



SUB SECTION 4.1

TECHNICAL SPECIFICATION

FOR

CIVIL WORK



Applicable Standards For Civil & Plumbing Works

APPLICABLE STANDARDS

Sr.	Description	Applicable Standards
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 (part i to iii)
13	Construction water	IS: 456-19778
14	Methods of sampling and test (physical and chemical water used in industry)	IS: 3025
15	Ordinary (33 grade)/low heat Portland cement	IS: 269-1989
16	Ordinary Portland cement (43 grade)	IS: 8112-1989
17	Ordinary Portland cement (53 grade)	IS: 12269-1989
18	White Portland cement	IS: 8042-e-1978
19	Portland pozzolana cement	IS: 1489-1976
20	Rapid hardening Portland cement	IS: 8041-1978 IS: 269-1976
21	Portland (blast furnace) slag cement	IS: 455-1976
22	Hydrophobic cement	IS: 8043-1978
23	High alumina cement.	IS: 6452-1972
24	Super sulphate cement	IS: 6909-1973
25	Oil well cement	IS: 8229e-1976
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: 383-1970, IS: 515
30	Gradation of coarse aggregates	IS: 383 (table ii)
31	Gradation of fine aggregates	IS: 383 (table iii) - 1970
32	All-in-aggregates	IS: 383 (table iv)- 1970
33	Method of tests for aggregates for concrete	IS: 2386 (part i to viii)- 1963
34	Methods of determination the maximum quantities of deleterious materials in	IS: 2386 (part ii) - 1970
35	Limiting values of the maximum quantities of deleterious materials in aggregates	IS: 383 (table i)-1970

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)-1966
39	Specification for plain hard drawn steel wire fabric for concrete reinforcement	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 for concrete reinforcement	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: 280-1972
44	Code of practice for welding of mild steel bars used for reinforced concrete construction	IS: 2751
45	Code of practice for plain and reinforced concrete	IS: 456-1978
46	Code of practice for general construction of plain and reinforced concrete for dams and other massive structures	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 R.C.C. 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 (single and double bucket type)	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 pre-cast concrete trusses	IS: 3201
65	Pre-stressed concrete	IS: 1343
66	Specification for high tensile steel bars used in code of practice for pre-stressed concrete	IS: 2090-1962
67	Specification for plain hard drawn steel wire for pre-stressed concrete	IS: 1785 (part i) 1962
68	Specification for plywood for concrete shuttering work	IS: 4990

69	Code of practice for steel tubular scaffolding	IS: 4014 (part i & ii)
70	Specification for steel scaffolding	IS: 2750
71	Safety code for scaffolds and ladders	IS: 3696
72	Common burnt clay building bricks	IS: 1077-1976
73	Classification of burnt clay bricks	IS: 3102
74	Burnt clay building bricks, heavy duty	IS: 2180
75	Burnt clay facing bricks	IS: 2691-1972, IS: 1077-1976
76	Method of sampling and testing clay building bricks	IS: 3495 (part I to IV)- 1976
77	Mortar for brick work	IS: 2250
78	Code of practice for brick work	IS: 2221
79	Masonry works	IS: 3466-1967
80	Structural safety etc. Of building masonry walls	IS: 1905-1969
81	Load bearing hollow concrete blocks	IS: 2185
82	Lime - cement - cinder hollow concrete blocks	IS: 5498
83	Lime - cement - cinder solid blocks	IS: 3115
84	Code of practice for construction of stone masonry	IS: 1597 (part i)
85	Stone tests	IS: 1124-1974
86	Code of practice for design and installation of joints in buildings	IS: 3414
87	Joint sealing compound	IS: 834-1961
88	Pre-moulded bituminous joint filler	IS: 1838-1961
89	Timber door, window and ventilator frames	IS: 4021
90	Material & workmanship for wood work	IS: 883, IS: 4021
91	Wooden flush door shutters (solid core type)	IS: 220 (Part-i) 1980
92	Timber paneled and glazed shutters	IS: 1003 (part i & ii)
93	Method of tests for wooden flush doors, type tests	IS: 4020
94	Plywood & tests	IS: 303-1975
95	General tests for wood work	IS: 1659-1979
96	Red lead for wood knot	IS: 103
97	Oil type wood preservative	IS: 218
98	Particle board	IS: 3087-1965
99	Transparent sheet glass for glazing & framing purposes	IS: 1761-1960
100	Resin bonded fibre glass	IS: 3144-1965
101	Putty for glazing	IS: 420
102	Steel door frames	IS: 4351
103	Steel window	IS: 1361
104	Steel doors	IS: 1038
105	Steel ventilators	IS: 1081
106	Rolling shutters	IS: 6248-1979
107	Primer for steel doors, windows & ventilators	IS: 102
108	Aluminum alloy for door/window frames	IS: DSGN-HEA-WP OF IS: 733- 1975, IS: DSGN.WVG-WP OF IS: L 285-1975 Sections IS: 1948
109	Anodizing	BS: 1616-1961
110	Hydraulic lime & storage	IS: 712-1973

111	General tests for lime	IS: 6932 (part I to x)-1973
112	Field tests for' lime	IS: 1624-1974
113	Lime mortar preparation	IS: 1625-1971
114	Slacked lime	IS: 1639-1960
115	Surkhi	IS: 1344
116	Code of practice for application of lime plaster finish	IS: 2394
117	Rough cast plaster	IS: 1661-1960 (Clause-165)
118	Specification for integral cement water proofing compounds	IS: 2645
119	Water proofing asphalt/maxphalt	IS: 702
120	Bitumen saturated layer	IS: 1322
121	Bitumen felt	IS: 1322-1970
122	Bitumen	IS: 702
123	Code of practice for laying and finishing of cement concrete flooring tiles	IS: 1443
124	Material & workmanship for flooring	IS: 1197 is: 1344
125	Code of practice for laying in situ terrazzo floor finish	IS: 2114
126	Code of practice for laying in-situ cement concrete flooring	IS: 2571
127	Mosaic tiles	IS: 1237
128	Glazed earthenware tiles	IS: 777-1970
129	Marble chips & marble mosaic terrazzo	IS: 2114-1962
130	Plain cement tiles & tests	IS: 1237-1980
131	Marble mosaic tiles	IS: 1237-1980
132	Marble slab	IS: 1130-1969
133	PVC flooring tiles & sheets	IS: 3461, IS: 3462-1966
134	Broken marble mosaic tiles	IS: 1257
135	Oxy-chloride	IS: 658
136	Magnesium chloride	IS: 657
137	C.I. Grid tiles	IS: 210
138	Pigment for terrazzo flooring	IS: a59
139	Rivets	IS: 1148-1973
140	Electrodes for welding	IS: 814-1963
141	Code of practice for use of electric arc welding for general construction in mild steel	IS: 813
142	Tests for welding works	IS: 1181
143	Welding works	IS: 816
144	Bolts and nuts	IS: 1367
145	Tests for bolts and nuts	IS: 1608
146	Structural steel sections & tests	IS: 226-1985
147	Structural steel plates	IS: 2062
148	Defects in structural steel	IS: 229-1975
149	Dimension & properties of steel section	IS: 808
150	Structural steel work	IS: 800
151	Galvanized steel for wire fabric	IS: 226 - 1975 IS: 4948-1974
152	Expanded metal steel sheet	IS: 412-1975
153	Mild steel wire gauze jail	IS: 280-1978
154	Welding procedure & edge preparation	IS: 823

155	Washers	IS: 2016
156	Storage of welding wire & electrodes	IS: 816
157	Primer to structural surface for bolts	IS: 2074
158	Chequered plates	IS: 3502
159	Code of practice for painting of ferrous metal in building and allied finishes	IS: 1477 (part i & 11)
160	Distemper and dry colour	IS: 427
161	Code of practice for painting concrete, masonry and plaster surfaces	IS: 2395
162	Distemper. And oil emulsion	IS: 428
163	Enamel paints	IS: 2933-1975
164	Coat of zinc chromate	IS: 104-1950
165	French spirit polish	IS: 348-1968
166	G.I. Sheets	IS: 227-1977
167	A.C. Sheets	IS: 459-1970
168	A.C. Sheet fixing	IS: 730
169	Mangalore pattern tiles	IS: 654-1972
170	Fibre glass reinforced polyester	IS: 4154
171	Galvanized steel for barbed wire	IS: 278-1978
172	Insulation of hot water pipes, tanks & heat exchanger	BS: 476:1953
173	G.I. Pipes & m. s. tubes	IS: 1239(part i) - 1979
174	Screw down bib cocks & stop cocks	IS: 781-1977
175	Vitreous sanitary fixtures (general)	IS: 2556(part i) - 1967
176	Gun metal wheel, globe, check, gate & non return valves	IS: 778.1971
177	Wash basin	IS: 2556 (part-iv)-1972, IS: 771-1979
178	European W.C.	IS: 2556-1 972, IS: 771-1979
179	Solid plastic seat & cover	IS: 2548-1980
180	Orissa pan W.C.	IS: 2556 (part-iii)-1981
181	Squatting pans & traps	IS: 2556(part iii)-1967
182	Indian W.C. (wash down W.C.)	IS: 2556(part ii)-1981, IS: 771-1979
183	Urinals	IS: 2556(part vi)-1967
184	Half round channels	IS: 2556 (part vii)-1967
185	Specific requirements of symphonic	IS: 2556 (part viii)-1967
186	wash down W.C. S.S. Sink/c.i./flushing tank brackets	IS: 775-1970
187	C.I. Symphonic flushing cistern	IS: 774-1971
188	Lead pipes	IS: 404 (part i)-1962
189	Sand cast pipes & fittings	IS: 1729-1964
190	Cast Iron spun soil pipes & fittings	IS: 3939-1970
191	Gully trap	IS: 651-1960
192	Glazed stone ware pipes & fittings	IS: 651-1960

193	A.C. Pipe	IS: 1626 - 1980 IS: 1626 (part i) - 1980
194	High pressure/Croydon ball valve	IS: 1703-1977
195	Cast Iron sluice valve	IS: 780-1969
196	Capstan head	IS: 1795-1961
197	Malleable iron Galvanized Iron fittings	IS: 1879 (part i to x)- 1975
198	Cast Iron pipes	IS: 1975
199	Molten (pig)lead	IS: 1536, IS: 1537
200	C.I. Manhole frames & covers	IS: 782
201	Concrete pipes	IS: 1726
202	Threads for screwed pipes	IS: 458
203	Lead jointing	IS: 554
204	Carbon steel for pipes	IS: 718
205	Low level ceramic cistern	IS: 9161
206	Bowl pattern flat back urinals	IS: 774-1971
207	Showers	IS: 2556 (part iv) - 1972
208	Heavy Cast Iron pipes	IS: 2064
209	Concrete mix design	IS: 1729
210	Code of practice for construction of floor and roof with joists and filler blocks	IS: 6061 (part i) - 1971
211	Code of practice for construction of light weight concrete block masonry	IS: 6042-1969
212	Specification for load bearing light weight Concrete blocks	IS: 3590-1966
213	Code of practice for construction of hollow concrete block masonry	IS: 2572-1963
214	Specification for concrete masonry units (hollow and solid concrete blocks)	IS: 2185 (part i) - 1979
215	Chemical composition of ordinary Portland cement	IS: 4032-1968
216	Sulphate resistant cement	BS: 4027 & ASTM C-150 type ii
217	Specifications for circular hollow sections	IS:1161
218	Properties of rectangular & square hollow sections	IS:4923
219	Cold formed welded & seamless carbon steel structural tubing for rounds & non-rounds	ASTMA 500
220	Cold but not formed welded & seamless carbon steel structural tubing for rounds & non-rounds	ASTMA 501
221	Hot formed welded & seamless high strength low alloy tubing	ASTMA 618
222	Hot rolled structural steel hollow section	BS: 4848/2
223	Burnt clay facing bricks	IS: 2691
224	Code of practice for application of lime plaster finish	IS: 2394
225	Flat transparent sheet glass for glazing and framing purposes	IS: 2835
226	Code of practice for finishing wood and wood base materials	IS: 2338 (part - I)
227	Bituminous primer for use in water proofing and damp proofing	IS: 2395



228	Bituminous compound for water proofing purposes	IS: 1580
229	Code of practice for water proofing of roofs with bitumen felts	IS: 1346
230	Specifications for admixtures for concrete	IS: 9013
231	Specification for paving bitumen	IS: 73
232	Specification for test sieves	IS: 460

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 material, 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.

Section B - List of Approved Make for Civil Works

All products shall be of premium quality of approved brand make and manufacture as per approval of AIC/EIC.

All the sanitary urinals, taps shall be sensor based.

Specification/brands names of materials to be used as per the scope of work are listed here. The agency to use indigenous products. The materials of any other brand/manufacturer may be proposed for use by the agency in case the brands specified below are not available in the market and/or agency intends to use some other brand better than the brands mentioned in this list. The alternate brand can be used only after the approval of Engineer-in-Charge.

S.No.	Material	Approved Makes / Brands		
1. CIVIL&STRUCTURAL				
1.	OrdinaryPortland Cement /Portland PozzolonaCement	ACC	Ultratech	J. K Cement
		Zuari Cement	Ambuja Cement	India Cement
2.	White Cement	Birla White	J.K. White	Lafarge
3.	Ready Mix Concrete	ACC	Ultratech	JK Cement
		Lafarge	L&T	
4.	Reinforcement Steel (HYSD TMT-Fe 550D)	SAIL	Tata Steel	RINL
5.	Structural Steel / M.S. Tubes	TATA	JSW	ASIAN
		Jindal		
6.	Plasticizer, Super Plasticizer, Admixtures, Other construction chemicals	MYK Arment	M.C. Bauchemie	Fosroc
		CICO	Sika	BASF
		Asian Laboratories	Ultracon	Kryton
		Pidilite	Fairmate	
7.	Waterproofing Compound (Crystalline)	MYK Arment	BASF	Sika
		Penetron	Fosroc	Kryton
		Pidilite	Carlisle	Sunanda
		Fire Stone	MYK Laticrete	
8.	Waterproofing Self Adhesive (HDPE) membrane	MYK Arment	GRACE	Fosroc
		Pidilite	Kintop	Keshun
		Sunanda	MYK Laticrete	
9.	EPDM Waterproofing Membrane	MYK Arment	Carlisle	Pidilite
		STP	Fire Stone	Polygamma
		Sunanda	MYK Laticrete	
10.	PU Elastomeric Membrane (spray applied for Deck Waterproofing)	MYK Arment	BASF	Fosroc
		Sika	Keshun	Pidilite
		Sunanda	MYK Laticrete	
11.	Glasswool Insulation	UP Twiga	Poly Glass	Ownscorning
12.	Rock Wool Insulation	Lloyds	Roxul Rockwool	
13.	Swellable Bar	MYK Arment	Fosroc	Pidilite
		Hayakawa	Keshun	
14.	Polycarbonate Sheet	GE Plastic (SABIC)	Gallina	DPI Daylighting
15.	Decking Steel Sheet	TATA Steel	Lloyds	JSW
16.	Shuttering Ply	Greenply	Century	Merino
		Vanmply	Wigwam	
17.	Rebarring Chemical	Hilti	3M India	Birla
18.	Fire Sealant	Hilti	3M India	Fischer
19.	Parallel Threaded Couplers (Compliant to IS 16172:2014)	Dextra	Halfen Moment	G-Tech
20.	Extruded Polysterene Board	STP	Supreme	Ownes Corning, Shalimar
21.	AAC Block	Aerocon	Builttech	Instablock
		Finecrete	Magicrete	JK
22.	AAC Mortar	Ferrouscrete	Ultratech	JK
23.	Moisture Resistant Board	Saint Gobain	Gyprox	USG Boral
		Greenlam	Duro	Merino
24.	Veneer	Greenply	Century	Winston

25.	Laminate	Merinolam	Greenlam	Winston
		Century	Royal Touch	AICA
26.	Flush door / Laminated Flush Doors	Century	Greenply	Merino
		Winston	Wingman	
27.	Toilet Cubicles	Merino	Greenlam	Winston
		Dorma		
28.	Hardware for Fire Check Door	Dorma	AssaAbloy	Hafale
		Ozone		
29.	Plywood/ Veneer/Laminate	Greenply	VANM	WIGMAN
		WINSTON	Greenlam	
30.	Expansion Joint – Modular	C.S.	Herculus	Z-Tech
		Vexcolt	Devin	Sainfield
31.	Polyster Powder Coating Paints Repellent /Weather Sealant	Nerolac	Berger	Akzonobel
		M.C.Bauchemie	Wacker	STP
32.	Poly-Sulphide Sealant	Fosroc	Pidilite	Sika
		MYK Arment	Wacker	Dow Corning
33.	Wall Putty	Birla Wall Care	JK White	Saint Gobain
		Ferrouscrete	Berger	
34.	Curing Compound	MYK Arment	Fosroc	Sika
		STP	Pidilite	BASF
		Cico		
35.	Oil Bound Washable Distemper	Asian Paints	AkzonobelDulux	Berger
		ICI	Nerolac	Ultratech
36.	Acrylic Distemper	Berger	Asian	Dulux
37.	Premium Acrylic Emulsion paints	Dulux	Nerolac	Asian Paints
		Berger		
38.	Cement Primer	BP White (Berger)	Decoprime WT (Asian)	Akzonobel (Dulux)
		Nerolac		
39.	Cement Paint	Snowcem Plus	Berger (Durocem Extra)	Nerolac (Nerocem with Titanium)
		Asian	Ultratech	
40.	Steel / Wood Primer	Akzonobel (Dulux)	Nerolac	Asian Paints
		Berger	Jenson & Nicholson	
41.	Textured Exterior Paint	Akzonobel (Dulux)	Asian (Apex Ultima)	Nerolac Kansai (Excel)
		Ultra Tech	Spectrum	Berger
42.	Synthetic Enamel Paint	Akzonobel (Dulux)	Asian (Apolite)	Kansai Nerolac (Synthetic Enamel)
		Berger		
43.	Epoxy Paint	MYK Arment	Asian Akzonobel (Dulux)	FOSROC
		ICI	Kansai Nerolac	
44.	Epoxy Flooring	Keshun	BASF	FOSROC
45.	Fire Paint	Asian	Jotun	Akzonobel
46.	Heat Resistant Tiles	Swastik	Thermax	Dalal Tiles
47.	Gypsum Plaster	Ferrous Crete	Elite (90)	Ultratech
48.	Pre-Cast GRC & GFRC	Aditya Birla, Birla white	Dalal Tiles Industries	Swastik
49.	Stainless Steel	Salem Steel	Jindal Alloys	SAIL
50.	Welding Electrodes	Advani	Oerlikon	Modi
		L & T		
51.	Stainless Steel Hardware	Dorma	Hafale	KICH
		OZONE		
52.	Formwork systems	Peri,	Doka,	Symons
53.	Aluminium Shuttering	Maini	S-Form	Kumkang

		MFE Form Work		
54.	Metal roofing system (Metal)	MULTI-INFRATECH -Multi-Zip	LYSAGHT Flex-lok of Tata Blue Scope	Lloyd
55.	Automatic Sliding Door	Dorma	Ozone	Hafale
56.	Metal roofing system (Aluminum)	Kalzip	Kingspan	Tiger
2. FALSECEILING				
57.	False Ceiling – Gypsum	SaintGobain	IndiaGypsum	Knauff Armstrong
58.	False Ceiling – Metal	SaintGobain	HunterDouglus	Knauff Armstrong
59.	Gyp Board	SaintGobain	Boral	Lafarge
60.	Open Cell Ceiling	Knauff Armstrong	Durlum	HunterDouglas
61.	False Ceiling Grid System	SaintGobain	GridSystem	Knauff Armstrong
62.	Baffle Ceiling	HunterDouglas	Durlum	Knauff Armstrong
63.	Acoustical Tile False Ceiling	Knauff Armstrong	Lafarge	HimalayaAcoustic
64.	Acrylic Solid Surfaces	Dupont	Neonex	Hanex
3. FLOORING				
65.	Mosaic / Chequered Tiles	Bisazza	NITCO	Unitile
		Dalal Tiles Industries	Unistone	
66.	Ceramic Tiles / Glazed Tiles	Simpolo	Lioli	Nexion
67.	Vitrified Tiles (Antiskid / Matt / Glazed)	Simpolo	Lioli	Nexion
68.	PVC Flooring	Armstrong	Target	LG
69.	Cement Concrete Tiles (Designer Tiles)	Unistone	Ultra	Eurocon
		Terra Firma		
70.	Paver Block & Kerb Stone	NITCO	Unitile	Ultra
		Dalal Tiles Industries	Vyara tiles	
71.	Tile / Stone Adhesive /Tile / Epoxy Grout	Pidilite	Ferrous Crete	MYK Laticrete
		Fosroc	BASF	Kryton
72.	Dash / Anchoring Fasteners	Hilti	Fisher	Bosch
73.	Floor Hardener	MYK Arment	Fosroc	Hardonite
		Sikka	Ironite	
74.	Laminated / Engineered wooden Floor	Squarefoot	Mikasa	Tesa
75.	Composite Marble / Granite / Engineered Stone	Classic Marble Company	Johnson	Kalinga stones
76.	Water Based Melamine Polish	Asian Paint	Pidilite	ICI Dulux
		Berger		
77.	Fire Retardant Paint	Asian Paint	Berger Paint	Shalimar
78.	Clamp System For Dry Stone Cladding	Hilti	Fischer	Bosch
		Rawl Plug	Axel Industries	
79.	Calcium Silicate False Ceiling	Everest	NCL	Aerolite
80.	Calcium Silicate Ceiling Tile / Board	Gyproc	Boral	Hilux
		Erolite	Armstrong	
4. GLAZINGS and FACADE				
81.	Anodised Aluminum Hardware (Heavy Duty)	Hardima	Indalco	Hindalco
		Everite	Godrej	Vitco
82.	Aluminum Structural Members – Windows, Glazing and	Jindal	Indalco	Hindalco
		Nalco	Bhoruka	Vitco

	Partitions			
83.	Glazing Structural / Suspended / Skylight	Vetrotech Saint Gobain	Pilkington	Glaverbal
84.	Clear / Float / Frosted Glass	Saint Gobain	AIS	Pilkington
		MODI Guard	Atul	
85.	Glass Spider Fittings	Dorma	Hafale	Ozone
86.	Stainless Steel Railing, Accessories etc. in Grade SS 304 & 316	Dorma	D-line	Ozone
		Kich		
87.	Hermitically Sealed performance glass Toughened Glass	Vetrotech Saint Gobain	Guardian Glass	Pilkington
		Modiguard		
88.	Fire Rated Vision Panels	Pilkington	Schott	Ferilite
		Vetrotech Saint Gobain	Glaverbel	
89.	Ceramic panel Cladding	Hunter Douglas	Neolith	Terreal
90.	Aluminum Louvers	Hunter Douglas	Kawneer	Colt
91.	Aluminium Composite Panels	Alstone	Eurobond	Aludecor
92.	G.I. Steel Door Frame	Synergy Thrislington	Navair	Shakti
93.	Friction Stay Hinges	Dorma	LG Sysmac	Dorset
94.	EPDM Gasket	Hanu	Anand	Osaka / Alps
95.	Glass Processor for making DGU / Toughing	Art N Glass	GSC (Noida)	Sejal
		ASAHI	Gold Plus	Kaenat Glass
96.	Mirror Glass	Atul	Modi Guard	Saint Gobain
		Glalverbel	AIS	
97.	UPVC Doors & Windows	Fenesta	Wintech	Aluplast
		Windowmagic	Rajshri	
98.	Poly Sulphine Sealant	Wacker	Dow Corning	GE
99.	Silicone / Weather Sealant	Wacker	Dow Corning	GE
100.	HPL High Press Laminate	ALSTONE	NEWMIKA	GREENLAM
5. HARDWARE				
101.	Nuts / Bolts / Fastners / Screws	GKW	Atul	Hilti
		Rawlplug		
102.	Door/Window Fittings	Godrej	Everite	Doorset
		Hardwyn	Ozone	
103.	Door Closer	Dorma	Godrej	Hettich
		Everite	Hardwyn	Ozone
104.	Die Cast Patch Fittings	Dorma	Geze	AssaAbloy
		Hettich	Ozone	
105.	Fire Rated Doors	Saint Gobain	Acodor	IGI
106.	Floor Springs	Dorma	Geze	Hettich
		Dorset	Everite	Ozone
107.	SS Mortise lock with one dead bolt and pair of SS handles steel grade SS 304	Dorma	Godrej	Hafele
		Dorset	Ozone	
108.	SS Mortise latch & lock with six levers and pair of SS handles steel grade SS304	Dorma	Godrej	Hafele
		Dorset	Ozone	
109.	SS Tower bolt	Dorma	Godrej	Hafele
		Ozone		
110.	SS Butt hinges with ball bearing grade SS 304	Dorma	Godrej	Ingersoll Rand
		Ozone		
111.	Stainless Steel Sliding Door bolts	Ingersoll Rand	Hafele	Godrej
		Ozone		
112.	Pull handle back-to-back of length 150mm of Steel Grade SS 304	Godrej	Geze	Ozone
113.	Pull handle, single side of	Godrej	Geze	Ozone

	length 150mm of Steel Grade SS 304			
114.	Aluminium lever Handles	Hardima Ozone	Godrej	Everite
115.	Lever handle in SS 304 finish	Dorma Daikin	Hafele Ozone	Godrej
116.	Magic Eye	Dorma Ozone	Godrej	Ingersoll Rand
6. HVAC/VENTILATIONS SYSTEM				
117.	Chillers	York Dunham Bush	Carrier Trane	Daikin
118.	Chilled/ Condenser Pumps:	Kirloskar Grundfos	Bell & Gossett	Wilo (Mather+Platt)
119.	Cooling Towers	Mihir	Advance	Paharpur
120.	Hot Water Generator	Rapid Cool	Emerald	Sandhu
121.	Air Handling Units & TFA:- Air Handling Units (Eurovent certified) Cooling Coil Fan	VTs Flaktwood As per manufacture standard of AHU Kruger / Comferi	System Air Edgetech	Stulz Zeco Nikotra
122.	Fan Coil Unit & Cassette Unit	Sinko	Carryaire	Trane
123.	Split AC	Daikin Carrier	Hitachi	Toshiba
124.	M.S. Pipes:- Any dia.	Tata	Jindal Hissar	Sail
125.	Butterfly Valves	Advance VTM	L&T Axim	Danfoss
126.	Motorized Butterfly Valve	Belimo Oventrop	Danfoss	Siemens
127.	Pressure independent control valve (PICV)	Belimo Oventrop	Danfoss	Siemens
128.	Check Valves	Advance VTM	L&T Axim	Danfoss
129.	Ball valve	Zoloto VTM	Audco Axin	RC
130.	Balancing Valves	Danfoss VTM	Advance Axin	Danfoss
131.	2-way Modulating Valves with Thermostat	Belimo	Honeywell	Siemens
132.	2-way on off valve with thermostat for FCU	Belimo	Honeywell	Siemens
133.	Expansion Bellows	Resistoflex Dunlop	Easyflex Axin	Areaflex
134.	Pot/Y-Strainers	Sandhu Axin	Rapid Cool	Emerald
135.	Suction Guide with Strainer	Anergy Axin	Armstrong	Emerald
136.	BTU meter	Belimo Shenitech	Siemens	Honeywell
137.	RH Sensor	Belimo Omnicon	Honeywell	Siemens
138.	Thermostat	Danfoss Siemens	Belimo Omnicon	Honeywell
139.	Pressure Gauge (Industrial Type)	Feibig Axin	H. Guru	Emerald
140.	Differential Pressure Switch	Siemens Sant	Rapid Contro	Anergy
141.	Thermometers	Feibig Emerald	H.Guru Axin	H.Guru
142.	Closed Expansion Tank	Anergy Emerald	Bell & Gossett	Sandhu

143.	Air Separator	Anergy	Emerald	Sandhu
144.	Auto Air Vent	Anergy	Rapid Cool	Oventrop
145.	Plug Valve	Anergy	Rapid Cool	
146.	G.I. Sheets	Sail	Tata	Jindal
147.	MS. Sheets	Hindalco	Balco	NALCO
148.	Fire Dampers	Systemair	Caryaire	Ruskin
		Greenheck		
149.	Damper Actuator	Belimo	Sinider	Sinider
150.	Grills / Diffusers	Systemair	Caryaire	Titus
		Trox		
151.	Fresh Air Louvers	Systemair	Caryaire	Titus
		Trox		
152.	Resin bonded Glass Wool Insulation	UP TWIGA	Owens Corning	Kimmco
		K-flex		
153.	Protective Coating over insulation (Lag coating)	Pidilite	Foster	Idendan
		CISBOND		
154.	Resin bonded Glass Wool Acoustic Insulation	UP TWIGA	Owens Corning	Kimmco
		K-flex		
155.	Insulation Adhesive	Pidilite	Foster	CISBOND
		Henkel		
156.	Factory Made ducting	Rolastar	Ductofab	Zeco
		Technofab	Ecduct	
157.	Filters (in Air-conditioning system) Ventilation Fans:	Thermodyne	Purolator	Anfilco
		Mackmark		
158.	Tube/Vane Axial	Kruger	System Air	Greenheck
159.	Inline (Centrifugal)	Kruger	System Air	Caryaire
		Ostberg		
160.	Propeller Fans	Kruger	GE	Crompton
161.	Air Washer / Scrubber	Edgetech	Zeco	System Air
		VTS	Crystal Air	
162.	Fan	Kruger	Nikotra	Comferi
163.	Pump	Kirloskar	Beacon	Wilo
164.	Filters	As per manufacturer's standard		
165.	Heat Recovery Wheel units	DRI	Enventus (Ostberg)	Flakt
166.	Heat Pipe	HPT	SPC	VTS
167.	Vibration Isolator	Easyflex	Resistoflex	Dunlop
168.	Anchor / Fastener	Hilti	Fisher	Gripple
		Rawlplug		
169.	Duct Support	GPL	Gripple	Easyflex Zip- Clip
170.	PUF Saddles	Lloyds	Beardsell	Malanpur
171.	FCU link	ATS (CSI)	Oventrop	CIM
172.	Sound Attenuator	Ruskin	Systemair	Trox
173.	CO Sensor	Siemens	Nextech	Johnson
174.	VFD	Danfoss	ABB	Siemens
		Fuji		
175.	CO ₂ Sensor	Siemens	Nextech	Johnson
	Demand Ventilation System			
176.	Equipment	Conaire	Glenstorm	Tristar
177.	Motorized Assembly	Conaire	Glenstorm	Tristar
178.	Integrator	Conaire	Glenstorm	Tristar
179.	High Density PVC Pipe	Finolex	Kissan	Prince
		Supreme		
180.	UVCI	Universal UV Solutions	UVTronix	Supco
181.	Online Scale preventer	Scale Guard	Ristello	Supremo
182.	Electronic Air Filtration System	Honeywell	Trion	Trane
183.	VRF / VRV System	Mitsubishi Electric	LG	Carrier

184.	Copper Refrigerant Pipe	Camipro	Rajco	Mandev
185.	Chilled Water Hi- Wall & Cassette	Midea	Caryaire	Edgetech
186.	AHU / FCU Motor	ABB	Crompton	Siemens
187.	PACs	Stuluz	Emerson	Blue Box
188.	Flexible Duct	UP Twiga	Caryaire	Atco
189.	Aluminium Sheet	Nalco	Hindalco	Balco
7. PLUMBING & SANITARY				
190.	Sanitary Fittings & Accessories	Gessi	Kohler	Toto
191.	Concealed cistern	Toto	Kohler	Roca
		Geberit	Jaquar	Euronics
192.	WC connector	Geberit	Kohler	Jaquar
193.	Auto Urinal Flush System	Duravit	Kohler	Roca
		Grohe	Jaquar	Euronics
194.	CP Brass Fittings	Toto	Kohler	Parryware
		Hindware	Grohe	Euronics
195.	G.I. / M.S. Pipe	Tata	Jindal (Hissar)	Surya Prakash
196.	G.I. Fittings	Unik	KS	Zoloto
		R-Brand	Surya	
197.	SS Pipes	Jindal	Tata	VIGA
198.	HDPE Pipes	Reliance	Jain Irrigation	Oriplast
		Vertex	West Well	Supreme
		Vectus		
199.	DI Pipes	Electrosteel	Jindal	Tata Ductura
200.	DI Fittings	Kartar	Electrosteel	Kalinga
201.	CI Fittings	Neel	Kartar	Electrosteel
202.	Float Valve	IVC	Leader	Zoloto
		KSB		
203.	UPVC Pipe and Fittings	Astral	Supreme	Finolex
		Prince	AKG	Surya Roshni
		Vectus	PKS Export	
204.	PVC Pipe & Fittings	AKG	Supreme	Finolex
		Surya Prakash	Vectus	
205.	CPVC Pipes & Fittings	AKG	Astral	Supreme
		Finolex	Surya Prakash	Vectus
		SFMC		
206.	Centrifugally Cast (Spun) Iron Pipes & Fittings	NECO	SKF	Electrosteel
		Saint Gobain	BIC	
207.	Centrifugally Cast (Spun) Iron (Class LA) Pipes	NECO	Electro Steel	TATA
		BIC		
208.	Centrifugally Cast (Spun) Ductile Iron Pipes & Fittings	Electro Steel	Jindal (Hissar)	Kalinga
209.	C.I. Manhole covers, Frames & GI Gratings	NECO	RIF	BIC
		SKF	Jain Spun Pipe Co.	
210.	SFRC Manhole covers & gratings	KK	OCR	Pargati
		T-CON		
211.	RCC manhole Covers & Frames	KK manhole	Grating Co. Pvt Ltd	
212.	D.I. Manhole Covers & Frames	Neco,	Raj Iron Foundry Agra	Kartar
213.	Gun Metal Valves, Globes	Kartar	Castle	Zoloto
214.	NRV - Ball type - Sewage application	Danfoss	ZALOTO AUDCO	
215.	Bellow Type, Pressure Reducing Valve	CIM	Danfoss	Honey well
216.	Floor Taps	Jayana	Chilly	Nirali
217.	Water Meter	Prima	Zoloto	Leader
		Capstan		



218.	Brass Stop & Bib Cock	Zoloto	Sant	L&K
		Leader	Astral	
219.	Non Return Valve (Check valve) 1/2" to 1 1/4"	Zoloto	Sant	Leader
		Kartar		
220.	Brass Ferrules	Dhawan Sanitary Udyog	Kalsi	Annapurna
221.	Polythylene water storage tank	Sintex	Polycon	SPL
		Vectus		
222.	Insulation for hot water pipes	Kaiflex	Armaflex	Careflex
		Lloyd		
223.	Insulation for external / exposed hot water pipe	Kaiflex	Armaflex	Careflex
		Lloyd		
224.	Pipe protection for external water supply pipes	Pypkote	Armaflex	Makpolykote
225.	GI / MS Pipe Protection Wrapping & Coating	IWL - Pypkote	Rustech - Coatek	
226.	Stainless Steel Sink	Neelkanth	Nirali	Jayna
		Cera	Anupam	Franke Fabre
227.	Stoneware Pipes	Perfect	Hind	Burn
		RK		
228.	Gully Traps	Perfect	Hind	Burn
		RK		
229.	RCC Pipes (NP-2)	Lakshmi	Sood&Sood	Jain & Co.
		Pragati Concrete		
230.	Atactic Polypropylene	STP	HTL	Hydro Tech
		Pidilite		
231.	C.P. Waste, Spreaders, Urinal Flush Pipes	Jaquar	Parko	
232.	Check Valve - Dual Plate	Advance	Danfoss	Kirloskar
233.	Ball Valves / wafer type valves	Zoloto	Leader	AIP
234.	Check Valve Forged Screwed	CIM / Leader	Sant	
235.	Ball Cocks	GPA	Sant	L&K
236.	Air Release Valves	Sant	Leader	Zoloto
237.	Pipecoat	IWL Ltd	Pypkote	STP
238.	CI Double Flanged Sluice Valve	Kirloskar	IVC	Sondhi
		Kejriwal		
239.	Adhesives	Nuwood	Duratuff	Pidilite
240.	PE-AL-PE	Kitec	Jindal	Supreme
241.	Solar Water Heating System	Tata BP	Honey Well	Solar
242.	Water Heater (Geyser)	Venus	Bajaj Spherhot	Photon
		Racold	Havells	
243.	Hand Drier	Euronics	Duravit	Grohe Kohler
244.	Backflow preventer (Water Hammer)	Normex	Kessel	Lahri
245.	Drinking Water Cooler	Blue Star, Usha	Voltas	Oasis
246.	Anti-Vibration Mounting & Flexible connections	Resistoflex	Dunlop	Flexionics
247.	Electronic Flow Meter	Blue Star	Usha	Voltas
248.	Temperature Sensor/ Gauge	Forbes Marshall	Danfoss	Wika
249.	Rain Water Harvesting System	Shri Ganga Boring Haryana, Aqra Water Solution Delhi,	Ugraya Water Pvt. Ltd.	Ashwath Infratech Pvt. Ltd. Delhi.
8. FIRE FIGHTING				
250.	M. S. Pipe	Tata	Jindal Hissar	SAIL
251.	G. I. Pipes	Jindal Hissar	TATA	SAIL
252.	Forged Fittings	SS	VS	True Forge
253.	ERW / butt Welded Fittings	MEC (Jainsons)	Unik	
254.	Groove Fittings (UL listed)	Victaulic	Jainson	New
255.	Ball Valve / Gate Valve	Sant	Leader	Zoloto

	(Gunmetal)	CIM		
256.	Butterfly Valve	Zoloto	Kirloskar	Leader
		Audco		
257.	Motorized Butterfly Valve	Advance	AUDCO	L&T
		Zoloto		
258.	Balancing Valve	Advance	Utam& VTM	L&T
259.	Non Return Valve	Advance	Utam& VTM	L&T
260.	Y-Strainer	Emerald	AUDCO	kirloskar
		Zoloto		
261.	Pot Strainer	Rapidcool	Emerald	Sant
		AUDCO	Zoloto	
262.	Thermometer	Emerald	Anergy	Honeywell
263.	PICB Valve	Danfoss	Frees	Ovenrop
		Spirotech	Reflex	
264.	Control Valve	HD	Viking (VL Listed)	
265.	Airvent	Anergy	Siemens	Emerald / CIM / Advance / Honeywell
266.	Expansion Tank	Anergy	Emerald	
267.	Hot Water Generator	Sant	Emerald	Rapidcool
268.	FIRE ALARM PANEL– ADDRESSABLE	hochiki	Bosch	Simplex
269.	FIRE ALARM PANEL-NON-ADDRESSABLE	hochiki	Bosch	Simplex
270.	FIRE ALARM & MUSIC WIRE	Nelco	Lappindia	Geoflex/Seimans/Jon ewell
271.	ADDRESSABLE HOOTER	hochiki	Bosch	Simplex
272.	Air Pressure Valve	Anergy	Flemco	Castle
		SKS	Leader	
273.	C.I. Double flanged sluice valves	Kirloskar	Zoloto	Sant
		IVC		
274.	C.I. Double flanged Non-return valves	Kirloskar	Zoloto	Leader
		IVC		
275.	Dual Plate / Wafer Type Non-return valves	Kirloskar	Zoloto	Leader
		IVC		
276.	Foot valve with Strainer	Kirloskar	Leader	Zoloto
277.	Y-Type / Pot / Suction Strainer	Kirloskar	Leader	Zoloto
		Tyco	Advance	
278.	Fire Extinguishers	Zenith	Minimax	Safex
		Ceasefire	Newage	Safe Fire
279.	First Aid Hose Reel Drum	Superex	Newage	Safex
		Safe Fire		
280.	Thermo Plastic Hose Reels for Drums	Superex	Newage	Safex
281.	R.R.L. Hose & C.P. Hose	Superex	Newage	Eversafe
		Safe Fire		
282.	Branch Pipe, Nozzle, Coupling etc.	Superex	Newage	Eversafe
		Minimax	Lifeguard	Safeguard
		Safe Fire		
283.	Landing Valves	Superex	Newage	Eversafe
		Safe Fire		
284.	Fire Brigade Connections	Superex	Newage	Eversafe
		Minimax	Safe Fire	
285.	Fire Fighting Equipment not covered elsewhere	Superex	Newage	Eversafe
286.	Hose Box	Superex	Newage	Eversafe
287.	Sprinkler & Rosette Plates	Tyco	Viking	HD
		Spray Safe		
288.	Flexible Connector (Drop) for Sprinkler	Easyflex	Viking	Newage
289.	Flow Switches	System Sensor	Honeywell	Potter

		Tyco		
290.	Inspector Test valve	Viking	Tyco	Hd
291.	Pre-Fabricated Structural supports and clamps	Chilly	Hitech	Camry
		Easyflex		
292.	Pressure Gauge	Emerald	Fiebig	H.Guru
		Danfoss		
293.	Alarm Valve	Viking	Tyco	HD
294.	Antsuction & delivery flexible pipe connectors	Easyflex	Resistoflex	Dunlop
		SAIL	Tata Steel Ltd	RINL
295.	Flexible Duct Connector	Mapro	Kanwall Industrial corporation	Resistoflex
296.	Stainless Steel Brach Pipe	Safex	Padmini	GETech
297.	Fireman Axe / Installation Control Valve	Safex	Padmini	GETech
298.	2-way / 4-way FBC	Safex	Newage	GETech
299.	Sprinkler Heads	Tyco	HD	Omax UL
300.	Pipe Protection Pypcoat wrapping	IWL	Taxa	Mac-poly coat
301.	Rubber Bellow	Kanwal Industrial Corporation	Resistoflex	AIP Valves
302.	Deluge Valve	Safex	Tyco	HD
303.	Flexible Drop (UL Approved)	Safex	HD	Kofulso
304.	Anti Vibration Pad	Cori Dunlop	Diamond Pipe Support	Easyflex
		Flexionics	Resistoflex	Emerald
305.	Motors for Fire Pumps	Siemens	Kirloskar	Crompton
		ABB		
306.	Fire Pumps	Kirloskar	Mather & Platt	Grundfoss
		Siemens	Schneider	ABB
307.	Electrical Switch Gears	Siemens	Schneider	ABB
		L&T		
308.	Power and Control Cables	Universal	Polycab	Havells
		Finolex	Grandplay	
309.	Control Panel of Terrace Pumps	Advance panel & Switchgear	Adlec	Tricolite Elect Industry
		SPC Electrotech	Ambit	RST
		Neptune		
310.	Voltmeter & Ammeter	HPL	ABB	SECURE
		INDIAN TRANSFORMERS	schnieder	Neptune
311.	Indicating Lamp and Selector Switches	Conserve	Bch	Rishabh
312.	CT	HPL	ABB	SECURE
		INDIAN TRANSFORMERS	AE	Kappa/Neptune Electrical
313.	MCCB / MPCB / MCB / RCCB	Siemens	Schneider	Legrand
		L&T	C&S	ABB/Havells
314.	Contractors / Times, Overload Relays / Starter	L&T	Siemens	Schneider
315.	Single phase preventor	Minilac	L&T	Siemens
316.	Anti-Vibration Mounting	Kanwal Industrial Corporation	Resistoflex	Ewren
317.	Starter	L&T	Siemens	Crompton
		GE	ABB	BCH
318.	Current Transformer (Cast Resin)	ABB	SCHNIDER	LEGRAND
		C&S	CGL	SIEMENS
319.	Nuts / bolts	Lakshmi	Unbrako	

9. INSULATION

320.	Glass Wool	U.P. Twiga	Owen Corning	
321.	Nitrile Rubber	Armacell	K-flex	Aerocell
322.	Expanded polystyrene	SHI	Beardshell	Styrene packaging
323.	Vibration isolator pads	Resistoflex	Kanwal	
324.	Paracoat BPC	Paramount	Pidilite	
10. PUMPS AND WATER TREATMENT SYSTEM				
325.	Pumps	Grundfoss		
		KSB	ITT Lowere	
326.	Submersible Drainage Pumps	KSB	Grundfoss	
327.	Ball Valves	LEADER	AUDCO	Zoloto
328.	Butterfly Valve	LEADER	Zoloto	AUDCO
329.	C.I. double flanged sluice valve	Zoloto	Sant	Castle
		Kartar		
330.	Non Return Valve	Zoloto	Sant	Castle
		Kartar	Leader	
331.	Y – Strainers	Zoloto	Sant	Castle
		Kartar		
332.	Float Switch	Nolta	Danfoss	Honey Well
333.	Pressure Gauge	Fiebig	H. Guru	Danfoss
334.	Dosing system	Milton Roy	Asialmi	Grundfoss
335.	Liquid Level Controllers / Liquid Level Indicator	Advance	Honey Well	Danfoss
336.	Filter / Softener	Ion Exchange	Renaissance Aqua	Pentair
		Watcon		
337.	Salt Saturator	Ion Exchange	Renaissance Aqua	Pentair
		Watcon		
338.	Water Meter	Kent	Marshall	Sant
339.	Water Treatment Plant	Ion Exchange	Thermax	Powerh20
340.	Vessels	Astral	KGM	Structural
341.	Mechanical Seal	Burgmann	Sealol	
342.	Grease Trap / Separator	ACO	Wade	Kassel
11. SEWAGETREATMENTPLANT(STP)				
343.	C.I. double flanged sluice valve	Kirloskar	Leader	Sant
344.	C.I. Disk Type non return valves (65mm dia. and above – Dual plate type)	Kirloskar	Leader	Sant
345.	C.I. Strainer more than 65mm dia.	Leader	Sant	Castle
346.	PVC Valves	Cepex	Astral	Audco
347.	C.I./D.I. Manholes cover	NECO	Kartar	SKF
348.	Plastic Encapsulated Foot Rest	KGM	KK	
349.	Filter feed pump	Grundfoss	ITT	WILO / KSB
350.	Hydro-Pneumatic Pumping Systems (Flushing, Soft and garden hydrant)	Grundfoss	ITT	WILO / KSB
351.	Submersible Sump Pumps for collection chamber, qualization tank, Plant room drainage, Filter backwash sump	KSB	Grundfoss	Crompton
352.	Domestic Hydro pneumatic transfer pump	Grundfos	DP-Holland	Willo - Mather
353.	Pressure Transmitters / Hydrostatic Level Indicators	WIKA	Siemens	Johnson Control
354.	Pressure Gauges	Fiebig	H. Guru	WIKA
355.	Dosing System	ASIA LMI	Milton Roy	Grundfoss

356.	Pump Vibration Pads & Suction & Delivery Flexible Connectors	Easyflex	Resistoflex	Dunlop
357.	Pressure Sand & Activated carbon filter	M.S. Prefabricated	BRISANZA	FONTUS
358.	Air Blowers	Everest	Beta	ABL
359.	Ultra Violet Disinfection for Treated Effluent	Alpha UV	Sukrut	Neotec
360.	Air Diffusors	BOBKAY	MM Aqua	REHAU
361.	MBBR media for Aeration tank	MM Aqua	PP Aqua	Tecpro
362.	Dosing Pumps	Milton Roy	Asia LMI	Grundfoss
363.	Sludge Pumps (Centrifugal)	Kirloskar	Grundfoss	ITT Industries
364.	Sludge Pumps (Screw)	Roto	UT Pumps	Stork
365.	Tube Settler media	MM Aqua	PP Aqua	Tecpro
366.	Centrifuge	Hiller	Alpha	Humboldt Wedag
367.	Pressure Gauge	H. Guru	Fiebeig	WIKA
368.	Level Gauge	H. Guru	Fiebeig	WIKA
369.	pH Meter	Hach	Toshniwal	Ionix
370.	Conductivity Meter	Hach	Toshniwal	Ionix
371.	DO Meter	Hach	Toshniwal	Oakton
372.	TDS Meter	Hach	Toshniwal	Oakton
373.	Ultra Violet Water Purifier (WTP / STP)	Alfa UV Mumbai	Pentair	Eureka Forbes
374.	Syphonic Roof Drainage System	Geberit	Saint Gobain	
375.	Ozonisation System	Oraipl	Ozonics	Voltas
376.	Geared Motor	Bonfiglioli	Grease Cotton	Motova rio
377.	Exhausters	Nicotra	Krigger	Green Heck
378.	Compost Plant	Excel, Smart Enviro Bombay	Ecoman	Clean India
379.	Solid Waste Handling and Conveying	Env Tech (P) Ltd.	Rosa Roca	
12. ELECTRICAL WORKS				
380.	Air Circuit Breaker	Schnieder	Crompton Greaves	ABB
		L&T	GE	Legrand
381.	LT Panel	Adishwaram	Swati Switchgear	JJ INDUSTRIES
		HI-TECH	Sterling Generator	Expert Engineers
		Adishwaram	Swati Switchgear	JJ INDUSTRIES
382.	TTA (Type Tested Assembly) Electrical Panels	Schneider	ABB	Siemens
		L&T	Legrand	
383.	MCCB	Siemens	Legrand	Schneider
		ABB	L&T / C&S	HPL
384.	MCB / MPCB / DB	Siemens	Legrand	Schneider
		ABB	Havells	
385.	Modular Type light & power Accessories (Switches, socket etc.) G.I. Switch Boxes	Legrand	Schneider Electric	Havel's
		MK Honeywell	L&T	Hager
386.	Multifunction Meters	Schneider	Siemens	Neptune
		Secure		
387.	Power Contactor-AC 3 Rating / Capacitor Duty Contactor / Starter / Thyristor Module	Siemens	L&T	ABB
		Schneider		
388.	APFC Relay	HPL	L&T	ENERCON
		SIEMENS	Schneider	C&S / LEGRAND

389.	Capacitor	NEPTUNE	L&T	Siemens
		Crompton Greaves	Schneider	ABB
390.	Electrical Motor / Motor Starter / Contactor / Switches	Siemens	ABB	Crompton
		L&T		
391.	Bus Ducts / Rising Mains	Schneider	Legrand	C&S
		L&T	Tricolite	RST
392.	FRLS PVC Insulated Copper Wire	KEI	Finolex	Havel's
		Universal	Polycab	RR Cables
393.	Power Cables / Control Cables up to 11 KV	Havells	Polycab	BatraHenlay
		Universal	Finolex	Grandlay
394.	Lugs / Gland	Dowel	Comet	HMT
		3D	Jainson	
395.	PVC Conduit	AKG	Precision	Polypack
		Finolex	Prestoplast	
396.	MS Conduit ISI Marked	Precision	AKG	Finolex
		Prestoplast		
397.	ESE Lighting Protection System	CGL	LAMCO	OBLUM
		ELPRO		
398.	DLP Trunking	MK Honeywell	OBO Betterman	Legrand
399.	FLOOD LIGHT/HIGH MAST	Philips	Crompton	Wipro
		Bajaj	Sumip	Ensava
400.	CEILING FAN/EXHAUST FAN	Crompton	Bajaj	Philips/Orient
401.B	Floor Trunking / Raceway	MK Honeywell	Profab	Legrand
402.	Cable Tray	Profab	Rite	Legrand
		Obo	Indiana	
403.	Solar Street Light Fitting with pole	Philips	Bajaj	Aviation Power System
		Trilux	Wipro	
404.	Ceiling Fan / Exhaust Fan	Crompton Greaves	Havells	Usha
		Orient	RR	
405.	Octagonal Steel Pole	Bajaj	Twinkle	Valmart
406.	Internal Lighting LED	Philips	Osram	Havells
		GM	Wipro	Crompton
		Ensava	Orient	Surya
407.	Outdoor Lighting	Orient	Philips	Wipro
		Surya	Insta Power	Aura Bright Light India
408.	Automatic Fire System	Fire Trex	Rotarex	Innovex 1230
409.	Solar Panels	Tata Solar Power	Adani	Topsun
		Waree		
13. SUB-STATION WORKS				
410.	Transformers	Crompton Greaves	Schneider Electric	ABB
		Siemens	Volt amp	Sudhir Transformers
411.	33 KV VCB HT Panels	Crompton Greaves	Siemens	ABB
		Schneider Electric	L & T	Ambit
412.	H.T. Termination & Joining Kit	Ray Chem	M-Seal	Birla – 3M
413.	Cables Glands	Comet	Dowell	Electromac
		Siemens	Jainsons	Braco
414.	Capacitor bank (ISI Marked)	Epcos	L&T	Schneider
		ABB	Siemens	
415.	Maintenance Free Earthing	Protec	Tercel	JMV
		Ecosafe		
416.	ATS (Automatic Transformer Switch)	Asco	Caterpillar	GE
		Vitzrotech		
417.	Protection Relays	ABB	Schneider Electric	Siemens
		L&T		
418.	Current Transformer (Cast Resin Epoxy Coated) /	Neptune	Gilbert & Maxwell	Kappa

	Potential Transformer			
419.	Electrical Digital Meter with LCD Display	Neptune	Schneider	Siemens
420.	HRC Fuse and Fuse Fitting	ABB	GE	Siemens
		L&T	Neptune	
421.	Indicating Lamps	L&T	Siemens	Schneider
		ABB		
14. DG SETS & RELATED ITEMS				
422.	DG Set	Kirolskar	Mahindra	SUDHIR
423.	Diesel Engine	Cummins	Caterpillar	Mahindra
		Ashok Leyland		
424.	Alternator	Leroy Somer	Caterpillar	Stamford
		Toyo Denki	KEC	
425.	Batteries	Panasonic	Exide	Amaron
426.	Batteries Charger	Uptron	Volstat Electronics	Statcon
		AE		
427.	PLC	Schneider	Allen Bradle	Siemens
428.	NIS / NGR	Resitech	Essen	RSI Switchgear
		Lachhman Electronics		
15. FIRE DETECTION & ALARM SYSTEM				
429.	Detectors & Devices – Intelligent multi criteria detector, smoke, heat & duct detectors, control & monitor module, faultisolator, hooters etc. Addressable Main Fire Alarm Panel with Digital Voice Evacuation System	Hochiki	Bosch	Simplex
430.	Fire Survival Cable	KEI	Polycab	Bonton
		Finolex	Havells	Caliplast
431.	UPS System	APC	Emerson	Schneider
		Mitsubishi	Siemens	Microtech
		XSYS		
432.	Public Address & Back ground music system	Commend	Bosch	Toa
		Heinrich	Electrovoice	BiAmp
433.	Access Control	Dorma	HID	Ghallagher
		Bosch	Link	Siemens
		UTC	Honeywell	Suprema
434.	Emergency Break Glass Unit	Hochiki	Bosch	Simplex
16. IP BASED CCTV SYSTEM				
435.	NVR & Accessories Encoder Decoder	Tyco	Bosch	Pelco
		Honeywell	Axis	Avigilon
436.	CCTV Cameras	Tyco	Bosch	Pelco
		Honeywell	Axis	Avigilon
437.	Power Supply	Tyco	Bosch	Pelco
438.	Weatherproofing housing	Honeywell	Axis	Avigilon
		Tyco	Axis	Avigilon
439.	Network Switch (L2 / L3)	Cisco	Xtream	Ruckus
		Junipor	Zykel	Signamax
440.	Multipurpose Poles	KeselecSchreder	Heper	Wipro
441.	Digital Lighting	Osram	Heper	Serenity
		Signamax		
442.	Boom Barrier	Came	Nice	Beninca
		Godrej	ZKtecto	
443.	Co-Axial TV Cable	L&T	Havells	Polycab
		Finolex	Skytone	
444.	CAT6 24Port Jack Panel	Legrand	Systimax	3C3
445.	Passive networking –	Legrand	Systimax	3C3

446.	Cat6A cable and accessories Passive networking – IT racks	Legrand Valrack	3C3	Rittal
447.	Structured Cabling and components	Legrand Schneider	Systimax Beldon	Siemon
448.	Fire Cable	Netapp	Netgear	EMD
449.	CCTV 180' FISHEYE CAMERA	TYCO PELCO	AXIS HONEYWELL	Mobitrick
450.	Network Attached Storage	HP	Dell	Lenova
451.	Desktop PC	HP	Dell	Lenova
452.	AMPLIFIER	BOSCH BIAMP	command	HARMAN
453.	CD CHANGER/DVD PLAYER/Media player	Sony Apart	Philips	Samsung
454.	Microphone	Sure Mipro	Schneider	Behringer
455.	MULTIPLEXER	Dedicated Javelin	Micros	Pelco
456.	TOUCH SCREEN KIOSK	Delta	Samsung	Barco/Q-lite
457.	Standee/Square LED Display	Delta	Samsung	Barco
458.	COMMERCIAL LED DISPLAY	Christie Panasonic	Samsung barco	q-lite Delta/ Extremedia
459.	SIGNAGE SOFTWARE	Cristie	Samsung	Barco
460.	VIDEO WALL PROCESSOR	Pixere	Linson	Novostar
461.	VIDEO LINE AMPLIFIER	Computer	Pelco	Molynx
462.	TELEPHONE INSTRUMENTS	Siemance	Panasonic	
463.	Professional Display Panel	CRISHTIE	SAMSUNG	Panasonic/Sony
464.	EPABX	NEC Matrix	Tridiran	Stntel
17. ELEVATORS&ESCALATORS				
465.	Elevators / Escalators	Mitsubishi OTIS	Kone Johnson	Schindler
18. LANDSCAPE WORKS				
466.	Water Body Vendors / Fountain	Astral	Premium Pools	Waterzone
467.	Irrigation Products	Stitchwell Qualite x	Irrigation Products International	Jain Irrigation Systems
19. MISCELLANEOUS / OTHER WORKS				
468.	Customized Cable tray for multi services, Lighting & LV wiring	RITE PROFAB	LEGRAND INDIANA	OBO
469.	Optical Turnstiles	Boon Edam	Gunnebo	kaba
470.	Central Vacuum System	Sistemair	Sachvac	Schonbach
471.	Multi-Purpose Poles	Keselec	Heper	Wipro
472.	Garbage Chute system	Ecotech Chutes	Horizon Chutes	Hardal
473.	Waste Compacter bins	Universal e cube	Big Belly Solar	Schonbach
474.	Polyurethane Sealent	Choksey	Fosroc	Pidilite
475.	Adhesive for Wood Work	Dunlop Pidilite	Fevicol	Vamicol
476.	Landscape Furniture	KK Manhole & Grating Co. Pvt. Ltd.	JSL Architecture Ltd	
477.	HDPE Grass Pavers & HDPE Drain Board	Ovillite	Aceturf	Plydex
478.	Ornate Pots (Removable Planters)	Yashvi Greenscape	Vertvista	Yuccabe
479.	Stone slabs – Marble & Granite	Classic CMC marble	Om Marble	Nitco
480.	Insulated Aluminium Panels	Luxalon	Qbiss	
481.	Kids Play Equipment	Koochie	Kompam	

482.	Art Work – Painting and Sculptures	As per design		
483.a	a) Furniture (Modular / Loose)	Sujako	Godrej	Herman Miller
	b) Chairs and other seating solutions	Indo Innovations	Herman Miller	Godrej
20. BMS WORKS				
484.	Standalone DDCs	Honeywell-Comfortpoint	Siemens (PX SERIES)	Johnson Controls Metasys
		Schneider Electric Struxureware	Enlite	Trane
485.	Web Based BMS Software with unlimited user license	Honeywell-EBI	Siemens Desigo	Johnson Controls Metasys
		Schneider Electric Struxureware	Enlite	Trane
486.	Web Based Router / Network Area Controller	Honeywell-Comfortpoint	Siemens Desigo	Johnson Controls Metasys
		Schneider Struxureware	Enlite	Trane
487.	Power& Energy Management Software.	Honeywell	Siemens	Johnson Controls
		Schneider Electric	Enlite	Trane
488.	Duct Temperature Sensor	Honeywell	Siemens	Johnson Controls
		Schneider Electric	Greystone Energy	Nextech
489.	Immersion Temperature Sensor	Honeywell	Siemens	Johnson Controls
		Schneider Electric	Greystone Energy	Nextech
490.	RoomTemperature Sensor	Honeywell	Siemens	Johnson Controls
		Schneider Electric	Greystone Energy	Nextech
491.	Duct Humidity Sensor	Honeywell	Siemens	Johnson Controls
		Schneider Electric	Greystone Energy	Nextech
492.	RoomHumidity Sensor	Honeywell	Siemens	Johnson Controls
		Schneider Electric	Greystone Energy	Nextech
493.	Flow Meter	Schenitech	Honeywell	Kampstrup
		Nextech		
494.	Duct Static Pressure Sensor	Honeywell	Siemens	Johnson Controls
		Schneider Electric	Greystone Energy	Nextech
495.	Water Level Switch	Veksler	Filpro	Sontay
		Nextech		
496.	DP Switch – Water	Honeywell	Siemens	Johnson Controls
		Schneider Electric	Greystone Energy	Nextech
497.	DP Switch – Air	Honeywell	Siemens	Johnson Controls
		Schneider Electric	Greystone Energy	Nextech
498.	CO ₂ Sensor / IAQ	Honeywell	Siemens	Johnson Controls
		Schneider Electric	Greystone Energy	Nextech
499.	Water Flow Switch	Honeywell	Siemens	Johnson Controls
		Schneider Electric	Greystone Energy	Nextech
500.	Pressure Transmitter – Water	Honeywell	Siemens	Johnson Controls
		Schneider Electric	Greystone Energy	Nextech
501.	Current Relay	Veris	Seto	Mamac
		Omron	ABB	Nextech
502.	Voltage / Current / Power	SETO	ABB	L&T

	Factor Transducer	Enercon	SETCO	Situ
		Nextech		
503.	Flame Proof Level Switch / Level Transmitter	Veksler	Filpro	Sontay
		Techtrol	Nextech	
504.	PH Sensor / TDS Sensor	Honeywell	Hach	Greisinger
		Shenitech	Nextech	
505.	Personal Computer and Servers	HP	DELL	LENOVO
		TOSHIBA		
506.	Colour Monitor	DELL (ULTRA SHARP)	HP (PAVILION)	SAMSUNG (SYNC MASTER)
		ASUS	LG (FLATRON)	Lenovo
507.	Printer	HP	EPSON	CANON
508.	Copper Conductor Control Cable	Finolex	Skytone	Delton
		Fusion Polymers	Polycab	Excel
509.	Communication Cables / Signal Cable	Finolex	Skytone	Delton
		Fusion Polymers	Polycab	Excel
510.	LAN cables for BMS Network	Belden	Digi-Link	Avaya/Panduit
511.	PVC Conduits	BEC	AKG	
512.	Network Switches	HP	Cisco	Extreme
21. Façade lighting				
513.	Façade Lighting	Philips	Trackon	Adishwaram
22. Rock Wall Cladding				
514.	Rock Wall Cladding	Flexstone	Kas	Stone Studion

Note:

1. Any other Item then above listed then agency have to take approval form Concern Department
2. Make and Model for works shall be approved by AIC/EIC before procurement.
3. Concern Department may be changing the make from above listed as per the requirement
4. In case of certain items as deemed necessary by AIC/EIC, the mock up or the actual product sampling needs to be done prior to the final work execution on site. Only after approval of the samples and/or product actual model, the agency can proceed further for final execution of works.



Cement Consumption

Section C - Cement Consumption

Item	Ratio/ Grade	Consumption	
A. CEMENT CONCRETE (OPC 43 grade Cement)			
BBCC (Volumetric)	1:5:10	2.60	Bags/m ³ .
	1:4:8	3.40	Bags/m ³ .
PCC (Volumetric)	1:6:12	2.30	Bags/m ³ .
	1:5:10	2.60	Bags/m ³ .
	1:4:8	3.40	Bags/m ³ .
	1:3:6	4.30	Bags/m ³ .
PCC (Controlled concrete)	M7.5	3.40	Bags/ m ³ .
PCC (Controlled concrete)	M15	5.50	Bags/ m ³ .
RCC (Controlled concrete Minimum cement content as per IS -456:2000)			
	M20	6.0	Bags/m ³ . (Considered for estimation)
	M25	6.5	Bags/m ³ . (Considered for estimation)
	M30	7.0	Bags/m ³ . (Considered for estimation)
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	3.83	Bags/m ³ .
C. MASONRY WORK			
Brickwork in Cement sand mortar (Conventional)			
	1:3	2.55	Bags/m ³ .
	1:4	1.90	Bags/m ³ .
	1:5	1.56	Bags/m ³ .
	1:6	1.27	Bags/m ³ .
	1:8	0.95	Bags/m ³ .
Stone masonry, Coursed			
	1:3	3.06	Bags/m ³ .
	1:4	2.28	Bags/m ³ .
	1:6	1.50	Bags/m ³ .
	1:8	1.18	Bags/m ³ .
Stone masonry Uncoursed			
	1:5	2.04	Bags/m ³ .

	1:6	1.65	Bags/m ³ .
Half Brick work (Conventional)	1:3	0.29	Bags/m ² .
	1:4	0.21	Bags/m ² .
	1:5	0.17	Bags/m ² .
D. PLASTERING			
10 mm. thick plaster in Cement mortar, on ceiling & soffit of stair, chajjas etc.	1:3	0.12	Bags/m ² .
	1:4	0.1	Bags/m ² .
15 mm. thick single coat plaster in on walls	1:3	0.17	Bags/m ² .
	1:4	0.13	Bags/m ² .
20 mm. thick plaster in Cement mortar, on unfair side of brick in single coat	1:3	0.23	Bags/m ² .
	1:4	0.17	Bags/m ² .
20 mm. thick plaster in Cement mortar, on unfair side of brick in double coat (First coat 15mm in 1:4 and second coat of 5mm in 1:3)		0.18	Bags/m ² .
20 mm. thick Sand Face plaster (First coat 15mm in 1:4 and second coat of 5mm in 1:2)		0.22	Bags/m ² .
15 mm. thick Water Proof plaster in 1:3 Cement mortar		0.21	Bags/m ² .
Neat Cement finishing		0.044	Bags/m ² .
E. POINTING			
Flush, Grooved or Struck in Cement Brick masonry	1:1	0.092	Bags/m ² .
	1:2	0.046	Bags/m ² .
	1:3	0.03	Bags/m ² .
	1:4	0.023	Bags/m ² .
Flush, Grooved or Struck in Cement Random Stone masonry	1:3	0.023	Bags/m ² .
F. FLOORING			
Precast Mosaic Tiles of 40mm thk. in cement mortar 1:6		0.30	Bags/m ² .
20mm thk. Green Kotah/Granite Stone in flooring, skirting & dado of 50mm thk. in cement mortar 1:6		0.50	Bags/m ² .
20 mm thick. Green Kotah/ Granite Stone in Risers and Treads		0.50	Bags/m ² .
20 mm thick. Double Polished		0.50	Bags/m ² .

Kotah/Granite Stone			
25mm thick. Rough Kotah, Dholpur, Red Mandana, Bansipahadpur stone etc. in flooring, skirting & dado of 50mm thk. in cement mortar 1:6		0.50	Bags/m ² .
Glazed Tiles, Ceramic tiles, vitrified tiles flooring in 25 mm thick. Bedding of C:M 1:6		0.20	Bags/m ² .
Glazed Tiles, Ceramic tiles, vitrified tiles dado in C:M 1:1		0.20	Bags/m ² .
China mosaic with 25 mm bedding mortar in C:M 1:6		0.22	Bags/m ² .
18-20mm Marble, Granite, Jesalmer Slab with avg. 50mm bedding mortar in cement mortar 1:6		0.50	Bags/m ² .
I.P.S.	40 mm. thick	0.35	Bags/m ² .
	50 mm. thick	0.40	Bags/m ² .
	75mm. thick	0.55	Bags/m ² .
115mm water proofing plaster		0.40	Bags/m ² .
Brick-on-edge		0.12	Bags/m ² .
Wet stone cladding in C:M 1:2		0.2	Bags/m ² .
Chemical water proofing 3 coats		0.05	Bags/m ² .
Sandwich platform		0.5	Bags/m ² .
G. MISCELLANEOUS			
Filling Zaris with C.M.	1:3	5.0	Bags/ 100 mts.
C.C	1:2:4	3.2	Bags/100 mts.
H. ROADWORK			
Precast exposed Curbs M20	1:2:4	35	Bags/100 mt.
I. 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.
Fixing wall hung type WC		0.1	Bag/no.
Fixing Urinal/s.		0.2	Bag/no.
Half Round Channel 100 mm.		15.86	Bags/100 m.



Fixing 100 mm. dia. SW Gully Trap

0.5

Bag/no.

Note: For the items not covered in above list, CPWD co-efficient shall be followed or proportionate from CPWD co-efficient or actual consumption shall be checked in the beginning, during execution of item in consultation with EIC.



LIST OF MATERIALS

Code No.Particulars

MC.01Cement
MC.1APortland cement
MC.02White Cement
MC.04Sand
MC.05Stone
MC.07Black Trap or Equivalent Hard Stone Coarse Aggregates for Design Mix Concrete
MC.08Stone Coarse Aggregates for Nominal Mix Concrete
MC.09Stone Grit
MC.10Stone Dust
MC.11Bricks
MC.13Cinder
MC.14Lime
MC.15Cement Mortar
MC.17Water
MC.21Mild Steel Binding Wires
MC.23Shuttering
MC.23ATimber / Wood Planking
MC.23BConcrete Shuttering Plywood
MC.26PVC Water stops
MC.27Admixtures for Mass Concrete and Mortar
MC.27AAbrasion Resistant Aggregates
MC.27BConcrete hardener
MC.27CPlasticizer
MC.27DWater reducing agent
MC.27EWater proof compound
MC.28Admixtures for Tile/Stone Cladding
MC.28AWaterproof Adhesive
MC.28BRainbow tile mate
MC.30Cement Concrete Hollow Blocks
MC.32Teak Wood
MC.34Wooden Flush Door Shutters (Solid Core)
MC.35Plywood
MC.35AWaterproof Plywood
MC.35CPre-laminated Plywood
MC.35DBlock boards
MC.36Particle Board
MC.37Fixtures & Fastening
MC.38 Aluminium Doors; Windows, Ventilators



MC.39	Sliding Door Tracks/Channels
MC.44	Mild Steel Wires (Wire Gauze Jali)
MC.45	Galvanized Iron Sheets
MC.46	G.I. Valleys Gutters Ridges
MC.47	Glass
MC.47A	Sheet Glass
MC.47B	Plate Glass
MC.47C	Obscured Glass
MC.47D	Wired Glass
MC.47E	Double Glazed Units
MC.48	Acrylic Sheets
MC.49	Expanded Polystyrene or Framed Styroper Slabs
MC.50	Resin Bonded Fiber Glass
MC.51	Expanded Polystyrene
MC.54	Polyethylene Sheets
MC.59	Gypboard
MC.60	Ceiling Tiles
MC.61	MDF (Medium Density Fiber) Wood
MC.63	Fiberglass Reinforced Plastic (FRP)
MC.64	Permagard
MC.65	Thermolay
MC.66	Marble Chips and Marble Mosaic Terrazzo
MC.67	Flooring Tiles
MC.67A	Plain Cement tiles
MC.67B	Coloured Cement tiles
MC.71	Marble Slab
MC.71A	Blended Marble tile
MC.72	Granite Stone Slab
MC.73	Sandstone Grills/Balusters
MC.75	Facing Tiles
MC.76	White Glazed Tiles
MC.76A	Coloured Glazed Tiles
MC.77	Ceramic Tiles
MC.78	Vitrified Floor Tiles
MC.80	Jesalmer Stone
MC.89	French Polish
MC.89A	WAX Polish
MC.89B	Melamine Polish
MC.89C	Acrylic Wood Polish
MC.90	Paints



MC.90A	Oil Paints
MC.90B	Enamel Paints
MC.90C	Heritage Wall Finish
MC.90D	Polyurethane coatings
MC.90E	Armor Quartz
MC.90F	Acrylic Emulsion
MC.90H	Cement Paint
MC.91	Silicone Paint
MC.92	Anti-Corrosive Paints
MC.92A	Ferro Shield
MC.92B	Tank mastic
MC.92C	Pipekote
MC.92D	Silver shield
MC.92E	Shali mastic HD
MC.93	Powder Paints
MC.94	Water Repellant Coating
MC.95	Joint Sealant
MC.96	Polyester Films
MC.97	High Molecular Plastic Film



MATERIALS SPECIFICATIONS IN DETAIL
FOR CIVIL WORK
PART A

MC-1Cement

MC.1APortland Cement

Cement shall be ordinary Portland slag cement, grade 33, as per IS: 269-1976, grade 43, as per IS 8112-1989-grade 53, as per IS: 12269-1989 or Portland slag cement as per IS: 455-1976.

Testing Standards

(i)Setting Time:

Sampling:

From a lot of 50 tons of cement, 2% of bags shall be picked out at random, from which one sample of 15 kg shall be taken.

- i. For a lot of 50 to 100 tones - 2 samples
- ii. For a lot of 100 to 200 tones - 3 samples
- iii. For a lot of 100 to 200 tones - 3 samples
- iv. For a lot of 200 to 300 tones - 4 samples
- v. For a lot of 300 to 500 tones - 5 samples
- vi. For a lot of 500 to 800 tones - 6 samples
- vii. 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

(ii)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.

(iii)Fineness test by determination of specific surface

Sampling:

Using any 5 samples, made as above, one test is carried out.

For O.P.C, the surface area shall be 225 cm²/gm. or more.

For P.P.C, the surface area shall be 3000 cm²/gm.

(iv)Consistency test

Sampling:

Sampling shall be as in A.

Results:

Consistency in all samples shall be about 30%:

(v)Compressive strength

Sampling:

Sampling shall be as in A.

Results:

On 2nd day, compressive strength must be 160 Kg/cm², for O.P.C

On 7th day, compressive strength must be 220 Kg/cm², for O.P.C

On 28th day, compressive strength must be 310 Kg/cm², for O.P.C

(vi) Chemical composition (IS: 4032-1968):

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 - up to 5%.

The above is for ordinary Portland cement.

MC-2White Cement

The white cement shall conform to IS: 8042-E-1978

MC-4Sand

4.1 Sand shall be 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 Project Manager and Design Consultant. The sand shall not contain more than 8% of silt as determined by field test, if necessary the sand shall be washed to make it clean.

4.2 Testing Standards:

a) Silt Content

Sampling:

Test shall be carried out for every 150 m³ of sand. The sample taken for testing shall weigh 10 Kgs.

Results:

Permissible content shall be 3%.

b) Fineness Modulus

Sampling:

Sampling shall be as in A. Results:

Fine sand: 2.2 to 2.6

Medium sand 2.6 to 2.9

Coarse sand 2.9 to 3.2

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

I.S. Sieve Designation	% By weight Passive sieve
mm	100
2.36 mm	90-100

1.18 mm	70-100
600 Micron	30-100
300 Micron	50-70
150 Micron	0-50

MC-5 Stones

- 5.1 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: 1124-1974. The minimum crushing strength of the stone shall be 200 Kg/cm² unless otherwise specified.

- 5.2 The samples of the stone to be used shall be got approved before the work is started.
- 5.3 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.

MC-7 Black Trap or Equivalent Hard Stone Coarse Aggregate's for Design Mix Concrete

- 7.1 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.
- 7.2 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.
- 7.3 The necessary tests indicated in IS: 383-1970 and IS: 456-1978 shall have to be carried out to ensure the acceptability of the material.
- 7.4 If the aggregates are covered with dust, they shall be washed with water to make them clean.

MC-8 Stone Coarse Aggregate for Nominal Mix Concrete

- 8.1 Coarse Aggregate shall be of machine crushed stone of black trap or equivalent and be hard, strong, dense, durable, clean and free from skin and coating likely to proper adhesion of mortar.
- 8.2 The aggregate shall generally be cubical in shape. Unless special stones of particular quarries are mentioned aggregates shall be machine crushed from the best 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

I.S. sieve Designation	% Passing for single size aggregates of normal size		
	40mm	20mm	16mm
80mm	-	-	-
63mm	100	-	-
40mm	85	100	100
20mm	0 – 20	85 – 100	100

16mm	-	-	85 – 100
12.5mm	-	-	-
10mm	0.5	0.20	0.30
4.75mm	-	0.5	0.5
2.35mm	-	-	-

Note: - This percentage may be varied somewhat by the Project Manager when considered necessary for obtaining better destiny and strength of concrete.

- 8.3 The grading test shall be taken in the beginning and at the change of source of materials. The necessary tests indicated in IS: 383-1970 and IS: 456-1978 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.

a) Flakiness Index

Sampling:

For every 200m³ 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 100m³ 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%.

MC-9 Stone Grit

- 9.1 Grit shall consist of crushed or broken 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:383-1970 Unless special stone of particular quarries is mentioned, grit shall be obtained from the best lack trap or equivalent hard stone as approved by the Project Manager and Design Consultant. The grit shall have no deleterious -reaction with cement.

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

I.S. sieve Designation	% passing Through sieve
12.50 mm	100%

10.00 mm	85-100%
4.72 mm	0-20%
2.36 mm	0-25%

- 9.3 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.
- 9.4 The necessary tests for grit shall be carried out as per the requirements of IS: 2386 (parts I to VIII) 1963, as per instructions of the Project Manager and Design Consultant. The necessity of test will be decided by the Project Manager and Design Consultant.

MC-10 Stone Dust

- 10.1 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 field test is given under:
- 10.2 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 up to 100 mm. mark. Then clean water shall be added up to 150 mm. mark. The mixture shall be stirred vigorously and the contents allowed settling for 3 hours.
- 10.3 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.
- 10.4 The fineness modulus of stone dust shall not be less than 1.80.

MC-11 Bricks

- 11.1 The bricks shall be 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 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 6 m.
- 11.2 The size of modular bricks shall be 190 mm. x 90 mm. x 90 mm.
- 11.3 The size of the conventional bricks shall be (9"x4.4/8" x 2.3/4") 225 mm. x 110 mm. x 75 mm.
- 11.4 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.).
- 11.5 The crushing strength of the bricks shall not be less than 50 Kg/cm². 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) 1976.

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/cm². And every result shall not be less than 20% of the IS standards.

