rigidly fixed to one jamb and for frames for door above 89cm wide, four hinges shall be rigidly fixed to one jamb, if it is single shutter. Where the height of door shutter exceeds 2.15 metres one additional hinge shall be provided for every 0.5m or part thereof of the additional height.

In all cases the hinges shall be so fixed that the distance from the inside of the head rebate to the top of the upper hinge is 20cm and distance from top of upper hinge to lower hinge is about 175cm.

Hinges shall be made of steel 2.5mm thick with zinc coated removable pin of 6mm diameter, unless specified. The space between the two leaves of the hinge when closed

shall be 3mm and the leaf that is not welded to the frame shall have four counter sunk holes to take No. 10 wood screws.

Mortar Guards: Mortar guards as instructed by Engineer-In-Charge shall be provided. These shall be welded to the frame at the head of the frame for double shutter doors to make provision for bolts.

Lock-Strike Plate: There shall be an adjustable lock strike plate of steel complete with mortar guard to make provision for locks or latches complying with the relevant Indian Standards. Lock-strike plates shall be of galvanized mild steel and fixed at 95cm from the head of the frame.

Shock Absorbers : For side hung door there shall not be less than three buffer of rubber or other suitable materials inserted in holes in the rebate and one shall be located on the centre line of the lock strike plate and the other two at least 45cm above and below the centre line of the lock strike plate. For double shutter doors, there shall be two buffers or rubber or similar suitable material inserted in holes in the rebate in the lock jamb only at the head and spaced 15cm at either side of the centre line of the door.

Finish

The surface of door frame shall be thoroughly cleaned, free of rust, mill-scale dirt, oil etc. either by mechanical means, for example, sand or shot blasting or by chemical means such as picking. After pre-treatment of the surface one coat of approved primer i.e. yellow zinc chrome primer conforming to IS : 2074 and two coats of synthetic enamel paints of approved make and shade as directed by the Engineer-In-Charge shall be applied to the exposed surface.

Fixing

Frames shall be fixed up right in plumb. To avoid sag or bow in width during fixing or during construction phase, temporary struts across the width preventing sides bulging inwards may be provided. Wall shall be built solid on each side and grouted at each course to ensure solid contract with frame leaving no voids behind the frame.

Three lugs shall be provided on each jamb with spacing not more than 75cm. The temporary struts should not be removed till the masonry behind the frame is set. In case screwed base tie is provided, this should be left in position till the flooring is laid.

After pre-treatment of the surface, two coats of zinc chromate primer and two coats of synthetic enamel paint, as described under clause 3010.7 above or as directed by the Engineer-In-Charge shall be applied to the exposed surface.

Measurements

i) Frames : The length shall be measured in running metre correct to a cm along the centre line of the frames.

ii) Shutters : Width and height of shutter shall be measured to the nearest to cm. The area shall be calculated in sq.m.

12.23. MS Fan Clamps :

Types

Fan clamp shall be fixed during the laying of RCC slab and shall be made of 16mm M.S. bar bent to shape with its ends hooked, as approved. The overall height of the clamps shall be made to suit the depth of the slab and minimum length shall be about 1200 mm.

Fixing

Holes for inserting the fan clamps in the position shown in the drawing or as instructed by the Engineer-In-Charge shall be made in the shuttering after the latter has been fixed in position. After steel reinforcement is tied, fan clamps shall be fixed with their loops truly vertical and at the correct depth from the underside of the slab or beam. The hooked arms and the loop shall be tied to the reinforcement, either directly or through cut pieces of M.S. bars with annealed steel wire 1.6mm or 1.00mm thick. The clamp shall neither be disturbed out of position during concreting nor shall they be bent out of shape when shuttering of slabs or beams is removed.

The exposed portion of loops of the clamp shall be given two coats of approved synthetic enamel paint, including priming coat, of approved steel primer as ordered by the Engineer-In-Charge.

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.

12.24. 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 confirm 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 bend 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. of 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.

12.25. 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^{o} 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 7^0C.

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.

13. FINISHING WORKS:

13.1. 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 other wise 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 upto 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 r 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.

13.2. 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 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 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.

13.3. 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.

13.4. 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 40^0 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.

13.5. 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 other wise 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.

13.6. 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.

13.7. 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.

13.8. 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 case.

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.

13.9. 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.

13.10. 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 form 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.

13.11. 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 rages 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

13.12. 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.

13.13. 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.

13.14. 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.

13.15. 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.

13.16. 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.**

13.17. 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.

14. 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.

14.1. 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.

14.2. 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 me 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 including roughening and cleaning the surface of base concrete. The base concrete shall be paid for separately.

14.3. 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.

14.4. 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.

14.5. 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 then 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.

14.6. Vinyl Flooring

Material

The PVC flooring material shall conform to IS: 3462. It may in the form of tiles, sheets or rolls as specified. It shall consist of thoroughly blended composition of thermoplastic binder, filler and pigments. The thermoplastic binder shall consist substantially to one or both of the following:

a) Vinyl chloride polymer
b) Vinyl chloride copolymer.

The polymeric material shall be compounded with plasticizers & stabilizers.

The thickness of PVC tiles for normal floor covering shall be normally1.5, 2.0, 2.5, 3.0, or 4.0 mm and only specified thickness shall be used for work.

Tiles shall be laid as per the design/details furnished by the Engineer-In-Charge conforming to the relevant IS Standards.

Rubber based adhesives are suitable for fixing over concrete, wooden and metal sub-floors. PVA based adhesives shall be used for concrete and wooden sub-floors. PVA based adhesives are not suitable for metallic surfaces and also for locations where there is constant spillage of water.

Laying and fixing

The surface of the floor or wall to be treated with these tiles shall be smooth and even. This surface as also the back side of the tile sheets shall be cleaned with dry cloth or cotton waste and then the sticking solution shall be applied evenly thereto and the same shall be allowed to dry. The sheets shall be placed with absolutely close joints and pressed at top from one end to the other to ensure proper sticking without any air gap.

The sheets shall finally be cleaned with cotton waste dipped in cleaning solution to remove any stains etc.

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 all required adhesives and surface preparations, cleaning etc.

14.7. 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.

15. ROOFING

15.1. 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.

15.2. 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.

15.3. 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.,

15.4. 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.

16. 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.

16.1. Scaffolding

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

16.2. 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.

16.3. 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.

16.4. 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.

16.5. 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.

16.6. 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.

16.7. 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.

16.8. 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.

16.9. 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.

16.10. 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.

16.11. 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 out side the premises into approved dumping grounds.

17. MISCELLANEOUS:

17.1. 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.

17.2. 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.

17.3. Bitumen: Bitumen for filling joints shall conform to IS 3117 / IS 3037.

17.4. 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.

17.5. Galvanised iron Chain link fencing

Materials

The material requirement shall confirm 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 consists 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 bye passed by the wire except where deviation is necessary at the straining posts. The second top line wire shall be stained 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.

17.6. 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.

18. ROAD WORK:

18.1. Specifications for road work shall be as described under Ministry of Road Transport & Highways (MORTH). Under relevant clauses as applicable.

18.2. Factory made Precast concrete paver blocks :

Materials

Cement

The cement used in the manufacture of high quality factory made precast concrete paving block shall be conforming to IS 12269 latest (53 grade) ordinary Portland cement or IS 8112 (43 grade ordinary Portland cement). The minimum cement content in concrete used for making paver blocks should be 400 kg/cu.m.

Aggregates

The fine and coarse aggregates shall consist of naturally occurring crushed or uncrushed materials, which apart from the grading requirements comply with IS 383 (latest). The fine aggregates used shall contain a minimum of 25 % natural silicon sand. Lime stone aggregates shall not be used. Aggregates shall contain no more than 3% by weight of clay and shall be free from deleterious salts and contaminants.

Water

The water shall be clean and free from any deleterious matter. It shall meet the requirements stipulated in IS: 456-2000.

Other materials

Any other material/ingredients used in the concrete shall conform to latest IS specifications.

Paver Block Characteristics

The factory made precast concrete paver block (conforming to IS 2745-1974), shall have a size of 200 x 100 x 100 mm and shall have a 6 mm peripheral chamfer on the top edges. The maximum dimensional deviation from the stated size shall be as follows –

Length/Width	+/- 2 mm
Thickness	+/- 3 mm

The average compressive strength of precast blocks when tested in accordance with the relevant IS Code shall not be less than 45 N/sq. mm. For every 1000 sq.m. of laid area, minimum 6 Nos. blocks shall be tested.

Sand (conforming to relevant IS Code) bedding shall have a compacted thickness of 50 mm. The sand for this purpose shall be clean, sharp and containing not more than 5 % silt and clay.

The concrete pavers should be perpendicular after release from the mould and the same should be retained until the laying.

The surface should be of anti-skid and anti-glare type.

The paver should have uniform chamfers to facilitate easy drainage of surface run off.

The pavers should have uniform interlocking space of 2 mm to 3 mm to ensure compacted sand filling after vibration on the paver surface.

The concrete mix design should be followed for each batch of materials separately and automatic batching plant is to be used to achieve uniformity in strength and quality.

The pavers shall be manufactured in single layer only.

Skilled labour should be employed for laying blocks to ensure line and level for laying, desired shape of the surface and adequate compaction of the sand in the joints.

The pavers are to be skirted all round with kerbing using solid concrete blocks of size 100 mm x 200 mm x 400 mm or as directed by the Engineer-In-Charge. The kerbing should be embedded for 100 mm depth. The concrete used for kerbing shall be cured properly for minimum 7 days.

Laying

Priming

It will be the responsibilities of the Contractor to ensure that the manhole / pipeline cable trenches / circular drainage system etc. raised to driveway level using the requisite materials as per instruction of Engineer-In-Charge. The areas of potholes / deep depressions at the isolated locations also have to be filled up before laying the paver blocks. No extra pavements will be made for this purpose.

It will be the responsibility of the Contractor to ensure that undulations on the pavers blocks are eliminated after the traffic is allowed on it. Proper slope for drainage of water needs to be ensured by the Contractor. All necessary materials, tools, tackles are required to be arranged by the Contractor.

Bedding sand course

The bedding sand shall consist of clean well graded sand passing through 4.75 mm sleeve and suitable for concrete. The bedding should be from either a single source or blended to achieve the following grading –

In sieve size	**% Passed**
9.52 mm.	100
4.75 mm	95-100
2.36 mm	80-100
1.18 mm.	60-100
600 microns	25-60
300 microns	10-30
150 microns	5-15
75 microns	0-10

Contractor shall be responsible to ensure that single-sized, gap-graded sands or sands containing an excessive amount of fins or plastic fins are not used. The sand particles should preferably be sharp not rounded as sharp sand possess higher strength and resist the migration of sand from under the block to less frequency areas even though sharp sands are relatively more difficult to compact than rounded sands, the use of sharp sands is preferred for the more heavily trafficked driveways. The sand used for bedding shall be free of any deleterious soluble salts or other contaminants likely to cause efflorescence.

The sand shall be of uniform moisture content and within 4% - 8% when spread and shall be protected against rain when stock piled prior to spreading. Saturated sand shall not be used. The bedding sand shall be spread loose in a uniform layer as per drawing. The

compacted uniform thickness shall be of 50 mm and within tolerance of ± 5 mm. Thickness variation shall not be used to correct irregularities in the base course surface.

The spread sand shall be carefully maintained in a loose dry condition and protected against pre-compaction both prior to and following screeding. Any pre-compacted sand or screeded sand left overnight shall be loosened before further laying of paving blocks take place.

Sand shall be slightly screeded in a loose condition to the predetermined depth only slightly ahead of the laying of paving unit.

Any depressions in the screeded sand exceeding 5 mm shall be loosened, raked and re-screeded before laying of paving blocks.

Laying of interlocking paver blocks :

Paver blocks shall be laid in herringbone laying pattern throughout the pavement. Once the laying pattern has been established, it shall continue without interruption over the entire pavement surface. Cutting of blocks, the use of infill concrete or discontinuities in laying pattern shall not be permitted other than at approved locations.

Paver blocks shall be placed on the uncompacted screeded sand bed to the nominated laying pattern, care being taken to maintain the specified bond throughout the job. The first row shall be located next to an edge restraint. Specially manufactured edge paving blocks are permitted or edge blocks may be cut using a power saw, a mechanical or hydraulic guillotine, bolster or other approved cutting machine.

Paver blocks shall be placed to achieve gaps nominally 2 to 3mm wide between adjacent paving joints. No joint shall be less than 1.5mm not more than 4mm. Frequent use of string lines shall be used to check alignment. In this regard the “laying face” shall be checked at least every two metres as the face proceeds. Should the face become out of alignment, it must be corrected prior to initial compaction and before further laying job proceed.

In each row, all full blocked shall be laid first. Closure blocks shall be cut and fitted subsequently. Such closer blocks shall consist of not less than 25% of a full block .

To infill spaces between blocks upto a gap of 50mm, concrete having screened sand, coarse aggregate mix and strength of 45 N/sq. mm shall be used. Within such mix the nominal aggregate size shall not exceed one third the smallest dimension of the infill space. For smaller spaces dry packed mortar shall be used of required strength.

Except where it is necessary to correct any minor variations occurring in the laying bond, the paver blocks shall not be hammered into position. Necessary care shall be taken to avoid premature compaction of the sand bedding when working adjustment of paver blocks,

Initial Compaction

After laying the paver blocks, they shall be compacted to achieve consolidation of the sand bedding and brought to design levels and profiles by not less than two (2) passes of a suitable plate compactor.

The compactor shall be a high-frequency, low amplitude mechanical flat plate vibrator having plate area sufficient to cover a minimum of twelve paving blocks. Prior to compaction all debris shall be removed from the surface.

