Construction of 400 meters Synthetic Athletic Track and AstroTurf Football field under Urban Sports Infrastructure Scheme (USIS) at PDEU campus, Gandhinagar.

HCP DESIGN, PLANNING AND MANAGEMENT PVT. LTD.
Paritosh, Usmanpura, Ahmedabad – 380 013, Phone: 2755 0875, Fax: 2755 2924.

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Part – A

General & Technical Specifications

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PART - A
GCC, SCC, General and Technical specifications
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Applicable Standards
For
Civil Works

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1	Conversion factors	IS:786
2	Method of measurement of building works	IS:1200
3	Code of practice for measurement of civil engineering works	IS:3385
4	Materials and workmanship for earthwork and excavation	IS:1200 (PART I)
5	Safety code for blasting and related drilling operations	IS:4081
6	Safety code for excavation work	IS:3764
7	Moisture content in sand for filling	IS:2720
8	Determination of moisture content	IS:2720 (PART II)
9	Determination of moisture content & dry density relation using light compaction	IS: 2720 (PART VIII)
10	Determination of dry density of soils in-place by the sand replacement method	IS:2720(PART XXVIII)
11	Determination of dry density of soils in-place by the core cutter method	IS:2720 (PART XXIX)
12	Anti termite treatment	IS:6313(PARTI TO III)
13	Construction water	IS:456
14	Methods of sampling and test (physical and chemical water used in industry)	IS:3025
15	Ordinary (33 grade)/low heat Portland cement	IS:269
16	Ordinary Portland cement (43 grade)	IS:8112
17	Ordinary Portland cement (53 grade)	IS:12269
18	White Portland cement	IS:8042-E
19	Portland pozzolana cement	IS:1489
20	Rapid hardening Portland cement	IS:8041, IS:269
21	Portland(blast furnace) slag cement	IS:455
22	Hydrophobic cement	IS:8043
23	High alumina cement	IS:6452
24	Super sulphated cement	IS:6909
25	Oil well cement	IS:8229E
26	Standard for testing of cement	IS:650
27	Methods of physical tests for hydraulic cement	IS:4031
28	Specification for standard sand for testing of cement	IS:650
29	Coarse and fine aggregates for concrete	IS:383, IS:515
30	Gradation of coarse aggregates	IS:383(TABLEII)
31	Gradation of fine aggregates	IS:383 (TABLE III)
32	All-in-aggregates	IS:383 (TABLE IV)
33	Method of tests for aggregates for concrete	IS:2386 (PART I TO VIII)
34	Methods of determination the maximum qty. of deleterious materials in aggregate	IS:2386 (PART II)
35	Limiting values of the maximum quantities of deleterious materials in aggregate	IS:383 (TABLE I)
36	Flakiness index of aggregates	IS:2396 (PART I), IS:5640
37	Moisture content test for aggregates	IS:2386 (PART III)
38	Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.	IS:432 (PART I & II)
39	Specification for plain hard drawn steel wire fabric for cement concrete	IS:1566
40	Specification for cold twisted steel bars for concrete reinforcement	IS:1786
41	Specifications for hot rolled mild steel and medium tensile steel deformed bars	IS:1139, IS:1739
42	Code of practice for bending and fixing of bars for concrete reinforcement	IS:2502
43	Mild steel binding wire	IS:280
44	Code of practice for welding of mild steel bars used for RCC	IS:2751
45	Code of practice for plain and reinforced concrete	IS:456
46	Code of practice for general construction of plain and RCC for dams	IS:457
47	Testing of reinforced cement concrete	IS:516
48	Method of tests for strength of concrete	IS:516
49	Methods of sampling & analysis of concrete	IS:1199
50	Code of practice for concrete structures for storage of liquids	IS:3370 (PART I TO IV)
51	Code of practice for composite construction	IS:3935
52	Code of practice for construction of reinforced concrete shell roof	IS:2204
53	Criteria for the design of RCC shell structures and folded plates	IS:2210
54	Specification for batch type concrete mixers	IS:1791
55	Specification for portable swing weigh batchers for concrete	IS:2722
56	Specification for roller pan mixer	IS:2438
57	Specification for concrete vibrators immersion type	IS:2505

58	Specification for screed board concrete vibrators	IS:2506
59	Specification for concrete vibrating tables	IS:2514
60	Specification for pan vibrators	IS:3366
61	Specification for form vibrators for concrete	IS:4656
62	Code of practice for use of immersion vibrators for consolidated concrete	IS:3558
63	Air entraining agent	ASTM:6260
64	Criteria for design and construction of precast concrete trusses	IS:3201
65	Prestressed concrete	IS:1343
66	Specification for high tensile steel bars used in code of practice for pre-stressed concrete	IS:2090
67	Specification for plain hard drawn steel wire for pre-stressed concrete	IS:1785 (PART I)
68	Specification for plywood for concrete	
69	Shuttering work	IS:4990
70	Code of practice for steel tubular scaffolding	IS:4014 (PART I & II)
71	Specification for steel scaffolding	IS:2750
72	Safety code for scaffolds and ladders	IS:3696
73	Common burnt clay building bricks	IS:1077
74	Classification of burnt clay bricks	IS:3102
75	Burnt clay building bricks, heavy duty	IS:2180
76	Burnt clay facing bricks	IS:2691,IS:1077
77	Method of sampling and testing clay building bricks	IS:3495 (PART I - IV)
78	Mortar for brick work	IS:2250
79	Code of practice for brick work	IS:2221
80	Masonry works	IS:3466
81	Structural safety etc. Of building masonry walls	IS:1905
82	Load bearing hollow concrete blocks	IS:2185
83	Lime - cement - cinder hollow concrete blocks	IS:5498
84	Lime - cement - cinder solid blocks	IS:3115
85	Code of practice for construction of stone masonry	IS:1597 (PART I)
86	Stone tests	IS:1124
87	Code of practice for design and installation of joints in buildings	IS:3414
88	Joint sealing compound	IS:834
89	Pre-molded bituminous joint filler	IS:1838
90	Timber door, window and ventilator frames	IS:4021
91	Material & workmanship for wood work	IS:883, IS:4021
92	Wooden flush door shutters (solid core type)	IS:2202 (PART I)
93	Timber paneled and glazed shutters	IS:1003 (PART I & II)
94	Method of tests for wooden flush doors, type tests	IS:4020
95	Plywood & tests	IS:303
96	General tests for wood work	IS:1659
97	Red lead for wood knot	IS:103
98	Oil type wood preservative	IS:218
99	Particle board	IS:3087
100	Transparent sheet glass for glazing & framing purposes	IS:1761
101	Resin bonded fiber glass	IS:3144
102	Putty for glazing	IS:420
103	Steel door frames	IS:4351
104	Steel window	IS:1361
105	Steel doors	IS:1038
106	Steel ventilators	IS:1081
107	Rolling shutters	IS:6248
108	Primer for steel doors, windows & ventilators	IS:102
109	Aluminum alloy for door/window frames	IS DSGN. HEA-WP OF IS:733
110	Sections	IS:1948
111	Anodizing	BS:1616
112	Hydraulic lime & storage	IS:712
113	General tests for lime	IS:6932 (PART I TO X)
114	Field tests for lime	IS:1624

115	Lime mortar preparation	IS:1625
116	Slacked lime	IS:1639
117	Surkhi	IS:1344
118	Code of practice for application of lime plaster finish	IS:2394
119	Rough cast plaster	IS:1661(CLAUSE-165)
120	Specification for integral cement water proofing compounds	IS:2645
121	Water proofing asphalt/maxphalt	IS:702
122	Bitumen saturated layer	IS:1322
123	Bitumen felt	IS:1322
124	Bitumen	IS:702
125	Code of practice for laying and finishing of cement concrete flooring tiles	IS:1443
126	Material & workmanship for flooring	IS:1197, IS:1344
127	Code of practice for laying in situ terrazzo floor finish	IS:2114
128	Code of practice for laying in-situ cement concrete flooring	IS:2571
129	Mosaic tiles	IS:1237
130	Glazed earthenware tiles	IS:777
131	Marble chips & marble mosaic terrazzo	IS:2114
132	Plain cement tiles & tests	IS:1237
133	Marble mosaic tiles	IS:1237
134	Marble slab	IS:1130
135	PVC flooring tiles & sheets	IS:3461,IS:3462
136	Broken marble mosaic tiles	IS:1257
137	Oxy-chloride	IS:658
138	Magnesium chloride	IS:657
139	C.I. grid tiles	IS:210
140	Pigment for terrazzo flooring	IS:459
141	Rivets	IS:1148
142	Electrodes for welding	IS:814
143	Code of practice for use of electric arc welding for general construction in steel	IS:813
144	Tests for welding works	IS:1181
145	Welding works	IS:816
146	Bolts and nuts	IS:1367
147	Tests for bolts and nuts	IS:1608
148	Structural steel sections & tests	IS:226
149	Structural steel plates	IS:2062
150	Defects in structural steel	IS:229
151	Dimension & properties of steel section	IS:808
152	Structural steel work	IS:226, IS:4948
154	Expanded metal steel sheet	IS:412
155	Mild steel wire gauze jali	IS:280
156	Welding procedure & edge preparation	IS:823
157	Washers	IS:2016
158	Storage of welding wire & electrodes	IS:816
159	Primer to structural surface for bolts	IS:2074
160	Checkered plates	IS:3502
161	Code of practice for painting of ferrous metal in building and allied finishes	IS:1477 (PART I & II)
162	Distemper and dry colour	IS:427
163	Code of practice for painting concrete, masonry and plaster surfaces	IS:2395
164	Distemper and oil emulsion	IS:428
165	Enamel paints	IS:2933
170	Coat of zinc chromate	IS:104
171	French spirit polish	IS:348
172	GI sheets	IS:227
173	Ac sheets	IS:459
174	Ac sheet fixing	IS:730
175	Mangalore pattern tiles	IS:654
176	Fiber glass reinforced polyester	IS:4154

177	Galvanized steel for barbed wire	IS:278
178	Insulation of hot water pipes, tanks & heat exchanger	BS:476
179	GI pipes & MS tubes	IS:1239 (PART I)
180	Screw down bib cocks & stop cocks	IS:781
181	Vitreous sanitary fixtures(general)	IS:2556 (PART I)
182	Gun metal wheel, globe, check, gate & non return valves	IS:778
183	Wash basin	IS:2556 (PART IV), IS:771
184	European W.C.	IS:2556, IS:771
185	Solid plastic seat & cover	IS:2548
186	Orissa pan W.C.	IS:2556 (PART III)
187	Squatting pans & traps	IS:2556 (PART III)
188	Indian W.C. (wash down W.C.)	IS:2556 (PART II), IS:771
189	Urinals	IS:2556 (PART VI)
190	Half round channels	IS:2556 (PART VII)
191	Specific requirements of siphonic wash down W.C.	IS:2556 (PART VIII)
192	Ss sink/C.I./flushing tank brackets	IS:775
193	C.I. siphonic flushing cistern	IS:774
194	Lead pipes	IS:404 (PART I)
195	Sand cast pipes & fittings	IS:1729
196	C.I. spun soil pipes & fittings	IS:3939
197	Gully trap	IS:651
198	Glazed stone ware pipes & fittings	IS:651
199	Ac pipe	IS:1626,IS:1626 (PART I)
200	High pressure/crydon ball valve	IS:1703
201	C.I. sluice valve	IS:780
202	Capstan head	IS:1795
203	Malleable iron fittings	IS:1879 (PART I TO X)
204	C.I. pipes	IS:1536, IS:1537
205	Molten (pig)lead	IS:782
206	C.I. manhole frames & covers	IS:1726
207	Concrete pipes	IS:458
208	Threads for screwed pipes	IS:554
209	Lead jointing	IS:718
210	Carbon steel for pipes	IS:9161
211	Low level ceramic cistern	IS:774
212	Bowl pattern flat back urinals	IS:2556 (PART IV)
213	Showers	IS:2064
214	Heavy C.I. pipes	IS:1729
215	Concrete mix design	IS:10262
216	Code of practice for construction of floor and roof with joists and filler blocks	IS:6061 (PART I)
217	Code of practice for construction of light weight concrete block masonry	IS:6042
218	Specification for load bearing light weight concrete blocks	IS:3590
219	Code of practice for construction of hollow concrete block masonry	IS:2572
220	Specification for concrete masonry units (hollow and solid concrete blocks)	IS:2185 (PART I)
221	Chemical composition of ordinary Portland cement	IS:4032
222	Sulphate resistant cement	BS:4027 & ASTMC-150 TYPE II
223	Specifications for circular hollow sections	IS:1161
224	Properties of rectangular & square hollow sections	IS:4923
225	Cold formed welded & seamless carbon steel structural tubing	ASTMA 500
226	Cold but not formed welded & seamless carbon steel structural tubing	ASTMA 501
227	Hot formed welded & seamless high strength low alloy tubing	ASTMA 618
228	Hot rolled structural steel hollow section	BS:4848/

Note : For the reference of all Codes and Standards, the latest version of the above specified Standards shall be followed, Wherever, such Standards are not specified for the construction materials, equipment and method, the relevant Indian Standard Codes of Practice shall be followed, in the absence of Indian Standards corresponding British Standard Codes of Practice or relevant American Standards shall be followed.

List of Approved Makes
for
Civil Work

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Sr No.	Material / Item	Approved Make
1	AAC Blocks	Xtralite from Ultratech, Magicrete, Aerocon from HIL, Biltech, Ethios Enviro Soluiton Pvt Ltd.. JK Laxmi
2	AAC block joining mortar	Fixoblock xtralite from Ultratech, Smartfix from Aerocon, MYK Laticrete, Ardex Endura
3	Acoustic Insulation (Mineral Wool)	Lloyd, Ecophone from Saint Gobain, U.P. Twiga Ltd, Rockwool India, Anuton, Knauf, Siderise
4	Acoustic Wooden (Fire) Door	Pacific, Navair, Tesco
5	Acoustic Seal	Lorient, Raven, Dorma, Kelargo, Reddiplex
6	Acoustical Ceiling / Wall Panelling	Anutone, Ecophon - Saint Gobain, USG Boral, Armstrong, Parmepho, Acoustics India
7	Access panel in False ceiling	Saint Gobain, USG Boral, Knauf Denoline
8	Adhesive For Wood Work	Ardex Endura, Laticrete, Pidilite, Vamicol
9	Admixture for Concrete	BAFS, SIKA, Fosroc, Fairmat, Ardrex Endura, Cico, Pidilite
10	Aggregates	From Approved quarry nearby site.
11	Air transfer grills	Trox, Ruskin Titus, Systemair India
12	Aluminium Accessories	Classic/ Argen/ Oxford/ Nulite/ Crown/ EBCO
13	Aluminium composite panel	Alucobond, Alstone, Alubond, Eurobond, Aludecor, Alstrong
14	Aluminium Sections	Hindalco, Jindal, Bhoruka, Indalco, Sapa
15	Aluminium System Windows	Kaluco, Technal, Domal, ALCOI, Geeta Aluminium, Eternia from Hindalco, Alumak,
16	Aluminium Systems Glazing/ Curtain wall (Façade system)	Domal, Technal, Schuco, SAPA Building Systems, Reyners, Kawneer, Eternia - Hindalco,
17	Aluminium D/W hardware	Alualpha, Lavaal, Giesse, Cotswold, Securistyle, Polismar
18	Aluminium Louvers	Hunter Douglas, Armstrong, Luxalon, Fameline
19	Anchor Fastner, Rebar, Chemcial/ Mechanical fastner, Core - cutting, Dry stone cladding clamp, Expandable fastners	Hilti, Fisher, ITW, Mungo, Power, Split, Wurth
20	Anti-Termite Pestisides - (Chloropyriphos)	DE - Nocil, Bayer, Biflex-TC from FMC, Hilban from HIL
21	Automatic Slidding doors/ Revolving Doors	Dorma, Geze, Hafele
22	Backer Road	Supreme, Fosroc, Armacell, Shalimar
23	Bricks	Locallly available as per approved sample having strength not less than 35 Kg/cm2
24	Bricks for Exposed work	Jalaram Bricks, JJB, Maa,or approved equivalent
25	Calcium Silicate Board	Hilux (Ramco), Aerolite, Pamtech, Promatech
26	Cement OPC/ PPC	Ultratech, ACC, Ambuja, JK Laxmi, Sanghi, Wonder
27	Cement - White	Birla, JK Laxmi, Shree, Travancor
28	Cement Fiber Board	Everest, NCL Industries (Bison Panel), Shera Board, Visaka Industries (V- Next), Century (Zykron),
29	Tiles/ Stone fixing Adhesive	Pidilite, MYK- Latricrete, Ardex Endura, KeraKoll, Ultratech, Mepai
30	Chemical Admixtures & Additives	BASF, Pidilite, Sika, Fosroc, Asian, Sunanda Chemicals, Mapei, Ardex Endura, MC Bauchemie, MYK Schomburg,
31	Compact laminated sheet	Greenlam, Marino, Vir Laminates, Bloom, Sunmica, Archidlam
32	Crystalline Integral Waterproofing	Kryton, Penetron, Pidilite, BASF, Fosroc, Sika, Xypex
33	Door Closer	Dorma, Hafele, Assa Abloy (Yale), Geze, Ozone
34	Door Locks and latch	Dorma, Geze, Kich, Hafele, Assa Abloy (Yale), Ozone
35	Door Hardware (other than Floor spring, Closer, Locks)	Dorma, Kich, Hafele, Assa Abloy (Yale), Dorset, EPPW, Magnum, Ozone

36	Door Seal – Wool pile Weather Strip	Reddiplex, Osaka rubber, Enviro Sealz, Anand
37	Double Side Tape, Decorative Tape	3M, Lamtex, Saint Gobain
41	EPDM Gaskets	Anand, Osaka Rubber, Roop, Bohra, Hanu, Maharashtra polymer
42	Epoxy Grout/ Cementitious Grout for Flooring	Ardex Endura, MYK Latricrete, Kerakoll, Pidilite
43	Expanded metel mesh (Powder Coated)	Tata, Asian Streck Metal
44	External Paving Tiles (Cement based)	Pavit, Basant baton, Vyara, Ultra, Eurocon, Super
45	Expansion Joint System	Kantaflex, Sanfield, Deevin, Vexcolt
46	Expansion Joint System for Basement wall	Sika, Butynol from Ardex Endura, BASF
47	Expansion Filler board - Premoulded compressible	Supreme (Capcell HD100), Shalitex -STP
48	Fabric (Acoustic and fire rated)	Atmosphere, Palette, D'décor Fabric
49	Fire Doors	Shakti Horman, Pacific, Navair, iCLEAN - IHMS
50	Fire Rated Hardware	Dorma, Hafele, Geze, Horman, Assa Abloy (Yale), Ozone
51	Fire Seal, Fire smoke Seal	3M, Hilti, Dorma, Sealz, Lorient, Kelargo, Raven
52	Fire rated Glass	Vetrotech Saint-Gobain, Pyroguard, Glaverbel, Schott - Pyran, Pyroswiss
53	Fire rated Glass fixing gasket, tape	Karfani, 3M
54	Floor Springs	Dorma, GEZE, Haffle, Assa Abloy (Yale), Ozone
55	Floor hardening compound	JBA, Ardex endura, Fosroc, BASF, Sika, Sunanda chemicals
56	Flush Door Shutter	Century, Greenply, Duroply, Kitply, Uniply, Anchorply, Archidply
57	Furniture Hardware	Hettich, Hafele, Kich, Ozone
58	Glass, Tinted Glass, High Performance Glass, Reflective Glass, back painted glass	Saint Gobain, AIS, Modiguard (Gujarat Guardian), Pilkington, Sisecam (HNG)
59	Glass Processing	IPH, Impact Safety, GlassTech, FGG, AIS, Nishu Glass Processor, Jajoo Glass
60	Glass Doors (Motorised)	DORMA, Haffle, Ozone
61	Glass Fibre Acoustical Tiles	ECOPHON, Armstrong, Anutone, AMF
62	Glass mosaic tiles	Picollo, Italia, Bissazza, Shon, Pino, Palidio
63	Grab Bars and Disabled Hardware	Dline, Cera, Jaquar, Hindware, Dorma
64	Gypsum ceiling board	Saint Gobain, Knauf, USG Boral, India Gypsum, Lafarge
65	Gypsum plaster	Stain Gobain, JK Laxmi, India Gypsum
66	Hollow Concrete Bolck	Winners ConMat, Alcock, Super, Nishu, Manibhadra
67	Laminates	Marino, Century, Greenlam, Formica, Sunmica, Vir,
68	Laminated Shuttering Ply	Green Ply , Century Ply, Archidply, Nipponply
69	Masking Tapes	3M, Sun Control, Wonder Polymer. Essentra
70	Metal Ceilings	Armstrong, Techno Ceiling Product, Saint Gobain, USG Boral, Hunter Douglas, Durlam
71	Metal Doors (Non Fire rated)	Shakti Horman, Naviar, Ahlada, Metaflex, Pacific
72	Mineral Fibre Grid Ceilings	Armstrong, Saint Gobain (Ecophon), Anutone, USG Boral, Knauf, AMF, Daiken
73	Mirrors	Saint Gobain, Modi Guard (Gujarat Guardian), AIS, Pilkington, Sisecam (HNG)
74	Modular Furniture	Wipro, Godrej, Fetherlite
75	Modular Toilet Cubical - Compact laminate	BESCO by Merino, Sturdo by Greenlam, Stylam, Fundermax
76	Non shrink cementious precision (anchoring) grout	Fosroc, Sika, Mapei, Ardex Endura, BASF
77	Patch Fitting	Dorma, Haffle, Geze, Ozone, Dorset
78	Paint - Cement Based	ICI Dulux, Ultratech, Berger Paints, Asian, Nerolac
79	Paint - Acrylic, Synthetic Enamel	Asian Paints, Akzo Nobel (Dulux), Berger, Nerolac, Jotun
80	Paint - (Exterior)	Akzo Nobel (Dulux), Asian Paints, Jotun, Berger, Nerolac

81	Paint - Texture Paints (Interior, Exterior)	Asian, Earthen Texture, Jotun, ICI Dulux, Berger, Ultratech, SKK, Luxture, Spectrum
82	Paint - Anti microbial paint	Asian, Berger, Jotun, ICI Dulux
83	Paint - Fire Retardant paint	Jotun, Akzo Nobel, Viper-Nullifire, Asian
84	Paint - High Albedo paint/ Solar reflective paint	BASF, Jotun, Sika, Fosroc, Pidilite,
85	Paint - Oil Bound Distemper & Dry Distemper	Asian Paints, AkzoNobel (ICI Dulux), Berger, Ultratech,
86	Paint - PU paint, epoxy paint and primer	Asian, Nippon, ICI, Berger, Jotun
87	Planters and Pot	Sandstone, Sereno, Green Revolution, Unique Industries (yashvi green scape), TDW
88	Plywood & Board (All type of play)	Greenply, Archidply, Century, Duroply, Uniply, Kitply, National, Merino
89	Polycarbonate Sheets & Panel system	Tuflite, Gallina India, Dan Pal (Dpi daylighting), Lexan, Polygal
90	Polycarbonate Dome	Acros, Multidomez, Palram, Argus
91	Polish for wooden work	MRF, Asian, ICI, ICA
92	Polysulphide Sealant	Pidilite, Fosroc, Dow corning, Sika, MC-bauchemie
93	Polyurethane Concrete Flooring, Epoxy flooring, Self Levelling compound	BASF, Fosroc, Ardex Endura, MYK Schomburg, Sika, Cipy
94	Polyurethane overdeck insulation foam	BASF, Pidilite, Lloyd Insulations
95	Polyster Powder coating/ PVDF Coating	Jotun, Akzo nobel (Interpon), Valspar, Asian PPG
96	Precast Concrete Block & Jali for masonry work	Winners ConMat, Alcock, Super, Nishu, Manibhadra
97	Precast concrete tiles, Interlocking Paving, Brick paver, Grass/ Grid Pavers	Vyara, Winners ConMat, Super, Nishu, Basant betons, Unistone,
98	Pre cast Concrete Landscape elements, gratings, kerb, Drain cover	Shilp, Vyara, Super, Nishu, Basant betons, Winners ConMat,
99	Precast Outdoor furniture	OTLO, Oblique, TDW, KK
100	Precoated Galvanised Sheets	Tata-Blue scope, Jindal, Everest, Interarch, Shree Prefeb
101	PVB/ SGP Laminate Film, Sentry film	Dupont, Saflex, Eastman, Saint Gobain, XDS
102	PVC continuous fillet for periphery Packing of Glazings/ Curtain Wall	Roop, Anand, Forex Plastic or approved equivalent
103	Reinforcement Steel: Main Producers only	SAIL, TATA (TISCO), RINL, JSW steel, JSPL
104	Rock wool Insulation	UP Twiga, Rockwool India, Lloyd, Ecophone, Knauf,
105	Rolling Shutter	Sona, Sagar, Suryoday, Gandhi, Avian
106	Roll down/ sliding moquito shutter	Netmos, Windoor marketing
107	Sand	Only River sand of approved area (Sea sand not acceptable) or manufactured sand
108	Safety and road marking equipments	3M, Protector, Asian for road marking paint,
109	Signage vinyl sticker	Claude Neon, Prolite 3M, Cosign
110	Silicon Gaskets	Sree Gaurav, Roop, Anand, Osaka
111	Silicone Sealant	Wacker, Dow Corning, GE momentive, MC-bauchemie, Pidilite
112	Silicone Paint	Wacker, Dow Corning, GE momentive
113	Spider Fittings/ WCP profiles	Dorma, Hefele, Hettich, Dline, Geze
114	Stainless Steel	SAI, Jindal, L, Salem
115	Stainless Steel Bolts, Washers and Nuts, Pressure plates, screws	Kundan, Puja, Atul, GKW
116	Stainless Steel Friction Stay	Giesse, Securistyle, Cotswold, Hefele
117	Structural Silicon sealant, Weather Silicone	Dow Corning, Momentive (GE), Sika, Ardex Endura
118	Structure Steel & Hallow Section Producers only	SAIL, TATA (TISCO), RINL, Jindal steel & Power (JSPL)
119	Suspended ceiling system	Armstrong, Saint Gobain, USG Boral, Knauf, Anuton

120	Tensile Fabric Roofing	Ferrari, Saint Gobain, Melher, Sattler
121	Tactile Guiding & Warning flooring	Johnson, Somani, Pavit, Nitco
122	Veneer - Natural	GreenLam, Century, Duroply, Turakhia
123	Ceramic Tiles	Kajaria, RAK, Restile, Somany, Jhonson, Nitco, Simpolo,
124	Vitrified Tiles, - Antiskid Series	Kajaria, RAK, Restile, Somany, Jhonson, Nitco, Simpolo,
125	Vitrified Tiles, - Homogeneous	RAK, Restile, Somany, Jhonson, Pavit, Simpolo, Kajaria
126	White cement based putty	Birla, JK, Perma, Asian
127	Water Proofing compound	Fosroc, Sika, BASF, Ecmas, Mepai, Pidilite, Shalimar Tar Products (STP), CICO, Contech Chemical, Asian
128	Water proofing membrane (PVC/ HDPE)/ Water proofing coating (PU/ Polyurea/ Acrylic/ Elastomeric cementitious)	Pidilite, Fosroc, BASF, SIKA, Mapei, Ecmas, Sunanda Chemicals, ASian
129	Water Stops - Hydrophilic Swellable rubber strip	Sika, Ecmas, BASF, Fosroc, Penetron, Pidilite, Asian
130	Wired Glass, Figured/ pattern glass	Gopal Glass or approved equivalent
131	Wood Wool board	Anutone, Armstrong, AMF, Himalaya Acoustic
132	Wooden Ceilings/ Wall panelling	Anutone, Armstrong,
133	Wooden flooring - Engineered	Armstrong, Pergo, Mikasa, Junkers, Haro, Tarkett, Havwoods

Note:
All the Materials/Makes listed above and other than as specified above shall be used after obtaining prior approval from the Architect/ Engineer-in-charge.

Cement Consumption

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Item	Ration/ Grade	Consumption	
A. CEMENT CONCRETE			
BBCC	1:6:12	2.30	Bags/m^3.
	1:5:10	2.60	Bags/m^3.
	1:4:8	3.40	Bags/m^3.
PCC	1:6:12	2.30	Bags/m^3.
	1:5:10	2.60	Bags/m^3.
	1:4:8	3.40	Bags/m^3.
RCC			
	1:3:6	4.30	Bags/m^3.
	1:2:4	6.40	Bags/m^3.
	1:1.5:3	8.00	Bags/m^3.
	1:1:2	12.2	Bags/m^3.
	1:2:5	5.40	Bags/m^3.
	1:2.5:5	5.10	Bags/m^3.
B. MORTARS			
Cement and Sand mortar			
	1:1	20.4	Bags/m^3.
	1:2	13.6	Bags/m^3.
	1:3	10.2	Bags/m^3.
	1:4	7.60	Bags/m^3.
	1:5	6.2	Bags/m^3.
	1:6	5.0	Bags/m^3.
	1:8	4.0	Bags/m^3.
Gauged mortar (Cement Lime and Sand mortar)			
	1:1:6	4.90	Bags/m3.
	1:1:8	3.80	Bags/m3.
	1:2:09	3.30	Bags/m3.
	1:5:10	2.95	Bags/m3.
	1:6:12	2.40	Bags/m3.
C. MASONRY WORK			
Brickwork in Cement sand mortar	**Conventional**		
	1:3	2.55	Bags/m^3.
	1:4	1.900	Bags/m^3.
	1:5	1.56	Bags/m^3.
	1:6	1.27	Bags/m^3.
	1:8	0.95	Bags/m^3.
Brickwork in Gauge Mortar			
	1:1:6	1.21	Bags/m^3.
	1:1:8	0.96	Bags/m^3.
	1:2:09	0.81	Bags/m^3.
Stone masonry, Uncoursed Random Rubble walling			
	1:3	2.95	Bags/m^3.
	1:4	2.29	Bags/m^3.
	1:6	1.51	Bags/m^3.
	1:8	1.18	Bags/m^3.

Stone masonry in Gauged Mortar	1:1:6	1.48	Bags/m^3.
	1:1:8	1.14	Bags/m^3.
	1:2:09	0.99	Bags/m^3.
Half Brick work	1:4	0.19	Bags/m².
D. PLASTERING			
12 mm. thick plaster in Cement mortar, on Brick masonry			
	1:2	0.24	Bags/m².
	1:3	0.17	Bags/m².
	1:4	0.14	Bags/m².
	1:5	0.10	Bags/m².
	1:6	0.09	Bags/m².
12 mm. thick plaster in Gauged mortar, on Brick masonry			
	1:1:8	0.07	Bags/m².
	1:2:09	0.60	Bags/m².
12 mm. thick plaster in Cement mortar, on Stone masonry			
	1:2	0.31	Bags/m².
	1:3	0.22	Bags/m².
	1:4	0.17	Bags/m².
	1:6	0.11	Bags/m².
12 mm. thick plaster in Gauged mortar, on Stone masonry			
	1:1:8	0.80	Bags/m².
	1:2:09	0.07	Bags/m².
20 mm. thick plaster in Cement mortar, on Brick masonry			
	1:2	0.34	Bags/m².
	1:3	0.24	Bags/m².
	1:4	0.19	Bags/m².
	1:5	0.13	Bags/m².
	1:6	0.12	Bags/m².
20 mm. thick plaster in Gauged mortar, on Brick masonry			
	1:1:8	0.10	Bags/m².
	1:2:09	0.80	Bags/m².
20 mm. thick plaster in Cement mortar, on Stone masonry			
	1:2	0.41	Bags/m².
	1:3	0.29	Bags/m².
	1:4	0.22	Bags/m².
	1:6	0.14	Bags/m².
20 mm. thick plaster in Gauged mortar, on Stone masonry			
	1:1:8	0.11	Bags/m².
	1:2:09	0.09	Bags/m².
20 mm. thick Sand Face plaster		0.20	Bags/m².
12 mm. thick Water Proof plaster in 1:4 Cement mortar		0.15	Bags/m².
Neat Cement finishing		0.44	Bags/m².
E. POINTING			
Flush, Grooved or Struck in Cement Brick masonry			
	1:1	0.600	Bags/m².
	1:2	0.50	Bags/m².
	1:3	0.30	Bags/m².
	1:4	0.28	Bags/m².
Flush, Grooved or Struck in Cement Random Stone masonry			
	1:2	0.10	Bags/m².
	1:3	0.80	Bags/m².
	1:4	0.60	Bags/m².

F. FLOORING			
Precast Mosaic Tiles in cement mortar		0.20	Bags/m².
Precast Mosaic Tiles dado in cement mortar		0.23	Bags/m².
Green and Brown Kotah Stone in flooring, skirting & dado		0.30	Bags/m².
Green Kotah Stone in Risers and Treads		0.30	Bags/m².
Double Polished Kotah Stone		0.30	Bags/m².
Rough Kotah Stone		0.30	Bags/m².
Glazed Tiles		0.20	Bags/m².
Spartek Tiles		0.20	Bags/m².
China mosaic		0.22	Bags/m².
Marble Slab		0.25	Bags/m².
Granite Slab		0.25	Bags/m².
Jesalmer		0.25	Bags/m².
Red Mandana		0.35	Bags/m².
I.P.S,	40 mm. thick	0.35	Bags/m².
	50 mm. thick	0.40	Bags/m².
Pinkish White Dholpur		0.15	Bags/m².
Red Dholpur		0.15	Bags/m².
Brick-on-edge		0.31	Bags/m².
Terrazzo		0.17	Bags/m².
G. STEEL WORK			
Fixing Windows in C.C Blocks 15 x 10 x 10 cm. in C.C	1:3:6	0.3	Bags/m².
Fixing Holdfasts in C.C Blocks			
15 x 15 x 30 cm. in C.C	1:3:6	3.3	Bags/100 nos.
23 x 25 x 30 cm. in C.C	1:3:6	7.76	Bags/100 nos.
30 x 30 x 45 cm. in C.C	1:3:6	19.8	Bags/100 nos.
H. MISCELLANEOUS			
Filling Zaris with			
C.M.	1:3	5.0	Bags/100 nos.
C.C	1:2:4	3.2	Bags/100 nos.
BBCC 1:5:10 Blocks, 30 x 30 x 50 cm. for Wire fencing		5.1	Bags/100 nos.
C.C Blocks for Flooring, 30 x 30 x 30 cm.	1:4:8	5.0	Bags/100 m².
I. ROADWORK			
Precast Curbs of P.C.C	1:2:4	21.5	Bags/100 m.
J. SANITARY WORK			
R.C.C Hume pipes jointed with Cement mortar 1:1			
	600 mm. dia.	6.4	Bags/100 m.
	450 mm. dia.	4.8	Bags/100 m.
	300 mm. dia.	2.2	Bags/100 m.
	230 mm. dia.	1.8	Bags/100 m.
	150 mm. dia.	1.2	Bags/100 m.
	100 mm. dia.	1.0	Bags/100 m.
SW pipes jointed with Cement mortar 1:1			
	300 mm. dia.	12.94	Bags/100 m.
	230 mm. dia.	9.74	Bags/100 m.
	150 mm. dia.	6.56	Bags/100 m.
	100 mm. dia.	4.34	Bags/100 m.

C.I Waste water line, concealed including filling the zari with Cement mortar 1:4 and joints in Cement mortar 1:1	75 mm. dia.	8.6	Bags/100 m.
	100 mm. dia.	10.88	Bags/100 m.
C.I Soil pipe/Rain water pipe, concealed, including filling the zari with C.M. 1:4 and joints in Cement mortar 1:1	100 mm. dia.	10.88	Bags/100 m.
	150 mm. dia.	14.66	Bags/100 m.
Fixing European type WC		0.1	Bag/no.
Fixing Orissa pan			
Fixing Urinal/s.		0.2	Bag/no.
Fixing Wash Hand Basin		0.3	Bag/no.
Fixing S.S Sink		0.5	Bag/no.
Brick Masonry Chambern 300 x 300 x 610 mm.		1.7	Bag/no.
Half Round Channel 100 mm.		15.86	Bags/100 m.
Fixing 100 mm. dia. SW Gully Trap		0.5	Bag/no.
K. STORM WATER DRAINAGE & CULVERTS			
R.C.C. pipe NP - 2			
	230 mm. dia.	1.8	Bags/100 m.
	300 mm. dia.	2.4	Bags/100 m.
	450 mm. dia.	5.4	Bags/100 m.
	900 mm. dia.	9.8	Bags/100 m.
Storm water Gully Chamber		6.0	Bag/no.

Material Specifications
for
Civil Works

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IV. MATERIALS SPECIFICATIONS – CIVIL

M-1 Water:

1.1 Water shall not be salty or brackish and shall be clean, reasonably clear and free from objectionable quantities of silt and traces of oil and injurious alkalies salts, organic matter and other deleterious material which will either weaken the mortar or concrete or cause efflorescence or attack the steel in RCC container for transport, storage and handling of water shall be clean. Water shall conform to the standards specified in IS : 456.

1.2 If required by the Engineer-in-charge and Architects it shall be tested by comparison with distilled water. Comparison shall be made by means of standard cement tests for soundness, time of setting and mortar strength as specified in IS : 269. Any indication of unsounding change in time of setting by 30 minutes or more or decrease of more than 10 per cent in strength of mortar prepared with water sample when compared with the results obtained with mortar prepared with distilled water shall be sufficient cause for rejection of water under test.

1.3 Water for curing mortar, concrete or masonry should not be too acidic or too alkaline. It shall be free of elements which significantly affect the hydration reaction or otherwise interfere with the hardening of mortar or concrete during curing or those which produce objectionable stains or other unsightly deposits on concrete or mortar surfaces.