- 11.6 First class bricks are those which strictly conform to the standard size of modular bricks, Length 19 cm. x 19 cm x 9 cm such that ten layers of brick laid in mortar shall form masonry of 1m height.
- 11.7 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.
- 11.8 They have straight edges and even surfaces. They are free from cracks, chips, flaws and modules of lime.
- 11.9 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.

MC-13Cinder

- 13.1 Cinder is well burnt furnace residue which has been fused or centered into lumps of varying sizes.
- 13.2 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.
- 13.3The average grading for cinder aggregates shall be as mentioned below,

I. S. sieve Designation	% Passing
20 mm	100
10 mm	86
4.75 mm	70
2.36 mm	52

MC-14Lime

- 14.1 Lime shall be hydraulic lime as per IS:712-1973. Necessary test shall be carried out as per IS:6932 (Parts I to X) 1973.
- 14.2The 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 un-burnt lime stone.
 - 2) Acid test for determining the carbonate content in lime. Excessive amount of impurities and rough. determination of class of lime.
- 14.3 Storage shall comply with IS:712-1973. 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.
- 14.4 Field testing shall be done according to IS:1624-1974 to show' the acceptability of materials.

MC-15Cement Mortar

- 15.1 Water shall conform to M-17 Cement shall conform to M-1Sand shall conform to MC-4.

15.2 Proportion of Mix:

15.2.1 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 M³. The mortar may be hand mixed or machine mixed as directed.

15.3 Proportion of Mortar

15.3.1 In hand mixed mortar cement and sand in the specified proportions shall be thoroughly mixed dry on a clean impervious platform by turning over at least 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.

15.3.2 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.

MC-17 Water

17.1 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 alkali salts, organic matter and other deleterious material which will either weaken the mortar or concrete or cause efflorescence or attack the steel in R.C.C. container for transport, storage and handling of water shall be clean. Water shall conform to the standards specified in IS:456-1978.

17.2 If required by the Project Manager and Design Consultant 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:269-1976. Any indication of un-sounding 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.

17.3 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.

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

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

17.6 Testing Standards: (According to IS Code)

Chemical Analysis:-

Sampling: Test shall be carried out only once for one particular source.

Results:

a) TDS - 3000 mg/liter

b) Sulphates - 5000 mg/liter

c) PH values - 6 to 8

d) Chlorides

P.P.O - 2000 mg/liter

R.C.O - 1000 mg/liter

e) Carbonic contents - 200 mg/liter

f) Non-carbonic contents - 3000 mg/liter

17.7 Testing standards:

Sampling:

For every 40 tonnes of steel, at least 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
40mm & more	42 Kg/cm ²	24 Kg/cm ²	23

MC-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:280-1972.

21.2.1 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.

MC-23 Shuttering

MC.23A Timber/Wooden planking

23A.1 The shuttering shall be either of wooden planking of 30 mm. minimum thickness with or without steel Mining 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 Baillie props, brick pillar of adequate section built in mud mortar may be used.

23A.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.

23A.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 Project Manager and Architect, before the reinforcement bars are placed in position.

23A.4 The props shall consist of ballies having 100 mm. minimum diameters, 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 m² lay on sufficiently hard base.

23A.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.

23A.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.

23A.7 As far as possible, clamps shall be used to hold the forms together and use of nails and spikes shall be avoided.

23A.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.

- 23A.9 The shuttering for beams and slabs shall have camber of 4mm per meter (1 in 250) or as directed by Project Manager and Design Consultant, 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 Project Manager and Design Consultant.

MC23B Concrete Shuttering Plywood

- 23B.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.
- 23B.2 Due to the bonding with Phenol Formaldehyde, it shall be moisture and weather proof. The use of selected hard-woods renders 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.
- 23B.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.
- 23B.4 Besides it shall be used as centering, shuttering and formwork of concrete columns, beams, slabs, walls, tanks, bridges, fly-Duets, 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.

MC-26PVC Water stops

- 26.1 The PVC water stop shall be of approved make, as approved by the Design Consultant and Project Manager.
- 26.2 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.
- 26.3 They shall be effective in tropical climate having high mechanical strength, good ageing, longer life, shall be unaffected by acids, alkali, 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.
- 26.4 It shall withstand a minimum hydrostatic pressure of 30 m. high column of water.
- 26.5 The selection criteria of water stop depends upon the hydrostatic pressure, however the following points should be kept in mind:
- a) Where substantial expansion/contraction of joints takes place, Dumb Bell type shall be used.
 - b) Where a firm grip in concrete is desired, serrated types should be used.
 - c) The overall width of the water stop should not be greater than the thickness of concrete.
 - d) The distance from the face of the concrete to the water stop must not be less than half the width of the water stop.
 - e) The width of the water stop must be at least 6 times the largest aggregate used for satisfactory compaction.

- 26.6 The prior approval of selected size and type of water stop shall be taken from the Design Consultant and Project Manager, before use.

MC-27 Admixtures for Mass Concrete and Mortar

MC.27A Abrasion Resistant Industrial Flooring Aggregate

- 27A.1 The flooring aggregate, shall be of best quality and from manufacturer like CICO or equivalent, as approved by the Design Consultant and Project Manager. The prior approval for the source shall be taken from the Stantec. It shall conform to the relevant I.S. Code.
- 27A.2 The flooring aggregate shall be a factory processed and specially graded non-oxidizing, non-magnetic and chemically inert metallic flooring aggregate, free from oil and grease.
- 27A.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.
- 27A.4 It shall be used with cement in the ratio, as per manufacturer's instructions and spread evenly on the surface to be treated, at the rate depending on finish 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 trowelled, in stages, to bring about a uniform and smooth finish.

MC.27B Concrete Hardener and Dust proofer

- 27B.1 The Concrete hardener and dust proofer, shall be of best quality and from manufacturer like CICO or equivalent, as approved by the Design Consultant and Project Manager. The prior approval for the source shall be taken from the Architect. It shall conform to the relevant I.S. Code.
- 27B.2 It shall have a specific gravity of 1.18 and shall be applied on concrete floors, at the rate of at least 25 liters per 10OM² 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 see 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.

MC.27C Accelerating, Water Reducing Admixture and Plasticiser

- 27C.1 The Accelerating, Water reducing admixture and plasticiser, shall be of best quality and from manufacturer like CICO or equivalent, as approved by the Design Consultant and Project Manager. The prior approval for the source shall be taken from the Architect. It shall conform to the relevant I.S. Code.
- 27C.2 It shall be in liquid state with a specific gravity of 1.30 and complying with ASTIVI C-494 Type E, IS:9103-1979 & IS:2645-1975. 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.

MC.27D Retarding, Water Reducing Admixture and Plasticiser

- 27D.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 Design Consultant and Project Manager. The prior approval for the source shall be taken from the Architect. It shall conform to the relevant I.S. Code.
- 27D.2 It shall be in liquid state with a specific gravity of 1.22 and complying with ASTM C-494 Type B & D, IS:9103-1979, 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.

MC.27E Water & Weather Proof Compound

- 27E.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 or equivalent, as approved by the Design Consultant and Project Manager. The prior approval for the source shall be taken from the Architect. It shall conform to the relevant I.S. Code.
- 27E.2 It shall be used as an excellent cement admixture in all types of concrete/plaster mortars, pointing mortars, masonry works, gunning 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.
- 27E.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.

MC.27F Plaster Admixture

- 27F.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), of equivalent, as approved by the Design Consultant or Project Manager. It shall comply to the relevant I.S. Codes.
- 27F.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.

MC-28Admixtures for Tile/Stone Cladding

MC.28A Waterproof Adhesive

- 28A.1 Waterproof adhesive, shall be of best quality and from manufacturer like Feb Roffe or equivalent, as approved by the Design Consultant and Project Manager. The prior approval for the source shall be taken from the Architect. It shall conform to the relevant I.S. 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.
- 28A.2 It is useful for permanent adhesion of ceramic tile, 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.

MC.28B Rainbow Tile Mate

- 28B.1 Rainbow tile mate, shall be of best quality and from manufacturer like Feb Roffe or equivalent, as approved by the Design Consultant and Project Manager. The prior approval for the source shall be taken from the Architect. It shall conform to the relevant I.S. Code.

- 28B.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 colors to match all types of glazed/ceramic tile. The organic coloring pigment, added in the compound shall not fade over the period of time.
- 28B.3 There shall be close adhesion of particle in the compound which imparts water-resistant qualities to the compound and allows rendering 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.

MC-30Cement Concrete Hollow Blocks

- 30.1 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.

- 30.2 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 Shell thickness Web thickness

Width minimum 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.

- 30.3 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 + 5 mm. and maximum variation in height and width shall not be more than + 3 mm.
- 30.4 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 de-moulding, the blocks shall be protected until they are sufficiently hardened to permit handling without damage. The blocks shall be thoroughly cured for at least 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.

- 30.5 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/m³ They shall possess min. average compressive strength of 35, 45, 55 and 70 Kg/cm² 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/m³ but not less than 1000 Kg/m³ They shall possess min. average compressive strength of 20, 30 and 50 Kg/cm² 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/m³ but not less than 1000 Kg/m³ They shall possess min. average compressive strength of 15 Kg/cm² at

Grade D - Solid Concrete Blocks - They shall be used as load bearing units and shall have block density not less than 1800 Kg/m³. They shall possess min. average compressive strength of 40 and 50 Kg/cm² respectively, for its sub-category, at 28 days.

- 30.6 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. Color shall lie rendered by adding non-fading mineral pigments.
- 30.7 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.

MC-32Teak Wood

32.1General

- 32.1.1 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 Design Consultant or Project Manager, shall be used. This teakwood, as mentioned above, shall be from specified sources/origins, as approved by the Architect.
- 32.1.2 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 fibers, 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 liable to rejection by the Project Manager and Architect.
- 32.1.3 All scantling, planks etc. shall be sawn in straight lines and planes, in the direction of grains and shall be of uniform thickness.
- 32.1.4 The tolerances in the dimensions shall be allowed at the rate of 1.5 mm. per face to be planned.

32.2First class teak wood:

- 32.2.1 First class teak wood shall have no individual hard and sound knots, more than 6 cm² 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.

32.3Second Class Teak Wood:

- 32.3.1 No individual hard and sound knots shall be more than 15 cm² in size and the aggregate area of such knots shall not exceed 2% of the area of the piece.

MC.33A Processed Rubber Wood

- 33A.1 The processed rubber wood shall be like Borotik, Silverteak or equivalent, as approved by the Design Consultant and Project Manager. It shall conform to IS:401-1982. 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 - 1982, and drying them uniformly in vacuum, to result into uniform texture and low moisture content wood.

- 33A.2 It shall be used for manufacturing furniture and furniture components, wall paneling, A.C grills, venitian 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 42 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

5, 6 and 72 x 2, 3 x 2, 4 x 2

- 33A.3 The moisture content of the processed rubber wood is 8 to 10% for furniture lengths up to 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 Rubber wood.

1) Density: 640 Kg/m³.

2) Hardness: Side - 538 Kg.

3) Compression

Perpendicular to grain - 60 Kg/cm.

Parallel to grain - 1 14 Kg/cm.

Perpendicular to grain - 43 N/mm².

Parallel to grain - 32 N/mm².

4) Modulus of elasticity - 9.24 N/mm².

5) Shear End - 627 Kg.

6) Shrinkage

Radial - 2.6%

Tangential - 6.1%

- 33A.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.

MC-34 Wooden Flush Door Shutters (Solid Core)

- 34.1 The solid core type flush door shutters shall be of decorative or non-decorative 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) 1980. 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 303-1975.

- 34.2 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. Alternatively, the core shall be of solid teak particle board. Edges of the core shall be lipped internally with 1st class teak wood battens of 4 cm (1 -1 /2") minimum depth, glued and machine pressed along with the core.

- 34.3 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.
- 34.4 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, revating, opening of glazing, venation etc. shall be provided if specified in the drawing.
- 34.5 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 smooth even texture.
- 34.6 The shutters shall be tested for -
- a) End immersion test: The test shall be carried out as per IS 2202 (part-1) 1980. There shall be no de-lamination at the end of the test.
 - b) Knife test: The face panel when tested in accordance with IS 1659-1979 shall pass the test.
 - c) Glue Adhesion test: The flush door shall be tested for glue adhesive test in accordance with IS:2202 (Part-1) 1980. The shutters shall be considered to have passed the test if no de-lamination occurs in the glue lines in the plywood and if no single de-lamination 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. De-lamination at the corner shall be measured continuously around the corner. De-lamination at the knots, knot holes and other permissible wood defects shall not be considered in assessing the sample.
- 34.7 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.
- 34.8 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,

MC-35 Plywood

35.1 General

35.1.1 The plywood for general purpose shall conform IS:303-1975.

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.

35.1.2 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.

35.1.3 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°C to 140°C and a pressure of 11 to 14 Kg/cm², on the wood. The time of heating may be anything from 2 to 60 minutes depending upon the thickness..

35.1.4 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.

35.1.5 According to IS:303-1975, 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 moisture content not less than 8% and not more than 16%.

35.1.6 Thickness of plywood boards:

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

MC.35A Water Proof (Weather Proof) Plywood

- 35A.1 The plywood shall be from Kitply, Wonder Wood, Anchor Board or equivalent, as approved by the Design Consultant and Project Manager. It shall conform to IS: 7 10-1976 and to the relevant Defence and Navy specifications.
- 35A.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.
- 35A.3 Plywood shall be waterproof, weather proof, boil proof, 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.
- 35A.4 The tensile strength of the plywood shall be minimum 600 kg/cm² and bending strength above 400 kg/cm². 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.
- 35A.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 paneling, underlayment for kitchen and other furniture, subjected to heat and moisture.

MC.35C Prelaminated - Standard and Veneered

35C.1 Decorative Plywood

- 35C.1.1 It shall be obtained from manufacturer as approved by the Design Consultant and Project Manager. It shall conform to relevant I.S. Code.
- 35C.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.

35C.2 Decorative Veneers

- 35C.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.

35C.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 up to 4 m.

MC.35D Block Boards

35D.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.

35D.2 They shall be strong, weather and water proof and shall be ideally used for high quality furniture and exterior applications.

MC-36 Particle Board

36.1 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:3087-1965 "Specifications for wood particle board for general purpose". The size and the thickness shall be as indicated.

36.2 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 homogenized panel.

36.3 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.

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

36.5 Particle board may also be available in veneered form.

MC-37 Fixtures and Fastenings

37.1 General

37.1.1 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.

37.1.2 They shall be of -iron, brass, aluminum, chromium plated iron, chromium plated brass, copper oxidised iron, copper oxidized brass or anodized aluminum, as specified.

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

37.1.4 The samples of. fixtures and fastenings shall be got approved by Project Manager and Architect, as regards its quality and shape before fixing them in position.

37.1.5 Brass and anodized aluminum fixtures and fastenings shall be bright finished.

37.2 Holdfasts

37.2.1 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.

37.3 Butt hinges

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

37.3.2 Tee and strap hinges shall be manufactured from M.S. Sheet.

37.4 Sliding door bolts (Aldrops)

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



37.5 Tower bolts (Barrel type)

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

37.6 Door Latch

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

37.7 Bathroom Latch:

37.7.1 Bathroom latch shall be similar to tower bolt.

37.8 Handle

37.8.1 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.

37.9 Door Stoppers / Door catches

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

37.9.2 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.

37.10 Wooden Door Stop with Hinges

37.10.1 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.

37.11 Casement Window Fastener

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

37.12 Casement Stays (Straight Peg Stay)

37.12.1 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.

37.13 Ventilator Catch

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

37.14 Pivot

37.14.1 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.

MC-38 Aluminum Doors, Windows, Ventilators

38.1 Aluminum alloy used in the manufacture of extruded window sections shall conform to I.S. designation HEA-WP of IS:733-1975 and also to I.S. designation WVG-WP of IS:1285-1975. The section shall be as specified in the drawing and design. The fabrication shall be done as directed.

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

38.3 The hinges shall normally be of 50 mm, operable/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 lock for the door, operable either from outside or inside shall be provided. In double shutter door, the first closing shutter shall have concealed aluminum alloy tower bolt at top and bottom.

MC-39 Sliding Door Tracks/Channel

- 39.1 It shall be from Agend, Coburn System or equivalent, as approved by the Design Consultant and Project Manager.
- 39.2 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 up to 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.

- 39.3 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.

MC-44Mild Steel Wire (Wire Gauze Jali)

- 44.1 Mild steel wire may be galvanized, 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:280-1978.

MC-45Galvanized Iron Sheets

- 45.1 The galvanized iron sheets shall be from Tata or equivalent, as approved by the Design Consultant and Project Manager. It shall be plain or corrugated, of gauge as specified in item. The G.I. sheets shall conform to IS:277-1977. 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.
- 45.2The width of G.I. sheet shall be as directed, as per site condition.

MC-46G.I. Valleys gutter ridges

- 46.1 The G.I. ridge and hips shall be of plain galvanized 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.
- 46.2 Valleys, gutters and flashing shall also be of galvanized 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.

MC-47Glass

- 47.1 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:

MC.47A Sheet Glass

- 47A.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/m² for panes up to 600 mm. x 600 mm.
- 47A.2 For panes larger than 600 mm. x 600 mm and up to 800 mm. x 800 mm., the glass weighing not less than 8.75 Kg/m². shall be used. For bigger panes up to 900 mm. x 900 mm, glass weighing not less than 11.25 Kg/m² shall be used.
- 47A.3 Sheet glass shall be patent flattened glass of best quality and for glazing and framing purposes shall conform to IS:1761-1960. 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.

MC.47B Plate Glass

- 47B.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.

MC.47C Obscured Glass

- 47C.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.

MC.47D Wired Glass

- 47D.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.

MC.47E Double Glazed units

- 47E.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.
- 47E.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
- (i) Total light penetration, but with dust and heat insulation.
 - (ii) Noise insulation.
 - (iii) 25% saving in electricity due to heat insulation.
 - (iv) Crystal clear transparency.

MC-48Acrylic Sheets

- 48.1 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.
- 48.2 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.

MC-49Expanded Polystyrene or Framed Styroper Slabs

- 49.1 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.

MC-50Resin Bonded Fiber Glass

- 50.1 The resin bonded fiber glass tiles or rolls shall be of approved make and shall be of sizes, thickness and finish, as indicated.
- 50.2 For test of mineral wool thermal insulation blanket, IS:3144-1965 shall be followed.
- 50.3 Insulation wool blanket shall be with the following coverings on one or both sides, as indicated.
- (1) Bituminized hessian kraft paper suitable for use in position where moisture has to be excluded.
 - (2)Hessian cloth or kraft paper, for keeping out dust.
 - (3)G.I. wire netting, suitable for surfaces to be plastered over.

MC-51Expanded Polystyrene

- 51.1 The Expanded Polystyrene shall be from Thermocole, Cooling or equivalent, as approved by the Design Consultant and Project Manager.
- 51.2 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, 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.
- 51.3 It shall have high, dynamic load bearing capacity, excellent resistance to water vapour. The density of Polystyrene shall be 20-25 kg/m³, having thermal conductivity value 0.025 KCal/hr m°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.
- 51.4 The compressive strength at 10% deformation and cross breaking strength shall not be less than 1.0 kg/cm² and 1.6 kg/CM² respectively. It shall have resistance to soaps, bleaching agents, dilute acids, alkalies, silicone oil, fresh & sea water, alcohol liquid paraffins, petroleum jelly etc.

MC-54Polyethylene Sheets

- 54.1 Polyethylene sheet shall be from Profeel, Ramplast or equivalent, as approved by the Design Consultant and Project Manager.
- 54.2 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.

- 54.3 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°C. It shall conform to IS:5913 and IS:3792-1978, wherever applicable. It shall prevent corrosion, chemical action, leakage, seepage, pollution.

MC-59 Gypsumboard

- 59.1 It shall be of the best quality from India Gypsum or equivalent, as approved by the Design Consultant and Project Manager.
- 59.2 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 gypsumboard 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 up to 60 db of sound, when erected in the proper manner.

MC-60 Ceiling Tiles

- 60.1 It shall be of the best quality, such as Gypsumboard, Sitatex or equivalent, as approved by the Design Consultant and Project Manager. It shall adequately follow the IS: 3129.
- 60.2 They shall be made either from gypsumboard or from sugarcane fibers, as specified in the item.
- 60.3 They shall be resistant to fire, termites, fungus, wood boring, insects and other wood deteriorates. They shall be resistant to de-lamination 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.² /hr/°C and good fire retardant properties. It shall have a density of 288 Kg/m³. + 10% and shall weigh 3.71 Kg /m². 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.
- 60.4 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 centers, telecommunication buildings etc.

MC-61 MDF (Medium Density Fiber) Wood

- 61.1 The MDF wood shall be from Nuwood or equivalent, as approved by the Design Consultant and Project Manager and shall conform to IS:12406-1988.
- 61.2 MDF wood shall be manufactured from wood fibers and synthetic resin binder to produce homogenous sheet material, having minimum density about 600 to 900 kg/m³. 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 at least 50 N/mm² and 0.8 N/mm², respectively.
- 61.3 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.

MC-63 Fiberglass Reinforced Plastics (FRP)

- 63.1 Fiberglass Reinforced Plastic shall be from CEAT or equivalent, as approved by the Design Consultant and Project Manager. It shall conform to relevant I.S. Code.

- 63.2 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.
- 63.3 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/m³, 1000 MPa and 40x10³ MPa, respectively. It shall have minimum tensile strength as specified. The FRP shall have conductivity about 0.2 w/m°C. Thermal coefficient of expansion shall be less than 10x10⁻⁶ per °K.
- 63.4 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.

MC-64Permagard

- 64.1 Permagard shall be from India Foils or equivalent as approved by the Design Consultant and Project Manager.
- 64.2 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.
- 64.3 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 0.26mm + 0.03 mm. The weight shall not be less than 0.54 Kg/m². It shall have excellent abrasion power.

MC-65Thermolay

- 65.1 It shall be from STP Ltd. or equivalent, as approved by the Design Consultant and Project Manager.
- 65.2 It shall comprise of modified bitumen impregnated reinforcement fabric, sandwiched between coats of polymer modified bitumen, with the underside covered with thermofusible polyethylene 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.
- 65.3 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.

MC-66Marble Chips for Marble Mosaic Terrazzo

- 66.1 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.
- 66.2 The size of various colours of marble chips ranging from the smallest up to 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 Project Manager and Design Consultant shall be used for marble mosaic tiles or works.

- 66.3 The marble chips shall be machine crushed. They shall be free from foreign matter, dust etc., except above, the chips shall conform to IS:21114-1962.

MC-67Flooring

MC.67A Plain Cement Tiles

- 67A.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 I.S.
- 67A.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/cm². 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:1237-1980, regarding strength, resistance to wear and water absorption.
- 67A.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.
- 67A.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.
- 67A.5 Tolerance of length and breadth shall be + 1 mm. Tolerance of thickness shall be + 5 mm.
- 67A.6 The tiles shall satisfy the test as regards transverse strength, resistance to wear and water absorption as per IS:1237-1980.

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/cm². When dry 120 Kg /CM².

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.

MC.67B Plain Coloured Tiles

- 67B.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: 1237-1980.
- 67B.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.
- 67B.3The colour of the tiles shall be specified in the item or as directed.

MC-71Marble Slab

- 71.1 Marble slab shall be white or of any other available colour and of best quality, as approved by the Project Manager and Design Consultant.
- 71.2 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.
- 71.3 Marble slabs with natural veins, if selected, shall have to be laid as per the pattern given by the Project Manager and Design Consultant. 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.
- 71.4 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.
- 71.5 Except as above, the marble slabs shall conform to IS:1130-1969.

MC.71A Blended Marble tile/slab

- 71A.1 It shall of the best-quality like Carara, Marbella or equivalent, as approved by the Design Consultant and Project Manager.
- 71A.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, along with 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.
- 71A.3 It shall be available in pre-cut, pre-polished, chamfered and grooved up to sizes of 600 mm. x 600 mm. Sizes up to 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

- 71A.4 It shall offer flexibility, high wear resistance, impact resistance and on testing shall be 1.5 Kg.cm/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.
- 71A.5 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 latex based glues..

MC-72Granite Stone Slab

- 72.1 Granite shall be of approved colour and quality. It shall be got approved by the Project Manager 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.
- 72.2The thickness of the stone shall be as specified in the item.
- 72.3 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.

MC-73Sand Stone Grills/Balusters

- 73.1 It shall be from Dilpasand Shilp or equivalent, as approved by the Design Consultant and Project Manager.

- 73.2 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.
- 73.3 The grills/Baluster shall be produced by fine chiseling. All edges, faces and angles of fine hand chiseled grills, columns, baluster shall be machine polished, as specified in item.

MC-75 Facing Tiles

- 75.1 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:2691-1972.
- 75.2 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.
- 75.3 The permissible tolerance in dimensions specified above shall be as follows:

Size	Tolerance 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

- 75.4 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.

- 75.5 The average compressive strength obtained as a sample of five tiles when tested in accordance with the procedure laid in IS: 1077-1976 shall not be less than 175 kg/cm². The average compressive strength of any individual bricks shall be not less than 160 Kg/cm².
- 75.6 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%.
- 75.7 The brick tiles when tested in accordance with IS:1077-1976, the rate of efflorescence shall not be more than 'Slightly effloresced'.

MC-76 White Glazed Tiles

- 76.1 The tiles shall be of best quality, as approved by the Project Manager and Design Consultant. 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.
- 76.2 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:777-1970.

MC.76A Coloured Glaze Tiles

- 76A.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 Design Consultant and Project Manager.

MC-77 Ceramic Tiles

- 77.1 Ceramic tiles shall be of 1st quality such as Romano, Regency, Spartek, Stiles or equivalent, as approved by the Design Consultant and Project Managers. They shall adequately meet the relevant IS.
- 77.2 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/cm² and flexural strength of 350 Kg/cm². They shall offer good resistance to abrasion, Le can withstand up to 5000 grindings. They shall be scratch resistance, their hardness of-, the Moh's scale shall be 6.8 to 7. They shall be resistant to all acids and alkalis except hydrofluoric acid. In addition, they shall be bacteria free and fire proof, as they are fired at @ 1160°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 up to 10 cycles and their co-efficient of linear thermal expansion shall be 9 from ambient temperature to 100°C.
- 77.3 They shall be available in various sizes, 8"x4", 8"x8", 8"x12", 12"x 12" and 12"x 16". 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%.
- 77.4 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.

MC-78Vitrified Floor Tiles

- 78.1 Vitrified floor tiles shall be of best quality like Granite or equivalent, as approved by the Design Consultant and Project Managers. They shall conform to the relevant LS. Codes.
- 78.2 They shall be monolithic and available in smooth, mirror-polished and anti-skid finishes, in sizes 12"x 12", 8"x 8" and 8"x 4". 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.
- 78.3 They shall be extremely strong, breaking strength of the tile being 1600 Kg/cm², flexural strength, 200 Kg/cm² and bonding strength of 2500 Kg/cm². 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 up to 10 cycles. They shall have a bond strength of 2500 Kg/cm² 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.

MC-89French Polish

- 89.1 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.

89.2The French polish so prepared shall conform to IS 348-1968.

MC.89A Wax Polish

- 89A.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:751967 and 1 part of Turpentine conforming to IS:83-1950 and 0.5 part Varnish conforming to IS:3371952.

89A.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 warm and turpentine and varnish added to it in the required proportions and entire mixture shall be well stirred.

MC.89B Melamine Polish

89B.1 The melamine polish shall be of best quality and make such as Asian Paints or equivalent, as approved by the Design Consultant and Project Manager. It shall be transparent or opaque, as specified by the Architect.

89B.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 peeling 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 leveling properties. It shall be durable and flexible to absorb cracks. It shall have resistant to scrubs, light rays, heat etc.

MC.89C Acrylic Wood Polish

89C.1 Acrylic wood polish shall be of the best quality and make such as Nebula Chemicals Pvt. Ltd. or equivalent, as approved by the Design Consultant and Project Manager. It shall be made from the best ingredients to give a consistent quality. It shall be water resistant, heat resistant and scratch resistant.

89C.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 surface, 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

MC-90Paints

MC.90A Oil Paints

90A.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 strainer shall be allowed. In such case, the Contractor shall ensure that the shade of the paint so allowed shall be uniform.

90A.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 re-dispersed 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 leveling 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.

90A.3 Ready mixed paint shall be used exactly as received from the manufacturers and generally according to their instructions and without any admixtures, whatsoever.

MC.90B Enamel Paints

- 90B.1 The enamel paint shall satisfy all general requirements in specification of oil paints. Enamel paint shall conform to IS:2933-1975. It shall be from Nerolac, Berger, Asian Paints or equivalent. It shall offer variety of finishes like Glossy, Semi-glossy, Pearl lustre and Matt.
- 90B.2 It shall be applied either by brush, roll or spray. It shall have a covering capacity of 13 to 18m², per coat, depending on the surface to be painted. It shall be used both on metal and wood surfaces.
- 90B.3 It shall have a viscosity of application of 60 to 65 seconds, if brush or roller are used and 30 to 40 seconds, if praying is done. It shall have flash point at above 30°C. The drying time shall however vary with the ambient temperature and humidity.

MC.90C Heritage Wall Finish

- 90C.1 It shall be from Bakelite Hylam Ltd. or equivalent, as approved by. the Design Consultant and Project Manager. It shall conform to relevant I. S. Codes.
- 90C.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 Design Consultant. 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. A.C. sheet, gypsum plaster or any other materials, to get homogenous layer.
- 90C.3 It shall be water based 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./cm². 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.

MC.90D Polyurethane Coatings

- 90D.1 It shall be from MRF Durodec or equivalent, as approved by the Design Consultant and Project Manager.
- 90D.2 It shall be a three coat application, using a brush 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.
- 90D.3 It shall be ideal for concrete, floor toppings, on calcium silicate brickwork, glass fiber reinforced concrete, wood fiber. Plaster board, fiber 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.

MC.90E Armor Quartz

- 90E.1 It shall be from Jenson & Nicholson or equivalent, as approved by the Design Consultant and Project Manager.

- 90E.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 Design Consultant. 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, A.C. 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.
- 90E.3 It shall be water based, 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 at least 10 years.

MC.90F Acrylic Emulsion

- 90F.1 It shall be from Nerolac, Asian Paints, ICI, Berger or equivalent, as approved by the Design Consultant and Project Manager. It shall conform to the relevant I.S. Codes.
- 90F.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 protector against all elements.
- 90F.3 It shall be water based. It shall require no primer. On a well prepared surface, it shall be applied, after one coat of cement primer, incase it is an interior surface and waterproof cement coating, incase it is an exterior surface. On a new but highly absorbant 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 m²/liter, 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.

MC.90G Cement Paints

- 90H.1 It shall be from Berger, ICI, Asian Paints or equivalent, as approved by the Design Consultant and Project Manager. It shall conform to the relevant I.S. Codes.
- 90H.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, fiber boards, brickwork, etc. It shall offer matt finish. It shall require no primer and shall be water based. It shall offer a covering capacity of 6-8 m² per Kg., depending on the surface and shade used. It shall preferably not be applied under direct sunlight to avoid patchy effect.

MC-91Silicone paint

- 91.1 It shall be of the best quality, like Hydroseal - Silicone Epoxy or equivalent, as approved by the Design Consultant and Project Managert. It shall conform to the relevant I.S. Codes.
- 91.2 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
- 91.3 It shall be water based. Before use, the hardener of the Silicone 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 semi-transparent on drying it shall become transparent.

MC-92Anti-Corrosive Paints

MC.92A Ferro shield

- 92A.1 It shall be from STP Limited or equivalent, as approved by the Design Consultant and Project Manager.
- 92A.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.

MC.92B Tankmastic

- 92B.1 It shall be from STP Limited or equivalent, as approved by the Design Consultant and Project Manager. It shall conform to IS:158-1982 and IS:9862-1982.
- 92B.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 connection, against corrosion. It shall be applicable on steel, wood, concrete, iron etc. It shall have a covering capacity of 12 M²/liter.

MC.92C Pipekote

- 92C.1 It shall be from Limited or equivalent, as approved by the Design Consultant and Project Manager. It shall conform to IS:158-1982.
- 92C.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 up to 150°C. It shall render a heavy body protective film. If zinc-rich, epoxy primer shall be used, better results of pipekote shall be obtained.

MC.92D Silvershield

- 92D.1 It shall be from STP Limited or equivalent, as approved by the Design Consultant and Project Manager.
- 92D.2 It shall be a bituminous aluminum-finish paint formulated for application over anti-corrosive paints. It shall have a covering capacity of 10 ml/liter.

MC.92E Shalimastic HD

- 92E.1 It shall be from STP Limited or equivalent, as approved by the Design Consultant and Project Manager. It shall comply with the US Dept. of interior bureau of reclamation specification CA-50.
- 92E.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.

MC-93Powder Paints

- 93.1 Powder paints shall of superior quality such as Hawcoplast of Hardcastle & Waud Mfg. Co. Ltd. or equivalent, as approved by the Design Consultant and Project Manager. It shall conform to the relevant I.S. specifications.
- 93.2It 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 over bake 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.

MC.94 Water Repellant Coating

- 94.1 The Water repellant coating, shall be of best quality and from manufacturer like CICO or equivalent, as approved by the Design Consultant and Project Manager. The prior approval for the source shall be taken from the Architect. It shall conform to the relevant I.S. Code.
- 94.2 Water repellant coatings for exterior exposed surfaces shall be acrylic resin based, having a Flash point of approx 40°C and specific gravity of 0.95.
- 94.3 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 & 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.

MC.95A Joint Sealant

- 95.1 The sealant shall be of best quality and from manufacturer like CICO, MC-BAUCHEMIE, PIDILITE, HMP or equivalent, as approved by the Design Consultant and Project Manager. The prior approval for the source shall be taken from the Architect. It shall conform to the relevant I.S. Code.
- 95.2 It shall be a two component poly-sulphide rubber joint sealant, based on a low molecular weight polymer. It should not contain chlorides or other corrosive substances.
- 95.3 It shall be used for sealing joints in water retaining structures, roofs, external walls, cladding, floors, 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, + 10% at 100% elongation. The shore "A" hardness of the sealant shall be 22 + 3 @ 25°C. The operating temperature range for the sealant shall be -25°C to 80°C. The permanent dynamic movement capability of the sealant shall be +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 alkalis, salt spray, aliphatic and aromatic solvents and shall not contain tar or bituminous ingredients.
- 95.4 It shall possess 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.

MC-96 Polyester Films

- 96.1 It shall be of the best quality such as Sun Control Garware or equivalent, as approved by the Design Consultant and Project Manager. It shall conform to the relevant I.S. Specifications.
- 96.2.1 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.

MC-97 High Molecular Plastic Film

- 97.1 The film shall be from Om Agro Industrial Plastics Pvt. Ltd. or equivalent, as approved by the Design Consultant and Project Manager. It shall conform to relevant I.S. Code.
- 97.2 It shall be fully impervious to provide a complete water barrier system. The tensile strength of the film shall be less than 450 kg/cm². 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/cm² and 90°C respectively.

- 97.3 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.

MC-98 Barbed Wire

- 98.1 The barbed wire shall be of galvanized steel and it shall generally conform to IS:278-1978. 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.
- 98.2 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° of the axis of the wire, forming the barbs.
- 98.3 The line and point wires shall be of circular section, free from scale and other defects and shall be uniformly galvanized. The line wire shall be in continuous length and shall not contain any weld other than those in the rod before it is drawn. The distance between two successive splices shall not be less than 15 M.

98.4 The length per 100 Kg. of barbed wire, I.S. type, shall be as under:

Nominal 1000 m.

Minimum 934 m.

Maximum 1066 m.



Item Specifications For Civil Works

Section No: 1 EARTH WORK

(1.01 to 1.05)

A.General

- A.1 For excavation & earth work following relevant IS codes shall be followed, for materials and workman ship.

IS: 1200 (Part 1) & IS 3764

B.SiteClearing & Cleaning

- B.1 The site of work shall be cleared off the shrubs and all obstructions loose stones & other materials, all kinds of rubbish, debris, temporary structures, etc shall be removed as directed. All these shall be conveyed and stacked at site or removed from site as advised, as these are the property of owner.
- B.2 No existing trees, plants, etc shall be cut before obtaining necessary prior permission from Govt/forest department. Contractor shall obtain such permission from the concern authority for the same, at his own expenses.
- B.3 All the materials received from the cutting shall be transported, stacked and handed over to the owner, as the same is owner's property.

C.Setting out of work at site

- C. 1 on completion of the site cleaning, the contractor shall establish grid lines & bench mark as directed by Architects/Project manager/Engineer in charge. On the basis of this, contractor will mark and / or set at site all the center lines, reference points, etc with his own expenses. The contractor shall be solely responsible for all reference points, alignments, elevations, dimensions of each and all items of the work. The setting out work shall be maintained by the contractor till its required.

D.Excavation Work

D.1General

All excavation work done manually and/or mechanically shall be carried out in workman like manner in true line level and strictly in accordance with the respective drawings or as directed. The bed of excavated area shall be truly leveled both longitudinally and transversely by removing excess soil and/or by watering as the case may be. Further, the roots coming in the sides of trenches shall be cut and coated with hot asphalt.

- D.1.1 Soft rock or disintegrated rock excavation or removal shall be carried out by crow bars, pickaxes or pneumatic drills or other approved means.

If excavation in soft rock strata is to be carried out thr'o blasting, it can be only implemented only after getting written permission prior to start the work from respective authorities, Architects/Project Manager, but nothing extra shall be paid for the same. All excavated stuff of soft rock shall be stacked at site as directed and shall be the property of owner.

- D.1.2 Excavation for hard rock may be done by blasting and/or by drilling strictly in accordance with the foundation drawings. During the process of work till completion, safety code (IS:4081) for blasting and respective code for drilling operations too shall be followed. The blasting shall be taken up for excavation work only with written permission from authority, Architect, Project Manager. The contractor shall take necessary license allowing to carry blasting work according to prevailing laws, regulations, etc from designated licensing authorities. All the precautions, safety

measures, acquisition, transport, storage, landing and usage of explosives along with relevant safety code shall be strictly observed, maintained & followed. Further, the rules & regulations established in year 1940 and revised regularly for explosives shall be strictly followed by the contractor, to handle explosives & to take up blasting work.

The magazine shall be built as per the design specifications provided by explosive authority without any modification and shall be located at the location approved by respective authority. It shall have specified lightening conductor & shall have secured locking system. In no case, un authorized person/s shall be permitted to enter into magazine. Further, no matches and / or inflammable materials shall be allowed to be taken in to the magazine. However, Architects/Project Manager shall be allowed to enter magazine for checking the explosives and accounts maintained by the permitted agency / contractor. Explosives shall be kept dry and shall not be exposed to direct sunrays. Only required quantity of explosive shall be brought to site and extra quantity after filling the holes shall be taken back to magazine. Blasting shall not be allowed closer than 30m to any structure and / or closer to location where concreting work has been done within seven days.

The contractor shall be responsible for damage to property, workman, public, third party, owner's / Architects representatives, due to any accident because of utilization of explosives and during blasting operations. The quantity & intensity of the explosive used shall be such as it will neither damage nor crack the rock beyond the limits of excavation line.

D.1.3 Precautions:

The blasting operation shall remain in charge of competent and experienced supervisor and workmen of the Contractor, per set of operation, who are thoroughly acquainted with the details of handling explosives and blasting operations. The blasting shall be carried out during fixed hours of the day, preferably during the mid-day/lunch hours or at the close of the work, as ordered in writing by the Architect and Project Manager. The hours of blasting shall be notified in advance to the people in the vicinity. All the charges shall be prepared by the man in charge only.

- D.1.4 Red danger flags shall be displayed prominently in all directions before the blasting operations.
- D.1.5 People except those who actually light the fuse shall be prohibited from entering into this area. The flag shall be stationed as much as 200 m. away from the firing site, in all directions and all persons, including workmen shall be excluded from the flagged area, at least 10 minutes before the firing warning whistle being sounded for this purpose.
- D.1.6 During excavation in rock by blasting, the lowest 15 cm. of the strata shall be blasted with light charges so as not to shatter or weaken the underlying rock on which the foundation will actually be laid. If excavation in rock is done to larger width and length than those shown on the drawings or as directed, no payment shall be made for such over break. If excavation is done to depth greater than shown on the drawings or as directed, excess depth shall be made up with foundation grade concrete, as directed, at the Contractor's cost.
- D.1.7 The charged hole shall be drilled to the required depth with pneumatic drills. The drilling pattern shall be such that the rock pieces after blasting shall be suitable for handling without secondary blasting. In dry weather and normal dry excavation, ordinary low explosive like gunpowder may be used. In damp rocks, high explosive like gelatine, dynamite with detonator and fuse wire may be used. Under water or in rocks with substantial accumulated seepage water, electric detonator shall be used. When blasting is done with powder, the fuse shall be cut to the required length and shall be inserted in the holes and the powder dropped in. The powder shall be gently tamped with copper rod with rounded ends or wooden tamping rod with a flat end. The explosive powder shall then be covered with trapping materials which shall be tamped lightly but firmly. When blasting is done with dynamite and other high explosive, dynamite/explosive cartridges shall be prepared by inserting the square cut ends of fuse into the detonator and finished with dippers at the open ends. The detonator

should be gently pushed into the primer leaving 1 /3rd of the copper exposed outside. The primer shall be housed into the explosive. Bore holes shall be of such size that the cartridges can be easily passed down. The holes shall be cleared of all debris before the explosive is inserted. A space of about 20 cm. above the charge shall then be gently filled with dry clay, pressed home and the rest of the tamping is firmed with any convenient materials gently packed with a wooden cover.

- D.1.8 At a time, not more than 20 nos. of such charges shall be prepared and fired. The man in charge shall blow a whistle, in a recognized manner, for cautioning the people. All the people shall then be required to move at safe distances. The charges shall be lighted, preferably electrically, by the man in charge only. The man in charge shall count the number of explosions. He shall satisfy himself that all the charges have been exploded before allowing the workmen to go to the work site.
- D.1.9 The Contractor shall be fully responsible to strictly follow the prevailing rules and procedures regarding blasting procedures. When blasting is done near any existing building or any other property, it shall be done under cover and the Contractor shall make all necessary muffling arrangements. Covering may be preferably done with M.S. plate with adequate dead weight over them. Blasting shall be done with small charges only and where directed, a trench shall have to be cut by chiseling prior to the blasting operation, separating the area under blasting from the existing structures.
- D.1.10 When excavation has almost reached the desired level, hand trimming shall be done for dressing the surface to the desired level. Any rock excavation beyond the limit of 75 mm. shall be filled up as directed by the Project Manager, with concrete of grade not less than M-150. The cost for the same shall be borne by the Contractor. Stepping in rock shall be done by hand trimming.

D.1.11 Misfire:

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

Sufficient time shall be allowed to account for the delayed blast. The man in charge shall inspect all the charges and determine the missed charge.

If it is the blasting powder charge, it shall be completely flooded with water. A new hole shall be drilled at about 45 cm. away from the misfired bore. This should blast the old charge. If it will not blast the old charge, then the above procedure shall be repeated till the old charge is blasted.

In case of charge of gelatin, dynamite etc., the man in charge shall gently remove the tamping and the primer with detonator. A fresh detonator and primer shall then be used to blast the charge. Alternatively, the hole may be cleared off for one foot of tamping and the direction of it shall then be ascertained by placing a stick in the hole. Another hole shall then be drilled 15 cm. away and parallel to it. This hole shall then be charged and fired so that the misfired hole should explode at the same time. The man in charge shall report to the office at once for all cases of misfire, the cause of the same and what steps were taken in connection therewith.

If a misfire has been found due to a defective detonator or dynamite, the whole quantity in the box from which defective article was taken must be sent to the authority, as directed for inspection to ascertain whether all the remaining materials in the box are also defective or not.

- D.1.12 Accidents: The Contractor shall be solely responsible for any accident during the entire procedure of handling explosive and blasting and shall pay necessary compensation to persons affected or damage to lands or property etc. due to the blasting without extra claims on the Client.
- D.1.13 Account: A careful and day-to-day account of explosive shall be maintained by the Contractor, in an approved manner and shall be open to inspection of the Architect and Project Manager, at all times. Surprise visit may also be paid by the Architect and Project Manager, to the storage and in case of any unaccountable shortage or unsatisfactory accounting is noticed and found, the Contractor shall be liable to be



penalized by forfeiture of part or whole of his security deposit or by cancellation of contract in which case he shall not be entitled for any -compensation.

D.2 Excess excavation

Due to any reason, if excavation is made deeper or wider than shown on the drawing, in no case earth filling will be permitted for making it to correct level. However the same shall be corrected by providing and laying similar concrete as specified for the foundation concrete for the excess excavated width and/or depth.

D.3 Shoring and strutting

Necessary and adequate shoring and strutting, etc or necessary slopes to a safe angle or steps as required or directed shall be provided by the contractor as measure of precaution. Nothing extra shall be paid to the contractor for the same as it is considered as part of excavation work.

D.4 Existing Utility Lines

Contractor shall provide all supporting system for all kinds of existing utility lines met with during excavation work and shall take all precautions to avoid any kind of damage to those lines as directed at his own expenses and without any extra charge. The same shall be kept in position till Architects/Project Manager considers it necessary.

D.5 Dewatering

Contractor shall at his own expenses and without any extra charge carry out dewatering or bailing out of water manually or with pumps either construction water, sub soil water, rain water, etc from the trenches till Architects/Project Manager considers it necessary. However, trenches shall be kept water free during masonry and/or concrete work is in progress.

D.6 Lighting

Contractor shall provide adequate & sufficient lighting to surrounding area of excavation trenches, pits, etc at his own expenses as a measure of precaution, without any extra charge.

D.7 Barriers, Fencing, signs, tags, etc

Contractor shall provide sturdy barriers, fencing surrounding excavation trenches, pits, etc with warning signs, tags, etc at his own expenses without any extra charge as safety measure.

E. Disposal of Excavated soil (Spoil), etc

- E.1 No materials excavated from foundation trenches of whatever kind they may be, are to be placed even temporarily nearer than 1.5 m. from the distance prescribed by the Architects or Project Manager, from the outer edge of excavation. Further, no excavated soil shall be stacked / dumped within the building area unless allowed by Architects/Project Manager. All materials excavated shall remain the property of the Client. The rate for excavation includes sorting out of useful materials and stacking them separately as directed within the specified lead. Materials suitable and useful for back filling or other use shall be stacked in convenient places but not in such a way as to obstruct free movement of men, animals and vehicles or encroach upon the area required for constructional purpose. The site shall be left clean of all debris on completion.
- E.2 Surplus or balance earth from excavated stuff shall be stacked within site area and / or taking away from the site as directed by Architects/Project Manager. Contractor shall take utmost care to stack selected soil which is to be used for back filling and stack the soil other than this separately as directed without any extra charge.
- E.3 Disposal of excavated materials is subject to the following:

Unsuitable materials obtained from clearing site and excavation shall be disposed off within a lead of 50m as directed. Useful materials obtained from clearing site and excavation shall be stacked within a lead of 50 m., beyond the building, as directed. Materials suitable for back filling shall be stacked at convenient places within a lead of 50 m. from the structure for reuse. Useful stones from rock excavation shall be stacked neatly within a lead of 50 m and will be allowed to be used by the Contractor, on payment at rates laid down in the contract or if not so paid down, at a mutually agreed rates.

- E.4 The disposal of the surplus earth includes loading the same in vehicle conveyance to the specified site (either it is to be disposed off within site area or conveyance to the location where contractor has obtained legal permission from the concern authorities for the disposal / dumping of the same) unloading and spreading the same.
- E.5 The contractor should notify / inform the program for disposal work before starting of the same i.e. loading of truck for disposal. Project Manager shall check each and every trip of truck (when they are being loaded) whether it is loaded properly to the pre-decided level and then note its number in the register to keep the record of trips by the same truck.

F. Back Filling

- F.1 Contractor shall back fill the excavated trenches, pits, etc on completion of concrete / masonry work up to G.L. with selected and approved earth / soil from excavated stuff in specified layers including watering, ramming, compacting, etc complete at his own expenses without any extra charges, unless otherwise specified.
- F.2 In back filling the trenches, clods bigger than 50mm size shall not be allowed.
- F.3 Before back filling, all debris, brick bats, mortar dropping, etc shall be cleared off from the sides of foundations, etc.
- F.4 Back filling shall be done in the layers of 15cm only and each layer shall be well watered, rammed & consolidated adequately before other layer is put. The back fill shall be consolidated as specified with hand roller, steel rammers, etc wherever feasible. However, where rammer can not be used, it shall be rammed with butt ends of crowbar.

G. Filling work

- G.1 Earth filling in plinth, etc

Plinth filling and/or other areas of fill shall be filled with selected & approved excavated soil or with selected approved earth brought from outside, as the case may be, in the layers of 15cm only sufficiently watered, rammed / consolidated / compacted with steel rammers, hand rollers, etc including leveling the surfaces. When filling is reached at finished level the area of fill shall be flooded with water at least for 24 hours. The same shall be allowed to dry. The depressions, pot holes, etc shall be filled to make the same good. Then complete area shall be adequately consolidated as specified. The finished final level shall be kept to shape and in gradient as per drawing. For heavy duty and/or large area of fill, the compaction of filled earth shall be done by power rollers wherever and wherever directed to the extent of consolidation as specified. Under no circumstances, black cotton soil and/or disapproved earth /soil shall be used for filling. Selected earth brought from outside shall be clean of good binding quality and as approved.

- G.2 Murrum filling

Murrum filling shall be carried out as described under section of earth filling in plinth, etc. However, quality of selected murrum shall be clean having good bonding quality and as approved. The same shall be collected & obtained from approved quarries which contain silicon materials and natural mixture of clay of calcareous origin. The size

of murrum particles shall not be greater than 20mm and shall be approved before it is filled. It shall confirm to material specifications as specified.

G.3 Sand filling

Sand filling shall be carried out with approved sand meeting with specified material specifications and the same shall be filled as described under section of earth filling in plinth, etc.

H. Anti - termite treatment

H.1 Materials:

H.1.1 The chemicals used for the soil treatment shall be only one of the following, with concentration shown against each, in aqueous emulsion.

Chemical Concentration: Heptachlor 0, 50% (w/w)

H.2 Execution

H.2.1 The chemical barrier shall be complete and continuous under whole of the structure, which is to be protected, from termite.

H.2.2 The bottom and the sides of foundations up to a height of 30 cm, above final ground level from the bottom of excavation made for masonry foundation and for basement, column pits, shall be treated with the chemical emulsion at the rate of 5.0 liters/m² of the surface area.

H.2.3 The chemical treatment shall be carried out when the surface is quite dry. Chemical treatment shall not be carried out when it is raining or when the soil is wet with rain water or sub soil water.

H.2.4 Top surface of the consolidated earth within the walls shall be treated with the chemical emulsion at the rate of 7.5 liters/m² of the surface area, before the sand bed or sub-grade is laid. If the filled earth has been well rammed and the surface does not allow the emulsion to seep through, holes up to 50 to 75 mm. deep, at 150 mm. centers, both ways, may be made with 12 mm. diameter M.S. rod, on the surface to facilitate absorption of the emulsion.

H.2.5 Once formed, treated soil barriers shall be not disturbed. If disturbed, immediate steps shall be taken to restore the continuity and compactness of the barrier system.

H.2.6 The treatment against termite infection shall remain effective for a period of 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 Project Manager. On Contractor's failure to do so, Project Manager may get the same rectified through any other agency at the Contractor's risk and cost, and the decision of Architect or Project Manager as to the cost payable by the Contractor for the same shall be final and binding to the Contractor.

H.2.7 A guarantee bond on necessary non-judicial stamp paper shall be given by the Contractor to the Client, in the manner form described 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."

- H.2.8 This guarantee shall remain in force for the 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.
- H.2.9 The deposit at the rate 10% (Ten Percent) of the cost of this item from the running and final bills shall be recovered and retained for the first one-year after virtual completion of the work.

I. Mode of Measurements

I.1 Excavation work

- I.1.1 Measurements shall be considered for payment according to the sections shown on the drawings or as per the sections given in writing by Architects/Project Manager. Surplus excavation done in excess to above or due to stepping and sloping back as required because of soil conditions and / or for safety purpose, shall not be measured and considered for payment.
- I.1.2 The classification of strata of the foundation soil including soft rock, hard rock, etc shall be certified & decided by Architects/Structural Consultants and will be acceptable to the contractor.
- I.1.3 Driving of sounding bards, drill holes to explore the nature of substratum up to total length of meter, distributed in two or three places, in each foundation, if necessary will be considered incidental work and will not be paid for separately shoring and strutting shall be provided, as demanded by the same conditions.
- I.1.4 The rate of excavation work shall be inclusive of
- (i) Cleaning & Clearing of site
 - (ii) Surface dressing
 - (iii) Tree Cutting with due permission
 - (iv) Setting out of the buildings
 - (v) Establishing bench mark
 - (vi) M.S. iron pegs/posts along with c.c. 1:2:4 placed adequately away from the building lines for permanent grids.
 - (vii) Adequate shoring, strutting, timbering, etc
 - (viii) Pumping out / bailing out construction water, rain water, surface water etc to the satisfaction of Architects/Project Managers.
 - (ix) Refilling / Back filling the trenches up to original ground level including watering, Ramming, compacting, etc complete as directed.
 - (x) Leveling and ramming of bottom of excavation including trimming as directed.
 - (xi) Taking out & removing the earth / soil fallen due to slip and blows in the foundation trenches including keeping the same form any loose earth / soil.
- I.1.5 Unit rate shall be for a unit of one m³.

I.2 Earth filling in plinth, etc

- I.2.1 Consolidated measurement of the area of fill only shall be considered for payment both for the filling done by the selected excavated earth and/or by approved earth brought from outside by the contractors.

1.2.2 The rate includes cost of collecting, loading, transporting / conveying, unloading, spreading, leveling watering, consolidating, etc with all lead lift and labour required for the all stated activities.

1.2.3. The rate shall be applicable for all kinds of earth filling work except back filling carried out to fill the remaining excavated area i.e. sides of foundations, basement, swimming pool, water tanks, etc

1.2.4 Unit rate shall be for a unit of one m³

1.3 Sand Filling

1.3.1 The relevant specifications as described under 1.2 above shall be followed and applicable except sand shall be used in place of earth / soil.

1.4 Disposal of surplus excavated earth/soil

1.4.1 The work shall be measured at the rate of 60% (sixty percent) of the quantity (i.e. in m³), loaded in a single truck (i.e. length x breadth x height of the leveled fill put in). The total no. of trips of truck shall be taken from the register in which day to day record is certified by project manager. On the basis of the same the quantities shall be worked out.

1.4.2 The specifications as described in 1.4.1 shall be applicable to disposal within the site area and/or disposal out side the site area to a location where disposal of spoils is legally allowed / permitted.

1.4.3 The rate shall include the expenses for spreading & leveling of earth/soil, when it is disposal off within site area.

1.4.4 Unit rate shall be for a unit of one m³

1.5 Anti - termite treatment

1.5.1 Only plinth area shall be measured for payment of this item, whether the building is consisting of basement/s or no basement.

1.5.2 Plinth area i.e. the length and breath shall be measured correct to cm at plinth level as per the drawings.

1.5.3 Open to sky areas such as chowk, shafts no techs, etc. shall be deducted from plinth area.

1.5.4 The rate shall include the cost of all materials as specified, all labour, all equipment required for the operations involved for satisfactory completion of specified Anti-termite treatment.

1.5.5 Unit rate shall be for a unit of one m²

Section No: 2& 3 Concrete Work & Form Work

(2.01 to 2.10)& (3.01 to 3.18)

PLAIN AND REINFORCED CEMENT CONCRETE WORKS

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, and Schedule of Item Rates and Unit Quantities apply to this Section.

A. Plain cement concrete without shuttering / form work.

(1:3:6 or 1:4:8 or 1:5:10 in proportion) for all kinds of work.

A.1 Materials

A.1.1 Cement, sand stone aggregates of 40mm nominal size and water shall 'conform' to respective specifications as specified under material specification -Part - A of Technical Specifications

A.1.2 All materials shall be approved by Design Consultant/ Project Manager before use.

A.2 Execution

A.2.1 General

Before commencing any concreting work, the bed of foundation trenches shall be cleared of from any debris, any loose soil, etc. leveled, watered and rammed as directed. However the same shall be free from water.

A.2.2 Mix proportion of concrete

The proportion of materials for concrete shall be as specified and shall be measured by volume e.g. 1:3:6 cement concrete shall contain one part of cement: three part of fine aggregates (coarse sand): six parts of stone aggregates of recommended size. Similar criteria shall be applicable for 1:4:8, 1:5:10, etc. cement concrete.

A.2.3 Procedure for mixing the concrete

The concrete shall be mixed in a mechanical mixer at the site of work. The mixing in mechanical mixer shall be done for a period of minimum 1.5 to 2 minutes. Hand mixing, may however, be allowed for smaller quantity of work, if approved by the Design Consultant and Project Manager. When hand mixing is permitted by the Design Consultant and Project Manager, in case of break down of machineries and in the interest of the work, it shall be carried out on a water tight platform and care shall be taken to ensure that the mixing is continued until the mass is uniform in colour and consistency. However in such cases, 10% more cement than otherwise required, shall have to be used without any extra cost. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the purpose.

A.2.4 Conveying, placing, compacting, etc. the concrete

The concrete shall be handled and conveyed from the place of mixing to the final position within 15 minutes by the adequate method and shall be placed into its final position, compacted and finished within 30 minutes of mixing with water i.e. before the setting commences. The concrete mix shall be laid in layers not more than 15 cm. to 20 cm thickness. The concrete shall be rammed with heavy iron rammers and rapidly to get the required compaction and to allow all the interstices to be filled with mortar.

A.2.5 Curing, watering, etc. the concrete

After the final set, the concrete shall be kept continuously wet, if required by ponding, for a period of not less than 7 days from the date of placement.

A.3 Mode of Measurements

A.3.1 Length, breadth and depth of concrete laid shall be measured only to the limiting dimensions as shown on drawing.

A.3.2 Unit rate shall be for a unit of one m³

B. Plain cement concrete in 1:2:4 proportion without shuttering / formwork for all kinds of work.

B.1 Materials

B.1.1 Cement, sand, stone aggregates of size 20mm (kapchi) and of size 6mm (grit), water, etc. shall conform to respective specifications as specified under material specifications – Part: A of Technical Specifications.

B.1.2 All materials shall be approved by Architects/Project Manager before use.

B.2 Execution

B.2.1 General

B.2.1.1 Before commencing any concreting work, the surfaces which are going to receive concrete, shall be cleared of from any debris, loose materials, soil, etc. as directed.

- B.2.2 The concrete mix is not required to be designed by preliminary tests and only nominal mix as per IS: 456 - 1978 shall be followed. The proportion of the concrete mix shall be 1:2:4 cement: 2 coarse sand: 4 graded stone aggregate 20 mm. nominal size).by volume. Concrete work shall have concrete surface as specified in the item.
- B.2.3 The ingredients required for ordinary concrete containing one bag of cement of 50 Kg. by weight (0.0342 m³.) for different proportions of mix shall be as under:

Grade of Concrete	Total quantity of dry aggregate by volume per 50 Kg. of cement to be taken as the sum of individual volume of fine and coarse aggregates, maximum.	Proportion of fine aggregate to coarse aggregate	Qty. of water per 50 Kg. of cem. Max.
M-100(1:3:6)	300 Liters	1:2 for fine aggregates to coarse aggregate by volume but subject to an upper limit of 1:1.5 and lower limit of 1:3	34 liters
M-150(1:2:4)	220 Liters		32 Liters
M-200(1:1.5:3)	160 Liters		30 liters
M-250(1:1:2)	100 Liters		27 liters

- B.2.4 The designation ordinary, M-100, M-150, M-200, M-250 specified as per I.S. corresponds approximately to 1:3:6, 1:2:4, 1:1.5:3 and 1:1:2 nominal mix of ordinary concrete, by volume respectively.
- B.2.5 The water cement ratios shall not be more than those specified in the above table. The cement of the mix specified in the table shall be increased, if the quantity of water in a mix has to be increased to overcome the difficulties of placement and compaction so that the water cement ratio specified in the table is not exceeded.
- B.2.6 The workability of the concrete shall be controlled by maintaining specified water-cement ratio that is bound to give a concrete mix which is just sufficiently wet to be placed and compacted without difficulty, with the means available.
- B.2.7 Proportioning shall be done by volume, except cement which shall be measured in terms of bags of 50 Kg weight. The volume of one such bag being taken as 0.0342 m³. Boxes of suitable sizes shall be used for measuring sand and aggregate. The size of the boxes (internal) shall be 35 cm. x 25 cm. and 40 cm. deep. While measuring the aggregate and sand, the box shall be filled without shaking ramming or hammering. The proportioning of sand shall be on the basis of its dry volume and in case of damp sand, allowances for bulkage shall be made.
- B.2.8 For all work, concrete shall be mixed in a mechanical mixer which along with other accessories shall be kept in first class working condition and maintained throughout the construction. Measured quantity of aggregate, sand and cement required for each batch shall be poured into the drum of the mechanical mixer while it is continuously running. After about half a minute of dry-mixing, measured quantity of water required for each batch of concrete mix shall be added gradually and mixing continued for another one and a half minute. Mixing shall be continued till materials are uniformly distributed and uniform colour of the entire mass is obtained and each individual particle of the coarse aggregate shows complete coating of mortar containing its proportionate amount of cement. In no case shall the mixing be done for less than 2 minutes after all ingredients have been put into the mixer.
- B.2.9 When hand mixing is permitted by the Design Consultant and Project Manager for small jobs or for certain other reasons, it shall be done on a smooth watertight platform large enough to allow efficient turning over the ingredients of concrete before and after adding water. Mixing platforms shall be so arranged that no foreign material gets mixed with concrete nor does the mixing water flow out. Cement in required number of bags shall be placed in a uniform layer on top of the measured quantity of fine and coarse aggregate, which shall also be spread in a layer of uniform thickness on the

mixing platform. However in such cases of hard mix concrete, 10% more cement than otherwise required shall have to be added without any extra charge.

B.2.10 In case of honeycombs concrete, the same shall be made correct with rich 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 comers 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 shaft 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.

B.2.11 If rock pockets/honeycombs in the opinion of Design Consultant and Project Manager 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.

B.2.12 Curing of various members shall be done as per given schedule or as directed by Project Manager.

B.3 Mode of Measurements

B.3.1 The consolidated cubical contents of concrete work as specified in item shall be measured. The concrete laid in excess of section shown on drawing or as directed shall not be measured. No deduction shall be made for:

a. Ends of dissimilar materials such as joists, beams, posts, girders, rafters, purline trusses, corbels and steps etc. up to 500 cm² in section.

b. Architectural openings up to 0.1 m².

c. No extra labour should be paid for forming such openings, voids or pockets.

B.3.2 The rate includes cost of all materials, labour, tools and plant required for mixing, placing in position, vibrating and compacting, finishing as directed, curing and all other incidental expenses for producing concrete of specified strength, for all floors, at any height and level, in any position. The rate excludes the cost of formwork.

B.3.3 The unit rate shall be for a unit of one m³.

C. Reinforced cement concrete in 1:2:4 proportion without shuttering / formwork for all kinds of work.

C.1 All the specifications described and specified for the item of plain cement concrete in 1:2:4 proportion (i.e. for materials, execution & mode of measurements) shall be applicable and hence shall be followed for the same. However, following additional specifications shall be applicable too.

C.2 The maximum size of coarse aggregate shall be as large as possible within the limits specified but in no case greater than one fourth of the minimum thickness of the member, provided that the concrete can be placed without difficulty so as to surround all reinforcement thoroughly and to fill the corners of the form.

C.3 For reinforced concrete work, coarse aggregates having a nominal size of 20 mm. are generally considered satisfactory.

C.4 For heavily reinforced concrete members as in the case of ribs of main beams, the nominal maximum size of coarse aggregate should usually be restricted to 5 mm, less than the minimum clear distance between the main bars, or 5 mm. less than the minimum cover to the reinforcement, whichever is smaller.

C.5 Where the reinforcement is widely spaced as in solid slabs, limitations of size of the aggregate may not be important and the nominal maximum size may sometimes be as great as or greater than the minimum cover.

- C.6 Admixture may be used in concrete only with approval of the Design Consultant and Structural Consultant based upon the evidence that with the passage of time, neither, the compressive strength of concrete is reduced nor are other requisite qualities of concrete and steel impaired by the use of such admixtures.
- C.7 The bars shall be kept in position by the following methods:
- (i) In case of beam and slab construction, sufficient number of precast cover blocks in cement mortar 1:2 (1 cement: 2 coarse sand) about 4 cm. x 4 cm. section and of thickness equal to the specified cover shall be placed between the bars and shuttering as to secure and maintain the requisite cover of concrete over the reinforcement. In case of cantilevered or doubly reinforced beams/slabs, the main reinforcing bars shall be held in position by introducing chain spacers or supports bar at 1.0 to 1.2 m. centers.
 - (ii) In case of columns and walls, the vertical bars shall be kept in position by means of timber templates with slots accurately cut in them. The templates shall be removed after concreting has been done below it. The bars may also be suitably tied by means of annealed steel wires to the shuttering to maintain their position during concreting.
- C.8 All bars projecting from pillars, columns beams, slabs, etc, to which other bars and concrete are to be P-5 attached or bounded to later on, shall be protected with a coat of thin neat cement grout, if the bars are not likely to be incorporated with succeeding mass of concrete within the following 10 days. This coat of thin neat cement shall be removed before concreting.
- C.9 The rate shall exclude the cost of formwork/shuttering and reinforcement bars.
- C.10 The volume occupied by reinforcement bars shall not be deducted from R.C.C. work
- C.11 All major concrete work will be only carried out by Ready Mix Concrete (RMC). However, concrete work with weigh batch system may be allowed only after evaluating the circumstances by Project Manager / Structural Consultants, on written permission from Project Manager.
- C.12 Contractor will have to carry out the concrete cube tests for seven days and twenty eight days along with other material testing as advised and as directed by Project Manager / Structural Consultant regularly. The documentation for the same shall be done in register day to day duly signed by contractor and project manager. Copy of which will be submitted to Architects with fail.
- D. Controlled Cement Concrete (Reinforced) of various grade such as M-150, M-200, M-250, etc. whether Ready Mix Concrete (RMC) / weigh batch concrete without shuttering / formwork for all kinds of work.**
- D.1 Materials
- The relevant specifications for materials as specified for plain and reinforced cement concrete items shall be applicable for the same.
- D.2 Execution
- D.2.1 The relevant specifications as described for plain cement concrete (B) and Reinforced cement concrete (c) of this section shall be followed except that the concrete mix shall be designed for the applicable grade on the basis of preliminary tests, the proportioning of cement and aggregates by weight instead of by volume. Necessary precaution shall be taken in the production to ensure that the specified and required cube strength is attained and maintained. The controlled concrete shall be in grades specified for various / different structural concrete members i.e of M-150, M-200, M-250 etc. with prefix controlled added to it. The letter "M" refers to mix and numbers specify 28 days works cube compressive strength of 150mm cubes of the mix expensed in kg/m²

- D.2.2 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 strength requirements of different grades of concrete shall be as under:

Grade of Concrete	Compressive strength of 15 cm. cubes in kg/cm ² , 28 days conducted in accordance with IS: 516-1959	
	Preliminary test	Work test min.
M-150	200	150
M-200	260	200
M-250	320	250
M-300	380	300
M-350	440	350
M-400	500	400

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

- D.2.3 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.
- D.2.4 To secure good exposed and normal concrete surface necessary care in formwork and concrete shall be taken. For any sub-standard results of exposed and normal surface concrete form-work shall be treated as one item even though they are two separate items in bills of quantities.
- D.2.5 The Contractor shall take necessary care to avoid sand streaks, air Holes, Honey combining etc, on finished concrete surface.
- D.2.6 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 Design Consultant and Project Manager 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 Design Consultant and Project Manager to ensure that the suppliers are maintaining the uniform grading, as approved for samples used in the preliminary tests.
- D.2.7 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 equipments shall be maintained in clean and serviceable condition. Their accuracy shall be periodically checked.
- D.2.8 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 Design Consultant and Project Manager, 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.

- D.2.9 The minimum cement content for the various mixes shall be as under:

MIX	MINIMUM CEMENT CONTENTS PER CU. M. OF CONTENTS
M-150	285 Kg
M-175	300 Kg
M-200	325 Kg
M-250	360 Kg
M-300	400 Kg
M-350	430 Kg

D.2.10 All R.C.C. works shall be carried out as per the detailed drawings and direction of Architects and Project Manager.

D.3 Mode of Measurements

D.3.1 The relevant specifications item no. B and C shall be followed except that the controlled concrete R.C.C. work for work as specified in item shall be measured under this item. The rate excludes cost of formwork and reinforcement and is for any cross sectional area of the members specified in the item.

D.3.2 The unit rate shall be for a unit of one m³.

E. Reinforcement bars for reinforced concrete work.

E.1 Materials

E.1.1 Cold twisted steel bars (high yield deform steel bars) Fe-415, Fe-500, etc. (TMT bars) for reinforcement work and mild steel annealed wires as binding wires for reinforcement bars shall strictly in conformation with the specifications as described in material specifications - Part 1.

E.1.2 All the materials as stated above shall be approved by Design Consultant and Structural Consultant, before use.

E.1.3 Reinforcement bars shall be purchased from recommended and approved vendors only. In any case, the same is required to be purchased from the vendors other than approved vendors, the written approval of the said vendor shall be obtained from Design Consultant/ Structural Consultants, before purchased order placed to the vendor.

E.2 Execution

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

E.2.2 Steel shall be clean and free from rust and loose mill scale, at the time of fixing in position and subsequent concreting.

E.2.3 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 'L' type hook at the end of each bar shall invariably be provided to main reinforcement as per drawing.

E.2.4 All the reinforcement bars shall be accurately placed in exact position shown on the drawings and shall be securely held in position during placing of concrete by annealed binding wire not less than 1 mm. in size and by using 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 be 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 other approved devices. 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.

- E.2.5 Bars crossing each other, where required shall be secured by 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.
- E.2.6 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.
- E.2.7 Whenever indicated on the drawings or desired by the Design Consultant/ Structural Consultant, 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.
- E.2.8 When permitted or specified on the drawings, joints of reinforcement bars shall be butt-welded so as to transmit their full stresses. 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 arc 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.
- E.2.9 The bars shall be kept in position by the following methods:
- (i) In case of beam and slab construction, sufficient number of precast cover blocks in cement mortar 1:2 (1 cement: 2 coarse sand) about 4 cm. x 4 cm. section and of thickness equal to the specified cover shall be placed between the bars and shuttering as to secure and maintain the requisite cover of concrete over the reinforcement. In case of cantilevered or doubly reinforced beams/slabs, the main reinforcing bars shall be held in position by introducing chain spacers or supports bar at 1.0 to 1.2 m. centers.
 - (ii) In case of columns and walls, the vertical bars shall be kept in position by means of timber templates with slots accurately out in them. The templates shall be removed after concreting has been done below it. The bars may also be suitably tied by means of annealed steel wires to the shuttering to maintain their position during concreting.
- E.2.8 All bars projecting from pillars, columns beams, slabs, etc. to which other bars and concrete are to be P-5 attached or bounded to later on, shall be protected with a



coat of thin neat cement grout, if the bars are not likely to be incorporated with succeeding mass of concrete within the following 10 days. This coat of thin neat cement shall be removed before concreting.

E.3 Mode of Measurements

- E.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. Length shall include hooks at the ends. The wastage and annealed steel wire for binding shall not be measured and the cost of these items shall be needed to be included in the rate for reinforcement.
- E.3.2 The rate for reinforcement includes cost of mild steel binding wires and its carting. 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 and concrete spacer blocks for adequate cover etc. for keeping reinforcement in approved position, cost of joining as per approved method and all wastage and spacer bars.
- E.3.3 The weight shall be computed on the basis of Indian standard weight table.
- E.3.4 In no case rolling margin shall be considered for payment.
- E.3.5 The reinforcement bars shall be measured & paid separately as the rate of all the items of concrete work is excluding the cost of reinforcement bars, unless otherwise specified under item description.
- E.3.6 The rate shall be for a unit of one Kg.

1.2 SUBMITTALS

Minutes of pre-installation conference.

Product Data: For each type of manufactured material and product.

Qualification Data for Installer, RMC supplier, RMC transporter (if different than RMC supplier), RMC plant certification, professional engineers qualifications, and laboratory and testing service qualifications.

Design Mixes: For each concrete mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

Indicate amounts of mix water to be withheld for later addition at Project site.

Submit back-up data for mix designs per ACI 318.

COORDINATION DRAWINGS: To scale drawings of slabs, walls, columns, beams, and foundations showing the size and location of:

Items of work furnished by other trades that are to be imbedded in concrete work such as conduit, piping, and rough boxes.

Items of work by other trades which must pass through concrete work such as ductwork, piping, and conduit.

Items of work that are by other trades that are supported from the concrete work such as pipe hangers, cable tray, bus duct, duct hangers, and suspended equipment.

Do not prepare reinforcement or formwork shop drawings until each trade has accurately marked its requirements on the COORDINATION DRAWINGS.

Schedule of Embedment and Inserts: Based on the Coordination Drawings, prepare a schedule of embedded items that are to be furnished by other trades and installed within the concrete.

Steel Reinforcement Shop Drawings: Details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams,



arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures and block-outs and supports for items of Work furnished by other trades that are to be installed in the concrete.

Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork. Design and engineering of formwork are Contractor's responsibility. Shop drawings shall be signed and sealed by the qualified professional engineer.

Shoring and Re-shoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and installing and removing re-shoring.

Additional Support and reinforcing: Indicate proposed locations and types of additional reinforcing required to support Work of other trades.

Welding certificates.

Material test reports.

Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements including Test Data demonstrating compliance with referenced standards:

Cementitious materials.

Aggregates including source.

Form materials and form-release agents.

Steel reinforcement and reinforcement accessories.

Fiber reinforcement.

Admixtures.

Waterstops.

Curing materials.

Floor and slab treatments.

Bonding agents.

Adhesives.

Vapour retarders.

Epoxy joint filler.

Joint-filler strips.

Repair materials.

Concrete Records including:

Batch delivery tickets including logs of field added materials.

Results of on-site testing of delivered batches.

Concrete sample logs.

Concrete test results.

Mock-ups:

At locations established by the Supervising Engineer and the Architect, provide separate Mock-ups of each of the following items to demonstrate procedures and protocols to govern concreting operations, establish expected results of concreting operations, demonstrate workmanship, and to serve as benchmarks to judge future completed work.

Corner Construction of water stop installation.

One full structural bay of slab on grade construction demonstrating, curing, finishing, and joint treatments.

One full bay of columns, beams, and elevated slab to demonstrate formwork, curing, finishing and repair of damage caused by removal of forms.

No additional payment will be made for the construction of mock-ups, but approved mock-ups may be incorporated into the finished Work of the Project.

Mock-ups which fail to meet the approval of the Supervising Engineer and the Design Consultant will be demolished and removed at the expense of the Contractor.

2.2.1 CAST-IN-PLACE CONCRETE

1 GENERAL

1.0.0.1 RELATED DOCUMENTS

1.0.0.1.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions (i.e. conditions of contract) and Division 1 Specification Sections, apply to this Section.

1.0.0.2 SUMMARY

1.0.0.2.1 This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Structural raft slab.
2. Basement walls.
3. Suspended slabs.
4. Building frame members.
5. Building walls.

1.0.0.2.2 This Section also specifies special requirements required for cast-in-place concrete for water tight reinforced concrete water tanks in Basement 2 and other similar water tight structures.

1.0.0.2.3 The Concrete grades are shown on the drawings and define the 28 day characteristic cube strength.

1.0.0.2.4 This specification shall be read in conjunction with the General Conditions of Contract, the 'Particular Clauses' and any supplementary specifications, schedules and drawings issued with it and enumerated in the invitation to tender. In the event of a discrepancy between this specification and its related documents and any drawings, they shall be submitted to the Engineer for his ruling.