Compaction shall proceed as closely as possible following laying and prior to any traffic. Compaction shall not, however, be attempted within one metre of the laying face. Compaction shall continue until lipping has been eliminated between adjoining blocks. Joints shall then be filled and re-compacted as described above.

All work further than one metre from the laying face shall be left fully compacted at the completion of each day's laying.

Any blocks that are structurally damaged prior to or during compaction shall be immediately removed and replaced.

Sufficient plate compactors shall be maintained at the paving site for both bedding compaction and joint filling.

Joint filling and final compaction :

As soon as possible after compaction and in any case prior to the termination of work on that day and prior to the acceptance of vehicular traffic, sand for joint filling shall be spread over the pavement.

Joint sand shall pass a 2.36 mm (No. 8) sieve and shall be free of soluble salts or contaminants likely to cause efflorescence. The same shall comply with the following grading limits –

In sieve size	**% passing**
2.36 mm.	100
1.18 mm	90-100
600 microns	60-90
300 microns	30-60
150 microns	15-30
75 microns	10-20

The Contractor shall supply a sample of the jointing sand to be used prior to delivery and such materials to site for incorporation into the works. Certificates of test results issued by a recognized testing laboratory conforming that the samples conform to the requirements of this specifications shall accompany the sample.

The jointing sand shall be broomed to fill the joints. Excess sand shall then be removed from the pavement surface and the jointing sand shall be compacted with not less than one (1) Pass by the plate vibrator and joints refilled with sand to full depth. This procedure shall be repeated until all joints are completely filled with sand. No traffic shall be permitted to use the pavement until all joints have been completely filled with sand and compacted.

Both the sand and paver blocks shall be dry when sand is spread and broomed into the joints to prevent premature setting of the sand.

The difference in level (lipping) between adjacent blocks shall not exceed 3mm with not more than 1% in any 3 m x 3 m area exceeding 2 mm. Pavement which is deformed beyond above limits after final compaction shall be taken out and reconstructed to the satisfaction of the Engineer-In-Charge.

Edge Restraint

Edge restrains need to be sufficiently robust to withstand override by the anticipated traffic to withstand thermal expansion and to prevent loss of the laying course material from beneath the surface course. The edge restraint should present a vertical face down to the level of the underside on the laying course.

The surface course should not be vibrated until the edge restraint together with any bedding or concrete hunching has gained sufficient strength. It is essential that edge restraints be adequately secured.

Sampling and testing

Frequency of testing shall be minimum 6 samples per 1000 Sq.m. laid area. Sampling for testing of paver blocks shall be done in accordance with following –

Method of Sampling

Before laying paver blocks, each designated section comprising not more than 50,000 blocks shall be divided into ten approximately equal groups. Nine blocks shall be drawn from each group.

Marking and Identification

All samples shall be clearly marked at the time of sampling in such a way that the designated section of part thereof and the consignment represented by the sample are clearly defined.

The sample shall be dispatched to the approved test laboratory taking precaution to avoid damage to the paving in transit. Protect the paving from damage and contamination until they have been tested. The samples shall be stored in water at $20^{O}C + 5^{O}C$ for 24 hours prior to testing.

Compressive Strength

The average compressive strength of the 100 mm. thick paver blocks tested shall be 45 N/Sq. mm. Testing for compressive strength shall be undertaken in accordance with the following -

Testing Machine

The testing machines shall be of suitable capacity for the test and capable of applying the load at the rate specified. It shall comply as regards repeatability and accuracy with the requirements of relevant IS Specification.

Procedure

The sample specimens shall be tested in wet condition after being stored for at least 24 hours in water maintained at a temperature of 20^{0} C + 5^{0} C before the specimens are submerged in water, the necessary area shall be determined.

The plates of the testing machine shall be wiped clean and any loose girt or other material removed from the contact faces of the specimen. Plywood normally 4 mm. thick shall be used as packing between the upper and lower faces of the specimen and the machine plates and these boards shall be larger than the specimen by a margin of at least 5 mm at all points. Fresh packing shall be used for each specimen tested. The specimen shall be placed in the machine with the wearing surface in a horizontal plane and in such a way that the axes of the specimen are aligned with those of the machine plates. The load shall be applied without shock and increased continuously at the rate of Approximately 15 N/sq. mm per minute until no greater load can be sustained. The maximum load applied to the specimen shall be recorded.

Calculation of corrected strength

The compressive strength of each block specimen shall be calculated by dividing the maximum load by full cross section area and multiplying by an appropriate factor as given below:

TABLE 15

Work size thickness	Correction Factors	
	Plain block	Chamfered block
60	1.00	1.06
80	1.12	1.18

100	1.18	1.24

Compressive strength calculations

The average corrected compressive strength for the designed block section shall be calculated.

Water Absorption

Testing for water absorption shall be in accordance with IS: 2185: 1979: (Specifications for Concrete Masonry Blocks) as follows –

2% absorbed after 10 minutes
5% absorbed after 24 minutes.

Method for the determination of water absorption

The test specimens shall be completely immersed in water at room temperature for 24 hours.

The specimens shall then be weighed, while suspended by a metal wire and completely submerged in water.

They shall be removed from the water and allowed to drain for one minute.

Visible surfaces water being removed with a damp cloth and immediately weighed.

Subsequent to saturation, all specimens shall be dried in a ventilated oven at 100 to 115 Dec. C for not less then 24 hours and until two successive weightings at intervals of 2 hours show an increment of loss not greater then 0.2 percent of the last previously determined mass of the specimen.

Calculate the absorption as follows:

Absorption, kg/cu.m = $\frac{A - B}{A - C}$ x 1000)	Where A = Wet mass of unit in Kg B = Dry mass of unit in Kg and
Absorption, percent = $\frac{A - B}{B}$ X 100	C = Suspended immersed mass of unit in Kg

Rates

The rate shall include the cost of all materials and labour involved in all the operations described above including the cost of cleaning of compacted sand bedding below including sampling and testing. The rate shall also allow for using different coloured paver blocks of unshaped as per drawing or as directed by the Engineer-In-Charge.

18.3. TACK COAT

HOT STRAIGHT RUN BITUMEN

The rate of application of binder which shall be as specified and which shall conform to 16.1.5 shall depend on the surface on which the premix carpet is to be laid.
(a) 0.75 kg/sqm on W.B.M. surface.
(b) 0.50 kg/sqm on existing black topped surface.

Materials

Bitumen : This shall be straight-run bitumen of penetration value 80/100 (VG 30) conforming to IS 73 specifications.

Preparation of Surface

Cleaning

Prior to the application of bitumen, all vegetation, loose sealing compound, caked mud, animal dung, dust, dirt and foreign material shall be removed from the entire surface of the pavement and from existing dummy, construction and expansion joints (wherever existing) by means of mechanical sweepers and blowers, otherwise with steel wire brushes, small picks, brooms or other implements as approved by the Engineer-in-Charge. The material so removed shall be disposed off as directed by the Engineer-in-Charge.

Weather and Seasonal Limitations

The tack coat shall not be applied nor any bitumen work done during rainy weather or when the surface is damp or wet or when the atmospheric temperature in the shade is not more than 16° C.

Application of Tack Coat

Heating : Bitumen shall be heated in a boiler to a temperature of 165 deg. C to 175 deg. C and maintained at that temperature. Temperature shall be checked at regular intervals with the help of a thermometer.

Application of Bitumen : Hot bitumen shall be applied evenly to the clean, dry surface by means of a pressure sprayer at specified rate. Even and uniform distribution of bitumen shall be ensured. Bitumen shall be applied longitudinally along the length of the pavement and never across it. Excessive deposits of bitumen caused by stopping or starting of the sprayer or through leakage or any other reason shall be suitably rectified.

Measurements

Length and breadth shall be measured correct to a cm, along the surface of pavement. Area shall be worked out in sqm correct to two places of decimal.

Rate

Rate shall include the cost of all materials and labour involved in all the operations described above.

TACK COAT WITH BITUMEN—EMULSION

Specification of item 24.1 to be followed except Bitumen emulsion (Rapid Setting) of specified grade and consistency to be used at room temperature instead of hot straight run bitumen at following rate.

1. on w.b.m @ 0.4kg/sqm.
2. on bituminous surface @ 0.25 kg/sqm.

18.4. ASPHALT ROAD

Please refer MORTH specification as mentioned below:

GSB – MORTH specification (401)

WMM - MORTH specification (406)

DBM - MORTH specification (507)

BC - MORTH specification (512)

19. PILE WORK:

PILE FOUNDATION

This work shall consist of construction of piles for structures in accordance with the details shown on the drawings and conforming to the requirements of these specifications.

. The construction of pile foundations requires a careful choice of the piling system depending upon sub–soil conditions and loading characteristics and type of structure. The permissible limits of total and differential settlements, unsupported length of pile under scour, impact/entanglement of floating bodies and any other special requirements of project are also equally important criteria for selection of the piling system. The method of installing the piles, including details of the equipment shall be submitted by the Contractor and got approved from the Engineer.

The work shall be done as per IS: 2911 except as modified herein.

18.1 MATERIALS

18.1.1. The basic materials shall conform to the specifications for materials given in Section 400. The specifications for steel reinforcement, structural concrete, and structural steel to be used in pile foundations shall be as given in the relevant sections.

18.1.2. Concrete in Piles

Grade of concrete to be used in cast-in-situ piles shall be as specified in the drawing and the cement content shall not be less than 400 kg per cubic meter of concrete. Maximum water cement ratio shall be 0.5 for cast-in-situ piles and 0.45 for precast piles.

The minimum slump of concrete for bored cast-in-situ piles shall be 150 mm to 200 mm. The slump should not exceed 200 mm in any case.

Concrete mix should have homogeneous mixture with required workability for the system of piling adopted. Suitable and approved admixtures may be used in concrete mix where necessary.

Where piles are exposed to action of harmful chemicals or severe conditions of exposure due to presence of sulphate, chloride etc. it may be preferable to opt for higher grades of concrete restricting water cement ratio to 0.45. Special types of cement, such as sulphate resistant cement may be used where considered appropriate.

18.2 TEST PILES

18.2.1 Test piles which are shown on the drawings or specified in the contract or installed by the Contractor on his own to determine the lengths of piles to be furnished shall conform to the requirements for piling as indicated in these specifications, if they are to be incorporated in the completed structure.

Test piles that are to become a part of the completed structure shall be installed with the same type of equipment that is proposed to be used for piling in the actual structure.

Test piles which are not to be incorporated in the completed structure shall be removed to at least 1000 mm below the proposed cut-off level of pile and the remaining hole (if any) shall be backfilled with earth or other suitable material.

The piles shall be load tested in accordance with provisions laid down in this section.

18.3 CAST-IN-SITU CONCRETE PILES

Cast-in-situ concrete piles shall be installed by making a bore into the ground by removal of material. Cast-in-situ concrete piles shall be cast in metal shells which may remain permanently in place.

The metal casing shall be of sufficient thickness and strength to hold its original form and show no harmful distortion after it and adjacent casings have been driven and the driving core, if any, has been withdrawn.

Liner or bore-hole which is improperly located or shows partial collapse that would affect the load carrying capacity of the pile, shall be rejected or repaired as directed by the Engineer at the cost of the Contractor.

Wherever practicable, concrete should be placed in a clean dry hole. Where concrete is placed in dry and there is casing present, the top 3 m of the pile shall be compacted using internal vibrators. The concrete should invariably be poured through a tremie with a funnel so that the flow is directed and concrete can be deposited in the hole without segregation.

The casing of cast-in-situ piles shall not be allowed to be withdrawn.

Care shall be taken during concreting to prevent as far as possible the segregation of the ingredients. The displacement or distortion of reinforcement during concreting shall be avoided.

The concrete shall be properly graded, shall be self-compacting and shall not get mixed with soil, excess water, or other extraneous matter. Special care shall be taken in silty clays and other soils with the tendency to squeeze into the newly deposited concrete and cause necking. Sufficient head of green concrete shall be maintained to prevent inflow of soil or water into the concrete.

The placing of concrete shall be a continuous process from the toe level to the top of the pile. To prevent segregation, a tube or tremie pipe as appropriate shall be used to place concrete in all piles.

To ensure compaction by hydraulic static heads, rate of placing concrete in the pile shaft shall not be less than 6 m (length of pile) per hour.

For bored cast-in-situ piles, casting/liner shall be driven open ended with a pile driving hammer capable of achieving penetration of the liner to the length shown on the drawing or as approved by the Engineer. Materials inside the casing shall be removed progressively by air lift, grab or percussion equipment or other approved means.

For piles used in soils liable to flow, the bottom of the casting shall be kept enough in advance of the boring tool to prevent the entry of soil into the casing, thus preventing the formation of cavities and settlements in the adjoining ground. The water level in the casing should generally be maintained at the natural ground water level for the same reasons. The joint of the casing shall be made as tight as possible to minimise inflow of water or leakage of slurry during concreting.

Boring shall be carried out using rotary or percussion type equipment. Unless otherwise approved by the Engineer, the diameter of the bore-holes shall be not more than the inside diameter of the liner.

Prior to the lowering of the reinforcement cage into the pile shaft, the shaft shall be cleaned of all loose materials. Cover to reinforcing steel shall be maintained by suitable spacers.

The diameter of the finished pile shall not be less than that specified and a continuous record shall be kept by the Engineer as to the volume of concrete placed in relation to the length cast.

Before concreting under water, the bottom of the hole shall be cleaned of drilling mud and all soft or loose material very carefully. In case a hole is bored with use of drilling mud, concreting should not be taken up when the specific gravity of bottom slurry is more than 1.2. The drilling mud should be maintained at 1.5 m above the ground water level.