1.4 Hard and bitter water shall generally be found unsuitable for curing mortar or concrete.

1.5 Potable water shall be generally found suitable for curing mortar and concrete.

Testing Standards :

A. Chemical Analysis:-
Sampling: Test shall be carried out only once for one particular source.
Results:
a) TDS - 3000 mg/lit.e) Carbonic contents - 200 mg/lit.
b) Sulphates - 5000 mg/lit. f) Non-carbonic contents - 3000 mg/lit.
c) pH values - 6 to 8
d) Chlorides
P.P.C - 2000 mg/lit.
R.C.C - 1000 mg/lit.

M-2 Lime :

2.1 Lime shall be hydraulic lime as per IS : 712. Necessary test shall be carried out as per IS : 6932 (Parts I to X) .

2.2 The following fields tests for limes are to be carried out:
(1) A very rough idea can be formed about the type of lime by its visual examination i.e. fat lime bears pure white colour, lime in form of Porous lumps of dirty white colour indicates quick lime, and solid lumps are the unburnt lime stone.

(2) Acid test for determining the carbonate contents in lime. Excessive amount of impurities and rough determination of class of lime.

2.3 Storage shall comply with IS : 712. The slaked lime, if stored, shall be kept in a weather proof and damp-proof shed with impervious floor and sides to protect it against rain, moisture, weather and extraneous materials mixing with it. All lime that has been damaged in any way shall be rejected and all rejected materials shall be removed from site of work.

2.4 Field testing shall be done according to IS : 1624 to show the acceptability of materials.

M-3 Cement :

3.1 Cement shall be ordinary Portland slag cement, grade 33, as per IS : 269, grade 43, as per IS : 8112 and grade 53, as per IS : 12269 or Portland slag cement as per IS : 455.

Testing Standards :

A. Setting time :
Sampling :
(i) From a lot of 50 tones of cement, 2% of bags shall be picked out at random, from which one sample of 15 kg. shall be taken.
(ii) For a lot of 50 to 100 tones - 2 samples
(iii) For a lot of 100 to 200 tones - 3 samples
(iv) For a lot of 100 to 200 tones - 3 samples
(v) For a lot of 200 to 300 tones - 4 samples
(vi) For a lot of 300 to 500 tones - 5 samples
(vii) For a lot of 500 to 800 tones - 6 samples
(viii)For a lot of 800 to 1300 tones - 7 samples
Results :
(a) Initial setting time - not less than 30 minutes
(b) Final setting time - not more than 100 minutes

B. Fineness test by Sieving :
Sampling :
Using any 5 samples, made as above, one test is carried out, using IS sieve no. 90 microns.
Results :
90% or more should pass through the above mentioned IS sieve.

C. Fineness test by determination of specific surface :
Sampling :
Using any 5 samples, made as above, one test is carried out.
Results :
For O.P.C, the surface area shall be 225 cm^2/gm. or more.
For P.P.C, the surface area shall be 3000 cm^2/gm.

D. Consistency test :
Sampling :
Sampling shall be as in A.
Results :
Consistency in all samples shall be about 30%.

E. Compressive strength :
Sampling :
Sampling shall be as in A.
Results :
On 2nd day, compressive strength must be 160 Kg/cm^2., for O.P.C
On 7th day, compressive strength must be 220 Kg/cm^2., for O.P.C
On 28th day, compressive strength must be 310 Kg/cm^2., for O.P.C

F. Chemical composition (IS : 4032):
Sampling :
Using any 5 samples, made as above, one test is carried out.
Results :
a. Magnesium oxide - less than 6%.
b. Sulphur as Sulphuric anhydride - less than 2.75%.
c. Loss on ignition - upto 5%.
The above is for ordinary Portland cement.

M-3A Rapid Hardening Cement (RHC) :

3A.1 Rapid hardening cement shall be from source like Gujarat High Tech, Ambuja, Birla or equivalent as approved by the Architect and Engineer-in-charge. It shall conform to IS : 8041. Test certificates showing that the cement complies to the specifications must be submitted to the Architect.

3A.2 It shall have strength in one day equal to that of OPC in 3 days. It shall be used for products like hume pipes, tiles, sleepers, poles, prestressed and precast concrete members. It shall also be used for foundations, bridges, culverts, causeways etc. where quick construction activity is required however, prior permission of the Architect and Engineer-in-charge shall be taken before use.

3A.3 It shall capable of giving required workability, final strength and better surface finish.

M-3B Sulphate Resistant Cement (SRC) :

3B.1 Sulphate resistant cement shall be from source like Gujarat High Tech or equivalent as approved by the Architect and Engineer-in-charge. It shall conform to relevant IS code or BS-4027 & ASTM C-150 Type-II. Test certificates showing that the cement complies to the specifications must be submitted to the Architect.

3B.2 It shall be used for structures in or near sea water, where the soil conditions are aggressive, where repeated cycles of drying and wetting are occur, and also for structures which are exposed to Sulphate attack & salty weather like foundations, bridges, dams, tunnels, industrial drains, sewage pipes.

3B.3 It should possess low heat of hydration, more compressive strength at 3,7 and 28 days than OPC. It should be capable of withstanding attack of aggressive substances which damage concrete structure like Sulphates of Sodium, Magnesium, Calcium etc. It should have low co-efficient of expansion.

M-4 White Cement :

4.1 The white cement shall conform to IS : 8042-E

M-5 Coloured Cement :

5.1 Coloured cement shall be with white or grey Portland cement mixed with pigments as specified in the item of the work.

5.2 The pigments used for coloured cement shall be of approved quality and its quantity shall not exceed 10% of the cement used in the mix. The mixture of pigment and cement shall be properly ground to have a uniform colour and shade. The pigments shall have such properties as to provide for durability for colour under exposure to sunlight and weather.

5.3 The pigment shall have the property such that it is neither affected by the cement nor detrimental to it.

M-6 Sand :

6.1 Sand shall be medium/coarse natural sand, clean, well graded, hard, strong, durable and gritty. Sand particles should be free from injurious amounts of dust, clay, kankar nodules, soft or flaky particles of shale, alkali, salts, organic matter loam, mica or other deleterious substances and shall be got approved from the Engineer-in-charge and Architects. The sand shall not contain more than 8% of silt as determined by field test and 3% by laboratory test , if necessary the sand shall be washed to make it clean. **All sand to be used for plaster, brickwork , concrete shall be strictly sieved by 4.75 mm seive.**

Testing Standards :

A. Silt Content :
Sampling :
Test shall be carried out for every 150 m^3 of sand. The sample taken for testing shall weigh 10 Kg.

Results :
Permissible content shall be 3% in laboratory test & 8 % in field Test.

B. Fineness Modulus :
Sampling :
Sampling shall be as in A.
Results :
Fine sand : 2.2 to 2.6 shall be used as earth filling in plinth, zari, etc.
Medium sand : 2.6 to 2.9 shall be sued for Brickwork and plaster.
Coarse sand : 2.9 to 3.2 shall be used for concrete.

In general, the fineness modulus of sand shall not be less than 2.5 and shall not exceed 3.0. A sand having a fineness modulus more than 3.2 will be unsuitable for making satisfactory concrete.

C. The sieve analysis of sand shall be as under

IS Sieve Designation	% By weight Passive sieve	IS Sieve Designation	% By Weight passive sieve
4.75 mm	100	600 Micron	30-100
2.36 mm	90-100	300 Micron	5-70
1.18 mm	70-100	150 Micron	0-50

M-7 Stone Dust :

7.1 This shall be obtained from crushing hard black trap or equivalent. It shall not contain more than 8% of silt as determined by field test with measuring cylinder. The method of determining silt contents by fields test is given under:

7.2 A sample of stone dust to be tested shall be placed without drying in 200 mm. measuring cylinder. The quantity of the sample shall be such that it fills the cylinder upto 100 mm. mark. Then clean water shall be added upto 150 mm. mark. The mixture shall be stirred vigorously and the contents allowed to settle for 3 hours.

7.3 The height of silt visible as settled layer above the stone dust shall be expressed as percentage of the height of the stone dust below. The stone dust containing more than 8% silt shall be washed so as to bring the content within the allowable limit.

7.4 The fineness modulus of stone dust shall not be less than 1.80.

M-8 Stone Grit :

8.1 Grit shall consist of crushed or broken **black trap stone** and be hard, strong, dense, durable clean of proper gradation and free from skin or coating likely to prevent proper adhesion of mortar. Grit shall generally be cubical in shape and as far as possible flaky elongated pieces shall be avoided. It shall generally comply with the provisions of IS : 383 Unless special stone of particular quarries is mentioned, grit shall be obtained from the best black trap or equivalent hard stone as approved by the Engineer-in-charge and Architects. The grit shall have no deleterious reaction with cement.

8.2 The grit shall conform to the following gradation as per sieve analysis:

IS Sieve Designation	% passing Through sieve	IS Sieve Designation	% Passing Through sieve
12.50 mm.	100%	4.75 mm.	0-20%
10.00 mm.	85-100%	2.36 mm.	0- 5%

8.3 The crushing strength of grit will be such so as to allow the concrete in which it is used to build up the specified strength of concrete.

8.4 The necessary tests for grit shall be carried out as per the requirements of IS : 2386 (parts I to VIII) , as per instructions of the Engineer-in-charge and Architect. The necessity of test will be decided by the Engineer-in-charge and Architect.

M-9 Cinder :

9.1 Cinder is well burnt furnace residue which has been fused or centered into lumps of varying sizes.

9.2 Cinder aggregates shall be well burnt furnace residue obtained from furnace using coal fuel only. It shall be sound clean and free from clay, dirt ash or other deleterious matter.

9.3 The average grading for cinder aggregates shall be as mentioned below:

IS Sieve Designation	% Passing	IS Designation	% Passing
20 mm.	100	4.75 mm.	70
10 mm.	86	2.36 mm.	52

M-10 Lime mortar :

10.1 Lime shall conform to M-2. Water shall conform to M-1. Sand shall conform to specification M-6.

10.2 Proportion of mix:

10.2.1 Mortar shall consist of such proportions of slaked lime and sand as may be specified in item. The slaked lime and sand shall be measured by volume.

10.3 Proportion of mortar:

10.3.1 Lime mortar shall be prepared by wet process as per IS : 1625. Power driven mill shall be used for preparation of lime mortar. The slaked lime shall be placed in the mill in an even layer and ground for 180 revolutions with a sufficient water. Water shall be added as required during grinding (care being taken not to add more water) that will bring the mixed material to a consistency of stiff paste. Thoroughly wetted sand shall then be added evenly and the mixture ground for another 180 revolutions.

10.4 Storage:

10.4.1 Mortar shall always be kept damp, protected from sun and rain till used up, covering it by tarpaulin or open sheds.

10.5 Use :

10.5.1 All mortar shall be used as soon as possible after grinding. It should be used on the day on which it prepared. But in no case, mortar made earlier than 36 hours shall be permitted for use.

M-11 Cement Mortar :

11.1 Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6.

11.2 Proportion of Mix:

11.2.1 Cement and sand shall be mixed to specified proportion sand being measured by measuring boxes. The proportion of cement will be by volume on the basis of 50Kg/Bag of cement being equal to 0.0342 m^3. The mortar may be hand mixed or machine mixed as directed.

11.3 Proportion of Mortar :

11.3.1 In hand mixed mortar. cement and sand in the specified proportions shall be thoroughly mixed dry on a clean impervious platform by turning over atleast 3 times or more till a homogeneous mixture of uniform

colour is obtained. Mixing platform shall be so arranged that no deleterious extraneous material shall get mixed with mortar or mortar shall flow out. While mixing, the water shall be gradually added and thoroughly mixed to form a stiff plastic mass of uniform colour so that each particle of sand shall be completely covered with a film of wet cement. The water cement ratio shall be adopted as directed.

11.3.2 The mortar so prepared shall be used within 30 minutes of adding water. Only such quantity of mortar shall be prepared as can be used within 30 minutes.

M-12 Stone Coarse Aggregate For Nominal Mix Concrete :

12.1 Coarse aggregate shall be of machine crushed stone of **black trap** and be hard, strong, dense, durable, clean and free from skin and coating likely to proper adhesion of mortar.

12.2 The aggregate shall generally be cubical/round in shape. Unless special stones of particular quarries are mentioned aggregates shall be machine crushed from the **black trap** or equivalent black hard stone as approved. Aggregate shall have no deleterious reaction with cement. The size of the coarse aggregate for plain cement concrete and ordinary reinforced cement concrete shall generally be as per the table given below. However, in case of reinforced cement concrete, the maximum limit may be restricted to 6 mm. less than the minimum lateral clear distance between bars or 6 mm. less the cover, whichever is smaller.

TABLE

IS Sieve Designation	% passing for single size aggregates of Nominal Size			IS Sieve Designation	% passing for single size aggregates of Nominal size		
	40 mm	20 mm	16 mm		40 mm	20 mm	16mm
80 mm.	-	-	-	12.5 mm.	-	-	-
63 mm.	100	-	-	10 mm.	0.5	0 - 20	0.30
40 mm.	100	100	-	4.75 mm.	-	0 - 5	0.5
20 mm.	0-20	85-100	100	2.35 mm.	-	-	-
16 mm.	-	-	85-100				

Note : This percentage may be varied some what by the Engineer-in-charge when considered necessary for obtaining better destiny and strength of concrete.

12.3 The grading test shall be taken in the beginning and at the change of source of materials. The necessary tests indicated in IS : 383 and IS : 456 shall have to be carried out to ensure the acceptability. The aggregate shall be stored separately and handled in such a manner as to prevent the intermixing of different aggregates. If the aggregates are covered with dust they shall be washed with water to make them clean.

Testing Standards :

A. Flakiness Index :
Sampling :
For every 200 m^3. of aggregates, one test shall be carried out.
Results :
The Flakiness index is taken as the total weight of the aggregates passing through the various thickness gauges, expressed as a percentage of the total weight of the sample taken.
Permissible is not more than 35% for aggregates used in concrete for wearing surfaces.

B. Impact value :
Sampling :
For every 100 m^3. of aggregates, one test shall be carried out.
Results :
The impact value shall not be more than 45% by weight for aggregates used for concrete other than

wearing surfaces.
For aggregates used for concrete to be used as wearing surface, the impact value shall not be more than 30%, by weight.

C. Abrasion Value :
Sampling :
Sampling shall be as in B.
Results :
The percentage of wear shall not be more than 35%.

M-13 Black Trap or Equivalent Hard Stone Coarse Aggregates for Design Mix Concrete :

13.1 Aggregate for Design Mix Concrete : Coarse aggregate shall be machine crushed stone of black trap or equivalent hard stone and hard, strong, dense, durable, clean and free from skin and coating likely to prevent proper adhesion of mortar.

13.2 The aggregates shall generally be cubical in shape. Unless special stones of particular quarried are mentioned, aggregates shall be machine crushed from the best black trap or equivalent hard stones as approved. Aggregates shall have no deleterious reaction with cement.

13.3 The necessary tests indicated in IS : 383 and IS : 456 shall have to be carried out to ensure the acceptability of the material.

13.4 If the aggregates are covered with dust, they shall be washed with water to make them clean.

M-14 Brick Bats Aggregates :

14.1 Brick bat aggregate shall be broken from well burnt or slightly over burnt and dense bricks. It shall be homogeneous in texture, roughly cubical in shape, clean and free from dirt or any other foreign material. The brick bats shall be less than 40 mm. size, unless otherwise specified in the item. The under-burnt or over-burnt brick bats and brick dust shall not be allowed.

14.2 The brick bats shall be hand measured by suitable boxes or as directed.

M-15 Bricks :

15.1 The bricks shall be of **first quality** hand or machine moulded and made from suitable soils and kiln burnt. They shall be free from cracks, flaws and modules of free lime. They shall have smooth rectangular faces with sharp corners and shall be of uniform In colour. The bricks shall be moulded with a frog of size 100 mm. x 40 mm., and 10 mm. to 20 mm. deep on one of its flat sides. The bricks shall not break when thrown on the ground from a height of 1 m.

15.2 The size of modular bricks shall be 190 mm. x 90 mm. x 90 mm.

15.3 The size of the conventional bricks shall be (9"x4.5" x 3") 230 mm. x 110 mm. x 76.5 mm.

15.4 Only bricks of one standard size shall be used on a particular work site. The following tolerances shall be permitted in the conventional size adopted in a particular work site.
Length : + 1/8"(3.0 mm.). Width : + 1/6" (1.50 mm.). Height : + 1/6"(1.50 mm.).

15.5 The crushing strength of the bricks shall not be less than **50 Kg./cm^{2,}**. No unburned/over burnt bricks shall be used for any structure. The bricks should have dimensional stability as per IS standards. The average water absorption shall not be more than 20% by weight. Necessary tests for crushing strength and water absorption etc. shall be carried out as per IS : 3495 (Part I to IV) .

Testing Standards :

A. Efflorescence :
Sampling :
Test of 20 bricks is carried out from a stock of 20,000 bricks.
Results :
Moderate.

B. Water Absorption :
Sampling :
Test of 32 bricks is carried out from a stock of 35,000 bricks.
Results :
Absorption shall not be more than 20%.

C. Compressive Strength :
Sampling :
Test of 50 bricks is carried out from a stock of 1,00,000 (1 Lac) bricks.
Results :
On average the compressive strength shall not be less than **50 Kg/cm^2**. And every result shall not be less than 20% of the IS standards.

M-15A First Class Bricks for Exposed brickwork :

15A.1 First class bricks are those which strictly conform to the standard size of modular bricks, i.e. 19 cm. x 19 cm. x 9 cm. actual size, such that ten layers of brick laid in mortar shall form masonry of 1 m. height. Conventional bricks should have quality standard as per modular brick except size.

15A.2 These bricks are manufactured from good quality plastic earth, which is free from saline deposits. They are of good uniform colour. They are well burnt, giving a hard ringing sound when two bricks are struck together.

15A.3 They should have straight edges and even surfaces. They are free from cracks, chips, flaws and modules of lime.

15A.4 When immersed in water for an hour, they do not absorb water more than 1/6th of their weight. On drying, these bricks do not show any sign of efflorescence.

M-15B Calcium Silicate Bricks :

15B.1 The bricks shall be machine moulded and made from good quality and clean silicious sand, lime and flyash (maximum content upto 30% in raw material composition). They shall be free from cracks, flaws, clay, free lime. They shall have smooth rectangular faces with sharp corners and shall be uniform in size, colour and shape.

15B.2 The size of bricks shall be 228 mm. x 110 mm.x 72 mm. or as approved by the Architect. The compressive strength of bricks shall be minimum 150 kg/m$^{2.}$ and the bricks shall have very high strength to weight ratio. The bricks shall have very good resistant capacity to atmospheric conditions, optimum building properties in relation to heat insulation, sound insulation, absorption of water and fire protection.

15B.3 Calcium silicate products shall conform to the appropriate IS standards and there shall be no change required in civil application techniques while using such products in the place of traditional clay bricks.

M-15C Glass Brick :

15C.1 It shall be from Imperial or equivalent as approved by the Architect and Engineer-in-Charge.

15C.2 It shall be free from any defects like, cracks, air bubbles, uneven surface, breaks etc. During handling and laying, its edges shall not be damaged. All edges and corners of all faces shall be sharp and well shaped.

It shall be of size and colour as specified in the item or as approved by the Architect. The glass bricks shall be of uniform size and tolerance of +2 mm. shall only be allowed in dimensions of glass brick. Spots of colour other than that of bricks or in bricks shall not be allowed. The weight of each brick shall be about 2.75 kg.

15C.3 The transmission of direct light through brick shall not be less than 40%. The glass brick shall have good thermal insulation. It shall be sound proof and vibration absorber having adequate compressive strength. If bricks with groove or projections shall be used, the groove or projections shall be uniform and regular in size & shape.

M-16 Stone :

16.1 The stone shall be of specified variety such as Granite/Trap Stone/Quartz or any other type of good hard stones.
The stones shall be obtained only from the approved quarry and shall be hard, sound, durable and free from defects like cavities, cracks, sand holes, flaws, injurious veins, patches of loose or soft materials etc. and weathered portions and other structural defects or imperfections tending to affect their soundness and strength. The stone with round surface shall not be used. The percentage of water absorption shall not be more than 5% of dry weight, when tested in accordance with IS : 1124. The minimum crushing strength of the stone shall be 200 Kg/cm^2. unless otherwise specified.

16.2 The samples of the stone to be used shall be got approved before the work is started.

16.3 The Khanki facing stone shall be dressed by chisel as specified in the item for Khanki facing in required shape and size. The face of stone shall be so dressed that the bushing on the exposed face shall not project by more than 40 mm. from the general wall surface and on face to be plastered it shall not project by more than 19 mm. nor shall it have depressions more than 10 mm. from the average wall surface.

M-17 Laterite Stone :

17.1 Laterite stone shall be obtained from the approved quarry. It shall be uniform in texture, sound, durable and free from soft patches. It shall have a minimum crushing strength of 100 Kg./cm^2. in its dry condition. It shall not absorb water more than 20% of its own weight, when immersed for 24 hours in water. After quarrying, the stone shall be allowed to weather for some time before using in work.

17.2 The stone shall be dressed into regular rectangular blocks so that all faces are free from waviness and unevenness, edges true and square.

17.3 Those type of stones in which white clay occurs should not be used.

17.4 Special corner stone shall be provided where so directed.

M-18 Mild Steel Bars :

18.1 Mild steel bars reinforcement for RCC work shall conform to IS : 432 (Part-II) and shall be of tested quality. It shall also comply with relevant part of IS : 456.

18.2 All the reinforcement shall be clean and free from dirt, paint, grease, mill scale or loose or thick rust, at the time of placing.

18.3 For the purpose of payment, the bar shall be measured correct upto 10 mm. length and weight payable worked out at the rate specified below :

1.	6 mm.	0.22 Kg/m.	8.	20 mm.	2.47 Kg/m.
2.	8 mm.	0.39 Kg/m.	9.	22 mm.	2.98 Kg/m.
3.	10 mm.	0.62 Kg/m.	10.	25 mm.	3.85 Kg/m.
4.	12 mm.	0.89 Kg/m.	11.	28 mm.	4.83 Kg/m.

5.	14 mm. 1.21 Kg/m.	12.	32 mm	6.31 Kg/m.
6.	16 mm. 1.58 Kg/m.	13.	36 mm.	7.99 Kg/m.
7.	18 mm. 2.00 Kg/m.	14.	40 mm	9.86 Kg/m.

18.4 Procurement of Steel should be from authorised/approved rolling mills and test certificates should be submitted with each lot.

Testing standards :

Sampling :
For every 40 tonnes of steel, atleast one test shall be done.
Results :

Thickness	Ultimate Tensile strength	Chilled state	% Elongation
0 - 20 mm.	42 Kg/cm^2.	26 Kg/cm^2.	23
20 - 40 mm.	42 Kg/cm^2.	24 Kg/cm^2.	23
40 mm. & more	42 Kg/cm^2.	24 Kg/cm^2.	23

M-19 A High Yield Strength Steel Deforms Bars :

19.1 High yield strength steel deformed bars be either cold twisted or hot rolled shall conform to IS : 1739 and IS : 1139 respectively.

19.2 Other provision and requirements shall conform to M-18 for Mild steel bars.

M-19 B Thermo-mechanically Treated Bars (TMT)

19.B.1 TMT bars shall conform to IS: 1786

19.B.1 Procurement of Steel should be from approved manufacturer and test certificates should be submitted with each lot.

M-19 C Corrosion Resisting Steel (CRS)

19.C.1 CRS bars shall conform to IS: 1786

19.C.1 Procurement of Steel should be from approved manufacturer and test certificates should be submitted with each lot.

M-20 High Tensile Steel Wire :

20.1 The high tensile wires for the use in prestressed concrete work shall conform to IS : 2090.

20.2 The tensile strength of the high tensile steel bars shall be as specified in the item. In absence of the given strength, the minimum strength shall be taken as per para 6.1 of IS : 1785. Testing shall be done as per IS requirements.

20.3 The high tensile steel shall be free from loose mill scale, rust oil, grease, or any other harmful matter. Cleaning of steel bars may be carried out by immersion in solvent solution, wire brushing or passing through a pressure box containing carborundum.

20.4 The high tensile wire shall be obtained from manufactures in coil having diameter not less than 350 time the diameter of wire itself, so that wire springs back straight on being uncoiled.

Testing standards :

Sampling :
For every 40 tonnes of steel, atleast one test shall be done.
Results :

Thickness	Ultimate Tensile strength	Chilled state	% Elongation
For all sizes	49.5 Kg/cm^2.	42.5 Kg/cm^2.	14.5

M-21 Mild Steel Binding Wire :

21.1 The mild steel wire shall be of 1.63 mm. or 1.22 mm. (16 or 18 gauge) diameter and shall conform to IS : 280.

21.2 The use of black wire will be permitted for binding reinforcements bars. It shall be free from rust, oil paint, grease, loose mill scale or any other undesirable coating which may prevent adhesion of cement mortar.

M-22 Structural Steel :

22.1 All structural steel shall conform to IS : 226. The steel shall be well and cleanly rolled to the dimensions and weight specified by the IS, subject to the permissible tolerances as per IS : 1852. The finished materials shall be reasonably free from cracks, surface flaws, laminations, rough and imperfect edges and all other harmful defects mentioned in IS : 229 and shall have a smooth finish. The material shall be free from loose mill scale, rust pits or other defects affecting the strength and durability. River bars shall conform to IS : 1148. The decision of the Engineer-in-charge regarding rejecting any steel section on account of any of the above defects shall be final and binding to the Contractor.

22.2 Structural steel shall conform to the following requirements. The mechanical and chemical properties shall be as below :

MECHANICAL COMPOSITION OF STEEL

Steel designation	Class of steel product	Nominal Tensile thickness in mm.	Yield stress strength min. Kgf/mm^2 in Kgf/mm^2	% elongation
ST-42 W &	Plates,	Below 6 mm.	Bend test only shall be required.	
ST-42 S	flats, bars.	upto 20 & Vc	42 to 54 26.0	23
		Over 20 upto Vc 40	42 to 54 24.0	23
		Below 10	Bend test only shall be required	
		10 upto 20 & Vc	42 to 54 28.0	23
		Over 20	42 to 54 24.0	23
ST-42 O	Plates,	Below 6 sections,	Bend test only shall be required.	
		flats,Over 6	42 to 54 28.0	23
		Below 10	Bend test only shall be required	
		10 & above	42 to 54 28.0	23

CHEMICAL COMPOSITION OF STEEL

Steel designation	Maximum percentage		
	Carbon	Sulphur	Phosphorous
ST-42 W	0.23	0.06	0.06
ST-42 S	0.25/0.28	0.06	0.06
ST-42 O		0.07	0.07

22.3 The following variety of steel shall be used for structural purposes :

ST-42 S : It shall be used for all types of structure (riveted or bolted), including those subjected to dynamic loading and where fatigue, wide fluctuations of stresses, reversal of stresses and great restraint are involved. It shall be suitable for welded structures, provided that the thickness of the material does not exceed 20 mm.

22.4 When the steel is supplied by the Contractor, test certificate of the manufacture shall be obtained according to IS : 226 and other relevant Indian Standards.

M-23 Galvanised Iron Sheets :

23.1 The galvanised iron sheets shall be from Tata or equivalent of approved zinc coating class , as approved by the Architect and Engineer-in-charge. It shall be plain or corrugated, of gauge as specified in item. The GI sheets shall conform to IS : 277. The sheets shall be undamaged in carriage and handling either by rubbing off of zinc coating or otherwise, they shall have clean and bright surface and shall be free from dents, holes, rust or white powdery deposit.

23.2 The width of GI sheet shall be as directed, as per site condition.

M-23.A GI Valleys gutter ridges :

23.A.1 The GI ridge and hips shall be of plain galvanised sheets, class-3, of the thickness, as specified in item. These shall be 600 mm. in width and properly bent up to the shape without damage to the sheets, in process of bending.

23.A.2 Valleys, gutters and flashing shall also be of galvanised sheet, of thickness, as specified in item. Valleys shall be 900 mm. wide overall and flashing shall be 380 mm. wide overall. They shall be bent to the required shape without damage to the sheet in the process of bending.

M-24 Asbestos Cement Sheets :

24.1 Asbestos cement sheets plain, corrugated or semi corrugated and curved shall be from Everest or equivalent, as approved by the Architect or Engineer-in-charge. It shall conform to IS : 459. The thickness of the sheet shall be as specified in the item. The sheet shall be free from all defects such as cracks, holes, deformation, chipped edge or otherwise damaged.

24.2 It shall manufactured by reinforcing Asbestos in cement, in such a manner that every fibre is covered with fine particles of cement to ensure maximum strength. It shall be alkali resistance and anti corrosive. It should not break during transportation, handling, laying etc. and should be non- destructible, non-inflammable and non-organic. It shall have high tensile strength and high slenderness ratio.

24.3 The minimum nominal thickness of sheets shall be 6 mm., having covering efficiency of about 90% and weight 1518 kg/cm^2. The sheet shall be free from all defects such as cracks, holes, deformation, chipped edge or otherwise damaged. The permissible bending stress shall be 130 kg/cm^2.

24.4 The accessories shall be same thickness that of AC sheets. They shall be suitable for all the types of sheets and locations. They also shall be from approved manufacturer and shall be free from any defects. The fixing of AC sheets and accessories shall conform to IS : 730.

24.5 Ridges & Hips :

24.5.1 Ridges and hips shall be of same thickness as that of AC sheets. The different types of ridges shall be suitable for its corresponding type of sheets and locations.

24.5.2 Other accessories to be used in roof such as flashing piece, caves, filler pieces, valley gutters, north light and ventilator curves, barge boards etc. shall be from standard manufacture and shall be suitable for the different types of sheets and location.

M-25 Mangalore Pattern Roof Tiles :

25.1 The mangalore pattern tiles shall conform to IS : 654 for Class AA or Class A type, as specified in the item. Samples of the tiles to be provided shall be got approved from the Engineer-in-charge and Architect. Necessary tests shall be carried out as directed.

M-26 Shuttering :

M-26A Timber/Wooden planking :

26A.1 The shuttering shall be either of wooden planking of 30 mm. minimum thickness with or without steel lining or steel plates stiffened by steel angles. The shuttering shall be supported on battens and beams and props of vertical ballies properly cross braced together, so as to make the centering rigid. In place of ballie props, brick pillar of adequate section built in mud mortar may be used.

26A.2 The form work shall be sufficiently strong and shall have camber, so that it assumes correct shape after deposition of the concrete and shall be able to resist forces caused by vibration, live load of men working over it and other incidental loads associated with it. The shuttering shall have smooth and even surface and its joints shall not permit leakage of cement grout.

26A.3 If at any stage of work, during or after placing concrete in the structure, the form work sags or bulges out beyond the required shape of the structure, the concrete shall be removed and work redone with fresh concrete and adequately rigid form work. The complete form work shall be got inspected by and got approved from the Engineer-in-charge and Architect, before the reinforcement bars are placed in position.

26A.4 The props shall consist of ballies having 100 mm. minimum diameter, measured at mid length and 80 mm. at thin end and shall be placed as per design requirement. These shall rest squarely on wooden sole plate 40 mm. thick and minimum bearing area of 0.10 m^2. laid on sufficiently hard base.

26A.5 Double wedges shall further be provided between the sole plate and the wooden props so as to facilitate tightening and easing of shuttering without jerking the concrete.

26A.6 The timber used in shuttering shall not be so dry as to absorb water from concrete and swell or bulge nor so green or wet as to shrink after erection. The timber shall be properly sawn and planned on the sides and surface coming in contact with concrete. Wooden form work with metal sheet lining or steel plates stiffened by steel angles shall be permitted.

26A.7 As far as possible, clamps shall be used to hold the forms together and use of nails and spikes shall be avoided.

26A.8 The surface of timber shuttering that would come on contact with concrete shall be well wetted and coated with soap solution before the concreting is done. Alternatively coat of raw linseed oil or oil of approved manufacture may be applied in place of soap solution. In case of steel shuttering, either soap solution or raw linseed oil shall be applied after thoroughly cleaning the surface. Under no circumstances, black or burnt oil shall be permitted.

26A.9 The shuttering for beams and slabs shall have camber of 4 mm. per meter (1 in 250) or as directed by Engineer-in-charge and Architect, so as to offset the subsequent deflection. For cantilevers, the camber at free end shall be 1/50 of the project length or as directed by the Engineer-in-charge and Architect.

M-26B Concrete Shuttering Plywood :

26B.1 It shall be made from strong and selected hard-woods. It shall be bonded with high quality Phenol Formaldehyde synthetic resin adhesive, hot pressed and then shall be further treated with a permanent type of preservative by vacuum-cum-pressure impregnation.

26B.2 Due to the bonding with Phenol Formaldehyde, it shall be moisture and weather proof. The use of selected hard-woods render hard and wear-resistant faces and thereby it shall be reusable several times. It shall be highly resistant to rot, termites and other wood inhabiting insects. Due to complete penetration of the preservative, it shall be exceedingly durable.

26B.3 It shall have high impact strength and therefore shall be used successfully in place of timber planks and steel sheets. It shall protect the concrete from rapid temperature changes and shall provide optimum conditions for setting of the concrete. As it shall possess remarkable design flexibility, it shall be ideal for curved formwork.

26B.4 Besides it shall be used as centering, shuttering and formwork of concrete columns, beams, slabs, walls, tanks, bridges, fly-overs, silos etc. It shall also be used for structural applications like external walling, roofing, flooring, curtain walls, work-site offices, in cabins of trucks, rail coaches etc.

M-26C Steel Sheeting and Steel Plates :

26C.1 Steel sheeting and steel plates should be free from clinks, twists, offsets, warps, etc. Their surface should be neat, clean and smooth. Before placing concrete, steel forms shall be thoroughly cleaned off of all rust, dust and loose materials. Colourless oil or grease of approved quality shall be applied before placing steel.

26C.2 The size of angles used for framing and bracing of steel plates should be sufficient to withstand the weight of concrete without forming clinks, twists, offsets, warps, etc. in the steel plates. Also, the gauge of steel sheeting used should not be higher than 14 G.

26C.3 Minimum two bracing angles should be provided along with angle framing while making the steel plates. It should be riveted or welded to suit the requirement of finish concrete surface. Minimum two rivets should be provided at all Four Corners and at junction of angle framing and bracing.

26C.4 If the plates are to be welded, steel sheet and angle framing/bracing should be welded from sides and at back. Welding on sides should be buffed to make the sides smooth. Also, intermittent welding should be done to keep steel sheet and angle framing/bracing in one plane.

M-27 Expansion Joints-Premoulded Filler :

27.1 The item provides for expansion joints in RCC frame structure, for internal joints as well as exposed joints, with the use of premoulded bituminous joint filler.

27.2 Premoulded bituminous joint filler, i.e. preformed strip of expansion joint filler shall not get deformed or broken by twisting, bending or other handling pressures, when exposed to atmospheric condition. Pieces of joint filler that have been damaged shall be rejected.

27.3 Thickness of the pre-moulded joint filler shall be 25 mm., unless otherwise specified.

27.4 Premoulded bituminous joint filler shall conform to BE : 1838.

M-28 Expansion Joints-Copper Strips & Hold fasts :

28.1 The item provided for expansion joints in RCC frame structure, for internal joint as well as for exposed joints, with the use of necessary copper strip and holdfasts.

28.2 Copper sheet shall be 1.25 mm. thick and 1.25 mm. wide and shall be of `U' shape, in the middle. Copper strip shall have holdfast of 3 mm. diameter copper rod, fixed to the plate, soldered on the strip at intervals of about 30 cm. or as shown in the drawing or as directed. The width of each flange (horizontal side) of the copper plate, to be embedded in the concrete work shall be 25 mm. Depth of `U' to be provided in the expansion joint, in the copper plate shall be of 25 mm.

M-29 Teak Wood :

29.1 The teak wood shall be of superior quality as required for the item to be executed. The kind of wood specifically mentioned as BURMA, MARSOVA, CP, CHILL or SAG teak wood, as approved by the Architect or Engineer-in-charge, shall be used. These teakwood, as mentioned above, shall be from specified sources/origins, as approved by the Architect.

29.2 Teak wood shall generally be free from large, loose, dead or cluster knots, flaws, shades, warps, twists, bends or any other defects. It shall generally be uniform in substance and of straight fibres, as far as possible. It shall be free from knot, decay, harmful fungi and other defects of harmful nature, which will affect the strength, durability and its usefulness for the purpose for which it is required. The colour shall be uniform, as far as possible. Any efforts like painting, using any adhesive or resins materials, made to hide the defects, shall render the pieces labile to rejection by the Engineer-in-charge and Architect.

29.3 All scantling, planks etc. shall be sawn in straight lines and planes, in the direction of grains and shall be of uniform thickness.

29.5 **First class teak wood :**

29.5.1 First class teak wood shall have no individual hard and sound knots, more than 6 cm^2. in size and the aggregate area of such knots shall not be more than 1% of the area of the piece. The timber shall be closed grained.

29.6 **Second Class Teak Wood :**

29.6.1 No individual hard and sound knots shall be more than 15 cm^2. in size and the aggregate area of such knots shall not exceed 2% of the area of the piece.

M-29.A Non-teak wood :

29A.1 The non teak-wood shall be chemically treated, seasoned as per IS specifications and shall be of good quality. The type of wood shall be got approved before collecting the same on site. Fabrication of wooden members shall be started only after the necessary approval.

29A.2 For this purpose, wood of Bio, Kalali, Siras, Behda, Jamun, Sisoo will be used for door-frames, where as only Kalali, Siras, Halda, Kalam etc. will be permitted for preparation of shutters, after proper seasoning and chemical treatment.