1.0.0.2.5 In addition to the General Conditions, the Contractor shall also refer to the following specifications:

1.0.0.3 REFERENCES

1.0.0.3.1 STANDARDS

AASHTO T 277	Rapid determination of chloride permeability of concrete
ACI 305R-91	Hot weather concreting
ASTM C 40	Test for organic impurities in sands for concrete
ASTM C 88	Test for soundness of aggregates by use of sodium sulfate or magnesium sulfate
ASTM C 94	Ready-mixed concrete
ASTM C 123	Test for lightweight pieces in aggregate
ASTM C 127	Specific gravity and absorption of coarse aggregate
ASTM C 128	Specific gravity and absorption of fine aggregate
ASTM C 131	Method of resistance to degradation of small size coarse aggregates by abrasion and impact in the Los Angeles machine.
ASTM C 142	Clay lumps and friable particles in aggregates
ASTM C 150	Portland cement
IS 269 / BS 12	Portland cement
IS 455 / BS 146	Portland blast furnace cement
IS 2386 / BS 812	Testing aggregates
	Part I to VIII
IS 383 / BS 882	Aggregates from natural sources for concrete
IS 9103 / BS 1014	Specification for pigments for Portland cement
IS 1791 / BS 1305	Batch type concrete mixers

BS 1377		Method of test for soils for civil Design Consultanting purposes
IS 516 / BS 1881		Testing concrete
IS 3025 / BS 3148	Part 22, 23	Methods of tests for water for making concrete
IS 3812 / BS 3892		Pulverised fuel ash
IS 12330 / BS 4027		Sulphate-resisting Portland cement
BS 4246		High Slag Portland - blastfurnace cement
BS 4248		Specification for supersulphated cement
IS 1139 / BS 4449		Carbon steel bars for the reinforcement of concrete
IS 1566 / BS 4483		Steel fabric for the reinforcement of concrete
BS 4550	Part 2	Methods of testing cements - chemical tests
IS 9103 / BS 5075	Part 1	Accelerating admixtures, retarding admixtures and water reducing admixtures
	Part 2	Air-entraining admixtures
	Part 3	Super plasticisers
IS 9595 / BS 5135		Arc welding of carbon and manganese steel
IS 1199 / IS 516 / BS 5328	Part 1	Guide to specifying concrete
	Part 2	Method for specifying concrete mixes
	Part 3	Specification for the procedures to be used in producing and transporting concrete
	Part 4	Specification for the procedures to be used in sampling, testing and assessing compliances of concrete
BS 5606		Accuracy in building
BS 5975		Code of Practice for false work
IS 13311 / BS 6089	Part 1 & 2	Guide to the assessment of concrete strength in existing structures
BS 6100		Glossary of building and civil Design Consultation terms
BS 6588		Portland pulverised fuel ash cements
BS 6610		Pozzolanic pulverised fuel ash cement
BS 6699		Ground granulated blast furnace slag for use with Portland cement
IS 814 / BS 7123	Part 1 & 2	Metal arc welding of steel for concrete reinforcement
BS 7542		Method of test of curing compounds for concrete
IS 14458 / BS 8002	Part 1 to 10	Design of earth retaining structures
BS 8004		Foundations
IS 3370 / BS 8007	Part 1 to 4	Design of concrete structures for retaining aqueous liquids
IS 456 / BS 8110		The structural use of concrete
BS 8500		Complementary British standard to BS EN 206-1
	Part 1	Method of specifying and guidance for the specified
	Part 2	Specification for constituent materials and concrete.
BS 8666		Bending dimensions and scheduling of bars for the reinforcement of concrete
BS EN 206		Concrete. Specification, performance, production and conformity
IS 516 / DIN 1048		Testing of concrete: Testing of hardened concrete
NS 3045		Silica Fume for Concrete
SABS 1491		Part 11 Portland Cement Extenders: Fly Ash

1.0.0.3.2 OTHER REFERENCES

BRE Special Digest 1:	Concrete in aggressive ground
BRE Digest 54:	Damp proofing solid floors
BRE Digest 357:	Shrinkage of Natural Aggregates in Concrete
BRE Digest 330:	Alkali Aggregate Reactions in Concrete

CIRIA report R91:	Early-age thermal crack control in concrete
CIRIA special publication SP31:	Guide to Concrete construction in the Middle East
CIRIA report R165:	Concrete mixes - planning and design for transporting, concrete placing and finishing
Concrete Society Technical Report 30:	Alkali Silica Reaction - minimising the risk of damage to concrete
Concrete Society:	Spacers for Reinforced Concrete
Institution of Structural Design Consultants/Concrete Society:	Standard Method of Detailing Structural Concrete
US Army Corps of Design Consultants CRD-C 39-81:	Test Method for the Coefficient of Linear Expansion of Concrete

Note: Equivalent IS codes are also applicable.

1.0.0.4 **SUBMITTALS**

1.0.0.4.1 The Contractor shall submit to the Engineer for approval full detailed shop drawings for all elements of the work including schedules for fabrication and use on site, and shall be based on the information given by the Engineer. Where appropriate the Contractor shall submit calculations as required or requested in the specifications. These shall be prepared under the supervision of a chartered or registered professional or similarly qualified engineer.

1.0.0.4.2 The Contractor shall submit to the Engineer for approval details of the following in accordance with the following clauses:

1. Cement test certificates and manufacturer's certificate Clause 2.2
2. Cement samples - Clause 2.2.B.6
3. Aggregate sources - Clause 2.3
4. Admixture clause 2.4
5. Water, ice test results - Clause 2.5
6. Reinforcement and Reinforcement tests – clause 2.6, 3.48 B
7. Preliminary concrete tests - Clause 3.48C
8. Durability Test Results - Clause 3.48F
9. Concrete records - Clause 3.48 I 2
10. Records – Clause 3.48 I 1
11. Concrete mix designs – Clause 3.2A
12. Formwork design - Clause 3.10
13. Reinforcement chairs - Clause 3.21 B
14. Ready mixed concrete - Clause 3.24 A
15. Concrete curing - Clause 3.29
16. Fresh mixed concrete temperature - Clause 3.30 to 3.32
17. Methods to limit the temperature of fresh mixed concrete – Clause 3.31 E
18. Position of Construction joints - Clause 3.34

1.0.0.5 **BAR SCHEDULES**

1.0.0.5.1 The Contractor shall produce reinforcement placement drawings and bar bending schedules in accordance with BS 8666 or equivalent IS code based upon the shop drawing general arrangement drawings and the reinforcement design drawings supplied by the Engineer or calculated based on loading information supplied by the Engineer.

1.0.0.6 **QUALITY ASSURANCE**

1.0.0.6.1 Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1.0.0.6.2 Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

1.0.0.6.3 Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

1.0.0.7 **WATER STOPS**

1.0.0.7.1 Self-expanding rubber strip water stops: Manufactured rectangular or trapezoidal strip, bentonite free hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete 10 by 19mm or other size acceptance to the Engineer.

1.0.0.8 **VAPOR RETARDERS**

1.0.0.8.1 Plastic vapor retarder: ASTM E1745, Class C, or polyethylene sheet, ASTM D4397, not less than 0.25mm thick. Include manufacturers recommended adhesive or pressure sensitive joint tape.

PART 2 -PRODUCT

2.5.1.1 **GENERAL**

2.5.1.1.1 All materials used in the insitu concrete works shall comply in all respects with the relevant Standard contained in this specification, IS 456 and the Standards referred therein.

2.5.1.1.2 The following materials are specifically precluded from the Works and all specifications relating to the Works:

2.5.1.1.2.1 High alumina cement

2.5.1.1.2.2 Wood wool slabs as permanent shuttering

2.5.1.1.2.3 Calcium chloride in admixtures for use in reinforced concrete

2.5.1.1.2.4 Asbestos in any form

2.5.1.1.2.5 Sea dredged aggregates for use in reinforced concrete unless otherwise instructed by the Engineer

2.5.1.1.2.6 Calcium silicate bricks

2.5.1.1.2.7 Urea formaldehyde

2.5.1.1.2.8 Materials or products containing lead which can be inhaled, ingested or absorbed

2.5.1.1.2.9 Vermiculite containing fibrous dust

2.5.1.1.3 All cast in place concrete shall be machine mixed and machine vibrated, compacted etc.

2.5.1.1.4 Ready Mix plant shall be installed at site

2.5.1.2 **CEMENT**

2.5.1.2.1 GENERAL REQUIREMENTS

1. The cement to be used throughout the Works shall be Portland Cement obtained from manufacturers approved in writing and shall be as described under one of the following headings.
2. Ordinary Portland Cement (OPC):
 - 2.5.1.2.1.1.1 Cement complying with either BS 12 or ASTM C150. Type I but containing not less than 7% and not more than 12% by weight of tricalcium aluminate (C3A). The application will be for internal structural elements above Ground level.
 - 2.5.1.2.1.1.2 It shall also meet with requirements of IS 455-M1976 including following
 - 1) Grade 33: IS 269-1976
 - 2) Grade 43: IS 8112-1989
 - 3) Grade 53: IS 12269-1989
 - 2.5.1.2.1.1.3 Testing Standards
 - 1) Setting Time:

Sampling:

 - a) W 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.
 - b) For a lot of 50 to 100 tones - 2 samples
 - c) For a lot of 100 to 200 tones - 3 samples
 - d) For a lot of 100 to 200 tones - 3 samples
 - e) For a lot of 200 to 300 tones - 4 samples
 - f) For a lot of 300 to 500 tones - 5 samples
 - g) For a lot of 500 to 800 tones - 6 samples
 - h) 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
 - 2) Fineness test by Sieving

Sampling:

 - a) Using any 5 samples, made as above, one test is carried out, using IS sieve no. 90 microns.

Results:

 - a) 90% or more -should pass through the above mentioned IS sieve.
 - 3) Fineness test by determination of specific surface

Sampling:

 - a) Using any 5 samples, made as above, one test is carried out.

Results

 - a) For O.P.C, the surface area shall be 225 cm²/gm. or more.
 - b) For P.P.C, the surface area shall be 3000 cm²/gm.
 - 4) Consistency test

Sampling:

 - a) Sampling shall be as in A.

Results:

 - a) Consistency in all samples shall be about 30%:
 - 5) Compressive strength

Sampling:

 - a) Sampling shall be as in A.

Results:

- a) On 2nd day, compressive strength must be 160 Kg/cm², for O.P.C
- b) On 7th day, compressive strength must be 220 Kg/cm², for O.P.C
- c) On 28th day, compressive strength must be 310 Kg/cm², for O.P.C
- 6) Chemical composition (IS : 4032-1968):

Sampling:

- a) 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 - up to 5%.
- d) The above is for ordinary portland cement.

3. Moderate Sulphate Resisting Portland Cement (MSRPC):

2.5.1.2.1.1.4 Cement complying with BS 12 or ASTM C150. Type II but containing not less than 5% and not more than 9% by weight of tricalcium aluminate (C₃A). In either case the cement shall not contain more than 2.7% by weight of sulphur trioxide (SO₃).

2.5.1.2.1.1.5 The application will be

- i) at substructure
- ii) for exposed structural elements.
- iii) 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

2.5.1.2.1.1.6 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

4. Rapid Hardening Cement (RHC) :

2.5.1.2.1.1.7 Rapid hardening cement shall be from source like Gujarat High Tech, Ambuja, Birla or equivalent as approved by Engineer. It shall conform to IS: 8041-1978. Test certificates showing that the cement complies to the specifications must be submitted to the Architect.

2.5.1.2.1.1.8 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.

2.5.1.2.1.1.9 It shall be capable of giving required -workability, final strength and better surface finish.

5. White Cement

2.5.1.2.1.1.10 The white cement shall conform to IS : 8042-E-1978

6. Coloured Cement

2.5.1.2.1.1.11 Coloured cement shall be with white or grey portland cement mixed with pigments as specified in the item of the work

2.5.1.2.1.1.12 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 under exposure to sunlight and weather

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

2.5.1.2.2 ADDITIONAL REQUIREMENTS

1. In addition to the above requirements for cement to be used in permanent Works the acid soluble alkali level measured as $(Na_2O + 0.658 K_2O)$ shall not exceed 0.6% by weight. Also the heat of hydration at 7 days in accordance with ASTM C186 or equivalent IS code shall not exceed 290 kJ/kg and the fineness (specific) in accordance with BS 4550 or equivalent IS code shall not be less than 280 m²/kg.
2. Cement shall be free flowing and free of lumps. It shall be supplied in the manufacturer's sealed and unbroken bags or in bulk.
3. Cement that has become hardened or lumpy or fails to comply with this Specification in any way shall be removed from the site.
4. High alumina cement shall not be used.
5. The Engineer will require the Contractor to submit the Manufacturer's Certificate indicating compliance with the relevant Standards contained in this specification.
6. The Engineer will require the Contractor at any time to submit samples of cement for testing. Such samples shall weigh not less than 7kg and shall be selected and tested in accordance with B.S.4550 or equivalent IS code.

2.5.1.2.3 RECOMMENDED MANUFACTURERS

1. Ordinary Portland cement- Ultra-Tec, Ambuja, Siddhi, ACC Ltd.
2. White cement – Birla, JK

2.5.1.3 AGGREGATES

2.5.1.3.1 Aggregates shall comply with IS 383 / B.S. 882 and be of a quality equivalent to crushed stone of black trap basalt or equivalent.

Where specific aggregate sizes do not comply, the grading shall be modified to the satisfaction of the Engineer.

2.5.1.3.2 Aggregates shall consist of crushed or naturally occurring materials having hard, strong, durable particles. All aggregates are to be washed with clean water to ensure compliance with the requirements of this specification. Nominal maximum aggregate size to be 20 mm unless agreed otherwise with the Engineer.

2.5.1.3.3 At least 28 days before concreting operations are due to commence, the Contractor shall submit for approval the names and locations of the pits, quarries or manufacturing plants from which he proposes to obtain aggregates, together with evidence showing that the material complies with the requirements of the appropriate Standards.

Max total chlorides content of combined aggregate shall not contain more than 0.04% by weight of chlorides soluble in dilute nitric acid, when expressed as sodium chloride (NaCl).

Combined aggregates shall not contain more than 0.5% by weight of total acid soluble sulphates, when expressed as sulphur trioxide (SO₃).

2.5.1.3.4 COARSE AGGREGATE

Coarse aggregate shall consist of naturally occurring gravel or crushed rock and shall not contain harmful material in sufficient quantity to affect adversely the strength or durability of the concrete or in the case of reinforced concrete to attack steel reinforcement.

The Contractor shall ensure the amount of dust in the aggregate is removed by washing the aggregate.

2.5.1.3.4.1 For nominal mix concrete

- i) Coarse Aggregate shall be of machine crushed stone of black trap or equivalent and be hard, strong, dense, durable, clean and free from skin and coating likely to proper adhesion of mortar
- ii) The aggregate shall generally be cubical in shape. Unless special stones of particular quarries are mentioned, aggregates shall be machine crushed from the best 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

I.S. sieve Designation	% Passing for single size aggregates of normal size		
	40mm	20mm	16mm
80mm	-	-	-
63mm	100	-	-
40mm	85-100	100	-
20mm	0-20	85-100	100
16mm	-	-	85-100
12.5mm	-	-	-
10mm	0.5	0.20	0.30
4.75mm	-	0.5	0.5
2.35mm	-	-	-

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

- iii) The grading test shall be taken in the beginning and at the change of source of materials. The necessary tests indicated in IS:383-1970 and IS:456-2000 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.

a. Flakiness Index

Sampling:

- i. For every 200 mm of aggregates, one test shall be carried out.

Results:

- i. 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.
- ii. Permissible is not more than 35% for aggregates used in concrete for wearing surfaces.

b. Impact value

Sampling:

- i. For every 100 mm of aggregates, one test shall be carried out.

Results:

- i. The impact value shall not be more than 45% by weight for aggregates used for concrete other than wearing surfaces.
- ii. 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 :

- i. Sampling shall be as in b Results :
- ii. The percentage of wear shall not be more than 35%.

2.5.1.3.4.2 For Design Mix Concrete

- i) 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.
- ii) 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-
- iii) The necessary tests indicated in IS : 383-1970 and IS : 456-2000 shall have to be carried out to ensure the acceptability of the material.

2.5.1.3.5 FINE AGGREGATE

Fine aggregate shall either consist of natural sand or be obtained by crushing clean hard rock or be a mixture of these.

Fine aggregate shall contain no excessive quantities of dust, soft or flaky particles, shells, lumps, nodules of soft clay, shale or other contamination likely to affect adversely the strength or durability of the concrete or in the case of reinforced concrete to attack the reinforcement.

2.5.1.3.5.1 Sand:-

- (a) Sand shall be natural sand, clean, well graded, hard, strong, durable and gritty. Sand particles should be free from injurious amounts of dust, clay, KariKar 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. The sand shall not contain more than 8% of silt as determined by field test, if necessary the sand shall be washed to make it clean.
- (b) Testing Standards:
 - i) Silt Content

Sampling:

Test shall be carried out for every 150 m³ of sand. The sample taken for testing shall weigh 10 Kgs.

Results:

Permissible content shall be 3%.

- ii) Fineness Modulus

Sampling: Sampling shall be as in

Results:

Fine sand: 2.2 to 2.6

Medium sand 2.6 to 2.9

Coarse sand 2.9 to 3.2

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.

- iii) The sieve analysis of sand shall be as under

I.S. Sieve Designation	% By weight Passive sieve
Mm	100
2.36 mm	90-100
1.18 mm	70-100
600 Micron	30-100
300 Micron	50-70
150 Micron	0-50

2.5.1.3.5.2 Stone dust:-

- 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:
- 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 up to 100 mm. mark. Then clean water shall be added up to 150 mm mark. The mixture shall be stirred vigorously and the contents allowed settling for 3 hours.
- 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.
- The fineness modulus of stone dust shall not be less than 1.80.

2.5.1.3.5.3 Stone Grit:-

- Grit shall consist of crushed or broken 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 : 383-1970 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. The grit shall have no deleterious -reaction with cement.
- The grit shall conform to the following gradation as per sieve analysis:

I.S. sieve Designation	% passing Through sieve
12.50 mm	100%
10.00 mm	85-100%
4.72 mm	0-20%
2.36 mm	0-25%

- 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.
- The necessary tests for grit shall be carried out as per the requirements of IS : 2386 (parts I to VIII) 1963, as per instructions of the Engineer. The necessity of test will be decided by the Engineer.

2.5.1.3.6 ALL-IN AGGREGATE.

The grading of an all-in aggregate when analysed by the method of sieve analysis described in IS 2386 / B.S.812 shall be in accordance with IS 383 / B.S.882.

All-in aggregates shall not contain more than 0.04% by weight of chlorides soluble in dilute nitric acid, when expressed as sodium chloride (NaCl).

All-in aggregates shall not contain more than 0.5% by weight of total acid soluble sulphates, when expressed as sulphur trioxide (SO₃).

2.5.1.3.7 MARINE AGGREGATES

Aggregates from marine sources may be used if approved by the Engineer, and the source of supply shall be stated. When sampled and tested in accordance with IS 2386 / B.S.812, the water soluble chloride salts and shell contents shall not exceed the limits given in the Table below.

2.5.1.3.8 TABLE OF WATER SOLUBLE CHLORIDE SALTS AND SHELL LIMITS

% By weight of dry aggregate

Nominal Size Of Water Soluble Aggregate (Mm)		Shell As Cac03		
		Chloride Salts	Total/Hollow	
Reinforced	40 Graded	0.04	6	1
Concrete	20 Graded	0.04	10	1
10 Single Size		0.40	15	2
Fine		0.80	No Limit	
Plain Concrete		No Limit	As Above	

2.5.1.3.9 Approval for the use of Marine Aggregates will not be given in the following circumstances:

1. Where cements other than Ordinary Portland, Rapid Hardening or Sulphate Resisting are used.
2. Or where the concrete is to be prestressed or steam cured.

2.5.1.3.10 SHELL CONTENT

The shell content shall not adversely affect the quality or cause permeability in the concrete and shall not in any circumstances exceed the limits given in Clause 2.3H

Method of determination for 40, 20 and 10mm sizes are by hand extraction, fines by an approved method.

2.5.1.3.11 SHAPE AND POROSITY

In construction specified on the drawings as watertight the coarse aggregates shall not have combined indices for flakiness and elongation exceeding 35%, nor shall the flakiness index exceed 15% as determined by tests carried out in accordance with IS 2386 / BS 812.

Aggregates having a water absorption greater than 2.5% by weight shall not be used in watertight construction.

2.5.1.3.12 COLOUR

The colour of the aggregates in exposed aggregate concrete and in white concrete shall be to the Engineer's approval. No deviation from the approved sources of supply for these aggregates will be allowed by the Engineer. Aggregates are to be free from absorbent particles likely to cause popouts and other particles such as coal and iron sulphide likely to cause staining.

2.5.1.3.13 LIMITS FOR PHYSICAL, CHEMICAL & MECHANICAL PROPERTIES OF AGGREGATES FOR CONCRETE

Limits for Physical, Chemical & Mechanical Properties of Aggregates for Concrete

Requirement	Test Methods		Permissible Limits	
	BS 812	ASTM	Fines	Coarse
1. Clays lumps and friable particles		C142	Max 1%	Max 1%
2. Lightweight prices		C123	Max 0.5%	Max 0.5%
3. Organic impurities	(BS 1377 Test 8)		Max 0.1%	

4. Water absorption		C128/C127	Max 2.5%	Max 2.0%
5. Specific gravity (apparent)		C128/C127	2.5-2.8	Min 2.5-2.8
6. Flat shell content in aggregate fraction	Part 106			
-Between 20mm & 40mm			Max 10%	Max 5%
-Between 10mm & 20mm			None	Max 10%
-Between 5mm & 10mm			None	Max 15%
-Between 2.36mm & 5mm				None
-Finer than 2.36mm				
-Hollow Shells	-	-	-	-
7. Particle shape				
-Flakiness index	Part 105.1		Max 5%	Max 25%
-Elongation index	Part 105.2			Max 25%
-Elongation/flakiness factor	See note 1			
8. Acid soluble sulphates (SO ₃) (See also clause 3.2.6)	Part 118		Max 0.4%	Max 0.4%
9. Acid soluble Chlorides (Cl) (See also clause 3.2.6)	Part 117 Appendix C		Max 0.06%	Max 0.03%
10. Soundness (Max loss in 5 cycles % weight)		C88	Max 10%	Max 12%
11. Material finer than 75mm		C117	Max 5%	Max 3%
12. Alkali reactivity		C1260	0.1% @ 16 days	0.1% @ 16 days
13. Alkali aggregate reactivity		C289 C227	Innocuous 0.1% @ 6 months	Innocuous 0.1% @ 6 months
14. Magnesium Sulphate MgSO ₄ , or Sodium sulphate Na ₂ SO ₄		C88	Max 10%	Max 10%
15. Mechanical strength:				
-10% fines value	Part 111	C131/C535		Min 100kN
-or Impact value	Part 112			Max 30%
-Los Angeles Abrasion				Max 30%

Note:

1. Not more than 5% of particles shall have ratios (w:b:1)* greater than 1:2:3 (flaky) and 1:1:3 (elongate) when tested by visual inspection of 100g of sand under a microscope.*w:b:1 – width: breadth : length
2. Equivalent IS codes are also applicable.

2.5.1.4 ADMIXTURES

- A.** Suitable admixtures may be used (with no extra cost) only if approved by the Engineer. Both the proposed dosage and method of use shall be submitted to the Engineer together with the following data:-
1. The typical dosage and detrimental effects of under dosage and over dosage.
 2. The chemical name(s) of the main active ingredient(s) in the admixture and compatibility if more than one admixture is used.
 3. Whether or not the admixture contains chlorides and, if so, the chloride content of the admixture expressed as a percentage of equivalent anhydrous calcium chloride by weight of admixture. Calcium chloride based admixtures will not normally be permitted.
 4. Whether or not the admixture leads to the entrainment of air when used at the Manufacturer's dosage.
 5. Whether or not the admixture affects the sulphate resistance of concrete used.

6. The suitability and effectiveness of any approved admixture should be verified by trial mixes with the cements, aggregates and other materials to be used in the works.
 7. Safety precautions in handling.
 8. Storage life and special storage requirements.
- B.** Unless otherwise approved by the Engineer, an admixture shall comply with one of the following Standard or equivalent IS codes.
- BS 1014 Pigments for cement, magnesium oxychloride and concrete.
- BS 5075 Concrete admixtures.
- C.** The use of calcium chloride as an admixture will not be approved.
- D.** When the use of a water reducing admixture is approved it shall have plasticising, dispersing and wetting properties and shall satisfy the following conditions.
1. It shall not contain any calcium chloride.
 2. It shall not entrain more than 1.5% of air in the concrete regardless of the mixing time.
 3. It shall increase the compressive strength of the concrete at 28 days by not less than 15% when the water cement ratio is reduced to give equivalent workability.
- E.** Admixtures should not impair the durability of the concrete nor combine with the ingredients to form harmful compounds nor increase the risk of corrosion of the reinforcement.
- F.** No deviation from the approved sources of colouring agents will be allowed by the Engineer.
- G.** Joint Sealant :
- i) The sealant shall be of best quality and from manufacturer like CICO, MC-BAUCHEMIE, PIDILITE, HMP or equivalent, as approved by the Engineer. The prior approval for the source shall be taken from the Engineer. It shall conform to the relevant I.S. Code.
 - ii) 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.
 - iii) It shall be used for sealing joints in water retaining structures, roofs, external walls, cladding, floors, Stainless Steel, Glass, Concrete, Marble, Stone, Brick, masonry, Timber etc. The modulus of elasticity of the sealant shall be less than 0.16 MPa, + 10% at 100% elongation. The shore "A" hardness of the sealant shall be 22 + 3 @ 250C. The operating temperature range for the sealant shall be -250C to 800C. The permanent dynamic movement capability of the sealant shall be +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.
 - iv) It shall possess 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.
- H.** Abrasion Resistant Industrial Flooring Aggregate :
- i) The flooring aggregate, shall be of best quality and from manufacturer like ' CICO or equivalent, as approved by the Engineer. The prior approval for the so LTF ce shall be taken from the Engineer. It shall conform to the relevant I.S. Code.

- ii) 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.
- iii) 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.
- iv) 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 trowelled, in stages, to bring about an uniform and smooth finish.

I. Concrete Hardener and Dustproofer

- i) The Concrete hardener and dustproofer, shall be of best quality and from manufacturer like CICO or equivalent, as approved by the Engineer. The prior approval for the source shall be taken from the Engineer. It shall conform to the relevant I.S. Code.
- ii) It shall have a specific gravity of 1.18 and shall be applied on concrete floors, at the rate of at least 25 liters per 100M² 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.

J. Water Repellant Coating

- i) The Water repellant coating shall be of best quality and from manufacturer like CICO or equivalent, as approved by the Engineer. The prior approval for the source shall be taken from the Engineer. It shall conform to the relevant I.S. Code.
- ii) Water repellant coatings for exterior exposed surfaces shall be acrylic resin based, having a Flash point of approx. 400C and specific gravity of 0.95.
- iii) 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 & 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.

K. Accelerating, Water Reducing Admixture and Plasticiser :

- i) The Accelerating, Water reducing admixture and plasticiser, shall be of best quality and from manufacturer like CICO or equivalent, as approved by the Engineer. The prior approval for the source shall be taken from the Engineer. It shall conform to the relevant I.S. Code.
- ii) It shall be in liquid state with a specific gravity of 1.30 and complying with ASTM C-494 Type E, IS : 9103-1979 & IS : 2645-1975. 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, pavings 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.

L. Retarding, Water Reducing Admixture and Plasticiser :

- i) 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 Engineer. The prior approval for the source shall be taken from the Engineer. It shall conform to the relevant I.S. Code.
- ii) It shall be in liquid state with a specific gravity of 1.22 and complying with ASTM C-494 Type B & D, IS : 9103-1979, 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. Water & Weather Proof Compound:

- i) The water & weather proof integral cement admixture shall be of best quality and from manufacturer like Feb Roffe's Roff Hysel Roff hyproof, Algiproof or equivalent, as approved by the Engineer. The prior approval for the source shall be taken from the Engineer. It shall conform to the relevant I.S. Code.
- ii) It shall be used as an excellent cement admixture in all types of concrete/plaster mortars, pointing mortars, masonry works, gunning 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.
- iii) 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.

N. Plaster Admixture :

- i) 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), of equivalent, as approved by the Architect or Engineer-in-charge. It shall comply to the relevant I.S. Codes.
- ii) 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.

2.5.1.5 WATER

- A.** The water, including any ice, to be used in mixing concrete shall be clean, free from all harmful matter in suspension and in solution, and shall satisfy the recommendations given in the IS 3025 codes as follows:

Test Type	Code	Limit
Chloride	IS 3025 Part 32	2000mg/l
Sulfates	IS 3025 Part 24	400mg/l
pH	IS 456	>6
Total Sod.	IS 3025 Part 18	3000mg/l

- B.** When flaked or crushed ice is added to the water, it shall have melted before the total water is added to the concrete.

- C. 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 R.C.C. container for transport, storage and handling of water shall be clean. Water shall conform to the standards specified in IS: 456-2000.
- D. If required by the Engineer 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: 269-1976. Any indication of unsoundness 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.
- E. 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.
- F. Hard and bitter water shall generally be found unsuitable for curing mortar or concrete.
- G. Potable water shall be generally found suitable for curing mortar and concrete.
- H. Testing Standards: (according to IS code)

Chemical Analysis :-

Sampling : Test shall be carried out only once for one particular source.

Results:

- a) TDS - 3000 mg/liter
- b) Sulphates - 5000 mg/liter
- c) PH values - 6 to 8
- d) Chlorides
 - P.P.O - 2000 mg/liter
 - R.C.O - 1000 mg/liter
- e) Carbonic contents - 200 mg/liter
- f) Non-carbonic contents - 3000 mg/liter

2.5.1.6 REINFORCEMENT

- A. Bars for reinforcement shall be:

1. Hot rolled high yield deformed bars to IS 1786 - minimum design characteristic strength 415 N/mm²
2. Cold worked deformed bars to B.S. 4461 or equivalent IS code - minimum design characteristic strength 415 N/mm²
3. Steel fabric to IS 1566 - minimum design characteristic strength 480 N/mm²
4. Mild Steel Bars:
 - i) Mild steel bars reinforcement for R.C.C. work shall conform to IS 432 (Part-11) 1966 and shall be of tested quality. It shall also comply with relevant part of IS: 456-2000.
 - ii) All the reinforcement shall be clean and free from dirt, paint, grease, mill scale or loose or thick rust, at the time of placing.

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

1.6mm	0.22 kg/m	8.20mm	2.47 kg/m
2.8mm	0.38 kg/m	9.22mm	2.98 kg/m
3.10mm	0.62 kg/m	10.25mm	3.85 kg/m
4.12mm	0.89 Kg/m	11.28mm	4.83 Kg/m
5.14mm	1.21 Kg/m	12.32mm	7.99 Kg/m
6.16mm	1.58 Kg/m	13.36mm	7.99 Kg/m
7.18mm	2.00 Kg/m	14.40mm	9.86 Kg/m

iv) 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
40mm & more	42 Kg/cm ²	24 Kg/cm ²	23

5. High tensile wires for the use in prestressed concrete work shall conform to IS :2090-1962.

- 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 1785-1962. Testing shall be done as per I.S. requirements.
- 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.
- 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.

iv) 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

6. Mild Steel Binding Wire

- The mild steel wire shall be of 1.63 mm. or 1.22 mm. (16 or 18 gauge) diameter and shall conform to IS :280-1972.
- 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.

B. Stainless Steel: (where recommended or permitted by the Engineer)

1. Stainless steel reinforcement or cast in fittings shall be Austenitic and reinforcement shall comply with BS 6744 or equivalent IS Code.

C. Each bundle of bent bars shall be clearly tagged with their drawing and mark number.

2.5.1.7 REINFORCEMENT COUPLERS

- A.** Where reinforcement couplers are specified or are permitted by the Engineer they shall be used in accordance with the manufacturer's recommendations, at no extra cost.
- B.** The tensile strength and the fatigue performance of coupled sections or bars shall satisfy the relevant British Standard for the type of bar being coupled or ACI 318, ACI 349-80, ACI 359-80 or equivalent IS Code.
- C.** Where reinforcement couplers are detailed they shall be staggered or the clear spacing shall be equal to the maximum overall coupler diameter plus 25mm.
- D.** Concrete cover shall be maintained to the reinforcement coupler.
- E.** The allowable slip or nonlinear elongation at the couplers' maximum design load shall be less than 0.1 mm. The couplers shall be self-locking.
- F.** Mesh/welded wire fabric to conform to BS 4483 or equivalent IS Code.

2.5.1.8 TYING DEVICES

A. Shall be:

1. Approved annealed mild steel wire of 1.6mm diameter
2. Approved rustproof binding wire
3. Approved proprietary ties
4. Ensure that the ends of the ties do not project into the concrete cover

2.5.1.9 SPACER BLOCKS

- A.** Spacer blocks shall be of such materials and design as will be dense durable, not lead to corrosion of the reinforcement, and not cause spalling of the concrete cover. Spacer blocks made from cement, sand and small aggregate shall match the mix proportions and appearance of the surrounding concrete and shall have compressive strength, durability of not less than the surrounding concrete.
- B.** They shall adequately support the reinforcement, resist displacement, not cause indentation of the formwork.
- C.** Plastic spacers shall be perforated to at least 75% of their area.
- D.** Concrete spacer blocks made on site are not permitted unless of similar properties to parent concrete.
- E.** Spacers will not be permitted against a concrete face which will be exposed in the finished works.

2.5.1.10 STORAGE

- A.** All cement shall be stored in its original bags in waterproof structures having a raised dry floor or in silos of approved design. Cement shall be used in the order in which it is received on site and same shall be used within 15days time from the date of received at site.
- B.** All aggregates shall be stored on hard paved self-draining areas or in approved hoppers or containers and in such a way as to avoid the mixing of different types of

aggregate with each other or the soil.

- C. All reinforcement shall be stored on racks clear of the ground.

PART 3 -EXECUTION

3.5.1.1 REFERENCE LEVEL AND LINES

3.5.1.1.1 At the start of the contract the Contractor should establish with the Engineer a datum level and a datum line with datum points along it.

3.5.1.1.2 As soon as possible the Contractor shall establish permanent reference points (which may be offset from the datum points). Such reference points should be such that:

1. The level or position is clearly defined to within 0.5mm.
2. They will not be displaced or obscured

3.5.1.1.3 Once the reference points have been approved by the Engineer all subsequent setting out shall be based on them.

3.5.1.1.4 The Contractor shall ensure that:

1. The reference points are not displaced or obscured
2. A means of checking and re-establishing the reference points is available.

3.5.1.2 SETTING OUT LEVELS AND GRID LINES

3.5.1.2.1 At every structural level the Contractor shall establish a datum and a horizontal reference grid in a form agreed with the Engineer and within an accuracy of whichever is the greater of 2mm or 0.03% of the vertical distance relative to any of:

1. The reference level and grid lines
2. The setting out level and grid lines at any other level
3. Any other setting out grid line at the same level

3.5.1.3 CONSTITUENTS OF CONCRETE

3.5.1.3.1 Concrete shall be made from cement, aggregate and water all as specified and approved.

3.5.1.3.2 No other ingredient shall be added without being approved by the Engineer.

3.5.1.3.3 Maximum total chloride content of concrete as a percentage of chloride on by mass of cement as defined in table 4 of BS 5328 or equivalent IS Code. It should not exceed 0.2 (0.1 for prestressed concrete including post-tensioned insitu work).

3.5.1.3.4 Total Water-soluble sulphate content of the concrete mix, expressed as SO₃, should not exceed 4% SO₃ by mass of the cement in the mix.

3.5.1.3.5 Total alkali content of concrete mix should be limited to 3 kg/m³ of Na₂O equivalent as defined in clause 5.2.4 of BS 5328 or equivalent IS Code, part 1.

3.5.1.4 MIX DESIGN PARAMETERS

3.5.1.4.1 The Contractor shall submit for approval concrete mix designs for each grade of concrete to be used in the works. The design parameters for these mixes are set out in Table 1. The Concrete strength is defined in terms of the 28 day characteristic cube strength. The strengths and other parameters specified are those assumed for the design of the structure and must be achieved by the Contractor in the finished Works.

3.5.1.4.2 The mix designs shall take account of the requirements for concrete to resist

chemical attack from the soil or ground in which it is to be placed, with due regard to geotechnical test results

Table 1:

3.5.1.4.3 Pile caps and Raft: Proportion normal-weight concrete mixture as follows: (if applicable)

1. Minimum Compressive Strength: 25 MPa at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.42.
3. Slump Limit: 125 mm for concrete with verified slump of 50 to 100 mm before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 25 mm.
4. Air Content: 1 percent, plus or minus 1.5 percent at point of delivery for 19-mm nominal maximum aggregate size.

3.5.1.4.4 Basement Walls: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 25 MPa at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.42.
3. Slump Limit: 150 mm for concrete with verified slump of 50 to 100 mm before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 25 mm.
4. Air Content: 1 percent, plus or minus 1.5 percent at point of delivery for 19-mm nominal maximum aggregate size.

3.5.1.4.5 Columns: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 25 MPa at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.42.
3. Slump Limit: 125 mm for concrete with verified slump of 50 to 100 mm before adding high-range water-reducing admixture or plasticizing admixture plus or minus 25 mm.
4. Air Content: 1 percent, plus or minus 1.5 percent at point of delivery for 19-mm nominal maximum aggregate size.

3.5.1.4.6 Building Walls: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 25 MPa at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.45.
3. Slump Limit: 150 mm for concrete with verified slump of 50 to 100 mm before adding high-range water-reducing admixture or plasticizing admixture plus or minus 25 mm.
4. Air Content: 1 percent, plus or minus 1.5 percent at point of delivery for 19-mm nominal maximum aggregate size.

3.5.1.4.7 Suspended Slabs and Beams: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 25 MPa at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.42.
3. Minimum Cement Content: 350 kg/cu. m.
4. Slump Limit: 125 mm, plus or minus 25 mm.
5. Air Content: 1 percent, plus or minus 1.5 percent at point of delivery for the specified 19-mm nominal maximum aggregate size.

- a) Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.

3.5.1.4.8 Post-Tensioned Suspended Slabs and Beams: Proportion normal-weight concrete

mixture as follows:

1. Minimum Compressive Strength: 40MPa at 28 days.
2. Minimum Cement Content: 400 kg/cu. m.
3. Maximum Water-Cementitious Materials Ratio: 0.42.
4. Slump Limit: 125 mm, plus or minus 25 mm.
5. Air Content: 1 percent, plus or minus 1.5 percent at point of delivery for the specified 19-mm nominal maximum aggregate size.
 - a) Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.

3.5.1.4.9 Water Tanks: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 25MPa at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.42.
3. Minimum Cement Content: 350 kg/cu. m.
4. Slump Limit: 125 mm, plus or minus 25 mm.
5. Air Content: 1 percent, plus or minus 1.5 percent at point of delivery for the specified 19-mm nominal maximum aggregate size.
6. Use corrosion Inhibitor admixtures

If the contractor is allowed to propose alternatives to the specified mixes by the engineer, he should submit mix designs for approval by the engineer. The information contained in these submissions should demonstrate to the satisfaction of the engineer that the proposed mixes are at least equal to the specified mixes in terms of durability, strength and any other parameters considered relevant by the engineer.

3.5.1.5 DESIGN MIXES

3.5.1.5.1 TARGET MEAN STRENGTH

1. The concrete mix shall be designed to have at least the required minimum cement content and/or maximum water/cement ratio and to have a mean strength greater than the required characteristic strength by at least the current margin.

3.5.1.5.2 The current margin for each particular type of concrete mix shall be determined; it may be taken as having the smaller of the values given by 1 or 2.

1. 1.64 times the standard deviation of cube tests on at least 100 separate batches of concrete of nominally similar proportions of similar materials and produced over a period not exceeding 12 months by the same plant under similar supervision, but not less than 3.75N/mm² for concrete of grade 20 or above.
2. 1.64 times the standard deviation of cube tests of batches of concrete of nominally similar proportions of similar materials and produced over a period exceeding 5 days but not exceeding 6 months by the same plant under similar supervision, but not less than 7.5N/mm² for concrete of grade 20 or above.

3.5.1.5.3 Where there are insufficient data to satisfy 1 or 2. above, the margin for the initial mix design should be taken 15N/mm² for concrete of grades 20 or above. On the basis of satisfactory and consistent works cube results the Engineer may at his discretion reduce this figure but to not less than 7N/mm² and the mix may be redesigned accordingly.

3.5.1.5.4 CHANGE OF CURRENT MARGIN

1. A recalculated margin should not be adopted unless it differs from the current margin by at least 18% when based on 40 separate batches, 11% when based on 100 batches, or 5% when based on 500 batches.

3.5.1.6 **EVIDENCE OF SUITABILITY OF PROPOSED MIX PROPORTIONS**

- 3.5.1.6.1 Evidence shall be submitted to the Engineer for each grade of concrete that the mix has been designed to give sufficient workability to be placed and compacted by the methods to be used on site.
- 3.5.1.6.2 If adequate data for "target mean strength" are not available, trial mixes shall be prepared.
- 3.5.1.6.3 The following information shall be supplied before any mix design is carried out. Subsequently the Contractor shall declare any change in cement content which results in a difference greater than 20kg/m³ from the cement content last declared.
 1. Nature and source of each material, and for aggregate, grading curves.
 2. Appropriate existing data as evidence of satisfactory previous performance for target mean strength and current margin and if required workability and water/cement ratio.
 3. Proposed quantities of each ingredient per cubic meter of fully compacted concrete.

3.5.1.7 **TRIAL MIXES**

- 3.5.1.7.1 Where trial mixes are required three separate batches of concrete shall be made using materials likely to be typical of the proposed supply and preferably under full scale production conditions. Sampling and testing shall be in accordance with IS 516 / B.S.1881.
- 3.5.1.7.2 The workability of each of the trial batches shall be determined and three cubes made from each batch for test at 28 days. A further three cubes from each batch shall be made for test at an earlier age if required. The trial mix proportions will be approved if the average strength of the nine cubes tested at 28 days exceeds the specified characteristic strength by the current margin minus 3.5N/mm² or if nine tests at an earlier age indicate that it is likely to be exceeded by this amount.
- 3.5.1.7.3 If trial mixes are required to demonstrate that the maximum free water/cement ratio is not exceeded, two batches shall be made in a laboratory with cement and surface dry aggregates known from past records of the supplier of the material to be typical. The proposed mix proportions will not be accepted unless both batches have the correct cement content and a free water/cement ratio below the maximum specified value.

3.5.1.8 **TESTING CONCRETE CUBES**

- 3.5.1.8.1 Concrete test cubes shall be 150mm cubes, made, cured and tested in accordance with IS 516 / B.S.1881.
- 3.5.1.8.2 Cubes shall be taken at the point of discharge from the mixer or the ready mix delivery vehicle.
- 3.5.1.8.3 Cubes shall be made individually.
- 3.5.1.8.4 Compliance with the specified characteristic strength may be assumed if:-
 1. The average strength determined from any group of four consecutive test cubes exceeds the specified characteristic strength by not less than 0.5 times the current margin and each individual test result is greater than 100% of the specified characteristic strength.

3.5.1.8.5 The Contractor shall make all necessary arrangements for curing and delivery of samples and test pieces to the Testing Authority.

3.5.1.9 **ACCEPTANCE OF WORKS CONCRETE**

3.5.1.9.1 The Contractor shall take four cubes from each sample, one for test at 7 day and three for test at 28 days. If early de-shuttering is envisaged by the Contractor, an additional cube shall be made. Sampling shall be at the rate of 4 per day for the first 35 days, and at one per 20m³ thereafter.

3.5.1.9.2 If any cube fails to meet the strength required then the Contractor shall carry out a full investigation into the cause. If the Engineer is not satisfied with the results of the Contractor's investigation or any additional tests which shall be carried out at the Contractor's expense then the works made from concrete mixed between the times of the sampling for the previous and subsequent satisfactory sets of cubes shall be classed as defective work.

3.5.1.10 **DEFINITION OF FORMWORK**

3.5.1.10.1 Formwork is the mould into which concrete is placed and/or its supports.

3.5.1.11 **MATERIALS FOR FORMWORK**

3.5.1.11.1 Temporary formwork shall be constructed of timber, sheet metal or other approved material such that the concrete with the required standard of finish will be produced.

3.5.1.11.2 Permanent formwork shall be constructed of slabs or blocks of precast concrete, natural stone, brickwork or other approved material with an exposed surface of the specified quality. They shall have positive anchorage to the structure, and the joints between them shall be made tight with mortar or by such other means as will prevent the leakage of grout from the concrete. Breeze blocks or other porous materials shall not be used as permanent formwork.

3.5.1.11.3 The type and treatment of any lining to the forms shall be appropriate to the concrete finish required.

3.5.1.11.4 Timber/Wooden planking

1. The shuttering shall be either of wooden planking of 30 mm. minimum thickness with or without steel Mining 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 bailie props, brick pillar of adequate section built in mud mortar may be used.
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.
3. If at any stage of work, during or after placing concrete in the structure, formwork 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, before the reinforcement bars are placed in position.
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 laid on sufficiently hard base.
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.

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.
7. As far as possible, clamps shall be used to hold the forms together and use of nails and spikes shall be avoided.
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.
9. The shuttering for beams and slabs shall have camber of 4 mm. per meter (1 in 250) or as directed by the Engineer, 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.

3.5.1.11.5 Concrete Shuttering Plywood :

1. It shall be made from strong and selected hard-woods. It shall be treated - 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.
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.
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.
4. Besides it shall be used as centering, shuttering and formwork of concrete columns, beams, slabs, walls, tanks, bridges, fly-Duets, 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.

3.5.1.11.6 Steel Sheeting and Steel Plates

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.
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 18 G.
3. Minimum two bracing angles should be provided along with angle framing while making the steel plates. It should be rivetted 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.
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.

3.5.1.12 **DESIGN OF FORMWORK**

3.5.1.12.1 The design of formwork shall be the responsibility of the Contractor for all insitu and precast elements.

3.5.1.12.2 Formwork (including supports) shall be sufficiently rigid to maintain the forms in their correct position, shape and required finish of the Engineer and profile so that the final concrete structure is within the limits of the dimensional tolerances.

3.5.1.12.3 The supports shall be designed to withstand the worst combination of self-weight, formwork weight, formwork forces, reinforcement weight, wet concrete weight, construction and wind loads, together with all incidental effects caused by placing, vibrating and compacting the concrete.

3.5.1.12.4 The Contractor shall, if required, supply to the Engineer drawings and calculations for the formwork he proposes to use.

3.5.1.13 **DEFLECTION AND CAMBER**

3.5.1.13.1 The Contractor shall make allowance for any settlement or deflection of formwork that is likely to arise during construction so that the hardened concrete conforms accurately to the specified line and level. Unless otherwise shown on the drawings or defined in the particular specification the formwork of all in situ beams and slabs shall be constructed with the following upward cambers:

Spanning between supports: 0.2% of span at centre

Cantilevers: 0.4% of span at free end

3.5.1.13.2 The Contractor shall undertake an assessment of the vertical movement of the structure during the construction period.

The study shall consider the movements due to shrinkage, creep and elastic deformation, taking due account of the construction timing of the elements.

This study shall contain, but not be limited to, deformations which affect

- Differential movement between adjacent vertically loaded elements
- Cladding joints
- Movement joints with vertical pipework

The Contractor shall make provision by pre-setting his formwork so that the levels of slabs shall move within the tolerance range.

The Contractor shall monitor the vertical movements of each floor throughout the construction period identifying the shortening deformation, i.e. excluding foundation settlements which shall be identified separately.

The Contractor shall submit to the Engineer all relevant information at 1 month intervals.

3.5.1.14 **SUPPORTS**

3.5.1.14.1 The formwork shall be so arranged as to be readily dismantled and removable from the cast concrete without shock, disturbance or damage. Where necessary the formwork shall be so arranged that the soffit form, properly supported on props only, can be retained in position for such period as may be required by maturing conditions or specifications.

3.5.1.14.2 Props shall be of sufficient strength and number and placed in such a manner

that they adequately and without excessive deflection support the loads likely to be imposed on them. Props should be adequately cross-braced.

3.5.1.14.3 Formwork props shall be positioned between permanent supports so that all members are supported at no more than 3m centres in both directions. The responsibility for the safe removal of the props shall rest with the Contractor.

3.5.1.14.4 Supports shall be carried to construction which is sufficiently strong to afford the necessary support without injury to any portion of the structure. This may mean in some cases that it be carried down to the foundations or other suitable bases.

3.5.1.14.5 Props and bracing shall be provided for temporary support to any precast composite construction where necessary.

3.5.1.15 JOINTS AND EDGES

3.5.1.15.1 All joints in formwork shall be close fitting to prevent leakage of grout from the concrete.

3.5.1.15.2 All construction joints in formwork shall be tightly secured against previous or hardened concrete to prevent the formation of stepping or ridges in the concrete.

3.5.1.15.3 Formwork shall be constructed to provide straight and true angles, arises or edges. Where chamfers are shown on the drawing, the fillets shall be accurately cut to size to provide a smooth and continuous chamfer.

Except where noted otherwise on the drawings, all arises in concrete shall be eased with 10mm x 10mm chamfers.

Open joints shall be constructed by the insertion and subsequent removal of a wood strip, metal plate, or other approved material. The insertion and removal of the template shall be accomplished without chipping or breaking the corners of the concrete. When not protected by metal armour, open joints in decks and sidewalks shall be finished with an edging tool. Upon completion of concrete finishing work, all mortar and other debris shall be removed from open joints.

3.5.1.15.4 Formwork shall have true edges to permit accurate alignment to sides and to provide a clean line at construction joints in the concrete.

3.5.1.15.5 Formwork panels shall be fixed with their joints either vertical or horizontal, unless otherwise specified.

3.5.1.15.6 Formwork shall be provided to the top surface of concrete where the slope or nature of work requires it.

3.5.1.16 FORMWORK TIES

3.5.1.16.1 No metal parts of any device for maintaining formwork in the correct location shall remain permanently within the specified minimum cover to reinforcement.

3.5.1.17 HOLES, INSERTS AND FIXINGS

3.5.1.17.1 Unless otherwise shown on the Engineer's drawings or specifically approved all holes and pockets shall be formed and all inserts and fixing and conduits cast in at the time of pouring.

3.5.1.17.2 The size, type and position of any hole, inserts of fixing required shall be shown on drawings prepared by the Contractor and issued to the Engineer for approval before casting the concrete.

3.5.1.17.3 No part of the concrete works shall be drilled or cut away without being approved by the Engineer.

3.5.1.17.4 If such drilling or cutting is carried out without approval the affected parts shall

be classed as defective work.

3.5.1.17.5 It shall be the Contractor's responsibility to ensure that each of his sub-Contractors, nominated or otherwise, is provided with a copy of this specification and abides by it.

3.5.1.18 **DEFECTIVE FORMWORK**

3.5.1.18.1 Where in the opinion of the Engineer any piece of formwork is damaged, deformed, worn or otherwise incapable of producing an acceptable finished concrete surface he may declare such formwork defective. Such formwork shall be repaired to the satisfaction of the Engineer or discarded.

3.5.1.19 **RELEASE AGENT**

3.5.1.19.1 Release agents shall be materials marketed as such and shall be one of the following types:-

- (a) cream emulsion
- (b) neat oil with surfactant added
- (c) chemical release agent

3.5.1.19.2 Release agents shall be stored and used strictly in accordance with the manufacturer's instruction.

3.5.1.19.3 Where the concrete surface is to be permanently exposed only one agent shall be used throughout the entire area.

3.5.1.19.4 When the surface is to receive an applied finish, care shall be taken to ensure the compatibility of the release agent with the finish.

3.5.1.20 **FINAL PREPARATIONS BEFORE CONCRETING**

3.5.1.20.1 Immediately before the concrete is placed in any section of the formwork the interior of that section shall be completely cleared of all extraneous materials including water.

3.5.1.21 **CUTTING AND BENDING OF REINFORCEMENT**

3.5.1.21.1 All reinforcement shall be bent cold to the details shown in the schedules produced by the Contractor in accordance with B.S.4466 or equivalent IS Code unless otherwise stated.

3.5.1.21.2 Reinforcement shall not be bent except as shown in the bending schedules without the approval of the Engineer. No reinforcement shall be re-bent without being approved by the Engineer.

3.5.1.21.3 High yield steel shall not be rebent.

3.5.1.21.4 All reinforcement shall be cut and bent off site at a facility approved by the engineer. Approval shall be obtained prior to cutting and bending.

3.5.1.22 **CLEANING OF REINFORCEMENT**

3.5.1.22.1 Reinforcement shall be free of all loose mill scale, rust, oil, grease, concrete or other harmful matter at the time of concreting.

3.5.1.22.1.1 All rust build up which occurs before concreting or any hardened grout from previous concreting shall be removed by thorough wire brushing.

3.5.1.23 **FIXING OF REINFORCEMENT**

3.5.1.23.1 GENERAL

All reinforcement shall be accurately placed and supported with the correct cover and securely fixed in the positions shown on the drawings and to the satisfaction of the Engineer, who shall be given 24 hours notice of the intention to pour concrete and that the reinforcement fixing is complete, for inspection.

3.5.1.23.2 SUPPORT TO REINFORCEMENT / CHAIRS

The Contractor shall supply and fix all chairs required to support the top mat of slab reinforcement or space the two mats of all reinforcement adequately. The same shall not be measured for payment.

In particular slab chairs must be close enough to prevent the reinforcement bending or sagging.

The Contractor shall submit to the Engineer for his prior approval details of his proposals for chairs, and any other means of supporting reinforcement. These supports should be supplied by the Contractor and allowed for in the price of reinforcement. The chairs and metal supports used in association with coated reinforcement should similarly be coated.

3.5.1.23.3 COVER

The maximum deviation of concrete cover from the required nominal shall be 5mm.

No metal part of any device used for connecting bars or for maintaining reinforcement in the correct position shall remain within the specified minimum cover.

The Contractor shall provide adequate concrete or plastic spacers to ensure that the correct cover is achieved. Any concrete spacer blocks used should be well made and high strength blocks (see clause 2.8).

The use of spacer blocks will not generally be permitted against a concrete face which is to be exposed in the finished works.

3.5.1.23.4 CORROSION RESISTANT

Galvanized and non-galvanized reinforcement should not be interconnected.

3.5.1.23.5 The Contractor is to detail all laps and anchorage length and to fix reinforcement all in accordance with IS 456 / BS 8110 requirements.

3.5.1.24 **PROJECTING REINFORCEMENT**

3.5.1.24.1 The Contractor shall protect projecting reinforcement without affecting its bond properties and shall ensure that it does not cause rust staining to any part of the works.

3.5.1.25 **WELDING**

3.5.1.25.1 Where specified or approved metal arc welding shall be carried out in accordance with B.S.5135 or equivalent IS Code. Details of all welding techniques materials and qualified welders to be used shall be submitted for approval and such trials made as are required to demonstrate the effect of the welding.

3.5.1.25.2 Welding reinforcement shall not generally be permitted.

3.5.1.26 **CONCRETE MIX**

3.5.1.26.1 READY MIXED CONCRETE

The Contractor shall submit to the Engineer for his prior approval full details of the proposed ready mixed concrete supplier and the mix proportions and workability. Any approval which may be given will apply only for so long as the Engineer is satisfied that

the concrete complies with the specification and recommendations of B.S.5328 or equivalent IS Code.

Each load shall be accompanied by a delivery note stamped with the time of mixing and stating the consignee, concrete grade and quantities of each material including water additives.

3.5.1.27 **TRANSPORTING CONCRETE**

3.5.1.27.1 Concrete shall be transported as quickly as possible from the mixer to its final position without segregation or loss of any of the ingredients.

3.5.1.27.2 Runs or gangways for the concrete transportation and main runs for foot traffic shall not be supported or allowed to bear on the fixed reinforcement.

3.5.1.28 **PLACING**

3.5.1.28.1 Concrete shall not be placed in the forms until all materials to be embedded and the adequacy of the foundation material or other casting surface has been inspected and approved by the Engineer.

3.5.1.28.2 Concrete shall be in its final position:

1. As soon as possible but not more than 45 minutes after the start of mixing (or as authorized by the Engineer) while it is sufficiently plastic for adequate compaction continuously up to forms or stop-ends in such a way that contamination, loss of the constituent materials and segregation of concrete or damage to reinforcement or formwork do not occur.

3.5.1.28.3 Starter sections of walls, columns, etc. shall be cast in such a way that their strength and other characteristics are at least equal to those specified for the whole member.

3.5.1.28.4 SUPERVISION

All placing and compacting shall be carried out under the direct supervision of a competent member of the Contractor's staff.

3.5.1.28.5 INTERRUPTED POUR:

1. If for any reason the placing of concrete in a form is interrupted for less than thirty minutes, the concrete shall be kept lightly vibrated to stop it going off before the pour is restarted or for more than thirty minutes then the pour shall be considered terminated and stop end constructed in a suitable position and concrete vibrated up to it in the normal manner.
2. Notwithstanding the above the Engineer may terminate any interrupted work immediately.

3.5.1.28.6 Concrete shall not be dropped from a height exceeding 1.5 metres.

3.5.1.29 **COMPACTING**

3.5.1.29.1 All structural concrete shall be compacted by the use of appropriate mechanical vibrators. External vibrators shall not be used without prior approval.

3.5.1.29.2 The concrete shall be thoroughly compacted and carefully worked around all reinforcement and embedded fixtures and into the sides and corners of the formwork. Internal vibrators shall not be allowed to remain in contact with formwork or reinforcement.

3.5.1.29.3 Compaction shall start as soon as there is concrete within the formwork and compaction shall continue during the placing operation so that at no time shall there be a large volume of uncompacted concrete in the formwork.

3.5.1.29.4 Whenever concrete is being placed there shall be at least one spare vibrator available in case of breakdown.

3.5.1.29.5 If the surface of a floor slab exhibits cracking while the concrete is still plastic it shall be reworked to close the cracks.

3.5.1.30 **CLEANING**

3.5.1.30.1 All equipment used for mixing, transporting, placing and compacting concrete shall be thoroughly cleaned before changing from one grade of concrete to another and whenever mixing ceases.

3.5.1.31 **CURING**

3.5.1.31.1 The methods of curing shall be as given below, or by other approved methods. The Contractor is to submit to the Engineer for approval full details of his proposed methods and duration's of curing.

3.5.1.31.2 IN SITU CONCRETE

Formed surfaces - all formwork must remain in place for at least 48 hours. If removal occurs within 7 days from casting, the exposed surface must be cured by an approved method.

Other concrete surfaces - curing shall proceed as soon as the surface is finished. The curing technique shall not affect the surface finish.

3.5.1.31.3 METHODS OF CURING

For shuttered surfaces, insulated steel or timber formwork is sufficient. When formwork is removed, a curing membrane shall be applied immediately.

For other surfaces, a curing membrane shall be applied immediately the surface is finished. In addition, if the area considered is exposed to the effects of sun or wind, ponding to a depth of at least 50mm or wrapping with damp hessian and polythene shall be provided.

Ponding shall take place as soon as possible at the end of concreting, but not before the concrete can resist surface damages. Under all circumstances, ponding shall be complete within 24 hours from the end of casting.

3.5.1.31.4 DURATION OF CURING

Curing procedures shall be carried out for minimum 7 days. The actual duration of curing for each element will be dependent upon weather conditions and will be at the direction of the Engineer.

3.5.1.31.5 PROTECTION FROM DRYING EFFECTS OF WIND.

When the humidity is less than 50% and the wind speed exceeds 4m/second, sheltering of the concrete, during casting and for a period of at least 24 hours after casting, shall be provided.

Methods of curing which rely on intermittent spraying of the concrete surface with cold water will not be accepted.

Such sheltering shall be in addition to the curing procedures of (3.31C) above. Formwork left in place shall be regarded as sheltering.

3.5.1.31.6 For concrete sections in excess of 1m thickness special measures will be required and the curing period increased to 14 days for sections 1m to 2m and 21 days for sections in excess of 2m section.

3.5.1.32 **MASS POURS**

3.5.1.32.1 For all concrete pours in excess of 1m thickness the contractor shall ensure that the differential temperature between the core and external surfaces or adjacent pours shall not be greater than 20 degrees Celsius and that the temperature does not exceed 70 degrees Celsius. The contractor shall give consideration to the method to be employed to achieve this and prepare and submit for approval to the Engineer his proposed method. Alternatives include, but are not limited to: pre-cooling the concrete mix with flaked ice, use of injected liquid nitrogen to cool the mix; casting in cooling pipes to allow refrigerated coolant to reduce the core temperature.

3.5.1.33 **CONCRETING IN HOT WEATHER**

3.5.1.33.1 On exposed concrete surfaces in high sun temperatures and/or strong drying wind conditions the Contractor shall use a curing method which also shields the concrete and this shall be placed in position no later than half an hour after final tamping. If the surface exhibits cracking while the concrete is still plastic then it shall be re-tamped to close the cracks.

3.5.1.33.2 Any formwork made of metal, concrete or other material of high thermal capacity shall be cooled with water before the concrete is placed against it.

3.5.1.33.3 No concrete shall be mixed and placed whilst the shade temperature is above the requirements of the relevant Indian Standards. The Contractor shall supply an accurate maximum and minimum thermometer and hang it in an approved position in the works.

3.5.1.33.4 The Contractor shall plan the day's concreting in such a manner as to ensure that each bay or panel is completed at a proper construction joint before the temperature rises above the permissible limit.

3.5.1.33.5 The temperature of fresh mixed concrete should not exceed 32°C and the Contractor shall submit for approval all his precautions to ensure that the limit is not exceeded. Concrete with a temperature less than 32°C can be produced by combinations of the following methods:

1. Use of sliced, flaked or crushed ice to reduce temperature of mixing water. All ice shall be melted before adding to concrete.
2. Night casting (subject to the prior approval of the Engineer).
3. Shading of aggregates.
4. Moistening of aggregates with potable water.
5. Cooling of formwork and reinforcement.
6. Use of white or light reflective paints on mixer drums and water storage tanks.
7. Shading of the mixing area.
8. Minimising the time from mixing to final placement.

The Contractor shall allow in his rates for any additional expense incurred by complying with this clause in order to complete the works within the "Time of Completion".

3.5.1.34 **CONCRETING IN COLD WEATHER, RAIN OR ADVERSE CONDITIONS**

3.5.1.34.1 The temperature of the concrete, when placed, shall be not less than 5°C and the temperature of the placed concrete shall not fall below 5°C for a period of 48 hours. The Contractor to take all necessary measures to ensure the concrete temperature does not fall below the specified levels.

3.5.1.34.2 Rain Protection: Under conditions of rain, the placing of concrete shall not commence or shall be stopped unless adequate protection is provided to prevent

damage to the surface mortar, or damaging flow, or wash of the concrete surface.

3.5.1.35 **STRIKING OF FORMWORK**

3.5.1.35.1 Provided that the concrete strength is confirmed by tests on cubes stored in the same conditions and adjacent to the elements to be depropped then the formwork may be struck when the cube strength is 24N/mm^2 or twice the stress to which it will be subjected, whichever is the greater, provided that the earlier striking will not result in unacceptable deflection due to shrinkage, creep etc.

3.5.1.35.2 In the absence of cube results the period before striking shall be in accordance with Table 2.

Table 2.		
Location	Minimum Period Before Striking Surface Temperature of Concrete in Degrees Centigrade	
	Not Less Than 16°C	Not Less Than 7°C
Beam sides, walls and columns	9 hours	12 hours
Slab soffits (formwork props undisturbed)	4 Days	7 Days
Formwork props of slabs	11 Days	14 Days
Beam soffits (formwork props undisturbed)	8 Days	14 Days
Formwork props to beams	15 Days	21 Days

3.5.1.35.3 The earlier striking of forms (but not props) may be approved if it can be shown to the Engineer that this can be done without damage to the concrete.

3.5.1.35.4 The making and testing of cubes to establish the period before striking shall be at the Contractor's expense.

3.5.1.35.5 The method of measuring the surface temperature of the concrete shall be submitted for the Engineer's approval.

3.5.1.35.6 Permission to strike formwork on the basis of the strength of specially cast cubes will be withdrawn if the Engineer is not satisfied that the strength of the cubes is representative of the strength of the concrete.

3.5.1.35.7 Notwithstanding the above, formwork props shall remain in position for at least 3 days.

3.5.1.35.8 Unless otherwise directed, no treatment of any kind, other than that required for curing the concrete, shall be applied to the concrete after removal of the forms until it has been inspected by the Engineer.

3.5.1.35.9 Where an upstand beam or wall is cast on top of a slab, the slab shall not be depropped in that area until 14 days after the beam or wall has been cast.

3.5.1.35.10 All formwork shall be removed without shock or vibration that might damage the concrete. Before the soffit and props are removed the surface of the concrete shall be exposed where necessary in order to ensure that the concrete has hardened sufficiently.

3.5.1.35.11 The final responsibility for striking of the formwork rests solely with the Contractor.

3.5.1.36 **POSITION OF CONSTRUCTION JOINTS**

3.5.1.36.1 The Contractor shall submit to the Engineer for his prior approval, his proposals for the positions of all joints not shown on the drawings.

3.5.1.36.2 All vertical joints shall be constructed with shear keys. Surfaces of fresh concrete at horizontal construction joints shall be rough floated sufficiently to thoroughly

consolidate the surfaces and intentionally left in a roughened condition. Shear keys shall consist of formed depressions in the surface covering approximately one third of the contact surface. The forms for keys shall be levelled so that removal will not damage the concrete.

All construction joints shall be cleaned of surface laitance, curing compound and other foreign materials before fresh concrete is placed against the surface of the joint. Abrasive blast or other approved methods shall be used to clean horizontal construction joints to the extent that clean aggregate is exposed. All construction joints shall be flushed with water and allowed to dry to a surface dry condition immediately prior to placing concrete.

3.5.1.36.3 The Table "Maximum Areas and Dimensions for Different Types of Construction" is for guidance and the Contractor shall satisfy the Engineer that the pour sizes proposed are consistent with other precautions against early thermal shrinkage.

Vertical joints in walls generally shall not be spaced at intervals greater than 5m and in no case shall be more than 10m. Where, however, a wall changes direction by at least 60 degrees, the overall spacing of joints may be increased to 10m subject to the length of pour in either leg of the wall being no more than 5m. Where possible joints shall be positioned at least 2m away from corners.

MAXIMUM AREAS AND DIMENSIONS FOR DIFFERENT TYPES OF CONSTRUCTION		
CONSTRUCTION	MAXIMUM AREA (M²)	MAXIMUM DIMENSION (M)
Watertight Walls	25	5
Watertight Slabs	100	10
Slabs with major restraints at both ends	100	13
Slabs with major restraints at one end only	250	20
Slabs with little restraints in any directions	500	30
Walls	40	10

3.5.1.37 **STOP ENDS**

All construction joints other than horizontal shall be formed against proper stop ends which shall be notched round the reinforcement (which shall not be displaced or bent), substantially grout-tight and fixed vertically unless otherwise directed.

3.5.1.38 **TREATMENT**

At construction joints all laitance and honeycombed concrete shall be removed from the contact face to expose the coarse aggregate by scabbling before the adjacent section is concreted. The contact face shall be clean without grout or mortar applied to it.

3.5.1.39 **SUBSEQUENT POUR**

Concrete may not be poured against an existing concrete face until 24 hours after that concrete was cast.

3.5.1.40 **FINISHING FORMED SURFACES**

3.5.1.40.1 No Special finish with form facing material is required.

3.5.1.41 **FINISHING FLOORS AND SLABS**

3.5.1.41.1 General: Comply with ACI 302.1R or equivalent IS Code recommendations for



screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

3.5.1.41.2Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces to be covered directly with fluid-applied or sheet waterproofing, built-up or membrane roofing or sand-bed terrazzo.

3.5.1.41.3Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating or flooring system.
2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M) or equivalent IS Code, for a randomly trafficked floor surface:
3. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 3.00-m-long straight edge resting on 2 high spots and placed anywhere on the surface does not exceed 6 mm for car park and garages floor slabs, 3 mm for other slabs specified or indicated to have trowel finish.

3.5.1.41.4Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.

3.5.1.41.5Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and similar applications.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

3.5.1.42 **MISCELLANEOUS CONCRETE ITEMS**

3.5.1.42.1Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

3.5.1.42.2Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

3.5.1.42.3Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.5.1.42.4When the moisture film has disappeared and the concrete has hardened sufficiently to prevent laitance from being worked to the surface a type U1 surface shall be steel floated by hand or machine to produce a dense, smooth, uniform surface free from marks.

3.5.1.43 **PROTECTION**

3.5.1.43.1 Concrete surfaces which will be exposed in the finished works shall be protected from spillage stains and any other damage.

3.5.1.44 **DEFECTIVE WORK**

3.5.1.44.1 Any finished work which in the opinion of the Engineer fails to meet the requirements of this specification or is in any way inferior to the standard of the relevant approved sample or which is subjected to subsequent damage or surface staining shall be classed as defective work and removed from the works.

3.5.1.45 **CONSTRUCTION TOLERANCES**

3.5.1.45.1 The concrete work shall be constructed to an accuracy that shall permit the proper assembly of components and installations and shall be compatible with the finish. The accuracy of the work shall be within the tolerances stated on the Drawings or specified elsewhere and in the absence of any other requirements, shall comply with the following:

All setting out dimensions	±5mm
Sections of concrete members	±5mm
Foundations	
Surface against ground (underside)	+20/-50mm
Top surfaces of bases and piers	+5/-10mm
Slabs	
Surface level (5m straight edge)	±5mm
Surface level to datum	±10mm
Position of slab edges	±5mm
Columns and walls	
Plumb in storey height (3.3m typical)	±3mm
Plumb in any 20m height	±10mm
Plumb in any height greater than 20m	1:2000 but not
	greater than ±50mm
Cross diagonal distortion in storey height (3.3m typical)	
between adjacent columns or walls	±7mm
Dimensions and position of openings	±5mm
Holding down bolt assemblies	±5mm
Position of embedded items	±5mm
Building vertical alignment (foundation to roof)	±50mm
Cover to reinforcement	
Members up to 500mm thick	±5mm
Members between 500mm and 1m thick	-5/+10mm
Members between 1m and 2m thick	-5/+15mm
Members greater than 2m thick	-5/+20mm

Notes:

a) The thickness of a slab shall not be less than 95% of the nominal thickness specified.



- b) Where stated on the drawings, slabs shall be laid to the specified falls
- c) Gaps and slots for sealants shall satisfy the requirements of the Specification for Joints and Sealants.
- d) Positions of slab edges, openings and embedded items are relative to a local grid established at a particular level. All other tolerances relate to main setting out lines.

3.5.1.46 **APPLICATION OF LOADS**

The following shall apply unless otherwise specified in the specification.

3.5.1.46.1 GENERAL

Loads shall not be applied to concrete structures until the concrete has attained its required strength so that damage will not occur.

3.5.1.46.2 BACKFILL

The sequence of placing backfill around structures shall be such that overturning and sliding forces are minimised. Unless otherwise approved by the Engineer the placement shall not begin until the concrete has reached not less than 80 percent of its specified strength.

3.5.1.46.3 CONSTRUCTION LOADS

Loads imposed on existing, new or partially completed portions of structures due to construction operations shall not exceed the load-carrying capacity of the structure. The compressive strength of concrete to be used in computing the load-carrying capacity shall be the smaller of the actual compressive strength at the time of loading or the specified compressive strength of the concrete.

3.5.1.47 **EMBEDDED ITEMS**

3.5.1.47.1 Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Coordinate with Division 3 Section "Post-Tension Tendons" for post tensioning conduits to be installed in suspended slabs.
2. Coordinate with Division 5 Sections for work items that require embedding of anchor rods or other fixation fitting in concrete.
3. Coordinate with Divisions 15 and 16 Sections for work items that require embedding of anchors rods or other fixation fittings in concrete.
4. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges." or equivalent IS Code.
5. Install reglets to receive waterproofing flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.5.1.48 **TESTING**

3.5.1.48.1 GENERAL

1. All tests and checks carried out on site shall be in the presence of or as directed by the Engineer.
2. The Contractor shall be responsible for carrying out all tests required by the specification or called for by the Engineer and shall make full allowance in his bills of quantity rates for such tests.

3. The Contractor shall obtain all necessary representative samples taken in the manner specified in the relevant Standard and deliver them to the approved Testing Authority unless otherwise instructed.
4. Unless otherwise specified the costs of all tests required are to be met by the Contractor whether the test results show the material or workmanship to be satisfactory for the work or not.

3.5.1.48.2 REINFORCEMENT TESTS

1. Before fixing any reinforcement, the following tests shall be carried out by an approved independent Testing Authority and the results submitted to the Engineer.
 - a) Tensile tests for each diameter and grade of steel to be used in the works
 - b) Bend tests for all bars with a diameter greater than 20mm
 - c) Rebend tests for mild steel bars with a diameter not greater than 20mm
2. Thereafter the Contractor shall provide three test specimens, not less than 1 meter long, in respect of each 25 tonnes or part thereof of each size of steel reinforcement from each consignment, or at frequency determined by the engineer.
3. The Contractor shall submit in respect of each consignment of steel reinforcement supplied to the site a manufacturer's certificate stating that the steel reinforcement complies with the relevant standard and provide proof, when required by the Engineer that each load of steel reinforcement delivered to the Site forms part of the same consignment and originates from the same source as that in respect of which previously submitted test lengths and manufacturer's certificate relate.
4. Under the supervision of the Engineer, the Contractor shall cut test specimens, appropriately mark same and deliver them to the Testing Authority, unless otherwise directed, to be tested in accordance with the relevant Indian Standards.

3.5.1.48.3 PRELIMINARY TESTS

1. If the Contractor states in writing that he proposes to adopt a designed concrete mix then he shall be responsible for the design and carrying out preliminary tests in accordance with IS 456. The results shall be submitted to the Engineer before placing any structural grade concrete made from the materials to be tested.

The Contractor shall give notice to the Engineer to enable him to be present at the making of trial mixes and preliminary testing of the cubes. The Contractor shall prepare trial mixes, using samples of approved material typical of those he proposes to use in the Works, for all grades to the Engineer's satisfaction prior to commencement of concreting. The Contractor shall determine the workability of the trial mixes. The concreting plant and means of transport employed to make the trial mixes and to transport them representative distances shall be similar to the corresponding plant and transport to be used in the Works.

2. The Engineer may forbid the use or placing of any structural grade concrete until he has received the satisfactory results of all relevant tests.
3. Preliminary Tests shall be carried out using samples of the materials the Contractor intends to use on the works.
4. Preliminary Tests shall be carried out at the start of the Contract and whenever the Contractor proposes to change his source of supply and whenever in the opinion of the Engineer there has been sufficient variation from the previously approved samples that new tests are required.

3.5.1.48.4 SLUMP TESTS

Slump tests on fresh concrete shall be carried out in accordance with IS 516.

3.5.1.48.5 GAMMA RADIOGRAPHY

When specified or approved, Gamma Radiography shall be carried out in accordance with the recommendations of BS 4408 Part 3 or equivalent IS Code, to detect the presence of local voids and/or the presence and location of reinforcement.

3.5.1.48.6 DURABILITY TESTS

The following tests shall be carried out on all trial mixes and on every 1000m³ of concrete produced:

Chloride Permeability to AASHTO T-277 or equivalent IS Code

Type of Concrete	Maximum Charge Pass (Coulombs) Age 28 days
OPC	3800
MSRPC	2500

Water Permeability to DIN 1048 or equivalent IS Code

Type of Concrete	Maximum Penetration (mm) Age 28 days
OPC	20mm
MSRPC	15mm

Initial Surface Absorption to BS 1818 Part 5 or equivalent IS Code

Type of Concrete	Maximum ISAT Age 28 days; 10 minute test
OPC	0.3 ml/m ² /sec
MSRPC	0.2 ml/m ² /sec

30 Minute Absorption to BS 1818 Part 12 or equivalent IS Code

Type of Concrete	30 Minute Absorption (Age 28 days)
OPC	2.5%
MSRPC	2.0%

3.5.1.48.7 ADDITIONAL TESTS

The Contractor shall be responsible for the carrying out any additional tests required by the Engineer and not covered in this specification. The nature of such tests and the manner of carrying them out shall be determined by the Engineer.

3.5.1.48.8 TESTING, MEASURING AND SURVEYING APPARATUS

The Contractor shall supply and maintain on site for the duration of structural work and in good repair for the Engineer's use testing, measuring and surveying apparatus required to check the compliance of the Works with the specification.

3.5.1.48.9 RECORDS

1. Temperature. A daily record shall be kept of maximum and minimum outside shade temperatures.
2. Concreting and Test Cubes. The Contractor shall submit weekly to the Engineer a complete record of concreting and test cubes.

Cube test reports must include at least:

Test laboratory and name of person responsible.

Title of project.

Identification number, numbers to be consecutive.

Certificate of sampling.
Certificate of method of making cubes.
Curing place and conditions.
Date of receipt by laboratory.
Condition on receipt by laboratory.
Actual or checked nominal dimensions.
Weight and density.
Date of test.
Age when tested.
Confirmation of testing to BS 1881 or equivalent IS Code.
Load at failure.
Compressive strength.
Type of fracture.
Date of dispatch of report to Engineer.

Graphical representation of consecutive test cube strengths shall be submitted with the compliance criteria indicated to establish trends over time.

3. These records shall be set out in such a way that the tests cube results may be easily referred to the works concrete to which they relate.

2.2.2 CONCRETE TOPPING

4 GENERAL

4.0.0.1 RELATED DOCUMENTS

- 4.0.0.1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this Section.

4.0.0.2 SUMMARY

4.0.0.2.1 Cementitious Wearing Surface Topping and Underlayment Filling (Screeding):

Provide following types of floor fill where required to provide a flat and level floor where required, or slope to drains as indicated on the drawings.

1. Provide a cementitious wearing surface for areas where a thickness of 75mm to 25mm typically in the basement parking areas.
2. Provide aerated concrete fill for areas where fill under pavers are required. Typically on inhabited floors such as podium, atrium and steel framed tower floors.
3. Provide aerated concrete lightweight fill as insulating layer under waterproofing membrane over all terrace roofing not covered with soil mix or other green treatment.

4.0.0.2.2 Related Work: Latex-type leveling compound for incidental areas where a thin layer, 0" to 1/8" thick, is required.

4.0.0.3 SUBMITTALS

4.0.0.3.1 Product Data: Provide manufacturer's data, including recommended applications, for each factory-mixed product.

4.0.0.3.2 Laboratory Test Reports: Submit laboratory reports for mix design test.



5 PRODUCTS

5.5.1.1 CEMENTITIOUS WEARING SURFACE

5.5.1.1.1 Provide products complying with requirements of the contract documents and made by one of the following:

5.5.1.1.1.1 L&M Construction Chemicals, Inc., 14851 Calhoun Road, Omaha, NE 68152,

5.5.1.1.1.2 PNA Construction Technologies,

5.5.1.1.1.3 Reef Industries,

5.5.1.1.1.4 India Equivalent

5.5.1.1.2 Heavy duty Emery Aggregate concrete topping: Class 6 and 7 industrial floors. Ready-mixed with Portland cement.

5.5.1.1.2.1 Physical properties and minimum test performance:

5.5.1.1.2.1.1 100% natural emery aggregates, minimum 58% aluminum oxide and 24% ferric oxide.