Concreting under water for cast-in-situ concrete piles may be done either with the use of tremie method or by the use of an approved method specially designed to permit under water placement of concrete.

General requirements and precautions for concrete under water are as follows:

(a) The concreting of a pile must be completed in one continuous operation. Also, for bored holes, the finishing of the bore, cleaning of the bore, lowering of reinforcement cage and concreting of pile for full height must be accomplished in one continuous operation without any stoppage.

(b) The concrete should be coherent, rich in cement with high slump and restricted water cement ratio.

(c) The tremie pipe will have to be large enough with due regard to the size of aggregate. For 20 mm aggregate the tremie pipe should be of diameter not less than 150 mm and for large aggregate, larger diameter tremie pipes may be necessary.

(d) The first charge of concrete should be placed with a sliding plug pushed down the tube ahead of it to prevent mixing of water and concrete.

(e) The tremie pipe should always penetrate well into the concrete with an adequate margin of safety against accidental withdrawal if the pipe is surged to discharge the concrete.

(f) The pipe should be concreted wholly by tremie and the method of deposition should not be changed part way up the pile to prevent the laitance from being entrapped within the pipe.

(g) All tremie tubes should be scrupulously cleared after use.

The minimum embedment of cast-in-situ concrete piles into the structure supported by pile shall be 150 mm. Any defective concrete at the head of the completed pile shall be cut away and made good with new concrete. The clear cover between the bottom reinforcement in structure supported by pile from the top of the pile shall be not less than 25 mm. The reinforcement in the pile shall be exposed for full anchorage length to permit it to be adequately bonded into the pile cap. Exposing such length shall be done carefully to avoid damaging the rest of the pile. Defective piles shall be removed or left in place as judged convenient without affecting the performance of adjacent piles or pile cap. Additional piles shall be provided to replace the defective piles.

18.4 Driving Equipment

Piles casings shall be driven with any type of drop hammer, diesel hammer or single-acting steam or compressed air hammer, provided they penetrate to the prescribed depth or attain the designed resistance without being damaged. The weight or power of the hammer should be sufficient to ensure a penetration of at least 5 mm per blow, unless rock has been reached. It is always preferable to employ the heaviest hammer practicable and to limit the stroke, so as not to damage the pile. The minimum weight of the hammer shall be 2.5t. In the case of precast concrete piles the mass of the hammer shall be not less than 30 times the mass of 300 mm length of pile.

Stream or air hammers shall be furnished along with boiler or air compressor of capacity at least equal to that specified by the manufacturer of the hammers. The boiler or air compressor shall be equipped with an accurate pressure gauge at all times. The valve mechanism and other parts of steam, air or diesel hammers shall be maintained in first class condition so that the length of stroke and number of blows per minute for which the hammer is designed, will be obtained. Inefficient steam, air or diesel hammers shall be removed from the work.

18.5 DRIVING

18.5.1 General Procedure

Details of the equipment and the method proposed for driving the pile casing shall be submitted with the tender for scrutiny and approval of the Engineer. Piles casing shall be installed from firm ground or from temporary supports or from fixed platform. The arrangement shall provide sufficient rigidity to ensure

accuracy of pile casing driving under all conditions of tide, stream flow or hammer drop.

During driving the top of pile casing shall be protected by a suitable helmet of substantial steel construction. The helmet shall provide uniform bearing across the top of the pile casing and shall hold the pile casing centrally under the hammer. No pile casing shall be driven unless inspected and approved by the Engineer.

Pile casing shall be driven from a fixed frame of sufficient rigidity to ensure accuracy of driving within specified tolerances. Forces producing undue bending or torsional stresses in piles shall not be applied during driving. The force of the hammer shall be directed centrally and axially during driving.

The stroke of a single acting or drop hammer shall be limited to 1.2 m unless otherwise permitted by the Engineer. A shorter stroke may be necessary when danger of damaging the pile casing is.

Pile casing s shall not be bent or sprung into position but shall be effectively guided and held on-line during the initial stages of driving. Attempts to correct any tendency for the pile to run off-line by the application of significant horizontal restraint will not be permitted. Shortly after the commencement of driving and at regular intervals throughout the driving operation, checks shall be made to ensure that the pile frame does not exert any undue lateral force on the pile due to restraint within the helmet.

If the indications are that a pile casing will finish outside the specified tolerances, driving operations on that pile casing will cease. The pile casing shall be withdrawn, the hole filled and the pile casing re-driven at no extra cost.

To avoid the possibility of premature "set-up" pile casing driving shall be continuous in the later stages, without any deliberate stops. (Delays of an hour or less may lead to significant "set-up" in piles i.e. resistance to further driving increases after driving is stopped).

If any pile casing is damaged in any way during driving, it shall be repaired or replaced as directed by the Engineer, at no extra cost. If during driving, the head of a pile is damaged to the extent that further driving is not possible, the head shall be cut off and driving continued. The cost of cutting off shall be borne by the Contractor and where, as a result of such cutting off the head, the pile is too short, the Contractor, shall, at his own cost, supply and splice on sufficient length of pile to restore the pile to its correct length.

Pile casings shall be driven to level required and specified on the drawing whichever gives the lowest toe elevation. The Engineer's decision in these matters shall be final.

18.6 PILE TESTS

18.6.1 General

The bearing capacity of a single pile may be determined from test loading a pile. The load test on a concrete pile may not be carried out earlier than 28 days from the time of casting of the pile.

There shall be two categories of test on piles, namely, initial tests and routine tests. Initial tests should be carried out on test piles which are not to be incorporated in the work. Routine tests shall be carried out as a check on working piles. The number of initial and routine tests on piles shall be as determined by the Engineer depending upon the number of foundations, span length, type of superstructure and uncertainties of founding strata. However, both initial and routine tests may be suitably increased for important structures or cases with large variation in the sub-surface strata.

The methodology of carrying out load tests and of arriving at safe load on piles shall conform to IS: 2911 (Part IV).

In case of any doubt of workmanship or load carrying capacity of working piles not subjected to routine tests, or when ordered by the Engineer, working piles may be subjected to non-destructive testing. Such tests may include "Integrity Testing" of concrete in the installed pile and utilisation of "Pile Driving Analyser" which gives an indication of pile capacity in end bearing and side friction.

However number of such tests will be limited to 3 (three) and the discretion of choosing the piles for such testing will lie solely with the Engineer. Contractor's quoted rate will include cost of such tests not quantified in the Bill of Quantities.

18.7 IMPORTANT CONSIDERATIONS/ INSPECTIONS

18.7.1 Bored Cast-in-situ Piles

18.7.2 While concreting uncased piles, voids in concrete shall be avoided and sufficient head of concrete is to be maintained to prevent inflow of soil or water into the concrete. It is also necessary to take precautions during concreting to minimise the softening of the soil by excess water. Uncased cast-in-situ piles shall not be allowed where mudflow conditions exist.

18.7.3 The drilling mud such as bentonite suspension shall be maintained at a level sufficiently above the surrounding ground water level to ensure the stability of the strata which is being penetrated throughout the boring process until the pile has been concreted.

18.7.4 Where bentonite suspension is used to maintain the stability of the bore-hole, it is essential that the properties of the material be carefully controlled at stages of mixing, supply to the bore-hole and immediatelybefore concrete is placed. It is usual to limit:

i) The density of bentonite suspension to 1.05 g/cc

ii) The marsh cone viscosity between 30 and 40

iii) The pH value between 9.5 and 12

iv) The silt content less than 1 per cent

v) The liquid limit of bentonite not less than 400 per cent

These aspects shall act as controlling factors for preventing contamination of bentonite slurry for clay and silt.

18.7.5 The bores shall be washed by bentonite flushing to ensure clean bottom at two stages viz. after completion of boring and prior to concreting after placing of reinforcement cage. Flushing of bentonite shall be done continuously with fresh bentonite slurry till the consistency of inflowing and out-flowing slurry is similar.

18.7.6 .Tremie of 150 mm to 200 mm diameter shall be used for concreting. The tremie should have uniform and smooth cross-section inside, and shall be withdrawn slowly ensuring adequate height of concrete outside the tremie pipe at all stages of withdrawal. Other recommendations for tremie concreting are:

(i) The sides of the bore-hole have to be stable throughout.

(ii) The tremie shall be water-tight throughout its length and have a hopper attached at its head by a water-tight connection.

(iii) The tremie pipe shall be large enough in relation to the size of aggregates. For 20 mm aggregate the tremie pipe shall be of diameter not less than 150 mm and for larger size aggregate tremie pipe of larger diameter is required.

(iv) The tremie pipe shall be lowered to the bottom of the bore-hole, allowing water or drilling mud to rise inside it before pouring concrete.

(v) The tremie pipe shall always be kept full of concrete and shall penetrate well into the concrete in the bore-hole with adequate margin of safety

against accidental withdrawal if the pipe is surged to discharge the concrete.

18.7.7 For very long or large diameter piles, use of retarding plasticiser in concrete is desirable.

18.7.8 For large diameter piles, it may be essential to conduct non-destructive pile integrity tests to evaluate integrity of the pile.

18.7.9 Where possible, it may be desirable to grout the base of pile with cement slurry under suitable pressure after concrete in the pile attains the desired strength. For this purpose, conduit pipes with easily removable plugs at the bottom end should be placed in the bore along with reinforcement cage before concreting.

18.8 TOLERANCES

18.8.1 Permissible Tolerances for Bored Piles

(a) Variation in cross-sectional dimensions : + 50 mm, -10 mm

(b) Variation from vertical or specified rake : 1 in 50

(c) Variation in the final position of the head in plan : 50 mm

(d) Variation of level of top of piles : +/- 25 mm

18.9 TESTS AND STANDARDS OF ACCEPTANCE

The materials shall be tested in accordance with these Specifications and shall meet the prescribed criteria.

The work shall conform to these Specifications and shall meet the prescribed standards of acceptance.

18.10 MEASUREMENTS FOR PAYMENT

For bored concrete piles of specified cross-section, the measurement shall be the length in metres of the accepted pile that remains in the finished structure complete in place. Reinforcement in cast-in-situ bored concrete piles shall be measured for payment as per Section 1200.

Routine and Initial Pile Load Tests shall also be measured for payment as per Bill of Quantities.

For installation of the pile by boring the measurement shall be the length in metre that remains in the finished structure complete in place, limited to that shown on the drawings or instructed by the Engineer. No distinction shall be made for penetration through hard strata or rock and socketing into rock.

For steel casing as shown on the drawing to be permanently left in place, the measurement shall be by weight in tones that remains in the finished structure complete in place, limited to that shown on drawings or instructed by the Engineer.

18.11 RATE

The contract unit rate for cast-in-situ bored piles shall include the cost of concrete and all other items as per Section 1300/I. The contract unit shall also include costs of all labour, materials, equipment and all other incidentals involved in conducting routine and initial pile load tests including installation of piles for initial load tests.

The contract unit for installation of piles shall include full compensation for furnishing all labour, materials, tools and equipment, and incidentals for doing all the works involved in making bores for cast-in-situ bored concrete piles, cutting off pile heads, all complete in place to the specified penetration of piles. Providing temporary liner/casing and its withdrawal and placing reinforcement in position shall also be deemed to be included in the rate for installation of piles and no additional payment shall be made for the same.

The contract unit rate for permanent liners shall include cost of all labour, fabrication and placing the steel liner to the required depth as shown on the drawings and as instructed by the Engineer.

20. SERVICES MISCELLANEOUS WORKS:

20.1. 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.

20.2. 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.

20.3. 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.

20.4. Embedding pipes in masonry (upto 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.

20.5. Dry stone pitching

As far as possible it should be ensured that one rainy season has elapsed before pitching or any kind of stone work is commenced, so that the embankment has time to settle, and loose spots in the cutting, if any, show up.

The sides and bottom of the drain or the sides and top of embankment, as the case may be, shall be brought to the required profile, slope and gradient and shall be compacted to a firm and even surface. If the situation demands, and where so required by the Engineer-In-Charge in consideration of the nature of the surface, the necessary back filling may be done with small broken stone, murum, gravel or ballast well consolidated to proper profile. In case the soil is unreliable and if the nature of the work requires it, a 75 mm thick layer of gravel or ballast may be provided over the prepared surface and well consolidated..

Pitching:

Pitching shall be of 22.5 cm depth, unless specified otherwise. Profiles shall first, be put up by means of pegs and strings or by placing stones, at interval of not more than 15 meter. Stone shall then be laid closely in position in between the profile and firmly embedded with joints staggered and with exposed faces true to line, gradient and in uniform slope throughout.

The cross bands of approximately 22.5 cm width through bond stones equal to the full depth of pitching, shall be provided at an interval of approximately 3 m centre to centre both longitudinally and transversely.

The interstices between adjacent stones shall be filled in with stones of proper size, well driven in with crow bars to ensure tight packing and complete filling of all interstices. Such filling shall be carried on simultaneously with the placing in position of the large stones and shall in no case be permitted to fall behind. Final wedging shall be done with the largest sized chip particles, each chip being well driven home with a hammer so that no chip is possible of being picked up or removed by hand.

Measurements:

The exposed finished surface shall be measured after the pitching has been done. The length, width and side slope shall be measured correct to a cm. The area of pitching for drains shall be calculated in sq.m by multiplying the perimeter (bed width plus side slopes) by the length of the pitching.

Rate:

The rate shall include the cost of the materials and labour involved in all the operations described above, except pitching stone which shall be paid for separately. The back filling done, if any except when done with earth as material obtained locally, shall be paid for separately.