29A.3 The non-teak wood shall be free from large, loose, dead of cluster knots, flows, shakes, warps, bends or any other defect. It shall be uniform in substance and of straight fibres, as far as possible. It shall be free from knots, decay, harmful fungi and other defects of nature which will effect the strength, durability or its usefulness for the purpose for which it is required. The colour of wood shall be uniform, as far as possible. The scantling, planks etc. shall be sawn in straight lines and planes in the direction of grain and shall be of uniform thickness. The Client will ask the agency to produce certificate from the Forest Department, in event of dispute and the decision of the Client shall be final and binding to the Contractor.

M-29B Processed Rubber Wood :

29B.1 The processed rubber wood shall be like Borotik, Silver teak or equivalent, as approved by the Architect and Engineer-in-Charge. It shall conform to IS : 401. The wood shall be made from best quality logs of rubber trees, by treating freshly sawn wood with boron base, timber preservative, as per IS : 401, and drying them uniformly in vacuum, to result into uniform texture and low moisture content wood.

29B.2 It shall be used for manufacturing furniture and furniture components, wall panelling, A.C grills, venetian blinds, wood carvings and handicrafts. It shall be suitably used for production of Door and Window shutters and panels. It shall be available in standard sizes, rough sawn, as listed below :

Length (in Ft.)	Section(W x T, in inches)
2, 3 and 4	2 x 1, 3 x 1, 4 x 1, 1.5 x 1.5, 2 x 1.5, 3 x 1.5, 4 x 1.5, 2 x 2 3 x 2, 4 x 2, 2.5 x 2.5
5, 6 and 7	2 x 2, 3 x 2, 4 x 2

29B.3 The moisture content of the processed rubberwood is 8 to 10% for furniture lengths upto 48 inches, in maximum section 3" x 2". For lengths of 48 to 84 inches, in maximum section 4" x 2.5", the moisture content is 10 to 12%. Its other properties are similar to rubberwood.

1) Density 640 Kg/m^3.
2) Hardness : Side - 538 Kg.
   End - 627 Kg.
3) Compression
   Parallel to grain - 32 N/mm^2.
   Perpendicular to grain - 4.7 N/mm^2.
4) Modulus of elasticity - 9.24 N/mm^2.
5) Shear
   Parallel to grain - 114 Kg/cm.
   Perpendicular to grain - 60 Kg/cm.
6) Shrinkage
   Radial - 2.6%
   Tangential - 6.1%

29B.4 Processed rubber wood, is easy to re-saw and for planning, boring, turning etc. It is also suitable for lacquering, painting and resin or melamine finish. Gluing or jointing shall be done with PG, UF, RF resins and PVAC glues. Butt joints and edge joints are possible and along with its property of hardness, it is suitable material for parquet flooring, staircase steps, door and window shutters and panel inserts.

M-30 Wooden Flush Door Shutters (Solid Core) :

30.1 The solid core type (water proof/ Commercial) flush door shutters shall be of decorative face or non-decorative face type, as specified in the drawing. The size and thickness of the shutter shall be as specified in drawings or as directed. The timber species for core shall be used as per IS : 2202-(Part-I). The timber shall be free from decay and insect attack. Knots and knot holes less than half the width of cross-section of the members in which they occur, may be permitted. Pitch pockets, pitch streaks and harmless pin holes shall be permissible except in the exposed edges of the core members. The commercial plywood, cross-bands shall conform to IS : 303. And waterproof plywood shall confirmed to IS 710.

30.2 The solid core shall be of wood laminate, prepared from battens of well seasoned and treated good quality wood, having straight grains. The battens shall be of uniform size of about 2.5 cm. width. These shall be properly glued and machine pressed together, with grains of each piece reversed from that of the adjoining one. The longitudinal joints of the battens shall be staggered and no piece shall be less than 50 cm. in length. Edges of the core shall be lipped internally with 1st class teak wood battens of 4 cm.(1-1/2") minimum width, glued and machine pressed along with the core.

30.3 The core surface shall then have two or three veneers firmly glued on each face. The first veneer (called cross hand) shall be laid with its grains at right angles to those of the core and the second and the third veneers with their grains parallel to those of the core.

30.4 The face panel of the shutters shall be formed by gluing, by the hot press process on both faces of the core with either plywood or cross-bands and face veneers. The lipping, reveting, opening of glazing, venation etc. shall be provided if specified in the drawing.

30.5 All edges of the door shutters shall be square. The shutters shall be free from twist or warp in its plane. Both faces of the shutters shall be sand papered to make smooth even texture.

30.6 The shutters shall be tested for -

(1) End immersion test : The test shall be carried out as per IS : 2202 (part-I). There shall be no delamination at the end of the test.

(2) Knife test : The face panel when tested in accordance with IS : 1659 shall pass the test.

(3) Glue Adhesion test : The flush door shall be tested for glue adhesive test in accordance with IS :2202 (Part-I) . The shutters shall be considered to have passed the test if no delamination occurs in the glue lines in the plywood and if no single delamination more than 80 mm. in length & more than 3 mm. in depth has occurred in the assembly glue lines between the plywood face and the style and rail. Delamination at the corner shall be measured continuously around the corner. Delamination at the knots, knot holes and other permissible wood defects shall not be considered in assessing the sample.

30.7 The tolerance in size of solid core type flush door shall be as under :
In Normal thickness +1.2 mm. In Normal height +3 mm.

30.8 The thickness of the shutters shall be uniform throughout, with a permissible variation of not more than 0.8 mm. when measured at any two points,

M-31 Aluminium Doors, Windows, Ventilators:

31.1 Aluminium alloy used in the manufacture of extruded window sections shall conform to IS designation HEA-WP of IS : 733 and also to IS designation WVG-WP of IS : 1285. The section shall be as specified in the drawing and design. The fabrication shall be done as directed.

31.2 The hinges shall be cast or extruded Aluminium hinge of same type as in window but of larger size.

31.3 The hinges shall normally be of 50 mm., openable/projecting type. Non-projecting type of hinges may also be used, if directed. The handles of the door shall be of specified design. A suitable locks for the door, operable either from outside or inside shall be provided. In double shutter door, the first closing shutter shall have concealed aluminium alloy tower bolt at top and bottom.

M-32 Rolling Shutters :

32.1 The rolling shutters shall conform to IS: 6248. Rolling shutters shall be supplied of specified type, with accessories. The size of the rolling shutters shall be as specified in the drawings. The shutters shall be constructed with interlocking lath sections formed from cold rolled steel strips not less than 0.9 mm.. thick and 80 mm. wide, for shutters upto 3.5 m. width and not less than 1.25 mm. thick and 80 mm. wide, for shutters 3.5 m. in width and above, unless otherwise specified.

32.2 Guide channels shall be of mild steel, deep channel section and roll pressed or built-up (fabricated), with jointless construction. The thickness of the sheet used shall not be less than 3.15 mm.

32.3 Hood covers shall be made of MS sheets, not less than 0.90 mm. thick. For shutters having width of 3.5 m. and above, the thickness of MS sheet for the hood cover shall be not less than 1.25 mm.

32.4 The spring shall be of best quality and shall be manufactured from tested high tensile spring steel wire or strip of adequate strength to balance the shutters in all positions. The spring pipe shaft etc. shall be supported on strong MS or malleable CI brackets. The brackets shall be fixed on or under the lintel as specified with rawlplugs and screws bolts, etc.

32.5 The rolling shutters shall be of self rolling upto 8 m^2. clear area, without ball bearing and upto 12 m^2. clear area, with ball bearing. If the rolling shutters are of large area, then gear operated type shutters shall be used.

32.6 The locking arrangement shall be provided at the bottom of shutter at both ends. The shutters shall be opened from outside.

32.7 The shutters shall be completed with door suspension shafts, locking arrangements, pulling hooks, handles and other accessories.

M-33 Collapsible Steel Gate :

33.1 The collapsible steel gate shall be in one or two leaves and size as per approved drawings or as specified. The gate shall be fabricated from best quality mild steel channels, flats etc. and either steel pulleys or ball bearings shall be provided in every double channel, unless otherwise specified. The particulars of collapsible gate shall be as under:

(a) Pickets: These shall be of 20 mm. MS channels of heavy section, unless otherwise shown on drawings. The distance, center to center of pickets shall be 12 cm. with an opening of 10 cm.

(b) Pivoted MS flats shall be 20 mm. x 6 mm.

(c) Top and bottom guides shall be from tee or flat iron of approved size.

(d) The fittings like stoppers, fixing hold fasts, locking cleats, brass handles and cast iron rollers shall be of approved design and size.

M-34 Welded Steel Wire Fabric :

34.1 Welded steel wire fabric for general purpose shall be manufactured from cold drawn steel wire "as drawn" or galvanised steel conforming to IS : 226 with longitudinal and transverse wire securely connected at every intersection by a process of electrical resistance welding and conforming to IS : 4948. It shall be fabricated and finished in workmanlike manner and shall be free from injurious defects and shall be dust proof. The type of mesh shall be oblong or square, as directed. The mesh sizes and sizes of wire for square as well as oblong, welded steel wire fabric shall be as directed. The steel wire fabric in panels shall be in one whole piece, in each panel, as far as stock sizes permit.

M-35 Expanded Metal Sheets :

35.1 The expanded metal sheets shall be free from flaws, joints, broken strands, laminations and other harmful surface defects. Expanded metal steel sheet shall conform to IS : 412 except that blank sheets need not be with guaranteed mechanical properties. The size of the diamond mesh of expanded metal and dimensions of strands (width and thickness) shall be as specified. The tolerance on nominal weight of expanded metal sheets shall be of $\pm$ 10%.

35.2 Expanded metal in panels shall be in one whole piece, in each panel, as far as stock sizes permit. The expanded metal sheets shall be coated with suitable protective coating to prevent corrosion.

M-36 Mild Steel Wire (Wire Gauze Jali) :

36.1 Mild steel wire may be galvanised, as indicated. All finished steel wire shall be well sawn to the dimensions, and the size of the wire shall be as specified in item. The wire shall be sound, free from splits, surface flaw, rough, jagged and imperfect edges and other harmful surface defects and shall conform to IS : 280.

M-37 Plywood :

37.1 The plywood for general purpose shall conform IS : 303.
Plywood is made by cementing together thin boards or sheets of wood into panels. There are always an odd number of layers, 3,5,7,9 ply etc. The plies are placed so that grain of each layer is at right angles to the grain in the adjacent layer.

37.2 The chief advantages of plywood over a single board of the same thickness is that, plywood offers more uniform strength, along its length and width and also offers greater resistance to cracking and splitting with change in moisture content.

37.3 Usually synthetic resins are used for gluing, phenolic resins are usually cured in a hot press which

compresses and simultaneously heats the plies between hot plates, which maintain a temperature of 90^0C to 140^0C and a pressure of 11 to 14 Kg/$cm^{2.}$, on the wood. The time of heating may be anything from 2 to 60 minutes depending upon the thickness.

37.4 When water glues are used the wood absorbs so much water that the finished plywood must be dried carefully. When synthetic resins are used as adhesive, the finished plywood must be exposed to an atmosphere of controlled humidity until the proper amount of moisture has been absorbed.

37.5 According to IS : 303, the plywood for general purpose shall be of the grades namely BWR, WWR and CWR, depending upon the adhesives used for bonding the veneers, and it will be further classified into six types namely AA, AB, AC, BB, BC and CC based on the quality of the two faces, each face being of three kinds namely, A,B and C. After pressing, the finished plywood should be reconditioned to a moisture content not less than 8% and not more than 16%.

37.6 Thickness of plywood boards:

Board	Thickness	Board	Thickness	Board	Thickness	Board	Thickness
3 ply	3 mm.	5 ply	5 mm.	7 ply	9 mm.	9 ply	16 mm.
	4 mm.		6 mm.		13 mm.		19 mm.
	5 mm.		8 mm.		16 mm.	11 ply	19 mm.
	6 mm.		9 mm.	9 ply	13 mm.		22 mm.
							25 mm.

Types of plywood :

M-37A Water Proof (Weather Proof) Plywood :

37A.1 The plywood shall be from Kitply, Wonder Wood, Anchor Board or equivalent, as approved by the Architect and Engineer-in-charge. It shall conform to IS : 710 and to the relevant Defence and Navy specifications.

37A.2 Plywood shall be made from veneers of hard wood timbers and bonded with high quality BWP type Phenol Formaldehyde Synthetic Resin Adhesive and hot pressed at high temperature and pressure, and further treated with a fixed type of preservative by vacuum-cum-pressure impregnation, to produce thin boards or sheets of wood panels. There are always an odd number of layers. The plies shall be placed, so that, grain of each layer is at right angles to the grain in the adjacent layer.

37A.3 Plywood shall be waterproof, weather proof, boilproof, and highly durable even against strenuous vulnerable uses. It shall resist the attack of termites, cockroaches, wood burrowers, fungus, mould, rot, decay and other wood destroying insects and marine organisms.

37A.4 The tensile strength of the plywood shall be minimum 600 kg/$cm^{2.}$ and bending strength above 400 kg/cm^2. The swelling of plywood in water should be almost negligible. Specific gravity of plywood should be 0.7 to 0.75, having screw and nail holding strength normal to face, atleast 250 kg. and 60 kg., respectively.

37A.5 The moisture content shall be less than 10% and the plywood shall have high fire resistance and shall be free from any cracks, wraps, split etc., and shall have uniform strength all over the panel surface. It shall be used for marine structures, leather tanning tables, wall panelling, and underlayment for kitchen and other furniture, subjected to heat and moisture.

M-37B Commercial Ply :

37B.1 The plywood shall be from Mafatlal Plywood Industries Ltd. or equivalent, as approved by the Architect and Engineer-in-charge. It shall conform to IS 303.

37B.2 Plywood shall be made from hard wood timbers, finished with selected species of timber, suitable for veneers and bonded with strictly controlled and evenly spread adhesives.

37B.3 It shall be smooth and strong and shall be free from warping, cupping and twisting.

M-37C Prelaminated - Standard and Veneered :

37C.1 **Decorative Plywood :**

37C.1.1 It shall be obtained from manufacturer as approved by the Architect and Engineer-in-charge. It shall conform to relevant IS Code.

37C.1.2 Plywood shall be made from hard wood timbers, finished with selected species of timber, suitable for veneers and bonded with strictly controlled and evenly spread adhesives. It shall be smooth and strong and shall be free from warping, cupping and twisting.

37C.2 **Decorative Veneers :**

37C.2.1 Decorative veneered plywood shall be manufactured using veneers of the best quality timbers like Teak, Rosewood, Walnut, Laurel, White Cedar and many others.

37C.2.2 They shall be available in flitch form as well as in lay-on form, in sizes suitable to the furniture industry. They shall be available either flat or quarter sliced, varying in thickness from 0.2 mm. to 1.5 mm. Lengths shall vary upto 4 m.

M-37D Block Boards :

37D.1 They shall be manufactured from well-selected and seasoned hardwood timbers, used in sturdy construction. They shall be usually bonded with Urea Formaldehyde, however against specific requirements, Phenol Formaldehyde bonded boards shall also be available.

37D.2 They shall be strong, weather and water proof and shall be ideally used for high quality furniture and exterior applications.

M-38 Glass :

38.1 All glass shall be of the best quality, free from specks, bubbles, smokes, veins, air holes, blisters, and other defects. The kind of glass to be used shall be as mentioned in the item or specification or in the special provisions or as shown in detailed drawings. Thickness of the glass panels shall be uniform. The specifications for different kinds of glass shall be as under:

38.2 **Sheet Glass :**

38.2.1 In absence of any specified thickness or weight in the item or detailed specifications of the item of work, sheet glass shall be weighing 7.5 Kg/m^2. for panes upto 600 mm. x 600 mm.

38.2.2 For panes larger than 600 mm. x 600 mm and upto 800 mm. x 800 mm., the glass weighing not less than 8.75 Kg/m^2. shall be used. For bigger panes upto 900 mm. x 900 mm., glass weighing not less than 11.25 Kg/m^2. shall be used.

38.2.3 Sheet glass shall be patent flattened glass of best quality and for glazing and framing purposes shall conform to IS : 1761. Sheet glass of the specified colours shall be used, if so shown on the detailed drawings or so specified for important buildings and for panes with any dimensions over 900 mm., plate glass of specified thickness shall be used.

38.3 **Plate Glass :**

38.3.1 When plate glass is specified, it shall be `Polished patent plate glass' of best quality. It shall have both the

surface ground flat and parallel and polished to obtain clear undisturbed vision and reflection. The plate glass shall be of thickness mentioned in the item or as shown in the detailed drawing or as specified. In absence of any specified thickness, the thickness of plate glass to be supplied shall be 6 mm. and a tolerance of 0.20 mm. shall be admissible.

38.4 **Obscured Glass :**

38.4.1 This type of glass transmits light so that vision is partially or almost completely obscured. Glass shall be plain rolled, figure, ribbed or fluted, or frosted, as may be specified or as required. The thickness and type of glass shall be as per details on drawings or as specified or as directed.

38.5 **Wired Glass :**

38.5.1 Glass shall be with wire netting embedded in a sheet of plate glass. Electrically welded 13 mm. Georgian square mesh shall be used. Thickness of glass shall not be less than 6 mm. Wired glass shall be of the type and thickness as specified.

38.6 **Double Glazed units :**

38.6.1 Double glazed unit shall comprise of two glasses, of appropriate thickness and absolutely machine-cleaned on both sides, with an air gap of 12 mm .in-between. The space between the two glasses is kept totally dry, avoiding any condensation by sealing the space with elastomeric sealant. Thus in all, it is an insulating glass unit of around 20mm. thickness.

38.6.2 It shall be suitably used for any kind of Doors and Windows, in all areas of work and residences. It shall be absolutely and clearly transparent, giving the following advantages :

1) Total light penetration, but with dust and heat insulation.
2) Noise insulation.
3) 25% saving in electricity due to heat insulation.
4) Crystal clear transparency.

M-39 Acrylic Sheets :

39.1 Acrylic sheets shall be of thickness as specified in the item and of specified shape and size, as the case may be. Panels may flat or curved. It should be light in weight. It shall be colourless or coloured or opaque, as specified in the item. Colourless sheet shall be as transparent as the finest optical glass. Its light transmission rate shall be about 95%. Transparency shall not be affected for the sheets of larger thickness. It shall be extremely resistant to sunlight, weather and low temperatures.

39.2 It shall not show any significant yellowing or change in physical properties or loss of light transmission over a longer period of use. The sheet shall be impact resistant also, sheets should be of such quality that they can be cut, bent and jointed, as desired. Solution for the joints shall be used as per the requirement of manufacturer.

M-40 Particle Board :

40.1 The particle board used for face panels shall of best quality free from any defects. The particle boards shall be made with phenolmaldehyde adhesive. The particle boards shall conform to IS : 3087 "Specifications for wood particle board for general purpose". The size and the thickness shall be as indicated.

40.2 Particle board shall be made completely from Teakwood and shall be bonded with BWP type Phenol Formaldehyde synthetic resin to give a flat, strong and homogenised panel.

40.3 It shall be durable and shall have smooth surface so as to take any type of surface treatment, like polishing, painting, laminating or veneers. It shall be fire resistant, weather resistant, termite and insect resistant. It shall be dimensionally stable, structurally strong and acoustically superior.

40.3 It shall be available in all standard sizes as that of the plywood.

40.4 Particle board may also be available in veneered form.

M-41 Expanded Polystyrene or Framed Styroper Slabs :

41.1 The expanded polystyrene ceiling boards and tiles shall be of approved make and shall be of sizes, thickness, finish and colour, as indicated. They shall be of high density and suitable for use as insulating material. The insulating material shall be like slab of Thermocole etc.

M-42 Resin Bonded Fibre Glass :

42.1 The resin bonded fibre glass tiles or rolls shall be of approved make and shall be of sizes, thickness and finish, as indicated.

42.2 For test of mineral wool thermal insulation blanket, IS : 3144 shall be followed.

42.3 Insulation wool blanket shall be with the following coverings on one or both sides, as indicated.
(1) Bituminised hessain Kraft paper suitable for use in position where moisture has to be excluded.
(2) Hessian cloth or Kraft paper, for keeping out dust.
(3) GI wire netting, suitable for surfaces to be plastered over.

M-43 Fixtures and Fastenings :

43.1 **General :**

43.1.1 The fixtures and fastenings, that is butt, hinges, tee and strap hinges, sliding door bolts, tower bolts, door latch, bath-room latch, handles, door stoppers, casement window fasteners, casement stays and ventilators catch shall be made of the metal, as specified in the item or its specification.

43.1.2 They shall be of iron, brass, aluminium, chromium plated iron, chromium plated brass, copper oxidised iron, copper oxidised brass or anodised Aluminium, as specified.

43.1.3 The fixtures shall be heavy types. The fixtures and fastenings shall be smooth finished and shall be such as will ensure ease of operations.

43.1.4 The samples of fixtures and fastenings shall be got approved by Engineer-in-charge and Architect, as regards its quality and shape before fixing them in position.

43.1.5 Brass and anodised aluminium fixtures and fastenings shall be bright finished.

43.2 **Holdfasts :**

43.2.1 Holdfasts shall be made from mild steel flat 30 cm. length and one of the holdfasts shall be bent at right angle and two nos. of 6 mm. diameter holes, shall be made in it for fixing it to the frame with screws. At the other end, the holdfast shall be forked and bent at right angles in opposite directions.

43.3 **Butt hinges :**

43.3.1 Railway standard heavy type butt hinges shall be used when so specified.

43.3.2 Tee and strap hinges shall be manufactured from MS Sheet.

43.4 **Siding door bolts (Aldrops) :**

43.4.1 The aldrops as specified in the item shall be used and shall be got approved.

43.5 **Tower bolts (Barrel type) :**

43.5.1 Tower bolts as specified in the item shall be used and shall be got approved.

43.6 **Door Latch :**

43.6.1 The size of door latch shall be taken as the length of latch.

43.7 **Bathroom Latch :**

43.7.1 Bathroom latch shall be similar to tower bolt.

43.8 **Handle :**

43.8.1 The size of the handles shall be determined by the inside grip length of the handles. Handles shall have a base plate of length 50 mm. more than the size of the handle.

43.9 **Door Stoppers :**

43.9.1 Door stoppers shall be either floor door stopper type or door catch types. Floor stopper shall be of overall size as specified and shall have a rubber cushion.

43.10 **Door Catch :**

43.10.1 Door catch shall be fixed at a height of about 900 mm. from the floor level such that one part of the catch is fitted on the inside of the shutter and the other part is fixed in the wall with necessary wooden plug arrangements for appropriate fixing. The catch shall be fixed 20 mm. inside the face for the door for easy operation of catch.

43.11 **Wooden Door Stop with Hinges :**

43.11.1 Wooden door stop of size 100 mm. x 60 mm. x 40 mm. shall be fixed on the door frame with a hinge of 75 mm. size and at a height of 900 mm. from the floor level. The wooden door stop shall be provided with 3 coats of approved oil paint.

43.12 **Casement Window Fastener :**

43.12.1 Casement window fastener for single leaf window shutter shall be left or right handed as directed.

43.13 **Casement Stays (Straight Peg Stay) :**

43.13.1 The stays shall be made from a channel section having three holes at appropriate position so that the window can be opened either fully or partially, as required. Size of the stay shall be 250 mm. to 300 mm., as directed.

43.14 **Ventilator Catch :**

43.14.1 The pattern and shape of the catch shall be as approved.

43.15 **Pivot :**

43.15.1 The base and socket plate shall be made from minimum 3 mm. thick plate, and projected pivot shall not be less than 12 mm. in diameter and 12 mm. in length and shall be firmly riveted to the base plate, in case of iron pivot and in single piece base plate, in the case of brass pivot.

M-44 Paints:

M-44A Oil Paints:

44A.1 Oil paints shall be of the specified colour and shade and as approved. The ready mixed paints shall only be used. However, if ready mixed paint of specified shade or tint is not available white ready mixed paint with approved stainer shall be allowed. In such a case, the Contractor shall ensure that the shade of the paint so allowed shall be uniform.

44A.2 All the paints shall meet with the following general requirements:

(i) Paint shall not show excessive setting in a freshly opened full can and shall easily be redispersed with a paddle to a smooth homogeneous state. The paint shall show no curdling, levering, caking or colour separation and shall be free from lumps and skins.

(ii) The paint as received shall brush easily, possess good levelling properties and show no running or sagging tendencies.

(iii) The paint shall not skin within 48 hours in a three quarters filled closed container.

(iv) The paint shall dry to a smooth uniform finish free from roughness grit, unevenness and other

imperfections.

44A.3 Ready mixed paint shall be used exactly as received from the manufacturers and generally according to their instructions and without any admixtures, whatsoever.

M-44B Enamel Paints :

44B.1 The enamel paint shall satisfy all general requirements in specification of oil paints. Enamel paint shall conform to IS : 2933. It shall be from Nerolac, Berger, Asian Paints or equivalent. It shall offer variety of finishes like Glossy, Semi-glossy, Pearl lustre and Matt.

44B.2 It shall be applied either by brush, roll or spray. It shall have a covering capacity of 13 to 18 m^2. per coat, depending on the surface to be painted. It shall be used both on metal and wood surfaces.

44B.3 It shall have a viscosity of application of 60 to 65 seconds, if brush or rollers are used and 30 to 40 seconds, if spraying is done. It shall have flash point at above 30 ^{0} C. The drying time shall however vary with the ambient temperature and humidity.

M-44C Heritage Wall Finish :

44C.1 It shall be from Bakelite Hylam Ltd. or equivalent, as approved by the Architect and Engineer-in-charge. It shall conform to relevant IS Codes. It shall be granules, flakes, granite-flakes and granules and flakes mix.

44C.2 It shall be a two component finish. It shall be easily applicable using trowels and no special tools and training shall be required for application. The single coat application thickness shall be 1.5 mm. thick, of colour and texture, as approved by the Architect. It shall be weather and fade resistant, water and damp resistant, durable and highly washable. It shall be acid and alkali resistant, high abrasion resistant, non-toxic and shall be capable to taking any shape. It can be applied on wide variety of surface like cement mortar, plywood, plaster board, AC sheet, Asbestos board, gypsum plaster or any other materials, to get homogenous layer.

44C.3 It shall be water thinnable to avoid water contamination, incombustible and flexible. It shall be good fire resistant, anti-fungal, good impact resistant having adhesion strength more than 8 kg./cm^2. There shall not be any development of hair line cracks and no peeling off shall occur, after the maximum drying time of 4 hours and curing period of 2 days.

M-44D Polyurethane Coatings :

44D.1 It shall be from MRF Durodec or equivalent, as approved by the Architect and Engineer-in-charge.

44D.2 It shall be a three-coat application, using a brush, spray or a roller. It shall be available in variety of decorative finishes, i.e. in almost all shades and in glossy and matt finishes. It shall offer the following properties :

1) Adhesion to concrete surfaces.
2) Sealing effect against heavy rain.
3) Good water vapour diffusion.
4) Weather resistance, colour stability, gloss retention and chalk resistance.
5) Resistance to disinfectants, chemical, fire, radiation, acid gases, abrasion and wear.
6) Low soil adhesion.

44D.3 It shall be ideal for concrete, floor toppings, on calcium silicate brickwork, glass fibre reinforced concrete, and wood fibre. plaster board, fibre reinforced plasterboard. It shall absorb UV radiation and shall be easily cleaned of radioactive contamination. The ultraviolet part of the solar radiation shall not affect the coating and thereby shall be long lasting.

M-44E Armor Quartz :

44E.1 It shall be from Jenson & Nicholson or equivalent, as approved by the Architect and Engineer-in-charge.

44E.2 It is used for exterior surfaces and shall give a thick rich opaque matt finish. It shall be easily applicable using a flat brush well moistened before use. No special tools or training shall be required for application. A single coat application is enough to render a smooth, well prepared surface, in the colour and texture, approved by the Architect. It shall be weather and fade resistant, water and damp resistant, durable. It shall resist fungi and algae. It can be applied on wide variety of surface like cement mortar, plywood, plaster board, AC sheet, Asbestos board, gypsum plaster or any other absorbent material to get homogenous layer. It shall touch dry within 20 minutes and covers 20% more area than other fine textured exterior finishes.

44E.3 It shall be water thinnable, thinned with 5 to 10% of water by volume. It shall require no primer. On a well prepared surface, it shall be applied, in single coat, after one coat of Robbiacem Super cement paint. On a previously painted surface, painted with oil paints, a base coat of Armor Quartz, diluted 1:1 with water is applied before the final coat of Armor Quartz, thinned with 5 to 10% of water by volume. It shall be formulated to last for atleast 10 years.

M-44F Acrylic Emulsion :

44F.1 It shall be from Nerolac, Asian Paints, ICI, Berger or equivalent, as approved by the Architect and Engineer-in-charge. It shall conform to the relevant IS Codes.

44F.2 It shall be used on both interiors and exteriors, on all different types of plaster, wooden surfaces, stone, brickwork, asbestos cement sheets, hard and soft boards, etc. It shall render rich smooth finish and shall provide a tough film that forms a suitable protection against all elements.

44F.3 It shall be water thinnable. It shall require no primer. On a well prepared surface, it shall be applied, after one coat of cement primer, in case it is an interior surface and waterproof cement coating, in case it is an exterior surface. On a new but highly absorbent surface, a thin coat of the same shall be applied by adding two parts of water by volume to two parts of Acrylic Emulsion by volume. On previously painted surfaces, one coat of the same shall be applied by thinning four parts of the emulsion with one or two parts of water. It shall be applied by brush, roller or spray. It shall have a covering capacity of 25-30 m^2/lit., depending on the surface and shade used. It can be washed to remove the day-to-day dirt, after the surface has been painted, minimum for a month.

M-44G Water Bound Distemper :

44G.1 It shall be from Berger, Nerolac, ICI, Asian Paints or equivalent, as approved by the Architect and Engineer-in-charge. It shall conform to the relevant IS Codes.

44G.2 It shall be available in dry powder form and shall be prepared by adding preferably warm water, in the manner and proportion, as described by the manufacturer. It shall be applied by the conventional distemper brush to all plastered walls, ceilings and woodwork. It shall generally not require any primer, but if found necessary, a size coat made by an experienced painter from glue, soap, warm water and distemper powder shall be applied. It shall offer a covering capacity of 13-16 m^2 per Kg. depending on the surface and shade used.

M-44H Cement Paints :

44H.1 It shall be from Berger, ICI, Asian Paints or equivalent, as approved by the Architect and Engineer-in-charge. It shall conform to the relevant IS Codes.

44H.2 It shall be manufactured from selected range of raw materials and a special cement, so the it shall be suitable for both indoors and outdoors. It shall be suitably used on concrete renderings, cement/sand renderings, cement/lime/sand renderings, asbestos sheets, fibre boards, brickwork, etc. It shall offer matt finish. It shall require no primer and shall be water thinnable. It shall offer a covering capacity of 6-8 m^2 per

Kg., depending on the surface and shade used. It shall preferably not be applied under direct sunlight to avoid patchy effect.

M-45 French Polish:

45.1 The French polish of required tint and shade shall be prepared with the below mentioned ingredients and other necessary materials.
(i) Denatured spirit of approved quality (ii) Chandras (iii) Pigment.

45.2 The French polish so prepared shall conform to IS : 348.

M-45A Laquar Polish

45A.1 Laquar polish of ASIAN or TARALAC with thinner of same company shall be used. Surfaces to be polished shall be properly grinned with sandpaper and all grains of the wood shall be filled by sealer coat over that multiple layers of approved company's Laquar to be applied up to hot water resistance.

M-45B Wax Polish :

45B.1 The Wax polish of required tint and shade shall be prepared with the below mentioned ingredients and other necessary materials.
(i) 2 parts Bees wax conforming to IS : 1504-1968 with 1.5 parts boiled linseed oil conforming to IS : 75 and 1 part of Turpentine conforming to IS : 83 and 0.5 part Varnish conforming to IS : 337.

45B.2 Pure bees wax free paraffin or bees adulterants shall be used. The polish shall be prepared from mixture of bees wax, linseed oil, turpentine and varnish in proportion 2 : 1.5 : 1 : 0.5 by weight. The bees wax and boiled linseed oil shall be heated over a slow fire. When the wax is completely dissolved the mixture shall be cooled till it is just warn and turpentine and varnish added to it in the required proportions and entire mixture shall be well stirred.

M-45C Melamine Polish:

45C.1 The melamine polish shall be of best quality and make such as Asian Paints or equivalent, as approved by the Architect and Engineer-in-charge. It shall be transparent or opaque, as specified by the Architect.

45C.2 It shall give silken, smooth finish. The Melamine polish shall have shade and shine, either satin or glossy, as approved by the Architect. It shall be two component polish consisting of a base and hardener. It shall be capable of protecting wood from moisture, heat, cold, scratches, stains, cigarette burns etc. It shall have excellent covering capacity. It shall be applicable to all wooden surface of every shape. It shall be applied using brush or spray gun. It shall require lesser time to dry and there shall be no cracks or pealing off of the polish. There shall not be any undulation on the finished surface nor cracks at joints. It shall be of any desired shade as approved by the Architect. It shall have excellent colour, shall be free flowing and shall have good levelling properties. It shall be durable and flexible to absorb cracks. It shall have resistant to scrubs, light rays, heat etc.

M-45D Acrylic Wood Polish:

45D.1 Acrylic wood polish shall be of the best quality and make such as Nebula Chemicals Pvt. Ltd. or equivalent, as approved by the Architect and Engineer-in-charge. It shall be made from the best ingredients to give a consistent quality. It shall be water resistant, heat resistant and scratch resistant.

45d.2 It shall offer a silky smooth wood finish. It shall offer any desired shade like rosewood, amber. mahogany, walnut etc. It shall have excellent covering capacity. It shall be applied to all wooden surfaces, of every shape. It shall give a tough and durable surface. It shall require lesser time to dry and shall cover a wider area. On application, it shall form a layer of acrylic which eliminates sanding the surface and therefore helps to reduce time and labour. It shall not require any special equipment to apply.

M-46 Marble Chips for Marble Mosaic Terrazzo :

46.1 The marble chips shall be of approved quality and shades. It shall be hard, sound dense and homogenous in texture with crystalline and coarse grains. It shall be uniform in colour and free from stains, cracks, decay and weathering.

46.2 The size of various colours of marble chips ranging from the smallest upto 20 mm. shall be used where the thickness of top wearing layer is 6 mm. size. The marble chips of approved quality and colours only as per grading as decided by the Engineer-in-charge and Architect shall be used for marble mosaic tiles or works.

46.3 The marble chips shall be machines crushed. They shall be free from foreign matter, dust etc., except as above, the chips shall conform to IS : 2114.

M-47 Flooring Tiles :

M-47A Plain Cement Tiles :

47A.1 The plain cement tiles shall be of general purpose type. For these tiles, no pigments are used, in their manufacture. Cement used in the manufacture of the tiles shall be as per IS

47A.2 The tiles shall be manufactured from a mixture of cement and natural aggregates, using pressure process. During the manufacture, the tiles shall be subjected to a pressure of not less than 140 Kg/cm^2. The proportion of cement to aggregate, in the backing of the tiles shall be not less than 1:3, by weight. The wearing face, though the tiles are of plain cement, shall be provided with stone chips of 1 to 2 mm. size. The proportion of cement to aggregate, in the wearing layer of the tiles shall be three parts of cement to one part chips, by weight. The minimum thickness of wearing layer shall be 3 mm. The colour and texture of the wearing layer shall be uniform throughout its face and thickness. On removal from mould, the tiles shall be kept in moist condition, continuously atleast for 7 days and subsequently, if necessary, for such long period, as would ensure their conformity to requirements of IS : 1237, regarding strength, resistance to wear and water absorption.

47A.3 The wearing face of the tiles shall be plane, free from projections, depressions and cracks and shall be reasonably parallel to the backing of the tile. All angles shall be right angles and all edges shall be sharp and true.

47A.4 The tiles shall generally be square in shape, with a size of 30 cm. x 30 cm. The thickness of the tiles shall be 25 mm.

47A.5 Tolerance of length and breadth shall be $\pm$ 1 mm. Tolerance of thickness shall be + 5 mm.

47A.6 The tiles shall satisfy the test as regards transverse strength, resistance to wear and water absorption as per IS : 1237.

Testing Standards :

A. Water Absorption :
Sampling :
6 tiles out of every 3000 tiles are taken for testing.
Results :
Absorption permissible, shall be at the most 10%.

B. Transverse strength test :
Sampling :
12 tiles out of every 3000 tiles are taken for testing.

Results :

When wet :- 80 Kg/cm^2.
When dry :- 120 Kg/cm^2.

C. Abrasion test :
Sampling :
6 tiles out of every 3000 tiles are taken for testing.
Results :
Average abrasion shall not be more than 3.5 mm.

M-47B Plain Coloured Tiles :

47B.1 These tiles shall have the same specifications as plain cement tiles, as in 47A above except that they shall have a plain wearing surface, wherein pigments are used. They shall conform to IS : 1237.

47B.2 The pigments used for colouring cement shall not exceed 10% by weight of cement used in the mix. The pigments, synthetic or otherwise, used for colouring tiles shall have permanent colour and shall not contain materials detrimental to concrete.

47B.3 The colour of the tiles shall be specified in the item or as directed.

M-47C Marble Mosaic Tiles :

47C.1 These tiles have the same specifications as plain cement tiles except for the requirements stated below:

47C.2 The marble mosaic tiles shall conform to IS : 1237. The wearing face of the tiles shall be mechanically ground and filled. The wearing face of tiles shall be free from projections, depressions and cracks and shall be reasonably parallel to the backing of the tiles. All angles shall be right angles and all edges shall be sharp and true.