5.5.1.1.2.1.2 ACI 544.2 R89, Impact resistance. At seven day, no cracking after 4500 blows.

5.5.1.1.2.1.3 ASTM C 1202, Chloride Ion Penetrability Results: rating: "Very Low," less than 1,000 coulombs passing.

5.5.1.1.2.1.4 ASTM C 666/666M, Freeze-Thaw Durability Factor not less than 90%

5.5.1.1.2.2 EMERY TOP 400 by L&M Construction Chemicals

5.5.1.1.3 Evaporation Retardant: E-CON, by L&M Construction Chemicals, Inc.

5.5.1.1.4 Curing compound: DRESS & SEAL WB 30, by L&M Construction Chemicals, Inc.

5.5.1.1.5 Semi-rigid Joint Filler: JOINT TITE 750, by L&M Construction Chemicals, Inc.

5.5.1.1.6 Bonding Agent for Slurry, EVERBOND, by L&M Construction Chemicals, Inc.

5.5.1.1.7 Other materials:

5.5.1.1.7.1 Concrete Curing Cover, Transguard 4000 by Reef industries, or Hydracure sheeting, by PNA Construction Technologies, or equal.

5.5.1.2 AERATED CONCRETE FILL

5.5.1.2.1 Portland cement: ASTM C150, Type I or Type III.

5.5.1.2.2 Aggregate: ASTM C33. Provide fine aggregate consisting of sand or crushed stone screenings, which is clean, hard, and free from deleterious matter.

1. Fine aggregate: Sharp clean silica sand

5.5.1.2.3 Wire Mesh Reinforcement: ASTM A185. 6" x 6" x 10/10-gage.

5.5.1.2.4 Lime: Non hydrated

5.5.1.2.5 Foaming Agent: pumped micro air bubble and a chemical air entraining foaming agent.

5.5.1.2.6 Bonding Compound: Provide a bonding compound with a polyvinyl acetate or acrylic base. Subject to compliance with requirements, provide one of the following products:

1. Euco Weld; Euclid Chemical Co.

2. Everbond; L & M Construction Chemicals.

3. Sonocrete; Sonneborn-Rexnord.

4. SBR Latex; Euclid Chemical Co.



5. India manufactured equivalent

5.5.1.2.7 Concrete Fill Mix: Design mix to produce concrete fill with following characteristics.

1. Compressive strength:
 - a. Floor Screed under Stone or Tile finish: 1200 kg/ cubic meter
 - b. Insulation Roof Screed under terrace waterproofing: 600 kg/ cubic meter
2. Consistency: creamy flowable aerated suitable for pumping with squeeze type pumping equipment.
3. W/C ratio: 40-45 liters per 100 kg of cement.
4. Screed depths: not less than 40mm for flooring and 40 to 75 mm for terraces.

5.5.1.2.8 Mixing: Provide batch-type mechanical mixer for mixing concrete fill at Project site. Equip batch mixer with a suitable charging hopper, water storage tank, and a water-measuring device. Use only mixers which are capable of mixing aggregates, cement, and water with pumped air into a uniform mix within specified time, and of discharging mix without segregation.

1. Mix each batch of 2 cu. meter or less for at least 1-1/2 minutes after ingredients are in mixer. Increase mixing time 15 sec. for each additional cu. meter or fraction thereof.

5.5.1.3 CURING MATERIALS

5.5.1.3.1 Moisture - Retaining Cover: If moisture - retaining cover is used, provide polyethylene - coated burlap complying with ASTM C171.

5.5.1.3.2 Liquid Membrane-Forming Curing Compound: If used, provide liquid-type membrane-forming curing compound complying with ASTM C309, Type I, Class A; moisture loss not more than 0.055 gr./sq.cm. When applied at 200 sq. ft. /gal. Subject to compliance with requirements, provide one of following, or approved substitute, products which will not adversely affect bond of finish materials.

1. Master seal; Master Builders.
2. Ecocure; Euclid Chemical Co.
3. Kure-N-Seal; Sonneborn-Rexnord.
4. L & M Cure; L & M Construction Chemicals.

6 EXECUTION

6.5.1.1 PREPARATION

6.5.1.1.1 Loose floor topping encountered during demolition shall be removed in its entirety prior to the installation of new concrete topping or fill.

6.5.1.1.2 Patch holes in floors and side walls to prevent leakage of materials into occupied spaces.

1. Provide dams and screeds at openings to adjacent spaces.

6.5.1.1.3 Remove dirt, loose material, oil, grease, paint or other contaminants, leaving a clean surface.

1. When base slab surface is unacceptable for good bonding, roughen surface by chipping or scarifying before cleaning. Prior to placing concrete fill, thoroughly dampen slab surface but do not leave standing water. Over dampened surface, apply specified bonding compound (re-wettable or non-rewettable) or epoxy adhesive. Place concrete fill after re-wettable bonding compound has dried or while non-rewettable bonding compound or epoxy adhesive is still tacky.

6.5.1.1.4 For concrete fill reinforced with wire mesh, provide necessary chairs or supports, and maintain position of reinforcing mesh as required.

6.5.1.1.5 If applicable, mark locations of joints in base slab so that joints in top course will be placed directly over them

6.5.1.2 **PLACING OF CEMENTITIOUS WEARING SURFACE**

6.5.1.2.1 Over pre-set concrete

The top surface of the concrete must be scarified and left sound but irregular, exposing the topmost surface of the coarse aggregate with minimum amplitude of 6mm between peaks and valleys.

6.5.1.2.2 The bonding slurry is prepared by mixing one part by volume Everbond with one part by volume dry Portland cement. The bonding slurry is scrubbed into the surface of the substrate that is saturated surface damp (SSD) no more than 15 minutes before the placement of the concrete topping. Do not allow Everbond slurry mix to dry or puddle. [Note: The saturated surface damp (SSD) condition is best achieved by soaking the substrate for 12 hours and just prior to the placement of concrete topping.]

6.5.1.2.3 Finish: Broomed non slip in a fan pattern.

6.5.1.3 **PLACING OF AERATED CEMENTITIOUS CONCRETE SCREEDS INDOORS**

6.5.1.3.1 Apply bonding agent over structural concrete floor after having it been thoroughly cleaned.

6.5.1.3.2 Moisten surface prior to placing screed, but not wet.

6.5.1.3.3 Over interior floors pump aerated grout and spread evenly typically to a depth of 40 mm. (where finish will be 75mm. using 20mm stone flooring) or as drawings indicate.

6.5.1.3.4 Screed flat and wood float trowel top providing a roughened, but level surface for finishes

6.5.1.3.5 Clean all adjacent finish surfaces free of screed spatters and stains.

6.5.1.4 **PLACING OF AERATED CEMENTITIOUS CONCRETE SCREEDS ON TERRACES**

6.5.1.4.1 Apply bonding agent over structural concrete floor after having it been thoroughly cleaned.

6.5.1.4.2 Keep surfaces moistened during screed placement to avoid premature drying.

6.5.1.4.3 At atrium terrace, install grout to slopes indicated on the drawings to slot drain. Form around planters evenly and provide an even base for finish materials of 20 mm stone on 10 mm setting bed. Trowel finish with wood float providing a roughened, but uniform, surface for finishes

6.5.1.4.4 Clean all adjacent finish surfaces free of screed materials



6.5.1.5 **CURING AND PROTECTION**

6.5.1.5.1 Begin initial curing as soon as free water has disappeared from exposed surfaces. Keep continuously moist for not less than 72 hours. Continue curing by use of moisture-retaining cover or membrane-forming curing compound.

6.5.1.5.2 Provide protection as required to prevent damage to exposed concrete surfaces.

6.5.1.5.3 Provide mechanical ventilation if required to remove odors.

6.5.1.6 **PERFORMANCE**

6.5.1.6.1 Failure of concrete fill to bond to substrate (as evidenced by a hollow sound when tapped), or disintegration or other failure of concrete fill to perform as a floor finish, will be considered failure of materials and workmanship. Repair or replace concrete fill in areas of such failures, as directed.

Section no: 4 Structural Steel

(4.01)

1. CONTRACT DOCUMENTS

6.5.1.6.2 Comply with Contract Documents:

6.5.1.6.2.1 All Work of this Section shall comply with the requirements of the Conditions of the Contract (General, Supplementary, and Special), with all Sections of Division 1 - General Requirements, with this Section of the Specification, with the Drawings and with all other Contract Documents.

2. WORK INCLUDED

6.5.1.6.3 **Scope:** Contractor shall examine all of the Contract Documents for the extent of the Work of this Section of the Specifications. That Work shall include all labor, materials, devices, plants, tools, equipment, appliances and services necessary for the **production**, fabrication, delivery and erection, complete, of structural steelwork as shown in the Structural Drawings, as specified herein, as required by job conditions, and as required by governing authorities having jurisdiction, including but not limited to the following:

6.5.1.6.3.1 Beams, columns, girders, bracing, trusses, elevator separator beams, all including connections and associated Work.

6.5.1.6.3.2 Base plates and bearing plates.

6.5.1.6.3.3 Posts, struts and hangers.

6.5.1.6.3.4 Furnishing but not installing embedded items such as anchor bolts, wall and anchor plates, and the like.

6.5.1.6.3.5 Steel support brackets, seat angles, and material for the support of concrete slabs.

6.5.1.6.3.6 Angles, plates and the like to support metal deck.

6.5.1.6.3.7 Galvanizing, shop and field painting, and field touch-up.

6.5.1.6.3.8 Field surveying of as-erected structural steel and re-plumbing as required.

6.5.1.6.3.9 Shop applied stud shear connectors.

6.5.1.6.3.10 Shop applied concrete anchors.

6.5.1.6.3.11 Bracing, guying and plumbing of structural steelwork.

6.5.1.6.3.12 Protection of Work of this Section.

6.5.1.6.3.13 Protection of other Work from activities under this Section.



6.5.1.6.3.14Shop Drawings and samples.

6.5.1.6.3.15Determination of detail dimensions, member locations and the like from information provided in the Architectural and Structural Drawings and/or as provided by Architect.

6.5.1.6.3.16Connection design by Contractor's Professional Engineer.

6.5.1.6.3.17Review and development of Construction Sequence as proposed by or implied from the Contract Documents.

6.5.1.6.3.18Submittals.

6.5.1.6.3.19Provisions for other Work, including holes through structural steel for other Work.

6.5.1.6.3.20Cooperate with Owner, with Construction Manager, with Architect and with Testing Agency in all aspects of quality assurance and in all other activities related to the Work of this Section 05 10 00.

6.5.1.6.3.21All other labor, materials and Work given in the Drawings, specified herein or required to make the structural steelwork complete.

6.5.1.6.3.22Mock-up of Architecturally Exposed Structural Steel (AESS).

3. RELATED WORK

6.5.1.6.4Related Work Specified Elsewhere, Amplified Elsewhere or Included in Other Contracts:

6.5.1.6.4.1Submittals: Section 01 30 00.

6.5.1.6.4.2Owner's shop and field testing and inspection of Work by Testing Agency engaged and paid for by Owner: Section 01 40 00.

6.5.1.6.4.3Installing anchor bolts and embedded plates in concrete:

6.5.1.6.4.4Section 03 30 00.

6.5.1.6.4.5Non-shrink grouting for structural steel base plates:

6.5.1.6.4.6Section 03 30 00.

6.5.1.6.4.7Cast-In-Place Concrete: Section 03 30 00.

6.5.1.6.4.8Metal Deck and Field-Applied Stud Shear Connectors:

6.5.1.6.4.9Section 05 30 00.

6.5.1.6.4.10Miscellaneous Metals: Section 05 50 00.

6.5.1.6.4.11Sprayed Fireproofing: Section 07 25 00.

6.5.1.6.4.12Finish Painting of Exposed Structural Steel: Section 09 90 00.

4. APPLICABLE CODES AND STANDARDS

6.5.1.6.5**General:** Except as modified or voided by requirements specified herein or by details or **notes** included in the Drawings, Work specified under this Section shall conform to all applicable provisions of the codes, specifications, standards and other reference documents cited in this Specification and/or noted in the Drawings.

6.5.1.6.6**Codes:** All Work under this Section shall conform to the requirements of The International Building Code, 2003 Edition, hereinafter referred to as Building Code, and to the **regulations** of all governmental authorities having jurisdiction. Where more stringent, the following codes, standards and specifications, latest edition and revision, shall apply to the Work, all as modified herein or by Building Code:

6.5.1.6.6.1Load and Resistance Factor Design Specification for Structural Steel Buildings, by the American Institute of Steel Construction (AISC Specification).



6.5.1.6.6.2 Code of Standard Practice for Steel Buildings and Bridges, published by the American Institute of Steel Construction (AISC Code). Sections 6, 7, 8 and 10, only, shall apply to the Work, except as modified in this Specification; the remainder being specifically excluded.

6.5.1.6.6.3 Structural Welding Code - Steel, ANSI/AWS D1.1 (AWS D1.1).

6.5.1.6.6.4 Specification for Structural Joints Using ASTM A325 or A490 Bolts, approved by the Research Council on Structural Connections of the Engineering Foundation (RCSC Specification). Endorsed by the American Institute of Steel Construction, and the Industrial Fasteners Institute.

6.5.1.6.6.5 Standard Symbols for Welding, Brazing, and Nondestructive Examination, ANSI/AWS A2.4 (AWS A2.4).

6.5.1.6.6.6 Structural Welding Code - Reinforcing Steel, ANSI/AWS D1.4 (AWS D1.4).

6.5.1.6.7 **Reference Documents:** To the extent that the best quality of Work is provided, Work shall conform to the examples, procedures and recommendations listed below, latest edition and revision.

6.5.1.6.7.1 Manual of Steel Construction, LRFD, Second Edition, by American Institute of Steel Construction (AISC Manual).

6.5.1.6.7.2 Detailing for Steel Construction, by the American Institute of Steel Construction.

6.5.1.6.7.3 SSPC Steel Structures Painting Manual, Volume 1, and Volume 2, by Steel Structures Painting Council.

6.5.1.6.7.4 Guide for the Visual Inspection of Welds, ANSI/AWS B1.11.

5. SUBMITTALS

6.5.1.6.8 **General:** Contractor shall submit samples, Shop Drawings, product data, test reports and data, manufacturer's names, certifications, procedures, methodology **statements**, and the like as stipulated in the drawings and/or in this Specification.

6.5.1.6.8.1 Review of Contractor's submittals is only for the limited purpose of the examination of submittals for conformance with the design concept of the project and to assist Contractor in ascertaining that the information given in the submittals conforms to the requirements of the Contract Documents.

6.5.1.6.8.2 Review of Contractor's submittals is not conducted for the purpose of determining the accuracy or the completeness of the submittal, for dimensions or quantities, or for installation or performance of the system or the piece(s) being submitted.

6.5.1.6.8.3 Submittals by Contractor implies that Contractor has checked the submittal with care. Where by error or other cause, Contractor's check has not been accomplished, Contractor shall not rely on review but shall first check and shall then resubmit such material as though the submittal had been rejected.

6.5.1.6.8.4 Should submittals be reviewed that are not required by the Contract Documents, Contractor shall not rely on any review of any unmarked portion of the submittal.

6.5.1.6.9 **Samples:** Submit for acceptance prior to purchase, fabrication or delivery:

6.5.1.6.9.1 Architecturally exposed welds; 12" (300 mm) long; each type.

6.5.1.6.9.2 Hidden welds of joints in AESS so as to display weld show-through; 12" (300 mm) long; each type.

6.5.1.6.9.3 Substitute Products, Materials and Fixtures, where requested by Contractor, shall be accompanied by sample(s) of an acceptable size.

6.5.1.6.9.4 Other Products, Materials and Fixtures, where requested in writing.

6.5.1.6.10 Shop Drawings:

6.5.1.6.10.1 Shop Drawings shall be submitted for review in accordance with the provisions of the Contract Documents. Shop Drawings shall consist of:

6.5.1.6.10.1.1 Job Standards Submit to Structural Engineer and to Architect

6.5.1.6.10.1.2 Erection Drawings Submit to Structural Engineer and to Architect

6.5.1.6.10.1.3 Index Sheets Submit to Structural Engineer and to Architect

6.5.1.6.10.1.4 Piece Drawings Submit to Structural Engineer where required

6.5.1.6.10.1.5 Field Work Drawings Submit to Structural Engineer and to Architect

6.5.1.6.10.2 Job Standards are intended to assist Contractor by developing the set of repetitive details, whether shop or field, welded or bolted. Job Standards shall be accepted prior to the commencing of dependent Work for Piece Drawings. The "name" or designation of the appropriate Job Standard connection shall be given in the Erection Drawings for each piece carrying a Job Standard connection.

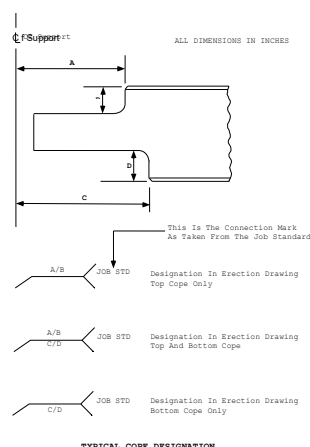
6.5.1.6.10.3 Erection Drawings shall show clearly the size, grade and location of each member. In addition to basic information given in the Structural Drawings, Erection Drawings shall contain (for each piece) the erection mark, the job standard connection mark, beam copes and blocks as given in the next page of this Specification, the location, size and reinforcing of beam penetrations, the elevation of top of beam, (where sloped) the elevation of the work point of both ends, camber, and such projecting elements as may be of concern to Architect.

Additionally:

6.5.1.6.10.3.1 Identify members for which Piece Drawings will be submitted. Both Architect and Structural Engineer reserve the right to mark Erection Drawings so as to require the submission of additional Piece Drawings.

6.5.1.6.10.3.2 Show each field connection complete with data and details necessary for assembling the structure. Direct special attention to the possible need for special guying, bracing or shoring to prevent deformation of existing or new structure due to stresses caused by erection procedures and equipment, by construction loadings and by forces imposed by natural phenomena.

6.5.1.6.10.3.3 Prepare anchor bolt, base plate and embedded plate Erection Drawings containing complete location and placing details. Include details of erection templates. Provide Erection Drawings to the concrete trade in advance of applicable Work and in coordination with concrete construction sequence.



6.5.1.6.10.4 Drawing Index: Prepare, keep up-to-date, and submit a Drawing Index, cross-referencing assigned piece mark with the drawing number upon which the piece is detailed. Erection Drawings may be used for this purpose. Shop Drawings submitted without an up-to-date Index and the applicable Erection Drawing(s)



showing the location of each piece, will be deemed an incomplete submission and will not be accepted as subject to any agreed Shop Drawing schedule.

6.5.1.6.10.5 Piece Drawings will be reviewed by Structural Engineer but not by Architect except that Architect will review Piece Drawings where given pieces have potential impact on building systems not associated with the Work of this Section.

6.5.1.6.10.5.1 The Job Standard and Erection Drawings as specified herein are to contain the information required for the review of typical beams, girders, and columns, without the need to submit the corresponding Piece Drawings. Accordingly, except as specified herein, or as requested, the submission of Piece Drawings for typical beams, girders, and columns is not required.

6.5.1.6.10.5.2 Submit complete and comprehensive Piece Drawings for the following:

- i) Those members indicated by the Architect and Structural Engineer in their review comments on Erection Drawings.

6.5.1.6.10.6 Submit Job Standards, Erection Drawings, Drawing Index and Piece Drawings in coordinated packages so that checking personnel will have all needed information in hand at the time of checking.

6.5.1.6.10.7 Field Work Drawings: Submit Field Work Drawings depicting all field Work required to accommodate field conditions.

6.5.1.6.10.8 Best Standards: Shop Drawings furnished under this Section shall be not less complete than indicated by the applicable procedures shown in AISC's Detailing for Steel Construction.

6.5.1.6.10.8.1 Contractor shall preprint or shall imprint Structural Engineer's shop drawing stamp in each Shop Drawing prior to commencing Work on that drawing, both stamps as given in this Specification.

6.5.1.6.10.8.2 Contractor shall provide detailer with tool clearances needed for both shop and field bolted connections.

6.5.1.6.10.9 Shop Drawings shall include plans, elevations, sections and complete details to describe clearly, at an ample scale, all Work to be provided. Shop Drawings shall be accurately dimensioned and shall be notated clearly.

6.5.1.6.10.10 Size and Grade of Steel for each component part of the structure shall be indicated clearly in Shop Drawings. Rolled shapes, tubes, plates and other components shall be identified by using the standard designations used in AISC's Detailing for Steel Construction.

6.5.1.6.10.11 Symbols: Welds and nondestructive tests shall be indicated by using the symbols conforming to AWS A2.4, Standard Symbols for Welding, Brazing, and Nondestructive Examination. Indicate joint designation, welding process, and other data in the tail of the welding symbol.

6.5.1.6.10.12 Detail in accord with and to accommodate Contractor's field measurements of supporting and adjoining construction. Do not fabricate before accepted Shop Drawings have been returned to Contractor.

Size reduction is encouraged provided legibility is maintained.



STRUCTURAL ENGINEER REVIEW

NO EXCEPTIONS TAKEN ☐ RESUBMISSION NOT REQUIRED ☐
MAKE CORRECTIONS NOTED ☐ RESUBMIT ☐
NOT REVIEWED ☐

LESLIE E. ROBERTSON ASSOCIATES, R.L.L.P.

BY: _____

DATE: _____

SHOP DRAWING STAMP

6.5.1.6.10.13 Structural Steel Connections: Identify explicitly the type of connection used at each location. Distinguish between shop and field connections. Determine and establish the arrangement and layout of each connection to the extent that detailing options are allowed in the Drawings or in this Specification. Connections shall be proportioned by LRFD.

6.5.1.6.10.13.1 Proportion connections not completely detailed in the Drawings to resist loads and load combinations given, noted, specified or required by the Contract Documents. Include reinforcing plates, web doubler plates, stiffeners and all else required to provide adequately for the given loads and load combinations.

6.5.1.6.10.13.2 Contractor shall ascertain that all connections have sufficient strength, stiffness and ductility to resist safely loads imposed by handling, shipping, erection, temporary conditions and the like.

6.5.1.6.10.13.3 Except where smaller connections are given explicitly in the Contract Documents, and except where larger connections are required to resist loads from handling, shipping erection and the like, Contractor shall provide connections for members in trusses and bracing capable of resisting not less than 50% of the tensile strength of the members.

6.5.1.6.10.13.4 Where bridging, sway bracing and the like spans from deflecting elements to rigid elements, provide temporary connections so as to allow the free motion of the deflecting element.

6.5.1.6.10.13.5 Fillet welds, partial penetration welds, weld returns, plug welds and the like shall equal or exceed the sizes given in the tables and notes included in the Drawings and in all cases shall equal or exceed the minimums permitted by AISC Specification.

6.5.1.6.10.13.6 Single-angle, one-sided and other types of eccentric connections shall not be used except where more concentric connections are not practical. Use of such eccentric connections is subject to prior acceptance.

6.5.1.6.10.13.7 Prior to start of Shop Drawings, Contractor shall select and shall submit for acceptance the range of bolt sizes to be used for each grade of bolt. There shall be no overlap in bolt size between grades.

6.5.1.6.10.14 Indicate clearly the grade, size and number of bolts, the type, number, position, designation and orientation of each washer, the bolt tension indicating system and the size of each hole, whether slotted or round. Proportion connection



details to ensure adequate wrench clearance for correct bolt tensioning sequences.

6.5.1.6.10.15 ASTM A490 bolts may not be used to carry direct tensile loads.

6.5.1.6.10.16 Design and detailing of structural steel connections to plates or anchors embedded in concrete shall be based on tolerances in excess of the most severe combination of structural steel, concrete structure, and embedded item location tolerances. Refer to Specification Section 03 30 00 for tolerances for concrete structure and embedded item location, and detail structural steel to accept those tolerances.

6.5.1.6.10.17 Camber and Sweep: Show all camber dimensions in Shop Drawings. Where specific camber is not given in the Drawings, note in affected Shop Drawing that such members shall be fabricated with natural camber up. Detail, fabricate and erect beams and girders so that natural sweep is away from the immediately adjacent edge of slab.

6.5.1.6.10.18 Stud Shear Connectors and Concrete Anchors: Show in Shop Drawings welded stud shear connectors and concrete anchors which will be shop applied.

6.5.1.6.10.19 Deck Supports: Indicate specifically in Shop Drawings all structural steel shelves required to support steel deck ends and edges at supporting beams, columns, and other structural steel elements.

6.5.1.6.10.20 Cleaning, Surface Preparation (SSPC), and Painting data and requirements, including specific identification of "no-paint" areas, shall be detailed and scheduled in Shop Drawings.

6.5.1.6.10.21 Deviations: Should Contractor desire a Deviation from Drawings or Specifications, or both, Contractor shall submit the specific Deviation in writing prior to the submittal of Shop Drawings showing Deviations. Requests for Deviations shall be submitted on Contractor's letterhead. Deviations not identified, or identified only in letters of transmittal or in Shop Drawings, or both, without the required written description on Contractor's letterhead, may not be accepted and shall be sufficient cause for the rejection and the return of such Shop Drawings without further action.

6.5.1.6.10.21.1 Substitute structural shapes will be accepted provided both structural stiffness and structure strength are not impaired in both the composite and the non-composite conditions and provided the substitute shape does not interfere with or otherwise compromise the Work of other trades.

6.5.1.6.10.22 Shop Drawing Review: Only Shop Drawings marked "No Exceptions Taken" or "Make Corrections Noted - Resubmission Not Required" may be used by Contractor in the Work. Shop Drawings marked "Make Corrections Noted - Resubmit" shall be corrected or completed (or both) as required and shall be resubmitted. This process shall be repeated the number of times required to achieve the mark "No Exceptions Taken" or "Make Corrections Noted" - "Resubmission Not Required".

6.5.1.6.10.22.1 Review of Shop Drawings will include the following:

- i) Member size, grade, spacing and elevation.
- ii) Structural integrity of connections, including conformance to job standard.
- iii) Penetrations, including size, location and conformance to job standards.

6.5.1.6.10.22.2 Temporary, shipping, handling or erection loadings will not be considered in this review.

6.5.1.6.10.22.3 Nonconformities and errors detected during review will be noted in Shop Drawings returned to Contractor upon completion of review. Acceptance of Shop Drawings, including Substitutions and Deviations not detected during review, will not relieve Contractor from sole responsibility to provide Work conforming strictly to the Contract Documents.



- 6.5.1.6.10.23 Resubmission of Shop Drawings: Prior to resubmission of Shop Drawings with additions, deletions, or corrections, Contractor shall circle and identify all changes from the prior issue. Drawings submitted without each change both circled and identified clearly will be returned and shall be resubmitted as though the original submittal had been rejected. Each submittal, whether or not accepted or rejected, shall contain a unique revision number, clearly identified.
- 6.5.1.6.11 **Product Data:** Submit printed manufacturer's literature for each manufactured item specified under Part 2 - Products - along with test data as may be requested. Include detailed instructions for application and installation.
- 6.5.1.6.12 **Mill Test Reports:**
- 6.5.1.6.12.1 Submit certified copies of mill test reports for all steel furnished. Comply with all applicable parts of ASTM Specifications.
- 6.5.1.6.12.2 Submit manufacturer's certification of bolts, nuts, washers, DTI's and the like for each production lot of each grade of each type and each size of fastener component and filler material for welding.
- 6.5.1.6.12.3 Mill test reports shall state clearly the governing ASTM specification and shall be certified and notarized by Contractor as conforming in all respects to that specification.
- 6.5.1.6.12.4 Material provided in accord with the above requirements may be used in the Work without further local tests. In the case of controversy, Contractor shall perform tension, bend and such other tests as are required to demonstrate compliance with the requirements of the Contract Documents.
- 6.5.1.6.12.5 Tests for unidentified steel: In the event that steel cannot be identified by heat or melt numbers but is accompanied by mill analysis and test reports, such stock may be used provided that one tension and one bend test is made for each 30 tons (33 tonnes) or fraction thereof. Complete, six-sided surface inspection shall be performed for such materials.
- 6.5.1.6.12.6 All steel that is not properly identified or whose source is subject to question shall be rejected.
- 6.5.1.6.12.7 Steel pipe and tubing shall have not less than one tension, one bend, and one flattening test for each one hundred lengths or fraction thereof, for each size, for each wall thickness and for each grade. Both tension and bend tests shall be made from coupons taken longitudinally.
- 6.5.1.6.13 **Names of Manufacturers/Suppliers:** Submit for acceptance the names of the following products and/or producers along with certification that the products conform in all respects to the requirements of the Contract Documents:
- 6.5.1.6.13.1 plates and shapes
- 6.5.1.6.13.2 welding materials
- 6.5.1.6.13.3 stud shear connectors
- 6.5.1.6.13.4 deformed bar anchors
- 6.5.1.6.13.5 bolts, nuts and washers
- 6.5.1.6.13.6 bolt tension indicating devices
- 6.5.1.6.13.7 drill-in anchors
- 6.5.1.6.13.8 anchor bolts
- 6.5.1.6.13.9 shop and field paint and galvanizing
- 6.5.1.6.13.10 coating of milled surfaces
- 6.5.1.6.13.11 gratings



6. MEASUREMENTS, TEMPLATES AND TOLERANCES

6.5.1.6.14Measurements:

6.5.1.6.14.1Field Measurements: Obtain all field measurements required for proper fabrication and installation of Work covered by this Section 05 10 00. Submit, prior to installation, all measurements indicating discrepancies from the Drawings. Describe in writing and, where applicable, by sketches proposed methods of correcting discrepancies. Measurements are the responsibility of Contractor.

6.5.1.6.14.2Lay out each part of the Work in strict accordance with the Architectural, Structural, Mechanical, Electrical, Plumbing and all other Drawings and be responsible for correct location of same. Lay out from at least two pre-established benchmarks and axis lines, individually correct for length and bearing.

6.5.1.6.14.3Templates: Furnish templates and layout drawings for exact locations of items to be embedded in concrete, with setting instructions required for installation of embedded items.

6.5.1.6.15**Tolerances:** Structural steel shall be fabricated and erected within the tolerances specified in the AISC Specification, AISC Code, and AWS, except that more or less restrictive tolerances, specifically shown or noted in the Drawings or provided under this Specification, shall take precedence and shall apply to the Work.

6.5.1.6.15.1The plumbness tolerance of columns, sometimes given as 1:500, shall be taken as the square root of the sum of the squares of the slope for the two orthogonal axis.

6.5.1.6.15.2The vertical dimension, measured from the column splice immediately above to the top of as-erected members framing to (or framing immediately adjacent to) the column, shall not vary by more than 1/4 inch (6 mm).

6.5.1.6.15.3Individual floor beams and girders shall be considered level where the difference in elevation between ends of the members does not exceed 1:750. Spandrel beams and girders shall be considered level where the difference does not exceed 1:1500.

6.5.1.6.15.4The ends of all members intended to be at the same elevation shall fall between two planes not farther apart than 1/8 in. (3mm).

6.5.1.6.15.5Overall plan dimensions shall not vary by more than plus or minus 1:2000 for the overall length or width or two diagonally opposite extremes, all measured to the centerline of columns. Regardless of the overall plan dimension, the variance shall not exceed 1/8 in. (3 mm).

6.5.1.6.15.6Columns along the perimeter column lines (lines ♣, ♣, ♣ and ♣) shall fall within 1/2 inches (12 mm) of the best fit straight line describing the column line.

6.5.1.6.15.7Camber tolerances for beams and girders, as measured in the shop, shall not exceed the following:

6.5.1.6.15.7.1For lengths to 45 feet (14 m), plus 0.5 inches, minus 0 inches (12 mm/0 mm).

6.5.1.6.15.7.2For lengths greater than 45 feet (14 m), an additional 1/8 inch (3 mm) for each 10 feet (3 m) of length or fraction thereof.

6.5.1.6.15.8Level column splices with shims to a tolerance of $\pm 1/16$ inch (1600 μ m) not less often than every sixth floor.

6.5.1.6.15.9At concrete walls.

7. TESTING AND INSPECTION

6.5.1.6.16**Owner's Testing Agency:** All work is subject to controlled inspection. Owner will engage and pay for the services of an independent testing agency (Testing Agency) as outlined in Section 01 40 00, Inspection and Testing. The selected Testing Agency will



meet the requirements of ASTM E329. Contractor shall not retain Owner's Testing Agency for its own work but may, subject to acceptance by Owner, contract through Owner for such Work. Where directed, and at the option of Owner, Testing Agency will provide such inspection and testing services as are deemed appropriate.

6.5.1.6.16.1 On instructions and at locations selected by Architect, Testing Agency may sample materials taken from the as-erected Work.

6.5.1.6.16.1.1 High-tensile bolts, nuts and washers, of each size and grade, may be sampled and tested in accord with ASTM procedures.

6.5.1.6.16.1.2 Coupons may be taken from structural steel shapes and plates and welds and tested in accord with ASTM procedures.

6.5.1.6.17 **Responsibilities and Duties of Testing Agency:** Testing Agency will inspect all shop and field welding, and high-strength bolting in accord with the provisions of this Specification.

6.5.1.6.17.1 Testing Agency, upon the completion of the Work, will be required to certify in writing that the welding and the high-strength bolting has been performed in accordance with the provisions of the Drawings and with this Specification, and with the applicable requirements of regulatory agencies having jurisdiction.

6.5.1.6.17.2 Testing and reporting by Testing Agency will be performed in accord with the following requirements:

6.5.1.6.17.2.1 Testing will be performed in accord with the provisions of ASTM A370, Standard Test Methods and Definitions for Mechanical Testing of Steel Products.

6.5.1.6.17.2.2 Liquid penetrant testing will conform to the provisions of ASTM E165 and AWS D1.1.

6.5.1.6.17.2.3 Magnetic particle inspection will conform to the provisions of ASTM E109 and AWS D1.1.

6.5.1.6.17.2.4 Ultrasonic, X-ray and gamma ray testing will conform to the provisions of AWS D1.1, Chapter 6.

6.5.1.6.17.3 Continuous inspection of high-tensile bolting will be performed by Testing Agency. Where the tension in any bolt is deemed to fall below the proper value, all bolts in that connection shall be examined.

6.5.1.6.17.3.1 All bolts will be visually examined for proper tension.

6.5.1.6.17.3.2 Ten percent of the bolts, but no fewer than two bolts, selected at random from each connection in question, shall be tested for bolt tension in accord with the provisions of the Specification for Structural Joints Using ASTM A325 or A490 Bolts.

6.5.1.6.17.4 Continuous inspection of complete penetration welds will be provided by Testing Agency using ultrasonic or other non-destructive tests.

6.5.1.6.17.4.1 Ultrasonic tests will be performed by specifically trained, qualified technicians, who will operate the equipment, visually examine the welds and will maintain records of welds examined, defects found and disposition of each defect.

6.5.1.6.17.4.2 Inspection instrumentation will be calibrated by the Testing Agency in accord with AWS D1.1.

6.5.1.6.17.4.3 Welds requiring ultrasonic testing will be tested at an initial rate of 100% in order to authenticate the qualifications of each welder and each welding operator. Where the rejection rate is found to be less than 5% of the welds tested, the frequency of testing may be reduced to 25%. Where the rate of rejection increases to 5% or above, the inspection rate will again be increased to 100% until the defect rate is reduced to less than 5%. Percentages will be calculated for each welder separately.



6.5.1.6.17.5 Where ultrasonic indications arising from the weld root can be interpreted as either a weld defect or a back-up bar, the bar shall be removed by Contractor and back-welded, where required. The weld will then be retested. Questionable root indications, where no defect is found, will not be counted against the welder's rejection rate.

6.5.1.6.17.6 All material stressed transverse to the grain by welds, located within 6 inches (150 mm) to either side of the weld, will be tested ultrasonically for laminations. Testing will be in accord with ASTM A578.

6.5.1.6.17.7 Approximately 25% of butt welds accomplished in the shop will be retested in the field. Retesting will not take place until the welds are not less than 4 days old. Similarly, approximately 25% of material stressed transverse to the grain will be retested for laminar tearing.

6.5.1.6.17.8 All columns splices and other compression joints that depend upon contact bearing after alignment will be tested for conformance with this Section 05 10 00.

6.5.1.6.18 Responsibilities and Duties of Contractor:

6.5.1.6.18.1 Access to Documents, Facilities and Materials: Furnish one copy of each accepted Shop Drawing and of each mill test certificate to Testing Agency for each location of Work. Provide authorized personnel convenient and free access to all parts, locations and areas of Work, including storage areas. Provide representative samples, coupons and the like as requested by Testing Agency. Provide hoisting, turning and moving of materials and reasonable quantities of scaffolding, power, casual labor, and other provisions and assistance necessary to allow quality and effective inspection and testing of Work.

6.5.1.6.18.2 Notice: Provide reasonable notice of the initiation of Work, including fabrication or erection requiring plant or jobsite testing or inspection.

8. QUALITY ASSURANCE

6.5.1.6.19 Bolt Installation shall be in accord with the provisions of this Specification and in no case less than the best industry practice.

6.5.1.6.19.1 A qualified representative of the manufacturer shall be present for the start-up installation of each bolt type (DTI and/or TCF) used in the Work. For DTI's, a representative of the bolt manufacturer and a representative of the DTI manufacturer shall be present.

6.5.1.6.19.2 Contractor shall provide and shall maintain in good condition a Skidmore Wilhelm bolt tension calibrator (or other device accepted by Structural Engineer) at each location where high-strength bolts are being tensioned. Contractor shall test regularly:

6.5.1.6.19.2.1 Each lot of structural fasteners (bolt, nut, DTI, washer and lubricant assemblies) before installation in the Work for the achievement of proper tension; and

6.5.1.6.19.2.2 The competence and understanding of bolting crews for each method of tensioning bolts for each size and grade employed in the work.

6.5.1.6.20 **Welding Procedure Qualification:** Each welding procedure shall be described fully in a welding procedure specification and shall be designated prequalified under AWS D1.1 or shall be qualified in accord with provisions of AWS D1.1 prior to use in the Work.

6.5.1.6.21 **Welder Qualification:** Welders and welding operators performing work under this Section shall be qualified in accordance with applicable AWS requirements for each specific welding procedure and process which the welder will use in the Work.



9. PRODUCT DELIVERY, STORAGE AND HANDLING

6.5.1.6.22 **Delivery of Materials to be Installed Under Other Sections:**

6.5.1.6.22.1 Anchor bolts, embedded plates, anchorage devices, columns and other items required to be embedded in cast-in-place concrete shall be delivered to the project site at times coordinated by Contractor to allow convenient installation and orderly cast-in-place concrete operations.

6.5.1.6.22.2 Include setting drawings, templates, and directions for installation with all anchor bolts and with all other items or devices furnished and delivered to the project site for installation under other Sections of this Specification.

6.5.1.6.23 **Identification:** Provide and maintain identification of all steels furnished to specified minimum yield strength greater than 36 ksi (Grade 235) in accordance with ASTM A6.

6.5.1.6.24 **Painted Steel:**

6.5.1.6.24.1 Handling, Shipping and Erecting of shop painted steel pieces shall not be performed until the paint has dried thoroughly. Special care shall be taken to avoid abrasion or other damage to painted surfaces. Stacking and storing of painted members in the shop, in transit, and at the jobsite shall be done using appropriate softeners and timbers suitable to protect the paint from damage and to keep individual members free from contact with the ground and with each other.

6.5.1.6.24.2 Contractor shall furnish members in-place, fully painted, including all touch-up painting required as specified herein, at all locations where painting is required in the Drawings, by the provisions of this Specification, and by Building Code.

6.5.1.6.25 **Cleaning:** Subsequent to shipment and prior to erecting into the Work, Contractor shall clean steel to the extent required to allow full bond of paint or of fireproofing materials, as appropriate.

6.5.1.7 **JOB CONDITIONS**

6.5.1.7.1 **Contractor's Responsibility:** Contractor shall be solely responsible for the correctness of dimensions and quantities and for the fitting to other Work; for Work to be confirmed and correlated at the site; for information pertaining to the fabrication procedure or to the means, methods, techniques, sequences and procedures of construction; and for the coordination of the Work of this Section with the Work of all other trades. The verification of the physical interrelationships of elements of the Work from Contract Documents and in the field is solely Contractor's responsibility. Review of Contractor's submissions does not relieve Contractor from these responsibilities.

6.5.1.7.2 **Diagonal Bracing** consisting of angles or tees shall be detailed short by 1/16 inch (1500 µm) for each 10 feet (3000 mm) of length, but with a maximum draw of 1/8 inch (3 mm) for tensile members, and 1/16 inch (1500 µm) for compression members. Diagonal bracing shall be located on column centers unless shown specifically to the contrary in the Structural Drawings.

6.5.1.7.3 **Construction Sequence:** Descriptions of limitations on construction sequence are intended to assist Contractor in coordinating the Work of the Project. Descriptions do not describe fully the limitations given, do not describe all limitations, nor do they preclude construction sequences not contemplated herein. Whether or not Contractor follows the limitations on construction sequence described herein, and until such time as the structural work is completed, Contractor remains fully responsible for both the stability and the safety of the Work; adherence to the limitations described herein does not relieve Contractor from that responsibility.

6.5.1.7.3.1 Generally, the structure is to be constructed from the bottom to the top, floor-by-floor, with Contractor supplying such temporary bracing and shoring as



may be required to compensate for the lack of completion of portions of the construction.

6.5.1.7.4 Construction Loads: The structure is designed to resist safely the loading prescribed by Building Code for the finished building. No provision is included for loads or stresses imposed or induced by Contractor's means and methods of construction.

6.5.1.7.4.1 Where Contractor elects to place loads on the structure or elects to otherwise load or deform the structure in excess of the design loads, Contractor shall submit drawings and supporting calculations.

6.5.1.7.4.2 Alternatively, Contractor may seek professional services from Structural Engineer. Such services may be obtained through Owner or, with the permission of Owner, may be obtained directly from Structural Engineer. Architect will not be involved contractually in any such services.

6.5.1.7.5 Installing and Rigging Equipment: Contractor shall shore all construction susceptible to impact loading from the installation of equipment installed by other trades.

6.5.1.7.5.1 Such equipment shall include but shall not be limited to boilers, chillers, refrigeration equipment, pumps, transformers, elevator machines and the like.

6.5.1.7.5.2 Remove shoring when equipment installation is complete.

10. DEFICIENT WORK

6.5.1.7.6 Repairing, Patching and Cleaning: Contractor shall correct all deficiencies in the Work of this Section 05 10 00, including areas where Testing Agency reports, or Construction Manager's or Architect's rejections have indicated that Work is not in full compliance with the Contract Documents.

6.5.1.7.7 Deficiencies: Where Work exhibits any one or more of the following Deficiencies, or where Work otherwise fails to conform to the requirements of the Contract Documents or to the requirements of Building Code, for any reason or combination of reasons, such Work shall be considered Deficient and not in conformance with the requirements of the Contract:

6.5.1.7.7.1 Bent, twisted, buckled or warped pieces.

6.5.1.7.7.2 Unauthorized cutting, reaming and so forth.

6.5.1.7.7.3 Materials or workmanship not in accord with the Drawings, with the Specifications, with accepted samples, or with referenced codes or standards.

6.5.1.7.7.4 Cracking, interior or surface defects and the like.

6.5.1.7.7.5 Exceedance of tolerances.

6.5.1.7.7.6 Painted, unpainted or galvanized surfaces not sufficiently clean to provide full bonding of spray fireproofing, paint or other coatings.

6.5.1.7.7.7 Tops of flanges not sufficiently clean to receive field-applied stud shear connectors or deck welding.

11. SHORT-TERM PARTICIPATION - PROJECT ENGINEER

6.5.1.7.8 Project Engineer: While Shop Drawing review will be accomplished at Structural Engineer's office in New York, on request by and at the option of Contractor, Structural Engineer will make available a Project Engineer to assist Contractor in development of its Shop Drawings. Toward that end, Contractor shall provide a furnished apartment, and internet service, suitable for the use of Project Engineer. It is assumed that Project Engineer will be provided suitable space in the offices of Structural Steel Contractor for up to two consecutive weeks, and will require the apartment for 4 additional days. Contractor shall compensate Structural Engineer in the amount of U.S. \$6,000 per week



for this service. Additionally, Contractor shall pay the costs of transportation from New York to the point of preparation of the Shop Drawings, and back to New York.

- 6.5.1.7.9**Services in New York:** As an alternative to the short-term participation of Project Engineer in the offices of Contractor, at the option of Contractor, Structural Engineer will make available project staff to assist Contractor in the development of Shop Drawings in its offices in New York. Compensation shall be at the rate provided above.

12. AESS MOCK-UP

- 6.5.1.7.10 Mockup of fabricated framing pieces shall be provided to create benchmark for future work. Work shall be indicative of all future work. The minimum mockup shall provide the following:

6.5.1.7.10.1 Column and base plate.

6.5.1.7.10.2 Column Splice.

6.5.1.7.10.3 Beam to column connection – one provided into web, the other provided into flange.

6.5.1.7.10.4 Exposed diagonal bracing element.

- 6.5.1.7.11 Mockup shall be left in place during the steel erection process to be used as a benchmark to assess the work. Benchmark shall be approved by the architect, the contractor and JSW prior to erection commences.

13. PRODUCTS

6.5.1.8 GENERAL

- 6.5.1.8.1 Structural Steel furnished for each location shall provide the minimum yield point given in the Drawings and shall conform to the applicable ASTM Steel Specification, shall be suitable for use in welded structures and shall meet the requirements both of the Drawings and of this Specification. All material shall be new and of best commercial quality. Steels produced to modified ASTM Specifications shall not be used without written acceptance.

6.5.1.8.1.1 Unless noted specifically as not carrying tensile loads or detailed as bolted, all steels and products selected for use in the Work shall be suitable for use as tension members, connected by welding.

6.5.1.8.1.2 All wide-flange sections with a flange thickness in excess of 1.60 inches (41 mm) shall be killed steel, produced to fine grain practice; for flange thickness of 2.00 inches (50 mm) or thicker, where used in welded construction, the section shall also be normalized. Alternatively, Contractor may propose a Deviation consisting of the use of built-up sections.

6.5.1.8.1.3 Where spliced by welding, wide flange members with flange thickness exceeding 1.60 inches (41 mm) and plates with thickness exceeding 2.00 inches (50 mm) shall meet the following toughness criteria:

6.5.1.8.1.3.1 Unless otherwise noted, provide material with Charpy V-notch impact values of not less than 20 ft-lb at 70°F

(27 N-m at 21°C).

6.5.1.8.1.3.2 Where exposed to weather or to ambient temperature changes, provide material with Charpy V-notch impact values of not less than 20 ft-lb at 40°F

(27 N-m at 4°C).

6.5.1.8.1.3.3 Test members in accordance with ASTM A673, with the following exceptions required by AISC Specification:

- i) For wide flange sections, the center longitudinal axis of the specimens shall be located as near as practical to midway between the inner flange surface and the center of the flange thickness at the intersection with the web mid-thickness.
- ii) For pieces produced from ingot, tests shall be conducted by the producer on material selected from a location representing the top of each ingot or part of an ingot used to produce the product represented by these tests.

6.5.1.8.1.3.4 Report test results in accordance with ASTM A370.

14. MATERIALS

6.5.1.8.2 **Welding Materials** shall be as required by AWS for the conditions of intended use and for the metal being welded. Provide welding materials with as-welded Charpy V-Notch impact values of not less than 20 ft-lb at 0°F (27 N-m @ -18°C). Welding materials shall conform to the base metal/filler metal combinations listed in the AWS Specifications and Table 2.2-1 and to the filler metal classifications listed in Table 2.2-2, except where other welding material or material combinations and related welding processes are accepted.

TABLE 2.2-1				
Base Metal Yield	Filler Metal Classifications			
	MAW	SAW	GMAW	CAW
Up to & Incl. 50 ksi	E70 (E480)	F7 (F48)	ER70 (ER480)	E7 (E48)
60 ksi & 65 ksi	E80 (E550)	F8 (F55)	ER80 (ER550)	E8 (E55)

TABLE 2.2-2			
Base Metal	Welding Processes	AWS Specification	Filler Metal Classification
Carbon Steel and Low Alloy Steel		A5.1	E7018
		A5.5	E8018-C3, E9018-D3
	SAW	A5.17	F7A2-EXXX
		A5.23	F8A2-EXXX, F9A4-EXXX
	GMAW	A5.18	ER70S-6, ER70S-2
		A5.28	ER80S-D2, ER90S-D2
	FCAW	A5.20	E71T-8, E71T-1, E70T-1, E70T-6
		A5.29	E71T-8Ni1, E81T1-Ni1, E91T1-Ni2

Welding electrodes which have been dampened or which have been contaminated by grease or other substances deleterious to welding shall not be used in the Work.

6.5.1.8.3 **Stud Shear Connectors:** Material and equipment for welded studs and stud shear connectors shall conform to AWS D1.1 and to applicable portions of Section 05 30 00 "Metal Deck and Stud Shear Connectors". Material shall conform to AWS D1.1, Chapter 7, Type B and to ASTM A108, Grade 1015 or 1020, cold finished carbon steel, with dimensions conforming to AISC Specification.

6.5.1.8.4 **Deformed Bar Anchors** shall be ASTM A496 deformed bars prepared for stud welding in accordance with AWS D1.1. Material shall conform to AWS D1.1, Chapter 7, Type C. Provide 1/2 inch (12 mm) diameter, 36 inch (1000 mm) long bars, unless otherwise given in drawings.



6.5.1.8.5**High Tensile Bolts, Tension Control Fasteners, Nuts, DTI's and Washers** shall conform to the applicable ASTM specification shown in Table 2.2-3.

TABLE 2.2-3			
Bolts	Nuts	DTI's	Washers
ASTM A325 (Type 1), ASTM F1852 (TCF), and ASTM A490 (Type 1)	ASTM A563 (DH)	ASTM F959	ASTM F436

NOTE: Neither A490 Type 2, A490 Type 3, nor A325 Type 3 shall be used in the work.

All fastener components shall bear the manufacturer's mark; nuts shall bear the DH symbol. Sleeve nuts, clevises and the like shall develop the full strength of the threaded rod or bolt. All bolts, nuts and washers shall be cold forged; bolts shall have rolled threads. Neither hot forged bolts or nuts nor cut threads may be used in the Work.

6.5.1.8.5.1In addition to the mandatory testing provided in the ASTM specification, proof load testing (ASTM F606), chemical analysis (ASTM A751) and certification shall be required of manufacturer; for galvanized bolts, nuts and washers, manufacturer's certification shall include the results of the rotational-capacity tests as well as the results of the zinc thickness measurements. Except for the rotational-capacity tests of galvanized bolt, nut and washer assemblies, which shall be performed in accord with the Shipping Lot Method, all testing and analysis shall be conducted in accord with the Production Lot Method. Testing shall be completed for each grade of each type of each size of fastener. Fastener components not in full conformance to the appropriate ASTM specification shall not be shipped to the Work.

6.5.1.8.5.1.1Proof load testing shall be conducted on full-size bolts and components not on machined test specimens.

6.5.1.8.5.1.2Proof load testing shall be accomplished using Method 1 (Length Measurement) of Method F606.

6.5.1.8.5.1.3Testing shall include both hardness and tensile strength.

6.5.1.8.5.2Bolts, nuts and washers shall be manufactured by a member of the Industrial Fasteners Institute.

6.5.1.8.5.3Accepted manufacturers are:

6.5.1.8.5.3.1LeJeune Bolt Company

6.5.1.8.5.3.2Infasco

6.5.1.8.5.3.3Nucor Fastener

6.5.1.8.5.3.4Unytite

6.5.1.8.5.3.5Vermont Fasteners Manufacturing

6.5.1.8.5.3.6Other where accepted.

6.5.1.8.5.4Mechanical galvanized bolts, nuts, washers, DTI's and inserts, as applicable, conforming to ASTM B695, Class 50 shall be used at all surfaces containing galvanized materials and at all surfaces exposed to ambient temperature. Galvanizing shall be undertaken only on A325, Type 1 bolts, ASTM A563 DH nuts, ASTM F959 DTI's, and F436 heat treated washers. ASTM F1852 tension control fasteners shall not be galvanized by any process.

6.5.1.8.5.5Beveled washers shall be square, smooth, and shall be sloped to provide contact surfaces in full bearing. Provide for all slopes of 1:20 and larger.

6.5.1.8.5.6The diameter of holes in special, beveled and square washers shall not exceed 1/16" (1600 □m) more than the nominal bolt diameter.

6.5.1.8.5.7Thread Lubrication shall conform to bolt manufacturer's written recommendation. All galvanized A563 nuts shall be provided with an additional



lubricant that shall be clean and dry to the touch and have a color that contrasts with the zinc coating so its presence is visually obvious. Galvanized structural bolts shall be Rotational Capacity Tested in accordance with the provisions of ASTM A325, and a record of such tests for each lot shall be submitted to the Structural Engineer

6.5.1.8.6 **Bolt Tension Indicating Devices** shall be direct-tension indicating washers (DTI) or tension control fasteners (TCF).

6.5.1.8.6.1 Direct-tension indicating washers shall conform to the latest revision of ASTM F959. No 'squirt-type' DTI's are to be used, nor DTI's with slots cut in the back. Provide mechanically galvanized (ASTM B695, Class 50) washers for all surfaces and assemblies containing galvanized materials.

6.5.1.8.6.2 Tension control fasteners shall conform to the latest revision of ASTM F1852 for the A325 strength level, and to the applicable provisions of ASTM A490 Type I as well as the provisions of Section 2.8 of the RCSC Specification pertaining to Alternative-Design Fasteners.

6.5.1.8.7 **Stainless Steel shapes, plates, fasteners, washers** and the like shall be Type 18-8 conforming to AISI Grade 304 or 316.

6.5.1.8.7.1 Stainless steel bolts shall conform to ASTM F593, Group 1 or 2, Condition SH or CW.

6.5.1.8.7.2 Stainless steel nuts shall conform to ASTM F594, Group 1 or 2, Condition SH or CW.

6.5.1.8.8 **Anchor Bolts:** May be of uncoated steel unless otherwise required by the Drawings. Unless otherwise provided in the Drawings provide 1 inch (25 mm) diameter or larger.

6.5.1.8.8.1 Unless otherwise given, provide as follows:

6.5.1.8.8.1.1 Bolt material conforming to ASTM A36 FY 36 (245 MPa).

6.5.1.8.8.1.2 Two heavy hex nuts as specified for ASTM A325.

6.5.1.8.8.1.33 x 3 x 3/8 (75x75x10 mm), FY 36 (245 MPa) plate washer.

6.5.1.8.8.2 Where designated A449, provide as follows:

6.5.1.8.8.2.1 Bolt material conforming to ASTM A449.

6.5.1.8.8.2.2 Two heavy hex nuts as specified for ASTM A325.

6.5.1.8.8.2.33 x 3 x 1/2 (75x75x12 mm), FY 50 (345 MPa) plate washer.

6.5.1.8.8.3 Where designated Dywidag, provide as follows:

6.5.1.8.8.3.1 Threadbars conforming to ASTM A615 except for marking.

6.5.1.8.8.3.2 Hex nut (developing not less than 125% of the yield strength of the bar) plus lock nut.

6.5.1.8.8.3.33 x 3 x 1/2 (75x75x12 mm), FY 50 (345 MPa) plate washer.

6.5.1.8.9 **Steel Deck Support Shelves:** Provide angles of 5/16 inch (8 mm) minimum thickness and 3 inch (75 mm) minimum width except where different shapes or dimensions are accepted.

6.5.1.8.10 **Shop and Field-Applied Paint** shall be provided where designated in the Drawings and specified herein. Paint materials shall be fully compatible with fireproofing and other materials in contact with the paint and shall be selected from the following:

6.5.1.8.10.1 Alkyd Modified Shop Primer and Field Touch-Up:

6.5.1.8.10.1.1 Carbocoat 150 Primer, by Carboline Inc.

6.5.1.8.10.1.2 Dulux Alkyd Primer 681-FD, by DuPont Co.

6.5.1.8.10.1.3 Tnemec Primer 10-99, by Tnemec Company Inc.

6.5.1.8.10.1.4 Other where accepted



6.5.1.8.10.2Zinc-Rich Shop Primer:

6.5.1.8.10.2.1Carbozinc 11 HS or Carbozinc 859, by Carboline Inc.

6.5.1.8.10.2.2Ganicin 347-Y-931, by DuPont Co.

6.5.1.8.10.2.3Tneme-Zinc 90-96 or Tneme-Zinc 90-97, by Tnemec Company Inc.

6.5.1.8.10.2.4Other where accepted

6.5.1.8.10.3Zinc-Rich Field Touch-Up:

6.5.1.8.10.3.1Carbozinc 859, by Carboline Inc.

6.5.1.8.10.3.2Ganicin 347-Y-937, by DuPont Co.

6.5.1.8.10.3.3Tneme-Zinc 90-97 by Tnemec Company Inc.

6.5.1.8.10.3.4Other where accepted

6.5.1.8.10.4Where aluminum alloy is in contact with or fastened to steel members, the aluminum shall be kept from direct contact with the steel by painting the steel with a dielectric separator such as Bitumastic 50 by Carboline Inc., or other where accepted.

6.5.1.8.11**Galvanized Steel:** Where required to be galvanized, members shall be hot-dipped after fabrication in accordance with ASTM A123 or with ASTM A153, as applicable. Galvanizing shall equal or exceed 2 oz. per square foot (600 g/m²) of surface.

6.5.1.8.12**Galvanizing Repair Paint:** Provide organic, zinc-rich paint that contains at least 90% zinc particles in the dried film. Galvanizing paint shall comply with either ASTM A-780, Federal Specification DOD-P-21035 or Military Specification MIL-P-26915.

6.5.1.8.13**Weldable Primer** shall be used for the protection of beveled surfaces to be complete penetration or partial penetration welded in the field. Weldable primer is also acceptable for the protection of milled surfaces used in bearing connections. Acceptable primers are CarboWeld 11 HS by Carboline, Deoxalumite by AACO, or other accepted weldable primer.

6.5.1.8.14**Milled Surfaces:** Coat with Multi-Bond 120 (Carbo-Crylic), by Carboline Inc., or other accepted rust-inhibitive coating.

6.5.1.8.15**Body Putty** shall be Premiere Plus Tack free lightweight auto body filler by U.S. Chemical & Plastics or other accepted Body Putty.

15. EXECUTION

6.5.1.9 CONTRACTOR'S INSPECTION

6.5.1.9.1**Examination of Field Conditions:** Examine all surfaces, features and facilities to which Work must be attached or applied, abut or clear. Notify Construction Manager and Architect in writing of all conditions which are or will be detrimental to proper and expeditious installation of Work. Starting of Work shall represent acceptance by Contractor of surfaces and of conditions as suitable and correct for performing Work as specified.

6.5.1.9.2**Field Measurements:** Contractor shall verify, by measurements at the jobsite, all dimensions affecting the Work of this Section. Field dimensions at variance with those in accepted Shop Drawings shall be reported in writing by Contractor. Decisions regarding corrective measures shall be subject to acceptance and acceptance shall be obtained before starting fabrication of items affected. The starting of Work shall represent acceptance by Contractor of all dimensions affecting the Work of this Section as suitable and correct for the performing of all Work under this Section.



16. FABRICATION

6.5.1.9.3**Camber and Sweep:** Except where specific camber or sweep is designated in the Drawings, beams shall be fabricated with natural camber up. Provide spandrels and beams adjacent to openings with the natural sweep inward (toward the building and away from immediately adjacent openings). Designated camber shall provide actual camber in the erected steelwork within camber tolerances set forth in AISC Manual (for rolled shapes) and in AWS D1.1, Chapter 5.23 (for built-up shapes).

6.5.1.9.3.1Camber trusses to compensate for truss deflection due to weight of supported construction, thereby providing top of truss, after completion of Work, at elevations designated in the Drawings.

6.5.1.9.4**Finishing** shall mean milled to ASA 250 or smoother, unless another finishing method is both designated in Shop Drawings and accepted. Finished surfaces shall be protected by a corrosion inhibiting substance. Finish contact surfaces of base plates, column splices, truss splices where indicated "fit to bear", and at other locations where indicated in Drawings.

6.5.1.9.5**Gas Cutting:** Gas cutting, including miscellaneous cuts, copes, cuts for weld access and the like, shall provide smooth, uniform, workmanlike surfaces and shall achieve a 1000 micron surface roughness or better as defined by ANSI/ASME B46.1. Except where accepted, gas cutting shall be machine guided; cutting by hand-guided tools will require grinding. Provide 1/2 inch (13 mm) minimum radius cut at all reentrant corners except where a smaller or larger radius for specific details is shown or noted in the Drawings or specifically proposed by Contractor and accepted in Shop Drawings. Gas cut surfaces shall be made uniform and notch-free by chipping, planing, welding and grinding as required, and shall be verified by Contractor by full visual inspection; where hand-held cutting tools are used, and where required by AISC Specification, Contractor shall provide 100% inspection by liquid-penetrant or by magnetic particle.

6.5.1.9.5.1Galvanized Members: Gas-cut surfaces at reentrant corners shall be ground to bright metal and tested by dye-penetrant or magnetic particle testing prior to galvanizing, and shall be verified by Contractor by full visual inspection after galvanizing.

6.5.1.9.6**Straightening:** Fabricated materials containing sharp kinks or bends shall be rejected. Material straightened prior to fabrication shall be examined carefully for signs of distress and for other defects before being placed in fabrication. Distressed or otherwise defective material shall not be used in the Work. Straightening by the use of properly controlled heat will be permissible if done by personnel skilled in heat straightening, using equipment and techniques in accord with written procedure documents and applicable detail sketches prepared by the Fabricator and accepted.

6.5.1.9.6.1Follow procedures provided under AWS D1.1.

6.5.1.9.6.2Fuel shall be propane and oxygen.

6.5.1.9.6.3Temperature may not exceed 1200°F (650°C) - a dull red color - or limits specified for quench and tempered steels, as applicable.

6.5.1.9.6.3.1Control with Tempilstick or Thermomelt Stick for 1000°F (550°C) to 1200°F (650°C) range.

6.5.1.9.6.3.2Single burner torches shall be used.

6.5.1.9.6.4Air cool at ambient temperature.

6.5.1.9.6.4.1Water cooling shall be used only with written permission.

6.5.1.9.6.5All welds in straightened material shall be reinspected by Contractor, by UT or MT as appropriate.

6.5.1.9.7**Grinding:** Sharp corners, projections, and similar rough or sharp surfaces or edges shall be eased and smoothed by grinding so as to provide notch-free surfaces.



- 6.5.1.9.8**Preheat:** Preheat for welding shall be soaked preheat and shall be verified by heat sensitive crayons (Tempilstik, by Tempil, Inc.) or other accepted means.
- 6.5.1.9.9**Welding Materials** and processes shall be selected from those specified herein and shall conform to accepted welding procedure specifications. Welding materials shall be fresh and new. Welding electrodes or flux contaminated by deleterious substances or moisture shall not be used and shall be removed promptly from the Work. Low hydrogen electrodes which cannot be used promptly after opening of hermetically sealed containers shall be stored in electric holding ovens at 250°F (120°C) minimum. Electrodes or flux which have been dampened or contaminated shall be removed promptly from the Work.
- 6.5.1.9.10**Tack Welds:** Exercise the same degree of control in making tack welds as required for structural welds, including provision of preheat and postheat appropriate to the basemetals joined. Tack welds which crack shall be cut or ground and damaged base metal repaired. Remove and grind smooth tack welds not incorporated into permanent structural welds.
- 6.5.1.9.11**Shop Bolting** with ASTM A325 or ASTM A490 bolts shall conform to applicable provisions of the AISC Specification and Specification for Structural Joints Using ASTM A325 or A490 Bolts except that all bolting provisions set forth in ERECTION of this Section shall apply to high-strength shop bolting.
- 6.5.1.9.12**Drainage Holes:** Provide hollow tubular, box and other members with effective drainage holes except where members are sealed tight at Contractor's option or in accord with notes and details included in the Drawings.
- 6.5.1.9.13**Bolt Holes:** Drill or punch holes at right angles to the surface of the metal. Provide holes not more than 1/16 inch (1500 µm) larger than the connector diameter unless oversize or slotted holes are shown or noted in the Drawings or specifically accepted. Do not make or enlarge holes by burning. Drill or sub-punch and ream material where thickness exceeds the connector diameter and in all material thicker than 7/8 inch (22 mm). Holes shall be true and fair without torn or ragged edges. Elongated punch and die sets shall be used to punch elongated holes. Burrs shall be removed.
- 6.5.1.9.14**Quality of Welds and Base Metal:** Quality of all welds shall conform to AWS D1.1, Chapter 6 - Part C. When examined by UT, partial and complete penetration welds shall conform to AWS D1.1, Chapter 6 statically loaded acceptance criteria. Unless otherwise noted, welds shall be assumed to be subjected to tension stress normal to the weld axis. Cracking or incomplete penetration shall be cause for rejection of each weld possessing such defects, regardless of other acceptance or rejection criteria. Base metal containing gross discontinuities before or after welding or lamellar tearing after welding shall be repaired in accord with procedures accepted by Structural Engineer or shall be discarded and replaced.
- 6.5.1.9.14.1 Provide material thickness and width transitions in accord with details in the Drawings where shown, and in accord with the provisions of AWS D1.1, Article 2.29.
- 6.5.1.9.14.2 Provide weld access holes or cuts in accord with details shown in the Drawings, the provisions of AWS D1.1, the provisions of the AISC Specification and the gas cutting provisions of this Specification.
- 6.5.1.9.15**Built-Up Members** shall be constructed true to line. Plate edges shall be cut or milled true to line. Included plate edges shall be parallel straight or curved lines with edge surfaces normal to the plate surface. Provide true and uniform camber where noted in the Drawings.
- 6.5.1.9.15.1 Weld built-up members using weld procedures, weld patterns and weld joint designs which will produce true lines and avoid distortion of base metal.
- 6.5.1.9.15.2 Splice web plates prior to cutting longitudinal edges to line and prior to bending or to curving. Splice flange plates prior to fitting up assembled web plates.



- 6.5.1.9.15.3Camber for built-up members shall be achieved by the cutting of web plates to the required parabolic curvature.
- 6.5.1.9.15.4Weld sequence shall be planned and executed so as to minimize locked-in stresses and to minimize distortion.
- 6.5.1.9.15.5Completed members shall be straight or uniformly curved, as applicable.
- 6.5.1.9.15.6At the finished ends of built-up members, prior to finishing (if required), carbon arc gouge grooves along lines of plate intersections in sufficient depth to provide positive, crack-free seal weld. Increase depth of gouge and weld size to the extent required to compensate for end finishing.
- 6.5.1.9.16**Stud Shear Connectors and Deformed Bar Anchors:** Prepare structural steel surfaces as recommended by the stud manufacturer. Use automatic stud welding systems and use such systems in strict accord with the manufacturer's printed instructions. All welding ferrules shall be broken and shall be removed from the Work. Fillet welding shall be used for repair welding only. Arc weld repairs to stud welds shall be made to the extent required by AWS D1.1, Chapter 7. Conform to applicable provisions of Section 05 30 00.
- 6.5.1.9.16.1Where indicated in the Drawings, bend deformed bar anchors in accordance with the Drawings and with this Specification:
- 6.5.1.9.16.1.1Before automatic stud welding, cold bend deformed bar anchors as required in accordance with the bend requirements given in the Contract Documents for concrete reinforcing bars of the same diameter. The use of heat to either bend or straighten deformed bar anchors is not permitted.
- 6.5.1.9.16.1.2Once bent, the shop straightening of either deformed bar anchors is not permitted. The field straightening of bars that have been embedded in concrete is not permitted except where accepted specifically.
- 6.5.1.9.17**Wide Flange Members of trusses**, at intersecting panel points, may have their webs trimmed back to provide clearance for flange welds, unless specific details require webs to be flush with member ends or extended and developed by bolting or welding.
- 6.5.1.9.18**Brittle Fracture Contractor** shall take all measures necessary to minimize the occurrence of brittle fracture. Measures shall include proper materials selection, fabrication techniques and the like.
- 6.5.1.9.18.1Both base metal and welding materials shall provide adequate notch toughness.
- 6.5.1.9.18.2Stress concentrations shall be minimized by carefully controlling notches and by controlling weld defects such as lack of fusion and cold cracking. Stress relief holes shall be provided at all welded web-to-flange interfaces for shapes with flange thickness in excess of 1.0 inches (25 mm).
- 6.5.1.9.18.3Welds, including multiple-pass welds shall be completed in a single operation, without interruption.
- 6.5.1.9.18.4Cooling rates and non-uniformity of cooling of welds shall be reduced by proper insulating blankets and, where necessary, by post-heating.
- 6.5.1.9.18.5Excessive elevation of welding temperatures shall be avoided. Practices such as the simultaneous welding of both sides of a stiffener within the bosom of a wide flange shape shall not be allowed.
- 6.5.1.9.18.6Provide and then remove run-on and run-off tabs at all locations where start-up or termination portion of weld may create a stress raiser.
- 6.5.1.9.18.7Particular care shall be taken to eliminate cold cracking.
- 6.5.1.9.18.7.1Pre-heat and post-heat conditions shall be provided not less than as provided in Table 3.2-1. In using this Table, the carbon equivalent of the steel shall be taken by the IIW mercury method as:

$$CE = C + Mn/6 + (Cu + Ni)/15 + (Cr + Mo + V)/5$$

6.5.1.9.18.7.2 The values given in Table 3.2-1 assume welding electrodes to be of the low hydrogen type, thoroughly baked, and that rust and oil in welding grooves is not present. Note that sufficient pre-heating, with lower heating rate and wider pre-heated zone is required in order to keep interpass temperatures above minimum values, particularly where heavier sections are being welded.

6.5.1.9.18.7.3 Weld cooling rate shall be controlled so as to reduce residual stresses caused by welding and to enhance hydrogen evolution.

TABLE 3.2-1

PREHEAT AND POSTHEAT CONDITIONS FOR WIDE FLANGE SHAPES

CE (IIW)	Flange Thickness				
	< 1-1/2 in (38 mm)	≥ 1-1/2 in (38 mm)	≥ 2 in (50 mm)	≥ 3 in (75 mm)	≥ 4 in (100 mm)
≤ 0.38	~	Preheat ≥ 350°F			
≤ 0.40	Preheat ≥ 125°F Interpass ≥ 125°F	Interpass ≥ 125°F			
≤ 0.42		Preheat ≥ 350°F Interpass ≥ 125°F			
≤ 0.44		Provide immediate postheat between 350°F and 600°F for more than 10 minutes			
≤ 0.46		Preheat ≥ 350°F Interpass ≥ 125°F			
≥ 0.46		Provide immediate postheat between 350°F and 600°F for more than 60 minutes			

Note: 125°F ≈ 52°C, 350°F ≈ 177°C, 600°F ≈ 316°C

6.5.1.9.19 **Weld Inspection:** Contractor shall inspect 100% of shop and field welds to assure that all welding conforms to the requirements of Contract Documents.

6.5.1.9.20 **Runon and Runoff Tabs** shall be removed and the surface made smooth prior to visual and non-destructive testing and prior to shipping Work to the site. Tabs for field welds shall be removed at all locations where required or directed.

6.5.1.9.21 **Clean, Paint and Galvanize steel** as provided herein. Do not paint steel except where provided specifically herein or in the Drawings.

6.5.1.9.22 **Architecturally Exposed Structural Steel:** Steel designated as AESS shall be fabricated and erected in accord with the provisions of AISC Code except as modified herein.

6.5.1.9.22.1 Cut edges shall be milled or shall be gas burned and shall be smooth and free of gouges, visible serrations and blow-outs. Minimal burn serrations will be acceptable. All other defective areas shall be weld filled as appropriate and ground smooth to line and profile. Sharp edges and corners shall be eased.

6.5.1.9.22.2 Exposed to view welds shall be finished and ground to a smooth and uniform profile. Use body putty as required to achieve a smooth surface.

6.5.1.9.23 **Weep Holes:** Where open members (such as wide flange shapes or channels) are positioned on their sides with flanges up, capable of holding water, provide weep holes as shown in the drawings or as specified. Unless otherwise noted, provide 1/2 inch (12 mm) diameter weep holes at 10 feet (3 meters) o.c., but not less than three 1/2 inch (12 mm) diameter weep holes per piece: one weep hole at each end, and one at midspan.



6.5.1.10 **ERECTION**

6.5.1.10.1 Surveys: Contractor shall organize structural steel surveying procedures and records to demonstrate the degree of conformance of the steelwork to tolerances applicable to plumb, level, horizontal alignment and allowable displacement from theoretical elevation. Contractor shall report all discrepancies. Contractor shall not proceed with each erection step until appropriate acceptable corrections have been made, or until compensating adjustments to the structural steelwork have been accepted. Contractor's surveys for steelwork shall:

6.5.1.10.1.1 Establish permanent bench marks as shown and as necessary for the accurate erection of structural steel;

6.5.1.10.1.2 Assure that elevations of bearing surfaces, and locations of anchor devices are checked by accurate surveying before erection work proceeds.

6.5.1.10.1.3 Provide survey data during the course of the Work and a final survey showing the E-W, N-S and elevation position of the work points of each steel truss, column and other major member as compared to theoretical location.

6.5.1.10.1.4 Take surveys and measure tolerances and plumbness at (30°C) or show corrections to surveys where temperature is either higher or lower.

6.5.1.10.2 Anchor Bolts and Other Connectors: Furnish anchor bolts, embedded plates and other connection materials which must be embedded into concrete Work, for placement under Section 03 30 00. Deliver to the site on-time and complete with templates and placing drawings.

6.5.1.10.2.1 Unless otherwise provided, for bolts designated as A325 or Dywidag threadbars, tighten 1/4 turn past snug tight.

6.5.1.10.3 Base Plates and Bearing Plates: Furnish and place base plates and bearing plates accurately. Securely shim, level and align. Be responsible for maintaining steel in proper position through completion of grouting and until grout has achieved full strength. Non-shrink grout will be furnished and placed under Section 03 30 00. Do not allow grouting until beams, girders, trusses and so forth are permanently attached to column.

6.5.1.10.4 Guying and Bracing: The structural system may require temporary bracing in addition to members shown in the Drawings in order to resist safely all imposed loads during construction and to maintain correct alignment. Provide temporary guying, bracing and connecting members where needed to resist safely all possible combinations of construction and erection loads including dead loads, erection loads, wind and other lateral loads and superimposed construction loads, both horizontal and vertical. Remove temporary members and connections after permanent members are in place, final connections are made and concrete has achieved design strength. Design of temporary shoring, bracing and guying is Contractor's sole and complete responsibility, including all details of installation and removal, methods, sequence and timing.

6.5.1.10.5 Bolt Tensioning: ASTM A325 and A490 bolts shall be installed using one of the following systems:

6.5.1.10.5.1 Tension controlled fasteners with splined twist-off nubs (TCF) shall be installed in accord with AISC Specification requirements and with applicable printed instructions and recommendations provided by the fastener manufacturer and tensioning system supplier. To provide uniform and full tensioning in multi-bolt joints, bolts shall be tightened in stages to assure uniform contact between faying surfaces and snug-tight condition at all points within each joint prior to final tensioning and shearing of the spline.

6.5.1.10.5.1.1 Contractor shall check each TCF bolt after tensioning to verify that the sheared surface does not display any abnormality. Bolts displaying an abnormality shall be removed and replaced.

6.5.1.10.5.2 As an alternative to the use of tension controlled fasteners, bolts shall be tensioned utilizing direct-tension indicating washers (DTI) in strict accord with



ASTM F959. Under no circumstance may a DTI be reused. DTI washers shall not be used directly over slotted or oversized holes but shall be used in addition to all special washers required at slotted or oversize holes. Tensioning methods, number, thickness and type of washers, procedure and measurements shall be in strict accord with the manufacturer's latest printed instructions and recommendations and the latest requirements of the RCSC Specification.

6.5.1.10.5.2.1 Contractor shall verify correct tension by measuring the average residual gap between the bolt head or nut and the DTI in strict accord with ASTM F959. Torque wrenches or calibrated wrenches shall not be used to inspect or to verify the tension.

6.5.1.10.5.2.2 For bolts exposed to the weather, gaps in Type 325 DTI shall be reduced to less than 0.005 inches (130 μ m) for not less than half of the perimeter of the DTI.

6.5.1.10.5.3 Filler beams may, at Contractor's option, be connected without making use of a tension control device but, if so, shall be tensioned by the "match marked" turn-of-the-nut technique. Filler beams do not frame to, or frame immediately adjacent to columns, do not frame to girders carrying columns, posts or hangers and do not frame to trusses.

6.5.1.10.5.4 Except where specifically waived in the Structural Drawings, all ASTM A325 and A490 bolts, whether or not used in bearing-type connections, shall be fully tensioned. This requirement shall be maintained whether or not required by AISC Specification.

6.5.1.10.6 Bolting Requirements:

6.5.1.10.6.1 Washers: A hardened washer shall be installed adjacent to the bearing face of the turned element (nut or bolt head) of each ASTM A325 or ASTM A490 bolt assembly. A 5/16 inch (8 mm) thick washer or thicker, otherwise conforming to ASTM F436, shall be used at both ends of 1-1/8 inch (28 mm) and 1-1/4 inch (32 mm) diameter A490 bolts connecting material with standard size holes where material is 5/8 inch (16 mm) or less in thickness.

6.5.1.10.6.2 Long Slotted Holes, where accepted, and where on an outside ply, shall be covered completely by 5/16 inch (8 mm) ASTM F436 hardened washers; alternatively, either plate washers or continuous bars of at least 3/8 inch (10 mm) thickness and minimum yield point of $F_y = 50$ ksi (345 MPa) may be used. Holes in plate washers or bars shall be standard size. Regular hardened washers are required in addition to plate washers or bars.

6.5.1.10.6.3 Short Slotted and Oversized Holes, where accepted, and where on an outside ply, shall be covered by ASTM F436 hardened washers, plate washers or continuous bars as provided for long slotted holes.