21. ALUMINIUM WORKS:

21.1. 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 upto 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 ± 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 confirm 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 confirming 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 ±1.5mm.

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 methylate 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 hoes 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 ±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.

21.2. 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 ±1.5mm

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.

21.3. 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 ±1.5mm.

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.

21.4. 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 ±1.5mm

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^{o}.

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.

21.5. 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 ±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.

21.6. Floor Spring (Hydraulically Regulated)

Type and size of floor spring

Type and size of floor spring shall be as specified in item description or as approved by the Engineer-In-Charge from reputed manufacturers.

Construction and Operational Details

The floor springs shall be suitable for fixing to the doors weighting up to 125 kg without use of additional door units.

The speed of the closing door shall be adjustable by means of a suitable controlling device. Tension of the spring shall be increased or decreased by turning the capstan nuts clock-wise or anti-clockwise. For exceptionally low temperature the adjustment in the speed could be made by change in the grade of oil.

The shoe shall be fitted to the governing pivot of the floor spring by a square profile.

Workmanship

The floor spring shall be free from all mechanical defects, sharp edges and other surface defects.

Quality Assurance

The floor spring should be with ISI mark for quality assurance.

Fixing

Suitable recess of the required size shall be cut in floor and the floor spring with all its components viz. cover plate, outer box with slide plate etc. shall be embedded in floor.

21.7. Anodized Aluminium Alloy Grid – For False Ceiling

Material & Anodizing :

Material for Tee / angle sections are used for frame work of false ceiling shall be used generally as described under-Aluminium Doors specifications.

Fabrication and fixing in position

The interlocking aluminium alloy grid shall consist of aluminium main "Tee" runners of size 25 x 40mm and 2.10mm thick or as specified / directed spaced 1200mm c/c and cross "Tee" of size 24 x 24mm and 2.10mm thick or as specified / directed, 1200mm long spaced between the main "Tee" at 600mm c/c to form a grid of 1200 x 600mm. Again a secondary cross "Tee" of length 600mm and size 24 x 24mm and 2.10mm thickness as specified or directed to be interlocked of the centre of 1200 x 600mm panel to form a grid of 600 x 600mm.

Main "Tee" runners are to be suspended from ceiling with M.S. level adjusting hangers.

The perimeter support on wall shall consist of aluminium angle of size 25 x 25 mm and 1.60mm thickness or as specified / directed fixed firmly to the walls with the help of rawl plugs spaced at 230mm c/c and tightened with 25mm long cadmium plated screws or as directed.

Measurements

The aluminium Tee or Angle iron sections when fixed in position shall be measured correct to 1mm.
The weight per metre length of used 'T' angle sections shall be ascertained by weighting the sample length and the weight thus worked out shall be compared with the weight per metre prescribed by the manufacturer. However, payment shall be made for only the actual weight worked out after ascertaining the weight of sample piece, subject to the condition that the weight per metre ascertained is within the tolerance limit of ±10% of the weight of section prescribed in the manufacturer's catalogue.

Rate

The rate includes the cost of materials and labour involved in all operations described above except the M.S. level adjusting hangers and its fixing arrangement which shall be measured and paid separately.

21.8. Level adjusting hangers 6mm dia. Mild steel rod (upto 1200mm length)

Materials
Mild steel bars shall conform to the specifications IS:432-Grade-I.These shall be fabricated from MS bar of 6mm diameter 1200mm length.

Fixing

Necessary holes for expansion hold fasteners as per the architect drawing shall be made in slab with drilling machine. MS angle 40 x 40 x 5mm and 40mm long be fixed with hold fasteners 12.5mm dia and 40mm long. MS angle and steel rod be given a priming coat of zinc chromate yellow primer complete as per direction of the Engineer-In-Charge.

21.9. 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.

21.10. 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 ±1.5mm of size shown on drawings. Actual weight of aluminium sections shall not vary by ±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.

22. WATERPROOFING WORKS:

22.1. 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.

22.2. 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.

22.3. Cement based patented type waterproofing treatment over Chajjas

Material and General specifications shall be as described under –Terrace water proofing specifications.

22.4. 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.

22.5. 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.

22.6. 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 upto 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.

22.7. 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 be 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).

22.8. Patented type cement based Box type waterproofing treatment – for under ground 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 other wise 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 form 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 un-used 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 and 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.

23. SANITARY APPLICIANCES AND FITTINGS:

23.1. All vitreous sanitary appliances (Vitreous China) shall conform to IS 2556 (Part-I) general requirements.

23.2. Flushing Cisterns

23.3. The flushing cisterns shall be automatic or manually operated high level or low level as specified, for water closets and urinals. A high level cistern is intended to operate with minimum height of 125 cm and a low level cistern with a maximum height of 30 cm between the top of the pan and the under side of the cistern.

Cisterns shall be of following type (i) Vitreous China (IS 774) for Flushing type (ii) Automatic Flushing Cistern (IS 2326) and (iii) Plastic cisterns (IS 7231).

23.4. *Vitreous Chine Cisterns:* The thickness of the body including cover shall be not less than 6 mm for vitreous China cisterns. The outlet of each syphon or stand pipe shall be securely connected to the cistern by means of lock nut. The cistern shall be free from manufacturing faults and other defects affecting their utility. All working parts shall be designed to operate smoothly and efficiently. Cistern shall be mosquito proof. A cistern shall be considered mosquito proof only if there is no clearance any where which would permit a 1.6 mm wire to pass through in the permanent position of the cistern i.e. in the flushing position or filling position.

The breadth of a low level cistern, from front to back shall be such that the cover or seat, or both, of water closet pan shall come to rest in a stable position when raised.

The cistern shall be supported on two cast iron brackets of size as approved by the Engineer-in- Charge and embedded in cement concrete 1:2:4 block 100 x 75 x 150' mm. These shall be properly protected by suitable impervious paint. Alternatively the cisterns shall have two holes in the back side above the overflow level for screwing into the wall, supplemented by two cast iron wall supports. A 5; litres cistern, however, may be supported by larger brackets cast on the body of the cistern.

The cistern shall have a removable cover which shall fit closely on it and be secured against displacement. In designs where the operating mechanism is attached to the cover this may be made in two sections, but the section supporting the mechanism shall be securely bolted or screwed to the body. The outlet fitting of each cistern shall be securely connected to the cistern. The nominal internal diameter of cistern outlet shall be not less than 38 + 1 mm for low level cisterns respectively. The length of the outlet of the cistern shall be 37 + 2 mm.

Ball valve shall be of screwed type 15 mm in diameter and shall conform to IS 1703. The float shall be made of polyethylene as specified in IS 9762. (The design shall permit the cistern to fill in rapidly and close effectively when the level of water reaches the working water level.)

In the case of manually operated cisterns the siphonicaction of the flushing cistern shall be capable of being rapidly brought into action by the operating lever, but shall not self siphon or leak. When tested according to IS 774 the discharge rate shall be 10 + 0.5 litre in 6 seconds and 5 + 0.5 litre in 3 seconds for cisterns of capacities 10 litre and 5 litre respectively. The cisterns shall be so designed that there is not appreciable variation in the force of flush during the discharge of the required quantity of water. The cistern shall have a discharge capacity of 5 & 10 litres as specified. When required to give a full flush, they shall respectively discharge 5 litres and 10 litres with variation of + 0.5 litres.

The flush pipe shall be of (a) medium quality Galvanised iron having internal diameter of 38 + 1 mm for low level cistern. The flush pipe shall be of suitable length with bends etc. as required for fixing it with front or back inlet W.C. Pan. (b) Polyethylene pipes low density conforming to IS 3076 or high density (c) Unplasticised PVC pipes. For high density

polyethylene and unplasticised PVC pipes, the outside diameter of the pipes shall be 40 mm. When PVC plumbing pipes are used the outside diameter of the pipe shall be 40 mm for high level cisterns and 50 mm for low level cisterns.

In case of low level cistern the flush pipe shall be a vertical pipe 30 cm long and having a nominal internal dia 38 ± 1 mm (except plastic flush pipes).

Over Flow Pipe

(a) GI overflow pipe shall be of not less than 20 mm nominal bore and shall incorporate a non-corrodible mosquito proof brass cover having 1.25 mm dia perforation, screwed in a manner which will permit it to be readily cleaned or renewed when necessary. No provision shall be made whereby the overflow from the cistern shall discharge directly into the water closet or soil pipe without being detected.

The invert of the overflow pipe in the case of high level and low level cisterns shall be 19 mm minimum above the working water level. In case of overflow due to any reason water should drain out through the over flow pipe and not through the siphon pipe.

(b) The plastic overflow pipes shall be manufactured from high density polyethylene conforming to IS 4984 or un-plasticized P.V.C. conforming to IS 4985.

Inlet and Overflow Holes: The cistern shall be provided with inlet and overflow holes, situated one at each end which shall be capable of accommodating an overflow pipe of not less than 20 mm nominal bore and a 15 mm size ball valve. The holes shall be cleanly cast or drilled and the adjacent surfaces shall be smooth.

The thickness of the body including cover at any point shall not be less than 2 mm for GRP, and not less than 3 mm for other plastic materials. The cistern shall be free from manufacturing faults and other defects affecting its utility. All working parts shall be designed so as to operate smoothly and efficiently. The cistern shall be mosquito-proof. It shall be deemed to be mosquito proof only when there is no clearance anywhere in it which would permit a 1.6 mm diameter wire to pass through. The outlet of each siphon or stand pipe or flush valve shall be securely connected to the cistern by means of a lock nut. In the case of plastic siphon, it shall be provided with suitable means of ensuring and maintaining watertight and airtight joint to the cistern.

The cistern shall be provided with a removable cover which shall fit closely and shall be secured against displacement. In designs, where the operating mechanism is attached to the cover, the cover may be made in two sections, the section supporting the mechanism being securely fixed or booked to the body.

The flush pipe (except plastic flush pipe) shall have an internal diameter of 32 .±. 1 mm for high level cistern and 38 + 1 mm for low level cistern. The steel flush pipe shall be not less than 1 mm thick whereas the lead flush pipe shall have a minimum thickness of 3.5 mm. For high density polyethylene pipes, the outside diameter of the pipes shall be 40 mm. For unplasticised PVC plumbing pipes the outside diameter of the pipe shall be 40 mm for high level cisterns, and 50 mm for low level cisterns. In the case of high level flushing cisterns, a pipe clip fitted with a rubber buffer shall be fixed to the flush pipe to prevent damage either to the pipe or to the seat when the seat is raised. No flush pipe is required for coupled cisterns.

> **Note:** The minimum thickness specified is for normal conditions of service. Where highly corrosive atmospheres are expected, greater thicknesses are required to be provided as per nomenclature of the item.

23.4.1. Flush Pipe Connection to Cistern

The flush pipe shall be securely connected to cistern outlet and made airtight by means of a coupling nut. The nuts made of injection-molded HDPE/Polyacetal may be used only if

the end pipe is also made of plastic. The nominal internal diameter of the cistern outset shall be not less than 32 mm and 38 mm for high-level and low-level cisterns respectively.

The screw threads for connection to the flush pipe shall not be less than size 1 ~ of IS 2643 (Part 3). In the case of polyethylene and unplasticised PVC flush pipes, the upper end of the flush pipe shall be provided with suitable means of ensuring and maintaining a watertight and airtight joint to the flushing cistern. When ordered for use with a flush pipe, the outlet connection may be supplied with coupling nut made of copper based alloy or other non-corrodible material and a plain tail piece having a minimum length of 60 mm. The centre of the outlet hole shall be generally central to the length of the cistern. The length of the outlet shall be 37±2 mm in case of interchangeable siphon; however, where integral siphon is provided, the outlet length shall be 20±2 mm.

> **Note:** The length of the cistern outlet shall be the dimension from the bottom surface of the cistern to the end of the outlet after the cistern with siphon/stand pipe has been duly fitted with all washers, lock-nuts, etc.

Inlet and Overflow Holes

The cistern shall be provided with inlet and overflow holes, situated one at each end, which shall be capable of accommodating overflow pipe of not less than 20 mm nominal bore and a 15 mm size float valve. The holes shall be cleanly moulded or drilled and the adjacent surfaces shall be smooth.

Float Valve

The float valve shall be 15 mm nominal size and shall conform to IS 1703 or IS 12234 or IS 13049.

Operating Mechanism Lever

The operating mechanism/lever shall not project beyond the side of the cistern for a distance greater than 350 mm measured from the centre of the cistern to the end of the lever arm. The lever arm shall be provided with a suitable hole near the end through which a split rings or S-hook can be inserted. A string (chain) shall be attached to the ring or hook. When S-hook is employed, it shall be effectively closed after assembly to prevent accidental disconnection.

In the case of low-level cisterns, where the mechanism is handle operated, the handle, whether situated on the front or at the end of the cistern, shall be within the projection limit. Particular attention shall be given to the case of operation of the handle. To be so designed that there is no appreciable variation in the force of the flush during the discharge of the required quantity of water. For coupled cisterns, this test shall not be applicable.

23.5. Draining Board

Draining board made of Glazed fireclay conforming to C.P.W.D. Specifications and as per directions of Engineer-in-Charge, shall be provided. The size of the board shall be as specified. The entire surface including bottom of the board shall be finished smooth.

23.6. Foot Rests

Foot rests shall be of Vitreous China conforming to IS 2556 (Part-X). Foot rests which are rectangular shall meet the minimum requirements and dimensions as shown in CPWD specification and may be of different designs where so specified. Foot rests of different shapes and sizes shall also be allowed subject to approval of Engineer-in-Charge.