47C.3 Chips used in the tiles shall be of the smallest size upto 20 mm. size. The minimum thickness of the wearing layer of tiles shall be 6 mm. For pattern of chips required on the wearing face, a few samples with or without their full size photographs, as directed shall be presented to the Engineer-in-charge and Architect, for approval.

47C.4 Any particular sample, if found suitable shall be approved by the Engineer-in-charge and Architect, or he may ask for a few more samples to be presented. The samples shall have to be made by the Contractor till a suitable sample is finally approved for use in the work. The Contractor shall ensure that the tiles supplied for the work shall be in conformity with the approved sample only, in terms of its dimensions, thickness of the backing layer and wearing surface, materials, ingredients, colour shade, chips distribution, etc. required.

47C.5 The tiles shall be prepared from cement conforming to IS or coloured Portland cement, generally depending upon the colour of tiles to be used or as directed.

M-47D Chequered Tiles :

47D.1 Chequered tiles shall be plain cement tiles or marble mosaic tiles. The former shall have the same specification as per 47A above, and the latter as per marble mosaic tiles as per 47C, except as mentioned below:

47D.2 The tiles shall be of nominal size of 250 mm. x 250 mm. or as specified. The center to center distance of chequer, shall not be less than 25 mm. and not more than 50 mm. The overall thickness of the tile shall be 22 mm.

47D.3 The grooves in the chequers shall be uniform and straight. The depth of the grooves shall not be less than 3 mm. The chequered tiles shall be plain, coloured or mosaic, as specified. The thickness of the upper layer measured from the top of the chequers shall not be less than 6 mm. The tiles shall be given the first

grinding, with machine, before delivery to site.

47D.4 Tiles shall conform to IS : 1237.

M-47E Chequred Tiles for Stair Cases :

47E.1 The requirements of these tiles shall be the same as chequred tiles, as per 47D above, except in the following respects:

(1) The length of a tile including note, shall be 330 mm.
(2) The minimum thickness shall be 28 mm.
(3) The nosing shall also have the same wearing layer as that at the top.
(4) The nosing edge shall be rounded.
(5) The front portion of the tile, for a minimum length of 75 mm. from and including the nosing, shall have grooves running parallel to the nosing and at center not exceeding 25 mm. Beyond that the tiles shall have normal chequer pattern.

M-48 Rough Kotah Stone :

48.1 The kotah stones shall be hard, even, sound and regular in shape and generally be uniform in colour. The colour of the stone shall generally be green. Brown coloured stones shall not be allowed for use. The stones shall be without any soft veins, cracks or flaws.

48.2 The size of the stones to be used for flooring shall be of size 600 mm. x 600 mm. and or size 600 mm. x 450 mm., as directed. However, smaller sizes will be allowed to be used to the extent of maintaining required pattern. Thickness shall be, as specified.

48.3 Tolerance of -30 mm., on accounts of chisel dressing of edges shall be permitted for length as well as breadth. Tolerance in thickness shall be +3 mm.

48.4 The edges of the stones shall be truly chiselled and table rubbed with coarse sand before paving. All angles and edges of the stones of shall be true, square and free from chipping and the surface shall be true and plain.

48.5 When machine cut edges are specified, the exposed edges and the edges at joints shall be machine cut. The thickness of the exposed machine cut edges shall be uniform.

M-49 Polished Kotah Stone :

49.1 Polished kotah stone shall have the same specification as Rough kotah stone, except as mentioned below:

49.2 The stones shall have machine polished surface. When brought on site, the stone shall be single polished or double polished, depending upon its use. Single polished kotah stone shall have single face of the stone polished whereas, double polished kotah stone shall have both the faces polished. The stones for paving shall generally be single polished. The stones to be used for dado, skirting, sink, veneering, sills, steps, etc., where machine polishing after the stones are fixed in situ, is not possible, shall be polished more than once for the desired finish, before fixing.

49.3 When brought at site, the colour of the stone shall be fairly uniform. It shall be ensured that the stones to be used in a particular work, shall not differ much in shade or tint, from the approved sample.

M-50 Dholpur Stone :

50.1 Dholpur sand stone shall be of best quality, as approved by the Architect and Engineer-in-charge. The stone slab shall be without any veins, cracks and flaws. The stone slab shall be even, sound and durable, regular in shape and of uniform colour.

50.2 The size of the slab shall be as specified in the item or detailed drawing or as approved by the Architect and Engineer-in-charge. The thickness of the stone shall be as specified in the item of work, with the permissible tolerance of ± 2 mm.

50.3 The stones shall have machine polished surface. When brought on site, the stone shall be rough, single polished or double polished, depending upon its use and as specified in the item or detailed drawing. The stones for paving shall generally be single polished. The stones to be used for sills, steps, brackets, coping, facias, bands, pillars, fabricated railings, jali work etc., where machine polishing after the stones are fixed in situ, is not possible, shall be double polished or polished more than once, as required.

50.4 All angles and edges of the stone slab shall be fine chiselled or polished, as specified in the item of work and all the four edges shall be machine cut. All angles and edges of the face of the stone slab shall be true and plane.

50.5 The sample of stone shall be got approved by the Engineer-in-charge and Architect, for a particular work. It shall be ensured that the stones to be used in a particular work shall not differ much in shade or tint, from the approved sample. No white, black or any other colour spots shall be there. Cheetah or tiger skinned stones shall not be allowed under any case.

M-50A Cobbler Stones (Interlock Pavers) :

50A.1 Cobbler stones shall be of best quality, as approved by the Architect and Engineer-in-charge and shall be obtained from reliable source. The make will be approved by the Architect and the source of supply shall not be changed without prior approval of the Architect. The stone shall be without any veins, cracks and flaws. The cobbler stones shall be even, sound, durable and regular in shape and of uniform colour.

50A.2 The size of the cobbler stone shall be as specified in the items or detailed drawing or as approved by the Architect and Engineer-in-charge. The thickness of the stone shall be as specified in the item of work, with permissible tolerance of ± 2 mm.

50A.3 The stone shall have machine polished surface. When brought on site the stone shall be single polished or double polished, depending upon its use and as specified in the item or detailed drawing. The cobbler stones to be used for walkways, roadways, parking, floors, docks, roofs, public squares etc., where machine polishing after the fixing of stones, is not possible, the stones to be fixed shall be double polished or polished more than once, as required. All angles and edges of the cobbler stone shall be true and plane.

M-51 Marble Slab :

51.1 Marble slab shall be white or of any other available colour and of best quality, as approved by the Engineer-in-charge and Architect.

51.2 Slabs shall be hard, close, uniform and homogeneous in texture. They shall have even crystalline grain and shall be free from defects and cracks. The surface shall be machine polished to an even and perfect plane surface and edges machine cut, true and square. The rear face shall be rough to provide key for the mortar.

51.3 Marble slabs with natural veins, if selected, shall have to be laid as per the pattern given by the Engineer-in-charge and Architect. Size of the slab shall be minimum 450 mm. x 450 mm. and preferably 600 mm. x 600 mm. However, smaller sizes will be allowed to be used to the extent of maintaining required pattern.

51.4 The slab shall not be thinner than the specified thickness, at its thinnest part. A few specimen of the finished slab to be used, shall be deposited by the Contractor in the office, for reference.

51.5 Except as above, the marble slabs shall conform to IS : 1130.

M-51A **Blended Marble tile/slab :**

51A.1 It shall of the best quality like Carara, Marbella or equivalent, as approved by the Architect and Engineer-in-charge.

51A.2 It shall be predominantly a marble tile/slab, composed of 80% to 95% of finest grains of quality selected marble aggregates, bonded together with 4% to 8% special resins, alongwith palette of colourants. It shall therefore offer a wide range of colour compared to natural marble. It shall be manufactured so, that its design goes right through the tile, insuring lasting designs.

51A.3 It shall be available in pre-cut, pre-polished, chamfered and grooved upto sizes of 600 mm. x 600 mm. Sizes upto 2400 mm. x 1200 mm. shall also be supplied. It shall have indispensable mechanical strength,

Test	Dry	Wet
Compressive strength in Kg/cm^2.	1340	1317
Flexural strength in Kg/cm^2.	308	453
Modulus of Rupture in Kg/cm^2.	462	453

It shall offer flexibility, high wear resistance, impact resistance and on testing shall be 1.5 kgcm/cm., hardness on the Moh's scale shall be 3 to 4, abrasive wear index shall be 22 and total water absorption shall be around 0.13%. It shall not be easily affected by the freeze and thawing cycling.

51A.4 It shall be non-porous and shall be used in all types of weather. It shall be used for internal and external surfaces. It shall be easily cut with a normal hand cutting machine, if required and shall be laid in the same manner as natural marble stone or with latexbased glues.

M-52 **Granite Stone :**

52.1 Granite shall be of approved colour and quality. It shall be got approved by the Engineer-in-charge and Architect, prior to procurement. The stone shall be hard, even, sound and regular in shape and generally uniform in colour. It shall be without any soft veins, cracks or flaws.

52.2 The thickness of the stone shall be as specified in the item.

52.3 All exposed faces shall be double polished to render truly smooth and even reflecting surface. The exposed edges and corners shall be rounded off, as directed. The exposed edges shall be machine cut and shall have uniform thickness.

M-53 **PVC / Vinyl Flooring :**

53.1 PVC sheets/tiles for PVC/ Vinyl floor covering shall be of the best quality like Wonderfloor, Indag or equivalent, as approved by the Architect and Engineer-in-charge. It shall be of homogeneous flexible type, conforming to IS : 3462. The PVC covering shall neither develop any toxic effect while put to use nor shall give off any disagreeable odour.

53.2 Thickness of flexible type covering tiles shall be as specified in the description of the item. The flexible type shall be backed with hessain or other woven fabric. It shall be available in form of tiles, size upto 600 mm. x 600 mm. or rolls of 1.5 m. width, continuous length of 20 m. The thickness shall be approx. 1.5 to 2 mm. The dimensional stability shall be 0.3%. The following tolerance shall be applicable on the nominal dimensions of the rolls or tiles :

(a) Thickness : + 0.15 mm.
(b) Length or Width :
1.300 mm. Square tiles, + 0.20 mm.
3.900 mm. Square tiles, + 0.60 mm
2.600 mm. Square tiles, + 0.40 mm
4 Sheets and roll, + 0.10 %

53.3 It shall offer colour fastness to daylight as per the relevant IS : 3462. Allowance for curling shall be 0.6 mm.

It shall be flexible and shall not break, crack or show any signs of failure.

53.4 It shall offer above average resistance to mild and diluted acids, alkalies, soaps and detergents. It shall have high abrasion resistance. At normal temperature, it shall develop an indent of 0.15 mm., after one minute and 0.20 mm., after ten minutes. It shall offer insulation resistance as per the IS : 2259. It shall have a sound reduction factor of 3db for 2 mm. thickness and 2db for 1.5 mm. thickness. It shall have self extinguishing property and water absorption at room temperature for 24 hrs. shall be 0.1%.

53.5 It shall be available in various designs and shall be recommended for floors and walls, in homes, institutions, commercial establishments, clinics and hospitals.

53.6 **Adhesive :**

53.6.1 The adhesive for PVC flooring shall be of the type and make recommended by the manufacture of PVC sheets/tiles.

M-54 Facing Tiles :

54.1 The facing tiles (burnt clay facing bricks) shall be free from cracks and nodules and of free lime. They shall be thoroughly burnt and shall have plane rectangular faces with parallel sides and sharp straight right angle faces. The texture of the finished surface that will be exposed when in place shall conform to an approved sample consisting not less than four stretcher bricks each representing the texture desired. The facing tiles shall have a pleasing appearance, sufficient resistance to penetration by rain and greater durability than common bricks. The tiles shall conform to IS : 2691.

54.2 The standard size of facing brick tiles shall be 19 cm. x 9 cm. x 4 cm. The facing brick tiles shall be provided with frog which shall conform to IS : 1077-1976.

54.3 The permissible tolerance in dimensions specified above shall be as follows :

Size	Tolerances for	
	1st Class Brick	**2nd Class Brick**
19 cm.	+ 6 mm.	+ 10 mm.
9 cm.	+ 3 mm.	+ 7 mm.
4 cm.	+ 1.5 mm	+ 2 mm.

54.4 The tolerance for distortion or warpage of face or edges of individual brick from a plane surface and from a straight line, respectively, shall be as follows :

Facing dimensions	Permissible tolerance
Max. below 19 cm.	Max. 2.5 mm.
- do - above 19 cm.	Max. 3.0 mm.

54.5 The average compressive strength obtained as a sample of five tiles when tested in accordance with the procedure laid in IS : 1077 shall not be less than 175 kg/cm^2. The average compressive strength of any individual bricks shall be not less than 160 Kg/cm^2.

54.6 The average water absorption for five bricks tiles shall not exceed 12% of average weight of brick before testing. The absorption for each individual bricks shall not exceed 25%.

54.7 The brick tiles when tested in accordance with IS : 1077, the rate of efflorescence shall not be more than `Slightly effloresced'.

M-55 White Glazed Tiles :

55.1 The tiles shall be of best quality, as approved by the Engineer-in-charge and Architects. They shall be flat and true to shape. They shall be free from cracks, crazing spots, chipped edges and corners. The glazing shall be of uniform shade.

55.2 The tiles shall be nominal size of 150 mm. x 150 mm., unless otherwise specified. The maximum variation from the stated sizes, other than the thickness of tile shall be ± 1.5 mm. The thickness of tile shall be 6 mm. Except for the above, the tiles shall conform to IS : 777.

M-55A Coloured Glaze Tiles :

55A.1 They shall be similar to white glazed tiles mentioned above, in all respects, except that they shall be available in variety of colours and shades, from Johnson & Johnson or equivalent, as approved by the Architect and Engineer-in-charge.

M-56 Ceramic Tiles :

56.1 Ceramic tiles shall be of 1st quality such as Romano, Regency, Spartek, Stiles or equivalent, as approved by the Architect and Engineer-in-charge. They shall adequately meet the relevant IS

56.2 They shall be light weight, with thickness varying between 6 to 8 mm., depending on the manufacturer. Therefore, they require thinner floor bedding compared to mosaic/stone flooring. On laying, they require no further polishing making the floor ready to live in and use. They shall be suitably used for residences, offices, hotels, hospitals, auditoriums, restaurants, canteens, commercial complex and such other public places. They shall be extremely strong, breaking strength of the tile being 350 Kg/cm^2. and flexural strength of 350 Kg/cm^2. They shall offer good resistance to abrasion, i.e. can withstand upto 5000 grindings. They shall be scratch resistance, their hardness on the Moh's scale shall be 6.8 to 7. They shall be resistant to all acids and alkalies except hydrofluoric acid. In addition, they shall be bacteria free and fire proof, as they are fired at @ 1160^{0}C. They shall have very high acoustic damping factor and their specific gravity shall be 0.12, making them good insulators. Their resistance to thermal shocks shall be upto 10 cycles and their co-efficient of linear thermal expansion shall be 9 from ambient temperature to 100^{0}C.

56.3 They shall be available in various sizes, 8"x4", 8"x8", 8"x12", 12"x12" and 12"x16". They shall have a size tolerance of ± 0.4% to 0.75%, in length and width and ± 5% in thickness. Allowable warpage shall be ± 0.5%. Allowable squareness wedging shall be ± 0.4 to 0.5%. The allowable straightness of edges shall be ± 0.5% and allowable flatness shall be ± 0.4 to 0.5%. Their water absorption rate shall be less than 5%.

56.4 Ceramic tile for Industrial purposes, shall have a hardness of 8.6 on the Moh's scale and shall be non-skid, hard wearing, long lasting and acid and alkali resistant. They shall adequately meet the IS : 4457.

M-57 Vitrified Floor Tiles :

57.1 Vitrified floor tiles shall be of best quality like Granamite or equivalent, as approved by the Architect and Engineer-in-charge. They shall conform to the relevant IS Codes.

57.2 They shall be monolithic and available in smooth, mirror-polished and anti-skid finishes, in sizes 12"x12", 8"x8" and 8"x4". They shall have a size tolerance of ± 0.5%, in length and width and ± 5% in thickness. Allowable warpage shall be ± 0.2%. Allowable squareness wedging shall be ± 0.5%. Their water absorption rate shall be less than 0.5%. They shall offer hard-working and hard-wearing floors for homes, public buildings, apartments and airports. The tiles shall be of ASTM or DIN standards.

57.3 They shall be extremely strong, breaking strength of the tile being 1600 Kg/cm^2., flexural strength, 200 Kg/cm^2. and bonding strength of 2500 Kg/cm^2. They shall offer good resistance to abrasion, i.e. greater than 100. They shall be scratch resistance, their hardness on the Moh's scale shall be min. 7. They shall be able to resist thermal shock upto 10 cycles. They shall have a bond strength of 2500 Kg/cm^2. and shall have a density of greater than 2.2 gm/cc. They shall have 0.60 co-efficient of friction for

polished/unpolished surfaces.

M-58 Red Mandana Stone :

58.1 Red mandana stone shall be of best quality, as approved by the Architect and Engineer-in-charge. The stone shall be without any veins, cracks and flaws. The stone shall be even, sound and durable, regular in shape and of uniform colour.

58.2 The size of the stone shall be as specified in the item or detailed drawing or as approved by the Architect and Engineer-in-charge. The thickness of the stone shall be as specified in the item of work, with the permissible tolerance of ± 2 mm.

58.3 The stones shall have machine polished surface. When brought on site, the stone shall be rough, single polished or double polished, depending upon its use and as specified in the item or detailed drawing. The stones for paving shall generally be single polished.

58.4 All angles and edges of the stone shall be fine chiselled or polished, as specified in the item of work and all the four edges shall be machine cut. All angles and edges of the face of the stone shall be true and plane.

58.5 The sample of stone shall be got approved by the Engineer-in-charge and Architect. It shall be ensured that the stones to be used shall not differ much in shade or tint, from the approved sample.

M-59 Jesalmer Stone :

59.1 Jesalmer stone shall be of best quality, as approved by the Architect and Engineer-in-charge. The stone shall be without any veins, cracks and flaws. The stone shall be even, sound and durable, regular in shape and of uniform colour.

59.2 The size of the shall be as specified in the item or detailed drawing or as approved by the Architect and Engineer-in-charge. The thickness of the stone shall be as specified in the item of work, with the permissible tolerance of ± 2 mm.

59.3 The stones shall have machine polished surface. When brought on site, the stone shall be rough, single polished or double polished, depending upon its use and as specified in the item or detailed drawing. The stones for paving shall generally be single polished.

59.4 All angles and edges of the stone shall be fine chiselled or polished, as specified in the item of work and all the four edges shall be machine cut. All angles and edges of the face of the stone shall be true and plane.

59.5 The sample of stone shall be got approved by the Engineer-in-charge and Architect, for a particular work. It shall be ensured that the stones to be used in a particular work shall not differ much in shade or tint, from the approved sample. No white, black or any other colour spots shall be there. Cheetah or tiger skinned stones shall not be allowed under any case.

M-60 Shon Tiles :

60.1 They shall be of best quality and from manufacturer like Shon Mosaics or equivalent, as approved by the Architect and Engineer-in-charge. They shall conform to the relevant IS

60.2 They shall be available in the form of sheet pasted on paper for easy fixing. They shall be non-slippery, non-porous, non-sensitive and non-conductive. They shall offer good resistance to temperature changes, chemical effects, impact and pressure and surface abrasion. They shall be weatherproof and 100% fire proof. They shall be light weight and so suitable for cladding on high rise buildings. They shall be available in wide selection of colours and shall be permanent in colour. They shall be stable in form and dimension. They shall be anti-static and easy to clean.

M-61 Sintered Tiles :

61.1 Sintered unglazed tiles shall be of the best quality from Kera or equivalent, as approved by the Architect and Engineer-in-charge. It shall adequately meet the IS : 4457 specification.

61.2 It shall be available in 7 mm., 12 mm. and 20 mm. thickness and shall be used in domestic and industrial applications. It shall be available as heavy duty and acid resistant tiles, as per individual requirement.

61.3 It shall have a very high load bearing capacity, with cold crushing strength as 1500 Kg/cm^2. and shall withstand a load of 3000 Kg/cm^2. in the compression strength test. The tiles shall have extremely low porosity, because of their monolithic body structure. The water absorption shall be less than 1% and the tiles shall remain free of stains due to lubricants, oils, grease etc. The tiles shall be non-glazed and anti-skid, having a matt finish. They shall be available in special ribbed surface, also. The tiles shall be tough, have high surface hardness, 9 on the Moh's scale and shall offer extremely high resistance to wear and abrasion. They offer good resistance to acids and when tested, the loss of weight shall be around 0.25%.

M-62 Rubber Floorings :

62.1 It shall be of the best quality such as Flora or equivalent, as approved by the Architect and Engineer-in-charge. It shall conform to the relevant IS specifications.

62.2 It shall be available in 6 different colours with special colours supplied on minimum order and in square and round pattern. It shall have a thickness of 2.5 mm., 3 mm., 3.5 mm. and 4 mm. and sizes of 600 mm. x 600 mm. It shall be able to withstand the heaviest traffic and shall have exceptional abrasion resistance, chemical resistance, flame resistance and cigarette burn resistance. It shall have good load bearing capacity, sound deadening characteristics and anti-slip surface. It shall be easy to clean and maintain.

62.3 It shall be successfully used in Hospitals, Airports, Computer rooms, Hotels and Restaurants, Laboratories, Office and Shopping complexes, Lifts, Buses, Cinema halls and Residences.

M-63 Admixtures for Tile/Stone Cladding :

M-63A Waterproof Adhesive :

63A.1 Waterproof adhesive, shall be of best quality and from manufacturer like Feb Roffe or equivalent, as approved by the Architect and Engineer-in-charge. The prior approval for the source shall be taken from the Architect. It shall conform to the relevant IS Code. It shall be in powdered state, complying with BS : 5980 Type 2, class AA and BS : 5385 Part 1. It shall comprise of selected Portland cements, graded sand and synthetic additives.

63A.2 It is useful for permanent adhesion of ceramic tiles, stone and marble cladding to surfaces that may be subjected to extreme weather conditions. It shall provide good tensile adhesion and shear adhesive strength, after application, in thick/thin layer beneath the tile/stone cladding. Its application and coverage shall be as specified by the manufacturer.

M-63B Rainbow Tile Mate :

63B.1 Rainbow tile mate, shall be of best quality and from manufacturer like Feb Roffe or equivalent, as approved by the Architect and Engineer-in-charge. The prior approval for the source shall be taken from the Architect. It shall conform to the relevant IS Code.

63B.2 It shall be a special high grade compound, formulated with organic additives and special blend of high grade cement filling compound. It shall be available in various colours to match all types of glazed/ceramic tile. The organic colouring pigment, added in the compound shall not fade over the period of time.

63B.3 There shall be close adhesion of particle in the compound which imparts water-resistant qualities to the compound and allows to render the joints permanently water-tight, i.e. no seepage and no cracking of joints. It shall have strong bonding property so that the joint in the tiling shall never wear out.

M-64 Selected Earth :

64.1 The selected earth shall be that obtained from excavated material or shall have to brought from outside, as indicated in the item. If item does not indicate anything, the selected earth shall have to be brought from outside.

64.2 The selected earth shall be good yellow soil and shall be got approved from the Architect and Engineer-in-charge. In no case, Black cotton soil or similar expansive and shrinkable soil shall be used. It shall be clean and free from all rubbish and perishable materials, stones, or brick bats. The clods shall be broken to a size of 50 mm. or less. Contractor shall make his own arrangement, at his own cost, for land for borrowing selected earth. The staking of the material shall be done as directed by Architect and Engineer-in-charge, in such a way as not to interfere with any constructional activities and in proper stacks.

64.3 When excavated material is to be used, only selected stuff got approved from the Architect and Engineer-in-charge shall be used. It shall be stacked separately and shall comply with all requirements of selected earth mentioned above.

M-65 Barbed Wire :

65.1 The barbed wire shall be of galvanised steel and it shall generally conform to IS : 278. The barbed wire shall be of type-I, whose nominal diameter for line wire, shall be 2.5 mm. and for point wire, shall be 2.24 mm. The nominal distance between two barbs shall be 75 mm., unless otherwise specified in the item. The barbed wire shall be formed by twisting together two line wires, one of them containing the barbs. The size of line and point wires and barbs spacing shall be as specified above. The permissible deviation from the nominal diameter of the line wire and point wire shall not exceed + 0.08 mm.

65.2 The barbs shall carry four points and shall be formed by twisting two point wires, each two turns, lightly round one line wire, making altogether four complete turns. The barbs shall be so finished that the four points are set and locked at right angle to each other. The barbs shall have a length of not less than 13 mm. and not more than 18 mm. The points shall be sharp and cut at an angle not greater than 35^0 of the axis of the wire, forming the barbs.

65.3 The line and point wires shall be of circular section, free from scale and other defects and shall be uniformly galvanised. The line wire shall be in continuous length and shall not contend any weld other than those in the rod before it is drawn. The distance between two successive splices shall not less than 15 m.

65.4 The length per 100 Kg. of barbed wire, IS type-I, shall be as under :
Nominal 1000 m.
Minimum 934 m.
Maximum 1066 m.

M-66 PVC Waterstops :

66.1 The PVC waterstop shall be of approved make, as approved by the Architect and Engineer-in-charge.

66.2 It shall have optimum resilience, high elasticity & stretch strength ,immune to corrosion, excellent weather resistance. They shall be manufactured to safeguard against hydrostatic pressure, water seepage, expansion or contraction of joints and to take care of any deflection or displacement arising due to change in temperature or settlement of foundation to eliminate danger of cracks.

66.3 They shall be effective in tropical climate having high mechanical strength, good ageing, longer life, shall be unaffected by acids, alkalies, metal salts and other chemicals. It shall not be hazardous and shall have fire retardant properties. It shall absorb less water than rubber, shall work as water tight seal but shall allow safe passage of seepage water and shall withstand high hydrostatic pressure. It shall be easily welded and can be installed easily, having high tensile strength and shall be capable of bearing heavy shocks arising due to turbines, earthquakes, floods etc.

66.4 It shall withstand a minimum hydrostatic pressure of 30 m. high column of water.

66.5 The selection criteria of waterstop depends upon the hydrostatic pressure, however the following points

should be kept in mind :
1) Where substantial expansion/contraction of joints takes place, Dumb Bell type shall be used. 2) Where a firm grip in concrete is desired, Serrated types should be used.
3) The overall width of the waterstop should not be greater than the thickness of concrete.
4) The distance from the face of the concrete to the waterstop must not be less than half the width of the waterstop.
5) The width of the waterstop must be atleast 6 times the largest aggregate used for satisfactory compaction.

66.6 The prior approval of selected size and type of waterstop shall be taken from the Architect and Engineer-in-charge, before use.

M-67 Admixtures for Mass Concrete and Mortar :

M-67A Joint Sealant :

67A.1 The sealant shall be of best quality and from manufacturer like CICO, MC-BAUCHEMIE, PIDILITE, HMP or equivalent, as approved by the Architect and Engineer-in-charge. The prior approval for the source shall be taken from the Architect. It shall conform to the relevant IS Code.

67A.2 It shall be a two component polysulphide rubber joint sealant, based on a low molecular weight polymer. It should not contain chlorides or other corrosive substances.

67A.3 It shall be used for sealing joints in water retaining structures, roofs, external walls, cladding, floors, partitions, ceilings etc. It shall have excellent property to adhere most of building materials like Aluminium, Stainless Steel, Glass, Concrete, Marble, Stone, Brick, Masonry block, Plaster, Ceramic and quarry tiles, Timber etc. The modulus of elasticity of the sealant shall be less than 0.16 MPa, $\pm$10% at 100% elongation. The shore "A" hardness of the sealant shall be 22$\pm$3 @ 25°C. The operating temperature range for the sealant shall be -25°C to 800C. The permanent dynamic movement capability of the sealant shall be $\pm$25%. The tensile strength of the sealant shall not be less than 0.4 MPa. The optimum width/depth ratio shall be 2:1. The Sp.gr. of the sealant shall be 1.6 kg/lit. The sealant should be capable to resist attack of water, sunlight, oxidation, corrosive fumes, oils, petrol, diluted acids and alkalies, salt spray, aliphatic and aromatic solvents and shall not contain tar or bituminous ingredients.

67A.4 It shall posses the properties like 550% elongation at break, non-toxicity when fully cured, no staining and shrinkage less than 1%. The trafficable strength shall be achieved within 24 hours and full at 7 days (at 25°C & 250% RH). It shall possess excellent coverage capacity and more strength at low dry temperatures.

M-67B Abrasion Resistant Industrial Flooring Aggregate :

67B.1 The flooring aggregate, shall be of best quality and from manufacturer like CICO or equivalent, as approved by the Architect and Engineer-in-charge. The prior approval for the source shall be taken from the Architect. It shall conform to the relevant IS Code.

67B.2 The flooring aggregate shall be a factory processed and specially graded non-oxidising, non-magnetic and chemically inert metallic flooring aggregate, free from oil and grease.

67B.3 It shall be used as a surface hardener to concrete floors. It is recommended for Factory floors, Warehouses, Hangers, Car parks and such other areas, subjected to heavy vehicular traffic. It shall also be used on open and continuously wet surfaces. The flooring aggregate shall build in wear resistance and shall produce high abrasion resistant floor surface. It shall impart extreme surface density and shall offer resistance to oil and water penetration. It shall provide a non-rusting floor surface which is easy to maintain.

67B.4 It shall be used with cement in the ratio, as per the manufacturer's instructions and spread evenly on the surface to be treated, at the rate depending on the type of floor. The flooring aggregate shall be spread

when the surface of the concrete floor is still fresh, i.e. as soon as the surface water has evaporated and then trawled, in stages, to bring about an uniform and smooth finish.

M-67C Concrete Hardener and Dustproofer :

67C.1 The Concrete hardener and dustproofer, shall be of best quality and from manufacturer like CICO or equivalent, as approved by the Architect and Engineer-in-charge. The prior approval for the source shall be taken from the Architect. It shall conform to the relevant IS Code.

67C.2 It shall have a specific gravity of 1.18 and shall be applied on concrete floors, at the rate of atleast 25 lit.s per 100 $m^{2.}$ per coat. A total of three coats shall be applied for permanently hardened concrete floor, with increased abrasion resistance, increased surface density, increased resistance to chemical attack and to eliminate dust accumulation. Drying time of 4-6 hours for each coat shall be allowed before the floor is put to use or is applied with another coat of the product. Precautions shall be taken while using the product, to avoid contact with eyes and open wounds and to work in good ventilation. After application, the affected parts shall be washed copiously. It shall not be stored for a period of more than 2 months before use.

M-67D Water Repellent Coating :

67D.1 The Water repellent coating, shall be of best quality and from manufacturer like CICO or equivalent, as approved by the Architect and Engineer-in-charge. The prior approval for the source shall be taken from the Architect. It shall conform to the relevant IS Code.

67D.2 Water repellent coatings for exterior exposed surfaces shall be acrylic resin based, having a Flash point of approx. 40^0C and specific gravity of 0.95.

67D.3 It shall be suitably used for concrete, brick, stone and plastered surfaces preventing moisture penetration and thus any damage to the interiors. It shall be quick acting, long lasting, invisible i.e. colourless so as to maintain the original colour of the surface treated. It shall impart sealing characteristics so that the treated surface becomes stain and dust free. The coating itself shall not darken or turn yellow with age.

M-67E Accelerating, Water Reducing Admixture and Plasticiser :

67E.1 The Accelerating, Water reducing admixture and plasticiser, shall be of best quality and from manufacturer like CICO or equivalent, as approved by the Architect and Engineer-in-charge. The prior approval for the source shall be taken from the Architect. It shall conform to the relevant IS Code.

67E.2 It shall be in liquid state with a specific gravity of 1.30 and complying with ASTM C-494 Type E, IS : 9103 & IS : 2645. It shall accelerate the setting and hardening of the concrete mix, thereby achieving higher early age strength. It shall reduce the water content of the concrete without affecting its workability. It is useful for pre-cast/pre-stressed works, structural concrete works, floors, roads, runways, paving etc. It shall be used at the rate instructed by the manufacturer, with cement, depending on the amount of acceleration of hardening required. It should be compatible to all types of cement.

M-67F Retarding, Water Reducing Admixture and Plasticiser :

67F.1 The Retarding, water reducing admixture and plasticiser, shall be of best quality and from manufacturer like CICO, Feb Roffe or equivalent, as approved by the Architect and Engineer-in-charge. The prior approval for the source shall be taken from the Architect. It shall conform to the relevant IS Code.

67F.2 It shall be in liquid state with a specific gravity of 1.22 and complying with ASTM C-494 Type B & D, IS : 9103, CRD-C87 Type B & D, BS 5075 Part 1. It shall be added to the concrete mix during the mixing process, at the same time as the water or the aggregates. No extension of normal mixing time is necessary. It shall extend the period of time as to placing the concrete and compacting, i.e. delay the initial and final setting time. It shall help to spread the heat of hydration over a longer period of time. It shall give a highly workable concrete with a low W/C ratio. It shall be used at the rate instructed by the manufacturer, with cement, depending on the amount of acceleration of hardening required. It should be compatible to all

types of cement.

M-67G Water & Weather Proof Compound :

67G.1 The water & weather proof integral cement admixture shall be of best quality and from manufacturer like Feb Roffe's Roff Hyseal, Roff hyproof, Algiproof, Hydro Shield of ConTech Chemicals or equivalent, as approved by the Architect and Engineer-in-charge. The prior approval for the source shall be taken from the Architect. It shall conform to the relevant IS Code.

67G.2 It shall be used as an excellent cement admixture in all types of concrete/plaster mortars, pointing mortars, masonry works, guniting works and pressure grouting works. It shall improve resistance of concrete surfaces to weathering and chemical attack. It shall be non-toxic so as to use for waterproofing water tanks, reservoirs, bio-gas tank, leaking ceiling, basements, tunnels, lift wells etc.

67G.3 It shall be mixed to concrete or plaster mortar, while mixing. First, water is added and then the admixture, at the rate instructed by the manufacturer. For use of the admixture, precaution shall be taken to use clean materials for preparation of mortar.

M-67F Plaster Admixture :

67F.1 An admixture which gives the plaster workability, durability and quality at an economical rate shall be of best quality from manufacturer like Feb Roffe (product name - Roff plaster master) Hydro Shield of ConTech Chemicals or equivalent, as approved by the Architect or Engineer-in-charge. It shall comply to the relevant IS Codes.

67F.2 It shall keep the plastering mortar plastic for a longer time, giving higher strength on prolonged curing. It shall provide cohesiveness, workability and eliminate efflorescence. It shall reduce shrinkage, cracking and crazing to the minimum.

M-68 Asbestos Septic Tank :

68.1 It shall be from Everest or equivalent, as approved by the Architect and Engineer-in-charge. It shall be of required size as shown in detailed drawing or as per specified in the item. It shall be of single piece in width and length but if required to match the specified size in depth, not more than four compartments shall be allowed (which includes top and bottom pieces and extension pieces). It shall be made from finest raw materials.

68.2 It shall be free from any joints in side walls, bottom piece, top cover and baffle walls. It shall be of two compartments separated by a baffle wall in a horizontal section. No leakage should be there from joints between pieces, depth wise. The side walls shall be capable of withstanding the earth pressure and the top cover shall be designed to carry the traffic load and surface covering load.

68.3 It shall be air tight and designed to disintegrate the sewage by bacterial action in absence of oxygen gas. It shall contain two inlets (one for regular connection and other for alternative connection) and one outlet. The inlet shall be of 100 mm. dia. and the outlet shall be of 75 mm. dia. All such connection shall be leakproof. Rejected materials shall not be used.

M-69 Asbestos Cement Building Boards:

69.1 Asbestos Cement boards shall be from Everest or equivalent, as approved by the Architect and Engineer-in-charge. It shall be made from blend of high quality asbestos mineral fibre and cement. It shall conform to IS : 2098, amended 1981.

69.2 It shall be light weight, easily workable using ordinary carpentry tools and it shall be strong enough, so as not to be broken or chipped during handling. It shall be durable, flexible, free from rot, rust and shall be termite proof, impervious to weather. It shall not sag, wrap, swell or crack and also satisfy the fireproof requirements. The thermal conductivity value `k' shall be @ 0.214 kcal/hr.m^{0}C. It shall have adequate properties of acoustics, having absorption co-efficient between 0.01 to 0.14 and noise resistance co-

efficient @ 0.03.

69.3 It shall be easily jointed using open or butt joint. Its surface shall be easily painted. It shall be of uniform thickness, as specified in detailed drawings or as approved by the Architect.

M-70 Expanded Polystyrene :

70.1 The Expanded Polystyrene shall be from Thermocole, Cooline or equivalent, as approved by the Architect and Engineer-in-charge.

70.2 It shall be processed from styropor expandable polystyrene beads. It shall have lower thermal conductivity, excellent shock absorption, better mechanical strength and high resistance to the moisture. It shall possess good acoustic properties, snow white appearance, and lightness. It shall easily be cut to any shape, size and can be fixed by any mechanical means or adhesives. It shall be painted easily.

70.3 It shall have high, dynamic load bearing capacity, excellent resistance to water vapour. The density of Polystyrene shall be 20-25 kg/m^3., having thermal conductivity value 0.025 Kcal/hr m^{O}C. The service temperature range shall be -150°C to +80°C. When soaked in water for 7 days, it shall not absorb water more than 2% by volume. The co-efficient of resistance to water vapour diffusion shall be 40 to 100.

70.4 The compressive strength at 10% deformation and cross breaking strength shall not be less than 1.0 kg/cm$^{2.}$ and 1.6 kg/cm$^{2.,}$ respectively. It shall have resistance to soaps, bleaching agents, dilute acids, alkalies, silicone oil, fresh & sea water, alcohol, liquid paraffin, petroleum jelly etc.