6.5.1.10.6.4 Bolts and Nuts, at time of tightening, shall be clean, rust-free, free from thread damage, and shall retain not less than the light residual coating of oil as received from the factory. Thread lubricants shall be applied to all ASTM A490 bolts or nuts, to all 1 inch (25 mm) and larger ASTM A325 bolts and to all bolts and nuts that display any sign of loss of residual oil, rust or other contaminant. Where galvanized nuts are not wax-dipped by manufacturer, apply thread lubricant.

6.5.1.10.6.4.1 Lubrication shall be completed prior to assembly and prior to being sent up into the Work, except that under no circumstance shall twist-off type tension-control fasteners be field lubricated.

6.5.1.10.6.5 Tightening Procedures: During tightening, to the full extent practical, the unturned bolt element shall be held without rotation. All plies shall first be brought into full contact by partially tensioning all of the bolts. Tensioning shall commence from the most rigid part of the connection, moving to the free edges.



- 6.5.1.10.6.6 **Retightening:** ASTM A490 bolts and galvanized ASTM A325 bolts, once completely or partially tensioned, shall not be reused. ASTM A325 bolts may be reused only with specific written acceptance.
- 6.5.1.10.6.7 **Length:** Bolts shall not project beyond the face of the nut by more than three full threads. However, bolts shall at least be flush with the other face of the nut.
- 6.5.1.10.7 **Unfair Holes** shall not be enlarged by burning or drifting alone. Enlarge holes where necessary and permitted by flame piercing and reaming or by reaming alone or by other accepted means. Holes after enlargement shall be true round holes normal to the surfaces joined. Increase bolt size to fill enlarged and reamed holes, which shall then meet the requirements for "normal-sized" holes relative to the bolt size selected.
- 6.5.1.10.8 **Faying Surfaces:** Paint materials not specified as satisfying the mean slip coefficient for Class A surfaces as defined in the Specification for Structural Joints Using ASTM A325 or A490 Bolts shall not be applied to faying surfaces.
- 6.5.1.10.9 **Splices:** Column splices, truss splices and other compression joints that depend upon contact bearing after alignment shall conform with the following:
- 6.5.1.10.9.1 Fastening of compression splices and joints shall be performed after the abutting surfaces have been brought uniformly into contact.
- 6.5.1.10.9.2 An area of not less than 65% of the contact area shall be in uniform bearing, where:
- 6.5.1.10.9.2.1 Contact area is the gross area of the smaller piece joined, without deduct for weld bevels and the like.
- 6.5.1.10.9.2.2 Area of uniform bearing is that portion of the contact area which is separated by not more than 0.02 inches (500 μ m) from the larger piece joined. Note that the total area of surface joined by welding is included. At Contractor's option, the area of uniform bearing may be increased to correct fit-up deficiencies by either:
- i) increasing the weld surface area; or
 - ii) packing with stainless steel shims, 0.02 inches (500 μ m) or thinner in thickness.
- 6.5.1.10.9.3 The area of uniform bearing shall be located symmetrically about both of the symmetrical axes of the smaller piece joined.
- 6.5.1.10.9.4 Outside of the area of uniform bearing, separations greater than 0.03 inches (750 μ m) shall be corrected by shimming.
- 6.5.1.10.10 **Finger Tight:** Bolts designated as "finger tight" shall be tensioned to 60 inch-pounds (6 N-m) with the goals of bringing the parts firmly together while allowing for a sliding connection. Provide thread locking compound at all such locations. Provide not less than two full cycles of torquing and untorquing to ensure that all bolts are properly tensioned.
- 6.5.1.10.11 **Truss Chords:** Erect trusses and align trusses in erected position so as to provide truss chords, end-to-end, located within $\pm 1/2$ inch (12 mm) of theoretical alignment.
- 6.5.1.10.12 **Shims**, where required to correct fit-up of Work, shall be free of corrosion and shall be of stainless steel.
- 6.5.1.10.13 **Runoff and Runon Tabs** shall be provided at the ends of all sensitive butt welds and both tabs and erection aids shall be removed at all locations where they interfere with the Work of other trades, and at all locations designated. Runoff tabs shall be not less than 1-1/4 inches (30 mm) in length.

17. CLEANING, PAINTING AND GALVANIZING

- 6.5.1.10.14 **General:** Steel Work shall be cleaned, painted or galvanized as provided herein. Basic Work shall be done in the shop, with field touch-up, only, done in the field.

6.5.1.10.15**Corrosion Protection:** This Specification contemplates 4 levels of corrosion protection:

6.5.1.10.15.1Concrete-Encased/Unpainted: Steel Work shall be cleaned to meet the requirements of SSPC-SP2, by wire brush or other means at the option of Contractor. Reclean following erection to the extent required to achieve original condition.

6.5.1.10.15.2Fireproofed/Unpainted: Steel Work shall be shop cleaned to meet the requirements of SSPC-SP3. Additional cleaning shall be accomplished in the field to ensure proper adherence of spray fireproofing.

6.5.1.10.15.3Exposed to Ambient Temperature: Steel which is enclosed, concrete-encased or fireproofed, but which is not protected from changes in ambient temperature, shall be cleaned to meet the requirements of SSPC-SP6 before painting with a zinc-rich primer with field touch-up, not less than 2.0 mils nor more than 4.0 mils dry film thickness (50 µm/100 µm).

6.5.1.10.15.4Exposed to Weather: Steel which is exposed to the weather shall be hot-dipped galvanized. Touch-up at welds and at damaged surfaces after first cleaning to SSPC-SP3, with slag and weld spatter removed first from all areas. Paint galvanized steel where shown in Drawings.

6.5.1.10.15.4.1Provide galvanized bolts, nuts, washers, DTI's, and inserts, as applicable, for the bolting of galvanized members.

6.5.1.10.16**Contact with Aluminum:** Surfaces which will be in contact with aluminum shall receive two coats of a dielectric separator over a shop-primed surface.

6.5.1.10.17**Architecturally Exposed Structural Steel:** All exposed steel work shall be 'architectural' grade.

6.5.1.10.17.1This shall be suitable for finish work, using cold roll shapes where ever possible, clear sharp bends, smooth cuts and fully ground and finished welding. All surface blemish shall be ground smooth and pits filled to surface level and sanded smooth. Finish shall be judged from a distance of 36" by the architect. His word shall be final on acceptability of finish architectural work.

6.5.1.10.17.2All architectural grade steel shall be shop painted with fire protective intumescent coatings, and finish painted per the finish schedule.

Section no: 5 Flooring Work

(5.01 to 5.10)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

A. Granolithic Concrete Flooring / Indian Patent Stone Flooring grey colour for finish.

A.1Materials

A.1.1 Cement, sand, stone aggregates of 20mm and 6mm size, water etc. shall conform to the specifications as described under material specifications Part A - Technical Specifications.

A.1.2 Cement Concrete 1:2:4 proportion measured by volume shall conform to relevant specifications as described for grade 1:2:4 Cement Concrete.

A.1.3 Thickness of the flooring shall be as specified.

A.1.4 All the materials shall be approved by the Design Consultant and Project Manager before its use.

A.2 Execution

A.2.1 Preparation of Surface:

Before the operation for laying the topping is started, the surface of the base concrete shall be thoroughly cleaned of all dirt, loose particles, caked mortar droppings and laitance, if any, by scrubbing with coir or steel wire brush. Where the concrete has hardened so much that roughening of surface by wire brush is not possible, the surface shall be roughened by chipping or hacking at close intervals. The surface shall then be cleaned with water and kept wet for 12 hours and surplus water shall be removed by mopping before the topping is laid.

A.2.2 Laying:

A.2.2.1 The screed strips shall be fixed over the base concrete dividing it into suitable panels. Before placing the concrete for topping, neat cement slurry shall be thoroughly brushed into the prepared surface of the base concrete just ahead of the finish. Concrete of specified proportion and thickness shall be laid in alternate panels to required level and slope and thoroughly tamped and cement concrete 1:2:4 shall conform to relevant IS specifications.

A.2.2.2 The cement concrete flooring of specified thickness is to - be laid as per the site condition. The concrete shall be mixed in a mechanical mixer at the work. Hand mixed may however be allowed for smaller quantities of work and in case of failure of machines or as permitted by the Design Consultant. It shall be carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. However, in such cases 10% more cement than otherwise required shall have to be used without any extra cost. The mechanical mixing shall be done for a period of 1.5 to 2 minutes. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the purpose. Flooring of specified thickness shall be laid in accordance with approved pattern or as directed. Finishing operation shall start shortly after the cessation of beating and shall be spread over a period of one to six hours depending upon the temperature and atmospheric conditions. The surface shall be left for some time till moisture disappears from it. Fresh quantity of cement shall be mixed with water to form a thick slurry and spread over the surface while the concrete is still green. Use of dry cement or cement and sand mixture sprinkled on this surface to stiffen the concrete or absorb excessive moisture shall not be permitted. The cement slurry shall then be properly pressed twice by means of iron floats, once, when the slurry is applied and the second time when cement starts setting and is to be finished smooth. The surface shall be marked with string or B.R.C. fabric jali to make the surface non-slippery as and when directed. The junction of floors with wall plaster, dado or skirting shall be rounded off where so required up to 25 mm. radius. Flooring in toilets shall be laid after fixing of water closet and squatting pans and floor traps which shall be plugged while laying the floors and opened after the floors are completed. Any damage, done to water supply or sanitary fittings during execution of work shall be replaced by new and made good.

A.2.3 Curing

After the final set, the concrete shall be kept continuously wet, if required by ponding, for a period of not less than 7 days from the date of placement.

A.2.4 Form work

The form work shall be provided if necessary as directed by Design Consultant. Concreting shall be done as per alternate bay method with necessary centering either by mastic or cement mortar as directed.

A.2.5 Finishing the Surface:

A.2.5.1 After the concrete has been fully compacted it shall be finished by trowel-ling or floating with neat cement rendering. Finishing operations shall start shortly after the compaction of concrete and the surface shall be trowel-led three times at intervals so as to produce an uniform and hard surface. The satisfactory resistance of floor to wear and tear, depends largely upon the care with which trowel-ling is carried out. The time interval allowed between successive trowel-ling is very important. Immediately after

placing cement rendering, only just sufficient trowel-ling shall be done to give a level surface. Excessive trowel-ling in the earlier stages shall be avoided as this tends to bring a layer in cement to the surface. Sometime, after the first trowel-ling, the duration depending upon the temperature and atmospheric conditions and the rate of setting of the cement used, the surface shall be re-trowel-led to close any pores in the surface now and to bring to surface and to scrape off any excess water in concrete or any laitance. No dry cement shall be used directly on the surface to absorb moisture or to stiffen the mix. The final trowel-ling shall be done well before the concrete has become too hard but at such a time that considerable pressure is required to make any impression on the surface.

A.2.5.2 When 1:2:4 mix is specified the topping shall be rendered with, 1: 1:2, (part cement mortar with a suitable mineral pigment (if directed), 1 part sand and 2 parts grit - 6 mm. and down size), instead of cement only. If specified in the schedule of quantities, the flooring shall be machine polished as per Design Consultant & Project Manager's instructions.

A.2.5.3 Wherever the patent flooring is used as a finishing on roof, the joints shall be filled with approved bitumastic filler in a workman-like manner.

A.3 Mode of Measurements

A.3.1 The rate shall include the cost of all materials and labour involved in all the operations described above. No deduction shall be made or extra paid for any opening up to 0.1 m² in area, in the floor, nothing extra shall be paid for laying the floor at different levels in the same room or the courtyard.

A.3.2 The unit rate shall be for a unit of one m².

B. Granolithic Concrete Flooring / Indian Patent Stone Flooring with pigments for coloured top finish.

B.1 Materials

All the relevant specifications of item G above are applicable. However, pigments shall conform to the specifications as described under materials specifications Part A - Technical Specifications.

B.2 Execution

All the relevant specifications of item G above are applicable. However, rendering of top finished surface shall be done with addition of approved pigments to have desired coloured surface and shade to the flooring, as specified and directed.

B.3 Mode of Measurements

All the relevant specifications of item G above are applicable.

C. Granolithic Concrete Flooring / Indian Patent Stone Flooring with lornite topping

C.1 Materials

All the relevant specifications of Item G above are applicable. However, lornite powder shall conform to the specifications as described under material specifications Part A of - Technical Specifications.

C.2 Execution

C.2.1 All the relevant specifications of item G above are applicable.

C.2.2 lornite Topping:

C.2.2.1 Instead of finishing the top with rendering coat of 1: 1 cement mortar, the top shall be finished with lornite topping. Unless, otherwise specified, one part of lornite and four parts of ordinary cement by weight shall be mixed dry thoroughly. This dry mixture shall be mixed with grit 6 mm. (1 / 4") and down size or as otherwise directed in the ratio of

1:2 by volume and well turned over. Just enough water shall be added to this dry mix and mixed thoroughly well and laid to uniform thickness of 12 mm. and compacted. After the initial set has started the surface shall be finished as directed.

C.3 Mode of Measurements

All the relevant specifications of item above are applicable.

D. Italian Marble Flooring

D.1 Materials

- D.1.1 Cement, white cement, water, lime mortar, cement mortar, sand, marble, pigments, etc. shall conform to the specifications described under materials specifications part A of - Technical Specifications.
- D.1.2 Thickness of the marble shall be as specified. However, no slab shall be thinner than the specified thickness at its thinnest part. The sizes of the slabs shall be as specified for the respective items.
- D.1.3 Thickness of mortar and its proportion shall be as specified.
- D.1.4 Marble slabs shall be of the best Italian marble of white or other approved colour as specified in the item. They shall be hard, dense, uniform and homogeneous in texture. They shall have crystalline grain and shall be free from defects and cracks. The surface shall be machine polished to an even and perfectly plane surface and edges shall be machine-cut, true to square. The rear face shall be rough enough to provide a key for the mortar.
- D.1.5 Italian Marble brought and used shall be from only one supplier and of only one quarry as approved by the Architects, for entire, work.
- D.1.6 All materials shall be approved by Design Consultant and Project Manager before use.
- D.1.7 Necessary sample of flooring shall be prepared as directed for Architect's approval.

D.2 Execution

- D.2.1 Dressing of slabs: Every shall be cut to the required size and fine chiseled, dressed to give a smooth and even surface on all sides, to the full depth. A straight edge laid along the sides of the slab shall be full), in contact with it. Chisel dressing shall also be done on the top surface to remove any waviness. The sides and top surface of the marble slabs shall be machine rubbed or table rubbed with coarse sand before using. All angles and edges of slabs.-shall be truly square and free from chipping.
- D.2.2 The thickness of the slab shall be 20 mm. The allowable tolerance shall be 2 mm. The tolerance shall be 15 mm. in length and breadth.
- D.2.3 Bedding: Bedding of marble slabs shall either be in lime mortar 1: 1.5 (1 lime putty 1: 1.5 coarse sand) or cement mortar 1:3 (1 cement: 3 coarse sand) of specified thickness 20 mm. as given in description of the item. Minimum thickness at any place shall not be less than 15 mm.
- D.2.4 Laying: The surface of sub grade shall be cleaned, wetted and mopped. Mortar of specified mix and thickness shall then be spread on an area sufficient to receive one marble slab. The slab shall be washed clean before laying. It shall be laid on top, pressed and tapped gently to bring it in level with other slabs. It shall then be lifted and laid aside. The top surface of the mortar shall then be corrected by adding fresh mortar at hollows or depressions. The mortar shall then be allowed to harden and over this surface, cement slurry of honey-like consistency at 4.4 Kg.cement/m² is spread. The edges of slabs already paved shall be buttered with grey cement. The slab shall then be gently placed in position and tapped with wooden mallet till it is properly bedded in level with and close to the adjoining slab. The joints shall be as fine as possible. Surplus cement on the surface of the slabs shall be removed. The slab fixed in the floor adjoining the walls shall enter not less than 10 mm. under the plaster, skirting or dado.

The junction between the walls and floors shall be finished neatly. The finished surface shall be true to level and slopes as directed.

D.2.5Curing: The floor shall be cured for a minimum period of seven days.

D.2.6 Polishing and finishing: Unevenness at the meeting edges of slab shall be removed by fine chiseling. Finishing etc. shall be done as per relevant specifications of terrazzo tiles flooring except that cement slurry with/ or without pigments shall be applied on the surface before each polishing.

D.3 Mode of Measurements

D.3.1 Marble flooring with various kinds of marble shall be measured in m². The length and breadth shall be measured between the finished face of skirting or dado or wall plaster. No deduction shall be made no extra shall be paid for any openings in the floor of area up to 0.05 m². Nothing extra shall be paid for laying at different levels in the same room. Treads and steps of stairs paved with marble slabs shall also be measured under this flooring.

D.3.2 No deductions shall be made nor extra paid for any opening in the floor area up to 0.1 m². Nothing extra shall be paid for use of cut tiles or for laying the floors at different levels in the same room or court yard. Mosaic tiles laid in floor borders and bands etc. shall be measured in the same item and nothing extra shall be payable on account of these or similar bands formed of half or multiples of half size standard tiles/ or other uncut tiles.

D.3.3 The treads of stairs and steps paved with tiles without nosing shall also be measured under this item.

D.3.4 The rate shall include the cost of all materials (inclusive of all taxes, levies, and delivery at site), labour & sundry involved in all the operations, at all floors, at any height and level, as described above. It shall also include for breakages and wastage. Floating materials and margin of profit shall also be included. All material samples shall be got approved by the Architect/Project Manager before placing orders.

D.3.5 No extra shall be paid for any small quantities like narrow widths, mitered & returned ends, rounds & cutting, fixing and making good up to & around pipes, fittings and fixtures etc.

D.3.6 The rate shall include for fixing the flooring in composite pattern as per the drawings, using different materials and sizes. The measurements of the different materials shall be taken category-wise separately and paid accordingly.

D.3.7 The basic rate, if at all provided or agreed upon includes cost of material, all taxes, levies & cost of delivery at site.

D.3.8The unit rate shall be for a unit of one m².

E. Polished Granite Stone Slab Flooring

E.1Materials

E.1.1 Cement, sand, lime mortar, cement mortar, white cement, water, Granite stone slab, pigments, etc. shall conform to the specifications as described under material specifications, Part A of - Technical Specifications.

E.1.2The thickness of Polished Granite Stone Slab shall be as specified.

E.1.3 The colour of Polished Granite Stone Slab shall be as specified and the same shall of uniform color for entire work, as approved by the Architect.

E.1.4 The proportion of mortar bedding including its thickness shall be provided as specified.

E.1.5 Polished Granite Stone slab brought and used shall be from only one source and of only one quarry as approved by the Design Consultantfor entire work.

E.1.6 All the materials shall be approved by Design Consultant& Project Manager before use.

E.1.7 necessary sample shall be prepared as directed for Architect's approval.

E.2 Execution

E.2.1 Each slab shall be cut to the required size and shape and fine chisel, dressed at all the edges.

The sides thus dressed shall have full contact if laid along a straight edge. The sides shall be table rubbed with coarse sand, before paving. All angles and edges of the slabs shall be truly square and free from chipping and shall give a plane surface. The thickness of the slab shall be 25 mm. (average) as specified in the item but not less than 20 mm. at any place of the slab.

E.2.2 Bedding for the shall be of cement mortar 1:6 (1 cement: 6 coarse sand) or lime mortar 1:1:5 of average thickness 20 mm. as given in the description of the item. Sub grade shall be cleaned, wetted and mopped. Mortar of the specified mix and thickness shall be then be spread on an area sufficient to receive one kotah slab. The slab shall be washed clean before laying. It shall be laid on top pressed, tapped gently to bring it in level with the other slabs. It shall then be lifted and laid aside. Top surface of the mortar shall then be corrected by adding fresh mortar at hollows or depressions. The mortar shall then be allowed to harden a bit. Over this surface, cement slurry of honey-like consistency shall be applied. The slab shall then be gently placed in position and tapped with wooden mallet till it is properly padded in level with and close to the adjoining slab. The joint shall be as fine as possible. The slabs fixed in the floor adjoining the wall shall enter not less than 10 mm. under the plaster, skirting or dado. The junction between the wall and floor shall be finished neatly. The finished surface shall be true to levels and slopes, as directed.

E.2.3 While laying, any chiseling which may be required for making the skirting or dado flush with the plaster and/or other finishes shall be done. Necessary grooves of required size in cm. between plaster and / or other finishes, dado or skirting (if required) shall be provided. Forming machine-cut/rounded edges, gutters, sills, platforms, channels, curbing, etc. i any, if required, shall be provided as per the drawing and design.

E.2.4 In places where full slabs cannot be fixed, the slabs shall be cut to the size and smoothened at edge to give straight and true joints.

E.2.5 All necessary slopes, gradients and levels shall be truly maintained as required and directed by the Design Consultant and Project Manager.

E.2.6 The floor shall be kept wet for a minimum period of 7 days, so that bedding and joints set properly.

E.2.7 Polishing shall be normally commenced after 14 days of laying the slab. First polishing shall be done with carborundum of 120 grade grit fitted in the heavy machine and then second polishing shall be done with carborundum of 220 to 350 grade grit fitted in the heavy machine. Water shall be properly used during polishing. The flooring shall then be washed clean with water and kerosene. As directed by the Design Consultant and as specified in the item, no waxing will be permitted. However, polishing specifications of marble mosaic terrazzo tiles shall be applicable too.

E.2.8 If any slab is disturbed or damaged it shall be refitted or replaced, properly jointed and polished.

E.2.9 The holes required for Nahni traps, pipes etc. or any other fittings shall be made without any extra cost.

E.3. Mode of Measurements

E.3.1 Polished Granite stone slab flooring shall be measured in m for visible area of work done.

E.3.2 No deductions shall be made nor extra paid for any opening in the floor area up to 0.1 m². Nothing extra shall be paid for use of cut slabs or for laying the floors at different levels in the same room or court yard. Polished Granite Stone slabs laid in floor borders and bands etc. shall be measured in the same item and nothing extra shall be payable

on account of these or similar bands formed of half or multiples of half size standard tiles/or other uncut slabs.

- E.3.3 The treads of stairs and steps paved with slabs without nosing shall also be measured under this item.
- E.3.4 The rate shall include the cost of all materials (inclusive of all taxes, levies, and delivery at site), labour & sundry involved in all the operations, at all floors, at any height and level, as described above. It shall also include for breakages and wastage. Floating materials and margin of profit shall also be included. All material samples shall be got approved by the Architect/Project Manager before placing orders.
- E.3.5 No extra shall be paid for any small quantities like narrow widths, mitered & returned ends, rounds & cutting, fixing and making good up to & around pipes, fittings and fixtures etc.
- E.3.6 The rate shall include for fixing the flooring in composite pattern as per the drawings, using different materials and sizes. The measurements of the different materials shall be taken category-wise separately and paid accordingly.
- E.3.7 The basic rate, if at all provided or agreed upon includes cost of material, all taxes, levies & cost of delivery at site.
- E.3.8 The risers of steps, skirting or dado shall be measured in ml. Length shall be measured along the finished faces of risers, skirting or dado. Height shall be measured from finished level of treads or floor to top. Lining of pillars shall be measured under this item.
- E.3.9 The rate shall include for any chiseling which may be required for making the skirting or dado flush with the plaster and/or other finishes. It shall include for a groove of required size in cm, between plaster and/or other finishes, dado or skirting (if required). It shall also include for forming machine-cut/rounded edges, gutters, channels, curbing etc. if required.
- E.3.10 The unit rate shall be for a unit of one m².

F. Marble Partitions

F.1 Materials

- F.1.1 Cement, white cement, water, lime mortar, cement mortar, sand, marble, pigments, etc. shall conform to the specifications described under materials specifications part A of - Technical Specifications.
- F.1.2 Thickness of the marble shall be as specified. However, no slab shall be thinner than the specified thickness at its thinnest part. The sizes of the slabs shall be as specified for the respective items.
- F.1.3 Thickness of mortar and its proportion shall be as specified.
- F.1.4 Marble slabs shall be of the best Indian marble of white or other approved colour as specified in the item. They shall be hard, dense, uniform and homogeneous in texture. They shall have crystalline grain and shall be free from defects and cracks. Both the surface shall be machine polished to an even and perfectly plane surface and edges shall be machine-cut, true to square and machine polished as specified.
- F.1.5 Marble brought and used shall be from only one supplier and of only one quarry as approved by the Architects, for entire work.
- F.1.6 All materials shall be approved by Design Consultant and Project Manager before use.
- F.1.7 Necessary sample shall be prepared as directed for Design Consultant approval.

F.2 Execution

- F.2.1 Dressing of slabs: Every marble slab shall be cut to required size and fine chisel or machine cut & machine polish dressed to give a smooth and even surface on all sides to the full depth. Chisel dressing shall also be done on both the surfaces to remove

waviness. The sides and top and bottom surfaces of marble slabs shall be machine rubbed or table rubbed with coarse sand before using. All angles and edges of slabs shall be true, square and free from chipping.

F.2.2 The thickness of slab shall be as specified. The allowable tolerance shall be 1mm allowable. The tolerance shall be 5 mm. in length and breadth.

F.2.3 Fixing: A minimum 100 mm. deep zari shall be made in the wall where the partition is to be fitted. The thickness of the zari will be slightly more than the thickness of the marble slab. However, specified stainless steel clamps with adequate anchorage shall be provided, as directed.

The zari shall be cleaned and well watered before grouting in the C.M. 1:4; The marble slab shall then be pushed in firmly in true plumb. All the excess mortar shall be pressed into the sides as much as possible before flushing the junction.

After the mortar has harden a little, the joint at the junction of the wall and marble slab shall be raked and pointed with white or pigmented neat cement slurry, to match the colour of the partition slab.

F.2.4Curing: Curing shall be done for atleast 7 days.

F.2.5 Polishing: Hand polishing shall be done after the curing period to give a good polished appearance. Exposed horizontal and vertical sides shall be polished and finished as shown on drawing and as approved by Design Consultant.

F.3.Mode of Measurements

F.3.1The rate shall be for a unit of m² and clear visible area shall be measured.

F.3.2 The rate shall include for all materials, labour and sundry involved in operation of the above specified item.

G. Vitrified tiles flooring, dado etc.

G.1Materials

G.1.1 Cement, Sand, Cement mortar, water, white cement, pigments, vitrified tiles, etc. shall conform to respective specifications as described under material specifications Part A of Technical Specifications.

G.1.2 Vitrified tiles shall be of first quality and of recommended manufacturers such as spartek, Naveen, Regency, Bell, Kajaria, etc. or approved equal.

G.1.3 The Pigment used for mixing with white cement for pointing shall be of Rainbow Tile Mate from Rofe or equivalent as approved.

G.1.4 Thickness of tiles and mortar bedding including its proportion shall be of as specified.

G.1.5 Tiles shall be brought and used from, only one source and of the company as approved, for entire work.

G.1.6 All materials shall be approved by Design Consultant and Project Manager before use.

G.2 Execution

G.2.1Bedding:

G.2.1.1The sub-grade shall be cleaned, wetted and mopped. The bedding shall then be laid evenly over the surface, as described above, tamped and corrected to desired level and allowed to harden enough to offer a rigid cushion to tiles and to enable the mason to place wooden planks across and squat on it.

G.2.1.2The white/coloured vitrified tiles shall then be laid on the cement mortar bedding of specified thickness & in C.M specified. The mortar shall have sufficient plasticity for laying and there shall be no hard lumps that would interfere with the evenness of the bedding. The base shall be cleaned and well wetted, before laying. The mortar shall

then be spread in thickness not less than 15 mm. at any place and average as specified. The proportion of the cement mortar shall be as specified in the item.

G.2.2 Fixing tiles:

G.2.2.1 The tiles before laying shall be soaked in water for at least two hours. Neat grey cement grout at 3.3 Kg. Cement/m² of honey-like consistency shall be spread over the mortar bedding as directed. The edges of the tiles shall be smeared with neat cement slurry. The tiles shall then be well pressed and gently tapped with a wooden mallet till they are properly bedded and in level with the adjoining tiles. There shall be no hollows in bed or joints. The joints between the tiles shall be as thin as possible in straight line or as per pattern.

G.2.2.2 The tiles shall not have staggered joints. The joints shall be true to center line both ways. The Nahni trap coming in the flooring shall be so positioned that its grating shall replace only one tile as far as possible. Where full size tiles cannot be fixed, they shall be cut (Sawn) to the required size and the edges rubbed smooth to ensure straight and true joints. After the tiles are laid, the joints shall be cleaned of grey cement grout with a wire brush to a depth of about 5 mm. and then grouted with white cement grout with or without pigment to match the shade of the topping of tiles. The same cement slurry shall then be spread over the whole surface in a thin coat to protect the surface from abrasive damage and to fill up pin holes that may exist on the surface. White cement with or without matching pigment shall be used for pointing the joints. After fixing the tile finally in an even plane the flooring shall be kept wet and allowed to cure undisturbed for 7 days.

G.2.2.3 While laying, any chiseling which may be required for making the skirting or dado flush with the plaster and/or other finishes shall be done. Necessary grooves of required size between plaster and/or other finishes, dado or skirting (if required) shall be provided. Forming machine-cut/rounded edges, gutters, sills, platforms, channels, curbing, etc. if any, if required shall be provided as per the drawing and design.

G.2.2.4 In places where full tiles cannot be fixed, the tiles shall be cut to the size and smoothened at the edges to give straight and true joints.

G.2.2.5 All necessary slopes, gradients and levels shall be truly maintained as required and directed by the Design Consultant and Project Manager.

G.2.3 Cleaning:

G.2.3.1 The surplus cement grout that may have come out of the joints shall be cleared off before it sets. Once the floor has set, it shall be carefully washed and cleaned by dilute acid and dried. Proper precautions and measures shall be taken to ensure that the tiles are not damaged in any way till the completion of the construction.

G.2.3.2 If any tile is disturbed or damaged it shall be refitted or replaced, properly jointed and cleaned as directed.

G.3 Mode of Measurements

G.3.1 The work done shall be measured in m² for the visible area of work done in floor and dado. The length and width of the flooring shall be measured between the faces of skirting or dados or plastered face of walls as the case may be. The paving under dado or skirting shall not be measured. No deduction shall be made nor extra paid for any opening in the floor of area up to 0.1 m². Nothing extra shall be paid for laying the floors at different levels in the same room. The dado will be measured from the finish floor level to the top of the fixed.

G.3.2 The rate shall include the cost of all materials (inclusive of all taxes, levies, and delivery at site), labour & sundry involved in all the operations, at all floors, at any height and level, as described above. It shall also include for breakages and wastage. Floating materials and margin of profit shall also be included. All material samples shall be got approved by the Design Consultant/Project Manager before placing orders.

- G.3.3 No extra shall be paid for any small quantities like narrow widths, mitred & returned ends, rounds & cutting, fixing and making good up to & around pipes, fittings and fixtures etc.
- G.3.4 The rate shall include for fixing the flooring in composite pattern as per the drawings, using different materials and sizes. The measurements of the different materials shall be taken category-wise separately and paid accordingly.
- G.3.5 The basic rate, if at all provided or agreed upon includes cost of material, all taxes, levies & cost of delivery at site.
- G.3.6 The rate shall include for any chiseling which may be required for making the skirting or dado flush with the plaster and/or other finishes. It shall include for a groove of required size in cm, between plaster and/or other finishes, dado or skirting (if required). It shall also include for forming machine-cut/rounded edges, gutters, channels, curbing etc. if required.
- G.3.7 The unit rate shall be for a unit of one m².

H. Wooden Flooring

H.1 Materials

- H.1.1 Teak wood, Non-teakwood, plywood, Adhesives, Enamel paint, polish, etc. shall conform to the specifications as described under material specifications part A of - Technical Specifications.
- H.1.2 All wood brought and used shall be from one supplier only as approved by the Design Consultant, for entire work.
- H.1.3 All the materials shall be approved by Design Consultant and Project Manager before use.
- H.1.4 Necessary sample shall be prepared as directed for Design Consultant's approval.

H.2 Workmanship

- H.2.1 Framing work for floors, stages, etc. shall be in accordance with every detail given by the Design Consultant. Joinery work shall be accurately set out, framed and finished in adequate workman like manner.
- H.2.2 The scantlings shall be accurately planed smooth. Rebates, rounding and mouldings shall be made as shown on the drawings. Patching or plugging of any kind shall not be allowed. Joints shall be coated with suitable adhesive like glue or synthetic resin before the frames are put together. All mortise and tenon joints shall fit in fully and accurately without wedging or filling. The joints shall be pinned with hard wood or bamboo pins of 10 mm. to 12 mm. dia., or rust resisting star shaped metal pins of 8 mm. dia., after the frames are put together and pressed in position by means of a press. The frames shall be protected during the progress of work by providing suitable boxing. All portions of timber abutting against or embedded in masonry or concrete shall be treated against termites by giving a coat of any approved wood preservative.
- H.2.3 All planks shall be of size and shape as shown on the drawing. The planks shall be laid as per drawing and as directed with necessary joints, bedding cement mortar of 1:6 etc. complete. All faces of the planks shall be truly at right angles to each other. Any moldings desired shall be carried out as directed.
- H.2.4 The work shall be of pattern and size as shown on the drawings or as directed by Design Consultant and Project Manager. Solid teak wood/plywood planks shall be in one piece wherever possible. Where two or more pieces are permitted, they shall be of equal width.
- H.2.5 Thickness of the planks shall be as specified in the item as shown in the detailed drawings and shall be joined with continuous groove with specified size. The end pieces of the plank shall be provided with continuous tongue to frame into groove. An air space of 1.5 mm. shall be left in the groove while fixing the planks. The faces of the

planks as well as various pieces of the floor shall be closely fitted to the sizes of the grooves. Finishing of the corners, edges shall be done as shown in drawings or as directed.

- H.2.6 The work shall be carried out in best possible manner with necessary brass screws, nails etc. The Contractor shall be responsible for the operation of all fittings even in cases when the materials are supplied by client. He will also be responsible for any breakage due to negligence during fixing or lack of protection, before the building is handed over.
- H.2.7 All teak wood/plywood faces shall be French or wax or Touch wood polished in desired tint or painted with 3 coats of approved synthetic enamel paint over a coat of approved primer as directed. Although 3 coats of paint/polish are normally specified additional coats of paint shall be given to obtain uniform and good finish at no extra cost. If directed, putty shall be applied all over the surface to ensure smooth and neat finish, at no extra cost. The relevant specification of painting / polishing section shall be followed for painting /polishing of wood work.

H.3 Mode of Measurement

- H.3.1 The rate for wood flooring in floors, stages etc. shall include the cost of providing wooden planks, wooden sub base painting/polishing of the same and fixing in position.
- H.3.2 Measurement and payment shall be made on m² basis. Only visible top surface of wooden flooring shall be measured.
- H.3.3 The unit rate shall be for a unit of one m².

I. Mirror Polishing of Floors

I.1 Materials

Not Applicable

I.2 Execution

- I.2.1 After the flooring is cured, first grinding shall be done with carborundum of 48 to 60 grade grit (emry) fitted in the machine. Water shall be adequately used during grinding. When the chips show up and the floor has been uniformly rubbed. It shall be cleaned with water, baring all pin holes. It shall then be covered with a thin coat of white cement with or without pigments / grey cement, as the case may be, to match the colour of the topping of the flooring pin holes, if any shall be filled. This grout shall be kept moist for a week. Thereafter, second grinding shall be started with carborundum of 120 grit (emry). Grouting and curing shall follow again. Third grinding shall be started with carborundum of grit (emry) 220 to 350 and grinding shall be started using water in abundance. To achieve mirror polish finish, more coats of polishing shall be done as approved by the Architect. However, final coat of polishing shall be carried out when all other works are completed. The floor shall then be washed with clean water. Oxalic acid powder shall then be dusted at 33 grams per square meter on the surface and the surface shall be rubbed with a machine fitted with Hessian bobs or rubbed hard with a pad of woolen rags. The floor shall then be washed clean and dried with a soft cloth or linen. However, daily moping with water and kerosene as directed for at least 15 days or up to the satisfaction of Design Consultant and Project Manager. In no case waxing will be permitted.

1.2 SUBMITTALS

A. Product Data:

- i. For each variety of stone. Along with data on physical properties required by referenced ASTM or respective Indian standards.
- ii. For stone accessories and other manufactured products.



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- B.** Shop Drawings: Include plans, sections, details, and attachments to other work.
 - C.** Samples for Initial Selection: For joint materials involving color selection.
 - D.** Samples for Verification:
 - i. For each stone type indicated, in 3 sets of Samples not less than **12 inches (300 mm)** square. Provide min. three Samples in each set and show the full range of variations in appearance characteristics expected in completed Work, to establish the standard by which stone will be judged.
 - ii. For each color of grout and / or pointing mortar required.
 - E.** Qualification Data: For qualified fabricator.
 - F.** Maintenance Data: For stone flooring to include in maintenance manuals. Include Product Data for stone-care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.3 QUALITY ASSURANCE

- A.** Fabricator Qualifications: A qualified fabricator that custom fabricates stone.
- B.** Installer Qualifications: Stone fabricator.
- C.** Source Limitations for Stone: Obtain each variety of stone, regardless of finish, from a single quarry, whether specified in this Section or in other Sections of the Specifications, with resources to provide materials of consistent quality in appearance and physical properties.
 - i. For stone types that include same list of varieties and sources, provide same variety from same source for each.
 - ii. Make quarried blocks available for examination by Design Consultant for appearance characteristics.
 - iii. Make stone slabs available for Design Consultant to examine for appearance characteristics.
- D.** Design Consultant will select aesthetically acceptable slabs. However, Design Consultant will indicate aesthetically unacceptable portions of slabs, if any.
- E.** Segregate slabs selected for use on Project and mark backs indicating approval.
- F.** Mark and photograph aesthetically unacceptable portions of slabs as directed by Design Consultant.
- G.** Source Limitations for Other Materials: Obtain each type of Cementitious material, grout, admixture, stone accessory, and other material from single source.
- H.** Mockups: Build mockups to demonstrate aesthetic effects and set quality standards for materials and execution.
 - i. Build mockup of typical interior floor area as shown on Drawings or as directed by Design Consultant.
 - ii. Build mockup of typical exterior pavement area as shown on Drawings or as directed by Design Consultant..
 - iii. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Design Consultant specifically approves such deviations in writing.
 - iv. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.



1.4 DELIVERY, STORAGE, AND HANDLING

- A. Lift stone with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.
- B. Store stone on wood frames crates or pallets as approved by Design Consultant.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

1.5 PROJECT CONDITIONS

- A. Cold-Weather Requirements for Interior Stone Flooring:
 - i. Do not set stone when air or material temperature is below 50 deg F (10 deg C).
 - ii. Maintain temperature at 50 deg F (10 deg C) or above in installation areas during installation and for 7 days after completion unless higher temperatures are required by fabricator's or supplier's instructions.
 - iii. Cold-Weather Requirements for Exterior Stone Paving: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1 / ASCE 6 / TMS 602 or respective IS code.
 - iv. Hot-Weather Requirements for Exterior Stone Paving: Comply with hot-weather construction requirements contained in ACI 530.1 / ASCE 6 / TMS 602 or respective IS code and with the following:
- B. Usually retain subparagraphs below for paving. Hot weather affects paving more than masonry because a horizontal surface absorbs more solar energy. Adjust requirements to suit local conditions.
- C. Maintain temperature of materials below 100 deg F (38 deg C).
- D. Do not apply mortar to substrates with temperatures of 100 deg F (38 deg C) and above.

When the ambient temperature exceeds 90 deg F (32 deg C), fog spray installed stone paving until damp at least 3 times a day until paving is 3 days old.

Section no: 6 Ceiling Work

(6.01 to 6.02)

6.01 WATER PROOF MARINE PLY Ceiling

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Water Proof Marine Ply suspended ceilings.
 - 2. Water Proof Marine Ply bulkheads at ceilings
 - 3. Water Proof Marine Ply walls.
- B. Related Sections include the following:
 - 1. Section "Fire-Resistive Joint Systems" for head-of-wall assemblies that incorporate Water Proof Marine Ply.



2. Section "Non-Structural Metal Framing" for non-structural framing and suspension systems that support Water Proof Marine Ply.
3. Section "Water Proof Marine Ply Shaft Wall Assemblies" for metal shaft-wall framing, Water Proof Marine Ply shaft liners, and other components of shaft-wall assemblies.
4. Section "Tiling" for cementitious backer units installed as substrates for ceramic tile.
5. Painting Sections for primers applied to Water Proof Marine Ply surfaces.
6. Sections for lighting fixtures, sprinklers, and air-distribution devices.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

- A. Standards: Within the text of this Section, reference is made to the Standards listed hereafter. Such standards are made a part of the Contract Documents by reference. Unless the Contract Documents include more stringent requirements, applicable requirements of these Standards shall have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced.
 1. British Standard Institute (BSI) - UK or respective IS code
 - a. BS 1230: or respective IS code Part 1 Water Proof Marine Ply Specification for excluding materials submitted to secondary operations
 - b. BS 8212Code or respective IS code of practice for dry lining and partitioning using Water Proof Marine Ply
 - c. BS 8290-1 or respective IS code Suspended ceilings. Code of practice for design
 - d. BS 8290-2Suspended ceilings. Specification for performance of components and assemblies
 - e. BS 8290-3 or respective IS code Suspended ceilings. Code of practice for installation and maintenance
 2. Deutsches Institute fur Normung (DIN) - Germany
 - a. DIN 18168-2or respective IS code Lightweight ceiling linings and suspended ceilings; verification of the load bearing capacity of metal substructures and hangers
 - b. DIN 18182-2 or respective IS codeAccessories for use with Water Proof Marine Ply s; dry wall screw
- B. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 or respective IS code by an independent testing agency.
- C. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 or respective IS code by an independent testing agency.
- D. Single Source Responsibility: Obtain Water Proof Marine Ply framing, suspension system and accessories from same manufacturer of boards.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.



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- B.** Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack Water Proof Marine Plys flat to prevent sagging.

1.6 PROJECT CONDITIONS

- A.** Environmental Limitations: Comply with requirements of referenced Standard Specifications and Water Proof Marine Ply manufacturer's written recommendations, whichever are more stringent.
- B.** Do not install interior products until installation areas are enclosed and conditioned.
- C.** Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A.** Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Steel Framing and Furring:
 - a. Indian Water Proof Marine Ply Company
 - b. G-P Water Proof Marine Ply.
 - c. National Water Proof Marine Ply Company.
 - d. USG Corporation.
 2. Water Proof Marine Ply and Related Products:
 - a. Indian Water Proof Marine Ply Company
 - b. G-P Water Proof Marine Ply.
 - c. National Water Proof Marine Ply Company.
 - d. USG Corporation.

2.2 STEEL SUSPENDED CEILING AND SOFFIT FRAMING

- A.** Components, General: Furnish all necessary components for each Water Proof Marine Ply assembly as indicated in technical data of approved manufacturer for selected system.
- B.** Clips: Steel wire, minimum Z275 or respective IS code zinc coating, soft temper, 2.65-mm- diameter minimum.
- C.** Hanger Attachments to Concrete: As follows:
1. Postinstalled Anchors: Provide torque-controlled expansion anchors, with capability to sustain, without failure, a load equal to six times the load imposed when installed in solid or grouted unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 or respective IS code conducted by a qualified independent testing agency.
 - a. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633 or respective IS code, Class Fe/Zn 5 (5 microns) for Class SC 1 service condition (mild).
 2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from zinc coated steel of the following minimum properties indicated below, with clips or other devices for attaching hangers of type indicated, and capable of sustaining,

without failure, a load equal to 10 times that imposed by construction as determined by testing per ASTM E 488 or respective IS code conducted by a qualified independent testing agency.

- a. Tensile Strength: 1900 Mpa.
- b. Shear Strength: 1117 Mpa.

D. Hanger: As follows:

1. Wire Hangers: to BS EN 10218 or respective IS code AND 10244 zinc coating, soft temper, 4.00 mm diameter minimum. Load capacity Class 25 kg to Din 18168 T2
2. Flat Hangers: Steel sheet, BS EN 10142, Z275 or respective IS code hot-dip galvanized zinc coating, furnish complete with cleats and fasteners.
 - a. Size: Load capacity Class 40 kg to Din 18168 T2 or respective IS code.

E. Carrying Channels: Cold-rolled, steel sheet with a base metal thickness of 0.80 mm, a minimum 12.50-mm- wide flange, to BS EN 10142, Z275 or respective IS code hot-dip galvanized zinc coating.

1. Depth: As recommended by manufacturer.

F. Furring Channels (Furring Members): Steel sheet to BS EN 10142, Z275 or respective IS code, hot-dip galvanized zinc coating.

1. Cold Rolled Channels: 0.55-mm bare steel thickness minimum.

G. Cross Connectors: Manufacturer's standard fabricated from corrosion-resistant material.

2.3 METAL FRAMING COMPONENTS

A. Standard: Comply with requirements of BS 7364 or respective IS code.

B. Material: Galvanized Steel Sheets: Continuously hot-dip zinc-coated, low-carbon steel sheets to BS EN 10142 or respective IS code as follows:

Steel Grade:	DX51D or according to IS code
Coating material:	Zinc (+Z)
Coating application:	Immersing in a molten bath containing a zinc content of at least 99%.
Coating finish:	Best quality surface (C).
Coating designation:	275 (Coating mass minimum 275 gm/m ² including both surfaces in triple spot test)
Surface treatment:	Chemical passivation (C).

C. Channels: 0.50 mm thick minimum, profile to details or hot-shaped if not indicated

D. Stud widths indicated on plans indicate local products in sizes using: 46mm, 70mm and 148mm. Other sizes from other manufacturers may be considered by the Design Consultant with prior approval and written notification.

2.4 INTERIOR WATER PROOF MARINE PLY WALLBOARD

A. Board Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

B. Sag-Resistant Water Proof Marine Ply Wallboard: BS 1230 or respective IS code: Part 1, manufactured to have more sag resistance than regular-type Water Proof Marine Ply.

1. Type: Table 1, Type 1, for regular applications. or as per IS code requirement
2. Thickness: 15.00 mm.
3. Longitudinal Edges: Tapered.



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4. Location: Ceiling membranes.

2.5 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 or respective IS code.
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Custom Building Products; Wonderboard.
 - b. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
 - c. USG Corporation; DUROCK Cement Board.
 - d. Comparable product manufactured in India.
 3. Thickness: 15mm.

2.6 VENEER PLASTER PANELS

- A. Recycled Content: Provide Water Proof Marine Ply panel products with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of <Insert number> percent by weight.
- B. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.
- C. Water Proof Marine Ply Base for Veneer Plaster: ASTM C 588/C 588M.
 1. Regular Type: 15mm

2.7 VENEER PLASTER MATERIALS

- A. Two-Component Water Proof Marine Ply Veneer Plaster: ASTM C 587, with separate formulations; one for base-coat and one for finish-coat application over substrates.

2.8 WATER PROOF MARINE PLY VENEER PLASTER MIXES

- A. Mechanically mix Water Proof Marine Ply veneer plaster materials to comply with ASTM C 843 and with Water Proof Marine Ply veneer plaster manufacturer's written recommendations.

2.9 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Steel Drill Screws: manufacturer's standard self drill and self tapping steel screws black phosphated for fixing s to metal framing, for use with:
 1. Lightweight metal up to 0.55 mm thick: to be tested to DIN 18182-2 or respective IS code, 50021 and 50942.
 2. Metal profiles from 0.70 mm to 1.20 mm thick: to be tested to DIN 18182-2 and 50942 or respective IS code.
- C. Plaster Board Lining to Walls:
 1. System: Lining on metal Furring.
 2. Furring: With Hat-shape profiles not less than 0.50 mm thick formed of galvanized steel sheets as specified. Use profiles of factory formed rids. (as applicable)



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- a. Fix at top of lining (lining stop).
 - b. Fix at bottom of lining (lining sill),
 - c. Fix at perimeter of each opening through lining.
 - d. Fix at side ends of each lined area.
 - e. Fix at not more than 400 mm intervals.
3. Plaster boards: Regular, 15.00 mm thick, tapered edges.
 4. Fixing Screws: Plaster board screws as specified at not more than 300 mm intervals.
 5. Coordination: Coordinate with the works of suspended ceilings and electromechanical works.
 6. Preparation of Substrates: Pretreat substrates to be lined to manufacturer's recommendations according to method of fixation specified.
 7. Furring Fixation: Fix with continuous strips of manufacturer's standard bonding compound.
 8. Jambs, Sills and Heads of Openings through Walls: Are to have lining as specified for walls.
 9. Finish of Joints: Taped seamless finish as specified in this Section.
 10. Tolerance: Finish lining to walls exactly to lines indicated on Drawings and perfectly plumb. No variation from lines or plumb shall be accepted. Installer is to examine walls and substrates prior to installation. Defects that will influence requirements of finished linings shall be rectified prior to fixing furring.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Ceilings: Coordinate installation of ceiling suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers at spacing required to support ceilings and that hangers will develop their full strength.

3.3 INSTALLATION OF WATER PROOF MARINE PLY ASSEMBLIES, GENERALLY

- A. General: Erect the work of Water Proof Marine Ply assemblies ceiling, lining to details indicated on Drawings or approved shop drawings.

3.4 INSTALLING SUSPENSION SYSTEM FOR SUSPENDED CEILINGS AND SOFFIT FRAMING

- A. Suspend ceiling hangers from building structures as follow:
 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counters playing, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacing that interfere with the location of hangers required to support

standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.
 4. Secure flat and angle hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 5. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- B.** Installation Tolerances: Install steel framing components for suspended ceilings so members for panel attachment are level to within 3 mm in 3.6 m measured lengthwise on each member and transversely between parallel members.
- C.** Sway-brace suspended steel framing with hangers used for support.
- D.** Wire-tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.
- E.** Install suspended steel framing components in sizes and spacing indicated, but not less than that required by the referenced steel framing and installation standards.
- F.** Cavity Barriers: Install to divide ceiling plenum in compartment not exceeding 100 m² in plan.
- G.** Access Panels: Provide access panels at locations selected by the Engineer and indicated on approved shop drawings.
1. Access panels are to comply with requirements specified in, Section "Access Doors and Frames".

3.5 INSTALLING FURRING AND STUDS

- A.** Install steel furring and studs for linings to solid backgrounds or for linings and single-layer walls in compliance with BS 8212 or respective IS code.

3.6 APPLYING AND FINISHING BOARDS, GENERAL

- A.** Water Proof Marine Ply Application and Finishing Standards: BS 8212 or respective IS code
- B.** Install ceiling board across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent board's not less than one framing member.
- C.** Install Water Proof Marine Plys with face side out. But boards together for a light contact at edges and ends with not more than 1.5 mm of open space between boards. Do not force into place.
- D.** Locate edge and end joints over supports, except in ceiling applications where intermediate supports or Water Proof Marine Ply back blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E.** Attach Water Proof Marine Plys to framing provide at openings and cut-outs.
- F.** Form control and expansion joints with space between edges of adjoining Water Proof Marine Plys.



- G.** Space fasteners in Water Proof Marine Plys according to referenced Water Proof Marine Ply application and finishing standard and manufacturer's written recommendations.
1. Space screws a maximum of 300 mm o.c. for vertical applications.
 2. Space screws a maximum of 200 mm o.c. for ceilings

3.7 BOARD APPLICATION METHODS

- A.** Single-Layer Application:
1. On ceilings, apply Water Proof Marine Plys before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
- B.** Single-Layer Fastening Methods: Apply Water Proof Marine Plys to supports with steel drill screws.

3.8 INSTALLING TRIM ACCESSORIES

- A.** General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for boards. Otherwise, attach trim according to manufacturer's written instructions.
- B.** Control Joints: Install control joints according to requirements of referenced installation standards and in specific locations approved by Engineer for visual effect.

3.9 INSTALLING JOINT REINFORCEMENT

- A.** Water Proof Marine Ply Base for Veneer Plaster: Reinforce interior angles and flat joints with joint tape and embedding material to comply with ASTM C 843 and with Water Proof Marine Ply veneer plaster manufacturer's written recommendations.
- B.** Abuse-Resistant Base: Reinforce joints between abuse-resistant panels with joint tape and embedding material according to panel manufacturer's written recommendations.
- C.** Impact-Resistant Base: Reinforce joints between impact-resistant panels with joint tape and embedding material according to panel manufacturer's written recommendations.
- D.** Moisture- and Mold-Resistant Base: Reinforce joints between moisture- and mold-resistant panels with joint tape and embedding material according to panel manufacturer's written recommendations.
- E.** Cementitious Backer Units: Reinforce joints between cementitious backer units with joint tape and embedding material according to unit manufacturer's written recommendations.

3.10 FINISHING WATER PROOF MARINE PLY ASSEMBLIES

- A.** Bonding Agent: Apply bonding agent on dry Water Proof Marine Ply surfaces according to Water Proof Marine Ply veneer plaster manufacturer's written recommendations.
- B.** Water Proof Marine Ply Veneer Plaster Application: Comply with ASTM C 843 and with veneer plaster manufacturer's written recommendations.
1. Two-Component Water Proof Marine Ply Veneer Plaster:
 - a. Base Coat: Trowel apply base coat over substrate to uniform thickness of (1.6 to 2.4 mm). Fill all voids and imperfections.



- b. Finish Coat: Trowel apply finish-coat plaster over base-coat plaster to uniform thickness of (1.6 to 2.4 mm).
2. Where Water Proof Marine Ply veneer plaster abuts only metal door frames, windows, and other units, groove finish coat to eliminate spalling.
3. Do not apply veneer plaster to Water Proof Marine Ply base if paper facing has degraded from exposure to sunlight. Before applying veneer plaster, use remedial methods to restore bonding capability to degraded paper facing according to manufacturer's written recommendations.

3.11 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: Before Contractor installs Water Proof Marine Ply ceilings, Engineer will conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of Water Proof Marine Ply to ceiling support framing until deficiencies have been corrected.
 1. Notify Engineer seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.
 2. Before notifying Engineer, complete the following in areas to receive Water Proof Marine Ply ceilings:
 - a. Installation of 80 percent of lighting fixtures, powered for operation.
 - b. Installation, insulation, and leak and pressure testing of water piping systems.
 - c. Installation of air-duct systems.
 - d. Installation of air devices.
 - e. Installation of mechanical system control-air tubing.

Installation of ceiling support framing.

6.02 Gypsum Board Ceiling

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 1. Gypsum board suspended ceilings.
 2. Gypsum board bulkheads at ceilings
 3. Gypsum board walls.
- B. Related Sections include the following:
 1. Section "Fire-Resistive Joint Systems" for head-of-wall assemblies that incorporate gypsum board.
 2. Section "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board.
 3. Section "Gypsum Board Shaft Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.
 4. Section "Tiling" for cementitious backer units installed as substrates for ceramic tile.
 5. Painting Sections for primers applied to gypsum board surfaces.



6. Sections for lighting fixtures, sprinklers, and air-distribution devices.

1.3 SUBMITTALS

- A.** Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

- A.** Standards: Within the text of this Section, reference is made to the Standards listed hereafter. Such standards are made a part of the Contract Documents by reference. Unless the Contract Documents include more stringent requirements, applicable requirements of these Standards shall have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced.

1. British Standard Institute (BSI) - UK or respective IS code

- a. BS 1230: or respective IS code Part 1 Gypsum plasterboard Specification for plasterboard excluding materials submitted to secondary operations
- b. BS 8212 Code or respective IS code of practice for dry lining and partitioning using gypsum plasterboard
- c. BS 8290-1 or respective IS code Suspended ceilings. Code of practice for design
- d. BS 8290-2 Suspended ceilings. Specification for performance of components and assemblies
- e. BS 8290-3 or respective IS code Suspended ceilings. Code of practice for installation and maintenance

2. Deutsches Institute fur Normung (DIN) - Germany

- a. DIN 18168-2 or respective IS code Lightweight ceiling linings and suspended ceilings; verification of the load bearing capacity of metal substructures and hangers
- b. DIN 18182-2 or respective IS code Accessories for use with gypsum plasterboards; dry wall screw

- B.** Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 or respective IS code by an independent testing agency.

- C.** STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 or respective IS code by an independent testing agency.

- D.** Single Source Responsibility: Obtain gypsum board framing, suspension system and accessories from same manufacturer of boards.

1.5 DELIVERY, STORAGE, AND HANDLING

- A.** Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.
- B.** Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum boards flat to prevent sagging.

1.6 PROJECT CONDITIONS



- A. Environmental Limitations: Comply with requirements of referenced Standard Specifications and gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Steel Framing and Furring:
 - a. Indian Gypsum Company
 - b. G-P Gypsum.
 - c. National Gypsum Company.
 - d. USG Corporation.
 - 2. Gypsum Board and Related Products:
 - a. Indian Gypsum Company
 - b. G-P Gypsum.
 - c. National Gypsum Company.
 - d. USG Corporation.

2.2 STEEL SUSPENDED CEILING AND SOFFIT FRAMING

- A. Components, General: Furnish all necessary components for each gypsum board assembly as indicated in technical data of approved manufacturer for selected system.
- B. Clips: Steel wire, minimum Z275 or respective IS code zinc coating, soft temper, 2.65-mm- diameter minimum.
- C. Hanger Attachments to Concrete: As follows:
 - 1. Postinstalled Anchors: Provide torque-controlled expansion anchors, with capability to sustain, without failure, a load equal to six times the load imposed when installed in solid or grouted unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 or respective IS code conducted by a qualified independent testing agency.
 - a. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633 or respective IS code, Class Fe/Zn 5 (5 microns) for Class SC 1 service condition (mild).
 - 2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from zinc coated steel of the following minimum properties indicated below, with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing per ASTM E 488 or respective IS code conducted by a qualified independent testing agency.
 - a. Tensile Strength: 1900 Mpa.
 - b. Shear Strength: 1117 Mpa.

D. Hanger: As follows:

1. Wire Hangers: to BS EN 10218 or respective IS code AND 10244 zinc coating, soft temper, 4.00 mm diameter minimum. Load capacity Class 25 kg to Din 18168 T2
2. Flat Hangers: Steel sheet, BS EN 10142, Z275 or respective IS code hot-dip galvanized zinc coating, furnish complete with cleats and fasteners.
 - a. Size: Load capacity Class 40 kg to Din 18168 T2 or respective IS code.

E. Carrying Channels: Cold-rolled, steel sheet with a base metal thickness of 0.80 mm, a minimum 12.50-mm- wide flange, to BS EN 10142, Z275 or respective IS code hot-dip galvanized zinc coating.

1. Depth: As recommended by manufacturer.

F. Furring Channels (Furring Members): Steel sheet to BS EN 10142, Z275 or respective IS code, hot-dip galvanized zinc coating.

1. Cold Rolled Channels: 0.55-mm bare steel thickness minimum.

G. Cross Connectors: Manufacturer's standard fabricated from corrosion-resistant material.

2.3 METAL FRAMING COMPONENTS

A. Standard: Comply with requirements of BS 7364 or respective IS code.

B. Material: Galvanized Steel Sheets: Continuously hot-dip zinc-coated, low-carbon steel sheets to BS EN 10142 or respective IS code as follows:

Steel Grade:	DX51D or according to IS code
Coating material:	Zinc (+Z)
Coating application:	Immersing in a molten bath containing a zinc content of at least 99%.
Coating finish:	Best quality surface (C).
Coating designation:	275 (Coating mass minimum 275 gm/m ² including both surfaces in triple spot test)
Surface treatment:	Chemical passivation (C).

C. Channels: 0.50 mm thick minimum, profile to details or hot-shaped if not indicated

D. Stud widths indicated on plans indicate local products in sizes using: 46mm, 70mm and 148mm. Other sizes from other manufacturers may be considered by the Design Consultant with prior approval and written notification.

2.4 INTERIOR GYPSUM WALLBOARD

A. Board Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

B. Sag-Resistant Gypsum Wallboard: BS 1230 or respective IS code: Part 1, manufactured to have more sag resistance than regular-type gypsum board.

1. Type: Table 1, Type 1, for regular applications. or as per IS code requirement
2. Thickness: 15.00 mm.
3. Longitudinal Edges: Tapered.
4. Location: Ceiling membranes.

2.5 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 or respective IS code.



1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Custom Building Products; Wonderboard.
 - b. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
 - c. USG Corporation; DUROCK Cement Board.
 - d. Comparable product manufactured in India.
3. Thickness: 15mm.

2.6 VENEER PLASTER PANELS

- A. Recycled Content: Provide gypsum panel products with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of <Insert number> percent by weight.
- B. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.
- C. Gypsum Base for Veneer Plaster: ASTM C 588/C 588M.
 1. Regular Type: 15mm

2.7 VENEER PLASTER MATERIALS

- A. Two-Component Gypsum Veneer Plaster: ASTM C 587, with separate formulations; one for base-coat and one for finish-coat application over substrates.

2.8 GYPSUM VENEER PLASTER MIXES

- A. Mechanically mix gypsum veneer plaster materials to comply with ASTM C 843 and with gypsum veneer plaster manufacturer's written recommendations.

2.9 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Steel Drill Screws: manufacturer's standard self drill and self tapping steel screws black phosphated for fixing plasterboards to metal framing, for use with:
 1. Lightweight metal up to 0.55 mm thick: to be tested to DIN 18182-2 or respective IS code, 50021 and 50942.
 2. Metal profiles from 0.70 mm to 1.20 mm thick: to be tested to DIN 18182-2 and 50942 or respective IS code.
- C. Plaster Board Lining to Walls:
 1. System: Lining on metal Furring.
 2. Furring: With Hat-shape profiles not less than 0.50 mm thick formed of galvanized steel sheets as specified. Use profiles of factory formed rids. (as applicable)
 - f. Fix at top of lining (lining stop).
 - g. Fix at bottom of lining (lining sill),
 - h. Fix at perimeter of each opening through lining.
 - i. Fix at side ends of each lined area.
 - j. Fix at not more than 400 mm intervals.



3. Plaster boards: Regular, 15.00 mm thick, tapered edges.
4. Fixing Screws: Plaster board screws as specified at not more than 300 mm intervals.
5. Coordination: Coordinate with the works of suspended ceilings and electromechanical works.
6. Preparation of Substrates: Pretreat substrates to be lined to manufacturer's recommendations according to method of fixation specified.
7. Furring Fixation: Fix with continuous strips of manufacturer's standard bonding compound.
8. Jambs, Sills and Heads of Openings through Walls: Are to have plasterboard lining as specified for walls.
9. Finish of Joints: Taped seamless finish as specified in this Section.
10. Tolerance: Finish lining to walls exactly to lines indicated on Drawings and perfectly plumb. No variation from lines or plumb shall be accepted. Installer is to examine walls and substrates prior to installation. Defects that will influence requirements of finished linings shall be rectified prior to fixing furring.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Ceilings: Coordinate installation of ceiling suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers at spacing required to support ceilings and that hangers will develop their full strength.

3.3 INSTALLATION OF GYPSUM BOARD ASSEMBLIES, GENERALLY

- A. General: Erect the work of gypsum board assemblies ceiling, lining to details indicated on Drawings or approved shop drawings.

3.4 INSTALLING SUSPENSION SYSTEM FOR SUSPENDED CEILINGS AND SOFFIT FRAMING

- A. Suspend ceiling hangers from building structures as follow:
 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counters playing, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacing that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
 3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate



for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.

4. Secure flat and angle hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 5. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- B.** Installation Tolerances: Install steel framing components for suspended ceilings so members for panel attachment are level to within 3 mm in 3.6 m measured lengthwise on each member and transversely between parallel members.
- C.** Sway-brace suspended steel framing with hangers used for support.
- D.** Wire-tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.
- E.** Install suspended steel framing components in sizes and spacing indicated, but not less than that required by the referenced steel framing and installation standards.
- F.** Cavity Barriers: Install to divide ceiling plenum in compartment not exceeding 100 m² in plan.
- G.** Access Panels: Provide access panels at locations selected by the Engineer and indicated on approved shop drawings.
1. Access panels are to comply with requirements specified in, Section "Access Doors and Frames".

3.5 INSTALLING FURRING AND STUDS

- A.** Install steel furring and studs for linings to solid backgrounds or for linings and single-layer walls in compliance with BS 8212 or respective IS code.

3.6 APPLYING AND FINISHING BOARDS, GENERAL

- A.** Gypsum Board Application and Finishing Standards: BS 8212 or respective IS code
- B.** Install ceiling board across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent board's not less than one framing member.
- C.** Install gypsum boards with face side out. But boards together for a light contact at edges and ends with not more than 1.5 mm of open space between boards. Do not force into place.
- D.** Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E.** Attach gypsum boards to framing provide at openings and cut-outs.
- F.** Form control and expansion joints with space between edges of adjoining gypsum boards.
- G.** Space fasteners in gypsum boards according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.
1. Space screws a maximum of 300 mm o.c. for vertical applications.
 2. Space screws a maximum of 200 mm o.c. for ceilings



3.7 BOARD APPLICATION METHODS

- A. Single-Layer Application:
 - 1. On ceilings, apply gypsum boards before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
- B. Single-Layer Fastening Methods: Apply gypsum boards to supports with steel drill screws.

3.8 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for boards. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to requirements of referenced installation standards and in specific locations approved by Engineer for visual effect.

3.9 INSTALLING JOINT REINFORCEMENT

- A. Gypsum Base for Veneer Plaster: Reinforce interior angles and flat joints with joint tape and embedding material to comply with ASTM C 843 and with gypsum veneer plaster manufacturer's written recommendations.
- B. Abuse-Resistant Base: Reinforce joints between abuse-resistant panels with joint tape and embedding material according to panel manufacturer's written recommendations.
- C. Impact-Resistant Base: Reinforce joints between impact-resistant panels with joint tape and embedding material according to panel manufacturer's written recommendations.
- D. Moisture- and Mold-Resistant Base: Reinforce joints between moisture- and mold-resistant panels with joint tape and embedding material according to panel manufacturer's written recommendations.
- E. Cementitious Backer Units: Reinforce joints between cementitious backer units with joint tape and embedding material according to unit manufacturer's written recommendations.

3.10 FINISHING GYPSUM BOARD ASSEMBLIES

- A. Bonding Agent: Apply bonding agent on dry gypsum surfaces according to gypsum veneer plaster manufacturer's written recommendations.
- B. Gypsum Veneer Plaster Application: Comply with ASTM C 843 and with veneer plaster manufacturer's written recommendations.
 - 1. Two-Component Gypsum Veneer Plaster:
 - a. Base Coat: Trowel apply base coat over substrate to uniform thickness of (1.6 to 2.4 mm). Fill all voids and imperfections.
 - b. Finish Coat: Trowel apply finish-coat plaster over base-coat plaster to uniform thickness of (1.6 to 2.4 mm).
 - 2. Where gypsum veneer plaster abuts only metal door frames, windows, and other units, groove finish coat to eliminate spalling.
 - 3. Do not apply veneer plaster to gypsum base if paper facing has degraded from exposure to sunlight. Before applying veneer plaster, use remedial methods to restore bonding capability to degraded paper facing according to manufacturer's written recommendations.

3.11 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: Before Contractor installs gypsum board ceilings, Engineer will conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
1. Notify Engineer seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.
 2. Before notifying Engineer, complete the following in areas to receive gypsum board ceilings:
 - a. Installation of 80 percent of lighting fixtures, powered for operation.
 - b. Installation, insulation, and leak and pressure testing of water piping systems.
 - c. Installation of air-duct systems.
 - d. Installation of air devices.
 - e. Installation of mechanical system control-air tubing.
 - f. Installation of ceiling support framing.

Section no: 7 Miscellaneous Work

(7.01 & 7.02) RAILING AND HAND RAIL

A. SS Railing and Hand rail

A.1 Materials

- A.1.1 All SS plates, pipe, tube, rolled floor plate, bars etc shall be of SS304 grade and conform to the specifications as described under materials specifications Part-A of Technical Specifications. Each should have smooth, flat surface and freedom from surface blemishes. Do not use materials with exposed pitting, seam marks.
- A.1.2 Fasteners shall be conform to the specifications as described under materials specifications Part A of Technical Specifications and of the type, grade, and class required to produce connections capable of withstanding design loadings

A.2 Execution

- A.2.1 Fasteners: All mechanical fasteners used in the assembly of stainless steel or aluminum railings shall be manufactured from stainless steel.
- A.2.2 Fabrication: Exposed work shall be in true line and level with accurate angles and surfaces and edges straight or curved as indicated. Close exposed ends of railing/handrail by use of appropriate end cap. Bend metal to smallest radius that will not cause grain separation or otherwise impair work.
- a. Form (rail-to-end post connections and) all changes in rail direction by miter/radius elbows.
 - b. Cut material square and remove burrs from all exposed edges, with no chamfer.
 - c. Make exposed joints butt tight and flush.
 - d. Close exposed ends of pipe/handrail by use of appropriate end cap.
 - e. For posts set in concrete, furnish matching sleeves or inserts not less than 5 inches long.
 - f. Locate intermediate rails midway/equally spaced between top rail and finished floor or center line of tread.
 - g. Verify dimensions on site prior to shop fabrication.



- h. Fabricate center column from steel pipe welded to base plate for anchorage to floor structure. Brace column at upper floors by means of landings attached to column and floor structure, unless otherwise indicated. Provide cap for column if top is exposed.

A.2.3 Weld connections continuously to comply with the following:

- a. Use materials and methods that minimize distortion and develop strength.
- b. Obtain fusion without undercut or overlap.
- c. Remove welding flux immediately.
- d. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and, except for fillet welds, contour of welded surface matches those adjacent.

A.2.4 Exposed connections shall be formed with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.

A.2.5 Railings: Provide railing system indicated, uniformly bent to spiral shape, and continuing at top to form guard rail around floor opening.

A.2.6 Space balusters not more than 4 inches clear. Fabricate balusters per specified model.

A.2.7 Fabricate top rail from stainless-steel round tubing.

A.2.8 Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing spiral stairs to in-place construction; include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, wood screws, and other connectors as required.

A.2.9 Do not cut, alter, or drill railing components in the field that do not fit properly. Return components that do not fit to the manufacturer for adjustment.

A.2.10 Protect finished tread surfaces during construction by covering with 1/2-inch thick plywood secured with plastic strapping or another non marring fastening method.

A.3 Mode of Measurements

A.3.1 The work as fixed in place shall be measured in running meters correct to a centimeter and their weights calculated on the basis of standard tables correct to the nearest kilogram or actual weight whichever is less unless otherwise specified.

A.3.2 The rate includes cost of all material, labor, welding, riveting, bolting, erection, hoisting, scaffolding, safety measures and sundry required for proper completion of the item of work, at all heights. This shall also include conveyance and delivery, handling, loading, unloading and storing etc. required for completion the item described including necessary wastage involved.

SIGNATURE OF CONTRACTOR

SEAL

DATE

END OF SECTION

7.03 Water Proofing

A. Integral cement water proofing over terraces, etc

A.1 Material

A.1.1 Cement, water, stone aggregates of 6mm size, Bricks bats, water proofing chemicals either in liquid form or in powder form, cement mortar, etc shall conform to the specifications described under material specifications Part - A of Technical Specifications.

A.1.2 All the materials provided for the work shall get approved from the Architects before supply order is placed including specialized agency selected by the contractor for water proofing works, such as India water proofing or its equivalent.

A.1.3 Approved water proofing chemicals shall be used strictly in accordance with manufacturer's specifications

A.2 Execution

A.2.1 Unless otherwise specified proprietary waterproofing treatment shall be executed through M/s. India Waterproofing Co. or approved equivalent, who should give a guarantee of 10 years on stamp paper to the employer directly and the tender rate shall be inclusive of the same.

A guarantee bond on appropriate non 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 water or any other form of humid condition, for a period of 10 years after completion of the work of water-proofing 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 water and or other similar form of humid conditions and hereby guarantees to make good any loss or damage suffered by the Client and further guarantees to redo the affected work without claiming any extra cost.

A.2.2 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.

A.2.3 While tendering, the contractors should clearly stipulate the type of treatment proposed to be provided by them and the name and particulars of firm through whom they propose to carry out the treatment.

A.2.4 The surface to be treated shall have a minimum slope of 1 in 120 or as per drawing and as directed. The grading shall be carried out prior to the application of water proofing treatment by establishing level marks in cement mortar. The brickbats of varying size as per requirement shall be arranged in proper gradient using cement mortar 1:3 according to the desired slope. Suitable waterproofing chemical shall be added to make the C.M. water tight and then cement mortar 1:3 shall again be provided on top of the brickbats, including the waterproofing compound which shall be added in the C.M. and finishing on top with neat cement @ 2.75 kg/m². The top surface shall be finished rough as per the direction so as to receive the next finishing item.

A.2.5 The testing shall be done by ponding for at least 48 hours.

A.2.6 Well defined cracks other than hair cracks in the treated structure shall be cut to 'V' section, cleaned and then filled up flush with cement sand slurry or with bitumen conforming to IS: 702-1961, as approved.

A.2.7 The surface under treatment, part of parapet (incase of balcony or terrace) and gutters, drain mouths etc. over which the water proofing treatment is to be applied, shall be cleaned of all foreign matter such as fungus, moss and dust by wire brushing and dusting.

A.2.8 Drain outlet shall be suitably placed with respect to the surface gradient to ensure rapid drainage and prevention of local accumulation of water on the treated surface. Masonry drain mouth shall be widened sufficiently and rounded with cement mortar.

A.2.9 For cast iron drain outlets, a groove shall be cut all around to touch the treatment.

A.2.10 When a pipe passes through a roof on which water proofing treatment is to be laid, a cement concrete angle fillet shall be built round it and the water proofing treatment shall be taken over the fillet.

- A.2.11 In case of parapet wall over 400 mm in height, groove 75 mm. wide and 65 mm. deep at minimum height of 150 mm. above roof level shall be left in the vertical face at the time of construction, the horizontal face of the groove shall be shaped with cement mortar 1:4.
- A.2.12 In case of low parapet where the height does not exceed 450 mm, no groove shall be provided and the water proofing treatment shall be carried right over the top or as per drawing.
- A.2.13 In case of existing R.C.C. and stone wall cutting the chase for tucking-in the water proofing treatment is not recommended.
- A.2.14 At the junction between the roof and vertical face of the parapet wall, a fillet 75 mm. in radius shall be Constructed.
- A.2.15 At the drain mouths the fillet shall be suitably cut back and rounded off for each application of water proofing treatment and easy flow of water.
- A.2.16 Outlet at every low dividing wall about less than 300 mm. in height, shall be rounded smooth and corners rounded off for easy application of water proofing treatment.
- A.2.17 Water proofing system as described above shall have average thickness of 115mm.

A.3 Mode of Measurements

A.3.1 The measurements for this item shall be taken as under:

- Area of water proofing of roof shall be measured i.e. length and breadth shall be measured correct to a centimeter.
- Measurement shall be taken for- the superficial area of roofing and flashing treatment including flashing over the parapet wall, low dividing walls and expansion joints and at the pipe projections etc. Overlapping and tucking into flashing grooves shall not be measured extra.
- Sloping and vertical surface of water proofing treatment shall be measured under this only and no extra payment shall be given.
- In measurements, no deduction shall be made for either openings or recess for chimney stacks, roof lights etc. having areas up to 0.1 m². Deduction shall be made in measurements for full opening but nothing extra shall be paid for extra labour and materials in forming such openings, which are more than 0.10 m² in area

A.3.2 The rate includes cost of all materials and labour required to carry the works as per the above specifications. The rate also includes cleaning of surface and treating the cracks shall not be paid separately. Cutting of horizontal grooves in parapet walls for tucking in water proofing treatment shall not be measured or paid separately.

A.3.3 Measurements shall be based on the drawings or as executed on site, the lesser of the two shall be given. No extra payment shall be made for rounding and vata at the junction of two different materials. A deposit at the rate of 50% of the cost of this item from the running and final bills shall be recovered and retained for the first one year after completion of the work and 10% of the same shall be retained for the balance of the guarantee period and shall be refunded only after the completion of the guarantee period.

A.3.4 The rate shall be for all kinds of terraces, wherever called for, at all levels.

A.3.5 This item shall be measured and paid in m²

B. Integral cement water- proofing for sunk slab of toilets, balconies, etc

B.1 Materials

B.1.1 Cement, water, stone aggregates of 6mm size, Bricks bats, water proofing chemicals either in liquid form or in powder form, cement mortar, etc shall conform to the

specifications described under material specifications Part - A of Technical Specifications.

B.1.2 All the materials provided for the work shall got approved from the Architects before supply order is placed including specialized agency selected by the contractor for water proofing works, such as India water proofing or its equivalent.

B.1.3 Approved water proofing chemicals shall be used strictly in accordance with manufacturer's specifications

B.2 Execution

B.2.1 Unless otherwise specified proprietary waterproofing treatment shall be executed through M/s. India Waterproofing Co. or approved equivalent, who should give a guarantee of 10 years on stamp paper to the employer directly and the tender rate shall be inclusive of the same.

A guarantee bond on appropriate non judicial 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 water or any other form of humid condition, for a period of 10 years after completion of the work of water-proofing 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 water and or other similar form of humid conditions and hereby guarantees to make good any loss or damage suffered by the Client and further guarantees to redo the affected work without claiming any extra cost.

B.2.2 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.

B.2.3 While tendering the contractors should clearly stipulate the type of treatment proposed to be provided by them and the name and particulars of firm through whom they propose to carry out the treatment.

B.2.4 The surface to be treated shall have a minimum slope of 1 in 120 or as per drawing and as directed. The grading shall be carried out prior to the application of water proofing treatment by establishing level marks in cement mortar. The brickbats of varying size as per requirement shall be arranged in proper gradient using cement mortar 1:3 according to the desired slope. Suitable waterproofing chemical shall be added to make the C.M. water tight and then cement mortar 1:3 shall again be provided on top of the brickbats, including the waterproofing compound which shall be added in the C.M. and finishing on top with neat cement @ 2.75 kg/m². The top surface shall be finished rough as per the direction so as to receive the next finishing item.