23.7. Mirror

The mirror shall be of superior glass with edges rounded off or beveled, as specified. It shall be free / from flaws, specks or bubbles. The size of the mirror shall be 60 x 45 cm unless

specified otherwise and its thickness shall not be less than 5.5 mm. It shall be uniformly silver plated at the back and shall be free from silvering defects. Silvering shall have a protective uniform covering of red lead paint. Where beveled edge mirrors of 5.5 mm thickness are not available, fancy looking mirrors with PVC beading/border or aluminium beading or stainless steel beading/border based on manufacture's specifications be provided nothing extra shall be paid on this account. Backing of mirrors shall be provided with environmentally friendly material other than asbestos cement sheet.

23.8. M.S. Stays and Clamps .

The clamps shall be made from 1.5 mm thick M.S. flat of 32 mm width, bent to the required shape and size to fit tightly on the socket, when tightened with nuts & bolts. It shall be formed of two semicircular pieces with flanged ends on both sides with holes to fit in the screws, bolts and nuts 40 mm long. The stay shall be minimum one metre long of 10 mm dia M.S. bar. One end of the stay shall be bent for embedding in the wall in cement concrete block of size 20 x 10 x 10 cm in 1 :2:4 mix (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size). The concrete shall be finished to match with the surrounding surface.

23.9. Pillar Taps

Pillar taps shall be chromium plated brass and shall conform to IS 1795. The nominal sizes of the pillar tap shall be 15 mm or 20 mm as specified. The nominal size shall be designated by the nominal bore of the pipe outlet to which the tap is to be fitted. Finished weights of 15 mm and 20 mm pillar taps shall be as prescribed in **Table 17**

TABLE 17
Minimum Finished Weights of Pillar Taps

Particulars	*Weights in gms*	
	15 mm size	*20 mm size*
Body	25	505
Washer plate loose valve	15	28
Back nut	40	50
Tap	6	1175

Casting shall be sound and free from laps, blow hole and pitting. External and internal surfaces shall be clean, smooth and free from sand and be neatly dressed. The body, bonnet and other parts shall be machined true so that when assembled, the parts shall be axial, parallel and cylindrical with surfaces smoothly finished.

The area of waterway through the body shall not be less than the area of the circle of diameter equal to the bore of the seating of the tap. The seating of pillar tap shall be integral with the body and edges rounded to avoid cutting of washer. Pillar taps shall be nickel chromium plated and thickness of coating shall not be less than service grade NO.2 of IS 4827 and plating shall be capable of taking high polish which shall not easily tarnish or scale.

Every pillar tap, complete with its component parts shall withstand an internally applied hydraulic pressure of 20 Kg/sq. cm maintained for a period of 2 minutes during which period it shall neither leak nor sweat.

23.10. Sand Cast Iron or Centrifugally Cast (Spun) Iron Pipes and Fittings

Sand cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories shall conform to IS 1729. Centrifugally cast (Spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories shall conform to IS 3989.

The fittings shall conform to the same I.S. specifications to which the p~ itself conforms in which they are connected.

The pipes shall have spigot and socket ends, with head on spigot end in case of sand cast iron pipes and without head on spigot end in case of cast iron (Spun) pipes. The pipes and fittings shall be true to shape, smooth and cylindrical, their inner and outer surface being as nearly as practicable concentric. They shall be sound and shall be free from cracks, taps, pinholes and other imperfections and shall be neatly dressed and carefully fettled. All pipes and fittings shall ring clearly when struck with a light hand hammer.

The ends of pipes and fittings shall be reasonably square to their axis. The sand cast iron pipes shall be 1.5/1.8/2.0 metre in length including socket ends, cast iron (Spun) pipes shall be l.5/1.75/2.0/2.5/3.0 metre in length excluding socket ends, unless shorter lengths are either specified or required at junctions etc. The· pipe and fittings shall be supplied without ears, unless specified or directed otherwise.

All pipes and fittings shall be coated internally and externally with the same material at the factory, the fitting being preheated prior to total immersion in a bath containing a uniformly heated composition having a tar or other suitable base. The coating material shall have good adherence and shall not scale off. In all instances where the coating material has tar or similar base it shall be smooth and tenacious and hard enough not to flow when exposed to a temperature of 77 degree centigrade but not so brittle at a temperature of 0 degree centigrade as to chip off when scribed lightly with a pen knife.

The standard weights and thicknesses of pipes and their tolerances shall be as prescribed standard.

The thickness of fittings and their socket and spigot dimensions shall conform to the thickness and dimensions specified for the corresponding sizes of straight pipes. The tolerance in weights & thicknesses shall be the same as for straight pipes.

The access door fittings shall be designed so as to avoid dead spaces in which filth may accumulate. Doors shall be provided with 3 mm rubber insertion packing and when closed and bolted, these shall be water tight.

23.11. Sand Cast Iron Floor Trap or Nahani Trap

Sand cast Iron Floor trap or Nahani trap shall be 'P' or 'S' type with minimum 50 mm seal. However, if the plumbing is in two pipe system and with a gully trap at the ground level the minimum water seal shall be 35 mm. The traps shall be of self cleansing design and shall have exit of same size as that of waste pipe. These shall conform to IS 1729.

23.12. Towel Rail

The towel rail shall be of PTMT as specified and as per direction of Engineer-in-charge.

23.13. Toilet Paper Holder

The toilet paper holder shall be of CP brass or vitreous china as specified and of size and design as approved by the Engineer-in-Charge. It shall be fixed in position by means of C.P. brass screws and rawl plugs embedded in the wall.

23.14. Urinals

23.14.1. ***Bowl Type Urinals*** **:** Urinal basins shall be of flat back or corner wall type in front. These shall be of white vitreous china conforming to IS 2556-(Part 6). The urinals shall of one piece construction. Each urinal shall be provided with not less than two fixing holes of minimum dia 6.5 mm on each side. Each urinal shall have an integral flushing rim of suitable type and inlet or supply horn for connecting the flush pipe. The flushing rim and inlet shall be of the self draining type. It shall have a weep hole at the flushing inlet of the urinals.

At the bottom of the urinal an outlet horn for connecting to an outlet pipe shall be provided. The exterior of the outlet horn shall not be glazed and the surface shall be provided with grooves at right angles to the axis of the outlet to facilitate fixing to the outlet pipe. The inside surface of the urinal shall be uniform and smooth throughout to ensure efficient flushing. The bottom of pan shall have sufficient slope from the front towards the outlet such that there is efficient draining.

23.14.2. ***Half Stall Urinals:*** They shall be of white vitreous China conforming to IS 2556 (Part 6). They shall be of one piece construction with or without an integral flushing box rim and provided with slots or alternative fixing arrangement at the flat back end. They shall be provided with ridges where integral flushing rim is not provided in the sides of the interior of the bowl, to divert the water towards the front line of the urinal where integral flushing box rim is specified, water spreaders provided shall conform to IS 2556 Part-6 (or as specified in CPWD specification). These shall be vitreous China of one piece construction with integral flush inlet. The tolerance of ± 4 per cent may be allowed on the dimensions specified.

23.15. Wash Basins

Wash basins shall be of white vitreous china conforming to IS 2556 (Part-I) and IS 2556 (Part-4). Wash basins either of flat back or angle back as specified shall be of one piece construction, including a combined overflow. All internal angles shall be designed so as to facilitate cleaning. Each basin shall have a rim of all sides, except sides in contact with the walls and shall have a skirting at the back. Basins shall be provided with single or double tap holes as specified. The tap holes shall be 28 mm square or 30 mm round or 25 mm round for pop up hole. A suitable tap hole button shall be supplied if one tap hole is not required in installation. Each basin shall have circular waste hole to which the interior of basin shall drain. The waste hole shall be either rebated or beveled internally with dia meter of 65 mm at top. Each basin shall be provided with a non-ferrous 32 mm waste fitting. Stud slots to receive the brackets on the underside of the wash basin shall be suitable for a bracket with stud not exceeding 13 mm diameter, 5 mm high and 305 mm from the back of basin to the centre of the stud. The stud slots shall be of depth sufficient to take 5 mm stud. Every basin shall have an integral soap holder recess or recesses, which shall fully drain into the bowl. A slot type of overflow having an area of not less than 5 sq. cm, shall be provided and shall be so designed as to facilitate cleaning of the overflow.

Where oval shape or round shape wash basins are required to be fixed these shall be fixed preferably in RCC platform with local available stone topping either fully sunk in stone top or top flush with the stone topping as directed by Engineer-in-Charge.

The wash basins shall be one of the following patterns and sizes as specified

a) Flat back: 660 x 460 mm (Surgeon's Basin)
630 x 450 mm
550 x 400 mm
450 x 300 mm

b) Angle back: 660 x 480 mm

400 x 400 mm

White glazed pedestals for wash basins, where specified shall be provided. The quality of the glazing of the pedestal ~all be exactly the same as that of the basin along with which it is to be installed. It shall be completely recessed at the back to accommodate supply and waste pipes and fittings. It shall be capable of supporting the basin rigidly and adequately and shall be so designed as to make the height from the floor to top of the rim of basin 75 to 80 cm or as specified in CPWD specification. All the waste fittings shall be brass chromium plated, or as specified.

23.16. Waste Fittings for Wash Basins and Sinks

The waste fittings shall be of nickel chromium plated brass, with thickness of plating not less than service grade 2 of IS 4827 which is capable of receiving polish and will not easily scale off. The fitting shall conform in all respect to IS 2963 and shall be sound, free from laps, blow holes and fittings and other manufacturing defects. External and internal surfaces shall be clean and smooth. They shall be neatly dressed and be truly machined so that the nut smoothly moves on the body.

Waste fitting for wash basins shall be of nominal size of 32 mm. Waste fittings for sinks shall be of nominal size 50 mm.

23.17. Water Closet

23.17.1. ***Squatting Pans (Indian Type W.C.)*: Squatting pans shall be of white vitreous china conforming to IS 2556 Part-I for General Requirements and relevant IS codes for each pattern as described below:**

(i) Long pattern-conforming to IS 2556 (Part-3).

(ii) Orissa pattern-conforming to IS 2556 (Part-3).

(iii) Integrated type conforming to IS 2556 (Part-14).

13 Preferably Orissa type pan should be used.
Each pan shall have an integral flushing rim of suitable type. It shall also have an inlet or supply horn for connecting the flush pipes, or as specified in CPWD specification. The flushing rim and inlet shall be of the self draining type. It shall have weep hole at the flushing inlet to the pan. The flushing inlet shall be in the front, unless otherwise specified or ordered by the Engineer-in-Charge. The inside of the bottom of the pan shall have sufficient slope from the front towards the outlet and the surface shall be uniform and smooth to enable easy and quick disposal while flushing. The exterior surface of the outlet below the flange shall be an unglazed surface which shall have grooves at right angles to the axis of the outlet. In all cases a pan shall be provided with a (100 mm) S.C.!. trap 'P' or 'S' type with approximately 50 mm water seal and 50 mm dia vent horn, where required by the Engineer-in-Charge.

23.17.2. *Wash Down Type (European Type W.C*): Water closets shall be of white vitreous china conforming to IS 2556 (Part-1) and 2556 (Part-2), as specified and shall be of 'Wash down type". The closets shall be either of the two patterns (Pattern I & Pattern II) and sizes as shown in or as specified in CPWD specification as specified. The closets shall be of one piece construction. Each water closet shall have not less than two holes having a minimum diameter of 6.5 mm for fixing to floor and shall have an integral flushing rim of suitable type. It shall also have an inlet or supply horn for connecting the flushing pipe of dimensions as shown in or as specified in CPWD specification the flushing rim may be boxed or open type. In the case of box rims adequate number of holes, on each side together with a slot opposite the inlet shall be provided. The flushing rim and inlet shall be of the self draining type. The water closet shall have a weep hole at the flushing inlet. Each water closet shall have an integral trap with

either 'S' or 'P' outlet with at least 50 mm water seal. For P trap, the slope of the outlet shall be 14 deg. below the horizontal. Where required the water closet shall have an antisiphonage 50 mm dia vent horn on the outlet side of the trap with dimension conforming to those given in or as specified in CPWD specification and on either right or left hand or centre as specified set at an angle of 45 deg. and invert of vent hole not below the central line of the outlet. The inside surface of water closets and traps shall be uniform and smooth in order to enable an efficient flush. The serrated part of the outlet shall not be glazed externally. The water closet, when sealed at the bottom of the trap in line with the back plate, shall be capable of holding not less than 15 litres of water between the normal water level and the highest possible water level of the water closet as installed.

23.18. GENERAL REQUIREMENTS FOR INSTALLATION OF W.C. PAN

23.18.1. The work shall be carried cut, .complying in all respects with the requirements of relevant byelaws of the local body in whose jurisdiction the work is situated.

23.18.2. Any damage caused to the building, or to electric, sanitary, water supply or other, installations etc. therein, either due to negligence on the part of the contractor, or due to actual requirements of the work, shall be made good and the building or the installation shall be restored to its original condition by the contractor. Nothing extra shall be paid for such restoration works except where otherwise specified.

23.18.3. For making good the damage to the under mentioned items of work, the specifications as given in the following paras shall apply, unless directed otherwise.

(a) Masonry Work: The masonry work shall be made good by using the same class of bricks, tiles or stones as was damaged during the execution of the work. The mortar used shall be cement mortar 1:5 (1 cement: 5 fine sand) or as directed by the Engineer-in-Charge.

(b) Plain Concrete Work: Concrete work for sub-grade of the flooring, foundations and other plain concrete works shall be cement concrete 1:5:10 (1 cement: 5 coarse sand: 10 graded stone aggregate 40 mm nominal size). A coat of neat cement slurry shall be applied at the junction with old work, before laying fresh concrete.