M-71 Phenotherm :

71.1 Phenotherm shall be from Bakelite Hylam or equivalent, as approved by the Architect and Engineer-in-charge. It shall conform to BS : 4370 and BS : 3927, wherever applicable.

71.2 It shall have superior fire resistance and thermal conductivity. There shall be no deterioration of K value on ageing, no emission of toxic fumes in an event of fire. It shall have good adhesion to facings and there shall be no shrinkage. It shall conform to the highest fire rating, Class `I' for surface spread of flame, Class `P' for ignitability and Class `O' for building regulations.

71.3 It shall not be flammable and shall retain its shape, during and after fire. It shall generate negligible smoke, so the obscuration shall remain less than 5% and shall emit non-toxic fumes during fire. It shall have K value less than 0.016 Kcal/hr m^{O}C and the working range of temperature shall be -196°C to +130°C. It shall easily be used on LSHS, fuel oil, low pressure steam and hot water lines for containers.

71.4 It shall have the closed cell content not less than 90% to result in very low water absorption, very low water vapour transmission and reduce condensation. It shall be unaffected by most aromatic and aliphatic solvents. It shall be odourless, non-colour absorbent. It shall not attract rodents/insects, resist fungal and bacterial growth, most organic solvents and chemicals. It shall be anti-corrosive, non-abrasive and hydrophobic. It shall possess good acoustical properties and electrical insulation. The density of the Phenotherm shall be 40-50 kg/m^3.

M-72 Ex-foliated Vermiculite :

72.1 The Vermiculite shall be from Bharat Heat Insulating & Refractory Industries or equivalent, as approved by the Architect and Engineer-in-charge.

72.2 It shall be hydrated laminar natural mineral having, Aluminium-Iron, Magnesium Silicates as content and shall consist of thin flat flakes, containing innumerable microscopic voids and layers. It shall have physical properties like chemical inertness, light weight, fire and rot proofness, porosity, non-abrasive nature, flakiness etc.

72.3 It shall have sintering temperature and melting point about 2300°F and 2400°F, respectively. The specific heat and specific gravity of minerals shall be 0.2 and 2.6, respectively. The mineral should possess pH

value of 7.0 and cation exchange rate 90 to 100 milli equivalent per 100 grams. The thermal conductivity K shall be 0.43-0.45 Btu.

72.4 The mineral should be incombustible and capable to withstand temperature upto 1100°C to give effective insulation. It shall be insoluble and inert to organic solvents having cold crushing strength atleast 250 Psi. The air contraction at maximum service temperature shall be less than 1%.

M-73 Cement Concrete Hollow Blocks :

73.1 Hollow concrete blocks shall be of size such that they can be bonded with brick masonry, if necessary. The blocks are generally referred by their nominal sizes which include the block and an allowance for joints. The nominal sizes are
a) 39 x 30 x 19 cm.
b) 39 x 20 x 19 cm.
c) 39 x 10 x 19 cm.
The block shall have one or more large holes or cavities which either pass through the block or do not effectively pass through (in case of closed cavity) and shall have the total solid material between 50 to 75% of the total volume of the block, calculated from the overall dimensions. In case of solid blocks, the solid material shall not be less than 75% of the total volume of the block.

73.2 The shell thickness of the blocks shall be not less than 65 mm., in any part, however based on the strength requirements, the thickness can be varied between 20 mm. to 50 mm., as follows :

Nominal block face width.	Shell thickness minimum.	Web thickness minimum.
100 or less	25	25
Over 100 to 150	25	25
Over 150 to 200	30	25
Over 200	35	30

All the above dimensions are in mm.

73.3 The volume of concrete shall not be less than half the gross volume of the block. The total width of the cavities shall not be less than 2/3rd of the overall thickness of the block. The maximum variation in the length of the blocks shall not be more than $\pm$ 5 mm. and maximum variation in height and width shall not be more than $\pm$ 3 mm.

73.3 Hollow blocks are manufactured by special machines. Casting is done in a single operation. Concrete shall be thoroughly compacted in the moulds with blunt end steel rods or vibrators or by using vibrating tables. Ordinary concrete mix 1:2:4 of very low water/cement ratio is used and shall be mixed as described in the section no. 2.00 of plain and reinforced concrete. Additives or admixtures shall be used such as a) Accelerating, water-reducing and air-entraining admixtures, b) Water-proofing agents, etc. High compressive strength and very dry consistency enables to remove the blocks for curing, immediately after casting. In case of manual compaction, the mixture shall be placed into the mould, in layers of about 50 to 75 mm. and each layer is thoroughly tamped until the whole mould is filled up and struck off level with a trowel. In case of mechanical compaction, the mould shall be filled up to overflow, vibrated or mechanically tamped and struck off level. Steel wire may be embedded in each block while casting. Rapid hardening cement may be used. After demoulding, the blocks shall be protected untill they are sufficiently hardened to permit handling without damage. The blocks shall be thoroughly cured for atleast 14 days and shall be dried out for a period of 4 weeks, before placing. They shall be stacked with voids horizontal to facilitate thorough passage of air. The blocks shall be allowed to complete their initial shrinkage before placing. Water absorption shall not be more than 10% by mass.

73.4 Hollow blocks have better thermal properties than solid blocks. Further hollow blocks made from light weight concrete have still better insulation against heat. They shall conform to the following three grades:

Grade A - They shall be used as load bearing units and shall have a min. block density of 1500 Kg/m^3. They shall possess min. average compressive strength of 35, 45, 55 and 70 Kg/cm^2. respectively, for its sub-category, at 28 days.

Grade B - They shall be used as load bearing units and shall have block density less than 1500 Kg/m^3. but not less than 1000 Kg/m^3. They shall possess min. average compressive strength of 20, 30 and 50 Kg/cm^2. respectively, for its sub-category, at 28 days.

Grade C - They shall be used as non-load bearing units and shall have block density less than 1500 Kg/m^3. but not less than 1000 Kg/m^3. They shall possess min. average compressive strength of 15 Kg/cm^2. at 28 days.

Grade D - Solid Concrete Blocks - They shall be used as load bearing units and shall have block density not less than 1800 Kg/m^3. They shall possess min. average compressive strength of 40 and 50 Kg/cm^2. respectively, for its sub-category, at 28 days.

73.5 They shall have a variety of surface textures ranging from very fine close texture to a coarse open texture, by proper selection, grading and proportioning of the aggregates. Further the texture shall be developed by treating the surface while the units are still green. Colour shall be rendered by adding non-fading mineral pigments.

73.6 Well made units shall not require plaster, in case of unimportant buildings. Two or three coats of cement paint shall be sufficient to render the masonry resistant to rain water. However, if plaster is intended, the unit shall have a sufficiently rough surface to afford good key to the plaster. Water-proofing admixtures shall be used in the plaster.

M-74 Silicone paint :

74.1 It shall be of the best quality, like Hydroseal - Siliconate Epoxy or equivalent, as approved by the Architect and Engineer-in-charge. It shall conform to the relevant IS Codes.

74.2 It shall be prepared by mixing Silicone and Epoxy. It shall be applied on dry as well as damp surfaces. It shall be non-toxic and odourless, so shall be suitable for drinking water structures also. It shall render the surface impervious to water and shall prevent water penetration. It itself shall penetrate into the structure and shall form a strong film on the pores of the structure surface, making the surface water-tight, non-toxic and erosion free.

74.3 It shall be water thinnable. Before use, the hardener of the Siliconate Epoxy shall be mixed with resin and thinned with water, in the proportions described by the manufacturer. It shall be applied with a suitable spray gun with a fine nozzle. An overlap of 25 to 30 cm. shall be preferred. It shall be semitransparent but on drying it shall become transparent.

M-75 Curved Corrugated Asbestos Cement Sheets :

75.1 It shall be of the best quality such as Everest or equivalent, as approved by the Architect and Engineer-in-charge. It shall conform to the relevant IS specifications.

75.2 It shall be available in nominal thickness of 6 mm. with an overall width of 1050 mm. and laid width of 876 mm. It shall be available in standard lengths of 2743 mm. and 3048 mm. It shall have a nominal radius of 2743 mm.

75.3 It shall provide an arch roofing system of which the semi-circular arch shall be the most stable. It shall provide a self-supporting roof construction and shall be used for wide varieties of structures for agricultural, industrial and domestic uses, garages and for temporary site offices and for storage of implements. It shall be easily erected without any need of expertise and as temporary sheds without any foundation requirements.

M-76 Red Mud Plastic (RMP) Sheet :

76.1 RMP sheet shall be of Regal, Elephant, Rita or equivalent, as approved by the Architect and Engineer-in-charge.

76.2 It shall not be hazardous to health. It shall have minimum thickness of 1.0 mm. and minimum tensile strength of 400 kg/cm^2. It shall have high impact strength and it shall not be easily breakable.

76.3 The roofing sheets shall withstand the effects of sun, wind, rain, snow, large temperature variations without any loss of smoothness and lustre. It shall be smoothly & attractively finished and opaque in nature. It should be extremely flexible, so as to be bent at any angle without cracking, stretching or becoming soft.

76.4 It shall be durable, free from any cracks and vermite & termite proof. It shall be very light in weight, @ 2.5 kg/m^2. It shall be easily handled and installed. It shall not break during cutting or drilling.

76.5 The roofing sheet shall have good thermal insulation and shall be resistant to heat, acid and alkali. It shall be of uniform colour, as approved by the Architect.

M-77 Polyethylene Sheets :

77.1 Polyethylene sheet shall be from Profeel, Ramplast or equivalent, as approved by the Architect and Engineer-in-charge.

77.2 It shall be produced by using a continuous, smooth chemical process, at constant pressure and temperature. The Polyethylene sheets should be light weight, soft, smooth and flexible, which can be easily handled and laid. It shall be 100% water proof, acid proof, alkali proof, fire resistant and fully opaque.

77.3 It shall be resistant to fungus, moth, toxic gases and agents having affinity to water. It shall have excellent bonding strength and thermal conductivity shall be 0.023 kcal/m hr^{O}C. It shall conform to IS : 5913 and IS : 3792, wherever applicable. It shall prevent corrosion, chemical action, leakage, seepage, pollution.

M-78 Aluminium Corrugated Building Sheets :

78.1 It shall be of the best quality and from reputed manufacturer like Indal or equivalent, as approved by the Architect and Engineer-in-charge. It shall conform to IS : 1254, in all respects. The aluminium alloys used in the manufacture of the sheets shall conform to IS : 737.

78.2 The sheets shall be light in weight, having a density of about 2.70 gms/cm^3. Due to the formation of a thin transparent hard film of inert aluminium oxide, on the surface of the sheet, it shall possess high corrosion resistance. The sheets shall be non-fragile and shall be exceptionally durable. As aluminium reflects a high proportion of the radiant heat, the sheets provide excellent insulation when used for cladding/roofing. The sheets shall be non-combustible, non-flammable and non-sparking. As aluminium is elastic, the sheets shall offer high resistance to denting and shall be shatter-proof. Co-efficient of linear expansion of aluminium is 0.000024 per ^{o}C and therefore the lateral expansion of the sheets shall be readily accommodated in the corrugations. The sheets shall offer no health hazard and shall be totally hygienic.

78.3 It shall be available in trapezoidal and rounded corrugations and shall be extensively used for various Industrial buildings, Warehouses, Aircraft hangers, Power plants, Storage sheds, Bunk houses etc. It shall be innovatively used as interior partitions, wall panels, flase ceiling etc.

M-79 Fibreglass Translucent Roofing :

79.1 It shall be of the best quality such as Glass poll or equivalent, as approved by the Architect and Engineer-in-charge. It shall conform to BSS : 4154.

79.2 It shall be a combination of glass fibre mat and polyester resin, suitably modified to resist ultraviolet degradation. It shall disperse light rays, allowing uniform diffused light penetration. It shall absorb the heat

rays and so helps to save electricity. It shall be available in (1) Clear grade - where light transmission shall be 87% to 90%. and (2) Natural white/green/blue/yellow/red - where light transmission shall be 60% to 70%. It shall be available in lengths of 1.5 m. to 3 m. The width shall be equivalent to that of asbestos/galvanised and aluminium corrugated sheets. It shall have a thickness of 1.2 mm., with a tolerance of $\pm$ 0.2 mm.

79.3 It shall have a coefficient of linear expansion of .000012 per ^{o}C. Its heat distortation temperature shall be approximately 75□C. It shall have thermal conductivity of 0.22 Kcal/mh^{O}C. It shall have an impact strength of 14.5 Ft, hardness of 40 - 50 Barcol and Brinell 26. It shall have a tensile strength of 600 - 800 Kg/cm$^{2.}$ and compressive strength of 1200 - 1400 Kg/cm^{2}. On soaking for 24 hrs., at 25°C, its water absorption shall be 0.24%. It shall have effective resistance to most chemicals except strong acids.

79.4 It shall be suitably used for industrial and residential roof coverings, where light transmission is desired. It shall also be used to cover swimming pools, gardens and terraces, if desired. It shall be normally self cleaning type but when used in industrial areas, it shall be cleaned with water and soap.

M-80 Poly-carbonate Sheet :

80.1 Polycarbonate sheets for versatile glazing shall of the best quality such as Lexan or equivalent, as approved by the Architect and Engineer-in-charge. It shall meet all the requirements of BS : 6262. For impact performance, it shall meet the BS : 6206 requirements and for anti-bandit requirements, it shall conform to BS : 5544.

80.2 It shall be as transparent as glass, but shall have half its weight. It shall be tough and yet flexible. It shall have strong impact strength and shall offer thermal and sound insulation. It shall resist the effects of weather, shall be unbreakable and shall provide protection against forced intrusion. It shall be used for roof glazing, door and window glazing as well as privacy glazing, on many different types of buildings. As light weight, it shall be feasible to use it on wider spans. It promotes natural light and shall impart an impression of spaciousness.

80.3 It shall have tensile strength greater than 70 N/mm^{2}. Its flexural modulus shall be 2500 N/mm$^{2.}$ and flexural yield strength shall be 100 N/mm^{2}. It shall have an impact strength (falling dart) greater than 200 Nm. It shall have an indentation hardness - H358 10 of 98 N/mm^{2}. and H358 60 of 93 N/mm^{2}. Its coefficient of linear expansion shall be 0.00067 per ^{o}C and thermal conductivity shall be 0.21 W/m.K. It shall have a specific gravity of 1.2 gm/cc. and water absorption @ 24 hrs. 23°C shall be 10 mg. Its elongation at break shall be greater than 100%. It shall have a higher coefficient of thermal expansion. It shall allow light transmission of between 82% and 90%, depending on the thickness of the sheet. It shall not transmit UV radiation upto 385 Nm. It shall resist the effect of chemicals. It shall have self-extinguishing, low flame spread characteristics and low fire propagation indices.

M-81 Bullet Resistant Laminate :

81.1 It shall be of the best quality such as Lexgard or equivalent, as approved by the Architect and Engineer-in-charge.

81.2 It shall be polycarbonate sheet, laminated together using a patented general electric interlayer film with a mar-resistant finish. It shall be bullet-resistant, shall not spall, splinter or crack and shall have a long lasting glazing for surface appearance. It shall be 60% less in weight compared to bullet-proof glass. It shall have a K-value of 3.06 W/m^{2}K for thermal insulation and allow light transmission of 63%, when 33 mm. thick.

81.3 It shall be suitably used in Banks, Police stations, Cash counter etc., wherever there is a risk of deliberate attack.

M-82 Polyester Films :

82.1 It shall of the best quality such as Sun Control Garware or equivalent, as approved by the Architect and Engineer-in-charge. It shall conform to the relevant IS specifications.

82.1 It shall reject about 75% of the total solar energy. It shall reduce 97% of the harmful UV radiation. It shall eliminate 80% of the sun glare. It shall make the glass surface shatter resistant when bonded on to glass. It shall be free from all fire hazards. It shall be available in various reflective shades.

M-83 High Molecular Plastic Film :

83.1 The film shall be from Om Agro Industrial Plastics Pvt. Ltd. or equivalent, as approved by the Architect and Engineer-in-charge. It shall conform to relevant IS Code.

83.2 It shall be fully impervious to provide a complete water barrier system. The tensile strength of the film shall not be less than 450 kg/cm^2. The tear resistance of the film shall not be less than 3200 g/100/micron having 650% ultimate elongation. The impact tensile strength and temperature resistance shall not be less than 2000 kg/cm^2. and 90°C respectively.

83.3 The film shall be flexible having uniform thickness as specified in the respective item. It shall have long life in buried condition. Saline or mineral water and alkali content in soil or cement or most of the chemicals shall have no effect on the film. The film shall discourage weed growth under the lining.

M-84 Gypboard :

84.1 It shall be of the best quality from India Gypsum or equivalent, as approved by the Architect and Engineer-in-charge.

84.2 It shall be formed by enclosing and bonding together a core of set gypsum plaster by two sheets of heavy paper. It shall offer high standard of safety, thermal efficiency and aesthetics. It shall be light in weight, shall offer good fire resistance and shall render faster construction. It shall be suitably used in areas subjected to continuously damp or wet conditions, except bathrooms, where gypboard partitions shall be properly protected by tiles or other impervious materials. It shall be a non-resonant material, rendering sound insulation. It shall be strong, durable and dimensionally stable. It shall offer a smooth surface which can be painted, tiled or wall papered. It shall block the passage of heat and shall retard the spread of fire. It shall hide upto 60 db of sound, when erected in the proper manner.

M-85 Ceiling Tiles :

85.1 It shall be of the best quality, such as Gypboard, Sitatex or equivalent, as approved by the Architect and Engineer-in-charge. It shall adequately follow the IS : 3129.

85.2 They shall be made either from gypboard or from sugarcane fibres, as specified in the item.

85.3 They shall be resistant to fire, termites, fungus, woodboring, insects and other wood deteriorators. They shall be resistant to delamination due to moisture and cyclic changes in weather and humidity. They shall have high structural strength, good thermal insulation properties, thermal conductivity at mean temperature shall be 4.2 K.cal/cm./m^2./hr./^{O}C and good fire retardant properties. It shall have a density of 288 Kg/m^3. $\pm$ 10% and shall weigh 3.71 Kg/m^2. Whenever, P.F resin shall be used in bonding, good weather and boiling-water proof properties shall be rendered under ISS and BSS specifications. They shall favourably absorb sound, rendering good acoustic properties.

85.4 They shall be available in ready-to-fix, ready-cut standard sizes of 610 mm. x 610 mm. x 12 mm., in various design and plain tiles shall be available in sizes, 2440 mm. x 1220 mm. x 12 mm., 1220 mm. x 1220 mm. x 12 mm., 1220 mm. x 610 mm. x 12 mm. and 610 mm. x 610 mm. x 12 mm. They shall be suitably used in residences, public places, bank buildings, studios, showrooms, computer centres, telecommunication buildings etc.

M-86 Permagard :

86.1 Permagard shall be from India Foils Ltd. or equivalent, as approved by the Architect and Engineer-in-charge.

86.2 It shall be made by laminating aluminium foil/strip with polyethylene film on both sides. It shall be a continuous sheet of metal having overlapped and sealed edges, which shall be sealed using a heat sealer or hot molten bitumen. It shall resist the action of water, moisture, salts, chemicals, oxidation and corrosion. It shall be 100% water proof.

86.3 No joints shall be allowed in sheets brought to site. However, the joints required at site shall be sealed using either hot molten bitumen or Teflon coated heat sealer, making an air tight bond, which is totally impervious to water and moisture. The thickness of permagard shall be 0.26 mm. $\pm$ 0.03 mm. The weight shall not be less than 0.54 kg/m^2. It shall have excellent abrasion power.

M-87 Thermolay :

87.1 It shall be from STP Ltd. or equivalent, as approved by the Architect and Engineer-in-charge.

87.2 It shall comprise of modified bitumen impregnated reinforcement fabric, sandwiched between coats of polymer modified bitumen, with the underside covered with thermofusible polythylene film and the topside finished with coarse sand. It shall be available in continuous roll, length 10 m. and width 1 m. The thickness of the membrane shall be 4 mm.

87.3 It shall have a tensile strength of 150 Kg. min. (longitudinal) and 100 Kg. min. (traverse). It shall have good heat resistance and flexibility. It shall be able to take up thermal and structural stresses, without fatigue. It shall offer high resistance to puncture and indentation load. Net weight per roll shall be 50 Kg. It shall act as a water-tight and vapour barrier system, when laid.

M-88 Sliding Door Tracks/Channel :

88.1 It shall be from Agend, Coburn System or equivalent, as approved by the Architect and Engineer-in-charge.

88.2 It shall be made with highest quality precision engineering to give the ultimate in smooth, frictionless action and to move the doors silently, at the touch of a finger. It shall carry a load upto 100 lbs., to ensure life time trouble free operation from all components. It shall be in three classifications :
Straight sliding :
When a clear wall space equivalent to the area of one leaf should be available to the right of the opening either inside or outside the opening.

Sliding and Folding, end hung :
Where clearance is restricted, such arrangement is recommended. It shall provide maximum possible free space when folded to the open position.

Sliding and Folding, center hung :
It shall be provided where there is restriction of space. It shall provide smooth running action and unobtrusiveness of fittings. It shall enable the leaves to fit closely between the jambs of the opening.

88.3 All these sliding gears are top hanging with bottom guides. All movements shall be on ball bearing so that friction is reduced to minimum.

Track : It shall be made from sturdy steel with protective zinc coating. The shape of the track shall ensure true, smooth running and prevents door from jumping off. It shall be adjusted horizontally to compensate for minor irregularities in floor level.

Roller Hangers : It shall be made from 16 gauge zinc plated steel, housing containing tough Nylon rollers with exclusive differential movement. No lubrication shall be required. The hanger platter fitted to the top of the doors shall have lateral adjustment feature, to compensate for minor irregularities in surface by positioning the door at slightly varying distances from wall.

End Stops : It shall be made from sturdy zinc plated steel angle, shaped to ensure positive stopping action

and prevent door in conjunction with rubber buffers or hangers.

Floor guide : It shall be manufactured from tough nylon, shaped, to allow smooth movement of grooved doors or non-grooved doors.

M-89 Sand Stone Grills/Baluster :

89.1 It shall be from Dilpasand Shilp or equivalent, as approved by the Architect and Engineer-in-charge.

89.2 It shall be made from best quality Bansipahadpur/Sandstone, having uniform colour (no other colour spot shall be allowed) and texture. The sand stone shall be even, sound, durable and free from any veins, cracks and flaws. The thickness of the stone used shall be as specified in item of work, with the permissible tolerance of 2 mm.

89.3 The grills/Baluster shall be produced by fine chiselling. All edges, faces and angles of fine hand chiselled grills, columns, baluster shall be machine polished, as specified in item.

M-90 Anti-Corrosive Paints :

M-90A Ferroshield :

90A.1 It shall be from STP Limited or equivalent, as approved by the Architect and Engineer-in-charge.

90A.2 It shall be a high build bituminous emulsion, specially formulated for protection against corrosion. It shall form a dry film, 2 mm. thick, which shall not crack at low temperatures nor crocodile at very high temperatures. It shall also be used as waterproofing material on flat, sloped and steeped roofs. It shall be applied by brush and by heavy duty airless spraying.

M-90B Tankmastic :

90B.1 It shall be from STP Limited or equivalent, as approved by the Architect and Engineer-in-charge. It shall conform to IS : 158-1982 and IS : 9862.

90.2.2 It shall be special bituminous paint, which shall have no harmful reaction on drinking water. It shall be used to protect the inside of water tanks and pipe connections, against corrosion. It shall be applicable on steel, wood, concrete, iron etc. It shall have a covering capacity of 12 m^2/lit..

M-90C Pipekote :

90C.1 It shall be from STP Limited or equivalent, as approved by the Architect and Engineer-in-charge. It shall conform to IS : 158.

90C.2 It shall be a heavy duty bituminous paint, which shall not impart any odour or taste to water, carried in the steel water pipelines, tanks and pen-stocks. It shall be applied on the inside surface of the water pipeline, tanks and pen-stocks. It shall be resistant to mild acids, alkalis and shall withstand heat upto $150^{O}C$. It shall render a heavy body protective film. If zinc-rich, epoxy primer shall be used, better results of pipekote shall be obtained.

M-90D Silvershield :

90D.1 It shall be from STP Limited or equivalent, as approved by the Architect and Engineer-in-charge.

90D.2 It shall be a bituminous aluminium-finish paint formulated for application over anti-corrosive paints. It shall have a covering capacity of 10 m^2/lit..

M-90E Shalimastic HD :

90E.1 It shall be from STP Limited or equivalent, as approved by the Architect and Engineer-in-charge. It shall comply with the US Dept. of interior bureau of reclamation specification CA-50.

90E.2 It shall be a viscous, heavy-duty, anti-corrosive waterproof coal tar paint. It shall offer resistance to acids and alkalis. It shall be used for protection of all types of iron and steel structures.

M-91 Powder Paints :

91.1 Powder paints shall of superior quality such as Hawcoplast of Hardcastle & Waud Mfg. Co. Ltd. or equivalent, as approved by the Architect and Engineer-in-charge. It shall conform to the relevant IS specifications.

91.2 It shall be available in the following types :
Epoxy :
It shall be tough and resistant to chemicals. However, it shall have poor exterior durability.
Epoxy polyester :
It shall provide a decorative finish and shall have better overbake resistance.
Polyester - TGIC :
It shall provide exterior durability but it shall form a slightly thicker film.
Polyurethane :
It shall provide exterior durability and shall form a thin film coating.

M-92 MDF (Medium Density Fibre) Wood :

92.1 The MDF wood shall be from Nuwud or equivalent, as approved by the Architect and Engineer-in-charge and shall conform to IS : 12406.

92.2 MDF wood shall be manufactured from wood fibres and synthetic resin binder to produce homogenous sheet material, having minimum density about 600 to 900 kg/m^3. It shall have moisture content less than 8% and water absorption less than 12% at 24 hours soaking. It shall have modulus of rupture and tensile strength atleast 50 N/mm$^{2.}$ and 0.8 N/mm$^{2.}$, respectively.

92.3 The screw withdrawal strength shall be minimum 3000 N. for face and 1800 N. for edge. It should be highly resistant against termite, insects and it should possess good heat and sound insulation. It should be easily workable for moulding, carpentry, routing etc. It should be free from any cracks, wraps, splits etc. and should possess uniform strength in all direction.

M-93 Polyurethene Foam Insulation :

93.1 Polyurethane foam shall be from SDC, FGP, Excilite, VCM or equivalent, as approved by the Architect and Engineer-in-charge. It shall conform to the relevant IS Code.

93.2 It shall have high strength to weight ratio alongwith excellent thermal insulation and acoustic absorption. It shall be based on the exothermic, catalytic reaction of polyisocynates with polyol molecules containing hydroxyl groups in the presence of blowing agent. It shall be perfectly homogenous and having uniform characteristics like perfect adhesion to metal surfaces, higher insulation capacity, maximum resistance and lightness. It shall be perfect non-hygroscopic, completely water proof having dimensional stability, optimum thermal insulation, fire retardancy.

93.3 It shall be of low foam density, not more than 40 Kg/m^3. The thermal conductivity shall be 0.02 Kcal/m hr□C. The compressive strength shall not be less than 2.5 Kg/cm$^{2.}$ and 1.2 Kg/cm$^{2.}$, in direction parallel to rise and perpendicular to rise respectively. The close cell content of the foam shall be 90 to 95% and it shall be workable within the temperature range of -150°C to +80°C. The water vapour permeability shall be 2.0 perms/in.

M-94 Fiberglas Reinforced Plastics (FRP):

94.1 Fiberglas Reinforced Plastic shall be from CEAT or equivalent, as approved by the Architect and Engineer-in-charge. It shall conform to relevant IS Code.

94.2 It shall be either unidirectional reinforced or sheet moulded or filament wound epoxy to match the purpose of work and item of tender. It shall have versatile chemical inertness, electrical resistance and mechanical strength, ease of processibility, repeatability and predictability. It shall have desirable characteristics like light weight, high strength, stiffness, toughness, thermal insulation properties, superior weather resistance,

complete elasticity, fatigue, creep, resistance to corrosion, rot, swelling, insects, fungus etc.

94.4 There shall be no yield point beyond which buckling or denting of the FRP occurs, to reduce the possibility of irritating damages for minor stresses or impacts. The density, flexural strength and flexural modules shall not be less than 1.5 mg/m^3., 1000 MPa and $40x10^3$ MPa, respectively. It shall have minimum tensile strength, tensile modulus and compressive strength of 1000 MPa, $40x10^3$ MPa and 250 MPa, respectively. The FRP shall have thermal conductivity about 0.2 w/m^OC. Thermal coefficient of expansion shall be less than $10x10^{-6}$ per ^OK.

94.5 The minimum glass content shall be 60%. The weight index for stiffness and tensile strength at yield shall not be less than 0.6 and 0.9 respectively. No damage should be there while testing at impact energy of 8 joules. The level of translucency should be greater than 80% of diffused transmission that of direct light. It shall provide superior aesthetic value with incorporated colour. It shall be good fire retardant, durable and impermeable to water.

M-29A (Amendment in material specification M-29 as per building specification)

Teak wood

29A.1 The teak shall be first quality as per **M29.5.** equivalent to best quality Ghana teak.

29A.2 All teak shall be used only after KILN seasoning.

29A.3 The teak wood shall be applied with linseed oil without any colour pigment or powder.

29A.4 Use of white teak wood shall not be permitted in any case.

29A.5 The colour of the teak wood shall be uniform as far as possible with no white grains.

M 35(A) Stainless steel wire mesh

35A.1 Stainless steel wire mesh shall be for general purpose mosquito net gauge 26x14 mesh of Stainless Steel.

M-37A Water Proof (Weather Proof) Plywood :

37A.1 The plywood shall be from Kitply, Anchor Gold or equivalent, as approved by the Architect and Engineer-in-charge. It shall conform to IS : 710-1976 and to the relevant Defence and Navy specifications.

37A.2 Plywood shall be made from veneers of hard wood timbers and bonded with high quality BWP type Phenol Formaldehyde Synthetic Resin Adhesive and hot pressed at high temperature and pressure, and further treated with a fixed type of preservative by vacuum-cum-pressure impregnation, to produce thin boards or sheets of wood panels. There are always an odd number of layers. The plies shall be placed, so that, grain of each layer is at right angles to the grain in the adjacent layer.

37A.3 Plywood shall be waterproof, weather proof, boilproof, highly durable even against strenuous vulnerable uses. It shall resist the attack of termites, cockroaches, wood burrowers, fungus, mould, rot, decay and other wood destroying insects and marine organisms.

37A.4 The tensile strength of the plywood shall be minimum 600 $kg/cm^{2.}$ and bending strength above 400 kg/cm^2. The swelling of plywood in water should be almost negligible. Specific gravity of plywood should be 0.7 to 0.75, having screw and nail holding strength normal to face, atleast 250 kg. and 60 kg., respectively.

37A.5 The moisture content shall be less than 10% and the plywood shall have high fire resistance and shall be free from any cracks, wraps, split etc., and shall have uniform strength all over the panel surface. It shall be used for marine structures, leather tanning tables, wall panelling, underlayment for kitchen and other furniture, subjected to heat and moisture.

M 45(A) Linseed oil

45A.1 The linseed oil shall be double boiled CAT brand only.

45A.2 No color pigment or powder shall be added.

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Item Specifications
for
Civil Works

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1.01 Excavation for foundation in loose or soft soil upto 1.5 m. depth including sorting out and stacking of useful materials and disposing of the excavated stuff upto any lead with in campus.

1.0 General

1.1 CPWD specifications clause no. 2.0, 2.1, 2.2, 2.3 shall be followed.

2.0 Site Clearance

2.1 CPWD specifications clause no. 2.4 shall be followed except nothing extra will be paid for removing, diverting existing structures and services and providing fencing for the any archeological monuments within or adjacent to the area.

3.0 Setting out and making profiles

3.1 CPWD specifications clause no. 2.5 shall be followed.

4.0 Excavation

4.1 CPWD specifications clause no. 2.7, 2.9 shall be followed up to any width (not restricted to 1.5m) and any area (not restricted to 10 sqm) on plan.

4.2 The Contractor shall do the necessary shoring and strutting or shall provide necessary slopes to a safe angle or steps as required or directed at his own cost. No extra payment shall be made for such precautionary measures taken by contractor.

4.3 The Contractor shall at his own expense and without extra charge make provision of supporting all utility services, lighting the trenches, separating and stacking serviceable materials neatly, shoring, timbering, strutting, bailing out water either sub-soil or rainwater, including pumping at any stage of the work. Trenches shall be kept free of water while masonry or concrete works are in progress and till the Architect and Engineer-in-charge considers it necessary, i.e. till the concrete is sufficiently set.

5.0 Back filling:

CPWD specifications clause no 2.10 shall be follows for back filling of trenches.

6.0 Disposal of the excavated stuff

6.1 The excavated stuff of the selected type shall be used in filling the trenches and plinth or leveling the ground in layers, including ramming and watering etc. complete as directed by the engineer-in-charge.

6.2 The Contractor has to dispose the surplus excavated earth within the plot at non objectionable place.

6.3 The lead is the shortest practical route and not necessarily the route actually taken. The decision of Engineer-In charge shall be final.

7.0 Mode of Measurement and Payment

7.1 Plan area of base PCC as per structural drawing shall be measured for payment (unless otherwise specified). Contractor shall quote the rate for excavation with additional quantity for surrounding working space (which shall not be paid).

7.2 The rate shall also include necessary shoring & strutting, dewatering, getting out the excavated soil, sorting and stacking of useful material, dressing of the sides, ramming of bottom, and disposal of surplus excavated earth at non objectionable place within the site.

1.02 Filling available excavated earth [excluding rock] in trenches, plinth sides of foundations etc. in layers not exceeding 20cms in depth consolidating each deposited layer by ramminag and watering.

1.0 Workmanship:

1.1 The earth to be used for filling shall be free from salts, organic or other foreign matter. All clods of earth shall be broken to a size not bigger than 50 mm.

1.2 As soon as the work in foundation has been completed and measured, the sides of foundation shall be cleared of all debris, brick bats, mortar dropping etc. and filled with earth in layers not exceeding 15 cm. Each layer shall be adequately watered, rammed well and consolidated before the succeeding layer is laid. The earth shall be rammed with mechanical rammer of different capacity as per site condition.

1.3 The plinth shall be similarly filled with earth in layers not exceeding 15 cm., adequately watered and consolidated by ramming with iron rammers/ mechanical rollers. When filling reaches finished level, the surface shall be flooded with water for atleast 24 hours and allowed to dry and then rammed and consolidated.

1.4 The finished level of filling shall be kept to shape and gradient, intended to receive any floor finish.

1.5 In case of large heavy duty flooring like factory flooring, the consolidation may be done by power rollers, where so specified or as directed. The extent of consolidation required shall also be as specified or as directed.

1.6 The excavated stuff of the selected type only shall be allowed to be used for filling the trenches and plinths. Under no circumstances, black cotton soil shall be used for filling the plinths.

1.7 The soil used for backfilling shall have optimum moisture content (OMC).

1.8 The compaction shall be carried out to achieve Proctor density of 95%. The procedure for OMC and proctor density shall be carried out as per relevant IS codes. The samples for test shall be as per the relevant IS codes.

2.0 Mode of Measurements and Payment :

2.1 The payment shall be made for filling in plinth and sides of foundations. No deductions shall be made for shrinkage or voids, if considered as instructed above.

2.2 The rate includes the cost of mechanical compaction by compactors.

2.3 The rate shall be for an unit of one m^3.

2.4 Only consolidated measurements of the fill shall be measured and paid for under this item.

1.03 Providing and injecting Chemical emulsion for PRE - CONSTRUCTIONAL anti-termite treatment and creating a chemical barrier on the top surface of plinth filling, inside junction of wall and floor, on top of damp proof course or on masonry at level of plinth filling as per IS 6313 (Part-2)-2013 using chemical like Imidacloprid 30.5% SC (CIB approved) and proportion of dilution with water shall be as per manufacturer's specification. The emulsion shall be applied as mentioned below, all as per specification and directions of Engineer-in-charge. Plinth area in plan at GF shall only be measured and paid. A guarantee bond of 10 years shall be furnished in prescribed proforma. Rate shall be inclusive of material required for Anti Termite Treatment and labour and equipment's required for applying in any condition all etc. complete as directed by engineer in charge. (Stage of treatment may be vary as per site condition. Contractor shall be approved by Engineer in charge before execution.)

a) Treatment to soil below raft - Before laying the PCC, the compact and levelled soil shall be treated at 5 liters per sq m. OR In case of soils/sand filled above the raft, the treatment at 5 liters per sq m shall be carried out on the top surface of filled soil/sand.

b) Treatment to soil along the retaining wall - The soil retained by the walls (soil coming in contact with retaining wall) shall be treated at the rate of 7.5 liter per sq m of the vertical surface in full depth.

c) Treatment of soil along external perimeter of building - After the building is complete, the earth along the external perimeter of the building shall be rodded at intervals of 150 mm and to a depth of 300 mm. The rods should be moved backward and forward, parallel to the wall to break up the earth and emulsion poured along the wall at the rate of 7.5 liter per square meter of vertical surfaces.

d) Top surface of the plinth filling including damp proof courses at the rate of 5 liter/sqm of internal plinth area (if required)(As per IS:6313 Part II-2013). For any area without basement, treatment shall be done as per IS:6313 Part-II-2013.

e) Treatment of soil surrounding pipes, wastes and conduits - When pipes, wastes and conduits enter the soil inside the area of the foundation, soil surrounding the point of entry shall be loosened around each of such pipe, waste or conduits for a distance of 150mm and up to a depth of 75 mm before the treatment is commenced. When they enter the soil external to the foundation, they shall be similarly treatment for a distance of 300 mm, unless they stand clear of the walls of the building are about 75 mm.

f) 1 liter / linear meter along the junction of wall and floor at all stages

g) 2 litre per linear meter for expansion joints in touch with soil/sand.