B.2.5 The testing shall be done by ponding for at least 48 hours.

B.2.6 Well defined cracks other than hair cracks in the treated structure shall be cut to 'V' section, cleaned and then filled up flush with cement sand slurry or with bitumen conforming -to IS: 702-1961, as approved.

B.2.7 The surface under treatment, part of parapet (incase of balcony or terrace) and gutters, drain mouths etc. over which the water proofing treatment is to be applied, shall be-cleaned of all foreign matter such as fungus, moss and dust by wire brushing and dusting.

B.2.8 Drain outlet shall be suitably placed with respect to the surface gradient to ensure rapid drainage and prevention of local accumulation of water on the treated surface. Masonry drain mouth shall be widened sufficiently and rounded with cement mortar.

B.2.9 For cast iron drain outlets, a groove shall be cut all around to touch the treatment.

- B.2.10 When a pipe passes through a roof on which water proofing treatment is to be laid, a cement concrete angle fillet shall be built round it and the water proofing treatment shall be taken over the fillet.
- B.2.11 In case of parapet wall over 400 mm in height, groove 75 mm. wide and 65 mm. deep at minimum height of 150 mm. above roof level shall be left in the vertical face at the time of construction, the horizontal face of the groove shall be shaped with cement mortar 1:4.
- B.2.12 In case of low parapet where the height does not exceed 450 mm, no groove shall be provided and the water proofing treatment shall be carried right over the top or as per drawing.
- B.2.13 In case of existing R.C.C. and stone wall cutting the chase for tucking-in the water proofing treatment is not recommended.
- B.2.14 At the junction between the roof and vertical face of the parapet wall, a fillet 75 mm. in radius shall be Constructed.
- B.2.15 At the drain mouths the fillet shall be suitably cut back and rounded off for each application of water proofing treatment and easy flow of water.
- B.2.16 Water proofing system as described above shall have average thickness of 115mm.
- B.2.17 Water proofing system described as above shall have average thickness of 75mm.
- B.2.18 The same may be provided over a hot coat of bitumen layer on which stone aggregate of 6mm size is spread to receive the successive coat of water proofing as composite water proofing system if required.
- B.3 Mode of Measurements
- B.3.1 The measurements for this item shall be taken as under:
- a) Area of water proofing of roof shall be measured i.e. length and breadth shall be measured correct to a centimeter.
 - b) Measurement shall be taken for- the superficial area of roofing and flashing treatment including flashing over the parapet wall, low dividing walls and expansion joints and at the pipe projections etc. Overlapping and tucking into flashing grooves shall not be measured extra.
 - c) Sloping and vertical surface of water proofing treatment shall be measured under this only and no extra payment shall be given.
 - d) In measurements, no deduction shall be made for openings having area up to 0.1m^2 . However, deduction shall be made in measurements for full opening having area more than 0.1m^2 but nothing extra shall be paid against extra labour and/or materials occurred in forming such openings, which are more than 0.1m^2 in area.
- B.3.2 The rate includes cost of all materials and labour required to carry the works as per the above specifications. The rate also includes cleaning of surface and treating the cracks shall not be paid separately. Cutting of horizontal grooves in parapet walls for tucking in water proofing treatment shall not be measured or paid separately.
- B.3.3 Measurements shall be based on the drawings or as executed on site, the lesser of the two shall be given. No extra payment shall be made for rounding and vats at the junction of two different materials. A deposit at the rate of 50% of the cost of this item from the running and final bills shall be recovered and retained for the first one year after completion of the work and 10% of the same shall be retained for the balance of the guarantee period and shall be refunded only after the completion of the guarantee period.
- B.3.4 The rate shall be for all kinds of terraces, wherever called for, at all levels.
- B.3.5 This item shall be measured and paid in m^2

C. Bitumen water proofing to sunk slabs of toilets, balconies, etc.

C.1 Materials

C.1.1 Bitumen, stone aggregates of 6mm size, etc shall conform to the specifications described under materials specifications part A of Technical Specifications.

C.1.2 All the materials provided for the work shall be approved by the Architects before it is used.

C.2 Execution

C.2.1 Unless otherwise specified proprietary waterproofing treatment shall be executed through M/s.shalimar tar products Ltd. or approved equivalent, who should give a guarantee of 10 years on stamp paper to the employer directly and the tender rate shall be inclusive of the same.

A guarantee bond on appropriate non judicial rupees 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 water or any other form of humid condition, for a period of 10 years after completion of the work of water-proofing 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 water and/or other similar form of humid conditions and hereby guarantees to make good any loss or damage suffered by the Client and further guarantees to redo the affected work without claiming any extra cost.

C.2.2 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.

C.2.3 While tendering the contractors should clearly stipulate the type of treatment proposed to be provided by them and the name and particulars of firm through whom they propose to carry out the treatment.

C.2.4 The testing shall be done by ponding for at least 48 hours.

C.2.5 Well defined cracks other than hair cracks in the treated structure shall be cut to 'V' section, cleaned and, then filled up flush with cement sand slurry or with bitumen conforming -to IS: 702-1961, as approved.

C.2.6 The surface under treatment, part of parapet (incase of balcony or terrace) and gutters, drain mouths etc. over which the water proofing treatment is to be applied, shall be-cleaned of all foreign matter such as fungus, moss and dust by wire brushing and dusting.

C.2.7 Drain outlet shall be suitably placed with respect to the surface gradient to ensure rapid drainage and prevention of local accumulation of water on the treated surface. Masonry drain mouth shall be widened sufficiently and rounded with cement mortar.

C.2.8 For cast iron drain outlets, a groove shall be cut all around to touch the treatment.

C.2.9 When a pipe passes through a roof on which water proofing treatment is to be laid, a cement concrete angle fillet shall be built round it and the water proofing treatment shall be taken over the fillet.

C.2.10 Over cleaned surface of the sunk slab a hot coat of bitumen having minimum thickness of 4mm shall be laid as water proofing layer.

C.2.11 Over a coat of hot bitumen stone aggregates of 6mm size shall be paid and spread to all over the surface to receive successive coat of composite water proofing system.

C.3 Mode of Measurements

C.3.1 The measurements for this item shall be taken as under:

- a) Area of water proofing of roof shall be measured i.e. length and breadth shall be measured correct to a centimeter.
- b) Measurement shall be taken for- the superficial area of roofing and flashing treatment including flashing over the parapet wall, low dividing walls and expansion joints and at the pipe projections etc. Overlapping and tucking into flashing grooves shall not be measured extra.
- c) Sloping and vertical surface of water proofing treatment shall be measured under this only and no extra payment shall be given.
- d) In measurements, no deduction shall be made for openings having area up to 0.1m^2 . However, deduction shall be made in measurements for full opening having area more than 0.1m^2 but nothing extra shall be paid against extra labour and/or materials occurred in forming such openings.

C.3.2 The rate includes cost of all materials and labour required to carry the works as per the above specifications. The rate also includes cleaning of surface and treating the cracks shall not be paid separately. Cutting of horizontal grooves in parapet walls for tucking in water proofing treatment shall not be measured or paid separately.

C.3.3 Measurements shall be based on the drawings or as executed on site, the lesser of the two shall be given. No extra payment shall be made for rounding and vats at the junction of two different materials. A deposit at the rate of 50% of the cost of this item from the running and final bills shall be recovered and retained for the first one year after completion of the work and 10% of the same shall be retained for the balance of the guarantee period and shall be refunded only after the completion of the guarantee period.

C.3.4 The rate shall be for all kinds of terraces, wherever called for, at all levels.

C.3.5 This item shall be measured and paid in m^2

D. Box type water proofing with two layers of stone to floors and external surfaces for basements and under ground structures.

D.1. Materials

D.1.1 Cement, sand, water, kotah stone, water proof chemicals, cement mortar, etc shall conform to the specifications as described under materials specifications - part A of Technical specifications.

D.1.2 All the materials provided for the work shall got approved from the Architects before supply order is placed including specialized agency selected by the contractor for water proofing work such as India water proofing co. or its equivalent.

D.1.3 Approved water proofing chemicals shall be used strictly in accordance with manufacturer's specifications.

D.2 Execution

D.2.1 The box type water proofing system shall be comprised or consisting of "cet roof" water proofing layers.

D.2.2 Total thickness of "cet roof" water proofing layers system shall not be less than 100mm and the same is for floors or horizontal surfaces only.

D.2.3 The system is applied externally and over P.C.C. before raft foundation is laid.

D.2.4 The layers for 100mm thick "cet roof" water proofing system as box type water proofing shall be provided in the layers as specified below.

- a) Bottom layer-of 15 mm. thick 1:3 C.M. bedding with approved waterproofing chemical.
- b) 20 mm. to 25 mm. thick rough kotah stone laid diagonally above the 1st layer with cut joints. Joints shall be sealed by 1:1 C.M. with approved waterproofing chemical.

c) The above two layers shall be laid again, in the same manner as described above in (a) & (b).

d) The final layer of 30 mm. thick I.P.S. shall be laid with approved water proofing chemical having desired finish as directed.

D.2.5 A guarantee bond on appropriate non judicial stamp paper shall be given by the contractor to the client in the manner form as described under item A of this section.

D.3 Mode of Measurements

D.3.1 Area water proofing shall be considered for payments either as per drawing or as laid and measured at site, whichever is less.

D.3.2 Length and breadth shall be measured correct to a centimeter.

D.3.3 The surface area of finished layer only shall be measured & paid as a consolidated & specified "cet roof" layer water proofing system consisting of above specified layers and specified thickness of the system & layers.

D.3.4 The unit rate shall be for a unit of m²

E. Box type water proofing with one layer of stone to walls applied externally (i.e. to external surfaces) for basements and under ground structures.

E.1 Materials

E.1.1 Cement, sand, water, kotah stone, water proof chemicals, cement mortar etc shall conform to the specifications as described under materials specifications - part A of Technical specifications.

E.1.2 All the materials provided for the work shall got approved from the Architects before supply order is placed including specialized agency selected by the contractor for water proofing work such as India water proofing co. or its equivalent.

E.1.3 Approved water proofing chemicals shall be used strictly in accordance with manufacturer's specifications.

E.2 Execution

E.2.1 The box type water proofing system shall be comprised or consisting of "cet roof" water proofing layers.

E.2.2 Total thickness of "cet roof" water proofing layers system shall not be less than 45mm and the same is for walls / vertical surfaces only.

E.2.3 The system is applied externally and over all kinds of walls only.

E.2.4 The layers for 45mm thick "cet roof" water proofing system as Box type water proofing shall be provided in the layers as specified below.

a) Under layer of average 12 mm. thick 1:3 C.M. plaster with approved waterproofing chemical.

b) 20 mm. to 25 mm. thick rough kotah stone laid diagonally above the 1st layer with cut joints and shall be fixed with neat cement paste, minimum at four comers. Joints to be sealed by 1:1 C.M. with approved waterproofing chemical.

c) After the above layer smooth plaster 10 mm. thick shall be applied over kotah stone in C.M. 1:3 with approved water proofing chemical.

d) After this the surface shall be finished smooth with cement slurry with approved water proofing chemical (If required sand can be added in small quantity as directed).

E.2.5 A guarantee bond on appropriate non judicial stamp paper shall be given by the contractor to the client in the manner form as described under item A of this section.

E.3 Mode of Measurements



- E.3.1 Area water proofing shall be considered for payments either as per drawing or as laid and measured at site, whichever is less.
- E.3.2 Length and breadth shall be measured correct to a centimeter.
- E.3.3 The surface area of finished layer only shall be measured & paid as a consolidated & specified "cet roof" layer water proofing system consisting of above specified layers and specified thickness of the system & layers.
- E.3.4 The unit rate shall be for a unit of m²

7.04 Mural Work

Supply & erection of custom Rock mural wall cladding in waterfall area including lift area.

The unit rate shall be for a unit of m²

7.05 Cleaning and Grubbing

Clearing and grubbing road land including uprooting rank vegetation grass bushes, shrubs, sapling and trees girth up to 300 mm removal of stumps of trees cut earlier and disposal of unserviceable materials (D) By mechanical means in area of thorny jungle

Scope of work

The item consist of cleaning of site by manual means in the area of light jungles and disposal of same to all lead and lift complete as directed by EIC/Architect

Mode of Payment:

The item shall be measured in Hectare.

7.06 SIGNAGES

13.1 VISUAL DISPLAY SURFACES

1 GENERAL

1.0.0.1 SUMMARY

1.0.0.1.1 Section Includes:

1.0.0.1.1.1 Tackboards.

1.0.0.1.1.2 Glass Writing Boards.

1.0.0.2 SUBMITTALS

1.0.0.2.1 Product Data: For each type of product indicated.

1.0.0.2.2 LEED Submittal:

1.0.0.2.2.1 Product Data for Credit EQ 4.4: For composite wood products, documentation indicating that the product contains no urea formaldehyde.

1.0.0.2.3 Shop Drawings: For visual display surfaces. Include plans, elevations, sections, details, and attachments to other work.

1.0.0.2.3.1 Show locations of panel joints.

1.0.0.2.3.2 Include sections of typical trim members.

1.0.0.2.4 Samples: For each exposed product and for each color and texture specified.

1.0.0.2.5 Qualification Data: For qualified Installer.

1.0.0.2.6 Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of fabrics.

1.0.0.2.7 Maintenance Data: For visual display surfaces to include in maintenance manuals.



1.0.0.2.8 Warranties: Sample of special warranties.

1.0.0.3 **QUALITY ASSURANCE**

1.0.0.3.1 Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of motor-operated, sliding visual display units required for this Project.

1.0.0.3.2 GLASS Vinyl Fabric: Mildew resistant, washable, complying with FS CCC-W-408D, Type II, weighing not less than 13 oz./sq. yd. (440 g/sq. m); with surface-burning characteristics indicated.

1.0.0.3.3 Preinstallation Conference: Conduct conference at Project site.

2 PRODUCTS

2.5.1.1 **TACKBOARD PANELS TB**

2.5.1.1.1 Basis-of-Design Product:

2.5.1.1.1.1 Marsh Industries, Inc.: KOROSEAL "BELAIR" 15oz type I vinyl

2.5.1.1.2 Vinyl-Fabric-Faced Factory Tackboard: ~~1/16-inch-~~ (1.6-mm-) thick, vinyl-fabric-faced with 1/8-inch (3.2 mm) cork sheet factory laminated to ~~1/8-inch-~~ (6.4-mm-) thick fiberboard backing.

2.5.1.1.2.1 Size: 60" wide x 40" height

2.5.1.1.2.2 Adhesive: Non-staining, non-pigmented recommended by manufacturer.

2.5.1.1.2.3 Wrap panel core material with vinyl covering edges and returning fabric approximately 2 inches on back of panel.

2.5.1.1.2.4 Concealed Hanger Bar for Mounting.

2.5.1.1.2.5 Clear Satin Anodized Aluminum Frame.

2.5.1.2 **GLASS WRITING BOARDS GB**

2.5.1.2.1 Basis-of-Design Product:

2.5.1.2.1.1 TK-Team

2.5.1.2.1.2 Egan Visual Inc.

2.5.1.2.2 Construction: 3/8" [10 mm] Laminated Glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written recommendations magnet compatible.

2.5.1.2.2.1 Laminated Glass made from multiple plies of uncoated, clear float glass.

2.5.1.2.2.2 Interlayer Color: White Frosted.

2.5.1.2.2.3 Polished square edges.

2.5.1.2.2.4 Concealed Fixings / Glazing Gasket: Refer to the drawing detail.

2.5.1.2.2.5 Size: Refer to the drawing detail.

2.5.1.2.2.6 Laminating Adhesive: Manufacturer's standard, moisture-resistant thermoplastic type.

2.5.1.2.3 Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

2.5.1.3 **FABRICATION**

2.5.1.3.1 Visual Display Boards: Factory assemble visual display boards unless otherwise indicated.



2.5.1.3.1.1 Where factory-applied trim is indicated, trim shall be assembled and attached to visual display boards at manufacturer's factory before shipment.

2.5.1.3.2 Factory-Assembled Visual Display Units: Coordinate factory-assembled units with trim and accessories indicated. Join parts with a neat, precision fit.

2.5.1.3.2.1 Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints.

2.5.1.3.2.2 Where size of visual display boards or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.

2.5.1.3.3 Modular Visual Display Boards: Fabricated with integral panel clips attached to core material.

2.5.1.3.4 Aluminum Frame: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to a neat, hairline closure.

2.5.1.3.4.1 Where factory-applied trim is indicated, trim shall be assembled and attached to visual display units at manufacturer's factory before shipment.

2.5.1.4 **ALUMINUM FINISHES**

2.5.1.4.1 Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

2.5.1.4.2 Color Anodic Finish: AAMA 611, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

3 EXECUTION

3.5.1.1 **INSTALLATION**

3.5.1.1.1 Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display surfaces and wall surfaces.

3.5.1.1.2 General: Install visual display surfaces in locations and at mounting heights indicated on Drawings. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

3.5.1.1.3 Visual Display Boards: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display boards with fasteners at not more than **16 inches (400 mm)** o.c. Secure both top and bottom of boards to walls.

3.5.1.1.3.1 Mounting Height: **72 inches (1829 mm)** above finished floor to top of cabinet.

3.5.1.1.4 Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room. Cover and protect visual display surfaces.

SIGNATURE OF CONTRACTOR

SEAL

DATE

END OF SECTION

7.07 Benches

Benches

Providing and Fixing Indian CP teak wood furniture work for various decks like benches... All wood work framing such as sitting stands, foot rest, legs, etc.. shall fabricate from wooden

batterns with any shape and size treated with Anti-Termite and Painted with Spar Varnish respectively under related line item specification under approved make list and manufacturer specifications. Table and benches shall have with clear top, comprising of 50mm thick best quality Indian CP teak wood, of size 2000mmx700mm (Clear Plank Size: 2000mmx233mm) & 2000mmx450mm (Clear Plank length not less than 2000mm) respectively fixed on Wooden frame work clear top area of any component. It allows: i) All wooden members shall be of seasoned teak wood treated with anti-termite chemical ii) wood plank top shall be treated with exterior grade Spar varnish of MRF/ASIAN or approved per manufacturer specification. Bottom of wood plank floor shall be treated with 2-coats of Black Japan paint with respective primer and application methodology as directed by EIC iii) All supporting post at any interval shall be interlocked and fixed rigidly with planks/metal cleats, screws, nuts & bolts-check nuts (60microne Hot deep Galv./ SS-304) and heavy duty virgin nylon buffers rigidly fixed to post etc.. complete in true line level and alignment to avoid rattle during usage and per details approved. All Wooden frame structures shall be treated with Spar varnish under relevant tender item and mfg. specs. iv) Various types of molding, grooves, kholiya etc.. shall be dressed with machine and finished in lucrative manner with proper joinery & jointed by inserting z-clips & pins on joints as approved per shop drawing. v) All necessary fittings, fixtures, nut bolts, washer, plates, customize detail for fixing and fittings, exterior grade glues & adhesive, etc. comp. all SS304 shall be with matt / brush finish as desired by architect to complete the entire product with satisfactory level. vi) it shall be wrapped with fixed chapda at specified interval per approved shop drawing with SS-304 patti having min. size 25mmx1mm with SS nails. vii) It shall be touched up for pin holes, hair cracks with wood saw and adhesive & smoothen. viii) Entire wood deck furniture shall be covered with bubble wrapper to protect the floor against scratches and hand over with neat & clean manner at level of satisfaction of EIC. No extra charge shall be paid in any case. At least one make-up shall be prepared as directed by Architect without any extra cost for approval. Seating Benches (2.5 mtr. Length (2500 mm x 450 mm x 500 mm (Ht))

7.08 Demolition of Flooring work

Dismantling tiled of stone floors laid in mortar including stacking of serviceable materials and disposal of unserviceable materials with all lead and lift.

Scope of work

Specification shall be conform to General Technical Specification Booklet for Building works.

Mode of Payment:Rate shall be for a unit of one Sqm.

7.09 Cement Fibre Board

Providing and Fixing 8 mm thick fire resistant heavy duty Cement Fibre Board (High pressure steam cured) Confirming to ASTM C1185 and ISO 8336 Part (E) in wall of one face of cold formed galvanised light gauge steel frame structure to form wall / partition as & Where directed by Engineer-in-Charge

Scope of Work

For Cladding

Material : Shera board or ECOPRO Pre coloured moisture board

A.General: Install attachment system required to support wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.

1.Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.

2.Do not begin installation until weather barrier and flashings that will be concealed by Fibre Board are installed.

B.Track-Support Installation: Provide manufacturer's standard horizontal and vertical tracks that provide support and complete secondary drainage system, draining to the exterior at horizontal joints. Install support system at locations, spacings, and with fasteners recommended by manufacturer. Attach panels to wall by interlocking tracks with perimeter

extrusions attached to wall panels. Fully engage integral gaskets and leave horizontal and vertical joints with open reveal.

1. Attach routed-and-turned flanges of wall panels to perimeter extrusions with manufacturer's standard fasteners.
2. Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
 - a. Do not apply sealants to joints, unless otherwise indicated on Drawings.
3. Install wall panels, Slab Bottom, soffits and copings as a continuous cladding system that is fully flashed, free draining and cannot leak, or be drawn into wall cavities or other interior spaces of the building.
4. All cutouts in panels, around pipes, conduits and other mechanical, and electrical appurtenances shall be tightly fitted over the pipe and sealed with matching sealant.

Mode of Payment: Rate shall be for a unit of one Smt.

Section No: 8 Masonry Work

(8.01 to 8.05)

A. Solid Pre-cast Concrete Block of 1:2:4 C.C. Masonry (200mm thick & above)

A.1 Materials

- A.1.1 Aggregates (20mm size) sand, cement, water and cement mortar of specified proportion shall conform to the specifications described under material specifications - part A of Technical Specifications.
- A.1.2 The cement concrete block shall be pre-cast with concrete of 1:2:4 mix (1 cement: 2 graded sand: 4 graded stone aggregate).
- A.1.3 A block shall be deemed to be solid if the solid material is not less than 75% of the total volume of the block calculated from over all dimensions.
- A.1.4 The actual size of the blocks shall be as per the drawing. The size other than those specified or shown on drawing may be used with the approval of the Architect.
- A.1.5 The blocks may be either machine made or hand made. The concrete mix, the mixing of concrete, the manufacturing of blocks, curing and drying shall be accordance with para-6 to 10 of IS: 2185-1967.
- A.1.6 Faces of blocks shall be flat and rectangular. Surface finish shall be rendered smooth or plastered with C.M. 1:3 (1 cement: 3 coarse sand), as directed.
- A.1.7 The average compressive strength of 8 blocks, when determined in the manner described in IS: 2185- 1967, shall not be less than 50 Kg/cm² of gross area. The lowest strength of an individual block shall not be less than 75% of average compressive strength of the 8 blocks.
- A.1.8 Concrete blocks shall be stored and stacked properly in such a way to avoid any contact with moisture at site. They shall be stock piled on planks or other supports free from contact with ground and covered to protect against wetting.
- A.1.9 All the materials shall be approved by Architects/Structural consultant before use.

A.2 Execution

A.2.1 General

The blocks need not be wetted before or during laying in the walls. In case climatic conditions so required, the top and sides of may only be slightly moistened so as to prevent absorption of water from the mortar and ensure the development of required bond with mortar.

A.2.2 Joints

Operations of laying pre-cast cement concrete block masonry shall be carried out in accordance with instructions detailed in IS: 6042-1962. The mortar shall not be spread



so much ahead of the actual laying of the units that it tends to stiffen and lose its plasticity thereby resulting in poor bond. For most of the work; mortar shall be spread over the entire top surface of the block so that the horizontal joint shall be 10 mm. thick except in the case of extended joint construction. The mortar joints shall be struck off flush with wall surface and when the mortar has started stiffening, it shall be compressed with rounded or U-shaped tool. The mortar shall be pressed against the units with a jointing tool after the mortar has stiffened in effect intimate contact between the mortar and the masonry unit and obtained a weather tight joint. Normally full mortar bedding shall be adopted as it shall enable full utilization of the load carrying capacity, however, where walls shall carry lighter loads, the mortar shall be spread only over the front and rear shells and not on the webs. This shall arrest the seepage of water through the joints.

For vertical joints, the mortar shall be applied on the vertical edges of the front and rear shells of the blocks. It shall be more convenient to apply mortar on the edges of the succeeding units and then placing it horizontally well-pressed against the previously laid unit. It may be necessary to add mortar, particularly to the vertical joints, to ensure that they are well-filled.

A.2.3 Laying:

The first course shall be laid with great care, making sure that it is properly aligned, leveled and plumbed. The blocks for this course shall be first laid without mortar, over the footing, along the string lightly stretched, to determine the correct position and also adjust their spacing. When the blocks are set in proper position, the 2 corner blocks are removed, a full mortar bed is spread for them on the footing and are then laid back again in place, truly level and plumb. The string is then stretched tightly along the faces of the two corner blocks. Thereafter, each block shall be removed and re-laid over a bed of mortar, with their faces to coincide with the string line. After every 3 or 4 blocks have been laid, their correct alignment, level and verticality shall be checked.

- A.2.4 Quoins and Closer: Special quoins blocks (with a return face equal to half the length of normal face) shall be cast for all building blocks and slabs and for external work. Proper half length closer shall be cast and not cut from full size blocks. The returned ends of blocks for doors and windows shall be finished with a fair face in the mould.

Construction of, the wall may be started either at the corners first or from one end proceeding on the other direction. If the corners shall be built first, they shall be built four or five courses higher than the center of the wall. Each block shall be checked with a level or straight edge to ascertain that the blocks are in one plane. Each course, shall be stepped back by half-block and the horizontal spacing of the block shall be checked by placing a mason's level diagonally across the corners of the block.

- A.2.5 Only double scaffolding shall be used. The scaffolding shall be strong and sound. No holes in the masonry for supporting shall be allowed.
- A.2.6 The curing of concrete block masonry shall be carried out at least for 7 days, as directed.

A.3. Mode of Measurements

- A.3.1 The measurement of this item shall be taken for the block masonry fully completed in foundation up to plinth and for super structure too. 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.
- A.3.2 No deduction shall be made from the quantity of block work, nor any extra payment shall be made for embedding in masonry or making holes in respect of following items:
- End of joists beams, posts, girders, rafters, purlins, trusses, corbel, steps etc. where cross sectional area does not exceed 500 cm².

- b. Architectural openings in walls, parapet and compound walls, not exceeding 1.0 m² area.
- c. 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.
- d. 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.
- e. Iron fixtures, pipes up to 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.
- f. Forming chases of section not exceeding 350 CM² in masonry.

- A.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, pattaas, work in narrow & small width residues, mitered & returned ends, etc.
- A.3.4 The rate shall also include the work around pipes, fixtures, fittings, cutting & making good around R.C.C. / Steel members, etc
- A.3.5 The work of concrete block masonry for all floors, at any height and level shall be measured under this item.
- A.3.6 The rate includes the cost of quoin block, jamb block, closers, etc required for masonry work.
- A.3.7 Plastering done for surface finishing shall be measured & paid separately.
- A.3.8 The unit rate shall be for a unit of one m³.

B. Solid Pre-cast Block of 1:2:4 C.C. Masonry (From 90mm thick to less than 200mm thick)

B.1 Materials

- B.1.1 Aggregates (20mm size) sand, cement, water and cement mortar of specified proportion shall conform to the specifications described under material specifications - part A of Technical Specifications
- B.1.2 The cement concrete block shall be precast with concrete of 1:2:4 mix (1 cement: 2 graded sand: 4 graded stone aggregate).
- B.1.3 A block shall be deemed to be solid if the solid material is not less than 75% of the total volume of the block calculated from over all dimensions.
- B.1.4 The actual size of the blocks shall be as per the drawing. The size other than those specified or shown on drawing may be used with the approval of the Architect.
- B.1.5 The blocks may be either machine made or hand made. The concrete mix, the mixing of concrete, the manufacturing of blocks, curing and drying shall be accordance with para-6 to 10 of IS: 2185-1967.
- B.1.6 Faces of blocks shall be flat and rectangular. Surface finish shall be rendered smooth or plastered with C.M. 1:3 (1 cement: 3 coarse sand), as directed.
- B.1.7 The average compressive strength of 8 blocks, when determined in the manner described in IS: 2185- 1967, shall not be less than 50 Kg/cm² of gross area. The lowest strength of an individual block shall not be less than 75% of average compressive strength of the 8 blocks.

B.1.8 Concrete blocks shall be stored and stacked properly in such a way to avoid any contact with moisture at site. They shall be stock piled on planks or other supports free from contact with ground and covered to protect against wetting.

B.1.9 All the materials shall be approved by Architects/Structural consultant before use.

B.2 Execution

B.2.1 General

The blocks need not be wetted before or during laying in the walls. In case climatic conditions so required, the top and sides of may only be slightly moistened so as to prevent absorption of water from the mortar and ensure the development of required bond with mortar.

B.2.2 Joints

Operations of laying pre-cast cement concrete block masonry shall be carried out in accordance with instructions detailed in IS: 6042-1962. The mortar shall not be spread so much ahead of the actual laying of the units that it tends to stiffen and loose its plasticity. thereby resulting in poor bond. For most of the work; mortar shall be spread over the entire top surface of the block so that the horizontal joint shall be 10 mm. thick except in the case of extended joint construction. The mortar joints shall be struck off flush with wall surface and when the mortar has started stiffening, it shall be compressed with rounded or U-shaped tool. The mortar shall be pressed against the units with a jointing tool after the mortar has stiffened in effect intimate contact between the mortar and the masonry unit and obtained a weather tight joint. Normally full mortar bedding shall be adopted as it shall enable full utilization of the load carrying capacity, however, where walls shall carry lighter loads, the mortar shall be spread only over the front and rear shells and not on the webs. This shall arrest the seepage of water through the joints.

For vertical joints, the mortar shall be applied on the vertical edges of the front and rear shells of the blocks. It shall be more convenient to apply mortar on the edges of the succeeding units and then placing it horizontally well-pressed against the previously laid unit. It may be necessary to add mortar, particularly to the vertical joints, to ensure that they are well-filled.

B.2.3 Laying:

The first course shall be laid with great care, making sure that it is properly aligned, leveled and plumbed. The blocks for this course shall be first laid without mortar, over the footing, along the string lightly stretched, to determine the correct position and also adjust their spacing. When the blocks are set in proper position, the 2 corner blocks are removed, a full mortar bed is spread for them on the footing and are then laid back again in place, truly level and plumb. The string is then stretched tightly along the faces of the two corner blocks. Thereafter, each block shall be removed and re-laid over a bed of mortar, with their faces to coincide with the string line. After every 3 or 4 blocks have been laid, their correct alignment, level and verticality shall be checked.

B.2.4 Quoins and Closer: Special quoins blocks (with a return face equal to half the length of normal face) shall be cast for all building blocks and slabs and for external work. Proper half length closer shall be cast and not cut from full size blocks. The returned ends of blocks for door and windows shall be finished with a fair face in the mould.

Construction of, the wall may be started either at the corners first or from one end proceeding on the other direction. If the corners shall be built first, they shall be built four or five courses higher than the center of the wall. Each block shall be checked with a level or straight edge to ascertain that the blocks are in one plane. Each course, shall be stepped back by half-block and the horizontal spacing of the block shall be checked by placing a mason's level diagonally across the corners of the block.

B.2.5 Only double scaffolding shall be used. The scaffolding shall be strong and sound. No holes in the masonry for supporting shall be allowed.

B.2.6 The curing of concrete block masonry shall be carried out at least for 7 days, as directed.

B.3 Mode of Measurements

B.3.1 The measurement of this item shall taken for the block masonry fully completed in foundation up to plinth and for super structure too. 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.

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

- a. End of joists beams, posts, girders, rafters, purlins, trusses, corbel, steps etc. where cross sectional area does not exceed 500 cm².
- b. Architectural openings in walls, parapet and compound walls, not exceeding 1.0 m² area.
- c. 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.
- d. 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.
- e. Iron fixtures, pipes up to 300 mm. diameter. 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.
- f. Forming chases of section not exceeding 350 CM² in masonry.

B.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, pattaas, work in narrow & small width residues, mitered & returned ends, etc.

B.3.4 The rate shall also include the work around pipes, fixtures, fittings, cutting & making good around R.C.C. / Steel members, etc

B.3.5 The work of concrete block masonry for all floors, at any height and level shall be measured under this item.

B.3.6 The rate includes the cost of quoin block, jumb block, closers, etc required for masonry work.

B.3.7 Plastering done for surface finishing shall be measured & paid separately.

B.3.8 The unit rate shall be for a unit of one m².

C. Hollow Pre-cast Concrete Block of 1:2:4 C.C. Masonry (200mm thick & above)

C.1 Materials

C.1.1 Aggregates (20mm size) sand, cement, water and cement mortar of specified proportion shall conform to the specifications described under material specifications - part A of Technical Specifications.

C.1.2 The blocks need not be wetted before or during laying in the walls. In case climatic conditions so required, the top and sides of may only be slightly moistened so as to

prevent absorption of water from the mortar and ensure the development of required bond with mortar.

- C.1.3 The actual size' of the blocks shall be as per the drawing. The size other than those specified or shown on the drawing may be used with the approval of Architects.
- C.1.4 Faces of blocks shall be flat and rectangular. Surface finish shall be rendered smooth or plastered with C.M. 1:3 (1 cement: 3 coarse sand) as directed.
- C.1.5 The average compressive strength of eight blocks when determined in the manner described in IS: 2185 - 1967 shall not be less than 50 Kg/cm² of gross area. The lowest strength of an individual block shall not be less than 75% of average compressive strength of eight blocks.
- C.1.6 Concrete blocks shall be stored and stacked properly in such a way to avoid any contact with moisture at site. They shall be stock piled on planks or other supports free from contact with ground and covered to protect against wetting.
- C.1.7 The blocks may be either machine made or hand made. The concrete mix, the mixing of concrete, the manufacture of blocks, curing and drying shall be accordance with pars-6 to 10 of IS: 2185-1967.
- C.1.8 All the materials shall be approved by Architects/Structural consultant before use.

C.2 Execution

- C.2.1 The relevant specification as described under 'A' of this section shall be applicable & followed. However, in addition, followings shall be applicable too.
- C.2.2 For provision of Door and window frames
 - a) A course of solid block masonry shall be provided under the door and window openings or a 10 cm. thick pre-cast concrete sill-block under the windows. This solid course shall extend for at least 20 cm. beyond the opening, on either side.
 - b) For iambs of very large doors and windows, either solid blocks shall be provided or the hollow blocks used shall be filled with concrete mix of 1:3:6.
 - c) Mild steel holdfasts shall be so fixed that they coincide with the block course level. Their ends shall be embedded in the hollow, which has to be filled with concrete mix 1:3:6.

C.3 Mode of Measurements

- C.3.1 The measurement of this item shall taken for the block masonry fully completed in foundation up to plinth and for super structure too. 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.
- C.3.2 No deduction shall be made from the quantity of block work, nor shall any extra payment be made for embedding in masonry or making holes in respect of following, items:
 - a. End of joists beams, posts, girders, rafters, purlins, trusses, corbel, steps etc. where cross sectional area does not exceed 500 cm².
 - b. Architectural openings in walls, parapet and compound walls, not exceeding 1.0 m² area.
 - c. 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.
 - d. 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.

- e. Iron fixtures, pipes up to 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.
- f. Forming chases of section not exceeding 350 CM² in masonry.

- C.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, pattaas, work in narrow & small width residues, mitered & returned ends, etc.
- C.3.4 The rate shall also include the work around pipes, fixtures, fittings, cutting & making good around R.C.C. / Steel members, etc
- C.3.5 The work of concrete block masonry for all floors, at any height and level shall be measured under this item.
- C.3.6 The rate includes the cost of quoin block, jumb block, closers, etc required for masonry work.
- C.3.7 Plastering done for surface finishing shall be measured & paid separately.
- C.3.8 The unit rate shall be for a unit of one m³.

D. Hollow Pre-cast Concrete Block of 1:2:4 C.C. Masonry (100mm thick to 190mm thick)

D.1 Materials

- D.1.1 Aggregates (20mm size) sand, cement, water and cement mortar of specified proportion shall conform to the specifications described under material specifications - part A of Technical Specifications
- D.1.2 The actual size' of the blocks shall be as per the drawing. The size other than those specified or shown on the drawing may be used with the approval of Architects.
- D.1.3 Faces of blocks shall be flat and rectangular. Surface finish shall be rendered smooth or plastered with C.M. 1:3 (1 cement: 3 coarse sand) as directed.
- D.1.4 The average compressive strength of eight blocks when determined in the manner described in IS: 2185 - 1967 shall not be less than 50 Kg/cm² of gross area. The lowest strength of an individual block shall not be less than 75% of average compressive strength of eight blocks.
- D.1.5 The blocks may be either machine made or hand made. The concrete mix, the mixing of concrete, the manufacture of blocks, curing and drying shall be accordance with pars-6 to 10 of IS: 2185-1967.
- D.1.6 All the materials shall be approved by Architects/Structural consultant before use.

D.2 Execution

- D.2.1 The relevant specification as described under 'A' of this section shall be applicable & followed. However, in addition to the same followings shall be applicable too.
- D.2.2 The relevant specifications of item no. 4.13.a shall be followed and in addition to that the following shall be followed

For provision of Door and window frames

- a) A course of solid block masonry shall be provided under the door and window openings or a 10 cm. thick pre-cast concrete sill-block under the windows. This solid course shall extend for at least 20 cm. beyond the opening, on either side.
- b) For iambs of very large doors and windows, either solid blocks shall be provided or the hollow blocks used shall be filled with concrete mix of 1:3:6.

- c) Mild steel holdfasts shall be so fixed that they coincide with the block course level. Their ends shall be embedded in the hollow, which has to be filled with concrete mix 1:3:6.

D.3 Mode of Measurement

- D.3.1 The measurement of this item shall be taken for the block masonry fully completed in foundation up to plinth and for super structure too. 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.
- D.3.2 No deduction shall be made from the quantity of block work, nor any extra payment shall be made for embedding in masonry or making holes in respect of following, items:
- End of joists beams, posts, girders, rafters, purlins, trusses, corbel, steps etc. where cross sectional area does not exceed 500 cm².
 - Architectural openings in walls, parapet and compound walls, not exceeding 1.0 m² area.
 - 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.
 - 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.
 - Iron fixtures, pipes up to 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.
 - Forming chases of section not exceeding 350 CM² in masonry.
- D.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, pattaas, work in narrow & small width residues, mitered & returned ends, etc.
- D.3.4 The rate shall also include the work around pipes, fixtures, fittings, cutting & making good around R.C.C. / Steel members, etc
- D.3.5 The work of concrete block masonry for all floors, at any height and level shall be measured under this item.
- D.3.6 The rate includes the cost of quoin block, jumb block, closers, etc required for masonry work.
- D.3.7 Plastering done for surface finishing shall be measured & paid separately.
- D.3.8 The unit rate shall be for a unit of one m³.

E. Light weight Concrete Block- A.A.C Blocks.

E.1 Material:

The light weight block shall be of Siporex (India) manufacture or equivalent. The blocks shall have thickness of 200 mm, 150 mm, 100 mm for load bearing walls, partitions and cladding work, etc. The blocks shall have a maximum density of 640 kg / cu.m. or less.

E.2 Structural Strength requirement:

- a) Compressive Strength: The light weight concrete block shall have a minimum compressive strength of 35 kg / sq.cm.

b) Bending Compression: 15 kg / sq.cm.

- E.3 The mortar used for light weight concrete block shall be as specified in the Schedule of Items; Cement and water used in mortar shall conform to the quality as described in 'Concrete', whereas sand used for mortar shall be fine screened only. The cement mortar shall be admixed with Cemex (Snowcem India) powder at a rate of one packet (100 gms) per bag (50 kg) of cement.
- E.4 The light weight concrete block masonry should not be used below ground or in plinth. The block masonry work shall be built in stretcher course only.
- E.5 The light weight concrete block (Siporex or equivalent) wall of required thickness as described in Schedule of Items, shall be constructed with R.C.C. vertical and horizontal stiffeners, of required size at suitable intervals, as directed by the Engineer-in-Charge, or as per drawing. R.C.C. and steel reinforcement shall be measured and paid for separately.
- E.6 The masonry work shall be raised truly in plumb. All courses shall be laid truly horizontal and all vertical joints shall be truly vertical. The vertical joints should be not more than 12mm thick and shall be fully filled from the top with cement mortar without any void in masonry.
- E.7 All face joints shall be raked out to a minimum depth of 15 mm. by raking tool, during the progress of the work, when the mortar is still green, so as to provide proper key for the plaster or pointing.
- E.8 All fixtures, pipes, outlets of water, holdfasts, of doors, windows, which are required to be built into the block masonry, shall be embedded in mortar or cement concrete, as specified, in correct position, as the work proceeds and as directed by the Engineer-in-Charge.
- E.9 After masonry work is over, the masonry shall be marked with date of construction, visible for inspection and curing.

E.10 Curing:

All joints of block masonry shall be kept constantly moist by sprinkling water on all joints for a minimum period of seven days.

E.11 Scaffolding:

Same as described in for Brick masonry.

F. Uncoarsed rubble Masonry with hard stone

F.1 Materials

F.1.1 Stones, Cement, Sand, Water and Cement mortar of specified proportion shall conform to the specifications described under material specification part A of Technical Specifications

F.1.2 The minimum crushing strength shall be as specified for respective item.

F.1.3 Stones/rubble provided & used shall be from one quarry only as approved for entire work.

F.1.4 All the materials shall be approved by Architects/Project Manager before use.

F.2 Execution

F.2.1 Dressing of Stones: Stone used for uncoarsed rubble masonry work shall be hammer dressed on the sides and beds in such a way as to close up with the adjacent stone in the masonry work as strongly as possible. The face stone shall be dressed in such a manner as to give a specified pattern such as diagonal touching etc. The face of the stone shall be so dressed that brushing on the exposed face shall not project by more than 20 mm. from the general wall surface and on the face to be plastered, it shall not

project by more than 19 mm. nor shall have depressions more than 10 mm. from the average wall surface.

F.2.2 Laying:

All the stone shall be sufficiently wetted before laying to prevent absorption of water from mortar. The wall shall be built truly in plumb (or true to required batter when so specified). All connected walls in a structure shall normally be raised up uniformly and regularly. However, if for any specific reason, one part of masonry is required to be left behind, the wall shall be racked back at an angle not steeper than 45°, vertical toothed joints in masonry shall not be allowed. The work shall be carried out regularly and masonry of any day will not be raised by more than 1 m. in height, at a time.

The stone shall be laid in an uncoarsed fashion or random facing etc. However, the masonry is required to be brought to level at various stages viz. plinth level, window sill level, roof level and any other level specifically shown in the drawings. This may be done by adjusting the laying of stones up to the level specified or the nearest to that level and then by providing leveling course of cement concrete 1:6:12 (1 cement: 6 sand: 12 graded stone aggregate 20 mm. nominal size) to bring the masonry work up to the desired level or as otherwise specified.

Proper bonding shall be achieved by closely filling in adjacent stones as well as by using bond stones or through stones as described herein below. Face stones shall extend back sufficiently and bond well with the masonry. The stone shall be carefully set so as to break joints and avoid formation of vertical joints. The depth of stone from the face of wall inward shall not be less than height or breadth at the face. The hearting or interior filling of the wall shall consist of rubble stones which may be of any shape. Neither the face stone nor the hearting stone shall be so small to pass through circular ring of 150 mm. internal diameters in any direction nor shall any of them shall have minimum thickness 100 mm.

All stone shall be carefully laid, hammered down by a wooden mallet into position and solidly embedded in mortar. Chips of stone may be used wherever necessary to avoid thick mortar beds or joints. At the same time no hollow space shall be left anywhere in the masonry. The chips used shall not be more than 20% by volume of masonry. The hearting stone shall be laid nearly in level with face stones except at vertical bond stone laid at 1 m. intervals or plumbs projecting about 150 to 200 mm. shall be firmly embedded to form vertical bonding in masonry.

- F.2.3 Bond stones or through stones running right across the thickness of the wall shall be provided in walls up to 600 mm. thick. In thicker walls two stones overlapping each other by at least 150mm. shall be provided across the thickness of the wall to form bond stones. There shall be at least one bond stone for every 0.5 m² of walls surface. The bond stone shall be marked by a distinguishing letter 69 during construction for subsequent verification and shall be laid staggered in subsequent layers.
- F.2.4 Quoins: The quoins or corner stone shall be selected stone neatly dressed with hammer and/or chisel to form the required corner angle and laid header and stretcher alternatively. The bed and top surface of quoins shall be chiseled, dressed to give horizontal joints. The quoins shall have a uniform chisel draft of at least 25 mm width at four edges of each exposed face, all the edges of the same face being in one plane. No quoin stones shall be smaller than 0.025 m³ in volume.
- F.2.5 Jamb Stones: The jamb stone shall be made with stone specified for quoins, except that the stone provided on the jambs shall have their length equal to thickness of wall up to 600 mm. and a line of headers shall be provided for walls thicker than 600 mm. as specified for bond.
- F.2.6 Joints: All the joints shall be completely filled with mortar and their width shall not exceed 25 mm. When plastering or pointing is not required to be done, the joints shall be struck and finished simultaneously while laying the stone. Otherwise the joints shall be racked to a minimum depth of 20 mm. by racking tools, during progress of laying while the mortar is still green.

F.2.7 Scaffolding: Single or double scaffolding shall be used. The scaffolding shall be strong and sound. The holes left in masonry for supporting scaffolding shall be filled and made good before plastering or pointing.

F.2.8 Curing: Green work shall be protected from rains by suitably covering the same. Masonry shall be kept constantly moist on all the faces at least for a period of 7 days. The top of masonry shall be flooded at the close of the day.

F.3.Mode of Measurements

F.3.1 All work shall be measured on the basis of finished dimensions and measured net except where otherwise specified. Only specified dimensions shall be allowed. Anything extra shall not be measured and paid for. The masonry work done at all levels shall be measured under this item. No deduction shall be made nor extra payment shall be made for the following

- a) Ends of joints, beams, posts, girders, rafters, purlins; trusses, corbels, etc. each up to 500 cm² in section.
- b) Opening each up to 0.1 m².
- c) Wall plates and bed plates bearings of chhajja and like up to 10 cm. depth (hearing of floor and roof slabs shall be deducted from masonry).
- d) Drain holes and recesses for cement concrete block to embed holdfasts for doors and windows.
- e) Building in the masonry iron fixtures pipes up to 300 mm. diameter holdfasts of doors and windows.
- f) Forming chases in masonry up to section of 350 cm².

F.3.2The unit rate shall be for a unit of one m³.

G. Coursed Rubble Masonry

G.1Materials

G.1.1 Stones, Cement, Sand, Water and Cement mortar of specified proportion shall conform to the specifications described under material specification part A of Technical Specifications

G.1.2The minimum crushing strength shall be as specified for respective item.

G.1.3 Stones/rubble provided & used shall be from one quarry only as approved for entire work.

G.1.4All the materials shall be approved by Architects/Project Manager before use.

G.2Execution

G.2.1 Dressing of Stone: The face stone shall be hammer dressed so as to give approximately rectangular block shape. They shall be squared on bed and side joints. The bed joints shall be rough chisel dressed for a depth of at least 50 mm. back from the faces and the side joints shall be dressed to a depth of at least 40 mm. back from the face, such that no portion of the dressed surface shall be projected more than 10 mm. from a straight edge held against the surface. The remaining portions of surface shall not project above the chisel dressed bed and. side joints. The bushing of the face shall not project by more than 40 mm. on an exposed face and 10 mm. on a face to be plastered. The hammer dressed stone shall also have a rough tooling for a minimum width of 25 mm. along the four edges of the face of the stone.

G.2.2Laying:

All stones shall be wetted before laying. The wall shall be built-up truly in plumb (or true to required batter where so specified).

All connected masonry in a structure shall normally be raised up uniformly and regularly. However, if for any specific reasons, one part of wall is required to be left behind, such wall shall be raked back at an angle not steeper than 45°. Vertical toothed joints in masonry shall not be allowed. The work shall be carried out regularly and masonry of any day shall not be raised by more than 1 m. in height at a time.

All the courses shall be laid truly horizontal. The height of course shall not be less than 150 mm nor more than 300 mm. Face stone shall be laid in alternate header and stretcher fashion.

They shall be so arranged as to break joints by at least 75 mm. Stones shall be laid with grains horizontal so that the load is transmitted along the direction of their maximum crushing strength. The depth of stone shall not be less than the height or breadth. The breadth of a face stone shall not be less than 150 mm. Each face stone shall be of the same height in any given course. The courses shall be built in perpendicular to the pressure which the masonry will bear. In case of battered wall (such as retaining walls) the beds of the stone and the plane of courses shall be laid with their bed perpendicular to the battered face.

The hearting or the interior filling of the wall shall consist of flat bedded stone carefully laid on their proper beds in mortar. Chips of stone shall be used where necessary to avoid excessive use of mortar. Care being taken to see that no hollow space shall be left anywhere in the masonry. Chips shall not be used below the hearting stone to bring these up to the level of stones. The use of chips shall be restricted up to the filling of interstices between the hearting stone but the volume of chips shall be limited to 15% of the total volume of the masonry work for that.

G.2.3 Bond Stones: The relevant specifications of item no. 4.21.a Para 2.3 shall be followed except that the hard stone shall be provided for at least 1.8 m. length of every course.

G.2.4 Quoins: The quoins, which shall be of the same height as the course to which it belongs shall be formed from selected stone of at least 400 mm. length. They shall be laid square or beds as stretcher and headers alternatively. The beds shall be rough, chisel dressed to a depth of at least 100 mm. These stones shall have a minimum uniform chisel draft of 25 mm. width at four edges. All the edges being in the same plane. Quoin stones shall not be smaller than 0.025 M3. in volume and it shall not be less than 300 mm. in length, 25% of them being not less than 500 mm. in length.

G.2.5 Joints: All the bed joints shall be horizontal and all side joints shall be vertical. Face joints shall not be more than 10 mm. thick. All joints shall be properly and completely filled up with mortar. On cases where no plastering or pointing is required to be done the joint shall be struck flush and finished simultaneously while laying stones. In other cases, the joint shall be raked to a minimum depth of 20 mm. by raking tools during the progress of work while the mortar is still green.

G.2.6 Curing: Green work shall be protected from rains by suitably covering the same. Masonry shall be kept constantly moist on all the faces at least for a period of 7 days. The top of masonry shall be flooded at the close of the day.

G.3 Mode of Measurements

G.3.1 All work shall be measured on the basis of finished dimensions and measured net except where otherwise specified. Only specified dimensions shall be allowed. Anything extra shall not be measured and paid for. The masonry work done at all levels shall be measured under this item. No deduction shall be made nor extra payment shall be made for the following

- a) Ends of joints, beams, posts, girders, rafters, purlins; trusses, corbels, etc. each up to 500 cm² in section.
- b) Opening each up to 0.1 m².
- c) Wall plates and bed plates bearings of chhajja and like up to 10 cm. depth (hearing of floor and roof slabs shall be deducted from masonry).



- d) Drain holes and recesses for cement concrete block to embed holdfasts for doors and windows.
- e) Building in the masonry iron fixtures pipes up to 300 mm. diameter holdfasts of doors and windows.
- f) Forming chases in masonry up to section of 350 cm².

G.3.2The unit rate shall be for a unit of one m³.

2.4.1 UNIT MASONRY ASSEMBLIES

4 GENERAL

4.0.0.1 RELATED DOCUMENTS

- 4.0.0.1.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to this Section.

4.0.0.2 SUMMARY

- 4.0.0.2.1 This Section includes unit masonry assemblies for exterior dry cladding and interior partitions consisting of the following:

- 4.0.0.2.1.1 Concrete masonry units.

- 4.0.0.2.1.1.1 Normal weight concrete units (CMUs).

- 4.0.0.2.1.1.2 Lightweight aerated autoclaved concrete masonry units.

- 4.0.0.2.1.2 Mortar and grout.

- 4.0.0.2.1.3 Masonry joint reinforcement.

- 4.0.0.2.1.4 Miscellaneous masonry accessories.

- 4.0.0.2.2 Types of masonry assemblies covered in this Section include, but shall not be limited to, the following:

- 4.0.0.2.2.1 Non-load-bearing non-fire-rated above-grade exterior assemblies (walls).

- 4.0.0.2.2.2 Non-load-bearing non-fire-rated above-grade interior assemblies (walls and partitions).

- 4.0.0.2.2.3 Non-load-bearing fire-rated above-grade interior assemblies (walls and partitions). Unless otherwise indicated on Drawings, fire resistance rating of concrete masonry assemblies shall be as follows:

- 4.0.0.2.2.3.1 2 hours for stair case perimeter walls.

- 4.0.0.2.2.3.2 2 hours for walls of corridors used as fire escape.

- 4.0.0.2.2.3.3 2 hours for mechanical or electrical shafts.

- 4.0.0.2.3 Masonry Schedule:

- 4.0.0.2.3.1 Normal-weight concrete masonry units.

- 4.0.0.2.3.1.1 Hollow blocks reinforced and grouted for exterior and interior walls to receive mechanically-fixed stone cladding.

- 4.0.0.2.3.1.2 Hollow blocks for partition assemblies indicated on the drawings.

- 4.0.0.2.3.1.3 Hollow blocks for fire stair enclosures in minus two and one basements and podium to atrium levels.

- 4.0.0.2.3.1.4 Hollow reinforced block piers to reinforce exterior knee walls under glazing built of light weight concrete masonry.

- 4.0.0.2.3.1.5 Exterior parapets of reinforced and grouted hollow masonry units.

- 4.0.0.2.3.2 Light-weight concrete masonry units.



4.0.0.2.3.2.1 Solid blocks for fire partitions for fire stair enclosures on steel framed floors.

4.0.0.2.3.2.2 Solid blocks for insulated masonry exterior knee walls under inner façade glazing.

4.0.0.2.4 Related Sections include the following:

4.0.0.2.4.1 Division 4, Section "Exterior Stone Cladding" for stone cladding to building elevations.

4.0.0.2.4.2 Division 7, Section "Joint Sealants" for materials and workmanship of joint sealant work related to unit masonry assemblies.

4.0.0.2.4.3 Division 10 Section "Toilet Compartments" for coordinating recesses in masonry assemblies with dimensions of recessed accessories.

4.0.0.3 **PERFORMANCE REQUIREMENTS**

4.0.0.3.1 Code of Practice: Design unit masonry assemblies in compliance with requirements of BS 5628-3 or respective IS code in respect of structural stability, accommodation for movement, durability, performance in fire where fire rated assemblies are indicated, thermal properties and sound control where sound rated assemblies are indicated.

4.0.0.3.2 Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined according to BS 476 respective IS code by a testing and inspecting agency or by equivalent concrete masonry thickness.

4.0.0.4 **SUBMITTALS**

4.0.0.4.1 LEED Submittals:

4.0.0.4.1.1 Product Data for Credit MR 4.1 and Credit MR 4.2: Indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.

4.0.0.4.1.2 Product Data for Credit MR 5.1 and Credit MR 5.2. Indicating percentages of materials and products that are extracted and manufactured regionally within a radius of 500 miles of the project. Include statement indicating costs for each product extracted and manufactured regionally.

4.0.0.4.2 Product Testing:

4.0.0.4.2.1 Test data for each type of unit to indicate compliance for compressive strength, and density.

4.0.0.5 **QUALITY ASSURANCE**

4.0.0.5.1 Standards: Within the text of this Section, reference is made to the Standards listed here after. Such standards are made a part of the Contract Documents by reference. Unless the Contract Documents include more stringent requirements, applicable requirements of these Standards shall have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced.

4.0.0.5.1.1 British Standards Institute (BSI) - UK

4.0.0.5.1.1.1 BS 476 Fire tests on building materials and structures

4.0.0.5.1.1.2 BS 1199 and BS 1200 Specifications for building sands from natural sources

4.0.0.5.1.1.3 BS 4255-1 Rubber used in preformed gaskets for weather exclusion from buildings. Specification for non-cellular gaskets

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- 4.0.0.5.1.1.4BS 4449:2005 Specification for carbon steel bars for the reinforcement of concrete
 - 4.0.0.5.1.1.5BS 4551-2005 Mortar. Methods of test for mortar. Chemical analysis and physical testing.
 - 4.0.0.5.1.1.6BS 5080Structural fixings in concrete and masonry
 - 4.0.0.5.1.1.7BS 5628-3 Code of practice for use of masonry. Materials and components, design and workmanship
 - 4.0.0.5.1.1.8BS 6073-1 Precast concrete masonry units. Specification for precast concrete masonry units
 - 4.0.0.5.1.1.9BS EN 197-1 Cement. Composition, specifications and conformity criteria for common cements.
 - 4.0.0.5.1.1.10BS EN 772-2 Methods of test for masonry units. Determination of percentage area of voids in masonry units (by paper indentation)
 - 4.0.0.5.1.1.11BS EN 934-3 Admixtures for concrete, mortar and grout. Admixtures for masonry. Definitions, requirements, conformity, marking and labelling
 - 4.0.0.5.1.1.12BS EN 998-1 Specifications for mortar for masonry. Rendering and plastering mortar.
 - 4.0.0.5.1.1.13BS EN 998-2 Specifications for mortar for masonry. Masonry mortar.
 - 4.0.0.5.1.1.14BS EN 1015 Methods of test for mortar for masonry
 - 4.0.0.5.1.1.15BS EN 10218-2Steel wire and wire products. General. Wire dimensions and tolerances.
 - 4.0.0.5.1.1.16BS EN 10244-2Steel wire and wire products. Non-ferrous metallic coatings on steel wire. Zinc or zinc alloy coatings
 - 4.0.0.5.1.1.17BS EN 12350-2 Testing fresh concrete. Slump test.
 - 4.0.0.5.1.1.18BS EN 12390-2 Testing hardened concrete. Compressive strength of specimens.
 - 4.0.0.5.1.1.19BS EN 10327 Continuously hot-dip zinc coated low carbon steels strip and sheet for cold forming. Technical delivery conditions
 - 4.0.0.5.1.1.20BS EN 12620 Aggregates for Concrete
 - 4.0.0.5.1.2American Society for Testing and materials (ASTM International) - USA
 - 4.0.0.5.1.2.1C 1386 Standard Specification for Precast Autoclaved Aerated Concrete (PAAC) Wall Construction Units

Note: respective IS code is applicable too.
 - 4.0.0.5.2Preconstruction Testing Service: Engage a qualified independent testing agency to perform the following preconstruction testing:
 - 4.0.0.5.2.1Testing samples of furnished concrete masonry units to requirements of BS 6073-1 and BS EN 772-2 respective IS code.
 - 4.0.0.5.2.2Mortar Test: To BS 1015 respective IS code.
 - 4.0.0.5.2.3Grout Test: To BS EN 12390-3respective IS code.
 - 4.0.0.5.3Sample Panels: Before installing unit masonry, build sample panels, using materials indicated for the completed Work, to verify selections made under sample Submittals and to demonstrate aesthetic effects. Build sample panels for each type of exposed unit masonry assembly in sizes approximately 1200 mm long by 1200 mm high by full thickness.
 - 4.0.0.5.3.1Demolish and remove sample panels when directed by the Engineer.

4.0.0.6 **DELIVERY, STORAGE, AND HANDLING**

- 4.0.0.6.1 Store masonry units on elevated platforms in a dry location.
- 4.0.0.6.2 If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
 - 4.0.0.6.2.1 Protect concrete masonry units from moisture absorption so that, at the time of installation, the moisture content is not more than the maximum allowed at the time of setting.
- 4.0.0.6.3 Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- 4.0.0.6.4 Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- 4.0.0.6.5 Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.
- 4.0.0.6.6 Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

4.0.0.7 **PROJECT CONDITIONS**

- 4.0.0.7.1 Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 4.0.0.7.1.1 Extend cover a minimum of 600 mm down both sides and hold cover securely in place.
- 4.0.0.7.2 Do not apply uniform loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.
- 4.0.0.7.3 Hot-Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required.
 - 4.0.0.7.3.1 Do not spread mortar beds more than 1200 mm ahead of masonry. Set masonry units within one minute of spreading mortar.

5 PRODUCTS

5.5.1.1 **NORMAL-WEIGHT CONCRETE MASONRY UNITS (CMUs)**

- 5.5.1.1.1 General: Provide shapes indicated and as follows:
 - 5.5.1.1.1.1 Provide special shapes for lintels, control joints, headers, bonding, and other special conditions.
 - 5.5.1.1.1.2 Provide square-edged units for outside corner.
- 5.5.1.1.2 Concrete Masonry Units: Precast concrete masonry units to local authorities and BS 6073-1 as follows:
 - 5.5.1.1.2.1 Type: Non-load-bearing, cellular blocks. Cellular blocks to be grouted solid where used as backup for stone drycladding.
 - 5.5.1.1.2.2 Binder: Ordinary Portland cement to BS EN 197-1 or respective IS code.
 - 5.5.1.1.2.3 Aggregates: Natural aggregates.
 - 5.5.1.1.2.4 Admixtures: Permitted.

5.5.1.1.2.5 Strength: Average crushing strength of 10 blocks shall be not less than 6.0 N/mm² when tested according to B1 sampling and test method of BS 6073-1 (Gross Area).

5.5.1.1.2.6 Weight Classification: Normal weight.

5.5.1.1.2.7 Width: As necessary to produce assemblies of thickness indicated on Drawings.

5.5.1.1.2.8 Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

5.5.1.1.2.9 Face Dimensions: 400 x 200 mm, nominal.

5.5.1.1.2.10 Curing: At factory. Provide autoclave-cured units.

5.5.1.1.2.11 Color: Gray.

5.5.1.2 **LIGHTWEIGHT AERATED CONCRETE MASONRY UNITS**

5.5.1.2.1 Lightweight Concrete Masonry Units: ASTM C 1386 or respective IS code.

5.5.1.2.1.1 Shapes and Type: Square-edged solid rectangular blocks.

5.5.1.2.1.2 Provide square-edged units for outside corners, unless otherwise indicated.

5.5.1.2.1.3 Thermal Conductivity: Maximum 0.134 Kg/m³ W/m². K under climatic conditions of 35 °C, 60% Relative Humidity (RH) and moisture content of 3.8% by mass.

5.5.1.2.1.4 Density: Not less than 600 kg/m³.

5.5.1.2.1.5 Unit Compressive Strength: Provide units with minimum average gross-area compressive strength of 3.20 N/mm².

5.5.1.2.1.6 Face Dimensions: 240 x 650 mm nominal.

5.5.1.2.1.7 Size (Width) and Face Dimensions: Manufactured to the following dimensions:

5.5.1.2.1.7.1 100 mm wide by 240 mm high by 650 mm long, nominal.

5.5.1.2.1.7.2 150 mm wide by 240 mm high by 650 mm long, nominal.

5.5.1.2.1.7.3 200 mm wide by 240 mm high by 650 mm long, nominal.

5.5.1.2.1.8 Faces: Porous.

5.5.1.2.1.9 Manufacture: Expanded aerated concrete, mass mold formed, cut and shaped and steam autoclaved to specified strength.

5.5.1.2.1.10 Fire Rating: To satisfy two or three hour fire resistance rating according to type of fire rated assembly as specified.

5.5.1.2.1.11 Lightweight concrete masonry units shall be insulating concrete units as specified.

5.5.1.3 **MORTAR AND GROUT MATERIALS**

5.5.1.3.1 Portland Cement: BS EN 197-1 or respective IS code, ordinary type of grey color.

5.5.1.3.2 Aggregate for Mortar: BS 1199 or respective IS code; except for joints less than 6.5 mm thick, use aggregate graded with 1.20 mm maximum particle size.

5.5.1.3.3 Aggregate for Grout: BS EN 12620 or respective IS code.

5.5.1.3.4 Water: Potable.

5.5.1.3.5 Admixtures: To BS 934-3 or respective IS code., admixtures certified by manufacturer to contain not more than 0.1 % water-soluble chloride ions by mass of



cementitious material and compatible with other admixture and cementitious materials.

5.5.1.3.5.1 Do not use admixtures containing calcium chloride.

5.5.1.3.6 Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete masonry units, containing integral water repellent by same manufacturer.

5.5.1.3.7 Pre-Packaged Portland Cement Mortar: BS EN 998-2 or respective IS code., manufacturer's standard factory-packaged blend of ordinary Portland cement, aggregates, water retaining and other suitable admixtures. Properties shall be as follows.

5.5.1.3.7.1 Wet mix life: < 1.5 hours.

5.5.1.3.7.2 Initial adhesive at 28 days: > 0.3 N/mm²

5.5.1.3.7.3 Bending Strength: 1 N/mm², minimum.

5.5.1.3.7.4 Compressive Strength: 5 ± 1 N/mm²

5.5.1.3.7.5 Minimum cement sand mix: 1: 3-4

5.5.1.3.7.6 Testing: BS EN 1015

5.5.1.3.8 Lime Mortar:

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

5.5.1.3.8.2 Proportion of mix:

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.

5.5.1.3.8.3 Proportion of mortar:

Lime mortar shall be prepared by wet process as per IS: 1625-1971. 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 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.

5.5.1.3.8.4 Storage:

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

5.5.1.3.8.5 Use:

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

5.5.1.3.9 Cement Mortar:

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

5.5.1.3.9.2 Proportion of Mix:

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 M³. The mortar may be hand mixed or machine mixed as directed.

5.5.1.3.9.3 Proportion of Mortar:

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

5.5.1.3.9.3.1 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.

5.5.1.4 MASONRY JOINT REINFORCEMENT

5.5.1.4.1 Expanded Steel mesh of suitable mesh size, galvanized.

5.5.1.4.1.1 Provide metal lath that is fabricated from galvanized steel sheets to BS EN 10327 - DX51D + Z 275.

5.5.1.4.1.2 Minimum intensity is to be 1.61 Kg/m².

5.5.1.4.1.3 Metal lath shall be prefabricated in coil form. Width of lath is to be 50 mm less than nominal width of wall with uniform 25 mm recess from wall face at both sides.

5.5.1.4.1.3.1 For 200 mm nominal wall width use 150-mm wide coils.

5.5.1.4.1.4 Provide prefabricated pieces for corners and intersections.

5.5.1.5 TIES AND ANCHORS, GENERAL

5.5.1.5.1 General: Provide ties and anchors, specified in subsequent articles, made from materials that comply with this Article, unless otherwise indicated.

5.5.1.5.1.1 Hot-Dip Galvanized Carbon-Steel Wire: to BS EN 10218-2 and 10244-2 zinc coated, soft temper.

5.5.1.5.1.2 Steel Sheet, Galvanized after Fabrication: BS EN 10327 cold-rolled, carbon-steel sheet hot-dip galvanized after fabrication, zinc coating intensity not less than 275 gm/m² including both faces.

5.5.1.6 MISCELLANEOUS MASONRY ACCESSORIES

5.5.1.6.1 Joint Filler for Non-Fire-Rated Masonry Assemblies: Non-absorbent, semi-rigid, polyurethane joint filler to BS 5628-3.

5.5.1.7 MORTAR AND GROUT MIXES

5.5.1.7.1 General: Do not use admixtures, including air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise approved by the Engineer.

5.5.1.7.1.1 Do not use calcium chloride in mortar or grout.

5.5.1.7.2 Job Mixed Mortar for Unit Masonry: Comply with the following requirements:

5.5.1.7.2.1 Reference Specification: Comply with BS EN 998-2.

5.5.1.7.2.2 Compressive Strength: 5 ± 1 N/ mm²

5.5.1.7.2.3 Minimum cement sand mix: 1: 3-4

5.5.1.7.2.4 Bending Strength: 1 N/ mm², minimum

5.5.1.7.2.5 Testing: BS EN 1015.



5.5.1.7.3 Grout for Unit Masonry: Comply with the following requirements:

5.5.1.7.3.1 Classification: Fine.

5.5.1.7.3.2 Binding Material: Ordinary Portland cement.

5.5.1.7.3.3 Aggregate: BS EN 10620, maximum size of coarse aggregates 10 mm.

5.5.1.7.3.4 Slump: 200-280 mm to BS EN 12350.

5.5.1.7.3.5 Admixture: Approved liquid-type.

5.5.1.7.3.6 Compressive Strength: Minimum 15 MPa at 28 days when tested to BS EN 12350

6 EXECUTION

6.5.1.1 EXAMINATION

6.5.1.1.1 Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

6.5.1.1.1.1 Proceed with installation only after unsatisfactory conditions have been corrected.

6.5.1.1.2 Before installation, examine rough-in and built-in construction to verify actual locations of piping connections.

6.5.1.2 INSTALLATION, GENERAL

6.5.1.2.1 Thickness: Build assemblies to the full thickness shown. Build single-wythe walls to the actual widths of masonry units, using units of widths indicated.

6.5.1.2.2 Build chases and recesses to accommodate items specified in this Section and in other Sections of the Specifications.

6.5.1.2.3 Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to the opening.

6.5.1.2.4 Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide a continuous pattern and to fit adjoining construction. Where possible, use full-size units without cutting. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

6.5.1.3 CONSTRUCTION TOLERANCES

6.5.1.3.1 Comply with requirements of BS 5628-3.

6.5.1.3.1.1 Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved its specified 28-day design compressive strength.

6.5.1.4 LAYING MASONRY WALLS

6.5.1.4.1 General: Construct concrete masonry units in accordance with requirements of BS 5628-3.

6.5.1.4.2 Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.



6.5.1.4.3 Lay concealed masonry with all units in running bond indicated below. Bond and interlock each course at corners (toothed masonry). Do not use units with less than nominal 100 mm horizontal face dimensions at corners or jambs.

6.5.1.4.3.1 Bond Type: One-half running bond with vertical joint in each course centered on units in corners above and below.

6.5.1.4.4 Stopping and Resuming Work: In each course, rack back one-half-unit length for one-half running bond or one-third-unit length for one-third running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly if required, and remove loose masonry units and mortar before laying fresh masonry.

6.5.1.4.5 Built-in Work: As construction progresses, build in items specified under this and other Sections of the Specifications. Fill in solidly with masonry around built-in items.

6.5.1.4.6 Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.

6.5.1.4.7 Fill cores in hollow concrete masonry units with grout 600 mm under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

6.5.1.4.8 Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.

6.5.1.4.8.1 Install compressible filler in joint between top of partition and underside of structure above.

6.5.1.4.8.2 For fire rated masonry assembly, use fire-rated head-of-wall joint system, as specified in Division 7, Section "Fire Resistive Joint Systems".

6.5.1.5 **MORTAR BEDDING AND JOINTING**

6.5.1.5.1 Lay hollow masonry units as follows:

6.5.1.5.1.1 With full mortar coverage on horizontal and vertical face shells.

6.5.1.5.1.2 Bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.

6.5.1.5.1.3 For starting course on footings where cells are not grouted, spread out full mortar bed, including areas under cells.

6.5.1.5.2 Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than the joint thickness, unless otherwise indicated.

6.5.1.5.3 Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint), unless otherwise indicated.

6.5.1.6 **MASONRY JOINT REINFORCEMENT**

6.5.1.6.1 General: Provide continuous masonry joint reinforcement as indicated. Install entire length of longitudinal side rods in mortar with a minimum cover of 16 mm on exterior side of walls, 13 mm elsewhere. Lap reinforcement a minimum of 150 mm.

6.5.1.6.1.1 Space reinforcement not more than 420 mm o.c.

6.5.1.6.1.2 Provide reinforcement not more than 200 mm above and below wall openings and extending 300 mm beyond openings.

6.5.1.6.1.2.1 Reinforcement above is in addition to continuous reinforcement.

6.5.1.6.2 Cut or interrupt joint reinforcement at control and expansion joints.

6.5.1.6.3 Provide continuity at corners and wall intersections by using prefabricated "L" and "T" sections. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

6.5.1.7 **ANCHORING MASONRY TO STRUCTURAL MEMBERS**

6.5.1.7.1 Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:

6.5.1.7.1.1 Provide an open space not less than 15 mm in width between masonry and structural member, unless otherwise specified in BS 5628-3. Keep open space free of mortar or other rigid materials.

6.5.1.7.1.2 Anchor masonry to structural members with flexible anchors embedded in masonry joints and attached to structure.

6.5.1.7.1.3 Space anchors as indicated, but not more than 620 mm o.c. vertically and 920 mm o.c. horizontally.

6.5.1.7.1.4 Fill space with compressible joint filler and seal edges flush with joint sealant, unless otherwise indicated. Comply with Division 7, Section "Joint Sealants".

6.5.1.8 **CONTROL JOINTS**

6.5.1.8.1 General: Install control joints in unit masonry where indicated. Build-in related items as masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in-plane restraint of wall or partition movement.

6.5.1.8.2 Form control joints in concrete masonry at maximum intervals of 6.0 meters as follows:

6.5.1.8.2.1 Install preformed control-joint gaskets designed to fit standard sash block.

6.5.1.9 **CURING**

6.5.1.9.1 Fresh work shall be protected from rain suitably. All kinds of Masonry work shall be cured and 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.

6.5.1.10 **FIELD QUALITY CONTROL**

6.5.1.10.1 Engage a qualified independent testing agency approved by the Engineer to perform field quality-control testing indicated below.

6.5.1.10.2 Testing Frequency: Tests and evaluations listed in this Article will be performed during construction for each 450 sq. m of wall area or portion thereof.

6.5.1.10.3 Mortar properties will be tested per BS EN 1015.

6.5.1.10.4 Grout will be sampled and tested for compressive strength per BS EN 12390.

6.5.1.10.5 Concrete Masonry Unit Tests: For each type of concrete masonry unit indicated, units will be tested according to BS EN 6073-1.

6.5.1.11 **REPAIRING, POINTING AND CLEANING**

6.5.1.11.1 Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

6.5.1.11.2 Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application.

In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

Section No: 9 PLASTER AND POINTING

(9.01 to 9.03)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions Specification Sections, apply to this Section.

A. Single Coat Cement Plaster

A.1 Materials

A.1.1 Cement, Sand, Water, Cement mortar, etc. shall conform to respective specifications as specified under materials specification - part A of Technical Specifications

A.1.2 Sand shall be screened before its use.

A.1.3 Sand used shall be 50% fine and 50% coarse or as directed.

A.1.4 All materials shall be approved by Design Consultant Project Manager before use.

A.2 Execution

A.2.1 General

The surface shall be cleaned of all dust, loose mortar droppings, traces of algae, efflorescence and other foreign matter by water or by brushing. Smooth surface shall be roughened by wire brushing if it is no; hard and by racking if it is hard. In case of concrete surface, if a chemical retarder has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting dust and loose particles shall be cleaned off and care shall be taken that none of the retarder is left on the surface. Trimming of projections on brick/concrete surface wherever necessary shall be carried out to get an even surface.

Raking of joints in case of masonry wherever necessary shall be allowed to dry out for sufficient period before carrying out the plaster work.

A.2.2 Scaffolding

Scaffolding for carrying out plastering work shall be double scaffolding having two sets of vertical supports so that the scaffolding is independent of the walls.

Scaffolding: Wooden ballies, bamboos, planks, trestles and other scaffolding shall be sound. These shag be properly examined before erection and use. Stage scaffolding shall be provided for ceiling plaster whirl shall be independent of the walls.

A.2.3 Preparation of surface

All putlog holes in brickwork and junction between concrete and brickwork shall be properly filled it advance. Joints in brick work shall be raked about 10 mm. and concrete surface shall be hacked to provide grip to the plaster. Projecting burrs of mortars formed due to gaps at joints in shuttering shall be removed. The surface shall be scrubbed clean with wire brush/coir brush to remove dirt, dust etc., and the surface thoroughly washed with clean water to remove efflorescence, grease and oil etc. and shall be kept, wet for a minimum of two hours before application of plaster.

For external plaster; the plastering operation shall be started from the top floor and carried downwards. For internal plaster, the plastering operations may be started wherever the building frame and cladding work are ready and the temporary supporting ceiling resting on the wall of the floor have been removed. Ceiling plaster shall be completed before starting plaster to walls.

A.2.4 Application of plaster

The plaster about 15 cm x 15 cm shall be first applied horizontally and vertically at not more than 2 m intervals over the entire surface to serve as gauge. The surfaces of these gauges shall be truly in plane of the finished plastered surface. The mortar shall then be applied in uniform surface slightly more than the specified thickness, and then brought to a true surface by working a wooden straight edge reaching across the gauges with small upwards and sideways movements at a time. Finally, the surface shall be finished of true with a trowel or wooden float according to the texture, smooth or sandy granular, as may be required. Excessive trowelling or over working the float shall be avoided. All corners, arises, angles and junctions etc. shall be carried out with proper templates to the size required.

Cement plaster shall be used within half an hour after addition of water. Any mortar or plaster which is partially set shall be rejected and removed from the site.

The surface shall be finished smooth as approved with steel trowel without applying cement / lime slurry (i.e. mala finish)

In suspending the work at the end of the day, the plaster shall be left out, clean to line both horizontally and vertically. While recommencing the plaster, the edges of the old work shall be scrapped clean and wetted with cement putty before plaster is applied to the adjacent areas to enable the two to properly join together. Plastering work shall be closed at the end of the day on the body of the wall and shall not be nearer than 15 cm, to any corners or arises. Horizontal joints in plaster work shall not also occur on parapet tops and copings as these invariably lead to leakage. No portion of the surface shall be left out initially to be packed up later on.

A.2.5 Watering, curing, etc.

Each coat shall be kept damp continuously till the next coat is applied or for a minimum period of 7 days. Moistening shall commence as soon as plaster is hardened sufficiently. Soaking of walls shall be avoided and only as much water as can be readily absorbed shall be used, excessive evaporation on the sunny or windward side of building in hot air or dry weather shall be prevented by hanging mats or gunny bags on the outside of the plaster and by keeping them wet.