(c) Cement Concrete Flooring and R.C.C. Work: Cement concrete 1:2:4 (1 Cement : 2 Coarse sand: 4 graded stone aggregate 20 mm nominal size) shall be used after applying a coat of neat .cement slurry at the junction with old work, and the surface finished to match with the surrounding surface.

23.19. Rate

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

23.20. FIXING AND JOINTING OF PIPES AND FITTINGS

23.20.1. The specifications described in sub-head 12.0 shall apply, as far as applicable, except that the joint shall be lead caulked. All soil pipes shall be carried up above the roof and shall have sand cast iron terminal guard.

23.20.2.Height of Ventilating Pipes

The ventilating pipe or shaft shall be carried to a height of at least 60 cms above the outer covering of the roof of the building or in the case of a window in a ga61e wall or a dormer window it shall be carried up to the ridge of the roof or at least 2 metres above the top of the window. In the case of a flat roof to which access for use is provided it shall be carried up to a height of 2 metres above the roof and shall not terminate within 2 metres, measured vertically from the top of any window opening which may exist up to a horizontal

distance of 3 meters from the vent pipe into such building and in no case shall be carried to a height less than 3 metres above plinth level. In case the adjoining building is taller, the ventilating pipe shall be carried higher than the roof of the adjoining building, wherever it is possible.

The pipes above the parapet shall be secured to the wall by means of M.S. stay and clamps as specified / instructed.

The connections between the main pipe and branch pipes shall be made by using branches and bends with access doors for cleaning. The waste from lavatories, kitchen, basins, sinks, baths and other floor traps shall be separately connected to respective waste stack of upper floors. The waste stack of lavatories shall be connected directly to manhole while the waste stack of others shall separately discharge over gully trap. Where single stack system is provided, the connection shall be made direct to the manhole.

23.20.3.Jointing

The interior of the socket and exterior of the spigots shall be thoroughly cleaned and dried. The spigot end shall be inserted into the socket right up to the back of the socket and carefully centered by two or three laps of treated spun yarn, twisted into ropes of uniform thickness well caulked into the back of the socket. No piece of yarn shall be shorter than the circumference of the pipe. The jointed pipe line shall be at required levels and alignment.

The leading of pipes shall be made by means of ropes covered with clay or by using special leading rings. The lead shall be melted so as to be thoroughly fluid and each joint shall be filled in one pouring.

The following precautions shall be taken for melting lead:

(a) The pot and the ladle in which lead shall be put shall be clean and dry.
(b) Sufficient quantity of lead shall be melted.
(c) Any scum or dross which may appear on the surface of the lead during melting shall be skimmed off.

After the lead has been run into the joint the lead shall be thoroughly caulked. Caulking of joints shall be done after a convenient length of the pipes has been laid and leaded.

The leading ring shall first be removed and any lead outside the socket shall be removed with a flat chisel and then the joint caulked round three times with caulking tools of increasing thickness and hammer 2 to 3 kg. weight. The joints shall not be covered till the pipe line has been tested under pressure.

Use of collars for jointing is not permitted in any concealed or embedded location. However, in exposed locations where full length pipes cannot be fixed due to site constraints, collars (and not loose sockets) may be used subject to the following:

(a) No two consecutive joint shall be with the use of collars.

(b) The joint of collar with the cut/spigot end of the pipe shall be made on the ground in advance and tested against leakage before fixing.

(c) Cut/spigot end of the pipes shall be inserted in the collars up to the projection inside the collar and jointing shall be done as in the case of socket and spigot joint. The jointed pipe line shall be at required level/slope and alignment.

Note: The dimensions of loose sockets shall correspond to those of appropriate nominal size of pipe.

23.20.4. Testing

In order to ensure that adequate lead is poured properly into the joints and to control waste in use of lead, at the beginning of work three or four sample joints shall be made and the quantum of lead per joint approved by the Engineer-in-Charge. All sand cast iron/cast iron (Spun) pipes and fittings including joint shall be tested by smoke test to the satisfaction of the Engineer-in-Charge and left in working order after completion. The smoke test shall be carried out as under:

Smoke shall be pumped into the pipes at the lowest end from a smoke machine which consists of a bellow and burner. The material usually burnt is greasy cotton waste which gives out a clear pungent smoke which is easily detectable by sight as well as by smell, if there is leak at any point of the drain.

23.20.5. Painting

All sand cast iron/cast iron (Spun) pipes and fittings shall be painted with shade to match the colour of the background as directed by the Engineer-in-Charge.

23.20.6. Measurements

(a) The pipes shall be measured net when fixed in position excluding all fittings along its length, correct to a cm.

(b) When collars are used for jointing SCI pipes these shall be measured as fittings and shall be paid for separately.

(c) No allowance shall be made for the portions of the pipe lengths entering the sockets of the adjacent pipes or fittings. The above shall apply to both cases i.e. whether the pipes are fixed on wall face or embedded in masonry.

(d) No deduction shall be made in the former case from the masonry measurement for the volume of concrete blocks embedded therein. Similarly no deduction shall be made for the volume occupied by the pipes from the masonry when the former are embedded in the later.

23.20.7. Rates

The rate shall include the cost of all labour and materials involved in all the operations described above, excluding fittings, lead caulk jointing, the supply and fixing M.S. holder bat clamps and M.S. stays and clamps, floor trap and painting, which shall be paid for separately.

23.21. Ball Valve (Brass)

The ball valve shall be of Brass or Gunmetal as specified conforming to IS 1703 (as specified in CPWD specification). The ball valve shall be of following two classes:-

(a) *High Pressure:* High pressure float valves are indicated by the abbreviation 'HP' and are designed for use on mains having pressure of 0.175 MPa or above.

(b) *Low Pressure:* Low Pressure float valves are indicated by the abbreviation 'LP' and are designed for use on mains having a pressure up to. 0.175 MPa.

The ball valves shall be of following nominal sizes 15 mm, 20 mm, 25 mm, 32 mm, 40 mm and 50 mm. The nominal size shall correspond with the nominal bore of the inlet shanks. Polyethylene floats shall conform to IS 9762

23.22. Bib Taps and Stop Valve

Brass (or as specified in CPWD specification): A bib tap is a draw off tap with a horizontal inlet and free outlet and a stop valve is a valve with suitable means of connections for insertion in a pipe line for controlling or stopping the flow. They shall be of specified size and shall be of screw down type and shall conform to IS 781. The closing device shall work by means of disc carrying a renewable non-metallic washer which shuts against water pressure on a seating at right angles to the axis of the threaded spindle which operates it. The handle shall be either crutch or butterfly type securely fixed to the spindle. Valve shall be of the loose leather seated pattern. The cocks (taps) shall open in anti-clock wise direction.

The bib tap and stop valve shall be polished bright. The minimum finished weights of bib tap and stop valve shall be as specified in Table 18.

TABLE 18

MINIMUM FINISHED MASS OF BIB TAPS AND STOP VALVES

Size (mm)	Bib Taps (kg)	Minimum Finished Mass		
		Stop Valves		
		Internally Threaded (kg)	Externally Threaded (kg)	Mixed End (kg)
8	0.250	0.220	0.250	0.235
10	0.300	0.300	0.350	0.325
15	0.400	0.330	0.400	0.365
20	0.750	0.675	0.750	0.710
25	1.250	1.180	1.300	1.250
32	-	1.680	1.800	1.750
40	-	2.090	2.250	2.170
50	-	3.700	3.850	3.750

In case these are required to be nickel plated, the plating shall be of the first quality with a good thick deposit of silvery whiteness capable of taking high polish which will not easily tarnish or scale.

23.23. Pipes – Centrifugally Cast (Spun) Iron Pipes

23.23.1. The spun iron pipes shall conform to IS 1536. The spun iron pipes shall be of cast iron cast centrifugally and vary in diameters from 80 mm to 750 mm. These shall be of class LA, class A and class B, as specified. Pipes shall be tested hydrostatically at the pressure specified in table 19 & 20. Tolerances on specified dimensions shall be as prescribed in CPWD specification

23.23.2. Specials: The specials shall conform to IS 1538. The hydraulic test pressure of each class shall be as detailed in **Table 21.** Tolerances on specified dimensions shall be as prescribed in in CPWD specification

TABLE 19

Hydrostatic Test Pressure for Centrifugally Cast Socket and Spigot Pipes in MPa
Hydrostatic Test pressure for works in MPa

Class	Up to DN 600	DN 700 & above
LA	3.5	1.5
A	3.5	2.0
B	3.5	2.5

TABLE 20

Hydrostatic Test Pressure for Centrifugally Cast Pipes with Screwed on flanges in MPa

Class	Up to DN 600	DN 700 & above
B	2.5	1.6

TABLE 21

Hydrostatic Test Pressure for Fittings in MPa (N/mm2) (metre head)

Nominal – Diameter	Fitting without branches or with branches not greater than half the principle diameter	Fitting with branches greater than half the principal diameter
Up to and including 300 mm	2.5 (25)	2.5 (25)
Over 300 mm and up to and including 600 mm	2.0 (20)	2.0 (20)
Over 600 mm and up to and including 1500 mm	1.5 (15)	1.0 (10)

23.23.3. Shower Rose Brass

The shower rose shall be of chromium plated brass of specified diameter. It shall have uniform perforations. The inlet size shall be 15 mm or 20 mm as required.

14

23.24. CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPES

23.24.1. CPVC pipes & fittings used in hot & cold potable water distribution system shall conform to requirement of IS 15778. The material from which the pipe is produced shall consist of chlorinated polyvinyl chlorides. The polymer from which the pipe compounds are to be manufactured shall have chlorine content not less than 66.5'9o.~

The internal and external surfaces of the pipe shall be smooth, clean and free from grooving and other defects. The pipes shall not have any detrimental effect on the composition of the water flowing though it.

Diameter and wall thickness of CPVC pipes are as per given in Table 22 below.

TABLE 22

Sr. No.	Nominal Size	Nominal Outside Diameter	Mean Outside Diameter		Outside Diameter at any point		Wall Thickness					
			Min	Max	Min	Max	Class 1, SDR 11			Class 3, SDR 17		
							Avg. Max	Min	Max	Avg. Max	Min	Max
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
I	15	15.9	15.8	16.0	15.8	16.0	2.2	1.7	2.2	-	-	-
Ii	20	22.2	22.1	22.3	22.0	22.4	2.5	2.02	2.5	-	-	-
Iii	25	28.6	28.5	28.7	28.4	28.8	3.1	2.6	3.1	-	-	-
Iv	32	34.9	34.8	35.0	34.7	35.1	3.7	3.2	3.7	-	-	-
V	40	41.3	41.2	41.4	41.1	41.5	4.3	3.8	4.3	-	-	-
Vi	50	54.0	53.9	54.1	53.7	54.3	5.5	4.9	5.5	-	-	-
Vii	65	73.0	72.8	73.2	72.2	73.8	-	-	-	4.8	4.3	4.8
Viii	80	88.9	88.7	89.1	88.1	89.7	-	-	-	5.9	5.2	5.9
Ix	100	114.3	114.1	114.5	113.5	115.1	-	-	-	7.5	6.7	7.5
X	150	168.3	168.0	168.6	166.5	170.1	-	-	-	11.1	9.9	11.1

Notes : For CPVC pipes SDR is calculated by dividing the average outer diameter of the pipe in mm by the minimum wall thickness in mm. If the wall thickness calculated by this formula is less than 1.52 mm, it shall be increased to 1.52 mm. The SDR values shall be rounded to the nearest 0.5.

23.24.2. Dimensions of Pipes

The outside diameter, outside diameter at any point and wall thickness shall be as given in Table 22.

23.24.2.1. ***Diameter:*** The outside diameter and outside diameter at any point as given **in Table 22** shall be measured according to the method given in IS 12235 (part 1).

23.24.2.2. ***Diameter at any point:*** The difference between the measured maximum outside diameter and measured minimum outside diameter in the same cross-section of pipe (also called tolerance on ovality) shall not exceed the greater of the following two values:

(a) 0.5 mm, and
(b) 0.012 d_n rounded off to the next higher 0.1 mm.

23.24.2.3. ***Wall Thickness:*** The wall thickness of the pipes shall be as given in Table 22. Wall thickness shall be measured by any of the three methods given in IS 12235 (part 1). To check the conformity of the wall thickness of the pipe throughout its entire length, it is necessary to measure the wall thickness of the pipe at any point along its length. This shall be done by cutting the pipe at any point along its length and measuring the wall thickness as above. Alternatively, to avoid destruction of the pipe, non destructive testing methods such as the use of ultrasonic wall thickness measurement gauges shall be used at any four points along the length of the pipe.

Tolerance on Wall Thickness

(a) For pipes of minimum wall thickness 6 mm or less, the permissible variation between the minimum wall thickness (eMin) and the wall thickness at any point (e), (e - eMin) shall be positive in the form of +Y, where y=0.1 eMin+0.2 mm.

(b) For pipes of minimum wall thickness greater than 6mm, the permissible variation of wall thickness shall again be positive in the form of +Y, where y would be applied in two parts.

(c) The average wall thickness shall be determined by taking at least six measurements of wall thickness round the pipe and including both the absolute minimum and absolute maximum measured values. The tolerance applied to this average wall thickness from these measurements shall be within the range 0.1 eMin+0.2 mm (see Table 22).

(d) The maximum wall thickness at any point shall be within the range 0.15 Min (see Table 22).

(e) The results of these calculations for checking tolerance shall be rounded off to the next higher 0.1 mm.