Foot print area of Ground Floor of the building shall be considered for payment in sqm.

CPWD specifications – clause no. 2.28.0, 2.28.1, 2.28.2, and 2.28.3 shall be followed except using the chemical like **Imidacloprid30.5% SC** (CIB approved) and proportion of dilution with water shall be as per manufacturer's specification.

Anti-termite treatment shall be carried out as per following:
(Stages of treatment may vary as per site condition and direction of engineer in charge. Same shall be got approved from the Engineer in charge before start of execution of work.)

a) **Treatment to soil below raft** - Before laying the rubble soling and PCC, the compact and leveled soil shall be treated at 5 litres per sq m. OR In case of soils/sand filled above the raft, the treatment at 5 litres per sq m shall be carried out on the top surface of filled soil/sand.

b) Treatment **to soil along the retaining wall** - The soil retained by the walls (soil coming in contact with retaining wall) shall be treated at the rate of 7.5 liter per sq m of the vertical surface in full depth.

c) Treatment **of soil along external perimeter of building** - After the building is complete, the earth along the external perimeter of the building shall be rodded at intervals of 150 mm and to a depth of 300 mm. The rods should be moved backward and forward, parallel to the wall to break up the earth and emulsion poured along the wall at the rate of 7.5 liter per square meter of vertical surfaces.

d) Top surface of the plinth filling including damp proof courses at the rate of 5 liter/sqm of internal plinth area.

e) Treatment of soil surrounding pipes, wastes and conduits - When pipes, wastes and conduits enter the soil inside the area of the foundation, soil surrounding the point of entry shall be loosened around each of such pipe, waste or conduits for a distance of 150mm and up to a depth of 75 mm before the treatment is commenced. When they enter the soil external to the foundation, they shall be similarly treatment for a distance of 300 mm, unless they stand clear of the walls of the building are about 75 mm.

f) 1 litre / linear meter along the junction of wall and floor at all stages

1.0 The treatment against termite infection shall remain effective for a period not less than 10 years, from date of issue of the final certificate of completion of work. If at any time during this period, any defects in treatment are revealed or any evidence of infection in any part of the building or structure is noticed, the Contractor shall rectify the concerned defects within 15 days on receipt of notice from Engineer-in-charge. On Contractor's failure to do so the Engineer-in-charge may get the same rectified through any other agency at the Contractor's risk and cost, and the decision of Engineer-in-charge as to the cost payable by the Contractor for the same shall be final and binding to the Contractor.

2.0 All anti-termite treatment work shall be got executed through specialized anti-termite agency. Contractor shall get the specialized agency approved from engineer in charge prior to start of the work. Contractor shall furnish a guarantee of 10 years on stamp paper to the employer directly and the tender rate shall be inclusive of the same which is also to be signed by the specialized agency. However, sole responsibility of performance of anti-termite treatment shall be of main contractor for the entire guarantee period.

3.0 Copy of work order issued by main contractor to the specialized agency shall also be attached with guarantee bond.

4.0A guarantee bond on appropriate stamp paper shall be given by the contractor to the client in the manner form prescribed below:

FORM OF GUARANTEE BOND

"I/We .....(Contractor) hereby guarantee that work will remain unaffected and will not be in any way damaged by termite or any other germs of similar types, for a period of 10 years after completion of the work of anti-termite, as per the terms and conditions of the contract and the Contractor hereby indemnifies and agrees to save the Client from any loss and or damage that might be caused on account of termite and or other similar type of germs and hereby guarantees to make good any loss or damages suffered by the Client and further guarantees to redo the affected work without claiming any extra cost"

5.0 This guarantee shall remain in force for a period of 10 years from the completion of the work under the contract and it shall remain binding to the Contractor for period of 10 years.

6.0 50% of the cost of this item shall be retained from the running and final bills. Release of retention amount shall be made in ten parts for ten years, i.e. 5% at every year only (after one year of actual completion of work) on successful performance of the anti-termite treatment.

7.0 **Mode of measurement –**
Foot print area of Ground Floor(in sqm)of the building shall be considered for payment under this item. Rate is inclusive for all above mentioned steps/stages of anti-termite treatment with relevant detailed specifications.

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Note :
1. All concrete produced shall be with automatic concrete mixing batching plant and rates for all type of concrete shall be inclusive of the same. No site mixing shall be permitted.
2. All formwork should be rigid & water tight using best quality of ordinary shuttering ply / steel plates with supporting system of MS adjustable steel props / spans / frames for any shapes, sizes, planes including strutting, propping, bracing, staging etc., complete to give smooth & fair finish. Rate shall be inclusive of form work for RCC.

2.01 Providing and laying Plain Cement Concrete M15 - using 40 / 20mm Nominal size graded hard granite / black trap stone aggregate obtained from approved quarry) including compaction, finishing top surface to the required level curing including cost of formwork etc. complete as per specifications and directions of Engineer - in - charge. of all size and shape in foundations, plinth, sub base, wall caps/ copings of floors etc. for all civil, plumbing, electrical & infrastructure works.

1.0 Material
1.1 Water
1.1.1 Water shall conform to M-1.

1.2 Cement
1.2.1 Cement shall conform to M-3.

1.3 Coarse Sand
1.3.1 Sand shall conform to M-6.

1.4 Coarse Aggregate
1.4.1 Coarse Aggregate shall conform to M-12.

2.0 Workmanship
2.1 CPWD specifications clause no. 4.2.1 to 4.2.14 shall be followed.

2.2 General
2.2.1 Before commencing the concreting, the depth and width of the excavated foundation shall be checked as per the drawing. The bed of foundation trenches shall be cleared off of all loose materials, leveled, watered and rammed, as directed by engineer-in-charge.

2.2.2 The cost of the formwork shall be included or excluded as per the item description.

2.3 Inspection
2.3.1 Contractor shall give the Architect and Engineer-in-charge due notice before reinforcement bars are placed in position, to permit him to inspect and accept the false work and forms as to their strength, alignment and general fitness but such inspection shall not relieve the Contractor of his responsibility for the safety of men, machinery, materials and for results obtained. Immediately before concreting, all forms shall be thoroughly cleaned. Contractor shall proper access with railing for inspection of work.

2.3.2 Centering design and its erection shall be got approved from the Engineer-in-charge. Sufficient carpenter with helper shall invariably be kept present throughout the period of concreting. Movement of labour and other persons shall be totally prohibited after reinforcement is laid in position. For access to different parts, suitable mobile platforms shall be provided so that steel reinforcement in position is not disturbed. For ensuring proper cover, mortar blocks/ PVC cover of suitable size and thickness as per the drawing shall be tied to the reinforcement. Timber, kapachi or stone pieces shall not be used for this purpose. For exposed concrete members PVC blocks of grey color shall only be used.

2.3.3 All formwork shall be cleaned and made free from standing water, dust, snow or ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the Architect and Engineer-in-charge has been obtained.

2.3.4 Formwork for Exposed concrete surface (If indicated)

2.3.4.1 All vertical members for formwork shall be of steel like acroprops, H frames / cup lock system etc. Care shall be taken to set all formwork in perfect line, level (or in required camber or slope as specified) and plumb. Formwork propping shall be strong, rigid and sturdy. The formwork shall be as per pattern, design shown in drawings. Formwork shall be done accurately and precisely so as to achieve neat, clean and smooth concrete surface, in line, level and plumb. Clinks, twists, offsets, warps, riveting etc. in plates or forms shall not be allowed. Before placing concrete, forms shall be thoroughly cleaned off of all rust, dust and loose materials. Mould release agent of approved make or as per the Architect / Engineer in charge shall be applied on sheathing before placing the reinforcement steel. Also the formwork material will be of laminated plywood/best quality steel sheathing or any sort of such material, as approved by the Architect, so that all exposed concrete surfaces have uniform colour and texture. After deshuttering, all concrete surfaces shall be properly rendered with sand paper or emery stone. The sample of the exposed concrete shall be got approved by the architect or engineer in charge.

For walls and columns, the sheathing plates shall be bolted with special nuts and bolts- spring coils and PVC cone spacer. No through bolts shall be allowed for basement walls and water retaining structure for which no extra amount shall be paid for.

2.3.4.2 For all kind of exposed concrete work only one brand (to be approved by the Architect or Engineer-in-charge) of cement shall be used.

For exposed concrete element specified in the drawing, steel shuttering made out of CR MS sheet not less than 2mm thickness (14 guage) or laminated plywood not less than 12 mm with MS angle steel supporting frame work shall be used.

For other concrete shuttering material shall be as follows:

- Columns: Moulds from marine ply with wooden battens or steel plates
- Straight walls / Curved wall in plan: Marine plywood with wooden battens / Acro make or equivalent make steel plates and soldiers.
- Beam: steel plates and marine ply with battens

2.3.5 Formwork for Exposed Work

2.3.5.1 **Exposed / Ordinary fair finished formwork for walls, columns, beams of basement and water retaining structures**

For water retaining structure the shuttering plates on either side shall be bolted with tie rods made from spring coils on either side, welded with two nos. 8mm MS rods. PVC cone shall be placed on either side of the tie rod. The whole tie rod assembly along-with PVC cone shall be placed/fixed with special type of bolts on either side of the shuttering plates. Length of the tie rod along-with PVC cone shall be equal to the width / thickness of the element to be shuttered. Holes of cones shall be filled with polymer concrete or non-shrink grout of approved make and as directed by Engineer in charge.

2.3.5.1 **Exposed / Ordinary fair finished formwork For walls, columns, beams of Super structure**

For walls, columns and beams, the shuttering plates on either side shall be bolted with through tie rods made from round bars minimum 12 mm with heavy quality PVC sleeves and minimum 25 mm thick PVC cones on either side of the sleeve. The whole tie rod assembly along-with PVC cone shall be placed /fixed with through bolts on either side of the shuttering plates. Holes of cones shall be filled with rich cement mortar (1:1) and bonding agent in recommended proportion.

2.4 Sampling and testing of concrete

2.4.1 The contractor shall set up a site laboratory to carry out various tests as specified. The laboratory shall include equipments like cube testing machine, slump cone, cube moulds for concrete and mortar, mechanical balance, sieve set, flakiness testing apparatus, core cutter etc.

2.4.2 Samples from fresh concrete shall be taken as per IS : 1199 and cubes shall be made, cured and tested at 7 days or 28 days as per requirements in accordance with IS : 516. A random sampling procedure shall be adopted to ensure that each concrete batch shall have a reasonable chance of being tested i.e. the sampling should be spread over the entire period of concreting and cover all mixing units. The minimum frequency of sampling of concrete of each grade shall be in accordance with following :

Qty. of concrete in the work	No. of samples of concrete for testing at 28 day
1-5 m^3.	1
6-15 m^3.	2
16-30 m^3.	3
31-50 m^3.	4
51 and above	4 + one additional for each additional 50 m^3 or part thereof.

NOTE : Atleast 1 sample shall be taken from each shift. Three test specimens shall be made for each sample for testing at 28 days. Additional samples must be taken to determine strength at 7 or 3 days or at the time of striking the formwork, or to determine the duration of curing, or to check the testing error. The samples of concrete shall be taken on each day of the concreting as per above frequency. The number of specimens may be suitably increased as deemed necessary by the Architect and Engineer-in-charge when procedure of tests given above reveals a poor quality of concrete and in other special cases.

2.4.3 The test results of the sample shall be average of the strength of 3 specimens. The individual variation shall not be 15% of the average strength of the sample. The compressive mean strength for the group of 4 non-overlapping consecutive test results shall be as per col. 2 table 11 of IS 456:2000 and individual test results shall be as per col. 3 of table 11 of IS 456:2000.

2.5 stripping

2.5.1 The Architect and Engineer-in-charge shall be informed in advance by the Contractor of his intention to strike the formwork. While fixing the time for removal of formwork, due consideration shall be given to local conditions, character of the structure, the weather and other condition that influence the setting of concrete and of the materials used in the mix. In normal circumstances (generally where temperature are above $20^{O}C$) and where ordinary concrete is used, forms may be struck after expiry of periods specified in IS 456:2000 11.3.1 page 25 for respective item of formwork.

2.5.2 All formwork shall be removed without causing any shock or vibration as would damage the concrete. Before the soffit and struts are removed, the concrete surface shall be gradually exposed, where necessary in order to ascertain that the concrete has sufficiently hardened. Centering shall be gradually and uniformly lowered in such manner as to permit the concrete to take stress due to its own weight uniformly and gradually. Where internal metal ties are permitted, they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortar. No permanently embedded metal part shall have less than 25 mm covers to the finished concrete surface. Where it is intended to re-use the formwork, it shall be cleaned and made good to the satisfaction of the Architect and Engineer in-charge. After removal of formwork and shuttering the Engineer-in-charge shall inspect the work and satisfy by random checks that concrete produced is of good quality.

2.5.3 The number of props left under, their sizes and disposition shall be such as to be able to safely carry the full load of the slab, beam or arch as the case may be together with any live load likely to occur during curing or further construction.

2.5.4 Immediately after the removal of forms, all exposed bolts etc. passing through the cement concrete member and used for shuttering or any other purpose shall be cut inside the cement concrete member to a depth of atleast 25 mm. below the surface of the concrete and the resulting holes be filled by cement mortar. All fine mortar lines caused by form joints, all cavities produced by the removal of form ties and all other holes and depressions honeycomb spots, broken edges or corners and other defects shall be thoroughly cleaned saturated with water and carefully pointed and rendered true with mortar of cement and fine sand. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surfaces, which are pointed, shall be kept moist for a period of 24 hours. For repairing concrete members, suitable bonding agent shall be used as directed by the consultant.

2.5.5 If rock pockets/honeycombs in the opinion of Architect and Engineer-in-charge are of such an extent or character so as to effect the strength of the structure, materially or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the portion of the structure affected with no extra cost.

3.0 Mode of Measurement and Payment

3.1 CPWD specifications clause no. 4.2.15.1 to 4.2.15.5 and 4.2.15.7 shall be followed.

3.2 All structural elements like footing, slab, beam, columns, walls, lintels, chajjas, etc. shall not be classified, measured and paid separately.

3.3 The rate includes the cost of material, labour, tools and plant required for mixing, placing in position vibrating and compacting, finishing, formwork, curing and all other incidental expenses for producing concrete of specified strength, for all floors, all shapes at any height and level, and in any position, but excluding the cost of reinforcement.

3.4 The rate shall be for an unit of one cum.

2.02 Providing and laying minimum 15 cm thick cement-controlled cement concrete slab over the existing sub base with a nominal mix of 1:1:2 (1 cement:1 coarse sand: 2graded stone aggregate 20mm nominal size) for making throwing circles for Discus/Hammer/Shot put in required diameter/size incl. cost of providing expanded metal mesh of size 20*60mm and 3.64 kg per sqm as reinforcement. Centering and shuttering and cost of fixing the required throwing circle rings for discus/hammer/shot-put with necessary fixing arrangement and Rate are also inclusive of Providing and Mixing plastisizer of approval make.

The relevant specifications item no. 2.01 shall be followed.
Rate shall be for unit of number for circles made from specified concrete and as per sports manual of required size.

2.03 Providing and laying cement concrete 1:4:8 (1 cement : 4 coarse sand : 8 stone aggregates 20 mm. nominal size) and curing complete including cost of form work in foundation and plinth.

The relevant specifications item no. 2.01 shall be followed except plain cement concrete of grade 1:4:8 (1 cement : 4 coarse sand : 8 stone aggregates 20 mm. nominal size) shall be considered instead of M15 grade concrete.

2.04 Supplying, fabricating and placing / fixing in position TMT reinforcement bars FE-500D as per approved make confirming to IS-1786 reinforcement for RCC structures / items as per design including transporting steel to the work site, handling, decoiling, cutting, bending, cranking, fabricating to required shape, placing in position and tying / binding the system with GI 18 gauge wires, welding if necessary, keeping it in position during concreting by means of stays, blocks, ties, spacers, chairs, hangars, etc. for all floors / any levels / any heights complete as per drawings, specifications and direction of Engineer in Charge.

1.0 Materials : Mild steel bars shall conform to M-18. GI binding wires to M-21. High yield deform steel M-19A. TMT M19B.

2.0 Workmanship :

2.1 The work shall consist of furnishing and placing reinforcement to the shape and dimensions, as shown on the drawings or as directed.

2.2 The type of reinforcement shall be as per the item description. The contractor shall submit the test certificate from steel manufacturer as and when required. The test results shall be verified, if required in any reputed laboratory.

2.3 Steel shall be clean and free from rust and loose mill scale, at the time of fixing in position and subsequent concreting.

2.4 Bar bending schedule shall be made by the contractor before starting the work. The payment shall be done based on quantity worked out in bar bending schedule. The bar bending schedule shall be prepared as per SP 34.

2.5 **Mild Steel:**

2.5.1 Reinforcing steel shall conform accurately to the dimensions given in the bar bending schedules shown on relevant drawings. Bars shall be bent cold to specified shape and dimensions or as directed using a proper bar bender, operated by hand or power to attain proper radius of bends. Bars shall not be bent or straightened in a manner that will injure the material. Bars bent during transportation or handling shall be straightened before being used on the work. They shall not be heated to facilitate bending. Unless otherwise specified, a U type hook at the end of each bar shall invariably be provided to main reinforcement. The radius of the bend shall not be less than twice the diameter of the round bar and the length of straight part of the bar beyond the end of the curve shall be atleast 4 times the diameter of the round bar. In case of bars which are not round and incase of deformed bars, the diameter shall be taken as the diameter of circle having an equivalent effective area. The hooks shall be suitably encased to prevent any splitting of the concrete.

2.6 **High yield strength deformed steel:**

2.6.1 The specification of HYSD steel shall be same as mild steel bars. The bars shall be used with or without hooks at the ends. Deformed bars without hooks shall comply with relevant anchorage requirements.

2.7 **TMT bars**

2.7.1 The specification of TMT steel shall be same as mild steel bars. The bars shall be used with or without hooks at the ends. Deformed bars without hooks shall comply with relevant anchorage requirements.

2.8 All the reinforcement bars shall be accurately placed in exact position shown on the drawings and shall be securely held in position with 16 Guage GI binding wire of size not less than 1mm as approved by Engineer-incharge or Architect. The rebars shall be placed with stay blocks or metal chair spacers, metal hangers, supporting wires or other approved devices at sufficiently close intervals. Bars shall not be allowed to sag between supports nor displaced during concreting or any other operations of the work. All devices used for positioning shall be of non-corrodible material. Wooden and metal supports shall not extend to the surface of concrete, except where shown on drawing. Placing bars on layers of freshly laid concrete as the work progresses for adjusting bar spacing shall not allowed. Pieces of broken stone or brick and wooden blocks shall not be used. Layers of bars shall be separated by spacer bars, Precast mortar blocks or PVC cover blocks shall be used to maintain the cover of the concrete members as directed by Engineer Incharge or Architect. Reinforcement after being placed in position shall be maintained in a clean condition until completely embedded in concrete. Special care shall be exercised to prevent any displacement of reinforcement in concrete already placed. To prevent reinforcement from corrosion, concrete cover shall be provided as indicated on drawing. All the bars projecting from concrete and to which other bars are to be spliced and which are likely to be exposed for a period exceeding 10 days shall be protected by a thick coat of neat cement grout.

2.9 Bars crossing each other where required shall be secured by 16 guage GI binding wires (annealed) of size not less than 1 mm., in such manner than they do not slip over each other at the time of fixing and concreting.

2.10 As far as possible, bars of full length shall be used. In case this is not possible, overlapping of bars shall be done as directed. Where directed, where practicable, overlapping bars shall not touch each other, but be kept apart by 25 mm. or 1.25 times the maximum size of the coarse aggregate, whichever is greater by concrete between them. Where not feasible, overlapping bars shall be bound with annealed wires not less than 1 mm. thick, twisted tight. The overlaps shall be staggered for different bars and located at points along the span where neither shear nor bending movement is maximum in beam and slab.

2.11 Whenever indicated on the drawings or desired by the Architect and Engineer-in-charge, bars shall be joined by couplings which shall have a cross section sufficient to transmit the full stresses of bars. The ends of the bars that are joined by coupling shall be upset for sufficient length so that the effective cross sectional the base of threads is not less than normal cross section of the bar. Threads shall be standard threads. Steel coupling shall conform to IS : 226.

2.12 When permitted or specified on the drawings, joints of reinforcement bars shall be welded with appropriate welding rod as per the instructions given by Structural Engineer. The type of welding, size of fillet etc shall be

as approved by Structural Engineer. Welded joints shall preferably be located at points when steel will not be subject to more than 75 % of the maximum permissible stresses and welds so staggered that any one section not more than 20 % of the rods are welded. Only electric are welding using a process which excludes air from the molten metal and conforms to any or all other special provisions for the work shall be accepted. Suitable means shall be provided for holding bars securely in position during welding. It shall be ensured that no voids are left in welding and when welding is done in 2 or 3 stages, previous surface shall be cleaned properly. Ends of the bars shall be cleaned of all loose scale, rust, grease paint and other foreign matter before welding. Only competent welders shall be employed on the work. The M.S electrodes used for welding shall conform to IS : 814. Welded pieces of reinforcement shall be tested. Specimen shall be taken from the actual site and their number and frequency of test shall be as directed.

2.13 At the time of concreting, a bar fitter shall remain at site to keep the reinforcement in position.

2.14 Rolling margin shall be checked for each lot of steel received at site. This rolling margin shall be considered for reconciliation of steel at the end of the project or after the end of each month as per the decision of engineer - incharge. Allowable wastage and rolling margin for the reconciliation of reinforcement steel shall be applicable as per Part B of *General Conditions of Contract.*

3.0 Mode of Measurements and Payment :

3.1 Reinforcement shall be measured in length including overlaps, separately for different diameters as actually used in the work. Where welding or coupling is resorted to in place of lap joints, such joints shall be measured for payment as equivalent length of overlap as per design requirement. From the length so measured, the weight of reinforcement shall be calculated in tones by using standard IS co-efficient. Length shall include hooks at the ends. The wastage of steel and binding wires shall not be measured and the cost of these items shall be needed to be included in the rate for reinforcement. The rolling margin of steel shall not be paid extra.

3.2 The rate for reinforcement includes cost of GI binding wires. Cutting, bending, placing, binding and fixing in position as shown on the drawings and as directed. It shall also include all devices like chairs, pins etc. for keeping reinforcement in approved position, cost of joining as per approved method and all wastage, covers – PVC or Cement mortar and spacer bars.

3.3 The rate shall be for a unit of one MT.

2.05 Providing and laying in position machine mixed, machine batch, machine vibrated design mix cement concrete for reinforced cement concrete work of M25 grade using graded stone aggregates of maximum 20mm nominal (down graded) size including fine aggregates conforming to latest IS 383 with minimum cement content (without fly ash) for durability shall be followed as per approved design mix and latest IS 456 (whichever is higher) for all elements of any shape and size, at all places and heights/ depths including transporting to site by continuous agitated mixer, laying of concrete to site by any means like pumping or tower crane etc., vibrating, finishing and curing etc. and including Admixtures in recommended proportions as per IS 9103 to accelerate, retard setting of concrete, to improve workability without impairing strength and durability as per direction of Engineer-in-charge. Rate shall be inclusive of cost of formwork, providing grooves, drip moulds, ghisis, pockets, cutouts etc. and labour for insert sleeves if any wherever required while casting but excluding the cost of reinforcement. Rate also to include lift charges and scaffolding for all heights / depths from FFL / GL. (for all civil, plumbing & electrical works).

1.0 Materials : Water shall conform to M-1. Cement to M-3. Sand to M-6. Grit to M-8. Coarse aggregate M-13. Design mix conform to M3G

2.0 General :

2.1 The relevant specifications of item no. 2.01 shall be followed except that the concrete mix shall be designed from preliminary tests the proportioning of cement and aggregates shall be done by weight and necessary precautions shall be taken in the production to ensure that the required work cube strength is attained and maintained. The controlled concrete shall be in grades of M-20, M-25, M-30 and M-35, with prefix controlled added to it. The letter "M" refers to mix and numbers specify 28 days works cube compressive strength of 150

mm. cubes of the mix expressed in N/mm^2.

2.2 **Before quoting the rate, contractor shall confirm the exposure condition for the design of concrete. Mix design shall be carried out for environmental exposure condition as given in IS 456:2000 page 18 table 3.**

2.3 **All concrete work shall have fair finish concrete surface unless otherwise specified.**
For exposed concrete element specified in the drawing fair finish steel shuttering made out of MS sheet not less than 14 gauge/ laminated plywood and supporting framework shall be of steel. Proper care shall be taken in MS shuttering at the time of concreting during monsoon to achieve rust free concrete surface. The concrete surface shall be rendered if required to give fair finish.

For other concrete shuttering material shall be as follows:
- Columns: Moulds from marine ply with wooden battens or MS steel plates
- Straight walls / Curved wall in plan: Marine plywood with wooden battens / Acro make or equivalent make plates and soldiers.
- Beam: Bottom - timber / steel plates, Sides - Steel plates / marine ply with battens

2.4 The concrete shall be designed as per relevant IS code- IS 10262 and SP 23, with or without chemical admixture to provide the grade of concrete having required workability and characteristic strength as per IS 456:2000. The proportion of cement, sand and coarse aggregates shall be determined by weight. The weight batch machine shall be used for maintaining proper control over the proportion of aggregates as per mix design. The design mix shall be got approved by Engineer in-charge before starting the concrete work. The minimum cement content shall depend on the exposure condition of the concrete. The minimum cement content given in table (IS 456:2000, table 5) shall be adopted irrespective of whether the contractor achieves the desired strength with less quantity of cement. The strength requirements of different grades of concrete shall be as under :

Grade of Concrete	Compressive strength of 15 cm. cubes in N/mm$^{2.}$ at 7 and 28 days conducted in accordance with IS : 516-1959.		
	At 7 days	At 28 days	Max size of agg. In mm
M-10	7	10	20
M-15	10	15	20
M-20	13.5	20	20
M-25	17	25	20
M-30	21	30	20
M-35	24	35	20
M-40	28	40	20

In all cases, the 28 days compressive strength specified in above table be the criteria for acceptance or rejection of the concrete.

2.5 Where the strength of a concrete mix as indicated by tests, lies in between the strength of any two grades specified in the above table, such concrete shall be classified in for all purposes as concrete belonging to the lower of the two grades between which its strength lies.

2.6 The Contractor shall take necessary care to avoid sand streaks, air holes, honey combining etc., on finished concrete surface.

3.0 Workmanship:

3.1 **Proportioning:**

3.1.1 The proportions for ingredients chosen shall be such that concrete has adequate workability for conditions prevailing on the work in question and can be properly compacted with means available except where it can be

shown to the satisfaction of the Architect and Engineer-in-charge that the supply of properly graded aggregate of uniform quality can be maintained till the completion of work. Grading of aggregate shall be controlled by obtaining the coarse aggregate, in different sizes and blending them in the right proportions as required. Aggregate of different sizes shall be stocked in separate stock piles. The required quantity of material shall be stock piled several hours, preferably a day before use. The grading of coarse and find aggregate shall be checked as frequently as possible, the frequency for a given job being determined by the Architect and Engineer-in-charge to ensure that the suppliers are maintaining the uniform grading, as approved for samples used in the preliminary tests.

3.1.2 In proportioning concrete, the quantity of both cement and aggregate shall be determined by weight. Where the weight of cement is determined by accepting the maker's weight per bag a reasonable number of bags shall be weighed separately, to check the net weight, where cement is weighed from bulk stocks at site and not by bags. It shall be weighed separately from the aggregates. Water shall either be measured by volume in calibrated tanks or weighed. All measuring equipment shall be maintained in clean and serviceable condition. Their accuracy shall be periodically checked and calibrated in standard laboratory.

3.2 **Mixing, consistency, inspection, transportation and laying, formwork for exposed concrete, sampling & testing of concrete and stripping time for the form works** These shall be same as item no. 2.01 The compressive strength and slump test shall be performed by third party or outside laboratory is required.

3.3 It is most important to keep the specified water cement ratio constant and at its correct value. To this end, moisture content in both fine and coarse aggregates shall be determined by the Architect and Engineer-in-charge, according to the weather conditions. The amount of mixing water shall then be adjusted to compensate for variations in the moisture content. For the determination of moisture content in the aggregates, IS : 2386 (Part III) shall be referred to. Suitable adjustments shall also be made in the weights of aggregates due to variation in their moisture content.

3.4 The minimum cement content for the various mixes shall be as as per approved mix design and/ or as per IS 456.

3.5 All RCC works shall be carried out as per the detailed drawings and direction of Architects and Engineer-in-charge. The concrete shall be placed at all heights, levels and for all shapes

3.6 **Incase contractor intends to use Ready Mix Concrete (RMC), contractor shall submit specifications for RMC and obtain prior approval from the engineer-incharge.**

2.3 Inspection

2.3.1 Contractor shall give the Architect and Engineer-in-charge due notice before reinforcement bars are placed in position, to permit him to inspect and accept the false work and forms as to their strength, alignment and general fitness but such inspection shall not relieve the Contractor of his responsibility for the safety of men, machinery, materials and for results obtained. Immediately before concreting, all forms shall be thoroughly cleaned. Contractor shall proper access with railing for inspection of work.

2.3.5 Centering design and its erection shall be got approved from the Engineer-in-charge. Sufficient carpenter with helper shall invariably be kept present throughout the period of concreting. Movement of labour and other persons shall be totally prohibited after reinforcement is laid in position. For access to different parts, suitable mobile platforms shall be provided so that steel reinforcement in position is not disturbed. For ensuring proper cover, mortar blocks/ PVC cover of suitable size and thickness as per the drawing shall be tied to the reinforcement. Timber, kapachi or stone pieces shall not be used for this purpose. For exposed concrete members PVC blocks of grey color shall only be used.

2.3.6 All formwork shall be cleaned and made free from standing water, dust, snow or ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the Architect and Engineer-in-charge has been obtained.

2.3.7 Formwork for Exposed concrete surface (If indicated)

2.3.7.1 All vertical members for formwork shall be of steel like acroprops, H frames / cup lock system etc. Care shall

be taken to set all formwork in perfect line, level (or in required camber or slope as specified) and plumb. Formwork propping shall be strong, rigid and sturdy. The formwork shall be as per pattern, design shown in drawings. Formwork shall be done accurately and precisely so as to achieve neat, clean and smooth concrete surface, in line, level and plumb. Clinks, twists, offsets, warps, riveting etc. in plates or forms shall not be allowed. Before placing concrete, forms shall be thoroughly cleaned off of all rust, dust and loose materials. Mould release agent of approved make or as per the Architect / Engineer in charge shall be applied on sheathing before placing the reinforcement steel. Also the formwork material will be of laminated plywood/best quality steel sheathing or any sort of such material, as approved by the Architect, so that all exposed concrete surfaces have uniform colour and texture. After deshuttering, all concrete surfaces shall be properly rendered with sand paper or emery stone. The sample of the exposed concrete shall be got approved by the architect or engineer in charge.

For walls and columns, the sheathing plates shall be bolted with special nuts and bolts- spring coils and PVC cone spacer. No through bolts shall be allowed for basement walls and water retaining structure for which no extra amount shall be paid for.

2.3.7.2 For all kind of exposed concrete work only one brand (to be approved by the Architect or Engineer-in-charge) of cement shall be used.

For exposed concrete element specified in the drawing, steel shuttering made out of CR MS sheet not less than 2mm thickness (14 guage) or laminated plywood not less than 12 mm with MS angle steel supporting frame work shall be used.

For other concrete shuttering material shall be as follows:

- Columns: Moulds from marine ply with wooden battens or steel plates
- Straight walls / Curved wall in plan: Marine plywood with wooden battens / Acro make or equivalent make steel plates and soldiers.
- Beam: steel plates and marine ply with battens

2.3.5 Formwork for Exposed Work

2.3.5.1 **Exposed / Ordinary fair finished formwork for walls, columns, beams of basement and water retaining structures**

For water retaining structure the shuttering plates on either side shall be bolted with tie rods made from spring coils on either side, welded with two nos. 8mm MS rods. PVC cone shall be placed on either side of the tie rod. The whole tie rod assembly along-with PVC cone shall be placed/fixed with special type of bolts on either side of the shuttering plates. Length of the tie rod along-with PVC cone shall be equal to the width / thickness of the element to be shuttered. Holes of cones shall be filled with polymer concrete or non-shrink grout of approved make and as directed by Engineer in charge.

2.3.5.1 **Exposed / Ordinary fair finished formwork For walls, columns, beams of Super structure**

For walls, columns and beams, the shuttering plates on either side shall be bolted with through tie rods made from round bars minimum 12 mm with heavy quality PVC sleeves and minimum 25 mm thick PVC cones on either side of the sleeve. The whole tie rod assembly along-with PVC cone shall be placed /fixed with through bolts on either side of the shuttering plates. Holes of cones shall be filled with rich cement mortar (1:1) and bonding agent in recommended proportion.

2.4 Sampling and testing of concrete

2.4.1 The contractor shall set up a site laboratory to carry out various tests as specified. The laboratory shall include equipments like cube testing machine, slump cone, cube moulds for concrete and mortar, mechanical balance, sieve set, flakiness testing apparatus, core cutter etc.

2.4.3 Samples from fresh concrete shall be taken as per IS : 1199 and cubes shall be made, cured and tested at 7 days or 28 days as per requirements in accordance with IS : 516. A random sampling procedure shall be adopted to ensure that each concrete batch shall have a reasonable chance of being tested i.e. the sampling should be spread over the entire period of concreting and cover all mixing units. The minimum frequency of sampling of concrete of each grade shall be in accordance with following :

Qty. of concrete in the work	No. of samples of concrete for testing at 28 day
1-5 m^3.	1
6-15 m^3.	2
16-30 m^3.	3
31-50 m^3.	4
51 and above	4 + one additional for each additional 50 m^3 or part thereof.

NOTE : Atleast 1 sample shall be taken from each shift. Three test specimens shall be made for each sample for testing at 28 days. Additional samples must be taken to determine strength at 7 or 3 days or at the time of striking the formwork, or to determine the duration of curing, or to check the testing error. The samples of concrete shall be taken on each day of the concreting as per above frequency. The number of specimens may be suitably increased as deemed necessary by the Architect and Engineer-in-charge when procedure of tests given above reveals a poor quality of concrete and in other special cases.

2.4.3 The test results of the sample shall be average of the strength of 3 specimens. The individual variation shall not be 15% of the average strength of the sample. The compressive mean strength for the group of 4 non-overlapping consecutive test results shall be as per col. 2 table 11 of IS 456:2000 and individual test results shall be as per col. 3 of table 11 of IS 456:2000.

2.5 stripping

2.5.1 The Architect and Engineer-in-charge shall be informed in advance by the Contractor of his intention to strike the formwork. While fixing the time for removal of formwork, due consideration shall be given to local conditions, character of the structure, the weather and other condition that influence the setting of concrete and of the materials used in the mix. In normal circumstances (generally where temperature are above 20°C) and where ordinary concrete is used, forms may be struck after expiry of periods specified in IS 456:2000 11.3.1 page 25 for respective item of formwork.

2.5.4 All formwork shall be removed without causing any shock or vibration as would damage the concrete. Before the soffit and struts are removed, the concrete surface shall be gradually exposed, where necessary in order to ascertain that the concrete has sufficiently hardened. Centering shall be gradually and uniformly lowered in such manner as to permit the concrete to take stress due to its own weight uniformly and gradually. Where internal metal ties are permitted, they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortar. No permanently embedded metal part shall have less than 25 mm covers to the finished concrete surface. Where it is intended to re-use the formwork, it shall be cleaned and made good to the satisfaction of the Architect and Engineer in-charge. After removal of formwork and shuttering the Engineer-in-charge shall inspect the work and satisfy by random checks that concrete produced is of good quality.

2.5.5 The number of props left under, their sizes and disposition shall be such as to be able to safely carry the full load of the slab, beam or arch as the case may be together with any live load likely to occur during curing or further construction.

2.5.4 Immediately after the removal of forms, all exposed bolts etc. passing through the cement concrete member and used for shuttering or any other purpose shall be cut inside the cement concrete member to a depth of atleast 25 mm. below the surface of the concrete and the resulting holes be filled by cement mortar. All fine mortar lines caused by form joints, all cavities produced by the removal of form ties and all other holes and depressions honeycomb spots, broken edges or corners and other defects shall be thoroughly cleaned saturated with water and carefully pointed and rendered true with mortar of cement and fine sand. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surfaces, which are pointed, shall be kept moist for a period of 24 hours. For repairing concrete members, suitable bonding agent shall be used as directed by the consultant.

2.5.6 If rock pockets/honeycombs in the opinion of Architect and Engineer-in-charge are of such an extent or character so as to effect the strength of the structure, materially or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the portion of the structure affected with no extra cost.

4.0 Mode of Measurements and Payment :

4.1 The relevant specifications item no. 2.05 shall be followed except that the controlled concrete RCC work for work as specified in item shall be measured under this item. The rate shall exclude the cost of formwork and reinforcement as per the item description.

4.2 The rate shall be for a unit of one m^3.

4.3 The rate shall be inclusive of chemical admixture like plasticizer etc. No additional payment shall be paid on this account.