A.3. Mode of Measurements

- A.3.1 The rate shall include for work at any height, position, and floor and for all necessary scaffolding, etc. and for work at all levels.
- A.3.2 The rates shall also include for hacking and/or bush hammering to form key for plaster and for spatter dash treatment, as specified, as and where necessary.
- A.3.3 The rates shall also include for all work in narrow width, arises, rounded angles, pattas, chamfered external angles, drip moulds, grooves and for making good after all trades.
- A.3.4 The rate shall also include for groove with cement finish up to 12 mm. x 6 mm. to be formed in plaster at junction of slab and beam and slab and brick without any extra charge. The rate shall also include for similar grooves in plaster at the junction of masonry and wood or steel door/window/ventilator frame or at bottom of beam/lintels as drip moulds without extra charge.
- A.3.5 All plastering shall be measured in m², unless otherwise specified. Length or breadth & height shall be measured correct to a centimeter.
- A.3.6 Thickness of the plaster shall be exclusive of the thickness of the key i.e. grooved or open joints in brick work, stone work, etc. or space between laths. Thickness of plaster shall be average thickness with minimum as specified at any point on the surface.
- A.3.7 The measurement of wall plastering shall be taken between the walls or partitions (dimensions after plastering being taken) for length and from the top of floor or skirting to ceiling for height. Depth of cover of cornices if any shall be deducted.
- A.3.8 Soffits of stairs shall be measured as plastering on ceilings. Flowing/folding soffits shall be measured separately.

- A.3.9 For jambs, soffits, sills, etc., openings exceeding 0.5 m² and not exceeding 3.0 m², area deductions and additions shall be made in the following manner:-
- a) No deductions shall be made for ends joints, beams, posts, etc. for openings not exceeding 0.5 m² each and no addition shall be made for reveals, jambs, soffits, sills, etc. of these opening for finish to plaster around ends of joints, beams, posts, etc.
 - b) Deduction for openings exceeding 0.5 m² but not exceeding 3.0 m² each shall be made as follows and no addition shall be made for reveals, jambs, soffits, sills, etc. of these openings.
 - i) When both faces of any wall are plastered with same plaster, deduction shall be made for one face only.
 - ii) When two faces of any wall are plastered with different types of plasters or if one faces is plastered and the other pointed, deductions shall be made from the plaster or pointing on the side of frame for door, windows, etc. on which width of -reveals is less than that on the other side but no deductions shall be made on the other side. Where widths of reveals on both faces of all are equal, deductions of 50% of area of opening on each face shall be made from area of plaster and/or pointing as the case may be.
- A.3.10 For openings having door frames equal to projection beyond the thickness of wall, full deduction for opening shall be made from each plastered face of the wall.
- A.3.11 In case of openings having area above 3.0 m² each, deduction shall be made for the opening but jambs, soffits, and sills shall be measured additionally.
- A.3.12 The unit rate shall be for a unit of one m².

B. Double Coat Cement Plaster

B.1 Material

- B.1.1 Cement, Sand, Water, Cement mortar, etc. shall conform to respective specifications as specified under materials specification - part A of Technical Specifications
- B.1.2 Sand shall be screened before its use.
- B.1.3 Sand used shall be 50% fine and 50% coarse or as directed.
- B.1.4 All materials shall be approved by Architect/Project Manager before use.

B.2 Execution

B.2.1 General

The surface shall be cleaned of all dust, loose mortar droppings, traces of algae, efflorescence and other foreign matter by water or by brushing. Smooth surface shall be roughened by wire brushing if it is no; hard and by racking if it is hard. In case of concrete surface, if a chemical retarder has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting dust and loose particles shall be cleaned off and care shall be taken that none of the retarder is left on the surface. Trimming of projections on brick/concrete surface wherever necessary shall be carried out to get an even surface.

Raking of joints in case of masonry wherever necessary shall be allowed to dry out for sufficient period before carrying out the plaster work.

B.2.2 Scaffolding

Scaffolding for carrying out plastering work shall be double scaffolding having two sets of vertical supports so that the scaffolding is independent of the walls.

Scaffolding: Wooden ballies, bamboos, planks, trestles and other scaffolding shall be sound. These shag be properly examined before erection and use. Stage scaffolding shall be provided for ceiling plaster whirl shall be independent of the walls.

B.2.3 Preparation of surface

All putlog holes in brickwork and junction between concrete and brickwork shall be properly filled in advance. Joints in brick work shall be raked about 10 mm. and concrete surface shall be hacked to provide grip to the plaster. Projecting burrs of mortars formed due to gaps at joints in shuttering shall be removed. The surface shall be scrubbed clean with wire brush/coir brush to remove dirt, dust etc., and the surface thoroughly washed with clean water to remove efflorescence, grease and oil etc., and shall be kept wet for a minimum of two hours before application of plaster.

For external plaster; the plastering operation shall be started from the top floor and carried downwards. For internal plaster, the plastering operations may be started wherever the building frame and cladding work are ready and the temporary supporting ceiling resting on the wall of the floor have been removed. Ceiling plaster shall be completed before starting plaster to walls.

B.2.4 Application of plaster

The plaster about 15 cm. x 15 cm. shall be first applied horizontally and vertically at not more than 2 m intervals over the entire surface to serve as gauge. The surfaces of these gauges shall be truly in plane of the finished plastered surface. The mortar shall then be applied in uniform surface slightly more than the specified thickness, then brought to a true surface by working a wooden straight edge reaching across the gauges with small upwards and sideways movements at a time. Finally, the surface shall be finished of true with a trowel or wooden float according to the texture, smooth or sandy granular, as may be required. Excessive troweling or over working the float shall be avoided. All corners, arises, angles and junctions etc. shall be carried out with proper templates to the size required.

Cement plaster shall be used within half an hour after addition of water. Any mortar or plaster which is partially set shall be rejected and removed from the site.

The plaster shall be provided in two coats and as specified. The base coat shall be carried out in C.M. 1:4 having minimum thickness of 12mm. Before the plastered surface hardens roughing shall be done to receive the second coat. Second coat shall be applied only after minimum curing for 24 hours. The second coat shall be carried out in C.M. 1:2 proportion having minimum thickness of 8mm accordingly total thickness of double coat plaster shall be minimum 20mm. the final surface of plaster shall be finished smooth with steel trowel without applying any kind of slurry, as approved (i.e. mala finish)

In suspending the work at the end of the day, the plaster shall be left out, clean to line both horizontally and vertically. While recommencing the plaster, the edges of the old work shall be scrapped clean and wetted with cement putty before plaster is applied to the adjacent areas to enable the two to properly join together. Plastering work shall be closed at the end of the day on the body of the wall and shall not be nearer than 15 cm, to any corners or arises. Horizontal joints in plaster work shall not also occur on parapet tops and copings as these invariably lead to leakage. No portion of the surface shall be left out initially to be packed up later on.

B.2.5 Watering, curing, etc

Each coat shall be kept damp continuously till the next coat is applied or for a minimum period of 7 days. Moistening shall commence as soon as plaster is hardened sufficiently. Soaking of walls shall be avoided and only as much water as can be readily absorbed shall be used, excessive evaporation on the sunny or windward side of building in hot air or dry weather shall be prevented by hanging mats or gunny bags on the outside of the plaster and by keeping them wet.

B.3. Mode of Measurements

B.3.1 The rates shall include for work at any height, position, and floor and for all necessary scaffolding, etc. for work at all levels.

- B.3.2 The rates shall also include for hacking and/or bush hammering to form key for plaster and for spatter dash treatment, as specified, as and where necessary.
- B.3.3 The rates shall also include for all work in narrow width, arises, rounded angles, pattas, chamfered external angles, drip moulds, grooves and for making good after all trades.
- B.3.4 The rate shall also include for groove with cement finish up to 12 mm. x 6 mm. to be formed in plaster at junction of slab and beam and slab and brick without any extra charge. The rate shall also include for similar grooves in plaster at the junction of masonry and wood or steel door/window/ventilator frame or at bottom of beam/lintels as drip moulds without extra charge.
- B.3.5 All plastering shall be measured in m², unless otherwise specified. Length or breadth & height shall be measured correct to a centimeter.
- B.3.6 Thickness of the plaster shall be exclusive of the thickness of the key i.e. grooved or open joints in brick work, stone work, etc. or space between laths. Thickness of plaster shall be average thickness with minimum as specified at any point on the surface.
- B.3.7 The measurement of wall plastering shall be taken between the walls or partitions (dimensions after plastering being taken) for length and from the top of floor or skirting to ceiling for height. Depth of cover of cornices if any shall be deducted.
- B.3.8 Soffits of stairs shall be measured as plastering on ceilings. Flowing/folding soffits shall be measured separately.
- B.3.9 For jambs, soffits, sills, etc., openings exceeding 0.5 m² and not exceeding 3.0 m², area deductions and additions shall be made in the following manner:-
- a) No deductions shall be made for ends joints, beams, posts, etc. for openings not exceeding 0.5 m² each and no addition shall be made for reveals, jambs, soffits, sills, etc. of these opening for finish to plaster around ends of joints, beams, posts, etc.
 - b) Deduction for openings exceeding 0.5 m² but not exceeding 3.0 m² each shall be made as follows and no addition shall be made for reveals, jambs, soffits, sills, etc. of these openings.
 - i) When both faces of any wall are plastered with same plaster, deduction shall be made for one face only.
 - ii) When two faces of any wall are plastered with different types of plasters or if one faces is plastered and the other pointed, deductions shall be made from the plaster or pointing on the side of frame for door, windows, etc. on which width of -reveals is less than that on the other side but no deductions shall be made on the other side. Where widths of reveals on both faces of all are equal, deductions of 50% of area of opening on each face shall be made from area of plaster and/or pointing as the case may be.
- B.3.10 For openings having door frames equal to projection beyond the thickness of wall, full deduction for opening shall be made from each plastered face of the wall.
- B.3.11 In case of openings having area above 3.0 m² each, deduction shall be made for the opening but jambs, soffits, and sills shall be measured additionally.
- B.3.12 The unit rate shall be for a unit of one m².

C. Double Coat Sand Faced Plaster

C.1 Materials

- C.1.1 Cement, Sand, Water, Cement mortar, etc. shall conform to respective specifications as specified under materials specification - part A of Technical Specifications
- C.1.2 Sand shall be screened before its use.
- C.1.3 Sand used shall be 50% fine and 50% coarse or as directed.
- C.1.4 All materials shall be approved by Design Consultant/Project Manager before use.

C.2 Execution

C.2.1 General

The surface shall be cleaned of all dust, loose mortar droppings, traces of algae, efflorescence and other foreign matter by water or by brushing. Smooth surface shall be roughened by wire brushing if it is no; hard and by racking if it is hard. In case of concrete surface, if a chemical retarder has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting dust and loose particles shall be cleaned off and care shall be taken that none of the retarder is left on the surface. Trimming o' projections on brick/concrete surface wherever necessary shall be carried out to get an even surface.

Raking of joints in case of masonry wherever necessary shall be allowed to dry out for sufficient period before carrying out the plaster work.

C.2.2 Scaffolding

Scaffolding for carrying out plastering work shall be double scaffolding having two sets of vertical support so that the scaffolding is independent of the walls.

Scaffolding: Wooden ballies, bamboos, planks, trestles and other scaffolding shall be sound. These should be properly examined before erection and use. Stage scaffolding shall be provided for ceiling plaster whirl shall be independent of the walls.

C.2.3 Preparation of surface

All putlog holes in brickwork and junction between concrete and brickwork shall be properly filled it advance. Joints in brick work shall be raked about 10 mm. and concrete surface shall be hacked to provide grip to the plaster. Projecting burrs of mortars formed due to gaps at joints in shuttering shall be removed. The surface shall be scrubbed clean with wire brush/coir brush to remove dirt, dust etc., and the surface thoroughly washed with clean water to remove efflorescence, grease and oil etc., and shall be kept, wet for a minimum of two hours before application of plaster.

For external plaster; the plastering operation shall be started from the top floor and carried downwards. For internal plaster, the plastering operations may be started wherever the building frame and cladding work are ready and the temporary supporting ceiling resting on the wall of the floor have been removed. Ceiling plaster shall be completed before starting plaster to walls.

C.2.4 Application of plaster

The plaster about 15 cm. x 15 cm., shall be first applied horizontally and vertically at not more than 2 m intervals over the entire surface to serve as gauge. The surfaces of these gauges shall be truly in plane o. the finished plastered surface. The mortar shall then be applied in uniform surface slightly more than the specified thickness, and then brought to a true surface by working a wooden straight edge reaching across the gauges with small upwards and sideways movements at a time. Finally, the surface shall be finished.of7 true with a trowel or wooden float according to the texture, smooth or sandy granular, as may be required. Excessive trowel-ling or over working the float shall be avoided. All corners, arises, angles and junction: etc. shall be carried out with proper templates to the size required.

Cement plaster shall be used within half an hour after addition of water. Any mortar or plaster which is partially set shall be rejected and removed from the site.

C.2.5 The work shall be carried out in two coats. The backing coat (Base coat) shall be provided in C.M. 1:4 proportion in minimum thickness of 12mm. before first coat hardens, its surface shall be beaten up by edges of wooden toppers and close dent shall be made on the surface to receive second cost. The subsequent coat shall be applied after this base coat has been allowed to set for at least 3 to 5 days depending upon the weather conditions. The surface shall not be allowed to dry during this period.

C.2.6 The second coat shall be completed to minimum thickness of 8mm in C.M. 1:2 proportions as described above. The surface shall be then tapped to uniform grained

texture, as approved by the Architect, by using 'Gutka' only, as specified & directed in no case, sponge shall be allowed in places of 'Gutka'. The sample of sand face shall be got approved from Design Consultant before the work is started and the approved sample shall be kept intact and undisturbed till completion of work. The whole work shall be carried out uniformly as per approved sample.

The surface shall be finished smooth as approved with steel trowel applying cement / lime slurry (i.e. mala plaster)

In suspending the work at the end of the day, the plaster shall be left out, clean to line both horizontally and vertically. While recommencing the plaster, the edges of the old work shall be scrapped clean and wetted with cement putty before plaster is applied to the adjacent areas to enable the two to properly join together. Plastering work shall be closed at the end of the day on the body of the wall and shall not be nearer than 15 cm, to any corners or arises. Horizontal joints in plaster work shall not also occur on parapet tops and copings as these invariably lead to leakage. No portion of the surface shall be left out initially, to be packed up later on.

C.2.7 Watering, Curing, etc

Each coat shall be kept damp continuously till the next coat is applied or for a minimum period of 7 days. Moistening shall commence as soon as plaster is hardened sufficiently. Soaking of walls shall be avoided and only as much water as can be readily absorbed shall be used, excessive evaporation on the sunny or windward side of building in hot air or dry weather shall be prevented by hanging mats or gunny bags on the outside of the plaster and by keeping them wet.

The curing shall be started overnight after finishing of the plaster work. The plaster shall be kept wet for minimum period of 7 (Seven) days.

C.2.8 Protection

It shall be protected from all damages, till building is handed over to the client.

C.3 Mode of Measurements

- C.3.1 The rate shall include for work at any work t, position, and floor and for all necessary scaffolding, etc. and for work at all levels.
- C.3.2 The rate shall also include for hacking and/or bush hammering to form key for plaster and for spatter dash treatment, as specified, as and where necessary.
- C.3.3 The rate shall also include for all work in narrow width, arises, rounded angles, pattas, chamfered external angles, drip moulds, grooves and for making good after all trades.
- C.3.4 The rate shall also include for groove with cement finish up to 12 mm. x 6 mm. to be formed in plaster at junction of slab and beam and slab and brick without any extra charge. The rate shall also include for similar grooves in plaster at the junction of masonry and wood or steel door/window/ventilator frame or at bottom of beam/lintels as drip moulds without extra charge.
- C.3.5 All plastering shall be measured in m², unless otherwise specified. Length or breadth & height shall be measured correct to a centimeter.
- C.3.6 Thickness of the plaster shall be exclusive of the thickness of the key i.e. grooved or open joints in brick work, stone work, etc. or space between laths. Thickness of plaster shall be average thickness with minimum as specified at any point on the surface.
- C.3.7 The measurement of wall plastering shall be taken between the walls or partitions (dimensions after plastering being taken) for length and from the top of floor or skirting to ceiling for height. Depth of cover of cornices if any shall be deducted.
- C.3.8 Soffits of stairs shall be measured as plastering on ceilings. Flowing/folding soffits shall be measured separately.
- C.3.9 For jambs, soffits, sills, etc, openings exceeding 0.5 m² and not exceeding 3.0 m², area deductions and additions shall be made in the following manner:-

a) No deductions shall be made for ends joints, beams, posts, etc. for openings not exceeding 0.5 m² each and no addition shall be made for reveals, jambs, soffits, sills, etc. of these openings for finish to plaster around ends of joints, beams, posts, etc.

b) Deduction for openings exceeding 0.5 m². but not exceeding 3.0 m². each shall be made as follows and no addition shall be made for reveals, jambs, soffits, sills, etc. of these openings.

i) When both faces of any wall are plastered with same plaster, deduction shall be made for one face only.

ii) When two faces of any wall are plastered with different types of plasters or if one face is plastered and the other pointed, deductions shall be made from the plaster or pointing on the side of frame for door, windows, etc. on which width of reveals is less than that on the other side but no deductions shall be made on the other side.

Where width of reveals on both faces of all are equal, deductions of 50% of area of opening on each face shall be made from area of plaster and/or pointing as the case may be.

C.3.10 For openings having door frames equal to projection beyond the thickness of wall, full deduction for opening shall be made from each plastered face of the wall.

C.3.11 In case of openings having area above 3.0 m² each, deduction shall be made for the opening but jambs, soffits, and sills shall be measured additionally.

C.3.12 The unit rate shall be for a unit of one m².

D. Single Coat Waterproof Plaster

D.1 Materials

D.1.1 Cement, Sand, Water, Waterproofing compound / chemicals, Cement mortar, etc. shall conform to respective specifications as specified under materials specification - part A of Technical Specifications

D.1.2 Sand shall be screened before its use.

D.1.3 Sand used shall be 50% fine and 50% coarse or as directed.

D.1.4 All materials shall be approved by Design Consultant/Project Manager before use.

D.1.5 Approved waterproofing compound / chemicals in powder form liquid form shall be added in dry cement mortar mix strictly in accordance with manufacturer's specifications.

D.2 Execution

D.2.1 General

The surface shall be cleaned of all dust, loose mortar droppings, traces of algae, efflorescence and other foreign matter by water or by brushing. Smooth surface shall be roughened by wire brushing if it is no; hard and by raking if it is hard. In case of concrete surface, if chemical retarders has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting dust and loose particles shall be cleaned off and care shall be taken that none of the retarders is left on the surface. Trimming of projections on brick/concrete surface wherever necessary shall be carried out to get an even surface.

Raking of joints in case of masonry wherever necessary shall be allowed to dry out for sufficient period before carrying out the plaster work.

D.2.2 Scaffolding

Scaffolding for carrying out plastering work shall be double scaffolding having two sets of vertical supports so that the scaffolding is independent of the walls.

Scaffolding: Wooden ballies, bamboos, planks, trestles and other scaffolding shall be sound. These shall be properly examined before erection and use. Stage scaffolding shall be provided for ceiling plaster which shall be independent of the walls.

D.2.3 Preparation of surface

All putlog holes in brickwork and junction between concrete and brickwork shall be properly filled in advance. Joints in brick work shall be raked about 10 mm, and concrete surface shall be hacked to provide grip to the plaster. Projecting burrs of mortars formed due to gaps at joints in shuttering shall be removed. The surface shall be scrubbed clean with wire brush/coir brush to remove dirt, dust etc., and the surface thoroughly washed with clean water to remove efflorescence; grease and oil etc. and shall be kept wet for a minimum of two hours before application of plaster.

For external plaster; the plastering operation shall be started from the top floor and carried downwards. For internal plaster, the plastering operations may be started wherever the building frame and cladding work are ready and the temporary supporting ceiling resting on the wall of the floor have been removed. Ceiling plaster shall be completed before starting plaster to walls.

D.2.4 Application of plaster

The plaster about 15 cm. x 15 cm, shall be first applied horizontally and vertically at not more than 2 m intervals over the entire surface to serve as gauge. The surfaces of these gauges shall be truly in plane of the finished plastered surface. The mortar shall then be applied in uniform surface slightly more than the specified thickness, then brought to a true surface by working a wooden straight edge reaching across the gauges with small upwards and sideways movements at a time. Finally, the surface shall be finished of true with a trowel or wooden float according to the texture, smooth or sandy granular, as may be required. Excessive trowelling or over working the float shall be avoided. All corners, arises, angles and junctions etc. shall be carried out with proper templates to the size required.

Cement plaster shall be used within half an hour after addition of water. Any mortar or plaster which is partially set shall be rejected and removed from the site.

The surface shall be finished smooth and as approved with steel trowel with application of neat cement slurry with little lime if permitted by Design Consultant/ Project Manager, at the rate of 2.2Kg/M². The plaster surfaces shall be rubbed with iron plate / steel trowel till the same has achieved its approved surface.

In suspending the work at the end of the day, the plaster shall be left out, clean to line both horizontally and vertically. While recommencing the plaster, the edges of the old work shall be scrapped clean and wetted with cement putty before plaster is applied to the adjacent areas to enable the two to properly join together. Plastering work shall be closed at the end of the day on the body of the wall and shall not be nearer than 15 cm, to any corners or arises. Horizontal joints in plaster work shall not also occur on parapet tops and copings as these invariably lead to leakage. No portion of the surface shall be left out initially to be packed up later on.

D.2.5 Watering, curing, etc.

Each coat shall be kept damp continuously till the next coat is applied or for a minimum period of 7 days. Moistening shall commence as soon as plaster is hardened sufficiently. Soaking of walls shall be avoided and only as much water as can be readily absorbed shall be used, excessive evaporation on the sunny or windward side of building in hot air or dry weather shall be prevented by hanging mats or gunny bags on the outside of the plaster and by keeping them wet.

D.2.6 Testing

Necessary testing against water leakage shall be carried out as directed.

D.3 Mode of Measurements

- D.3.1 The rate shall include for work at any height, position, and floor and for all necessary scaffolding, etc. and for work at all levels.
- D.3.2 The rate shall also include for hacking and/or bush hammering to form key for plaster and for spatter dash treatment, as specified, as and where necessary.
- D.3.3 The rate shall also include for all work in narrow width, arises, rounded angles, chamfered external angles, drip moulds, grooves and for making good after all trades.
- D.3.4 The rate shall also include for groove with cement finish up to 12 mm. x 6 mm. to be formed in plaster at junction of slab and beam and slab and brick without any extra charge. The rate shall also include for similar grooves in plaster at the junction of masonry and wood or steel door/window/ventilator frame or at bottom of beam/lintels as drip moulds without extra charge.
- D.3.5 All plastering shall be measured in m², unless otherwise specified. Length or breadth & height shall be measured correct to a centimeter.
- D.3.6 Thickness of the plaster shall be exclusive of the thickness of the key i.e. grooved or open joints in brick work, stone work, etc. or space between laths. Thickness of plaster shall be average thickness with minimum as specified at any point on the surface.
- D.3.7 The measurement of wall plastering shall be taken between the walls or partitions (dimensions after plastering being taken) for length and from the top of floor or skirting to ceiling for height. Depth of cover of cornices if any shall be deducted.
- D.3.8 Soffits of stairs shall be measured as plastering on ceilings. Flowing/folding soffits shall be measured separately.
- D.3.9 For jambs, soffits, sills, etc., openings exceeding 0.5 m² and not exceeding 3.0 m², area deductions and additions shall be made in the following manner:-
- a) No deductions shall be made for ends joints, beams, posts, etc. for openings not exceeding 0.5 m² each and no addition shall be made for reveals, jambs, soffits, sills, etc. of these opening for finish to plaster around ends of joints, beams, posts, etc.
 - b) Deduction for openings exceeding 0.5 m² but not exceeding 3.0 m² each shall be made as follows and no addition shall be made for reveals, jambs, soffits, sills, etc. of these openings.
 - i) When both faces of any wall are plastered with same plaster, deduction shall be made for one face only.
 - ii) When two faces of any wall are plastered with different types of plasters or if one faces is plastered and the other pointed, deductions shall be made from the plaster or pointing on the side of frame for door, windows, etc. on which width of -reveals is less than that on the other side but no deductions shall be made on the other side. Where width of reveals on both faces of all are equal, deductions of 50% of area of opening on each face shall be made from area of plaster and/or pointing as the case may be.
- D.3.10 For openings having door frames equal to projection beyond the thickness of wall, full deduction for opening shall be made from each plastered face of the wall.
- D.3.11 In case of openings having area above 3.0 m² each, deduction shall be made for the opening but jambs, soffit, and sills shall be measured additionally.
- D.3.12 The unit rate shall be for a unit of one m².

E. Double Coat Waterproof Plaster

E.1 Materials

- E.1.1 Cement, Sand, Water, Waterproofing compound / chemicals, Cement mortar, etc. shall conform to respective specifications as specified under materials specification - part A of Technical Specifications

E.1.2 Sand shall be screened before its use.

E.1.3 Sand used shall be 50% fine and 50% coarse or as directed.

E.1.4 All materials shall be approved by Architect/Project Manager before use.

E.1.5 Approved

Waterproofing compound / chemicals in powder form or liquid form shall be added in dry cement mortar mix strictly in accordance with manufacturer's specifications.

E.2 Execution

E.2.1 General

The surface shall be cleaned of all dust, loose mortar droppings, traces of algae, efflorescence and other foreign matter by water or by brushing. Smooth surface shall be roughened by wire brushing if it is no; hard and by racking if it is hard. In case of concrete surface, if a chemical retarder has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting dust and loose particles shall be cleaned off and care shall be taken that none of the retarder is left on the surface. Trimming of projections on brick/concrete surface wherever necessary shall be carried out to get an even surface.

Raking of joints in case of masonry wherever necessary shall be allowed to dry out for sufficient period before carrying out the plaster work.

E.2.2 Scaffolding

Scaffolding for carrying out plastering work shall be double scaffolding having two sets of vertical supports so that the scaffolding is independent of the walls.

Scaffolding: Wooden ballies, bamboos, planks, trestles and other scaffolding shall be sound. These should be properly examined before erection and use. Stage scaffolding shall be provided for ceiling plaster which shall be independent of the walls.

E.2.3 Preparation of surface

All putlog holes in brickwork and junction between concrete and brickwork shall be properly filled in advance. Joints in brick work shall be raked about 10 mm. and concrete surface shall be hacked to provide grip to the plaster. Projecting burrs of mortars formed due to gaps at joints in shuttering shall be removed. The surface shall be scrubbed clean with wire brush/coir brush to remove dirt, dust etc., and the surface thoroughly washed with clean water to remove efflorescence; grease and oil etc. and shall be kept, wet for a minimum of two hours before application of plaster.

For external plaster; the plastering operation shall be started from the top floor and carried downwards. For internal plaster, the plastering operations may be started wherever the building frame and cladding work are ready and the temporary supporting ceiling resting on the wall of the floor have been removed. Ceiling plaster shall be completed before starting plaster to walls.

E.2.4 Application of Plaster

The plaster about 15 cm. x 15 cm, shall be first applied horizontally and vertically at not more than 2 m intervals over the entire surface to serve as gauge. The surfaces of these gauges shall be truly in plane of the finished plastered surface. The mortar shall then be applied in uniform surface slightly more than the specified thickness, then brought to a true surface by working a wooden straight edge reaching across the gauges with small upwards and sideways movements at a time. Finally, the surface shall be finished of true with a trowel or wooden float according to the texture, smooth or sandy granular, as may be required. Excessive troweling or over working the float shall be avoided. All corners, arises, angles and junctions etc. shall be carried out with proper templates to the size required.

Cement plaster shall be used within half an hour after addition of water. Any mortar or plaster which is partially set shall be rejected and removed from the site.

The plaster shall be provided in two coats and as specified. The base coat shall be carried out in 1:3 C.M. having minimum thickness of 12mm including provided approved waterproof chemicals as specified. Before the plastered surface hardens roughing shall be done to receive second coat. The second coat shall be carried out in 1:2 C.M., proportion having minimum thickness of 8mm. accordingly total thickness of plaster will be minimum 20mm.

The surface shall be finished smooth and as approved with steel trowel with application of neat cement slurry with little lime if permitted by Design Consultant/ Project Manager, at the rate of 2.2Kg/M². The plaster surfaces shall be rubbed with iron plate / steel trowel till the same has achieved its approved surface.

In suspending the work at the end of the day, the plaster shall be left out, clean to line both horizontally and vertically. While recommencing the plaster, the edges of the old work shall be scrapped clean and wetted with cement putty before plaster is applied to the adjacent areas to enable the two to properly join together. Plastering work shall be closed at the end of the day on the body of the wall and shall not be nearer than 15 cm, to any corners or arises. Horizontal joints in plaster work shall not also occur on parapet tops and copings as these invariably lead to leakage. No portion of the surface shall be left out initially to be packed up later on.

E.2.5 Watering, Curing, etc.

Each coat shall be kept damp continuously till the next coat is applied or for a minimum period of / days. Moistening shall commence as soon as plaster is hardened sufficiently. Soaking of walls shall be avoided and only as much water as can be readily absorbed shall be used, excessive evaporation on the sunny or windward side of building in hot air or dry weather shall be prevented by hanging mats or gunny bags on the outside of the plaster and by keeping them wet.

E.2.6 Necessary testing against water leakage shall be carried out as directed.

E.3 Mode of Measurements

- E.3.1 The rates shall include for work at any height, position, and floor and for all necessary scaffolding, etc. and for work at all levels.
- E.3.2 The rates shall also include for hacking and/or bush hammering to form key for plaster and for spatter dash treatment, as specified, as and where necessary.
- E.3.3 The rates shall also include for all work in narrow width, arises, rounded angles, chamfered external angles, drip moulds, grooves and for making good after all trades.
- E.3.4 The rate shall also include for groove with cement finish up to 12 mm x 6 mm to be formed in plaster at junction of slab and beam and slab and brick without any extra charge. The rate shall also include for similar grooves in plaster at the junction of masonry and wood or steel door/window/ventilator frame or at bottom of beam/lintels as drip moulds without extra charge.
- E.3.5 All plastering shall be measured in m², unless otherwise specified. Length or breadth & height shall be measured correct to a centimeter.
- E.3.6 Thickness of the plaster shall be exclusive of the thickness of the key i.e. grooved or open joints in brick work, stone work, etc. or space between laths. Thickness of plaster shall be average thickness with minimum as specified at any point on the surface.
- E.3.7 The measurement of wall plastering shall be taken between the walls or partitions (dimensions after plastering being taken) for length and from the top of floor or skirting to ceiling for height. Depth of cover of cornices if any shall be deducted.
- E.3.8 Soffits of stairs shall be measured as plastering on ceilings. Flowing/folding soffits shall be measured separately.
- E.3.9 For jambs, soffits, sills, etc., openings exceeding 0.5 m² and not exceeding 3.0 m², area deductions and additions shall be made in the following manner:-

- a) No deductions shall be made for ends joints, beams, posts, etc. for openings not exceeding 0.5 m² each and no addition shall be made for reveals, jambs, soffits, sills, etc. of these opening for finish to plaster around ends of joints, beams, posts, etc.
- b) Deduction for openings exceeding 0.5 m² but not exceeding 3.0 m² each shall be made as follows and no addition shall be made for reveals, jambs, soffits, sills, etc. of these openings.
 - i) When both faces of any wall are plastered with same plaster, deduction shall be made for one face only.
 - ii) When two faces of any wall are plastered with different types of plasters or if one faces is plastered and the other pointed, deductions shall be made from the plaster or pointing on the side of frame for door, windows, etc. on which width of -reveals is less than that on the other side but no deductions shall be made on the other side. Where width of reveals on both faces of all are equal, deductions of 50% of area of opening on each face shall be made from area of plaster and/or pointing as the case may be.

E.3.10 For openings having door frames equal to projection beyond the thickness of wall, full deduction for opening shall be made from each plastered face of the wall.

E.3.11 In case of openings having area above 3.0 m² each, deduction shall be made for the opening but jambs, soffits, and sills shall be measured additionally.

E.3.12 The unit rate shall be for a unit of one m².

F. Cement Pointing to Brickwork

F.1 Materials

F.1.1 Cement, Sand, Water, Cement mortar, etc. shall conform to respective specifications as specified under materials specification - part A of Technical Specifications

F.1.2 Sand shall be screened before its use.

F.1.3 Sand used shall be 50% fine and 50% coarse or as directed.

F.1.4 All materials shall be approved by Architect/Project Manager before use.

F.2 Execution

F.2.1 The specified pointing work shall be carried out with cement mortar in proportion of 1:2 (one part of cement and two parts of coarse sand) by volume.

F.2.2 The joints shall be raked to such a depth that the average of new mortar measured from either the sunk surface of finished pointing or from the edge of the brick shall be average 10 mm.

The joints shall then be cleaned with a wire brush and wetted thoroughly for 6 hours before pointing is commenced.

F.2.3 The mortar shall be pressed into the raked out joints with a pointing trowel according to the type of pointing specified in item. The mortar shall not spread over the corner edges or surface of the masonry. The pointing shall then be finished with the pointed tools.

F.2.4 The pointing shall be cured for 7 days. During this period, it shall be suitably protected from all damages.

F.3. Mode of Measurements

F.3.1 Area of wall to which pointing is provided shall be measured for payment.

F.3.2 No deductions shall be made for end of joints, beams and posts, etc. for openings not exceeding 0.5 m² each and no addition shall be made for reveals, jambs, soffits, sill, etc. of these openings.

- F.3.3 Deductions for openings exceeding 0.5 m² but not exceeding 3.0 m² each, shall be paid as follows and no addition shall be made for reveals, jambs, soffits, sills, etc. of these openings.
- i) When both faces of walls are pointed with same type of pointing deduction shall be made for one face only.
 - ii) When two faces of walls are pointed with different type of pointing or if one face is plastered and the other is pointed, deduction shall be made in the plaster or pointing on the side of frame for door, windows, etc, on which the width of reveals is less than that on the other side but on the other side but no deduction shall be made from plaster or pointing on the other side.
 - (iii) When only one face is treated and the other face is not treated, full deduction shall be made, if the width of the reveals on the treated side is less than on the untreated side, but if the width of the reveal is more, then no deduction shall be made nor any addition shall be made for reveals jambs soffits, sills, etc.
- F.3.4 In case of openings of area above 3.0 m² each, deduction shall be made for opening but jambs, sills and soffits, shall be measured.
- F.3.5 For all kinds of pointing such as flush, flush inclined, grooved, struck, V grooved, V shaped, etc. all above specification shall be applicable including mode of measurements.
- F.3.6 The unit rate shall be for a unit of one m².

- G.** Cement Concrete Vata in 1:2:4 proportion with top plaster of cement mortar in 1:3 proportion including top finished with neat cement.

G.1 Materials

- G.1.1 Cement, Sand, Aggregates of 6mm size, water, cement mortar, etc. shall conform to respective specifications as specified / described under material specifications - part A of Technical Specifications.
- G.1.2 Sand shall be screened before its use for cement mortar.
- G.1.3 Sand used in cement mortar shall be 50% fine and 50% coarse or as directed.
- G.1.4 All materials shall be approved by Design Consultant/Project Manager before use.
- G.1.5 Proportion of cement concrete as base material shall be in proportion of (1:2:4) i.e. one part cement: two parts of sand: four parts of 6mm size stone aggregates.
- G.1.6 Proportion of cement mortar shall be 1:3 (i.e. one part of cement: three parts of sand) and thickness shall be minimum 6mm.
- G.1.7 Top surface shall be finished with neat cement.

G.2 Execution

- G.2.1 All the specifications as described for item of Plain Cement Concrete shall be applicable.
- G.2.2 The work of cement concrete vata of specified size shall be carried out at the junctions of parapets and terrace, junction of wall and chajja etc. or as directed. The vata shall be finished in quarter round shape. The work shall be carried out in best workmanlike manner. The internal portion of rain water pipe shall be rounded off as per detail & as directed during constructing vata.
- G.2.3 The work shall be cured minimum for seven days, as directed.

G.3 Mode of Measurements

- G.3.1 The work shall be measured as actually laid/Constructed and finished at site.
- G.3.2 The unit rate shall be for a unit of one Rmt. (Running meter)

H. Hexagonal Chicken Mesh

H.1 Material

- H.1.1 Chicken wire mesh shall have openings of 20mm x 20mm size and manufactured from 26 gauge steel wires. The mesh is to be fixed with wire nails as directed.
- H.1.2 Chicken wire mesh shall be obtained from only one supplier and of one company only for entire work.
- H.1.3 All the materials to be used shall be approved by Architects before use.

H.2 Execution

- H.2.1 Chicken mesh shall be straightened up and cut by scissor only in required length.
- H.2.2 Small pieces shall not be used in the work unless it is allowed by Architect/Project Manager.
- H.2.3 Mesh shall be put correctly in position and shall be fixed with wire nail in such a way that wire nail is adequately embedded in successive coat of plaster.
- H.2.4 Wire nails shall be put @ 600mm o.c. in both the directions, without fail. No portion of mesh shall bulge out from its plain surface.

H.3 Mode of Measurements

- H.3.1 Actual laid area (i.e. clear visible area) only shall be measured.
- H.3.2 Overlaps shall not be considered for payment & hence same shall not be paid.
- H.3.3 Mesh laid at the junctions of concrete & masonry or between two different materials shall not be measured under this item as the same is the part of plaster work items.
- H.3.4 The rate shall include the cost of wire nails.
- H.3.5 The unit rate for a unit of m²

I. Stone cladding / dado fixed with specified cement mortar (i.e. wet cladding / dado)

I.1 Materials

- I.1.1 Stone slabs, cement, water, sand, cement mortar etc. shall conform to respective specifications as described under material specifications - part A of Technical Specifications.
- I.1.2 Stone slabs of approved shade, variety, size and thickness as specified in the items shall be provided & used. They shall be of selected quality, dense, uniform in colour and homogeneous in texture, free from cracks or other structural defects, etc.
- I.1.3 The exposed face shall have no veins or unsightly stains & defects.
- I.1.4 Approved stones shall be procured from one supplier and one quarry only for the entire work.
- I.1.5 Samples shall be got approved by Design Consultant before ordering the stone slab.
- I.1.6 Mock up shall be prepared at site as directed for approval of Design Consultant and the same shall be kept intact & undisturbed till the completion of cladding / dado work externally or internally.
- I.1.7 The surface shall be as specified and sides machine cut, true to square
- I.1.8 Maximum tolerance allowed shall be
 - Thickness $\pm$ one mm
 - Length $\pm$ Five mm
 - Breadth $\pm$ Two mm

I.2 Execution

- I.2.1 When a single course of stone slab is to be fixed as in dado etc., the slabs shall be fixed as described below. Mortar pads of 1:2 C.M. of uniform width shall be stuck on to the wall at close intervals and the sand stone slabs shall be pressed on to them firmly. The remaining cavities if any, shall then be filled with thin grout of cement mortar of the same proportion. The sound coming, on gently tapping of the slab will indicate if there are any hollows. When the hollow cannot be filled with grout and the finished slab continues to give a hollow sound on tapping the slab shall be removed and reset.
- I.2.2 For facade work, where more than one course is required, the stone slabs shall be fixed in the same way as described above except that at horizontal joints of the slabs, adjacent slabs shall be held together by a wrought iron/copper pin passing through a hole drilled into the slabs.
- I.2.3 The stones shall be secured to the backing by channeled shape gun metal clamps, 30 cm. long, 25 mm. wide and 6 mm. thick. The legs of the channel shall be 2.5 cm. high. The adjoining stone shall be secured to each other by 6 mm. dia., 75 to 150 mm. long copper pin dowels. The clamps and pin dowels shall be spaced not more than 600 mm. apart. The samples of pins dowels and clamps shall be got approved from the Architects and Project Manager. One end of the clamp shall be positioned in the groove on the top edge of the stone and the other end in the joint of the brick masonry or RCC at the back.
- I.2.4 In addition, holdfasts/dowels shall be provided to anchor the slabs to the wall. The holdfast shall be counter-sunk into the joints of the slab and it shall be located about a meter apart' subject to a minimum of one for each slab for each horizontal joint. The facing shall be fixed truly in plumb and in perfect line or curves as shown on the plans. The courses and joints shall be as directed by Design Consultant and Engineer-in-charge. The surface shall be protected from sun and rain and cured for ten days and shall be finally hand polished. The rate shall include erecting and removing double scaffolding, equipment etc.
- ## I.3 Mode of Measurement
- I.3.1 Actual laid and clear visible area only will be measured for payment.
- I.3.2 The rates shall include for work at any height, position, and floor and for all necessary scaffolding, etc. and for work at all levels.
- I.3.3 The rates shall also include for hacking and/or bush hammering to form key for plaster and for spatter dash treatment, as specified, as and where necessary.
- I.3.4 The rates shall also include for all work in narrow width, arises, rounded angles, chamfered external angles, drip moulds, grooves and for making good after all trades.
- I.3.5 The rate shall also include for groove with cement finish up to 12 mm. x 6 mm. to be formed in plaster at junction of slab and beam and slab and brick without any extra charge. The rate shall also include for similar grooves in plaster at the junction of masonry and wood or steel door/window/ventilator frame or at bottom of beam/lintels as drip moulds without extra charge.
- I.3.6 All plastering shall be measured in m², unless otherwise specified. Length or breadth & height shall be measured correct to a centimeter.
- I.3.7 Thickness of the plaster shall be exclusive of the thickness of the key i.e. grooved or open joints in brick work, stone work, etc. or space between laths. Thickness of plaster shall be average thickness with minimum as specified at any point on the surface.
- I.3.8 The measurement of wall plastering shall be taken between the walls or partitions (dimensions after plastering being taken) for length and from the top of floor or skirting to ceiling for height. Depth of cover of cornices if any shall be deducted.
- I.3.9 Soffits of stairs shall be measured as plastering on ceilings. Flowing/folding soffits shall be measured separately.



- I.3.10 For jambs, soffits, sills, etc., openings exceeding 0.5 m² and not exceeding 3.0 m², area deductions and additions shall be made in the following manner:-
- a) No deductions shall be made for ends joints, beams, posts, etc. for openings not exceeding 0.5 m² each and no addition shall be made for reveals, jambs, soffits, sills, etc. of these opening for finish to plaster around ends of joints, beams, posts, etc.
 - b) Deduction for openings exceeding 0.5 m² but not exceeding 3.0 m² each shall be made as follows and no addition shall be made for reveals, jambs, soffits, sills, etc. of these openings.
 - i) When both faces of any wall are plastered with same plaster, deduction shall be made for one face only.
 - ii) When two faces of any wall are plastered with different types of plasters or if one faces is plastered and the other pointed, deductions shall be made from the plaster or pointing on the side of frame for door, windows, etc. on which width of -reveals is less than that on other side but no deductions shall be made on the other side. Where width of reveals on both faces of all are equal, deductions of 50% of area of opening on each face shall be made from area of plaster and/or pointing as the case may be.
- I.3.11 For openings having door frames equal to projection beyond the thickness of wall, full deduction for opening shall be made from each plastered face of the wall.
- I.3.12 In case of openings having area above 3.0 m² each, deduction shall be made for the opening but jambs, soffits, and sills shall be measured additionally.
- I.3.13 The unit rate shall be for a unit of one m².

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show locations and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other work.
- C. Samples for Initial Selection: For each type of factory-prepared finish coat indicated.
- D. Samples for Verification: For each type of factory-prepared colored and/or textured finish coat indicated; 305 by 305 mm, and prepared on rigid backing.

1.3 QUALITY ASSURANCE

- A. Fire-Resistance Ratings: Where indicated, provide Portland cement plaster assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 or respective IS code by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- B. Sound-Transmission Characteristics: Where indicated, provide portland cement plaster assemblies identical to those of assemblies tested for STC ratings per ASTM E 90 or respective IS code and classified according to ASTM E 413 or respective IS code by a qualified testing agency.
- C. Mockups: Before plastering, install mockups of at least 9.3 sq. m in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Install mockups for each type of finish indicated.



2. For interior plasterwork, simulate finished lighting conditions for review of mockups.
 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D.** Preinstallation Conference: Conduct conference at Project site. To comply with requirements in 'Division-1- Project Management and Co-ordination'.

1.4 DELIVERY, STORAGE, AND HANDLING

- A.** Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

1.5 PROJECT CONDITIONS

- A.** Comply with ASTM C 926 or respective IS code requirements.
- B.** Interior Plasterwork: Maintain room temperatures at greater than 4.4 deg C for at least 48 hours before plaster application, and continuously during and after application.
1. Avoid conditions that result in plaster drying out during curing period. Distribute heat evenly; prevent concentrated or uneven heat on plaster.
 2. Ventilate building spaces as required to remove water in excess of that required for hydrating plaster in a manner that prevents drafts of air from contacting surfaces during plaster application and until plaster is dry.
- C.** Exterior Plasterwork:
1. Apply and cure plaster to prevent plaster drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.
 2. Apply plaster when ambient temperature is greater than 4.4 deg C.
 3. Protect plaster coats from freezing for not less than 48 hours after set of plaster coat has occurred.
- D.** Factory-Prepared Finishes: Comply with manufacturer's written recommendations for environmental conditions for applying finishes.

Item no: 47 GYPSUM BOARD Ceiling

PART 1 - GENERAL

3.12 RELATED DOCUMENTS

- A.** Drawings and general provisions of the Contract apply to this Section.

3.13 SUMMARY

- A.** This Section includes the following:
1. Gypsum board suspended ceilings.
 2. Gypsum board bulkheads at ceilings
 3. Gypsum board walls.
- B.** Related Sections include the following:
1. Section "Fire-Resistive Joint Systems" for head-of-wall assemblies that incorporate gypsum board.



2. Section "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board.
3. Section "Gypsum Board Shaft Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.
4. Section "Tiling" for cementitious backer units installed as substrates for ceramic tile.
5. Painting Sections for primers applied to gypsum board surfaces.
6. Sections for lighting fixtures, sprinklers, and air-distribution devices.

3.14 SUBMITTALS

- A. Product Data: For each type of product indicated.

3.15 QUALITY ASSURANCE

- A. Standards: Within the text of this Section, reference is made to the Standards listed hereafter. Such standards are made a part of the Contract Documents by reference. Unless the Contract Documents include more stringent requirements, applicable requirements of these Standards shall have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced.
 1. British Standard Institute (BSI) - UK or respective IS code
 - a. BS 1230: or respective IS code Part 1 Gypsum plasterboard Specification for plasterboard excluding materials submitted to secondary operations
 - b. BS 8212 Code or respective IS code of practice for dry lining and partitioning using gypsum plasterboard
 - c. BS 8290-1 or respective IS code Suspended ceilings. Code of practice for design
 - d. BS 8290-2 Suspended ceilings. Specification for performance of components and assemblies
 - e. BS 8290-3 or respective IS code Suspended ceilings. Code of practice for installation and maintenance
 2. Deutsches Institute fur Normung (DIN) - Germany
 - a. DIN 18168-2 or respective IS code Lightweight ceiling linings and suspended ceilings; verification of the load bearing capacity of metal substructures and hangers
 - b. DIN 18182-2 or respective IS code Accessories for use with gypsum plasterboards; dry wall screw
- B. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 or respective IS code by an independent testing agency.
- C. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 or respective IS code by an independent testing agency.
- D. Single Source Responsibility: Obtain gypsum board framing, suspension system and accessories from same manufacturer of boards.

3.16 DELIVERY, STORAGE, AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.



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- B.** Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum boards flat to prevent sagging.

3.17 PROJECT CONDITIONS

- A.** Environmental Limitations: Comply with requirements of referenced Standard Specifications and gypsum board manufacturer's written recommendations, whichever are more stringent.
- B.** Do not install interior products until installation areas are enclosed and conditioned.
- C.** Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

PART 4 - PRODUCTS

4.1 MANUFACTURERS

- A.** Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Steel Framing and Furring:
 - a. Indian Gypsum Company
 - b. G-P Gypsum.
 - c. National Gypsum Company.
 - d. USG Corporation.
 2. Gypsum Board and Related Products:
 - a. Indian Gypsum Company
 - b. G-P Gypsum.
 - c. National Gypsum Company.
 - d. USG Corporation.

4.2 STEEL SUSPENDED CEILING AND SOFFIT FRAMING

- A.** Components, General: Furnish all necessary components for each gypsum board assembly as indicated in technical data of approved manufacturer for selected system.
- B.** Clips: Steel wire, minimum Z275 or respective IS code zinc coating, soft temper, 2.65-mm- diameter minimum.
- C.** Hanger Attachments to Concrete: As follows:
1. Postinstalled Anchors: Provide torque-controlled expansion anchors, with capability to sustain, without failure, a load equal to six times the load imposed when installed in solid or grouted unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 or respective IS code conducted by a qualified independent testing agency.
 - a. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633 or respective IS code, Class Fe/Zn 5 (5 microns) for Class SC 1 service condition (mild).
 2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from zinc coated steel of the following minimum properties indicated below, with clips or other devices for attaching hangers of type indicated, and capable of sustaining,

without failure, a load equal to 10 times that imposed by construction as determined by testing per ASTM E 488 or respective IS code conducted by a qualified independent testing agency.

- a. Tensile Strength: 1900 Mpa.
- b. Shear Strength: 1117 Mpa.

D. Hanger: As follows:

1. Wire Hangers: to BS EN 10218 or respective IS code AND 10244 zinc coating, soft temper, 4.00 mm diameter minimum. Load capacity Class 25 kg to Din 18168 T2
2. Flat Hangers: Steel sheet, BS EN 10142, Z275 or respective IS code hot-dip galvanized zinc coating, furnish complete with cleats and fasteners.
 - a. Size: Load capacity Class 40 kg to Din 18168 T2 or respective IS code.

E. Carrying Channels: Cold-rolled, steel sheet with a base metal thickness of 0.80 mm, a minimum 12.50-mm- wide flange, to BS EN 10142, Z275 or respective IS code hot-dip galvanized zinc coating.

1. Depth: As recommended by manufacturer.

F. Furring Channels (Furring Members): Steel sheet to BS EN 10142, Z275 or respective IS code, hot-dip galvanized zinc coating.

1. Cold Rolled Channels: 0.55-mm bare steel thickness minimum.

G. Cross Connectors: Manufacturer's standard fabricated from corrosion-resistant material.

4.3 METAL FRAMING COMPONENTS

A. Standard: Comply with requirements of BS 7364 or respective IS code.

B. Material: Galvanized Steel Sheets: Continuously hot-dip zinc-coated, low-carbon steel sheets to BS EN 10142 or respective IS code as follows:

Steel Grade:	DX51D or according to IS code
Coating material:	Zinc (+Z)
Coating application:	Immersing in a molten bath containing a zinc content of at least 99%.
Coating finish:	Best quality surface (C).
Coating designation:	275 (Coating mass minimum 275 gm/m ² including both surfaces in triple spot test)
Surface treatment:	Chemical passivation (C).

C. Channels: 0.50 mm thick minimum, profile to details or hot-shaped if not indicated

D. Stud widths indicated on plans indicate local products in sizes using: 46mm, 70mm and 148mm. Other sizes from other manufacturers may be considered by the Design Consultant with prior approval and written notification.

4.4 INTERIOR GYPSUM WALLBOARD

A. Board Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

B. Sag-Resistant Gypsum Wallboard: BS 1230 or respective IS code: Part 1, manufactured to have more sag resistance than regular-type gypsum board.

1. Type: Table 1, Type 1, for regular applications. or as per IS code requirement
2. Thickness: 15.00 mm.
3. Longitudinal Edges: Tapered.



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4. Location: Ceiling membranes.

4.5 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 or respective IS code.
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Custom Building Products; Wonderboard.
 - b. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
 - c. USG Corporation; DUROCK Cement Board.
 - d. Comparable product manufactured in India.
 3. Thickness: 15mm.

4.6 VENEER PLASTER PANELS

- A. Recycled Content: Provide gypsum panel products with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of <Insert number> percent by weight.
- B. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.
- C. Gypsum Base for Veneer Plaster: ASTM C 588/C 588M.
 1. Regular Type: 15mm

4.7 VENEER PLASTER MATERIALS

- A. Two-Component Gypsum Veneer Plaster: ASTM C 587, with separate formulations; one for base-coat and one for finish-coat application over substrates.

4.8 GYPSUM VENEER PLASTER MIXES

- A. Mechanically mix gypsum veneer plaster materials to comply with ASTM C 843 and with gypsum veneer plaster manufacturer's written recommendations.

4.9 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Steel Drill Screws: manufacturer's standard self drill and self tapping steel screws black phosphated for fixing plasterboards to metal framing, for use with:
 1. Lightweight metal up to 0.55 mm thick: to be tested to DIN 18182-2 or respective IS code, 50021 and 50942.
 2. Metal profiles from 0.70 mm to 1.20 mm thick: to be tested to DIN 18182-2 and 50942 or respective IS code.
- C. Plaster Board Lining to Walls:
 1. System: Lining on metal Furring.
 2. Furring: With Hat-shape profiles not less than 0.50 mm thick formed of galvanized steel sheets as specified. Use profiles of factory formed rids. (as applicable)
 - k. Fix at top of lining (lining stop).



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- l. Fix at bottom of lining (lining sill),
 - m. Fix at perimeter of each opening through lining.
 - n. Fix at side ends of each lined area.
 - o. Fix at not more than 400 mm intervals.
- 3. Plaster boards: Regular, 15.00 mm thick, tapered edges.
 - 4. Fixing Screws: Plaster board screws as specified at not more than 300 mm intervals.
 - 5. Coordination: Coordinate with the works of suspended ceilings and electromechanical works.
 - 6. Preparation of Substrates: Pretreat substrates to be lined to manufacturer's recommendations according to method of fixation specified.
 - 7. Furring Fixation: Fix with continuous strips of manufacturer's standard bonding compound.
 - 8. Jambs, Sills and Heads of Openings through Walls: Are to have plasterboard lining as specified for walls.
 - 9. Finish of Joints: Taped seamless finish as specified in this Section.
 - 10. Tolerance: Finish lining to walls exactly to lines indicated on Drawings and perfectly plumb. No variation from lines or plumb shall be accepted. Installer is to examine walls and substrates prior to installation. Defects that will influence requirements of finished linings shall be rectified prior to fixing furring.

PART 5 - EXECUTION

5.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

5.2 PREPARATION

- A. Suspended Ceilings: Coordinate installation of ceiling suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers at spacing required to support ceilings and that hangers will develop their full strength.

5.3 INSTALLATION OF GYPSUM BOARD ASSEMBLIES, GENERALLY

- A. General: Erect the work of gypsum board assemblies ceiling, lining to details indicated on Drawings or approved shop drawings.

5.4 INSTALLING SUSPENSION SYSTEM FOR SUSPENDED CEILINGS AND SOFFIT FRAMING

- A. Suspend ceiling hangers from building structures as follow:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counters playing, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacing that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental



suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.
 4. Secure flat and angle hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 5. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- B.** Installation Tolerances: Install steel framing components for suspended ceilings so members for panel attachment are level to within 3 mm in 3.6 m measured lengthwise on each member and transversely between parallel members.
- C.** Sway-brace suspended steel framing with hangers used for support.
- D.** Wire-tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.
- E.** Install suspended steel framing components in sizes and spacing indicated, but not less than that required by the referenced steel framing and installation standards.
- F.** Cavity Barriers: Install to divide ceiling plenum in compartment not exceeding 100 m² in plan.
- G.** Access Panels: Provide access panels at locations selected by the Engineer and indicated on approved shop drawings.
1. Access panels are to comply with requirements specified in, Section "Access Doors and Frames".

5.5 INSTALLING FURRING AND STUDS

- A.** Install steel furring and studs for linings to solid backgrounds or for linings and single-layer walls in compliance with BS 8212 or respective IS code.

5.6 APPLYING AND FINISHING BOARDS, GENERAL

- A.** Gypsum Board Application and Finishing Standards: BS 8212 or respective IS code
- B.** Install ceiling board across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent board's not less than one framing member.
- C.** Install gypsum boards with face side out. But boards together for a light contact at edges and ends with not more than 1.5 mm of open space between boards. Do not force into place.
- D.** Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E.** Attach gypsum boards to framing provide at openings and cut-outs.
- F.** Form control and expansion joints with space between edges of adjoining gypsum boards.
- G.** Space fasteners in gypsum boards according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.



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1. Space screws a maximum of 300 mm o.c. for vertical applications.
 2. Space screws a maximum of 200 mm o.c. for ceilings

5.7 BOARD APPLICATION METHODS

A. Single-Layer Application:

1. On ceilings, apply gypsum boards before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.

B. Single-Layer Fastening Methods: Apply gypsum boards to supports with steel drill screws.

5.8 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for boards. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to requirements of referenced installation standards and in specific locations approved by Engineer for visual effect.

5.9 INSTALLING JOINT REINFORCEMENT

A. Gypsum Base for Veneer Plaster: Reinforce interior angles and flat joints with joint tape and embedding material to comply with ASTM C 843 and with gypsum veneer plaster manufacturer's written recommendations.

B. Abuse-Resistant Base: Reinforce joints between abuse-resistant panels with joint tape and embedding material according to panel manufacturer's written recommendations.

C. Impact-Resistant Base: Reinforce joints between impact-resistant panels with joint tape and embedding material according to panel manufacturer's written recommendations.

D. Moisture- and Mold-Resistant Base: Reinforce joints between moisture- and mold-resistant panels with joint tape and embedding material according to panel manufacturer's written recommendations.

E. Cementitious Backer Units: Reinforce joints between cementitious backer units with joint tape and embedding material according to unit manufacturer's written recommendations.

5.10 FINISHING GYPSUM BOARD ASSEMBLIES

A. Bonding Agent: Apply bonding agent on dry gypsum surfaces according to gypsum veneer plaster manufacturer's written recommendations.

B. Gypsum Veneer Plaster Application: Comply with ASTM C 843 and with veneer plaster manufacturer's written recommendations.

1. Two-Component Gypsum Veneer Plaster:

a. Base Coat: Trowel apply base coat over substrate to uniform thickness of (1.6 to 2.4 mm). Fill all voids and imperfections.

b. Finish Coat: Trowel apply finish-coat plaster over base-coat plaster to uniform thickness of (1.6 to 2.4 mm).

2. Where gypsum veneer plaster abuts only metal door frames, windows, and other units, groove finish coat to eliminate spalling.

3. Do not apply veneer plaster to gypsum base if paper facing has degraded from exposure to sunlight. Before applying veneer plaster, use remedial methods to restore bonding capability to degraded paper facing according to manufacturer's written recommendations.

5.11 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: Before Contractor installs gypsum board ceilings, Engineer will conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
 1. Notify Engineer seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.
 2. Before notifying Engineer, complete the following in areas to receive gypsum board ceilings:
 - a. Installation of 80 percent of lighting fixtures, powered for operation.
 - b. Installation, insulation, and leak and pressure testing of water piping systems.
 - c. Installation of air-duct systems.
 - d. Installation of air devices.
 - e. Installation of mechanical system control-air tubing.
 - f. Installation of ceiling support framing.

Section No: 10 Doors and Windows

10.01 FLUSH DOORS, ETC.

A. Flush (Solid core) wood doors

A.1 Materials

- A.1.1 Flush door, plywood, wood for lipping shall conform to the specifications as described in material specifications part A of Technical Specifications.
- A.1.2 All flush doors shall be solid core having teak lipping unless otherwise specified. It shall conform to the relevant specifications of IS: 2202 and shall be obtained from approved manufacturers like Mafatlal, Anchor, Sitapur or equivalent. The finished thickness of the shutter shall be as mentioned in the items. Face veneers shall be of the pattern and colour approved by the Architect & Project Manager and an approved sample shall be deposited with the Architect & Project Manager for reference.
- A.1.3 The under veneers shall be of good quality, durable and well seasoned wood. The face veneer shall be of minimum 1 mm. thickness and of well matched and seasoned 1st class teak, laid along with grains of the core patterns, The combined thickness of all the veneers on each face shall not be less than 4 mm. Thermosetting synthetic resin conforming to IS: 303, for moisture proof plywood, grade M.P.F.I. shall be used in manufacture.
- A.1.4 All the flush wood door shutters shall be of the same quality and of same supplier and the manufacturer as approved by the Architect, for entire work.
- A.1.5 All the materials shall got approved by the Architect & Project Manager, before it is used.
- A.1.6 The solid core type flush door shutters shall be of decorative or non-decorative type and of premier grade, 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-1) 1980. 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 303-1975.

- A.1.7 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. Alternatively, the core shall be of solid teak particle board. Edges of the core shall be lipped internally with 1st class teak wood battens of 4 cm. minimum depth, glued and machine pressed along with the core.
- A.1.8 The core surface shall then have two or three veneers firmly glued on each face. Adhesives used shall not contain urea formaldehyde. 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.
- A.1.9 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, revating, opening of glazing, venation etc. shall be provided if specified in the drawing.
- A.1.10 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 smooth even texture.
- A.1.11 The shutters shall be tested for - -
- a) End immersion test: The test shall be carried out as per IS 2202 (part-1) 1980. There shall be no de-lamination at the end of the test.
 - b) Knife test: The face panel when tested in accordance with IS 1659-1979 shall pass the test.
 - c) Glue Adhesion test: The flush door shall be tested for glue adhesive test in accordance with IS:2202 (Part-1) 1980. The shutters shall be considered to have passed the test if no de-lamination occurs in the glue lines in the plywood and if no single de-lamination 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. De-lamination at the corner shall be measured continuously around the corner. De-lamination at the knots, knot holes and other permissible wood defects shall not be considered in assessing the sample.
- A.1.12 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
- A.1.13 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.
- A.1.14 For fire - rated doors, construction and core specified above for type of face indicated or manufacturers standard core construction shall be as needed to provide indicated fire rating, including furnishing formed steel edges and astragals for pairs of fire rated doors, unless otherwise indicated with backed enamel same colour as of doors.
- A.1.15 Wooden beads for light openings or for vision panel shall be of approved teak wood species in profile as per manufacturers standard shape, unless otherwise indicated on drawings. For fire doors, metal frames for the same shall be provided as per manufacturers standard frame formed of 1.2mm thick, cold - rolled steel sheet, factory primed and approved for use in doors of fire rating indicated.
- A.1.16 Door shutters shall be fabricated / manufactured in sizes indicated for project - site fitting. Factory aligned and fit door in frames shall be with uniform clearances and bevels as indicated below. Door shutter shall not be trimmed in excess of limits set by manufacturer or permitted for fire - rated doors. Cut surfaces after fitting and machining (for hardware) shall be sealed.

- a) Clearance - 3mm at heads, jambs and between pair of door shutters, including from bottom of door to top of decorative floor finish / covering for clearance to fire rated door shutters, the same shall comply with NFPA 80 or respective Indian Standard.
- b) Bevel non-fire rated doors 3 ½ degree at lock and hinge edges.
- c) Bevel fire-rated door 3 ½ degree at lock edge.

A.1.17 Exterior door shutters shall be treated at factory with water repellent after manufacturing has been completed.

A.1.18 Doors (i.e. shutter and frame) shall be finished in approved shade with Asian or approved equivalent synthetic enamel paint consisting of minimum two coats of enamel paint including coat of relevant primer and a coat of anti-termite chemical, along with putting the surfaces as indicated.

A.1.19 For fire-rated doors (i.e. shutter and frame) shall be finished in approved shade with approved intumescent (fire resisting) paint meeting with indicated fire-rating along with a coat of respective primer, as per manufacturer's recommendations & specifications over coat of anti-termite chemical.

A.2 Execution

A.2.1 The item of flush door shutter covers the requirement of preparation of shutters for doors, windows, clearstory windows, their supply and fixing. The work shall be carried out as per the detailed drawings and sample approved by the Architect and Project Manager.

A.2.2 Door shutters and installed door frames shall be examined & inspected before hanging doors. i.e.

- a) Doing verification of sub frames or wood blocking have been fixed in compliance with drawings.
- b) Doing verification of compliance of frames and swing characteristics and have been installed with level heads and plumb jambs.
- c) Rejecting the doors which are defective

A.2.3 Installation of doors shall be proceeded only after unsatisfactory conditions have been corrected.

A.2.4 Installation of doors shall comply with manufacturer's written instructions, referenced quality Standard and as indicated. Fire rated doors shall be installed in corresponding fire - rated frames according to NFPA 80 or respective Indian Standards.

A.2.5 Doors that do not swing or operate freely shall be re - hanged or replaced.

A.3 Mode of Measurements

A.3.1 Rate shall include the cost of respective painting work as indicated.

A.3.2 The dimensions of the shutter shall be measured the clear size of shutter, excluding frame.

A.3.3 The unit rate shall be for a unit of m².

B. Flush (Solid core) wood with Vision Panel doors

B.1 Materials

B.1.1 Flush door, plywood, wood for lipping shall conform to the specifications as described in material specifications part A of Technical Specifications.

B.1.2 All flush doors shall be solid core having teak lipping unless otherwise specified. It shall conform to the relevant specifications of IS: 2202 and shall be obtained from approved manufacturers like Mafatlal, Anchor, Sitapur or equivalent. The finished thickness of the shutter shall be as mentioned in the items. Face veneers shall be of the pattern and

colour approved by the Architect & Project Manager and an approved sample shall be deposited with the Architect & Project Manager for reference.

- B.1.3 The under veneers shall be of good quality, durable and well seasoned wood. The face veneer shall be of minimum 1 mm. thickness and of well matched and seasoned 1st class teak, laid along with grains of the core patterns, The combined thickness of all the veneers on each face shall not be less than 4 mm. Thermosetting synthetic resin conforming to IS: 303, for moisture proof plywood, grade M.P.F.I. shall be used in manufacture.
- B.1.4 The glass for the Vision panel 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 from Saint Gobain, Modiguard or approved equivalent 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.
- B.1.5 All the flush wood door shutters shall be of the same quality and of same supplier and the manufacturer as approved by the Architect, for entire work.
- B.1.6 All the materials shall got approved by the Architect & Project Manager, before it is used.
- B.1.7 The solid core type flush door shutters shall be of decorative or non-decorative type and of premier grade, 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-(Par-t-1) 1980. 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 303-1975.
- B.1.8 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. Alternatively, the core shall be of solid teak particle board. Edges of the core shall be lipped internally with 1st class teak wood battens of 4 cm. minimum depth, glued and machine pressed along with the core.
- B.1.9 The core surface shall then have two or three veneers firmly glued on each face. Adhesives used shall not contain urea formaldehyde. 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.
- B.1.10 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, revating, opening of glazing, venation etc. shall be provided if specified in the drawing.
- B.1.11 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 smooth even texture.
- B.1.12 The shutters shall be tested for -
- End immersion test: The test shall be carried out as per IS 2202 (part-1) 1980. There shall be no de-lamination at the end of the test.
 - Knife test: The face panel when tested in accordance with IS 1659-1979 shall pass the test.
 - Glue Adhesion test: The flush door shall be tested for glue adhesive test in accordance with IS:2202 (Part-1) 1980. The shutters shall be considered to have passed the test if no de-lamination occurs in the glue lines in the plywood and if no single de-lamination 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 stile and rail. De-lamination at the corner shall be measured continuously around the corner. De-lamination at the knots, knot holes and other permissible wood defects shall not be considered in assessing the sample.

- B.1.13 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
- B.1.14 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.
- B.1.15 For fire - rated doors, construction and core specified above for type of face indicated or manufacturers standard core construction shall be as needed to provide indicated fire rating, including furnishing formed steel edges and astragals for pairs of fire rated doors, unless otherwise indicated with backed enamel same colour as of doors.
- B.1.16 Wooden beads for light openings or for vision panel shall be of approved teak wood species in profile as per manufacturers standard shape, unless otherwise indicated on drawings. For fire doors, metal frames for the same shall be provided as per manufacturers standard frame formed of 1.2mm thick, cold - rolled steel sheet, factory primed and approved for use in doors of fire rating indicated.
- B.1.17 Door shutters shall be fabricated / manufactured in sizes indicated for project - site fitting. Factory aligned and fit door in frames shall be with uniform clearances and bevels as indicated below. Door shutter shall not be trimmed in excess of limits set by manufacturer or permitted for fire - rated doors. Cut surfaces after fitting and machining (for hardware) shall be sealed.
- a) Clearance - 3mm at heads, jambs and between pair of door shutters, including from bottom of door to top of decorative floor finish / covering for clearance to fire rated door shutters, the same shall comply with NFPA 80 or respective Indian Standard.
 - b) Bevel non-fire rated doors 3 ½ degree at lock and hinge edges.
 - c) Bevel fire-rated door 3 ½ degree at lock edge.
- B.1.18 Exterior door shutters shall be treated at factory with water repellent after manufacturing has been completed.
- B.1.19 Doors (i.e. shutter and frame) shall be finished in approved shade with Asian or approved equivalent synthetic enamel paint consisting of minimum two coats of enamel paint including coat of relevant primer and a coat of anti-termite chemical, along with puttying the surfaces as indicated.
- B.1.20 For fire-rated doors (i.e. shutter and frame) shall be finished in approved shade with approved intumescent (fire resisting) paint meeting with indicated fire-rating along with a coat of respective primer, as per manufacturer's recommendations & specifications over coat of anti-termite chemical.
- B.2 Execution
- B.2.1 The item of flush door shutter covers the requirement of preparation of shutters for doors, their supply and fixing. The work shall be carried out as per the detailed drawings and sample approved by the Architect and Project Manager.
- B.2.2 Door shutters and installed door frames shall be examined & inspected before hanging doors. i.e.
- a) Doing verification of sub frames or wood blocking have been fixed in compliance with drawings.
 - b) Doing verification of compliance of frames and swing characteristics and have been installed with level heads and plumb jambs.
 - c) Rejecting the doors which are defective
- B.2.3 Glass vision panel fixing in the shutter shall be as per the drawing.

B.2.4 Installation of doors shall be preceded only after unsatisfactory conditions have been corrected.

B.2.5 Installation of doors shall comply with manufacturer's written instructions, referenced quality

Standard and as indicated. Fire rated doors shall be installed in corresponding fire - rated frames according to NFPA 80 or respective Indian Standards.

B.2.6 Doors that do not swing or operate freely shall be re - hanged or replaced.

B.3 Mode of Measurements

B.3.1 Rate shall include the cost of respective painting work as indicated.

B.3.2 The dimensions of the shutter shall be measured the clear size of shutter, excluding frame.

B.3.3 The unit rate shall be for a unit of m².

C. Storages, Pelmet, Furniture and other wood works

C.1 Materials

C.1.1 All Materials brought on site of works and meant to be used in the same shall be the best of their respective kinds and to the approval to the Architect/Designer/ Site in charge.

C.1.2 Samples of all materials shall be got approved by the Architects/ Site in charge and shall be deposited with him before the order for the material is placed with the suppliers. The material brought on the works shall confirm in every respect with approved samples.

C.1.3 Woodwork and Carpentry under this specification shall include supply, fitting and fixing of pelmet, shelves, furniture, etc. as shown in drawings, including a prime coat of approved paint, varnish, or fixing of decorative plastic laminate where called for in the schedule. This shall also include the supply and fixing of all hardware and fixtures shown in drawing.

C.1.4 Specified timber of best quality shall be used. It shall be well seasoned and free from large or loose, knots cracks or other defects. Timber shall be treated with approved wood preservative before use. Before starting the carpenter's work, the Contractor shall have the rough timber approved by the Client / Designer/ Architect.

C.1.5 Plywood shall be commercial quality or with decorative surface veneer. Unless specifically permitted otherwise, the adhesive used in plywood shall be phenol formaldehyde resin of B W R grade conforming to IS: 848.

C.1.6 The colour, pattern, finish and texture of decorative Laminated Plastic Sheets shall be approved by the Client / Designer/ Architect. Sheet sizes should be ordered considering the design to ensure the least number of joints in one surface.

C.1.7 Adhesive used for bonding cross- band and plywood to core and face veneers to cross band, shall be phenol formaldehyde synthetic resin conforming to B.W.P. type specified in IS: 848 - 1974-Specification for synthetic resin adhesives for plywood (Phenolic & Aminoplastic (First Revision)).

C.1.8 Fixtures shall be as shown on drawing and as approved by Client / Designer/ Architect.

C.2 Execution

C.2.1 Skilled carpenters shall execute the work as per details shown on drawing or as instructed by the Engineer.

C.2.2 Timber shall be sawn in the direction of the grains. Sawing shall be truly straight and square. Special care shall be taken to match the grain of timbers or plywood to give a uniform and pleasing appearance, which will be subsequently polished.

- C.2.3 The timber shall be planed smooth and accurate to the full dimensions, rebates, roundings, and mouldings as shown in the drawings made, before assembly. Any framing timber and other work shall be close-fitting with proper wood joinery, accurately set to required lines or levels and rigidly secured in place.
- C.2.4 Patching or plugging of any kind shall not be permitted. Screwing or nailing will not be permitted to the edge of plywood and particleboard.
- C.2.5 Sides, front and top of the pelmets shall be of 12 mm ply board of specified quality and width unless otherwise stated. These shall project from the wall face by 15 cm or as specified, and shall be securely fixed to walls with wood screws by means of wooden plugs and 10 cm long 25 × 3 mm M.S.flat bent in the form of angle or by any other device approved by the Engineer-in-Charge or any mechanism detailed in Design. The pelmets shall be provided with curtain rods and brackets or curtain rails with rollers, stop ends and wooden, brass or chromium plated brass brackets as specified. Intermediate wooden brackets shall be provided, if the front length of pelmet exceeds 1.5 metres
- C.2.6 The edge of all plywood, block board and particle board shall be finished with teakwood lipping unless otherwise shown on drawings. Joints shall not be permitted in the lipping. It shall have a standard depth. Edge band may be provided separately, when its species is different from that of backing or as one piece with the stile, designated as frame-cum-lipping, when edge-band and backing are of the same species.
- C.2.7 All carpentry work after finishing shall be sand papered smooth. No unsightly nail marks etc. shall be permitted.
- C.2.8 The surface of timber etc. that will come in contact with masonry after fixing shall be given two coats of approved paint before fixing. Prime coat paint shall be given after inspection of the Engineer to all surfaces other than those, which shall be subsequently polished or covered with laminated plastic sheet.
- C.2.9 When shown on drawings decorative ply or laminated plastic sheets shall be bonded under pressure to the surface to be finished. The adhesive used shall be of approved brand and brought to site in sealed containers. The rate of application and the length of time for which the pressure is to be applied shall be as per the manufacturer's instructions. The edge of sheets shall be protected by teak lipping or bevelled as shown on drawings.
- C.2.10 Pelmets shall be checked for rigidity of fixing and adequate clearance of fixture.
- C.2.11 Cupboard Shutters shall operate smoothly without jamming and locks, bolts and double ball catches shall engage securely. Single ball catches shall not be used.
- C.2.12 Drawers shall operate smoothly and have backstops to prevent them from being pushed too far. Locks shall engage securely.
- C.2.13 Loose Furniture when placed on a level surface tables tops etc. shall be horizontal and the pieces stand stably on legs or supports.
- C.3 Mode of Measurement
- C.3.1 The rate includes the cost of materials including specified species of timber and plywood, sawn to requisite sizes without any defects, wrought, framed, labour involved in all the operations for complete work as described and specified and shall be inclusive of supply and fixing of fittings and fixtures, nails, screws, preservatives shop coats, primers etc. No separate payment will be made for fixing caulking etc. unless separately provided for in Item Description. Varnish/polishing shall be paid as per item description in Painting and Polishing.
- C.3.2 Wrought (planed) and framed woodwork shall be measured for finished dimensions. All work shall be measured net as fixed, no extra allowance in measurement shall be made for shape, joints, etc. and or any wastage of material.

- C.3.3 Length shall be measured overall to the nearest centimeter. Width and thickness shall be measured to the nearest millimeter. Areas shall be worked out to the nearest 0.01 m²
- C.3.4 Shelves shall be measured for actual area of finished surface. Pelmet shall be measured for length of different types enumerated in the Schedule.
- C.3.5 Furniture shall be measured for actual number of each type. Woodwork and joinery work shall be measured in square meters.
- C.3.6 In case of mouldings, roundings, rebates, circular and varying sections, the sectional area of the piece shall be taken as the area of the least square or rectangle from which such a section can be cut.

10.02 Aluminum Extrusion

Aluminium extrusion shall be of Alloy 6063 T5/T6 confirming to BS 1475 or equivalent. Minimum wall thickness for the structural members shall be 2.5 mm. The extrusion tolerances shall confirm to DIN -17615 (Part1) In case of Aluminium structural support brackets the Alloy shall be 6005 grade & T6 temper. Extruded profiles shall be free from die lines, pressure marks, scratches or graphite lines.

FINISH TO ALUMINIUM PROFILES.

a.PVDF COATING:

All externally visible Profiles, Panels including Aluminium Louvers:

PVDF finish to the visible surface of the profile shall be resin kynar 500 or Hylar 500 based PVDF/acrylic blends should be not less than 70 % of Polyvinylidene fluoride resin. The film thickness shall be minimum 35 microns. The finish to confirm as per AAMA 2605-2 and the paint manufacturer's specification. The coating manufacturers shall be VALSPAR CORP. USA, PPG INDUSTRIES INC. Duranar XL. Or approved equivalent.

AAMA 2605.2 – Specification for high performance organic coating

BS 4842 – Liquid organic coating for aluminium alloy extrusions, sheets and preformed sections for external architectural purposes. Colors, to be selected by the architect or owner, shall be per the full range of manufacturer's offerings including premium and all metallic finishes.

b.SUPER DURABLE POWDER COATING:

All internally visible profiles shall have 65-80 microns SUPER DURABLE POWDER coating; Performance shall conform to AAMA 2604.

c.ANODIC COATING:

If applicable: All visible profiles shall have 25 microns neutral anodic coating, class A confirming to British standard for architectural grade anodic coating. Anodizing shall be hot sealed to close the porosity in the anodic surface for resistance against atmospheric attack. Anodizing shall confirm to BS 3987:Anodic oxidation coating on aluminium for external architectural application. Testing Shall confirm to BS 6161- Test method for anodic oxidation coatings on aluminium and its alloys.

d.CHROMATIZING:

All non visible aluminium profiles shall have achromatizing treatment to improve resistance to corrosion.