23.24.2.4. ***Effective Length (Le):*** If the length of a pipe is specified, the effective length shall not be less than that specified. The preferred effective length of pipes shall be 3, 5 or 6 m. The pipes may be supplied in other lengths where so agreed upon between the manufacturer and the purchaser.

23.24.2.5. ***Pipe Ends:*** The ends of the pipes meant for solvent cementing shall be cleanly cut and shall be reasonably square to the axis of the pipe or may be chamfered at the plain end.

The internal and external surface of the pipe shall be smooth, clean and free from grooving and other defects.

23.24.2.6. ***Opacity:*** The wall of the plain pipe shall not transmit more than 0.1 per cent of the visible light falling on it when tested in accordance with IS 12235 (Part 3).

23.24.2.7. ***Effect on Water:*** The pipes shall not have any determinate effect on the composition of the water flowing through them, when tested as per 10.3 of IS 4985.

23.24.3. Marking

23.24.3.1. Each pipe shall be clearly and indelibly marked in ink/paint or hot embossed on white base at intervals of not more than 3 m. The marking shall show the following:

(a) Manufacturer's name
(b) Outside diameter,
(c) Class of pipe and pressure rating, and
(d) Bath or lot number

23.24.3.2. Fittings

The fittings shall be as follows:
(a) Plain CPVC solvent cement fittings from size 15 mm to 160 mm.
(b) Brass threaded fittings.
(c) Valve from size 15 mm to 160 mm
(d) Brass *Threaded Fittings:* All types of one end brass threaded male/female adaptors in various fittings like coupler, socket, elbow, tee are available for transition to other plastic/metal piping and for fixing of CP fittings. Ball, Gate valves in CPVC are available in all dimensions. All fittings shall carry the following information:
(i) Manufacturer's name/trade mark.
(ii) Size of fitting

23.25. POLYETHYLENE WATER STORAGE TANKS

23.25.1. Material

Polyethylene used for manufacture of tanks and manhole lids may be high density (HOPE) density (LDPE) or linear low density (LLDPE) and shall conform to IS 10146. Polyethylene sh compounded with carbon black so as to make the tank resistant to ultra violet rays from the sun percentage of carbon black content in polyethylene shall be 2.5 ± 0.5 percent and it shall be unif distributed. The materials used for the manufacture of tank, manhole lid and fittings shall be use they neither contaminate the water nor impart any taste, colour, odour or toxity to water.

23.25.2. Manufacture and Finish

The tanks shall be manufactured by rotational moulding process. Each tank and the

manhole shall be single piece having arrangement for fixing and locking the manhole lid with the tanks. E material at the mould parting line and near the top rim shall be neatly cut and finished. The internal external surface of the tanks shall be smooth, clean and free from hidden internal defects like bubbles, pit and metallic or other foreign material inclusion. Capacity of the tank, minimum weight empty tank (without manhole lid) and the manufacture brand name shall be embossed on the surface of the tank near manhole.

23.25.3. Shape, Size and Capacity

The tank shall be cylindrical vertical with closed top having a manhole. Diameter and height tank of various capacities shall be as per manufacturer's specifications and a clearance of ± 3 pe shall be permitted on these dimensions. Capacity of the tank or up to the bottom of the inlet 10 whichever is less. Capacity of the tank shall be specified. Extra capacity if any shall be ignored.

23.25.4. Weight and Wall Thickness

Minimum weight of the empty tank (exclusive of manhole lid fittings) and the minimum wall thick of top, bottom and sides shall be specified in Table below. Wall thickness shall be checked beyon mm of the edge where the direction the plane of tank surface changes.

23.25.5. Installation and Fittings

The flat base of the tank shall be fully supported over its whole bottom area on a durable rigio and level platform sufficiently strong to stand without deflection the weight of the tank when fully j with water. Depending upon the capacity and location tanks may be suitably anchored as per directions of the Engineer-in-Charge. For inlet, outlet and other connections fully threaded GI, HOP PVC connections with hexagonal check nuts and washers on either side of the tank wall shal provided. Holes for threaded connections shall be drilled and not punched. Pipes entering of leaving tank shall be provided with unions and suitably supported on a firm base to avoid damage to the walls.

23.25.6. Manhole Lid

The lid shall rest evenly and fit over the rim of the manhole so as to prevent the ingress of any for matter into the tank. The lid shall be provided with suitable arrangement for locking it with the tank.

23.25.7. The tank and its component shall confirm to local bye laws for preventions of mosquito menace.

23.25.8. Measurements

Dimensions shall be measured to the nearest cm. and weight of the empty tank shall be recorded to the nearest 100g. Capacity of the tank as defined in above shall be calculated to the nearest litre.

TABLE 25

S. No.	*Capacit /itres*	*Minimum Wall* mm	*Minimum Weight Empty Tank (kg)*
1	2	3	4
1.	200	4.4	7.8
2.	300	4.4	9.0
3.	400	5.5	15.0
4.	500	6.0	18.0
5.	700	6.6	23.5
6.	1000	7.0	33.0
7.	1250	7.0	40.0

8.	1500	7.0	47.0
9.	1700	7.0	54.0
10.	2000	8.2	64.0
11.	2500	8.2	81.0
12.	3000	8.8	96.0
13.	4000	10.4	138.0
14.	5000	10.7	191.0
15.	6000	10.7	209.0
16.	7500	10.7	250.0
17.	10000	11.5	363.0
18.	15000	11.5	550.0
19.	20000	13.2	814.0

23.25.9.Rates

The rate shall include the cost of the tank, manhole lid, carriage and delivery at the place specified. Hoisting, installation, fittings, platform and anchoring shall be payable separately.

23.26. MANHOLES

At every change of alignment, gradient or diameter of a drain, there shall be a manhole or inspection chamber. Bends and junctions in the drains shall be grouped together in manhole as far as possible. The maximum distance between manholes shall be 30 m.

Manholes of different types and sizes as specified shall be constructed in the sewer line at places and to such levels and dimensions as shown in the drawings or as directed by the Engine Charge. The size specified shall indicate the inside dimensions between brick faces of the manholes.

Where the diameter of the drain is increased, the crown of the pipe shall be fixed at the same level and necessary slope given in the invert of the manhole chamber. In exceptional cases and where unavoidable, the crown of the branch sewer may be fixed at lower level but in such cases the peak flow level of the two sewers shall be kept the same.

Sewers of unequal sectional area shall not be jointed at the same invert in a manhole. The invert of the smaller sewer at its junction with main shall be at least 2/3 the diameter of the main above the invert of the main. The branch sewers shall deliver sewage in the manhole in the direction of main flow and junction must be made with care so that flow in main is not impeded.

No drain from house fittings, e.g. gully trap or soil pipe, etc. to manhole shall normally exceed a length of 6 m unless it is unavoidable.

Manholes 90 x 80 cm are generally constructed within compound for house drainage only and near the buildings for house drainage. Manholes 1.2 m x 90 cm are generally constructed for main drainage work for depths less than 1.5 m.

Manhole 1.4 m x 90 cm is of the arched type and is generally constructed for main drainage works where depth is 1.50 m or more. The width of manholes shall be increased more than 90 cm on bends or junctions or pipes with diameter greater than 450 mm and that the benching width on either side channel is minimum 20 cm.

Manholes 1.4 m internal diameter are generally constructed for main drainage works where depth is 2.45 m or more as an alternative to manholes of arch type. The diameter shall be increased suitably, for pipes with diameter greater than 450 mm in the same manner as in the case of rectangular manholes.

Before deciding size of manholes, Local Municipal Bye Laws shall be consulted. As a general guide some typical type designs of manholes followed have been as per CPWD specification. When manholes are constructed on foot path, these shall be provided with

cover of medium duty casting and when built within the width of the road under vehicular traffic, these shall be provided with cover of heavy duty casting.

23.26.1. Excavation

The excavation for manhole shall be true to dimensions and levels shown on the plans or as directed by the Engineer-in-Charge.

23.26.2. Bed Concrete

The manhole shall be built on a bed of cement concrete 1:4:8 (1 cement: 4 coarse sand: 8 graded stone aggregate 40 mm nominal size) unless required by local authorities. The thickness of the bed concrete shall be 20 cm for manholes up to 4.25 m depth and 30 cm for depths beyond 4.25 m unless otherwise specified or directed by the Engineer-in-Charge. In bad ground, special foundation as suitable shall be provided.

23.26.3. Brick Work

The brick work shall be with class 75 bricks in cement mortar 1:4 (1 cement: 4 coarse sand). The external joints of the brick masonry shall be finished smooth, and the joints of the pipes with the masonry shall be made perfectly leak proof. For arched type and circular manholes, brick masonry in arches and arching over the pipes shall be in cement mortar 1.3 (1 cement: 3 fine sand). In the case of manholes of circular type, the excess shaft shall be corbelled inwardly on three sides at the top to reduce its size to
the cover frame to be fitted. .

The walls shall be built of one brick thickness for depths up to 4.25 m. Below a depth of 4.25 m in ordinary subsoil the wall thickness shall be increased to one and half brick and at 9.75 m below ground two brick thick walls shall be built.

23.26.4. Plaster and Pointing

The walls of the manholes shall be plastered inside with 12 mm thick cement plaster 1: 3 (1 cement: 3 coarse sand) finished smooth. In the case of arched type manhole, the walls of the manhole shall be plastered inside all-around only up to the crown level, and flush pointed for the shaft with cement mortar 1:2 (1 cement: 2 fine sand). Where the saturated soil is met with, also the external surface of the walls of the manhole shall be plastered with 12 mm thick cement plaster 1: 3 (1 cement: 3 coarse sand) finished smooth up to 30 cm above the highest sub-soil water level with the approval of the Engineer-in-Charge. The plaster shall further be water proofed with addition of approved water proofing compound in a quantity as per manufacturer's specifications. In case Local Authorities/Bye Laws specify richer specifications, the same shall be adopted.

For earth work excavation, bed concrete brick work, plaster and pointing, R.C.C. work and refilling of earth, respective specifications shall be followed.

23.26.5. Benching

The channels and benching shall be done in cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) and rendered smooth with neat cement. The depth of channels and benching shall be as given in Table below.

23.26.6. Foot Rests

All manholes deeper than 0.8 m shall be provided with M.S. foot rests. These shall be embedded 20 cm deep in 20 x 20 x 10 cm blocks of cement concrete 1:3:6 (1 cement: 3 coarse sand 6 graded stone aggregate 20 mm nominal size). The concrete block with M.S. foot rest placed in its centre shall be cast in situ along with the masonry and surface finished with 12 mm thick cement plaster 1:3 (1 cement: 3 coarse sand) finished smooth.

TABLE 26

Sizes of mm	*Top of channel lilt the above bed concrete* *cm*	*Depth of benching at side above bed concrete* *cm*
100	15	20
150	20	30
200	25	35
250	30	40
300	35	45
350	40	50
400	45	55
450	50	60

Foot rests which shall be of 20 x 20 Sq. M.S. bars as specified in CPWD specifications shall be fixed 40 cm vertically and staggered laterally and shall project 10 cm beyond the surface of the wall. The top foot shall be 45 cm below the manhole cover.

Foot rests shall be painted with coal tar, the portion embedded in the cement concrete block t painted with thick cement slurry before fixing.

23.26.7.Manhole Covers and Frames

The frame of manhole shall be firmly embedded to correct alignment and levels in R.C.C. slG plain concrete as the case may be on the top of the masonry. After completion of the work, man covers shall be sealed by means of thick grease.

23.26.8.Measurements

Manholes shall be enumerated under relevant items. The depth of the manhole shall be reckc from the top level of C.1. cover to the invert level of channel. The depth shall be measured correct m. The extra depth shall be measured and paid as extra over the specified depth.

23.26.9.Rate

The rate shall include the cost of materials and labour involved in all the operations described above but excludes the cost of (i) excavation, (ii) M.S. foot rests and (iii) 12 mm thick cement plaster with water proofing material applied at the external surface of the manhole if required. These items shall be paid for separately under relevant items of work.

Payment for extra depths of manholes shall be made separately under relevant items of work.

24. EXTERNAL DRAINAGE & SEWAGE DISPOSAL:

24.1. General Scheme

The contractor shall install a drainage system to effectively collect; drain and dispose all soil and waste water from various parts of the buildings, appurtenances and equipment. The piping system shall finally terminate and discharge into the Municipal sewer / Sewage treatment plant. The piping work mainly consists of laying of Salt glazed stoneware pipes, reinforced cement concrete pipes and cast iron soil pipes as called for. Unless otherwise stated or permitted by Engineer-In-Charge, all piping shall be installed at depth at least 60 cm below finished ground level. The disposal system shall include construction of gully traps, manholes, intercepting chambers as indicated. The piping system shall be vented suitably at the starting point of all branch drains, main drains, the highest / lowest point of drain and at intervals as shown. All ventilating arrangements shall be un obstructive and concealed. The work shall be executed strictly in accordance with IS: 1742. The sewage system shall be subject to smoke test for its soundness as directed by the Engineer-In-Charge. Wherever the sewerage pipes run above water supply lines, same shall be completely encased in cement concrete 1:3:6 all round with the prior approval of the Engineer-In-Charge.

24.2. Piping Material

24.2.1. Stoneware Pipes

Stoneware pipes shall be perfectly salt glazed, sound, free from cracks, deformities and imperfections in glazing. They shall be cylindrical, straight and of standard nominal diameter, length and depth of socket. They shall be made of hard burnt stoneware of dark grey colour and thoroughly glazed and shall give a sharp clear note when struck with a light hammer. The pipe shall conform to the requirements of Indian Standards IS: 651 & the sizes and make specified in the Bill of Quantities.