2.06 Providing in position PVC pipe sleeves of 6Kg/cm2 and length as per design for following diameters for services pipes pass through walls / slabs / beam. All pipes shall be accurately cut to the required sizes, laid as per drawing, kept in the position while concreting, and burrs removed before laying. Open ends of the pipe shall be closed as the pipe is installed to avoid clogging while concreting. Measurement should be taken up to two decimal. (minimum 0.01 mt.). Rate shall be inclusive of removal of sleeves before water proofing or grouting. For all floors / all levels / all heights.

a) 75mm Diameter
b) 110mm Diameter
c) 160mm Diameter
d) 200mm Diameter

1.0 Materials and Workmanship

1.1 The PVC pipe shall confirm to M – P28. Before pouring the concrete PVC sleeves are placed in between the reinforcement as per drawing. Both ends of the sleeves shall be closed with Pipe sleeves 50mm larger diameter than pipes shall be provided wherever pipes pass through walls, slab and circular space filled with fire proof materials like putty, fire seals etc. all pipes shall be accurately cut the required sizes in accordance with relevant code and bars removed before laying. Open ends of the pipes shall be closed with thermocol or gunny bags to avoid entrance of foreign matters. Care shall be taken that sleeves remain in position while concreting. To Vertical sleeves shall finish 50mm above finish floor level.

2.0 Mode of Measurements and Payment:

The rate shall be for unit of one Rmt. No wastage should be paid.

Measurement should be taken up to two decimal. (minimum 0.01 mt.)

2.07 Construction of construction of Reinforced Controlled cement concrete drain of approved design and discharge of mix cc M-25 inclusive of centering and shuttering and reinforcement and surface plastered smooth with neat cement finish including 50mm thick top perforated precast cover with necessorry reinforcement as directed by Engineer-in-Charge. Rate are also inclusive of Providing and Mixing Plastisizer approved make.

The relevant specifications item no. 2.05 shall be followed.

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(I) **BRICKWORK:**

4.01 **Providing and laying Conventional Brick masonry works in Superstructure using common burnt clay building bricks confirming to IS 1077-1992 having crushing strength not less than 35 Kg/Sq.cm., in cement mortar 1:5 (1 cement : 5 coarse sand) in any shape, thickness and all depth including curing, scaffolding racking / flush jointing etc. complete, as per drawing / specification and / or as directed by Engineer in Charge. For all civil, plumbing, electrical & infrastructure works.**

1.0 **Materials :** Water shall conform to M-1. Cement to M-3. Sand to M-6. Brick to M-15. Cement mortar to M-11.

2.0 **Workmanship :**

2.1 **Proportion :** The proportion of the CM shall be as mentioned in the item description (cement : medium sand), by volume.

2.2 **Soaking of bricks :** The bricks required for masonry shall be thoroughly wetted with clean water for about 24 hours before use or as directed. The cessation of bubbles, when the bricks are wetted with water is an indication of thorough wetting of bricks.

2.3 **Laying :**

2.3.1 Bricks shall be laid in English bond unless directed otherwise. Half or cut bricks shall not be used except when necessary to complete the bond; closer and in such case it shall be cut to required size and used near the ends of walls.

2.3.2 A layer of mortar shall be spread on full width for suitable length of the lower course. Each brick shall first be properly bedded and set home by gently tapping with the handle of the trowel or wooden mallet. Its inside face shall be flushed with mortar before the next brick is laid and pressed against it. On completion of the course, the vertical joints shall be fully filled from the top, with mortar.

2.3.3 The walls shall be taken up truly in plumb. All courses shall be laid truly horizontal and all vertical joints shall be truly vertical. Vertical joints in alternate courses shall generally be in one vertical plane. The thickness of brick course shall be kept uniform.

2.3.4 The bricks shall be laid with the frog facing upwards. A set of tools comprising of wooden straight edges, manson's spirit level, square half meter rub (right angle), pins, string, level pipe and plumb shall be kept on the site of work for frequent checking during the progress of work.

2.3.5 Both the faces of walls, having thickness greater than 23 cm. shall be kept in proper plumb. All the connected brick work shall be kept not more than 1 m. over the rest of the work. Where this is not possible, the work shall be raked back according to bond (and not left toothed) at an angle not steeper than 45°. In a day brick work shall not be laid more than 1m or 10 courses in height.

2.3.6 All the fixtures, pipe outlets of water, etc. which are required to be built in the wall shall be embedded in CM, as per the drawings or as directed. The frames of doors, windows, cupboards, etc. shall be housed into the brick work at the correct location and level, as directed. The heavy steel doors, windows frames, etc. shall be built in with brick work, but for ordinary steel doors and windows, required opening for frames, hold-fasts, etc. shall be left in the wall and frames shall be embedded later on in order to avoid damage to the frames.

2.3.7 Necessary scaffolding shall be provided by the Contractor. The supports of the scaffolding shall be sound and strong, tied together with horizontal pieces over which the scaffolding planks shall be fixed. Normally simple scaffolding only shall be allowed. In this case horizontal pieces of the scaffolding shall rest in the holes, made in the header coarse only. The Contractor is responsible for providing and maintaining sufficiently strong scaffolding so as to withstand all loads likely to come upon it.

2.3.8 No through holes shall be left in brickwork to support the scaffolding. Only double scaffolding shall be erected. In case the holes are left in the brickwork, it shall be filled with 1:4:8 PCC.

2.4 **Joints :**

2.4.1 Bricks shall be so laid that all joints are quite flush with mortar. Thickness of joints shall not exceed 12 mm. The face joints shall be raked out as directed by raking tools daily, during the progress of work, when the mortar is still green so as to provide key for plaster or pointing to be done, subsequently.

2.4.2 The face of bricks shall be cleaned everyday on which the brick work is laid and all mortar dropping shall be removed.

2.4.3 At the end of day's work or on holidays the top of unfinished masonry shall be kept wet. If the mortar becomes dry, white or powdery, for want of curing, work shall be pulled down and re-built at Contractor's expense.

2.5 **Curing :** Fresh work shall be protected from rain suitably. Masonry work shall be kept moist on all the faces for minimum period of 7 days. The top of masonry work shall be kept well wetted at the end of the day's work.

2.6 **Preparation of foundation bed :** If the foundation is to be laid directly on the excavated bed, the bed shall be levelled, cleared off of all loose materials, cleaned and wetted before starting masonry work. If masonry is to be laid on concrete footing, the top of concrete shall be roughened, cleaned and moistened. The Contractor shall obtain approval of the Engineer-in-charge for the foundation bed, before foundation masonry is started. When pucca flooring is to be provided flush with the top of the plinth, the inside of the plinth wall shall be lowered down having an offset of the same thickness of the flooring with respect to the outside plinth wall top or as directed.

3.0 Mode of Measurements and Payment :

3.1 The measurement of this item shall be taken for the brick masonry fully completed in foundation upto plinth or above plinth for all levels, heights, shapes and locations as per the item description.. The limiting dimensions not exceeding those shown on the drawings or as directed shall be final. Battered, tapered and curved portions shall be measured net.

3.2 No deduction shall be made from the quantity of brick work, nor any extra payment shall be made for embedding in masonry or making holes in respect of following items :

(1) End of joists beams, posts, girders, rafters, purlins, trusses, corbel, steps etc. where cross sectional area does not exceed 500 cm^2.
(2) Architectural openings in walls, parapet and compound walls, not exceeding 1.0 m^2. area.
(3) Wall plates and bed plates, bearing of slabs, chhajjas and the like whose thickness does not exceed 10 cm. and the bearing does not extend to the full thickness of wall.
(4) Drainage holes, recesses for cement concrete blocks to embed hold fasts for doors, windows etc., forming toothings, grooves etc. and providing cramps for holding stone lining.
(5) Iron fixtures, pipes upto 300 mm. dia.; holdfasts and doors and windows built into masonry and sanitary and water supply pipes, etc., for concealed electrical wiring and any other fixtures or inserts.
(6) Forming chases of section not exceeding 350 cm^2. in masonry.

3.3 Apertures for fire places shall not be deducted nor shall extra labour required to make splaying of jambs, throating and making arches over the aperture be paid for separately. The rate shall include for work of any shape e.g. pillars of any size and shape, curved or tapered walls, drip courses, projections, parapets, load bearing walls, sills, ottas, steps, tank walls, platforms and counter walls, ducts, channels and architectural mouldings like corbelling, pattas, etc.

3.4 The rate shall be for a unit of one m^3.

10.01 **Providing and fixing in position, interlocking rolling shutter of approved make, made of 18 gauge, 75mm wide cold rolled MS lath interlocked, including top cover (16 gauge), spring, axles (specially designed shaft), guide rails (10 gauge), tees, iron pulleys, ball bearings, handles, arrangement for inside and outside locking arrangement, with push and pull arrangement (manually operated), holding down bolts embedded in CC 1:2:4 / anchor fastener of HILTI or equivalent including 1 coat of epoxy/ zinc rich primer and 2 coat of Hi-Gloss Metal PU Paint of approved make over all the surfaces etc. as directed. (Measurements considered for payments shall be clear size of opening plus guide channels on both the sides for width and 450mm on top for drum height.)**

1.0 **Materials :** Rolling shutter shall conform to M-32, PU paint of approved make and shade.

2.0 **Workmanship :** The top cover, spring, axles, tees, iron pulleys etc. shall be supported on strong MS / CI brackets which shall be fixed into the CC 1:2:4 of the lintel/beam as specified with rawl plugs, screws, bolts etc. The guide rails shall be fixed on to the sides of the opening as per the manufacturer's instructions. The lathe curtain (shutters) shall be laid on ground and the side-guide rails shall be bound with it with ropes etc. The shutter shall then be placed in position and top fixed with suspension shaft with bolts and nuts. The side-guide channels and the cover frame 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 screw bolts and rawl plugs drilled in the wall. The plates and screw bolts shall be concealed in plaster to make their location invisible.

Fixing shall be done accurately so as to ensure easy and smooth operation of the shutter.

3.0 **Mode of measurement and payment:**

3.1 Measurement considered for payment shall be clear size of opening, between the jambs plus guide channels on both the sides for width and 450mm on top for drum height shall be added to the height of the opening, the clear distance between the sill and the soffit of the opening.

3.2 The rate shall include for all materials, its transportation at site, labour etc. involved in the operation described as above. It shall include for a required coat of epoxy/ zinc rich primer and 2 coat of PU paint of approved make and shade.

3.3 The rate shall be for a unit of one sq. m.

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5.01 Providing, laying and consolidation of WBM sub base consisting of machine crashed B.T. stone metal of 63mm to 40mm grade stone aggregate of compacted thickness 1 including using 20% stone screening Grit and stone dust as filler with power/road roller of as per specification consolidate the sub base to proper camber with vibratory road roller as per specification complete in all respect to required slope as directed by the Engineer-in -charge.

1.0 Materials :

1.1 Hand broken metal 90 mm. to 63 mm. size shall be collected by the Contractor to the site of work. Stacking shall be done in systematic way so as to allow easy inspection and in such a place as will not cause any loss. The metal shall be collected from approved quarry as approved by the Architects and Engineer-in-charge.

1.2 Murrum or selected earth brought from outside shall be clean, of good binding quality, and of approved quality obtained from approved pots/quarries of disintegrated rocks which contain silicones materials and natural mixture of clay of calcareous origin. The size of murrum shall not be more than 20 mm. and shall be approved by the Engineer-in-charge before use.

1.3 The control on quality of material shall be exercised by the Engineer by carrying out the required tests at the frequencies as per IS norms from time to time as directed by the Engineer-in-charge.

1.4 The sample of the metal collected shall be got tested at Govt. recognised laboratory or as approved by the Architect and Engineer-in-charge. The cost of the same shall be born by the Contractor.

1.5 Materials for the purpose shall be of approved quality. Any material which is found of inferior quality shall be rejected and the Contractor shall remove such rejected material from the site at his own cost immediately. The material shall be collected from quarries approved by the Engineer-in-charge.

1.6 The material shall be got approved by Engineer-in-charge prior to collection on site. It shall be free from all rubbish, dust and any organic materials as well as clods of black cotton soil. Material shall not be allowed to be collected within the road boundary. Material to be used as crust and for side shoulders shall have a C.R.B.I's report and that to be used as blindage in W.B.M. road construction shall have P.I. Value of less than 6, as determined in accordance with IS:2720 (Part-V).

2.0 Workmanship:

2.1 Regular stacks shall be done by the Contractor on a fairly level ground. Stacking of the metal shall be done in a manner as directed by the Architect and Engineer-in-charge.

2.2 Stacking of material as per requirement shall be carried out. The metal stack shall be checked by the Engineer-in- charge before spreading. The collection shall always commence at one end of the road and carried out continuously towards the other end unless the Architect and Engineer-in-charge shall direct otherwise.

2.3 It shall be spread evenly on the prepared surface in required grade and camber by using camber broads etc. so as to ensure that the surface is in true camber and grade. At least two camber boards shall be in use on site. The surface shall be checked at every 50 ft. by means of templates, while the correctness of the camber in between shall be tested by strings and corrected as required. Between the straight lengths and the curves and the meeting points of the convex and concave portions of reverse curves the change in camber of the road and super elevation shall be made very gradually as directed by the Architect and Engineer-in-charge.

2.4 Metal shall not be spread without permission of the Architect and Engineer-in-charge. Metal should be spread under careful supervision and by trained collies only. Contractor shall see that uniform spreading as per collection of metal is done. The Contractor shall spread the metal fully from the stacks without keeping any balance unless directed by the Architect and Engineer-in-charge to keep

some stacks in balance for making unevenness or depressions good during rolling work.

2.3 To ensure that the materials are spread to the required thickness, the road surface shall be marked out on to the length over which the contents of heaps are to be spread. The bounds of earth or murrum (one on either side) shall be made along the outer edge of metalling simultaneously with spreading of metal. These bounds shall be laid with a distance equal to the width of the road to be metalled and shall be enough to prevent the loose metal from spreading out during consolidation and to retain water used for consolidation as well.

2.4 The spreading of metal shall proceed only 200 m. (maximum) advance of the rolling operations. At the time of rolling, all surface irregularities hollows, depressions, humps, shall be set right. The spreading of metal in required layer shall be done by the Contractor.

2.5 Immediately after the spreading of the stone rolling shall be started with three wheeled power roller 8 to 12 ton capacity or tandem roller or equivalent vibrator roller. The weight of the roller shall depend upon the type of the aggregate and as indicated by the Architect and Engineer-in-charge.

2.6 Except on super elevated portions where the rolling shall proceed from inner edge to outer, rolling shall begin from the edges gradually progressing towards the center. First the edge/s shall be compacted with roller running forward and backward. The roller shall then move inward parallel to the center line of the road, in successive passes uniformly lapping preceding tracks by at least one half way width.

2.7 Rolling shall continue until the aggregate is thoroughly keyed and the creeping of the aggregate ahead of the roller is no longer visible. During rolling slight sprinkling of water may be done. If necessary, rolling shall not be done. When the sub-grade is soft or yielding or when it causes a wave like motion in the sub-grade or sub-base course.

2.8 The roller surface shall be checked transversely and longitudinally with templates and any irregularities corrected by loosening the surface, adding or removing necessary amounts of aggregate and rerolling until the entire surface conforms to desired camber and grade. In no case shall be use of screening be permitted to make up depressions.

2.9 The blindage material where it is required to be used shall be applied, successfully in two or more thin layers at a slow and uniform rate. After each application, the surface shall be continuously sprinkled with water, the resulting slurry shall be swept in with hand brooms or mechanical brooms to fill the voids properly and rolled, during which water shall be applied to the wheels of the rollers if necessary to wash down the binding materials sticking to them. These operations shall continue until the resulting slurry after filling of voids, forms a wave ahead of the wheels of the moving roller.

2.10 After the final compaction of water bound macadam course, the road shall be allowed to dry overnight. Next morning hungry spots shall be filled with screening of binding materials as directed, lightly sprinkled with water if necessary, and rolled. No traffic shall be allowed on the road until the macadam has set. The Architect and Engineer-in-charge shall have the discretion to stop hauling traffic from using the completed water bound macadam course if in his opinion it would cause excessive damage to the surface.

3.0 Mode of Measurement and Payment:

3.1 Payment shall be made on m3 basis without deduction for voids.

3.2 The rate includes digging the murrum, supplying, conveying with all lead and lift on the road side and stacking the same in regular stacks and making side shoulders. Material shall be collected in required quantity only at any stage of work.

3.2 The contract unit rate for collecting, carting and spreading shall include :

1. Obtaining metal and murrum from approved quarry.
2. Transporting at site.
3. Storing, stacking, protecting and spreading.
4. Keeping record of supply and use.
5. Rolling the metalled surface with 8 to 10 ton capacity power driven roller.
6. Testing the samples in the approved laboratory.

5.02 Providing, laying, spreading and consolidation graded stone aggregate to wet mix macadam 75mm compacted thick as per MORT & H specifications including premixing the material with water at OMC in mechanical plant carriage of mixed material by tippers to site, laying in uniform layers with paver in sub base/ base course on well prepared surface and compacting with vibratory roller to achieve the desired density.

5.02.1 Scope

This work shall consist of laying and compacting clean, crushed, graded aggregate and granular material, premixed with water, to a dense mass on a prepared subgrade/sub-base/base or existing pavement as the case may be in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as necessary to lines, grades and cross-sections shown on the approved drawings or as direction by the Engineer.

The thickness of a single compacted Wet Mix Macadam layer shall not be less than 75 mm. When vibrating or other approved types of compacting equipment are used, the compacted depth of a single layer of the sub-base course may be increased to 200 mm upon approval of the Engineer.

5.02.2 Materials

5.02.2.1 Aggregates

5.02.2.1.1 Physical requirements: Coarse aggregates shall be crushed stone. The aggregates shall conform to the physical requirements set forth in Table 400-10 below. Sevaliya special aggregate is only acceptable.

TABLE 400-10. PHYSICAL REQUIREMENTS OF COARSE AGGREGATES FOR WET MIX MACADAM FOR SUB- BASE/BASE COURSES

	Test	Test Method	Requirements
1	*Los Angeles abrasion value	IS : 2386 (Part-4)	40% (Max.)
	Or		
	*Aggregate Imapct value	IS : 2396 (Part-4) Or IS : 5640	30% (Max)
2	Combined Flakiness and Elongation indices (Total)	IS : 2396 (Part-1)	30% (Max)

* Aggregate may satisfy requirements of either of the two tests.
** To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Fl akiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles be separated out from th e remaining (non-flaky) stone metal. Elongation index is weight of elongated particles divided by total non-flaky particles. The value of flakiness index and elongation index so found are added up.

If the water adsorption value of the coarse aggregate is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS : 2386 (Part- 5).

5.02.2.1.2 Grading requirements: The aggregates shall conform to the grading given in Table 400-11.

TABLE 400-11. GRADING REQUIREMENTS OF AGGREGATES FOR WET MIX MACADAM

IS Sieve Designation	Per cent by weight passing the IS sieve
53.00 mm	100
45.00 mm	95-100
26.50 mm	-
22.40 mm	60-80
11.20 mm	40-60
4.75 mm	25-40
2.36 mm	15-30
600.00 micron	8-22
75.00 micron	0-8

Materials finer than 425 micron shall have Plasticity Index (PI) not exceeding 6.
The final gradation approved within these limits shall be well graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa.

5.02.3 Construction Operations

5.02.3.1 Preparation of base: Clause 404.3.1. shall apply.

5.02.3.2 Provision of lateral confinement of aggregates: While constructing wet mix macadam, arrangement shall be made for the lateral confinement of wet mix. This shall be done by laying materials in adjoining shoulders along with that of wet mix macadam layer and following the sequence of operations described in Clause 407.4.1.

5.02.3.3 Preparation of mix: Wet Mix Macadam shall be prepared in an approved mixing plant of suitable capacity having provision for controlled addition of water and forced/positive mixing arrangement like pugmill or pan type mixer of concrete batching plant. For small quantity of wet mix work, the Engineer may permit the mixing to be done in concrete mixers.
Optimum moisture for mixing shall be determined in accordance with IS : 2720 (Part-8) after replacing the aggregate fraction retained on 22.4 mm sieve with material of 4.75 mm to 22.4 mm size. While adding water, due allowance should be made for evaporation losses. However, at the time of compaction, water in the wet mix should not vary from the optimum value by more than agreed limits. The mixed material should be uniformly wet and no segregation should be permitted.

5.02.3.4 Spreading of mix: Immediately after mixing, the aggregates shall be spread uniformly and evenly upon the prepared subgrade/sub-base/base in required quantities. In no case should these be dumped in heaps directly on the area where these are to be laid nor shall their hauling over a partly completed stretch be permitted.
The mix may be spread either by a paver finisher or motor grader. For portions where mechanical means cannot be used, manual means as approved by the Engineer shall be used. The motor grader shall be capable of spreading the material uniformly all over the surface. Its blade shall have hydraulic control suitable for initial adjustments and maintaining the same so as to achieve the specified slope and grade.

The paver finisher shall be self-propelled, having the following features:

(i) Loading hoppers and suitable distribution mechanism
(ii) The screed shall have tamping and vibrating arrangement for initial compaction to the layer as it is spread without rutting or otherwise marring the surface profile.
(iii) The paver shall be equipped with necessary control mechanism so as to ensure that the finished surface is free from surface blemishes.

The surface of the aggregate shall be carefully checked with templates and all high or low sports remedied by removing or adding aggregate as may be required. The layer may be tested by depth

blocks during construction. No segregation of layer and fine particles should be allowed. The aggregates as spread should be of uniform gradation with no pockets of fine materials.

5.02.3.5 **Compaction:** After the mix has been laid to the required thickness, grade and crossfall/camber the same shall be uniformly compacted, to the full depth with suitable roller. If the thickness of single compacted layer does not exceed 100 mm, smooth wheel roller of 80 to 100 kN weight may be used. For a compacted single layer upto 200 mm, the compaction shall be done with the help of vibratory roller of minimum static weight of 80 to 100 kN or equivalent capacity roller. The speed of the roller shall not exceed 5 km/h.

In portions having unidirectional cross fall/superelevation, rolling shall commence from the lower edge and progress gradually towards the upper edge. Thereafter, roller should progress parallel to the centre line of the road, uniformly over-lapping each preceding track by at least one third width until the entire surface has been rolled. Alternate trips of the roller shall be terminated in stops at least 1 m away from any preceding stop.

In portions in camber, rolling should begin at the edge with the roller running forward and backward until the edges have been firmly compacted. The roller shall then progress gradually towards the centre parallel to the centre line of the road uniformly overlapping each of the preceding track by at least one-third width until the entire surface has been rolled.

Any displacement occurring as a result of reversing of the direction of a roller or from any other cause shall be corrected at once as specified and/or removed and made good.
Along forms, kerbs, walls or other places not accessible to the roller, the mixture shall be thoroughly compacted with mechanical tampers or a plate compactor. Skin patching of an area without scarifying the surface to permit proper bonding of the added material shall not be permitted.

Rolling should not be done when the subgrade is soft or yielding or when it causes a wave-like motion in the sub-base/base course or subgrade. If irregularities develop during rolling which exceed 12 mm when tested with a 3 metre straight edge, the surface should be loosened and premixed material added or removed as required before rolling again so as to achieve a uniform surface conforming to the desired grade and crossfall. In no case should the use of unmixed material be permitted to make up the depressions.

Rolling shall be continued till the density achieved is at least 98 per cent of the maximum dry density for the material as determined by the method outlined in IS : 2720 (Part-8).

After completion, the surface of any finished layer shall be well-closed, free from movement under compaction equipment or any compaction planes, ridges, cracks and loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of the layer and recompacted.

5.02.3.6 **Setting and drying:** After final compaction of wet mix macadam course, the road shall be allowed to dry for 24 hours.

5.02.4 **Opening to Traffic**
Preferably no vehicular traffic of any kind should be allowed on the finished wet mix macadam surface till it has dried and the wearing course laid.

5.02.5 **Surface Finish and Quality Control of Work**

5.02.5.1 **Surface evenness:** The surface finish of construction shall conform to the requirements of Clause 902.

5.02.5.2 **Quality control:** Control on the quality of materials and works shall exercised by the Engineer in accordance with Section 900.

5.02.6 **Rectification of Surface Irregularity**

Where the surface irregularity of the wet mix macadam course exceeds the permissible tolerances or where the course is otherwise defective due to sub grade soil getting mixed with the aggregates, the full thickness of the layer shall be scarified over the affected area, reshaped with added premixed material or removed and replaced with fresh premixed material as applicable and recompacted in accordance with Clause 406.3. The area treated in the aforesaid manner shall not be less than 5 m long and 2 m wide. In no case shall depressions be filled up with unmixed and ungraded material or fines.

5.02.7 Arrangement for Traffic

During the period of construction, arrangement of traffic shall be done as per Clause 112.

5.02.8 Measurements for Payment

Wet mix macadam shall be measured as finished work in position in cubic metres.

5.02.9 Rates

The Contract unit rate for wet mix macadam shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 401.8.

5.03 Clearing the Existing W.M.M road surface incl. removing of binding material and other foreign matter with wire brushes and small picks, sweeping with brooms or soft brushes and compressed air to receive bitumious treatment complete in all respects as per specification of MOT No 502.42 and 503.1 and Binder shall be confirming be the specification complete in all respected to the entire specification of the Engineer-in-charge.

Existing WMM road shall be dresses with wire brushes and small pick to receive bituminous treatment as per specifications and as directed by Engineer in charge.

The rate shall be for unit of Sqm.

5.04 Providing and laying of prime coat provided before the laying of bituminious emulsion VG-10 layer on WBM surface including cleaning the road surface and spraying primer a the rate of 10 kg/10 sqm using mechanical means. Binder shall be confirming to the specifications complete in all respect to the entire satisfaction of Engineer-in-charge.

1.1 Scope

This work shall consist of the application of a single coat of low viscosity liquid bituminous material to a porous granular surface preparatory to the superimposition of bituminous treatment or mix. The work shall be carried out on a previously prepared granular/ stabilized surface to Clause 501.8.

1.2 Materials

1.2.1 The primer shall be cationic bitumen emulsion SS1 grade conforming to IS: 8887 or medium curing cutback bitumen conforming to IS: 217 or as specified in the Contract.

1.2.2 Quantity of SS1 grade bitumen emulsion for various types of granular surface shall be as given in Table 500-3.

Table 500-3 : Quantity of Bitumen Emulsion for Various Types of Granular Surfaces

Type of Surface	Rate of Spray (kg/sq.m)
WMM/ WBM	0.7-1.0
Stabilized soil bases/Crusher Run Macadam	0.9-1.2

1.2.3 Cutback for primer shall not be prepared at the site. Type and quantity of cutback bitumen for various types of granular surface shall be as given in Table 500-4.

Table 500-4: Type and Quantity of Cutback Bitumen for Various Types of Granular Surface

Type of Surface	Type of Cutback	Rate of Spray (kg/sq.m)
WMM/ WBM	MC30	0.6-0.9
Stabilized soil bases/Crusher Run Macadam	MC70	0.9-1.2

1.2.4 The correct quantity of primer shall be decided by the Engineer and shall be such that it can be absorbed by the surface without causing run-off of excessive primer and to achieve desired penetration of about 8-10 mm.

1.3 Weather and Seasonal Limitations

Primer shall not be applied during a dust storm or when the weather is foggy, rainy or windy or when the temperature in the shade is less than 10OC. Cutback bitumen as primer shall not be applied to a wet surface. Surfaces which are to receive emulsion primer should be damp, but no free or standing water shall be present. Surface can be just wet by very light sprinkling of water.

1.4 Construction

1.4.1 Equipment

The primer shall be applied by a self-propelled or towed bitumen pressure sprayer equipped for spraying the material uniformly at specified rates and temperatures. Hand spraying shall not be allowed except in small areas, inaccessible to the distributor, or in narrow strips where primer shall be sprayed with a pressure hand sprayer, or as directed by the Engineer.

1.4.2 Preparation of Road Surface

The granular surface to be primed shall be swept clean by power brooms or mechanical sweepers and made free from dust. All loose material and other foreign material shall be removed completely. If soil/ moorum binder has been used in the WBM surface, part of this should be brushed and removed to a depth of about 2 mm so as to achieve good penetration.

1.4.3 Application of Bituminous Primer

After preparation of the road surface as per Clause 1.4.2, the primer shall be sprayed uniformly at the specified rate. The method for application of the primer will depend on the type of equipment to be used, size of nozzles, pressure at the spray bar and speed of forward movement. The Contractor shall demonstrate at a spraying trial, that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified.

No heating or dilution of SS1 bitumen emulsion and shall be permitted at site. Temperature of cutback bitumen shall be high enough to permit the primer to be sprayed effectively though the jets of the spray and to cover the surface uniformly.

1.4.4 Curing of Primer and Opening to Traffic

A primed surface shall be allowed to cure for at least 24 hours or such other higher period as is found to be necessary to allow all the moisture/volatiles to evaporate before any subsequent surface treatment or mix is laid. Any unabsorbed primer shall first be blotted with a light application of sand, using the minimum quantity possible. A primed surface shall not be opened to traffic other than that necessary to lay the next course.

1.5 Quality Control of Work

For control of the quality of materials and the works carried out, the relevant provisions of Section 900 shall apply.

1.6 Arrangements for Traffic

During construction operations, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

1.7 Measurement for Payment

Prime coat shall be measured in terms of surface area of application in square metres.

1.8 Rate

The contract unit rate for prime coat shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 1.7 (i) to (v) and as applicable to the work specified in these Specifications. Payment shall be made on the basis of the provision of prime coat at an application rate of quantity at 0.6 kg per square metre or at the rate specified in the Contract, with adjustment, plus or minus, for the variation between this quantify and the actual quantity approved by the Engineer after the preliminary trials referred to in Clause 1.4.3.

The rate shall be for unit of Sqm.

5.05 Providing and laying 50 mm B.M. with B.T. agreegate as per MORT & H specification and Emulsion for tack coat @2.5 kg/10 sqmt with mechanical sprayer & bitumen grade 70 / 60or 80/100 for mixing at 40.00 kg/mt i.e. 4.00% of total mix including heating the agreegate continuous batching drum mix plant and spreading the same by sensor paver finisher and consolidation with vibratory roller including providing all materials equipments, tools and plants, fire wood, oil, kerosene, labour charges etc. complete using contractor's own machinery drum mix plant and paver finisher etc complete.

1.1 Scope

The specification describes the design and construction procedure for Dense Bituminous Macadam, (DBM), for use mainly, but not exclusively, in base/binder and profile corrective courses. The work shall consist of construction in a single or multiple layers of DBM on a previously prepared base or sub-base. The thickness of a single layer shall be 50 mm to 100 mm.

1.2 Materials

1.2.1 Bitumen

The bitumen shall be viscosity grade paving bitumen complying with the Indian Standard specification IS:73, modified bitumen complying with Clause 501.2.1 or as otherwise specified in the Contract. The type and grade of bitumen to be used shall be specified in the Contract.

1.2.2 Coarse Aggregates

The coarse aggregates shall consist of crushed rock, crushed gravel or other hard material retained on 2.36 mm sieve. They shall be clean, hard, durable, of cubical shape, free from dust and soft or friable matter, organic or other deleterious substances. Where the Contractor's selected source of aggregates has poor affinity for bitumen, the Contractor shall produce test results that with the use of anti-stripping agents, the stripping value is improved to satisfy the specification requirements. The Engineer may approve such a source and as a condition for the approval of that source, the bitumen shall be treated with an approved anti-stripping agent, as per the manufacturer's recommendations, at the cost of the Contractor. The aggregates shall satisfy the requirements specified in Table 500-8.

Where crushed gravel is proposed for use as aggregate, not less than 90 percent by weight of the crushed material retained on the 4.75 mm sieve shall have at least two fractured faces.

1.2.3 Fine Aggregates

Fine aggregates shall consist of crushed or naturally occurring mineral material, or a combination of the two, passing the 2.36 mm sieve and retained on the 75 micron sieve. These shall be clean, hard, durable, dry and free from dust, and soft or friable matter, organic or other deleterious matter. Natural sand shall not be allowed in binder courses. However, natural sand up to 50 percent of the fine aggregate may be allowed in base courses. The fine aggregate shall have a sand equivalent value of not less than 50 when tested in accordance with the requirement of IS:2720 (Part 37). The plasticity index of the fraction passing the 0.425 mm sieve shall not exceed 4, when tested in accordance with IS:2720 (Part 5).

1.2.4 Filler

Filter shall consist of finely divided mineral matter such as rock dust, hydrated lime or cement approved by the Engineer. The filler shall be graded within the limits indicated in Table 500-9.

The filler shall be free from organic impurities and have a plasticity Index not greater than 4. The Plasticity Index requirement shall not apply if filler is cement or lime. Where the aggregates fail to meet the requirements of the water sensitivity test in Table 500-8, then2 percent by total weight of aggregate, of hydrated lime shall be used and percentage of fine aggregate reduced accordingly.

1.3 Aggregate Grading and Binder Content

When tested in accordance with IS.2386 Part 1 (wet sieving method), the combined grading of the coarse and fine aggregates and filler for the particular mixture shall fall within the limits given in Table 500-10 for grading 1 or 2 as specified in the Contract. To avoid gap grading, the combined aggregate gradation shall not vary from the lower limit on one sieve to higher limit on the adjacent sieve.

Table 500-8 : Physical Requirements for Coarse Aggregate for Dense Bituminous Macadam

Property	Test	Specification	Method of Test
Cleanliness (dust)	Grain size analysis	Max 5% passing 0.075 mm sieve	IS:2386 Part I
Particle shape	Combined Flakiness and Elongation Indices*	Max 35%	IS:2386 Part I
Strength	Los Angeles Abrasion Value or Aggregate Impact Value	Max 35% Max 27%	IS:2386 Part IV
Durability	Soundness either : Sodium Sulphate or Magnesium Sulphate	Max 12% Max 18%	IS:2386PartV
Water Absorption	Water Absorption	Max 2%	IS:2386 Part III
Stripping	Coating and Stripping of Bitumen Aggregate Mix	Minimum retained coating 95%	IS:6241
Water Sensitivity	Retained Tensile Strength**	Min. 80%	AASHTO 283

* To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles be separated out from the remaining (non-flaky) stone metal. Elongation index is weight of elongated particles divided by total non-flaky particles. The values of flakiness index and elongation index so found are added up.

** If the minimum retained tensile test strength falls below 80 percent, use of anti-stripping agent is to meet the requirement.

Table 500-9: Grading Requirements for Mineral Filler

IS sieve (mm)	Cumulative Percent Passing by Weight of Total Aggregate
0.6	**100**
0.3	**95-100**
0.075	**85-100**

Table 500-10: Composition of Dense Graded Bituminous Macadam

Grading	**1**	**2**
Nominal aggregate size*	37.5 mm	26.5 mm
Layer thickness	75-100 mm	50 - 75 mm
IS Sieve1 (mm)	Cumulative % by weight of total aggregate passing	
45	100	
37.5	95-100	100
26.5	63-93	90-100
19	-	71-95
13.2	55-75	56-80
9.5	-	-
4.75	38-54	38-54
2.36	28-54	28-42
1.18	-	-
0.6	-	-
0.3	7-21	7-21
0.15	-	-
0.075	2-8	2-8
Bitumen content ** percent by mass of total mix	Min 4.0**	Min 4.5**

* The nominal maximum particle size is the largest specified sieve size upon which any of the aggregate is retained.

** Corresponds to specific gravity of aggregates being 2.7. In case aggregate have specific gravity more than 2.7, the minimum bitumen content can be reduced proportionately. Further the region where highest daily mean air temperature is 30°C or lower and lowest daily air temperature is - 10°C or lower, the bitumen content may be increased by 0.5 percent.
Bitumen content indicated in Table 500-10 is the minimum quantity. The quantity shall be determined in accordance with Clause 505.3.

1.3 Mix Design

The bitumen content required shall be determined following the Marshall mix design procedure contained in Asphalt Institute ManualMS-2.
The Fines to Bitumen (F/B) ratio by weight of total mix shall range from 0.6 to 1.2.

1.3.1 Requirements for the Mix

Apart from conformity with the grading and quality requirements for individual ingredients, the mixture shall meet the requirements set out in Table 500-11.

Table 500-11: Requirements for Dense Graded Bituminous Macadam

Pro parties	**Viscosity Grade Paving Bitumen**	**Modified bitumen**		**Test Method**
		Hot climate	**Cold climate**	
Compaction level	75 blows on each face of the specimen			

Minimum stability (Kn at600C)	**9.0**	12.0	**10.0**	AASHTO T245
Marshall flow (mm)	2 - 4	2.5-4	3.5-5	AASHTO T245
Marshall Quotient stability flow (mm)	2 - 5	2.5-5		MS-2 and ASTM D2041
% air voids	3 - 5			
% Voids Filled with Bitumen (VFB)	65-75			
Coating of aggregate particle	95% minimum			IS:6241
Tensile Strength ratio	80% Minimum			AASHTO T 283
% Voids in Mineral Aggregate (VMA)	Minimum percent voids in mineral aggregate (VMA) are set out in Table 500-13			

1.3.2 Binder Content

The binder content shall be optimized to achieve the requirements of the mix set out in Table 500-11. The binder content shall be selected to obtain 4 percent air voids in the mix design. The Marshall method for determining the optimum binder content shall be adopted as described in the Asphalt Institute Manual MS-2.

Where maximum size of the aggregate is more than 26.5 mm, the modified Marshall method using 150 mm diameter specimen described in MS-2 and ASTM D 5581 shall be used. This method requires modified equipment and procedures. When the modified Marshall test is used, the specified minimum stability values in Table 500-12 shall be multiplied by 2.25, and the minimum flow shall be 3 mm.