24.2.2. Stoneware Gully Trap

Gully trap shall be stoneware as specified above. These shall be sound and free from visible defects such as any type of crack. The glaze of the traps shall be free from cracks. They shall give a sharp clear note when struck with light hammer. There shall be no broken blisters. Each gully trap shall have one CI grating of square size corresponding to the dimensions of inlet of gully trap. It will also have a water tight CI cover with frame inside dimensions 300 x 300 mm the cover weighing not less than 4.5 kg and the frame not less than 2.7 kg. The grating cover and frame shall be of good casting and shall have truly square machined seating faces.

24.2.3. Cast Iron Pipes

Cast iron pipes and fittings shall conform to IS:3989 in the documents.

24.2.4. Cast Iron Manhole Cover and Frame

The Cast Iron Manhole Cover and Frame shall conform to IS: 1726 and the grade and types have been specified in the Bill of Quantities. The cover and frames shall be cleanly cast & they shall be free from air and sand holes and from cold shuts. They shall be neatly dressed and carefully trimmed. All castings shall be free from voids whether due to shrinkage or other causes. Covers shall have a raised checkered design on the top surface to provide an adequate non-slip grip.

The sizes of covers specified shall be taken as the clear internal dimensions of the frame.

The covers and frames shall be coated with a black bituminous composition. The coating shall be smooth and tenacious. It shall not flow when exposed to a temperature of 63° C and shall not brittle as to chip off at a temperature of 0° C.

24.3. Laying and Jointing of Pipes

24.3.1. General

All the material shall be new of best quality conforming to specifications and subject to the approval of the Engineer-In-Charge. Drainage lines shall be laid to the required gradients and profiles. All drainage work shall be done in accordance with the local municipal by-laws.

Contractor shall obtain necessary approval and permission for the drainage system from the municipal or any other competent authority. Location of all manholes, catch basins etc. shall be confirmed by the Engineer-In-Charge before the actual execution of work at site. All work shall be executed as directed by the Engineer-In-Charge.

24.3.2. Alignment and Grade

The sewer and storm water drainage pipes shall be carefully laid to levels and gradients shown in the plans and sections but subject to modifications as shall be ordered by the Engineer-In-Charge from time to time to meet the requirements of the works. Great care shall be taken to prevent sand etc. from entering the pipes.

The pipes between two manholes shall be laid truly in straight lines without vertical or horizontal undulations. The body of the pipes shall rest on an even bed in the trench for its length and places shall be excavated to receive collar for the purpose of jointing. No deviations from the lines, depths of cuttings or gradients as called for on the drawings shall be permitted without the written approval of the Engineer-In-Charge. All pipes shall be laid atleast 60 cms below the finished ground level or as called for on the drawings.

24.3.3. Setting out Trenches

The contractor shall set out all trenches, manholes, chambers and such other works to true grades and alignments as called for. He shall provide the necessary instruments for setting out and verification for the same. All trenches shall be laid to true grade and in straight lines and as shown on the drawings.

The trenches shall be laid to proper levels by the assistance of boning rods and sight rails which shall be fixed at intervals not exceeding 10 meters or as directed by the Engineer-In-Charge.

24.4. Trench Excavation

The trenches for the pipes shall be excavated with bottoms formed to level and gradients as shown on the drawings or as directed by the Engineer-In-Charge. In soft and filled in ground, the Engineer-In-Charge may require the trenches to be excavated to a greater depth than the shown on the drawings and to fill up such additional excavation with concrete (1:4:8) consolidated to bring the excavation to the required levels as shown on the drawings.

All excavations shall be properly protected where necessary by suitable timbering, piling and sheeting as approved by the Engineer-In-Charge. All timbering and sheeting when withdrawn shall be done gradually to avoid falls. All cavities shall be adequately filled and consolidated. No blasting shall be allowed without prior approval in writing from the Engineer-In-Charge. It shall be carried out under thorough and competent supervision, with the written permission of the appropriate authorities taking full precautions connected with the blasting operations. All excavated earth shall be kept clear of the trenches to a distance equal to 75 cms.

24.5. Obstruction of Roads

The contractor shall not occupy or obstruct by his operation more than one half of the width of any road or street and sufficient space shall then be left for public and private transit. He shall remove the materials excavated and bring them back again when the trench is required to be refilled. The contractor shall obtain the consent of the Engineer-In-Charge in writing before closing any road to vehicular traffic and the foot walks must be clear at all times.

24.6. Protection of Pipes etc.

All pipes, water mains, cables etc. met in the course of excavation shall be carefully protected and supported. Care shall be taken not to disturb the cables, the removal of which shall be arranged by the contractor with the written consent from the Owner.

24.7. Trench Back Filling

Refilling of the trenches shall not be commenced until the length of pipes therein has been tested and approved. All timbering which may be withdrawn safely, shall be removed as filling proceeds. Where the pipes are unprotected by concreted hunching, selected fine material shall be carefully hand-packed around the lower half of the pipes so as to buttress them to the sides of the trench.

The refilling shall then be continued to 150 mm over the top of the pipe using selected fine hand packed material, watered and rammed on both sides of the pipes with a wooden hammer. The process of filling and tamping shall proceed evenly in layers not exceeding 150 mm thickness, each layer being watered and consolidated so as to maintain an equal pressure on both sides of the pipe line. In gardens and fields the top solid and turf if any, shall be carefully replaced.

24.8. Contractor to ensure Settlement and Damages

The contractor shall at his own costs and expenses, make good promptly during the whole period for the works in hand if any settlement occurs in the surfaces of roads, beams, footpaths, gardens, open spaces etc. in the public or private areas caused by his trenches or by his other excavations and he shall be liable for any accident caused thereby. He shall also, at his own expense and charges, repair (and make good) any damage done to building and other property. If in the opinion of the Engineer-In-Charge he fails to make good such works with all practicable dispatch, the Engineer-In-Charge shall be at his liberty to get the work done by other means and the expenses thereof shall be paid by the contractor or deducted from any money that may be or become due to him or recovered from him by any other manner according to the laws of land.

The contractor shall at his own costs and charges provide places for disposal of all surplus materials not required to be used on the works. As each trench is refilled, surplus soil shall be immediately removed, the surface shall be properly restored and roadways and sides shall be left clear.

24.9. Removal of water from Sewer, trench etc

The contractor shall at all times during the progress of work keep the excavations free from water which shall be disposed by him in a manner as will neither cause injury to the public health nor to the public or private property nor to the work completed or in progress nor to the surface of any road or streets, nor cause any interference with the use of the same by the public.

If any excavation is carried out at any point or points to a greater width of the specified cross section of the sewer with its cover, the full width of the trench shall be filled with concrete by the contractor at his own expense and charges to the requirements of the Engineer-In-Charge.

24.10. Route Markers

Markers indicating the particular service shall be provided along with the routes of pipe trenches. Markers shall be of mild steel indicating the type of service installed and the direction of flow painted on it. The markers shall be set firmly in a concrete base and installed at all corner and turning points. Over straight runs, markers shall be spaced centre to centre at 50 meter centre (generally).

24.11. Laying and Jointing of Cement Concrete pipes

Cement concrete pipes shall be laid and jointed as described in IS:783. After setting out the pipes, the collar shall be centered over the joint and a few skins of spun yarn soaked in a neat cement wash shall be inserted in the groove at the end of the pipe and two adjoining pipes butted against each other. After setting out the pipes, the collar shall then be slipped over the joint, covering equally both the pipes. Spun yarn soaked in neat cement wash shall be passed round the pipes and inserted in the joint by means of caulking tools from the ends of the collar. More skins of yarn shall be added and well rammed above.

Cement mortar with one part of cement and two parts of sand shall be slightly moistened and must in no account be soft or sloppy and shall be carefully inserted by hand into the joint and more cement mortar be added until the space of the joint has been filled completely with tightly caulked mortar. The joint shall be finished off neatly outside the collar on both sides at an angle of 45 degree, any surplus mortar projecting inside the joint is to be removed and to guard against any such projection, sack or gunny bags shall be drawn past each joint after completion. Cement mortar joint shall be cured for seven days.

24.12. Fixing Of Stoneware Gully Trap

The excavation for gully traps shall be done true to dimensions and levels as indicated on plans or as directed by the Engineer-In-Charge. The gully traps shall be fixed on cement concrete foundation [wherever required] 65cm square and not less than 10 cm thick. The mix for the concrete will be 1:4:8. The jointing of gully outlet to the branch drain shall be done similar to the jointing of S.W. Pipes described earlier. After fixing and testing gully and branch drain, a brick work of specified class in cement mortar 1:5 shall be built with a half brick masonry work round the gully trap from the top of the bed concrete upto ground level. The space between the chamber and trap shall be filled in with cement concrete 1:3:6. The upper portion of the chamber i.e. above the top level of the trap shall be plastered inside the cement mortar 1:3 finish with a floating coat of neat cement. The corners and bottom of the chamber shall be rounded off so as to slope towards the grating.

CI cover with frame 300 x 300 mm (inside) shall then be fixed on the top of the brick masonry with cement concrete 1:2:4 and rendered smooth. The finished top cover shall be so as to prevent the surface water from entering the gully trap.

24.13. Construction of Manhole

Where manholes are to be constructed, the excavation, filling back and ramming, disposal of surplus earth, preparation of bottom and sides etc. shall be carried out as described earlier under trench excavation. Manhole shall be sized and depths as called for in the drawings and Bill of Quantities.

The manhole shall be normally constructed as per detail drawing having lean mix concrete provided for leveling pores with 230mm thick BB masonry for shade walls usually plastered smooth from inside and outside and top of manhole provided with RCC slab as shown in the drawing along with cast iron or fibre reinforced concrete manhole frame and cover as specified or directed by Engineer-In-Charge. The bottom of the chamber will be provided with lean mix concrete for providing benching of suitable size and shape. The surface of benching shall be finished smooth with neat cement. The cost of benching, plaster and neat cement finishing shall deemed to have been included in the quoted rate of the manhole. Manholes with left more than 900 mm shall be provided with suitable size of cast iron rungs as indicated in the drawing and as specified in the item. These rungs will be paid separately as per rates shown in the Bill of Quantities.

Above the horizontal diameter, the sides of channel shall be extended vertically to the same level as the crown of the outgoing pipe and the top edge shall be suitably rounded off. The branch channels shall also be similarly constructed with respect to the benching but at their junction with the main channel an appropriate fall suitably rounded off in the direction of flow in the main channel shall be given. Rungs of cast iron or mild steel of suitable dimensions shall be provided in all manholes over 800 mm depth. These rungs shall be set at 30 cms interval in two vertical runs at 380 mm apart horizontally. The top rung shall be 450 mm below the manhole cover. Unless otherwise mentioned, manholes shall be constructed to the requirements of Indian Standard IS:4111 (Part I). All manholes shall be constructed so as to be water tight under test. All angles shall be rounded to a 75 mm radius with cement plaster 20 mm thick. The benching at the side shall be carried out in such a manner so as to provide no lodgment for any splashing in case of accidental flooding. Manhole cover with frame shall be cast iron of an approved make. The covers and frame shall generally be double seal as specified in the Bill of Quantities.

24.14. Drop Connection

Drop connection shall be provided between branch sewer and main sewer in the main sewer itself in steep ground when the difference in invert level of two exceeds 45 cms of the required sizes. Drop connections from gully traps to main sewer in rectangular shall be made inside the manholes and shall have HCI special types door bend on to top and heel rest bend at bottom connected by a HCI pipe. The pipe shall be supported by holder bat clamps at 180 cms intervals with at least one clamp for each drop connection. All joints shall be lead caulked joints 25 mm deep.

Drop connections from branch sewer to main sewer shall be made outside the manhole wall with HCI / CI class LA pipe, connection, vertical pipe and bend at the bottoms. The top of the tee shall be finished upto the surface level and provided with a CI hinges type frame & cover 30 cms x 30 cms. The connection and tee upto the surface chamber of the tee.

Drop connection made from vertical stacks directly into manholes shall not be considered as drop connections. They shall be paid for under the relevant soil and waste pipes.

24.15. Making Connections

Contractor shall connect the new sewer line to the existing manhole by cutting the walls benching and restoring them to the original condition. A new channel shall be cut in the benching of the existing manhole for the new connection. Contractor shall remove all sewage & water if encountered in making the connection without additional cost.

24.16. Shifting of Excavated Surplus Material

Contractor shall make his own arrangement to shift the surplus excavated material within the site limits as directed by Engineer-In-Charge.

24.17. Testing

All lengths of the sewer and drain shall be carefully tested for water tightness by means of water pressure maintained for not less than 30 minutes. Testing shall be carried out from manhole to manhole. All pipes shall be subject to a test pressure of 1.5 metre head of water. The test pressure will however, not exceed 6 metres head at any point. The pipes shall be plugged preferably with standard design plugs with rubber plugs on both sides, the upper end shall, however, be connected to a pipe for filling with water and getting the required head poured at one time permit.

Sewer lines shall be tested for straightness by:

(a) Inserting a smooth ball 12mm less than the internal diameter of the pipe. In the absence of obstructions such as yarn or mortar projecting at the joints the ball should roll down the invert of the pipe and emerge at the lower end.

(b) Means of a mirror at one end and a lamp at the other end. If the pipe is straight the full circle of light will be seen otherwise obstructions or deviations will be apparent.

(c) The contractor shall alternatively give a smoke test to the drain and sewer at his own expense and charge, if directed by the Engineer-In-Charge.

(d) A test register shall be maintained which shall be signed and dated by contractor, Engineer-In-Charge.

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.