Table 500-12 : Minimum Percent Voids In Mineral Aggregate (VMA)

Nominal Maximum Particle Size1 (mm)	Minimum VMA Percent Related to Design Percentage Air voids		
	3.0	4.0	5.0
26.5	11.0	12.0	13.0
37.5	10.0	11.0	12.0

Note : Interpolate minimum voids in the mineral aggregate (VMA) for designed percentage air voids values between those listed.

1.3.3 Job Mix Formula

The Contractor shall submit to the Engineer for approval at least 21 days before the start the work, the job mix formula proposed for use in the works, together with the following details:

i) Source and location of all materials;

ii) Proportions of all materials expressed as follows:

a) Binder type, and percentage by weight of total mix;

b) Coarse aggregate/Fine aggregate/Mineral filler as percentage by weight of total aggregate including mineral filler;

iii) A single definite percentage passing each sieve for the mixed aggregate;

iv) The individual grading of the individual aggregate fraction, and the proportion of each in the combined grading;

v) The results of mix design such as maximum specific gravity of loose mix (Gmm), compacted specimen densities, Marshall stability, flow, air voids, VMA, VFB and related graphs and test results of AASHTO T 283 Moisture susceptibility test:

vi) Where the mixer is a batch mixer, the individual weights of each type of aggregate, and binder per batch;

vii) Test results of physical characteristics of aggregates to be used;

viii) Mixing temperature and compacting temperature.

While establishing the job mix formula, the Contractor shall ensure that it is based on a correct and truly representative sample of the materials that will actually be used in the work and that the mix and its different ingredients satisfy the physical and strength requirements of these Specifications.

Approval of the job mix formula shall be based on independent testing by the Engineer for which samples of all ingredients of the mix shall be furnished by the Contractor as required by the Engineer.

The approved job mix formula shall remain effective unless and until a revised Job Mix Formula is approved. Should a change in the source of materials be proposed, a new job mix formula shall be forwarded by the Contractor to the Engineer for approval before the placing of the material.

1.4 Plant Trials - Permissible Variation in Job Mix Formula

Once the laboratory job mix formula is approved, the Contractor shall carry out plant trials to establish that the plant can produce a uniform mix conforming to the approved job mix formula. The permissible variations of the individual percentages of the various ingredients in the actual mix from the job mix formula to be used shall be within the limits as specified in Table 500-13 and shall remain within the gradation band. These variations are intended to apply to individual specimens taken for quality control tests in accordance with Section 900.

Table 500-13 : Permissible Variations in the Actual Mix from the Job Mix Formula

Description	Base/binder Course
Aggregate passing 19 mm sieve or larger	±8%
Aggregate passing 13.2 mm, 9.5 mm	±7%
Aggregate passing 4.75 mm	± 6%
Aggregate passing 2.36 mm, 1.18 mm, 0.6 mm	±5%
Aggregate passing 0.3 mm, 0.15 mm	±4%
Aggregate passing 0.075 mm	±2%
Binder content	± 0.3%
Mixing temperature	± 10°C

1.5 Laying Trials – Once the plant trials have been successfully completed and approved, the Contractor shall carry out laying trials, to demonstrate that the proposed mix can be successfully laid and compacted all in accordance with Clause 501. The laying trial shall be carried out on a suitable area which is not to form part of the works. The area of the laying trials shall be a minimum of 100 sq. M. of construction similar to that of the project road, and it shall be in all respects, particularly compaction, the same as the project construction, on which the bituminous material is to be laid.

The Contractor shall previously inform the Engineer of the proposed method for laying and compacting the material. The plant trials shall then establish if the proposed laying plant, compaction plant, and methodology is capable of producing satisfactory results. The density of the finished paving layer shall be determined by taking cores, no sooner than 24 hours after laying, or by other approved method. The compacted layers of Dense Graded Bituminous Macadam (DBM) shall have a minimum field density equal to or more than 92%of the density based on theoretical maximum specific gravity (Gmm) obtained on the day of compaction in accordance with ASTM D 2041.

Once the laying trials have been approved, the same plant and methodology shall be applied to the laying of the material on the project, and no variation of either shall be acceptable, unless approved in writing by the Engineer, who may at his discretion require further laying trials

1.6 Construction Operations

1.6.1 Weather and Seasonal Limitations

The provisions of Clause 501.5.1 shall apply.

1.6.2 Preparation of Base

base on which Dense Graded Bituminous Material is to be laid shall be prepared in accordance with clauses 501 and 902 as appropriate, or as directed by the Engineer.

1.6.3 Geo synthetics

Where Geo synthetics are specified in the Contract, this shall be in accordance with the requirements stated in Clause 703.

1.6.4 Stress Absorbing Layer

Where a stress absorbing layer is specified in the Contract, this shall be applied in accordance with the requirements of Clause 517.

1.6.5 Prime Coat

Where the material on which the dense bituminous macadam is to be laid is other than a bitumen bound layer, a prime coat shall be applied, as specified, in accordance with the provisions of Clause 1, or as directed by the Engineer.

1.6.6 Tack Coat

Where the material on which the dense bituminous macadam is to be laid is either bitumen bound layer or primed granular layer, tack coat shall be applied, as specified, in accordance with the provisions of Clause 1, or as directed by the Engineer.

1.6.7 Mixing and Transportation of the Mix

The provisions as specified in Clauses 501.3 and 501.4 shall apply. Table 500-2 gives the mixing, laying and rolling temperature for dense mixes using viscosity grade bitumen. In case of modified bitumen, the temperature of mixing and compaction shall be higher than the mix with viscosity grade bitumen. The exact temperature depends upon the type and amount of modifier used and shall be adopted as per the recommendations of the manufacturer. In order to have uniform quality, the plant shall be calibrated from time to time.

1.6.8 Spreading

The provisions of Clauses 501.5.3 and 501.5.4 shall apply.

1.6.9 Rolling

The general provisions of Clauses 501.6 and 501.7 shall apply, as modified by the approved laying trials. The compaction process shall be carried out by the same plant, and using the same method, as approved in the laying trials, which may be varied only with the express approval of the Engineer in writing.

1.6.10 Opening to Traffic

It shall be ensured that the traffic is not allowed without the approval of the Engineer in writing, on the surface until the dense bituminous layer has cooled to the ambient temperature.

1.6.11 Surface Finish and Quality Control of Work

The surface finish of the completed construction shall conform to the requirements of Clause 902. All materials and workmanship shall comply with the provisions set out in Section 900 of these Specifications.

1.6.12 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

1.7 Measurement for Payment

Dense Graded Bituminous Materials shall be measured as finished work either in cubic meters, tonnes or by the square meter at a specified thickness as indicated in the Contract drawings, or documents, or as otherwise directed by the Engineer.

1.8 Rate

The contract unit rate for Dense Graded Bituminous Macadam shall be payment in full for carrying out all the required operations as specified and shall include, to all components listed in Clause 501.8.8.2. The rate shall include the provision of bitumen, at 4 percent and 4.5 percent by weight of the total mixture for grading 1 and grading 2 respectively. The variation in actual percentage of bitumen used shall be assessed and the payment adjusted plus or minus accordingly.

The Measurement of the item shall be in MT basis.

5.06 Providing and laying 30 mm thick compacted asphaltic concrete with B.T. agreegate as per MORT & H specification and asphalt 80/100 for tack coat @2.5 kg/10 sqmt with mechanical sprayer & bitumen grade 80/100 for mixing at 60.00 kg/mt i.e. 6.00% of total mix including heating the agreegate & asphalt VG-10 in continuous batching drum mix plant and spreading the same by sensor paver finisher with rolling and consolidation with 10-12 tones vibratory and power roller including providing all materials equipments, tools and plants, fire wood, oil, kerosyn, labour charges etc. complete using contractor's own machinery drum mix plant and paver finisher etc complete.

The relevant specifications for Bituminous Concrete are as per MORT&H fifth revision Clause 507 applicable to this item.

1.1 Scope

This work shall consist of construction of Bituminous Concrete, for use in wearing and profile corrective courses. This work shall consist of construction in a single layer of bituminous concrete on a previously prepared bituminous bound surface. A single layer shall be 30 mm/40 mm/50 mm thick.

1.2 Materials

1.2.1 Bitumen

The bitumen shall conform to Clause 1.2.1.

1.2.2 Coarse Aggregates

The coarse aggregates shall be generally as specified in Clause 1.2.2, except that the aggregates shall satisfy the physical requirements of Table 500-16 and where crushed gravel is proposed for use as aggregate, not less than 95 percent by weight of the crushed material retained on the 4.75 mm sieve shall have at least two fractured faces.

Table 500-16: Physical Requirements for Coarse Aggregate for Bituminous Concrete

Property	Test	Specification	Method of Test
Cleanliness (dust)	Grain size analysis	Max 5% passing 0.075 mm sieve	IS:2386 Part I
Particle shape	Combined Flakiness and Elongation Indices*	Max 35%	IS:2386 Part I
Strength	Los Angeles Abrasion Value or Aggregate Impact Value	Max 30% Max 24%	IS:2386 Part IV
Durability	Soundness either : Sodium Sulphate or Magnesium Sulphate	Max 12% Max 18%	IS:2386PartV
Polishing	Polished stone value	Min 55	BS:812-114
Water Absorption	Water Absorption	Max 2%	IS:2386 Part III
Stripping	Coating and Stripping of Bitumen Aggregate Mix	Minimum retained coating 95%	IS:6241
Water Sensitivity	Retained Tensile Strength**	Min. 80%	AASHTO 283

* If the minimum retained tensile test strength falls below 80 percent, use of anti-stripping agent is recommended to meet the requirement.

1.2.3 Fine Aggregates

The fine aggregates shall be all as specified in Clause 505.2.3.

1.2.4 Filler

Filler shall be as specified in Clause 505.2.4.

1.2.5 Aggregate Grading and Binder Content

When tested in accordance with IS:2386 Part 1 (Wet grading method), the combined grading of the coarse and fine aggregates and filler shall fall within the limits shown in Table 500-17. The grading shall be as specified in the Contract.

Table 500-17: Composition of Bituminous Concrete Pavement Layers

Grading	**1**	**2**
Nominal aggregate size*	19 mm	26.5 mm
Layer thickness	50 mm	50 - 75 mm
IS Sieve1 (mm)	Cumulative % by weight of total aggregate passing	
45		
37.5		
26.5	100	
19	90-100	100
13.2	59-79	90-100
9.5	52-72	70-88
4.75	35-55	53-71
2.36	28-44	42-58
1.18	20-34	34-48
0.6	15-27	26-38
0.3	10-20	18-28
0.15	5-13	12-20
0.075	2-8	4-10
Bitumen content ** percent by mass of total mix	Min 5.2*	Min 5.4**

Notes:

* The nominal maximum particle size is the largest specified sieve size up on which any of the aggregate is retained.

** Corresponds to specific gravity of aggregate being 2.7. In case aggregate have specific gravity more than 2.7, the minimum bitumen content can be reduced proportionately. Further the region where highest daily mean air temperature is 30°C or lower and lowest daily air temperature is - 10°C or lower, the bitumen content may be increased by 0.5 percent

1.3 Mix Design

1.3.1 Requirements for the Mix

Clause 505.3.1 shall apply.

1.3.2 Binder Content

Clause 505.3.2 shall apply.

1.3.3 Job Mix Formula

Clause 505.3.3 shall apply.

1.3.4 Plant Trials - Permissible Variation in Job Mix Formula

The requirements for plant trials shall be as specified in Clause 505.3.4, and permissible limits for variation as given in Table 500-18.

Table 500-18: Permissible Variations in Plant Mix from the Job Mix Formula

Description	Base/binder Course
Aggregate passing 19 mm sieve or larger	±7%
Aggregate passing 13.2 mm, 9.5 mm	±6%
Aggregate passing 4.75 mm	±5%
Aggregate passing 2.36 mm, 1.18 mm, 0.6 mm	±4%
Aggregate passing 0.3 mm, 0.15 mm	±3%
Aggregate passing 0.075 mm	±1.5%
Binder content	± 0.3%
Mixing temperature	± 10°C

1.3.5 Laying Trials

The requirements for laying trials shall be as specified in Clause 505.3.5. The compacted layers of bituminous concrete (BC) shall have a minimum field density equal to or more than 92 percent of the average theoretical maximum specific gravity (Gmm) obtained on the day of compaction in accordance with ASTM D2041.

1.4 Construction Operations

1.4.1 Weather and Seasonal Limitations

The provisions of Clause 501.5.1 shall apply.

1.4.2 Preparation of Base

The surface on which the bituminous concrete is to be laid shall be prepared in accordance with Clauses 501 and 902 as appropriate, or as directed by the Engineer. The surface shall be thoroughly swept clean by mechanical broom and dust removed by compressed air. In locations where a mechanical broom cannot get access, other approved methods shall be used as directed by the Engineer.

1.4.3 Geo synthetics

Where Geo synthetics are specified in the Contract, this shall be in accordance with the requirements stated in Clause 703.

1.4.4 Stress Absorbing Layer

Where a stress absorbing layer is specified in the Contract, this shall be applied in accordance with the requirements of Clause 517.

1.4.5 Tack Coat

The provisions as specified in Clause 1.4.6 shall apply.

1.4.6 Mixing and Transportation of the Mix

The provisions as specified in Clauses 501.3, 501.4 and 1.4.7 shall apply.

1.4.7 Spreading

The general provisions of Clauses 501.6 and 501.7 shall apply, as modified by the approved laying trials.

1.4.8 Rolling

The general provisions of Clauses 501.6 and 501.7 shall apply, as modified by the approved laying trials.

1.5 Opening to Traffic

Provisions in Clause 1.5 shall apply.

1.6 Surface Finish and Quality Control

The surface finish of the completed construction shall conform to the requirements of Clause 902. All materials and workmanship shall comply with the provisions set out in Section 900 of these Specifications.

1.7 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

1.8 Measurement for Payment

The measurement shall be as specified in **Clause 505.8.**

1.9 Rate

The contract unit rate shall be all as specified in Clause 1.9, except that the rate shall include the provision of bitumen at 5.2 percent & 5.4 percent for grading 1 and grading 2 by weight of total mix respectively. The variation in actual percentage of bitumen used will be assessed and the payment adjusted plus and minus accordingly.

The Measurement of the item shall be in MT basis.

5.07 Providing and laying evenly priming/tack coat on the prepared surface, heating bitumen with sprey set fitted on bitumen boiler on black topped surface bitumen at 5kg/10smt

And

5.08 Providing and laying premix seal coat surfacing on the prepared surface as wearing course with specified graded crushed aggregates premixed with bituminous binder.

Scope

The work shall consist of the application of a single coat of low viscosity liquid bituminous material to existing bituminous, cement concrete or primed granular surface preparatory to the superimposition of a bituminous mix, when specified in the Contract or as instructed by the Engineer. The work shall be carried out on a previously prepared surface in accordance with Clause 501.8.

Materials

The binder used for tack coat shall be either Cationic bitumen emulsion (RS 1) complying with IS:8887 or suitable low viscosity paving bitumen of VG 10 grade conforming to IS:73. The use of cutback bitumen RC:70 as per IS:217 shall be restricted only for sites at sub-zero temperatures or for emergency applications as directed by the Engineer. The type and grade of binder for tack coat shall be as specified in the Contract or as directed by the Engineer.

Weather and Seasonal Limitations

Bituminous material shall not be applied during a dust storm or when the weather is foggy, rainy or windy or when the temperature in the shade is less than 10°C. Where the tack coat consists of emulsion, the surface shall be slightly damp, but not wet. Where the tack coat is of cutback bitumen, the surface shall be dry.

Construction

Equipment

The tack coat shall be applied by a self-propelled or towed bitumen pressure sprayer, equipped for spraying the material uniformly at a specified rate. Hand spraying shall not be permitted except in small areas, inaccessible to the distributor, or narrow strips, shall be sprayed with a pressure hand sprayer, or as directed by the Engineer.

Preparation of Base

The surface on which the tack coat is to be applied shall be clean and free from dust, dirt, and any extraneous material, and be otherwise prepared in accordance with the requirements of Clauses 501.8. The

granular or stabilized surfaces shall be primed as per Clause 502. Immediately before the application of the tack coat, the surface shall be swept clean with a mechanical broom, and high pressure air jet, or by other means as directed by the Engineer.

Application of Tack Coat

The application of tack coat shall be at the rate specified in Table 500-5, and it shall be applied uniformly. If rate of application of Tack Coat is not specified in the contract, then it shall be the rate specified in Table 500-5. No dilution or heating at site of RS1 bitumen emulsion shall be permitted. Paving bitumen if used for tack coat shall be heated to appropriate temperature in bitumen boilers to achieve viscosity less than 2 poise. The normal range of spraying temperature for a bituminous emulsion shall be 20°C to 70°C and for cutback, 50°C to 80°C.

The method of application of tack coat will depend on the type of equipment to be used, size of nozzles, pressure at the spray bar, and speed or forward movement. The Contractor shall demonstrate at a spraying trial, that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified.

Table - Rate of Application of Tack Coat

Type of Surface	Rate of Spray of Binder in Kg per sq.m
Bituminous surfaces	0.20-0.30
Granular surfaces treated with primer	0.25-0.30
Cement concrete pavement	0.30-0.35

Curing of Tack Coat

The tack coat shall be left to cure until all the volatiles have evaporated before any subsequent construction is started. No plant or vehicles shall be allowed on the tack coat other than those essential for the construction

.

Quality Control of Work

For control of the quality of materials and the works carried out, the relevant provisions of Section 900 shall apply.

Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

Measurement for Payment

Tack coat shall be measured in terms of surface area of application in square metres.

Rate

The contract unit rate for tack coat shall be payment in full for carrying out the required operations including for all components listed in Clause 401.8 (i) to (v) and as applicable to the work specified in these Specifications. The rate shall cover the provision of tack coat, at 0.2 kg per square metre or at the rate specified in the Contract, with the provision that the variation between this quantity and actual quantity of bitumen used will be assessed and the payment adjusted accordingly.

The Measurement of the item shall be in Sqm basis.

5.10 Providing & fixing to wall ceiling, floor & trenches CPVC pipes SDR-11 ISI mark of following outside dia. Tube fittings & clamps with all as per required fitting such as reducing coupler , union, band plug, end cap ,pipe clip, tee, hex niple, elbow, coupler, etc. complete with using bonding materials rates are including of making good the wall ceiling & floor etc. Complete (excavation of earth in trenches and filling will be paid separately) (1) 32mm inner dia

5.11 Providing & fixing to wall ceiling, floor & trenches CPVC pipes SDR-11 ISI mark of following outside dia. Tube fittings & clamps with all as per required fitting such as reducing coupler , union, band plug, end cap ,pipe clip, tee, hex niple, elbow, coupler, etc. complete with using bonding materials rates are including of making good the wall ceiling & floor etc. Complete (excavation of earth in trenches and filling will be paid separately) (2) 20.00 mm inner dia.

5.11 CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPES

5.11.1 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%.
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 18.16 below.

TABLE 5.11.16

Sl. No.	Nominlal Size	Nominal Outside Dia.	Mean Outside dia		Wall thickness at any point		Class thickness					
							Class 1, SDR 11			Class 3, SDR 17		
			Min	Max	Min	Max	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	2.0	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
1. 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.

18.9.2 Dimensions of Pipes
The outside diameter at any point and wall thickness shall be as given in Table 18.16.

18.9.2.1 ***Diameter :*** The outside diameter at any point as given in Table 18.16 shall be measured according to the method given in IS 12235 (part 1).

15.11.2.2 *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 dn rounded off to the next higher 0.1 mm.

15.11.2.3 *Wall Thickness :* The wall thickness of the pipes shall be as given in Table 18.16. 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 18.16).

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(d) The maximum wall thickness at any point shall be within the range 0.15eMin (see Table 18.16).
(e) The results of these calculations for checking tolerance shall be rounded off to the next higher 0.1 mm.

15.11.2.4 ***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.

15.11.3 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.

15.11.4 Physical and Chemical Characteristics

15.11.4.1 ***Visual Appearance :*** The colour of the pipes shall be off-white. Slight variations in the appearance of the colour are permitted.
The internal and external surface of the pipe shall be smooth, clean and free from grooving and other defects.

15.11.4.2 ***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).

15.11.4.3 ***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.

15.11.4.4 ***Reversion Test :*** When tested by the method prescribed in IS 12235 (Part 5/ Sec 1 and Sec 2), a length of pipe 200 ±20 mm long shall not alter in length by more than 5 per cent.

15.11.4.5 ***Vicat Softening Temperature :*** When tested by the method prescribed in IS 12235 (part 2), the Vicat softening temperature of the specimen shall not be less than 110°C.

15.11.4.6 ***Density :*** When tested in accordance with IS 12235 (Part 14), the density of the pipes shall be between 1450kg/m3 and 1650kg/m3.

15.11.5 Mechanical Properties

15.11.5.1 ***Hydrostatic Characteristics :*** When subject to internal hydrostatic pressure test in accordance with the procedure given in IS 12235 (part 8/Sec 1), the pipe shall not fail during the prescribed test duration. The temperatures, duration and hydrostatic (hoop) stress for the test shall conform to the requirements given in Table 18.17. The test shall be carried out not earlier than 24 h after the pipes have been manufactured.

TABLE 15.11.17
Requirements of Pipes for Internal Hydrostatic Pressure Test
(Clause* 15.11.*5.1)

Sl. No.	*Test*	*Test Temperature Min*	*Test Period*	*Hydrostatic (Hoop) stress*
		Deg C	h	Mpa
1	2	3	4	5
i	Acceptance	20	1	43.0
ii	Type	95	195	5.6
iii	Type	95	1000	4.6
iv	Type	95	8760	3.6 (Test for thermal stability)

15.11.5.2 ***Thermal Stability by Hydrostatic Pressure Testing :*** When subject to internal hydrostatic pressure test in accordance with the procedure given in IS 12235 (Part 8/Sec 1) and as per requirement given in Table 18.17, Sl. No. (iv), the pipe shall not burst or leak during the prescribed test duration.

15.11.5.3 ***Resistance to External Blow at 0°C :*** When tested by the method prescribed in IS 4985, with classified striker mass and drop height as given in Table 18.18, the pipe shall have a true impact rate of not more than 10 per cent.

TABLE 15.11.18
Classified Striker Mass and Drop Height Conditions for the Falling Weight Impact Test
(Clause* 15.11.*5.3)

Sl no	*Nominal Pipe Size*	*Mass of Falling Weight*	*Falling Height*
	mm	*Kg*	*mm*
1	2	3	4
i	*15*	0.5±0.5%	300±10
ii	*20*	0.5±0.5%	400±10
iii	*25*	0.5±0.5%	500±10
iv	*32*	0.5±0.5%	600±10
v	*40*	0.5±0.5%	800±10
vi	*50*	0.5±0.5%	1000±10
vii	*65*	0.8±0.5%	1000±10
viii	*80*	0.8±0.5%	1200±10
ix	*100*	1.0±0.5%	1600±10
x	*150*	1.6±0.5%	2000±10

15.11.5.4 ***Flattening Test :*** When tested by the method prescribed in IS 12235 (part 19), pipe shall show no signs of cracking, splitting and breaking.

15.11.5.5 ***Tensile Strength :*** When tested by the method prescribed in IS 12235 (Part 19), the tensile strength at yield shall not be less than 50 MPa at 27 ± 2°C.

15.11.6 Sampling and Criteria for Conformity
The sampling procedure and criteria for conformity shall be as given in Annexure F.

15.11.7. Marking

15.11.7.1 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 or trade-mark
(b) Outside diameter,
(c) Class of pipe and pressure rating, and
(d) Bath or lot number

15.11.7.2 ***BIS Certification Marking :*** Each pipe may also be marked with the Standard Mark.

18.9.8 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:
(1) Manufacturer's name/trade mark.
(2) Size of fitting

Workmanship:

15.11.9 Piping Installation Support and Spacing

15.11.9.1 ***Concealed Piping:*** Pipes can be concealed in chases. The pipes and fitting are to be pressure tested prior to concealing the chases. To maintain alignment of CP fittings while joining, all alignment of fittings and pipe shall be done correctly. DO NOT USE NAILS FOR HOLDING OF PIPES IN THE CHASES.

15.11.9.2 ***External Installations:*** For pipes fixed in the shafts, ducts etc. there should be sufficient space to work on the pipes. Pipes sleeves shall be fixed at a place the pipe is passing through a wall or floor so as to allow freedom for expansion and contraction. Clamping of the pipe is done to support it while allowing the freedom for movement. All pipes exposed to sunlight shall be painted with a water based acrylic paint emulsion to enhance UV protection. Pipes in trenching shall be laid in accordance to the Good Plumbing practices followed for Metal piping.

Recommended Support Spacing (Distance between Pipe Clamps Horizontal Support)

Pipe Size	**Horizontal Support (In meters)**			
	Temperature			
	23°C	38°C	60°C	82°C
16 mm (1/2")	1.22	1.22	1.07	0.92
20 mm (3/4")	1.53	1.37	1.22	0.92
25 mm (1/0")	1.68	1.30	1.37	0.92
32 mm (1 1/4")	1.83	1.68	1.53	1.22

40 mm (1 1/2")	1.98	1.83	1.68	1.22
50 mm (2")	2.29	2.14	1.98	1.22

15.11.9.3 ***Expansion LOOP:*** CPVC systems, like all piping materials, expand and contract with changes in temperatures. CPVC pipes shall expand 7.5 cm per 30 m length for a 400C temperature change. Expansion does not vary with Pipe size. Thermal expansion can be generally be accommodated at changes in direction. On a long straight run, an offset or loop based on the following chart is required.

Nominal Pipe size	**Length of Run (Meter), Loop length in cms.**				
	6 metre	**12 metre**	**18 metre**	**24 metre**	**30 metre**
15 mm	43	56	69	79	86
20 mm	48	66	81	91	104
25 mm	53	74	91	104	117
32 mm	58	81	102	117	130
40 mm	63	89	109	127	142
50 mm	71	102	124	145	63

15.11.10 Testing
All water supply systems shall be tested to hydrostatic pressure test. The pressure tests are similar to the test pressure used for other plastic/metal pipes. System may be tested in sections and such section shall be entirely checked on completion of connection to the overhead tank or pumping system or mains.

15.11.11 Mode of measurement and payment :
The net length of pipes as laid or fixed shall be measured in running meters correct to a cm for the finished work, which shall include CPVC pipe and all types of specials including plain and Brass threaded fittings and jointing solvent cement.

The rate shall include the cost of labour, materials, tools, plant etc involved in all the operations described above.

The rate shall be for a unit of one Rmt.

5.15 Providing & fixing M25 grade of concrete precast exposed/ fare finish kerb stones (factory made) of approved make and as per approved sample of any size and shape. Kerb shall be fixed on the foundation prepared of M15 grade concrete including joining, curing, formwork (if required for base) etc. complete. The rate shall also include the flush pointing in CM (1:2) for all joints of the kerb stones. (Sample must be approved). The contractor rate shall also include the cost of excavation, base PCC M15 grade and finish good, curing etc complete as directed by engineer in charge. The rate shall be for unit of Cum of kerb volume.

1.0 Material
Pre cast kerb shall be of approved make and as per approved sample. Shape and size of kerb shall be as per design.

2.0 Workmanship

2.1 All Precast members shall be factory made, fair finish, M25 grade and as per approved sample..

2.2 The method of transporting and placing the precast members shall be as approved by the Architect and Engineer-in-charge. Members shall be so transported that no breakage or undue stresses are induced in them.

2.3 The pits of required size shall first be excavated, true to line and level. The specifications for excavation

shall be followed as per relevant item.

2.4 The pits shall be filled with a layer of 0.15 M. thick lean concrete M15. The kerbs shall be laid on existing PCC base in true line and plumb. The specifications for PCC work shall be followed as per relevant item.

2.5 The rate shall also include for erecting and fixing the pieces in position for complete Kerb systems with Chamfered type of kerbs including necessary accessories of kerb like Radius Kerbs, Angles and Quadrant Kerbs etc complete as per drawing. The rate shall also include the flush pointing in CM (1:2) for all joints of the kerb stones.

3.0 Mode of Measurement

3.1 The rate shall include the cost of all labour and activities involved in the operations described above i.e. excavation, back filling, PCC, precast kerb, laying, jointing and finishing the same.

3.2 The rate shall be for a unit of one Cum.

5.16 Providing and fixing welded wire mesh jali (Chainlink fencing) of panel 2.50 x2.50 mt size fabricated from vertical and Horizontal support of M.S. 75mmSquare Pipe and wire gauge jali of 10 gauge wire with spacing of 3 inches fitted with 50x5 mm M.S. Flat including welding and erecting the same in position in cc block 1:2:4 of size 50x50x50 cms at required spacing with necessary excavation including two coats of oil painting over single coat of primer etc. complete as directed

1.0 Material

1.1 Welded Steel wire fabric

1.1.1 Welded steel wire fabric shall conform to M-62.

Workmanship

2.1 The relevant specifications of item no. 10.02.a shall be followed except the work is to be carried out for wire mash jail as described in the item or as directed by the engineer-in-charge. The MS Angles, MS Flats etc. shall be used as per the drawing. The rate includes application of required coats of metal putty to make the surface smooth, 1 coat of Rustocap primer and 2 coat of Hi-Gloss Metal PU Paint of Asian paint or equivalent or as specified in item as per manufacture's specification.

3.0 Mode of Measurement and Payment

3.1 The rate shall be for an unit of one sqm. Clear visible area of the jail shall be measured. The rate shall be inclusive of all material and labor required for all operations as described in the item.

5.17 Providing and Laying trimix Controlled cement concrete M-25 finishing smooth with curing etc. complete including the cost of formwork but excluding the cost of reinforcement for R.C.C Road work having thickness of 19cms.compaction and finishing of cc road by trimix process on cc road surface by using vacuum dewatering, floater surface vibrator, making grooves, etc. Complete including the cost of formwork but excluding the cost of reinforcement for R.C.C Road work having thickness of 19cms. Rates are also inclusive of providing and Mixing Plasticizer of approved make.

Material and Workmanship:

1.1.1 General

The Contractor shall improve the quality of all concrete floor slabs by placing the concrete according to the Trimix system as indicated on the drawings and as specified herein.

1.1.2 Technical Assistance/Training of Labour

During the placement of concrete, the Contractor shall have a minimum of one person present at all times who has been adequately trained by a representative of the equipment manufacturer. This person shall be experienced in the vacuum dewatering process, and in the operation of all related equipment and shall

direct all concrete dewatering work performed. The Contractor shall provide the services of a representative from the manufacturer of the vacuum dewatering equipment on site for a period of time of at least eight (8) hours. The manufacturer's representative shall proved technical assistance for the vacuum dewatering process on the initial day of operation.

2.5.5 Equipment for compacting, placing, vacuum processing and finishing of slab

All process equipment to be used shall be of a design representative of the state of the art, and shall be subject to the approved of the engineer. Equipment shall be Trimix or approved equal. System shall have a demonstrated five years history of performing such work. The vacuum pumps shall be able to generate a minimum vacuum of 609mm (24 inches) of mercury (0.80 atmospheres) in actual operation using the maximum number and size of suction mats required for this work.

The Contractor shall have at the job site sufficient equipment (vacuum pumps, mats, fitter pads and accessories) to ensure that the vacuum dewatering process continues uninterrupted to completion. Stand by equipment is sometimes required.

2.5.6 Mix Design

The Contractor is responsible for the mix designs of the class as called for on the drawings and must submit the mix proposed for use in the contract before any work is started. All mix parameters must conform to the values specified in Trimix recommendations and design mix report.

The Contractors shall utilize a knowledgeable and experienced concrete technician for the design and production of mix (mixes) meeting all the requirements of the specifications.

Do not deliver any concrete to the construction site until all the approvals have been obtained.

2.5.7 Quality Control

The Contractor has the responsibility for achieving the quality of concrete specified by controlling the concrete mixes, placing, vacuum process finishing and curing. The concrete technician in charge must be present at the site when work is in progress.

The Contractor shall be responsible for mix adjustments, performing necessary tests, correcting deficiencies and trouble shooting in general.

The Contractor shall be required to maintain control charts showing individual test results for aggregate gradation, slump, air content, cement content and compressive strength.

2.5.8 Planning of Placing

The Contractors shall submit for review shop drawings for floor slabs detailing the location of all construction joints and the sequence of the slab placement and manufacturer's literature describing the equipment to be used. In addition to the shop drawings, the Contractor shall indicate the quantity of each piece of dewatering equipment that will be located at the construction site and shall include the dimensions of all suction mats.

Before concreting is started the work should be planned with a view to determine areas to be placed daily, the required amount of equipment, size of vacuum mats, length of vacuum hoses, arrangement of rails, if any, or screeds etc. Crew required for the vacuum process is two men to handle the mats and the pump. Note that placing, vibration, vacuum treatment and floating follow immediately behind each other.

Check position of vacuum pump in relation to vacuum mat location to find whether extra vacuum hoses are required.

2.5.9 Concrete Materials

Note: All concrete mix design shall meet the requirements of this section and section TRIMIX concrete mix design recommendations.

1.1.7.1 Cement

Portland cement of normal grinding fineness, which corresponds to a specific surface of 2600-3500

cm2/g, is required. Cement of higher grinding fineness, e.g. rapid-hardened Portland cement of larger specific surface's shall be avoided especially in concrete mixes with a cement content 590 lb/sq.yd. Recommended content is 421 to 590 LB/sq.yd.

2.5.10 Equipment Specification Trimix System

Poker vibrator with high frequency preferably 335 hz (20000 vibr/min) dia.1 to 1 1/2".
Surface vibrator type double beam with beam spacing 12".
Preferably one piece beam in full length exceeding bay width 8" to 24". Beam should easily be adjusted to absolute straightness and controlled every morning before placing of concrete starts.
Suction mat type RM 60. 100% tight plastic material weight 650 gram/m2. Width same as bay size and length 20' for capacity and flexibility.
Filter Pad type RD 12 weight 600 g/m2, width 4' length-bay width-minus 8".
Vacuum Pump P 4001 8 with 10 HP engine and specially designed pump unit with heavy duty chrome housing and sealing. Adjustable vacuum by valve on top of tank for ease of operation with different mix designs.
Skim floater type G 900/G 700 with disc which allows direct floating of dewatered concrete. Weight maximum 90kg (200 pounds) for 40"(W.disc.) Finishing is done with G 900, using blades only and is normally done with 30 minutes intervals between passes.
The above equipment specified should be used for the production of quality concrete floors according to the Trimix System. Inter-changeability of equipment is not recommended.

1.1.9 Execution Trimix System

1.1.9.1 General

The work shall be planned and executed so that there is no delay between the placement, screeding, dewatering and floating of the concrete. Concrete to be vacuum dewatered shall be handled and placed so as to prevent segregation. The concrete shall be internally vibrated prior to screeding.

1.1.9.2 Leveling

Immediately following placement, the concrete shall be leveled with a vibrating screeding running on a true surface, set at the proper elevation required to provide the specified finished elevation. The concrete surface shall be screeded high by 2% of the slab's thickness to compensation for the compaction caused by the vacuum dewatering process. (Slabs to have an aggregate hardener shall have compensation made to maintain elevation). The vibrating screed shall be moved forward as rapidly as proper consolidation allows. The proper surcharge of concrete must be maintained in front of the leading edge of the screed.

1.1.9.3 Vacuum

Immediately after leveling, the concrete shall be covered with filter pads and suction mats in strict accordance with the recommendation of the manufacturer to have the slab fully dewatered. The suction mat shall extend 4 inches beyond the edge of the filter pad on all sides. The pads shall extend to within 4" of the edge of concrete slab, and the mats shall cover entire slab. Before connecting the hose on the suction mat to the vacuum pump, the edges of the mat shall be smoothed to enable an airtight seal to be created. A vacuum shall then be applied to the mat. After a minute the gauge on the vacuum pump should indicate a minimum vacuum of 0.70 atmospheres (24.0 in. Hg) and if not, the mat must be checked for leakage. For concrete that dewaters readily the vacuum should then be maintained awt 0.70-0.80 atmospheres (24.0-25.5 in. Hg) For concrete which dewaters less efficiently (e.g. air-entrained concrete) the vacuum shall then be reduced to 0.50-0.60 atmospheres (15.0-18.0 in.Hg). After approximately 10 minutes the vacuum can then be increased to 0.80 atmospheres.

The vacuum shall be maintained for at least 3 minutes per inch of concrete thickness at 0.80 atmospheres. (Where aggregate hardeners are specified, sufficient moisture shall be maintained to meet manufacturer's requirements). The suction mats and filter pads shall then be removed and moved to the next section in leapfrog manner.

Stop the vacuum dewatering when light footprints only are left in the concrete when stepped upon. A suitable suction time can also be checked with a Proctor-apparatus, which should show 1.5-2 kp/cm2.

1.1.9.4 Floating

Upon removal of the suction mats and filter pads the concrete surface shall be power-floated without delay until all imprints from the vacuum process are removed. If crusting occurs, the floating operation must be delayed till the concrete carries the machine.

The higher speed is recommended for the floating operation. Two passes with the floating disc should be made in the junction of two mats in order to avoid risk for cracking.

1.1.9.5 Finishing

The waiting time after the floating operation depends on concrete temperature and humidity and varies from 10 minutes to 2 hours.

The trowelling operation cannot take place before the concrete has hardened enough to carry the machine, i.e. the trowelling blades will not leave any marks on the concrete. Repeated trowelling. With intervals between the passes, which are adapted to the setting of the concrete, greatly improves the surface characteristics. The surface will be more wear resistant and less dusty.

At least two passes are recommended for floors, which are not to be covered.

1.1.9.6 Curing

Vacuum dewatered concrete should be cured like any other quality concrete in order to achieve a good final result with ponding.

2.6 Mode of measurement:

The item shall be measured and paid in Cum. Rate of shuttering with MS channels is inclusive.

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