The chemical conversion coating shall confirm to ASTM D 1730, TYPE B, METHOD 7- AMORPHOUS CHROMATE TREATMENT.

PROCESS: TYPICAL SEVEN STEP PRETREATMENT PROCESS

STEP 1: Clean – Alkaline or acid uniform mild etching – 1 to 5 minutes – 140-180 Deg. F

STEP 2: Rinse - Water rinse – 30 seconds – Ambient temperature.

STEP 3: Deoxidize - Acid – 1 minutes – Ambient temperature.



STEP 4: Rinse – Water rinse – 45 seconds – Ambient temperature.

STEP 5: Conversion Coating – Amorphous Chrome Chromate - 45 seconds – 75 to 90 Deg F.

STEP 6: Rinse – Water rinse – 30 seconds – Ambient temperature.

STEP 7: Final Rinse – Acidulated rinse or water with T.D.S Less than 300 ppm – 15 seconds – Ambient Or may be heated to 150 Deg F to facilitate drying. Coating weight – Coating weights of these coatings are required to be in the range of 30 to 100mgs/sq.ft.



Minimum Requirement – Coating weight should be minimum of 431 mg/m² or 40 mg/ sq.ft.

2.FINISH TO STRUCTURAL STEEL:

All structural steel system shall be factory primed and painted. Paint shall consist of 2 coat system with minimum 1.0 mils epoxy primer and 2.5 mils polyurethane top coat. Paint shall be supplied by TNEMEC / AKZO NOBEL / JOTUN.

3.SILICONE GASKETS

All exposed weather gaskets and Spacer gasket (replacing Norton tape) shall be of SILICON GASKET Confirming to ASTM C 1115 – Silicone Rubber Gaskets. Silicone gaskets shall be black in color unless specifically asked for.

4.EPDM GASKETS

All unexposed weather gaskets shall be of EPDM micro wave cured gaskets confirming BS 4255. All gaskets shall be black in color unless specifically asked for.

5.SCREWS AND FASTENERS

All screw and fasteners shall be of Stainless steel A2 grade (304 Grade) confirming to BS 6105.

BS 6105 –SS grade A2 (304 general use) Corrosion resistant Stainless steel A4 grade (316 grade for severely corrosive climates). Screws and fasteners threading shall confirm to DIN standard or equivalent.

6.ANCHOR BOLTS

The anchor bolts shall be of Hilti/ Fischer make Stainless steel grade SS 304 confirming to grade A2 of BS 6105. Anchor bolt design loads shall confirm with E 488 – Strength of anchors in concrete and masonry elements

7.SEALANTS

The sealants shall be of DOW CORNING / WACKER / GE make with warranty of 15 yrs.

The structural sealant shall be two part compound sealant DC 983 or equivalent. The weather sealant shall be DC 991 non staining non bleeding sealant.

BS 6213 Selection of constructional sealants

BS 5889 Silicon Sealants

BS 4254 Two part polysulphide based sealant

ASTM C 1184 Specification for Structural Silicone sealant

ASTM C 920, Specification for Joint Sealants.

ASTM C 1135 Specification for Tensile, Adhesion & Properties of Sealant

ASTM C 509 Specifications for Sealing Material

ASTM C 1087 Specification for test method of determining

Compatibility of materials and other accessories

8.BRACKETS

The brackets shall be of Stainless steel A4 grade confirming SS 316 Grade / Aluminium alloy of 6005 T6 with possibility of three dimensional building tolerance to accommodate with serrations on the bracket as well on the locking washer OR MS Hot dip galvanized in accordance with BS 729 after manufacture i.e. welding, holing, slotting with serrations and movement as described above shall confirm to following standards.

BS 4190 Mild steel BS 4360 Mild steel grades

BS 2659 (Part1) Protection of iron and steel against atmospheric corrosion

BS 2989 (Part1) Continuously hot dip zinc coated steel

BS 3019 TIG welding

BS 3571 MIG welding

Signature of Bidder/JV Firm



BS 729 Hot dip galvanized coating on iron and steel

9.FIRE STOP AND SMOKE SEAL

The fire stop and smoke seal at all floor levels continuously running at beam bottom. The rock wool shall be of 2 hr fire rating of 120 mm thk with 64 density tightly filled in the gap between the curtain wall and the building structure. The smoke seal is by means of in tumescent applied over the rock wool slab with a thickness of 3 mm. The assembly is supported by the G I flashing fixed to the structure.The whole assembly to perform for 2 hr fire rating.

10.SPACER TAPE

The two sided adhesive spacer tape of Norton make as per design requirements.

11.SETTING BLOCKS

The setting block shall be extruded silicone block with a minimum shore a hardness of 75-85 of Durometer.

12.FLASHING AND TRIMS

Minimum thickness of the flashing and trims shall be 1.6 mm aluminium.

The finish shall be matching with the profile finish in the interior with Super Durable Powder Coat finish of minimum 65 microns. And on the exterior PVDF FINISH unless and otherwise asked for. The aluminium sheet alloy shall be 3003/3005/3105 H 14 confirming to BS 1475.

13.STAINLESS STEEL SHEET

Stain less steel shall be of A4 grade confirming to BS 1449.

Finish shall be brushed satin finish or mirror finish as per architect requirement.

14.GLASS FOR CURTAIN WALL GLAZING

Annealed Glass shall conform to ASTM C-1036.

Heat strengthened and tempered glass shall conform to ASTM C 1048.

Hermetically sealed double glass unit shall confirm to BS 5713

Glass for glazing shall be confirming to BS 952

Glazing for building shall confirm to BS 6262

15.Vision Panel-

SGU of Double wall façade – Single glass unit of 8 MM

Outer lite: 8mm thk Tinted Blue Green glass, Heat Strengthened flat machine ground.

The minimal Spectral Photometric Properties of the glass shall conform to the values given as under.

SGU Glass: 8 mm thk = 8mm Outer light HS.

Substrate Glass: Blue Green tinted Glass

Light Transmittance: 70 %

Light reflection outdoor: 7%

Light reflection indoor: 7 %

Shading Coefficient: 0.66

U – Value : 5.22 W/m2.K

16.Spandrel Panel- SGU –

Single glass unit of 8mm thk.

Outer lite: 8mm thk Tinted Blue Green with 55% Ceramic frit, Heat Strengthened flat machine ground.

The minimal Spectral Photometric Properties of the glass shall conform to the values given as under.

Substrate Glass: Blue green tint

Light Transmittance: 32 %

Light reflection outdoor: 7%

Light reflection indoor: 7 %

Shading Coefficient: 0.3

U – Value : 5.22 W/m².K

IGU Glass: 24 mm thk. = 6mm Outer light + 12 mm Alum spacer + 6mm Inner light

Substrate Glass: Clear

Light Transmittance: 70-75 %

Light reflection outdoor: 10-15%

Light reflection indoor: 10-15 %

Shading Coefficient: 0.5- 0.65

U – Value : 1.3- 1.8 W/m².K

a.Heat strengthened and toughened glass shall be examined by the glass manufacturer to detect and discard any lights, which exceed the following tolerances:

b.Where the strengthening process results in essentially parallel ripples or waves the deviation from flatness at any peak shall not exceed 0.125 mm, and the difference between adjacent peaks shall not exceed 0.076mm.

c.Where bow tolerance and wave tolerance differ, the stricter requirements shall govern. Direction ripples shall be consistent and in conformance with Architectural design. Normally parallel to the eye sight or ground surface.

d.Insulated glass shall have double edge seals. The primary seal between Aluminium spacer and glass shall be a continuous butyl tape with no skips or voids. The preferred primary seal shall be Poly Isobutylene (PIB).The Aluminium spacer shall be of silver anodized and the same shall be bent to shape of glazed unit profile and the bent aluminium spacer shall be filled with desiccant drying agent. The secondary seal shall be DOW CORNING Two part silicon sealant DC 982 or WACKER or GE approved equivalent.

e.The secondary seal shall completely cover the spacer with no voids or gaps, and shall be continuously bonded on both plates of glass. The required thickness of the secondary seal be determined by calculation and verified by testing of samples as specified. The Glass panel shall be separated by de-hydrated air space. Edge seal construction of the insulated unit shall be able to withstand at least three time the stress caused by design wind pressures specified in the Bills of Quantities. The Double glazed unit processor shall be approved by consultant or architect and shall use only approved sealant / produce with the prior approval of the Architect. Necessary test Certificate shall be produced by the processor ensuring the approved sealant and its bite size and application method.

17. GLASS FOR EXTERNAL SINGLE WALL GLAZING

a.Vision Panel-GU – Hermetically sealed unit of 29 MM.

Outer lite: 8mm thk Blue Green glass, Heat Strengthened flat machine ground.

Glass substrate is BLUE GREEN.

Air Gap (Spacer):15 mm thick natural anodized aluminium spacer profile with one piece bent spacer.

Inner lite: 6mm thk Reflective clear Low E HS glass, flat machine ground.

Desiccant: Silica molecular sieve.

Primary Seal: Butyl seal (PIB = Poly Iso Butyl)

Signature of Bidder/JV Firm



Secondary seal: Structural sealant two Part DC 982

The minimal Spectral Photometric Properties of the glass shall conform to the values given as under.

IGU Glass: 29 mm thk. = 8mm Outer lite + 15 mm Alum spacer + 6mm Inner lite

Substrate Glass: light green tint

Light Transmittance: 50-60 %

Light reflection outdoor: 10-15%

Light reflection indoor: 10-15 %

Shading Coefficient: 0.35- 0.45

U – Value : 1.3- 1.8 W/m².K

2)Spandrel Panel- SGU – Single glass unit of 8 mm.

8mm thk Tinted Blue Green with 55% Ceramic frit, Heat Strengthened flat machine ground.

18.SPIDER GLAZING GLASS:

The spider glass panel shall be of 34.52mm thick IGU with laminated glass comprised of 6mm sunergy clear HS + 15mm air gap + 6mm clear FT + 1.52mm Sentry glass plus Dupont film + 6mm clear FT glass. The glass shall be free from the defects and the edge of the glass shall be machine polished, the glass shall have required drill hole and counter as per spider design and all this processing to be completed before the glass is toughened.

The lamination shall use Sentyglass plus inner layer in thickness 1.52 mm of Dupont make.

The spider glass panel assembly shall have stainless steel spiders of SS 316 grade Of Dorma make or approved equivalent, Connected to Glass fin system, structurally suspended between floor and slab in line with the drawings.

The glass panel shall be suspended from top with the help of hanger brackets and shall have provision of 20 mm expansion at the bottom most panel to accommodate movement of the upper floor without cracking or creating any additional stressed on the bottom glass. Bottom glass panel is embedded in Aluminium anodized channel concealed in the floor finish and sealed with sealant to provide weather seal. Spider glass panel joints shall be minimum 8mm and shall have sealant joint of color as per architect's choice.

19.STAINLESS STEEL SPIDERS SYSTEM

The stainless steel spider to the façade shall be 300 series non magnetic stainless steel pf AISI 316 grade. The surface finish for the stainless steel spider shall be Mirror polished. The structural glass system is to be retained only at limited points by means of flat head rotational bolts. The flat head bolts in the spiders shall be articulated type to accommodate tolerances and movement due to wind pressure. Shall allow minimum of 12 deg rotation of the bolt perpendicular to the plane of glass. The rotation allows the glass to transfer only translational or axial loads to the supporting structure.

Fiber gaskets and shear bolts shall be used for all patch fittings. There shall be no glass to metal contact in any location especially when using Heat strengthened / toughened glass.

Fiber gaskets and shear bolts shall be used for all splice fittings. There shall be no glass to metal contact in any location especially when using Heat strengthened / toughened glass.

Spiders shall be supported on Glass fin assembly suspended at the top with hanger brackets. Glass sealant joint shall be of minimum 8-10 mm and shall be filled with DC 795 Sealant color as per Architects choice. All taking in to account the building tolerances, Weather and structural performance requirements.

20.ENTRANCE GLASS CANOPY

Canopy glass shall be of minimum 15.52 mm thick clear laminated fully tempered glass, comprising of 8mm clear float fully tempered + 1.52 clear Sentry glass plus of Dupont make + 6 mm clear float FT. The glass panel edges duly flat machined ground with drilled holes before toughening of glass.

The glass panels are connected by articulated bolts and supported by Stainless steel spider system to the main structural MS members. Canopy main structural members are made out of MS T section in line with drawing and structural requirements. The provision of gutter system to collect and drain water is made out of 3mm thk GI Sheet. Sealing the canopy glass with the spider glazing wall by means of SS flashing. The general scheme of the structural support and the canopy to be followed as per design intent drawings. The permissible deflection shall be as per Australian standards. The MS structural members shall receive 3 coat Epoxy coating in line with the Tnemec / Jotun / Akzonobel product guidelines.

21.SKYLIGHT GLASS

The skylight glass shall be minimum 30.76mm Laminated glass comprising of 8mm Sunergy Clear FT + 12mm air gap + 10.76 laminated ceramic frit glass . Ceramic frit surface # 4 .

Ceramic frit design pattern and color shall be as per architect's choice. The glass panel edges shall be duly flat machined ground. The maximum bow of the glass under dead wt. shall be limited to 2mm.

The skylight system is made out of fully unitized system with drainage provision on which the glass is fixed using structural sealant. The horizontal joints are butt glazed and shall receive weather sealant DC 795 with color as per architect choice. The glass to sealant joint shall be 15mm. The Al. profile system shall take support on structural MS members. The general scheme of the structural support & the fixing arrangement to be followed as per the design intent drawings. The MS structural members shall receive 3 coat Epoxy coating in line with the Tnemec product guidelines.

22.ATRIUM GLAZING GLASS

The panel glass shall be minimum 13.52 Clear Laminated glass comprising of 6mm Clear FT + 1.52 Sentry Glass Plus + 6mm Clear FT glass . The glass panel edges shall be duly flat machined ground.

Pilkington make Profilit channels / LINIT glass channels by LAMBERTS supplied by Bendheim Wall System Inc of 250 wide x 6mm thk in Either frosted finish or with milky white color.

23.METAL COPPING

Copping at terrace level sealing the main façade Unitised glazing system and parapet wall shall be of 3MM thk solid aluminium sheet of 3000 series tension leveled in PVDF finish with required MS/Aluminium structural back up support designed for wind load of 2.68 kpa . Additional stiffeners shall be provided in the form of top hat profile running continuous length wise and connected mechanically at panel joint returns. Joints at the grid center shall have weather sealant covered with cap on top to avoid any insect or birds damaging sealant as 1st barrier and GI Sheet laid under to provide 2nd barrier for weather.

24.AUTOMATIC SLIDING DOORS

Glass for sliding doors shall be of 12 mm thk clear float FT HST with edges properly machine ground mirror polished with DORMA make fittings. Automatic door mechanism is mounted on stainless clad steel header assembly with the help of Dorma fittings. Refer to drawing details.

Item no: 50 to 53 Paint Work

A. Waterproof Cement Paint

A.1 Materials

A.1.1 Water proofing cement paint, water, etc. shall conform to the specifications as described under material specifications part A of Technical Specifications. However, water cement. Paint shall conform to IS: 5410-1969

A.1.2 Water proofing cement paint brought and used shall be from one source of supply and from only one manufacturer or make as approved by the Architects, for entire work.

A.1.3 All the materials shall got approved by the Design Consultant and Project Manager, before it is used.

A.2.Execution

A.2.1 Scaffolding: The relevant specifications of this section shall be followed.

A.2.2Preparation of surface

The relevant specifications of this section shall be followed except that the work whitewash, colour wash shall be substituted with water proofing cement paint. The surface shall be thoroughly wetted with clean water before cement water proofing paint is applied.

A.2.3 Preparation of paint: Portland cement paint shall be prepared by adding paint powder to water and stirring to obtain a thick paste, which shall then be diluted to a brushable consistency. Generally, equal volumes of paint powder and water make a satisfactory paint. In all cases, the manufacture's instructions shall be followed. The paint shall be mixed in such quantities as can be used up within an hour of mixing as otherwise the mixture will set and thicken, affecting flowing and finish. The lids of cement paint drums shall be kept tightly shut when not in use.

A.2.4Application of Paint:

- a) No painting shall be done when the paint is likely to be exposed to a temperature of below 7°C within 48 hours after application.
- b) When weather conditions are such as to cause damage, the work shall be carried out in shadow as far as possible. This helps the proper hardening of the paint film by keeping the surface moist for a longer period.
- c) To maintain the uniform mixture and to prevent segregation, the paint shall be stirred frequently in the bucket.
- d) For undecorated surfaces, the surface shall be treated with minimum two coats of water proof cement paint. Not less than 24 hours shall be allowed between two consecutive coats. Next coat shall not be started until the proceeding coat has become sufficiently hard to resist marking by the Drus being used. In hot dry weather, the preceding coat shall be slightly moistened before applying the subsequent coat.
- e) The finished surface shall be even and uniform in shade, without patches, brush marks, paint drops etc.
- f) The cement paint shall be applied with a brush with relatively short stiff hog or fiber bristles. The paint shall be brushed in uniform thickness and shall be free from excessively heavy brush marks. The lumps shall be well brushed out.
- g) Water proof cement paint shall not be applied on surfaces already treated with white wash, colour wash, distemper dry or oil bound varnishes, paint etc. It shall not be applied on gypsum, wood and metal surfaces.

A.2.5Curing:

Painted surfaces shall be sprinkled with water two or three times a day. This shall be done between coats and for at least two days following the final coat. The curing shall be started as soon as the paint has hardened so as not to be damaged by the sprinkling of water say about 12 hours after the application.

A.2.6Protection measures shall be taken as per Para no. 2.6 of D of this section.

A.3.Mode of Measurements

A.3.1The relevant specifications of this section shall be followed.

A.3.2The unit rate shall be for a unit of one m².

B. Plastic Emulsion Paint

B.1 Materials

- B.1.1 Plastic emulsion paint shall conform to IS:5411 - 1969 (part - 1) and to the Specifications as described under material specifications part A of Technical Specifications.
- B.1.2 Plastic emulsion paint brought and used shall be from only one source and of only one make or manufacturer as approved by the Architects, for entire work.
- B.1.3 All the materials shall got approved by Design Consultant & Project Manager, for entire work.

B.2 Execution

B.2.1 General

- a) The materials required for work of painting work shall be obtained directly from approved manufacturers or approved dealer and brought to the site in maker's drums, cage etc. with seal unbroken.
- b) All materials not in actual use shall be kept properly protected, lid of containers shall be kept closed and surface of paint in open or partially open containers covered with a thin layer of turpentine to prevent formation of skin. The materials which have become stale or flat due to improper and long storage shall not be used. The paint shall be stirred thoroughly in its container before pouring into small containers. While applying also, the paint shall be continuously stirred in smaller container. No left over paint shall be put back into stock tins when not in use.
- c) If for any reasons, thinning is necessary, the brand of thinner recommended by the manufacturer shall be used.
- d) The surface to be painted shall be thoroughly cleaned and dusted. All rust, dirt and grease shall be thoroughly removed before painting is started. No painting on exterior or other exposed parts of the work shall be carried out in wet, damp or otherwise unfavorable weather and all the surfaces shall be thoroughly dry before painting work is started.
- e) For Glossy, Flat, Pearl lustre and Matt finish, painting of same specification shall be followed except that the type of paint shall be changed as per the direction of Design Consultant and Project Manager, to give the desired finish.

B.2.2 Scaffolding: The relevant specifications of Para of this section shall be followed.

B.2.3 Preparation of surface: The relevant specifications of Para 2.2 of item D of this section shall be followed.

B.2.4 Preparation of Mix

This shall be done as per the manufacture's instructions. The thinning of emulsion is to be done with water and not with turpentine. The quantity of thinner to be added to shall be as per manufacturer's instructions.

B.2.5 Application:

- a) Before pouring into small containers for use of applying, the paint shall be stirred thoroughly in its container. Also, the paint shall be continuously stirred in the smaller container, so that its consistency is kept uniform.
- b) Brushing operations are to be adjusted to the spreading capacity advised by the manufacturer of particular paint. The paint shall be laid on evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area over with paint, brushing the surface hard for the first time over and then brushing alternately in opposite directions two or three times and then finally brushing lightly in direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and

laying off will constitute one coat. No hair marks from the brush or clogging of paint puddles in the corners of panels, angles of moldings etc. shall be left on the work.

- c) The paint shall be applied with brush for first two coats and final coat shall be done with roller only. The surface shall be treated with minimum one coat of alkali resistant primer and putty as specified in relevant specification of workmanship of item D of this section. The second or subsequent coat shall not be started until the preceding coat has become sufficiently hard to resist marking of the brush being used.
- d) The surface on finishing shall present a flat velvety smooth/pearl luster (semi gloss) finish, as specified in the item. It shall be even and uniform in shade without patches, brush marks, paint drops etc.

B.2.6 Precautions:

- a) Old brushes if they are to be used with emulsions paints, shall be completely dried of turpentine or oil paint by washing in warm soap water. Brushes shall be quickly washed in water immediately after use and shall be kept immersed in water during break periods to prevent the paint from hardening on the brush.
- b) In the preparation of walls for plastic emulsion painting, no oil base putties shall be used in filling cracks, holes etc.
- c) Splashes on floors etc. shall be cleaned out without delay as they will be difficult to remove after hardening.
- d) Washing of surfaces treated with emulsion paint shall not be done within 3 to 4 weeks of application.

B.2.7 Protective measures: The relevant specifications of Para 2.4 of item B of this section shall be followed.

B.3. Mode of Measurements

B.3.1 The relevant specifications of item No A of this section shall be followed.

B.3.2 The unit rate shall be for a unit of 1 m².

C. Red Lead primer

C.1 Materials

- C.1.1 The ready mix primer, brushing red lead shall conform to the specifications described under material specification Para - A of Technical Specifications including to IS 102 - 1962.
- C.1.2 The thinner (linseed oil) shall conform to IS:75-1973, if, for any reason, thinning is necessary. In case of ready mix paint, the brand of thinner recommended by manufacturer shall be used.
- C.1.3 Red lead ready mix primer, thinner, etc. brought & used shall be from only one source and of only one make / manufacturer as approved by the Design Consultant, for entire work.
- C.1.4 All the materials shall got approved by the Design Consultant & Project Manager before it is used.

C.2 Execution

C.2.1 Preparation of surfaces

The surfaces to be painted shall be cleaned of all rust, scale, dirt and other foreign matter sticking to it with wire brushes, steel wool, scrapers, sand paper etc. This surface shall then be wiped finally with mineral turpentine which shall also removed grease and perspiration of hand marks. The surface shall then be allowed to dry.

C.2.2 Application of primer:

- a) After the preparation of the surface, the priming coat shall be applied immediately. The brushing operations are to be adjusted to the spreading capacity advised by the manufacturer of the particular primer. The paint shall be applied evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area over with paint, brushing alternately in opposite directions, two or three times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat.
- b) During painting, every time after the priming coat has been worked out of the brush bristles or after the brush has been unloaded of the primer, the bristles of the brush shall be opened up by striking the brush against portion of the unpainted surface with the end of the bristles, held at right angles to the surface, so that bristles thereafter will collect the correct amount of paint when dipped again into a paint container. The primary coat shall be allowed to dry completely before painting is started.
- c) No hair marks from the brush or clogging of paint puddles in the corner or panels angles of mouldings etc. shall be left on the work.
- d) Special care shall be taken while painting over bolts, nuts, rivets overlaps etc.
- e) The container when not in use shall be kept close and free from air so that paint does not get thickened and also shall be kept guarded from dust.

C.3.Mode of Measurements:

Note Applicable as the same is part of respective painting items of steel work.

D. Enamel paint (To all kinds of surfaces, i.e. steel, wood, plaster, etc)

D.1.Materials

- D.1.1 Enamel paint, etc. shall conform to the specification as described under material specifications as described under material specifications as described under material specifications part A of Technical Specifications.
- D.1.2 Enamel paint, thinner, etc. brought & used shall be from only one source of supply and of only one make / manufacturer as approved by Architect, for entire work.
- D.1.3 All the materials shall got approved by the Design Consultant& Project Manager before it is used.

D.2 Execution

D.2.1 General

- a) The materials required for work of painting work shall be obtained directly from approved manufacturers or approved dealer and brought to the site in maker's drums, cage etc. with seal unbroken.
- b) All materials not in actual use shall be kept properly protected, lid of containers shall be kept closed and surface of paint in open or partially open containers covered with a thin layer of turpentine to prevent formation of skin. The materials which have become stale or flat due to improper and long storage shall not be used. The paint shall be stirred thoroughly in its container before pouring into small containers. While applying also, the paint shall be continuously stirred in smaller container. No left over paint shall be put back into stock tins when not in use.
- c) If for any reasons, thinning is necessary, the brand of thinner recommended by the manufacturer shall be used.
- d) The surface to be painted shall be thoroughly cleaned and dusted. All rust, dirt and grease shall be thoroughly removed before painting is started. No painting on exterior or other exposed parts of the work shall be carried out in wet, damp or

otherwise unfavorable weather and all the surfaces shall be thoroughly dry before painting work is started.

- e) For Glossy, Flat, Pearl lustre and Matt finish, painting of same specification shall be followed except that the type of paint shall be changed as per the direction of Design Consultant and Project Manager, to give the desired finish.

D.2.2 Scaffolding: The relevant specifications of Para 2.3 of item No. A of this section shall be followed.

D.2.3 Preparation of surface: The relevant specifications of Para 2.2 of item D of this section shall be followed.

D.2.4 Preparation of Mix

This shall be done as per the manufacture's instructions. The thinning of emulsion is to be done with water and not with turpentine. The quantity of thinner to be added to shall be as per manufacturer's instructions.

D.2.5 Application:

- a) Before pouring into small containers for use of applying, the paint shall be stirred thoroughly in its container. Also, the paint shall be continuously stirred in the smaller container, so that its consistency is kept uniform.
- b) Brushing operations are to be adjusted to the spreading capacity advised by the manufacturer of particular paint. The paint shall be laid on evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area over with paint, brushing the surface hard for the first time over and then brushing alternately in opposite directions two or three times and then finally brushing lightly in direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat. No hair marks from the brush or clogging of paint puddles in the corners of panels, angles of moldings etc. shall be left on the work.
- c) The paint shall be applied with brush for first two coats and final coat shall be done with roller only. The surface shall be treated with minimum one coat of alkali resistant primer and putty as specified in relevant specification of workmanship of item D of this section. The second or subsequent coat shall not be started until the preceding coat has become sufficiently hard to resist marking of the brush being used.
- d) The surface on finishing shall present a flat velvety smooth/pearl luster (semi gloss) finish, as specified in the item. It shall be even and uniform in shade without patches, brush marks, paint drops etc.

D.2.6 Precautions:

- a) Old brushes if they are to be used with emulsions paints, shall be completely dried of turpentine or oil paint by washing in warm soap water. Brushes shall be quickly washed in water immediately after use and shall be kept immersed in water during break periods to prevent the paint from hardening on the brush.
- b) In the preparation of walls for plastic emulsion painting, no oil base putties shall be used in filling cracks, holes etc.
- c) Splashes on floors etc. shall be cleaned out without delay as they will be difficult to remove after hardening.
- d) Washing of surfaces treated with emulsion paint shall not be done within 3 to 4 weeks of application.

D.2.7 Protective measures: The relevant specifications of Para 2.4 of item B of this section shall be followed.

D.3 Mode of Measurements

- (a) For steel work

-
- (i) The new steel and other metal surface shall be measured under this item.
 - (ii) All the work shall be measured net, in the decimal system as executed, subject to the following limits unless otherwise stated herein after
 - a) Dimensions shall be measured to the nearest 0.01 m.
 - b) Areas shall be worked out to the nearest 0.01 m².
 - (iii) No deductions shall be made for openings not exceeding 0.5 m² each and no addition shall be made for painting to beading, mouldings, edges, iambs, soffits etc. of such opening.
 - (iv) In case of fabricated structural steel and iron work, primer coat of oil paint shall be included with fabrication. In case of trusses, if measured in ml, compound girders, stanchions, lattices, girder and similar work, actual area shall be measured in ml and no extra shall be paid for painting on bolts, heads, nuts, washers etc. No addition shall be made to the weight calculated for the purpose of measurements of steel for weight of prime
 - (v) The different surfaces shall be grouped into one general item, areas of uneven surface being converted into equivalent plain areas in accordance with the relevant I.S. code for payment.
 - (vi) The rate shall include the cost of all materials, labour, scaffolding, protective measures etc. required for the above specified operation, at all floors, at any height, in any position. Scrapping of surface, washing etc. of surfaces spoiled by smoke, soot, removal of oil and grease spots, treatment for infection with efflorescence, moulds, moss, fungi, algae and lichen shall not be paid extra. 'This shall also include conveyance, delivery, handling, unloading, storing work etc.
 - (vii) The unit rate shall be for a unit of one m².
- (b) For Surfaces other than steel work
- (i) The relevant specifications of item No. A of this section shall be followed.
 - (ii) The unit rate shall be for a unit of one m².

E. Wood Primer Pink for wood work

E.1 Materials

- E.1.1 The ready mix paint for brushing wood primer pink like wood entities of Asian paints or approved equal shall conform to the specifications as described under material specifications Part A of Technical Specification including to IS:3536 - 1966
- E.1.2 The ready mix paint for brushing wood primer pink brought & used shall be from only one source of supply and of only one make / manufacturer as approved by the Design Consultant, for entire work.
- E.1.3 All the materials shall got approved by the Design Consultant & Project Manager before it is used.

E.2 Execution

E.2.1 Preparation of surfaces:

- a) All wood work shall be dry and free from any foreign matter incidental to building operations. Nails shall be punched well below the surface to provide a firm key for painting. Mouldings shall be carefully smoothened with abrasive paper and projecting fibers shall be removed. Flat portion shall be smoothened off with abrasive paper used across the grain prior to painting and with the grain prior to staining, if the wood is to be left in its natural colour. Wood work which is to be stained may be smoothened by scraping instead of by glass papering if so required.

- b) Any knots, resinous or streaks or bluish sap wood that are not large enough to justify cutting out shall be treated with two coats of pure shellac knotting applied thinly and extended about 25 mm. beyond the actual area requiring treatment.

E.2.2 Application of primer:

- a) After the preparation of the surface, the painting coat shall be applied immediately. The brushing operations are to be adjusted to the spreading capacity advised by the manufacturer of the particular primer. The paint shall be applied evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area over with paint, brushing alternately in opposite directions, two or three times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat.
- b) During painting, every time after the priming coat has been worked out of the brush bristles or after the brush has been unloaded of the primer, the bristles of the brush shall be opened up by striking the brush against portion of the unpainted surface with the end of the bristles, held at right angles to the surface, so that bristles thereafter will collect the correct amount of paint when dipped again into a paint container. The primary coat shall be allowed to dry completely before painting is started.
- c) No hair marks from the brush or clogging of paint puddles in the corner or panels angles of mouldings etc. shall be left on the work.
- d) The container when not in use shall be kept close and free from air so that paint does not get thickened and also shall be kept guarded from dust.

E.3. Mode of Measurements

Not Applicable

As the same is Part of respective painting work items, of wood work.

F. Wood Primer for Enamel paint to wood work

F.1 Materials

- F.1.1 The ready mix paint for brushing priming for enamel on all kinds of wood work and wood based surfaces shall conform to the specifications described under material specifications Part A of Technical Specifications.
- F.1.2 The ready mix paint for brushing priming for enamel brought and used shall be from only one source and of only one make / manufacturer as approved by the Architect, for entire work.
- F.1.3 All the materials shall got approved by the Design Consultant & Project Manager before it is used.

F.2 Execution

F.2.1 Preparation of surfaces:

- a) All wood work shall be dry and free from any foreign matter incidental to building operations. Nails shall be punched well below the surface to provide a firm key for painting. Mouldings shall be carefully smoothened with abrasive paper and projecting fibers shall be removed. Flat portion shall be smoothened off with abrasive paper used across the grain prior to painting and with the grain prior to staining, if the wood is to be left in its natural colour. Wood work which is to be stained may be smoothened by scraping instead of by glass papering if so required.
- b) Any knots, resinous or streaks or bluish sap wood that are not large enough to justify cutting out shall be treated with two coats of pure shellac knotting applied thinly and extended about 25 mm. beyond the actual area requiring treatment.

F.2.2 Application of primer:

- a) After the preparation of the surface, the priming coat shall be applied immediately. The brushing operations are to be adjusted to the spreading capacity advised by the manufacturer of the particular primer. The paint shall be applied evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area over with paint, brushing alternately in opposite directions, two or three times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat.
- b) During painting, every time after the priming coat has been worked out of the brush bristles or after the brush has been unloaded of the primer, the bristles of the brush shall be opened up by striking the brush against portion of the unpainted surface with the end of the bristles, held at right angles to the surface, so that bristles thereafter will collect the correct amount of paint when dipped again into a paint container. The primary coat shall be allowed to dry completely before painting is started.
- c) No hair marks from the brush or clogging of paint puddles in the corner or panels angles of mouldings etc. shall be left on the work.
- d) The container when not in use shall be kept close and free from air so that paint does not get thickened and also shall be kept guarded from dust.

F.3 Mode of Measurements

Not Applicable

As the same is Part of respective painting work items, of wood work.

G. French Polish to Wood work

G.1 Materials

- G.1.1 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) Chadras, (iii) Shellac (iv) Pigment. The French polish so prepared shall conform to IS:348-1968 and to material specifications as described under material specifications part A - Technical Specifications.
- G.1.2 All the ingredients as specified in K.1.1 above for French polish brought and used shall be from only one source of supply and of only one make / manufacturer as approved by the Architect, for entire work.
- G.1.3 All the materials shall get approved by the Design Consultant and Project Manager before it is used.

G.2 Execution

G.2.1 Preparation of surface:

- a) All unevenness shall be rubbed down smooth with sand paper and the surface shall be well dusted. The pores in the wood shall be filled up with filler made of paste of whiting chalk in water or mentholated spirit (with suitable pigment like burnt sienna or umber if required), otherwise the French polish will get absorbed and a good gloss will be difficult to obtain.
- b) In case a surface is to be re-polished, the old polish shall be thoroughly scrapped off by very fine sand paper and if required shall be washed off by lukewarm water mixed with caustic soda powder to remove stains.

G.2.2 Application

- a) A polishing pad of soft woolen cloth/absorbent cotton covered by a fine cloth shall be used to apply the polish. The pad shall be moistened with polish and rubbed in quick light strokes along the grain, overlapping the former stroke thus, applying the

polish sparingly but uniformly over the entire area to give an even surface. A trace of linseed oil on the face of the pad may be added which shall facilitate this operation. The surface shall be allowed to dry and the remaining coats applied in the same way. To finish off, the pad shall be covered with a fresh piece of clean fine cloth, slightly dampened with mentholated spirit and rubbed lightly and quickly with circular motions. The finished surfaces shall present a uniform texture and high gloss.

G.2.3 Protective measure

The surface of doors, windows, ventilators, floors, articles of furniture etc. and such other part of the buildings which are not to be distempered shall be protected from being splashed upon. Such surfaces shall be cleaned of distemper splashes, if any.

G.3 Mode of Measurements

G.3.1 All the wood and wood based surfaces shall be measured under this item.

G.3.2 All the work shall be measured net, in the decimal system as executed, subject to the following limits unless otherwise stated herein after

a) Dimensions shall be measured to the nearest 0.01 m.

b) Areas shall be worked out to the nearest 0.01 m².

G.3.3 No deductions shall be made for openings not exceeding 0.1 m² each and no addition shall be made for painting to beading, mouldings, edges, jambs, soffits etc. of such opening.

G.3.4 The different surfaces shall be grouped into one general item, areas of uneven surface being converted into equivalent plain areas in accordance with the relevant I.S. code for payment.

G.3.5 The rate shall include the cost of all materials, labour, scaffolding, protective measures, etc. required for the above specified operations, at all floors, at all height, in any position.

G.3.6 The rate shall include the sand papering of surface, removal of all kinds of spots treatment for infection, the cost of wood fillers, etc.

G.3.7 The rate shall also include conveyance, delivery, handling, loading, storing, etc

G.3.8 The unit rate shall be for a unit of one m²

H. Wax Polish

H.1 Materials

H.1.1 Bee's wax shall conform to IS:1504 - 1968, lin seed oil shall conform to IS:75 - 1967. Turpentine shall conform to IS:83 - 1950. Varnish shall conform to IS:337 - 1952. However, wax polish, etc. shall conform to specification as described under material specification Part A of Technical Specifications.

H.1.2 All the materials as described in Para L1.1 brought and used shall be from only one source of supply and only one make / manufacturer as approved by the Design Consultant, for entire work.

H.1.3 All the materials shall got approved by the Design Consultants and Project Manager before it is used.

H.2 Execution

H.2.1 Preparation of bees wax

a) In case of bee's wax, it shall be prepared locally with following specifications

b) Pure bee's wax free paraffin or bee's 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 bee's 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 warm and turpentine and varnish shall be added to it in the required proportions and entire mixture shall be well stirred.

H.2.2Preparation of surface:

- a) The surface to be waxed shall be prepared to produce a smooth dry, neat surface, previous coat of paint or stain if any, shall be allowed to dry and be rubbed down, lightly wiped off and allowed to dry. All dust and dirt shall be removed from the surface to be waxed, and also from the neighborhood. Damp atmosphere and draughts shall be avoided. For waxing, normal dry day shall be chosen.

H.2.3Application

- a) The wax shall be applied evenly with clean soft pad of cotton cloth in such a way that the surface is completely and fully covered. The surface shall then be rubbed continuously for half an hour. After well rubbing in one coat of wax polish, the work shall be covered with dust proof sheet (cloth for preventing dust falling on the work. Subsequent coat shall be applied after the surface is quite dry and shall be rubbed off with soft flannel until the surface has assumed a uniform gloss and in dry showing no sign of sickness.
- b) The final wax polish depends largely on the amount of rubbing which shall be continuous and with uniform pressure with frequent changes in the direction.

H.3Mode of Measurements

H.3.1All the wood and wood based surfaces shall be measured under this item.

H.3.2 All the work shall be measured net, in the decimal system as executed, subject to the following limits unless otherwise stated herein after

- a) Dimensions shall be measured to the nearest 0.01 m.
- b) Areas shall be worked out to the nearest 0.01 m².

H.3.3 No deductions shall be made for openings not exceeding 0.1 m² each and no addition shall be made for painting to beading, mouldings, edges, iambs, soffits etc. of such opening.

H.3.4 The different surfaces shall be grouped into one general item, areas of uneven surface being converted into equivalent plain areas in accordance with the relevant I.S. code for payment.

H.3.5 The rate shall include the cost of all materials, labour, scaffolding, protective measures, etc. required for the above specified operations, at all floors, at all height, in any position.

H.3.6 The rate shall include the sand papering of surface, removal of all kinds of spots treatment for infection, the cost of wood fillers, etc.

H.3.7 The rate shall also include conveyance, delivery, handling, loading, storing, etc

H.3.8 The unit rate shall be for a unit of one m²

I. Melamine polish

I.1Materials

I.1.1 The melamine polish shall be of best quality and of make such as Asian or approved equivalent and shall conform to the specifications as described under material specification Part A of Technical Specifications

I.1.2 Melamine Polish, etc. brought and used shall be from only one source of supply and only one make / manufacturer as approved by the architect, for entire work.

I.1.3 All the materials shall got approved by the Design Consultant and Project Manager before it is used

I.2 Execution

I.2.1 Preparation of surface:

- a) All unevenness shall be rubbed down smooth with sand paper and the surface shall be well dusted. The pores in the wood shall be filled up with a filler made of paste of whiting chalk in water or mentholated spirit (with suitable pigment like burnt sienna or umber if required), otherwise the French polish will get absorbed and a good gloss will be difficult to obtain.
- b) In case a surface is to be re-polished, the old polish shall be thoroughly scrapped off by very fine sand paper and if required shall be washed off by luke warm water mixed with caustic soda powder to remove stains.

I.2.2 Application

- a) A polishing pad of soft woolen cloth/absorbent cotton covered by a fine cloth shall be used to apply the polish. The pad shall be moistened with polish and rubbed in quick light strokes along the grain, overlapping the former stroke thus, applying the polish sparingly but uniformly over the entire area to give an even surface. A trace of linseed oil on the face of the pad may be added which shall facilitate this operation. The surface shall be allowed to dry and the remaining coats applied in the same way. To finish off, the pad shall be covered with a fresh piece of clean fine cloth, slightly damped with mentholated spirit and rubbed lightly and quickly with circular motions. The finished surfaces shall present a uniform texture and high gloss.

- I.2.3 The melamine polish shall be applied on doors & windows wood work or any kind of wood work or wood based surfaces with the help of spray gun, as directed by the Design Consultant and Project Manager.

I.3 Mode of Measurements

- I.3.1 All the wood and wood based surfaces shall be measured under this item.

- I.3.2 All the work shall be measured net, in the decimal system as executed, subject to the following limits unless otherwise stated herein after

- a) Dimensions shall be measured to the nearest 0.01 m.

- b) Areas shall be worked out to the nearest 0.01 m².

- I.3.3 No deductions shall be made for openings not exceeding 0.1 m² each and no addition shall be made for painting to beading, moldings, edges, iambs, soffit etc. of such opening.

- I.3.4 The different surfaces shall be grouped into one general item, areas of uneven surface being converted into equivalent plain areas in accordance with the relevant I.S. code for payment.

- I.3.5 The rate shall include the cost of all materials, labour, scaffolding, protective measures, etc. required for the above specified operations, at all floors, at all height, in any position.

- I.3.6 The rate shall include the sand papering of surface, removal of all kinds of spots treatment for infection, the cost of wood fillers, etc.

- I.3.7 The rate shall also include conveyance, delivery, handling, loading, storing, etc

- I.3.8 The unit rate shall be for a unit of one m²

J. Varnish Finish

J.1 Materials

- J.1.1 Varnish for the finishing coat shall be of superior quality spar copal or as stipulated in the item and for under coat it shall be flatting varnish of the same approved manufacturer.
- J.1.2 Varnish for under coat and for finishing coat brought and used shall be from only one source of supply and only one make / manufacturer as approved by the Design Consultant, for entire work.
- J.1.3 All the materials shall got approved by the Design Consultant and Project Manager before it is used
- J.2 Execution
- J.2.1 Preparation of surface:
- a) Now wood work shall be finished smooth with a carpenter's plane. Knots shall be cut to a slight depth, cracks and holes shall be cleaned of dust and then filled with approved quality wood putty. The surface shall then be rubbed down perfectly smooth with medium and fine grained sand paper and wiped clean and dry.
 - b) Sizing or transparent wood filler from the same manufacturer; shall then be applied with a brush or rag and allowed to dry. Finally it shall be rubbed with fine sand paper or emery paper. This will seal the pores in the wood and prevent absorption of oil it) the varnish.
- J.2.2 Application:
- a) An under coat of Halting varnish shall be applied. It shall dry hard and brittle and when rubbed down Shall produce a smooth surface, enhancing the gloss of the finished varnish.
 - b) Varnish shall be applied liberally with a full brush and spread evenly with short light strokes to avoid frothing. Rubbing down with fine sand paper and flatting the surface shall be done after each coat except the final coat. The surface shall be allowed to dry and the finished surface shall present an uniform, fine glossy surface free from streaks, blisters etc. Special fine haired varnishing brushes only, shall be used for the work.
- J.3 Mode of measurements
- J.3.1 All the wood and wood based surfaces shall be measured under this item.
- J.3.2 All the work shall be measured net, in the decimal system as executed, subject to the following limits unless otherwise stated herein after
- a) Dimensions shall be measured to the nearest 0.01 m.
 - b) Areas shall be worked out to the nearest 0.01 m².
- J.3.3 No deductions shall be made for openings not exceeding 0.1 m² each and no addition shall be made for painting to beading, mouldings, edges, iambs, soffits etc. of such opening.
- J.3.4 The different surfaces shall be grouped into one general item, areas of uneven surface being converted into equivalent plain areas in accordance with the relevant I.S. code for payment.
- J.3.5 The rate shall include the cost of all materials, labour, scaffolding, protective measures, etc. required for the above specified operations, at all floors, at all height, in any position.
- J.3.6 The rate shall include the sand papering of surface, removal of all kinds of spots treatment for infection, the cost of wood fillers, etc.
- J.3.7 The rate shall also include conveyance, delivery, handling, loading, storing, etc
- J.3.8 The unit rate shall be for a unit of one m²



K. Acrylic Polish**K.1 Materials**

- K.1.1 Acrylic Polish shall conform to the specifications described under material specifications Part A of Technical Specifications.
- K.1.2 Acrylic Polish brought and used shall be from only one source of supply and from only one make / manufacturer as approved by the Design Consultant, for entire work.
- K.1.3 All the materials shall got approved by the Architects and Project Manager before it is used

K.2 Execution**K.2.1 Preparation of surface**

- a) Prepare the surface by proper sanding, filling and priming as per the conventional method in polishing wood surfaces.
- b) Incase, surface previously polished with French polish is to be re-polished, the surface is sandpapered with emery paper no. 80 along the grains, thoroughly. Wipe off the loose dust completely and then clean the surface with a cloth pad filled with thinner N 83.

K.2.2 Application:

- a) Apply 2 or 3 even coats rubbing well into the grains. For extra tough and durable coating, apply 4 to 5 coats.
- b) Incase dilution is required; use thinner N 83 for the same.

K.3 Mode of Measurements

K.3.1 All the wood and wood based surfaces shall be measured under this item.

K.3.2 All the work shall be measured net, in the decimal system as executed, subject to the following limits unless otherwise stated herein after

a) Dimensions shall be measured to the nearest 0.01 m.

b) Areas shall be worked out to the nearest 0.01 m².

K.3.3 No deductions shall be made for openings not exceeding 0.1 m² each and no addition shall be made for painting to beading, mouldings, edges, iambs, soffits etc. of such opening.

K.3.4 The different surfaces shall be grouped into one general item, areas of uneven surface being converted into equivalent plain areas in accordance with the relevant I.S. code for payment.

K.3.5 The rate shall include the cost of all materials, labour, scaffolding, protective measures, etc. required for the above specified operations, at all floors, at all height, in any position.

K.3.6 The rate shall include the sand papering of surface, removal of all kinds of spots treatment for infection, the cost of wood fillers, etc.

K.3.7 The rate shall also include conveyance, delivery, handling, loading, storing, etc

K.3.8 The unit rate shall be for a unit of one m²

1.2 ACTION SUBMITTALS**A. Qualification Data for:**

- 1. Manufacturer.
- 2. Installer.
- 3. Testing Agency.



- B.** Product Data: For each type of product. Include preparation requirements and application instructions.
- C.** Samples: For each type of paint system and in each colour and gloss of topcoat.
- D.** Product List: For each product indicated. Include printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- A.** Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than 3.8 L of each material and colour applied.

1.4 QUALITY ASSURANCE

- A.** Mockups: Apply mockups of each paint system indicated and each colour and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Design Consultant will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 9 sq. m.
 - b. Other Items: Design Consultant will designate items or areas required.
 - 2. Final approval of colour selections will be based on mockups.

If preliminary colour selections are not approved, apply additional mockups of additional colours selected by Design Consultant at no added cost to Owner.

Section No: 11 Paint Work

(11.01 to 11.04)

A. Waterproof Cement Paint

A.1 Materials

- A.1.1 Water proofing cement paint, water, etc. shall conform to the specifications as described under material specifications part A of Technical Specifications. However, water cement. Paint shall conform to IS: 5410-1969
- A.1.2 Water proofing cement paint brought and used shall be from one source of supply and from only one manufacturer or make as approved by the Architects, for entire work.
- A.1.3 All the materials shall got approved by the Design Consultant and Project Manager, before it is used.

A.2. Execution

- A.2.1 Scaffolding: The relevant specifications of this section shall be followed.

A.2.2 Preparation of surface

The relevant specifications of this section shall be followed except that the work whitewash, colour wash shall be substituted with water proofing cement paint. The surface shall be thoroughly wetted with clean water before cement water proofing paint is applied.

- A.2.3 Preparation of paint: Portland cement paint shall be prepared by adding paint powder to water and stirring to obtain a thick paste, which shall then be diluted to a brushable consistency. Generally, equal volumes of paint powder and water make a satisfactory

paint. In all cases, the manufacture's instructions shall be followed. The paint shall be mixed in such quantities as can be used up within an hour of mixing as otherwise the mixture will set and thicken, affecting flowing and finish. The lids of cement paint drums shall be kept tightly shut when not in use.

A.2.4 Application of Paint:

- h) No painting shall be done when the paint is likely to be exposed to a temperature of below 7°C within 48 hours after application.
- i) When weather conditions are such as to cause damage, the work shall be carried out in shadow as far as possible. This helps the proper hardening of the paint film by keeping the surface moist for a longer period.
- j) To maintain the uniform mixture and to prevent segregation, the paint shall be stirred frequently in the bucket.
- k) For undecorated surfaces, the surface shall be treated with minimum two coats of water proof cement paint. Not less than 24 hours shall be allowed between two consecutive coats. Next coat shall not be started until the proceeding coat has become sufficiently hard to resist marking by the Drus being used. In hot dry weather, the preceding coat shall be slightly moistened before applying the subsequent coat.
- l) The finished surface shall be even and uniform in shade, without patches, brush marks, paint drops etc.
- m) The cement paint shall be applied with a brush with relatively short stiff hog or fiber bristles. The paint shall be brushed in uniform thickness and shall be free from excessively heavy brush marks. The lumps shall be well brushed out.
- n) Water proof cement paint shall not be applied on surfaces already treated with white wash, colour wash, distemper dry or oil bound varnishes, paint etc. It shall not be applied on gypsum, wood and metal surfaces.

A.2.5 Curing:

Painted surfaces shall be sprinkled with water two or three times a day. This shall be done between coats and for at least two days following the final coat. The curing shall be started as soon as the paint has hardened so as not to be damaged by the sprinkling of water say about 12 hours after the application.

A.2.6 Protection measures shall be taken as per Para no. 2.6 of D of this section.

A.3. Mode of Measurements

A.3.1 The relevant specifications of this section shall be followed.

A.3.2 The unit rate shall be for a unit of one m².

B. Plastic Emulsion Paint

B.1 Materials

- B.1.1 Plastic emulsion paint shall conform to IS:5411 - 1969 (part - 1) and to the Specifications as described under material specifications part A of Technical Specifications.
- B.1.2 Plastic emulation paint brought and used shall be from only one source and of only one make or manufacturer as approved by the Architects, for entire work.
- B.1.3 All the materials shall got approved by Design Consultant & Project Manager, for entire work.

B.2 Execution

B.2.1 General

- f) The materials required for work of painting work shall be obtained directly from approved manufacturers or approved dealer and brought to the site in maker's drums, cage etc. with seal unbroken.
- g) All materials not in actual use shall be kept properly protected, lid of containers shall be kept closed and surface of paint in open or partially open containers covered with a thin layer of turpentine to prevent formation of skin. The materials which have become stale or flat due to improper and long storage shall not be used. The paint shall be stirred thoroughly in its container before pouring into small containers. While applying also, the paint shall be continuously stirred in smaller container. No left over paint shall be put back into stock tins when not in use.
- h) If for any reasons, thinning is necessary, the brand of thinner recommended by the manufacturer shall be used.
- i) The surface to be painted shall be thoroughly cleaned and dusted. All rust, dirt and grease shall be thoroughly removed before painting is started. No painting on exterior or other exposed parts of the work shall be carried out in wet, damp or otherwise unfavorable weather and all the surfaces shall be thoroughly dry before painting work is started.
- j) For Glossy, Flat, Pearl lustre and Matt finish, painting of same specification shall be followed except that the type of paint shall be changed as per the direction of Design Consultant and Project Manager, to give the desired finish.

B.2.2 Scaffolding: The relevant specifications of Para of this section shall be followed.

B.2.3 Preparation of surface: The relevant specifications of Para 2.2 of item D of this section shall be followed.

B.2.4 Preparation of Mix

This shall be done as per the manufacture's instructions. The thinning of emulsion is to be done with water and not with turpentine. The quantity of thinner to be added to shall be as per manufacturer's instructions.

B.2.5 Application:

- e) Before pouring into small containers for use of applying, the paint shall be stirred thoroughly in its container. Also, the paint shall be continuously stirred in the smaller container, so that its consistency is kept uniform.
- f) Brushing operations are to be adjusted to the spreading capacity advised by the manufacturer of particular paint. The paint shall be laid on evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area over with paint, brushing the surface hard for the first time over and then brushing alternately in opposite directions two or three times and then finally brushing lightly in direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat. No hair marks from the brush or clogging of paint puddles in the corners of panels, angles of moldings etc. shall be left on the work.
- g) The paint shall be applied with brush for first two coats and final coat shall be done with roller only. The surface shall be treated with minimum one coat of alkali resistant primer and putty as specified in relevant specification of workmanship of item D of this section. The second or subsequent coat shall not be started until the preceding coat has become sufficiently hard to resist marking of the brush being used.
- h) The surface on finishing shall present a flat velvety smooth/pearl luster (semi gloss) finish, as specified in the item. It shall be even and uniform in shade without patches, brush marks, paint drops etc.

B.2.6 Precautions:

- e) Old brushes if they are to be used with emulsions paints, shall be completely dried of turpentine or oil paint by washing in warm soap water. Brushes shall be quickly

washed in water immediately after use and shall be kept immersed in water during break periods to prevent the paint from hardening on the brush.

- f) In the preparation of walls for plastic emulsion painting, no oil base putties shall be used in filling cracks, holes etc.
- g) Splashes on floors etc. shall be cleaned out without delay as they will be difficult to remove after hardening.
- h) Washing of surfaces treated with emulsion paint shall not be done within 3 to 4 weeks of application.

B.2.7 Protective measures: The relevant specifications of Para 2.4 of item B of this section shall be followed.

B.3. Mode of Measurements

B.3.1 The relevant specifications of item No A of this section shall be followed.

B.3.2 The unit rate shall be for a unit of 1 m².

C. Red Lead primer

C.1 Materials

C.1.1 The ready mix primer, brushing red lead shall conform to the specifications described under material specification Para - A of Technical Specifications including to IS 102 - 1962.

C.1.2 The thinner (linseed oil) shall conform to IS:75-1973, if, for any reason, thinning is necessary. In case of ready mix paint, the brand of thinner recommended by manufacturer shall be used.

C.1.3 Red lead ready mix primer, thinner, etc. brought & used shall be from only one source and of only one make / manufacturer as approved by the Design Consultant, for entire work.

C.1.4 All the materials shall get approved by the Design Consultant & Project Manager before it is used.

C.2 Execution

C.2.1 Preparation of surfaces

The surfaces to be painted shall be cleaned of all rust, scale, dirt and other foreign matter sticking to it with wire brushes, steel wool, scrapers, sand paper etc. This surface shall then be wiped finally with mineral turpentine which shall also remove grease and perspiration of hand marks. The surface shall then be allowed to dry.

C.2.2 Application of primer:

- f) After the preparation of the surface, the priming coat shall be applied immediately. The brushing operations are to be adjusted to the spreading capacity advised by the manufacturer of the particular primer. The paint shall be applied evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area over with paint, brushing alternately in opposite directions, two or three times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat.
- g) During painting, every time after the priming coat has been worked out of the brush bristles or after the brush has been unloaded of the primer, the bristles of the brush shall be opened up by striking the brush against portion of the unpainted surface with the end of the bristles, held at right angles to the surface, so that bristles thereafter will collect the correct amount of paint when dipped again into a paint container. The primary coat shall be allowed to dry completely before painting is started.

- h) No hair marks from the brush or clogging of paint puddles in the corner or panels angles of mouldings etc. shall be left on the work.
- i) Special care shall be taken while painting over bolts, nuts, rivets overlaps etc.
- j) The container when not in use shall be kept close and free from air so that paint does not get thickened and also shall be kept guarded from dust.

C.3.Mode of Measurements:

Note Applicable as the same is part of respective painting items of steel work.

D. Enamel paint (To all kinds of surfaces, i.e. steel, wood, plaster, etc)

D.1.Materials

- D.1.1 Enamel paint, etc. shall conform to the specification as described under material specifications as described under material specifications as described under material specifications part A of Technical Specifications.
- D.1.2 Enamel paint, thinner, etc. brought & used shall be from only one source of supply and of only one make / manufacturer as approved by Architect, for entire work.
- D.1.3 All the materials shall got approved by the Design Consultant& Project Manager before it is used.

D.2 Execution

D.2.1 General

- f) The materials required for work of painting work shall be obtained directly from approved manufacturers or approved dealer and brought to the site in maker's drums, cage etc. with seal unbroken.
- g) All materials not in actual use shall be kept properly protected, lid of containers shall be kept closed and surface of paint in open or partially open containers covered with a thin layer of turpentine to prevent formation of skin. The materials which have become stale or flat due to improper and long storage shall not be used. The paint shall be stirred thoroughly in its container before pouring into small containers. While applying also, the paint shall be continuously stirred in smaller container. No left over paint shall be put back into stock tins when not in use.
- h) If for any reasons, thinning is necessary, the brand of thinner recommended by the manufacturer shall be used.
- i) The surface to be painted shall be thoroughly cleaned and dusted. All rust, dirt and grease shall be thoroughly removed before painting is started. No painting on exterior or other exposed parts of the work shall be carried out in wet, damp or otherwise unfavorable weather and all the surfaces shall be thoroughly dry before painting work is started.
- j) For Glossy, Flat, Pearl lustre and Matt finish, painting of same specification shall be followed except that the type of paint shall be changed as per the direction of Design Consultant and Project Manager, to give the desired finish.

D.2.2 Scaffolding: The relevant specifications of Para 2.3 of item No. A of this section shall be followed.

D.2.3 Preparation of surface: The relevant specifications of Para 2.2 of item D of this section shall be followed.

D.2.4Preparation of Mix

This shall be done as per the manufacture's instructions. The thinning of emulsion is to be done with water and not with turpentine. The quantity of thinner to be added to shall be as per manufacturer's instructions.

D.2.5Application:

- e) Before pouring into small containers for use of applying, the paint shall be stirred thoroughly in its container. Also, the paint shall be continuously stirred in the smaller container, so that its consistency is kept uniform.
- f) Brushing operations are to be adjusted to the spreading capacity advised by the manufacturer of particular paint. The paint shall be laid on evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area over with paint, brushing the surface hard for the first time over and then brushing alternately in opposite directions two or three times and then finally brushing lightly in direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat. No hair marks from the brush or clogging of paint puddles in the corners of panels, angles of moldings etc. shall be left on the work.
- g) The paint shall be applied with brush for first two coats and final coat shall be done with roller only. The surface shall be treated with minimum one coat of alkali resistant primer and putty as specified in relevant specification of workmanship of item D of this section. The second or subsequent coat shall not be started until the preceding coat has become sufficiently hard to resist marking of the brush being used.
- h) The surface on finishing shall present a flat velvety smooth/pearl luster (semi gloss) finish, as specified in the item. It shall be even and uniform in shade without patches, brush marks, paint drops etc.

D.2.6 Precautions:

- e) Old brushes if they are to be used with emulsions paints, shall be completely dried of turpentine or oil paint by washing in warm soap water. Brushes shall be quickly washed in water immediately after use and shall be kept immersed in water during break periods to prevent the paint from hardening on the brush.
- f) In the preparation of walls for plastic emulsion painting, no oil base putties shall be used in filling cracks, holes etc.
- g) Splashes on floors etc. shall be cleaned out without delay as they will be difficult to remove after hardening.
- h) Washing of surfaces treated with emulsion paint shall not be done within 3 to 4 weeks of application.

D.2.7 Protective measures: The relevant specifications of Para 2.4 of item B of this section shall be followed.

D.3 Mode of Measurements

(b) For steel work

- (viii) The new steel and other metal surface shall be measured under this item.
- (ix) All the work shall be measured net, in the decimal system as executed, subject to the following limits unless otherwise stated herein after
 - a) Dimensions shall be measured to the nearest 0.01 m.
 - b) Areas shall be worked out to the nearest 0.01 m².
- (x) No deductions shall be made for openings not exceeding 0.5 m² each and no addition shall be made for painting to beading, mouldings, edges, iambs, soffits etc. of such opening.
- (xi) In case of fabricated structural steel and iron work, primer coat of oil paint shall be included with fabrication. In case of trusses, if measured in ml, compound girders, stanchions, lattices, girder and similar work, actual area shall be measured in ml and no extra shall be paid for painting on bolts, heads, nuts, washers etc. No addition shall be made to the weight calculated for the purpose of measurements of steel for weight of prime

(xii) The different surfaces shall be grouped into one general item, areas of uneven surface being converted into equivalent plain areas in accordance with the relevant I.S. code for payment.

(xiii) The rate shall include the cost of all materials, labour, scaffolding, protective measures etc. required for the above specified operation, at all floors, at any height, in any position. Scrapping of surface, washing etc. of surfaces spoiled by smoke, soot, removal of oil and grease spots, treatment for infection with efflorescence, moulds, moss, fungi, algae and lichen shall not be paid extra. This shall also include conveyance, delivery, handling, unloading, storing work etc.

(xiv) The unit rate shall be for a unit of one m².

(b) For Surfaces other than steel work

(iii) The relevant specifications of item No. A of this section shall be followed.

(iv) The unit rate shall be for a unit of one m².

E. Wood Primer Pink for wood work

E.1 Materials

E.1.1 The ready mix paint for brushing wood primer pink like wood entities of Asian paints or approved equal shall conform to the specifications as described under material specifications Part A of Technical Specification including to IS:3536 - 1966

E.1.2 The ready mix paint for brushing wood primer pink brought & used shall be from only one source of supply and of only one make / manufacturer as approved by the Design Consultant, for entire work.

E.1.3 All the materials shall got approved by the Design Consultant & Project Manager before it is used.

E.2 Execution

E.2.1 Preparation of surfaces:

c) All wood work shall be dry and free from any foreign matter incidental to building operations. Nails shall be punched well below the surface to provide a firm key for painting. Mouldings shall be carefully smoothened with abrasive paper and projecting fibers shall be removed. Flat portion shall be smoothened off with abrasive paper used across the grain prior to painting and with the grain prior to staining, if the wood is to be left in its natural colour. Wood work which is to be stained may be smoothened by scraping instead of by glass papering if so required.

d) Any knots, resinous or streaks or bluish sap wood that are not large enough to justify cutting out shall be treated with two coats of pure shellac knotting applied thinly and extended about 25 mm. beyond the actual area requiring treatment.

E.2.2 Application of primer:

e) After the preparation of the surface, the painting coat shall be applied immediately. The brushing operations are to be adjusted to the spreading capacity advised by the manufacturer of the particular primer. The paint shall be applied evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area over with paint, brushing alternately in opposite directions, two or three times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat.

f) During painting, every time after the priming coat has been worked out of the brush bristles or after the brush has been unloaded of the primer, the bristles of the brush shall be opened up by striking the brush against portion of the unpainted surface

with the end of the bristles, held at right angles to the surface, so that bristles thereafter will collect the correct amount of paint when dipped again into a paint container. The primary coat shall be allowed to dry completely before painting is started.

- g) No hair marks from the brush or clogging of paint puddles in the corner or panels angles of mouldings etc. shall be left on the work.
- h) The container when not in use shall be kept close and free from air so that paint does not get thickened and also shall be kept guarded from dust.

E.3.Mode of Measurements

Not Applicable

As the same is Part of respective painting work items, of wood work.

F. Wood Primer for Enamel paint to wood work

F.1Materials

- F.1.1 The ready mix paint for brushing priming for enamel on all kinds of wood work and wood based surfaces shall conform to the specifications described under material specifications Part A of Technical Specifications.
- F.1.2 The ready mix paint for brushing priming for enamel brought and used shall be from only one source and of only one make / manufacturer as approved by the Architect, for entire work.
- F.1.3 All the materials shall got approved by the Design Consultant & Project Manager before it is used.

F.2 Execution

F.2.1Preparation of' surfaces:

- c) All wood work shall be dry and free from any foreign matter incidental to building operations. Nails shall be punched well below the surface to provide a firm key for painting. Mouldings shall be carefully smoothened with abrasive paper and projecting fibers shall be removed. Flat portion shall be smoothened off with abrasive paper used across the grain prior to painting and with the grain prior to staining, if the wood is to be left in its natural colour. Wood work which is to be stained may be smoothened by scraping instead of by glass papering if so required.
- d) Any knots, resinous or streaks or bluish sap wood that are not large enough to justify cutting out shall be treated with two coats of pure shellac knotting applied thinly and extended about 25 mm. beyond the actual area requiring treatment.

F.2.2Application of primer:

- e) After the preparation of the surface, the priming coat shall be applied immediately. The brushing operations are to be adjusted to the spreading capacity advised by the manufacturer of the particular primer. The paint shall be applied evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area over with paint, brushing alternately in opposite directions, two or three times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat.
- f) During painting, every time after the priming coat has been worked out of the brush bristles or after the brush has been unloaded of the primer, the bristles of the brush shall be opened up by striking the brush against portion of the unpainted surface with the end of the bristles, held at right angles to the surface, so that bristles thereafter will collect the correct amount of paint when dipped again into a paint

container. The primary coat shall be allowed to dry completely before painting is started.

- g) No hair marks from the brush or clogging of paint puddles in the corner or panels angles of mouldings etc. shall be left on the work.
- h) The container when not in use shall be kept close and free from air so that paint does not get thickened and also shall be kept guarded from dust.

F.3 Mode of Measurements

Not Applicable

As the same is Part of respective painting work items, of wood work.

G. French Polish to Wood work

G.1 Materials

G.1.1 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) Chadrac, (iii) Shellac (iv) Pigment. The French polish so prepared shall conform to IS:348-1968 and to material specifications as described under material specifications part A - Technical Specifications.

G.1.2 All the ingredients as specified in K.1.1 above for French polish brought and used shall be from only one source of supply and of only one make / manufacturer as approved by the Architect, for entire work.

G.1.3 All the materials shall get approved by the Design Consultant and Project Manager before it is used.

G.2 Execution

G.2.1 Preparation of surface:

- c) All unevenness shall be rubbed down smooth with sand paper and the surface shall be well dusted. The pores in the wood shall be filled up with filler made of paste of whiting chalk in water or mentholated spirit (with suitable pigment like burnt sienna or umber if required), otherwise the French polish will get absorbed and a good gloss will be difficult to obtain.
- d) In case a surface is to be re-polished, the old polish shall be thoroughly scrapped off by very fine sand paper and if required shall be washed off by lukewarm water mixed with caustic soda powder to remove stains.

G.2.2 Application

- b) A polishing pad of soft woolen cloth/absorbent cotton covered by a fine cloth shall be used to apply the polish. The pad shall be moistened with polish and rubbed in quick light strokes along the grain, overlapping the former stroke thus, applying the polish sparingly but uniformly over the entire area to give an even surface. A trace of linseed oil on the face of the pad may be added which shall facilitate this operation. The surface shall be allowed to dry and the remaining coats applied in the same way. To finish off, the pad shall be covered with a fresh piece of clean fine cloth, slightly dampened with mentholated spirit and rubbed lightly and quickly with circular motions. The finished surfaces shall present a uniform texture and high gloss.

G.2.3 Protective measure

The surface of doors, windows, ventilators, floors, articles of furniture etc. and such other part of the buildings which are not to be distempered shall be protected from being splashed upon. Such surfaces shall be cleaned of distemper splashes, if any.

G.3 Mode of Measurements

G.3.1 All the wood and wood based surfaces shall be measured under this item.

G.3.2 All the work shall be measured net, in the decimal system as executed, subject to the following limits unless otherwise stated herein after

a) Dimensions shall be measured to the nearest 0.01 m.

b) Areas shall be worked out to the nearest 0.01 m².

G.3.3 No deductions shall be made for openings not exceeding 0.1 m² each and no addition shall be made for painting to beading, mouldings, edges, jambs, soffits etc. of such opening.

G.3.4 The different surfaces shall be grouped into one general item, areas of uneven surface being converted into equivalent plain areas in accordance with the relevant I.S. code for payment.

G.3.5 The rate shall include the cost of all materials, labour, scaffolding, protective measures, etc. required for the above specified operations, at all floors, at all height, in any position.

G.3.6 The rate shall include the sand papering of surface, removal of all kinds of spots treatment for infection, the cost of wood fillers, etc.

G.3.7 The rate shall also include conveyance, delivery, handling, loading, storing, etc

G.3.8 The unit rate shall be for a unit of one m²

H. Wax Polish

H.1 Materials

H.1.1 Bee's wax shall conform to IS:1504 - 1968, lin seed oil shall conform to IS:75 - 1967. Turpentine shall conform to IS:83 - 1950. Varnish shall conform to IS:337 - 1952. However, wax polish, etc. shall conform to specification as described under material specification Part A of Technical Specifications.

H.1.2 All the materials as described in Para L1.1 brought and used shall be from only one source of supply and only one make / manufacturer as approved by the Design Consultant, for entire work.

H.1.3 All the materials shall got approved by the Design Consultants and Project Manager before it is used.

H.2 Execution

H.2.1 Preparation of bees wax

c) Incase of bee's wax, it shall be prepared locally with following specifications

d) Pure bee's wax free paraffin or bee's 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 bee's 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 warm and turpentine and varnish shall be added to it in the required proportions and entire mixture shall be well stirred.

H.2.2 Preparation of surface:

b) The surface to be waxed shall be prepared to produce a smooth dry, neat surface, previous coat of paint or stain if any, shall be allowed to dry and be rubbed down, lightly wiped off and allowed to dry. All dust and dirt shall be removed from the surface to be waxed, and also from the neighborhood. Damp atmosphere and draughts shall be avoided. For waxing, normal dry day shall be chosen.

H.2.3 Application

c) The wax shall be applied evenly with clean soft pad of cotton cloth in such a way that the surface is completely and fully covered. The surface shall then be rubbed continuously for half an hour. After well rubbing in one coat of wax polish, the work

shall be covered with dust proof sheet (cloth for preventing dust falling on the work. Subsequent coat shall be applied after the surface is quite dry and shall be rubbed off with soft flannel until the surface has assumed a uniform gloss and in dry showing no sign of sickness.

- d) The final wax polish depends largely on the amount of rubbing which shall be continuous and with uniform pressure with frequent changes in the direction.

H.3 Mode of Measurements

H.3.1 All the wood and wood based surfaces shall be measured under this item.

H.3.2 All the work shall be measured net, in the decimal system as executed, subject to the following limits unless otherwise stated herein after

a) Dimensions shall be measured to the nearest 0.01 m.

b) Areas shall be worked out to the nearest 0.01 m².

H.3.3 No deductions shall be made for openings not exceeding 0.1 m² each and no addition shall be made for painting to beading, mouldings, edges, iambs, soffits etc. of such opening.

H.3.4 The different surfaces shall be grouped into one general item, areas of uneven surface being converted into equivalent plain areas in accordance with the relevant I.S. code for payment.

H.3.5 The rate shall include the cost of all materials, labour, scaffolding, protective measures, etc. required for the above specified operations, at all floors, at all height, in any position.

H.3.6 The rate shall include the sand papering of surface, removal of all kinds of spots treatment for infection, the cost of wood fillers, etc.

H.3.7 The rate shall also include conveyance, delivery, handling, loading, storing, etc

H.3.8 The unit rate shall be for a unit of one m²

I. Melamine polish

I.1 Materials

I.1.1 The melamine polish shall be of best quality and of make such as Asian or approved equivalent and shall conform to the specifications as described under material specification Part A of Technical Specifications

I.1.2 Melamine Polish, etc. brought and used shall be from only one source of supply and only one make / manufacturer as approved by the architect, for entire work.

I.1.3 All the materials shall got approved by the Design Consultant and Project Manager before it is used

I.2 Execution

I.2.1 Preparation of surface:

c) All unevenness shall be rubbed down smooth with sand paper and the surface shall be well dusted. The pores in the wood shall be filled up with a filler made of paste of whiting chalk in water or mentholated spirit (with suitable pigment like burnt sienna or umber if required), otherwise the French polish will get absorbed and a good gloss will be difficult to obtain.

d) In case a surface is to be re-polished, the old polish shall be thoroughly scrapped off by very fine sand paper and if required shall be washed off by luke warm water mixed with caustic soda powder to remove stains.

I.2.2 Application

b) A polishing pad of soft woolen cloth/absorbent cotton covered by a fine cloth shall be used to apply the polish. The pad shall be moistened with polish and rubbed in quick light strokes along the grain, overlapping the former stroke thus, applying the polish sparingly but uniformly over the entire area to give an even surface. A trace of linseed oil on the face of the pad may be added which shall facilitate this operation. The surface shall be allowed to dry and the remaining coats applied in the same way. To finish off, the pad shall be covered with a fresh piece of clean fine cloth, slightly damped with mentholated spirit and rubbed lightly and quickly with circular motions. The finished surfaces shall present a uniform texture and high gloss.

I.2.3 The melamine polish shall be applied on doors & windows wood work or any kind of wood work or wood based surfaces with the help of spray gun, as directed by the Design Consultant and Project Manager.

I.3 Mode of Measurements

I.3.1 All the wood and wood based surfaces shall be measured under this item.

I.3.2 All the work shall be measured net, in the decimal system as executed, subject to the following limits unless otherwise stated herein after

a) Dimensions shall be measured to the nearest 0.01 m.

b) Areas shall be worked out to the nearest 0.01 m².

I.3.3 No deductions shall be made for openings not exceeding 0.1 m² each and no addition shall be made for painting to beading, moldings, edges, iambs, soffit etc. of such opening.

I.3.4 The different surfaces shall be grouped into one general item, areas of uneven surface being converted into equivalent plain areas in accordance with the relevant I.S. code for payment.

I.3.5 The rate shall include the cost of all materials, labour, scaffolding, protective measures, etc. required for the above specified operations, at all floors, at all height, in any position.

I.3.6 The rate shall include the sand papering of surface, removal of all kinds of spots treatment for infection, the cost of wood fillers, etc.

I.3.7 The rate shall also include conveyance, delivery, handling, loading, storing, etc

I.3.8 The unit rate shall be for a unit of one m²

J. Varnish Finish

J.1 Materials

J.1.1 Varnish for the finishing coat shall be of superior quality spar copal or as stipulated in the item and for under coat it shall be flatting varnish of the same approved manufacturer.

J.1.2 Varnish for under coat and for finishing coat brought and used shall be from only one source of supply and only one make / manufacturer as approved by the Design Consultant, for entire work.

J.1.3 All the materials shall got approved by the Design Consultant and Project Manager before it is used

J.2 Execution

J.2.1 Preparation of surface:

c) Now wood work shall be finished smooth with a carpenter's plane. Knots shall be cut to a slight depth, cracks and holes shall be cleaned of dust and then filled with approved quality wood putty. The surface shall then be rubbed down perfectly smooth with medium and fine grained sand paper and wiped clean and dry.

- d) Sizing or transparent wood filler from the same manufacturer; shall then be applied with a brush or rag and allowed to dry. Finally it shall be rubbed with fine sand paper or emery paper. This will seal the pores in the wood and prevent absorption of oil it) the varnish.

J.2.2 Application:

- c) An under coat of Halting varnish shall be applied. It shall dry hard and brittle and when rubbed down Shall produce a smooth surface, enhancing the gloss of the finished varnish.
- d) Varnish shall be applied liberally with a full brush and spread evenly with short light strokes to avoid frothing. Rubbing down with fine sand paper and flatting the surface shall be done after each coat except the final coat. The surface shall be allowed to dry and the finished surface shall present an uniform, fine glossy surface free from streaks, blisters etc. Special fine haired varnishing brushes only, shall be used for the work.

J.3 Mode of measurements

J.3.1 All the wood and wood based surfaces shall be measured under this item.

J.3.2 All the work shall be measured net, in the decimal system as executed, subject to the following limits unless otherwise stated herein after

a) Dimensions shall be measured to the nearest 0.01 m.

b) Areas shall be worked out to the nearest 0.01 m².

J.3.3 No deductions shall be made for openings not exceeding 0.1 m² each and no addition shall be made for painting to beading, mouldings, edges, iambs, soffits etc. of such opening.

J.3.4 The different surfaces shall be grouped into one general item, areas of uneven surface being converted into equivalent plain areas in accordance with the relevant I.S. code for payment.

J.3.5 The rate shall include the cost of all materials, labour, scaffolding, protective measures, etc. required for the above specified operations, at all floors, at all height, in any position.

J.3.6 The rate shall include the sand papering of surface, removal of all kinds of spots treatment for infection, the cost of wood fillers, etc.

J.3.7 The rate shall also include conveyance, delivery, handling, loading, storing, etc

J.3.8 The unit rate shall be for a unit of one m²

K. Acrylic Polish

K.1 Materials

K.1.1 Acrylic Polish shall conform to the specifications described under material specifications Part A of Technical Specifications.

K.1.2 Acrylic Polish brought and used shall be from only one source of supply and from only one make / manufacturer as approved by the Design Consultant, for entire work.

K.1.3 All the materials shall got approved by the Architects and Project Manager before it is used

K.2 Execution

K.2.1 Preparation of surface

- c) Prepare the surface by proper sanding, filling and priming as per the conventional method in polishing wood surfaces.



- d) In case, surface previously polished with French polish is to be re-polished, the surface is sandpapered with emery paper no. 80 along the grains, thoroughly. Wipe off the loose dust completely and then clean the surface with a cloth pad filled with thinner N 83.

K.2.2 Application:

- c) Apply 2 or 3 even coats rubbing well into the grains. For extra tough and durable coating, apply 4 to 5 coats.
- d) In case dilution is required; use thinner N 83 for the same.

K.3 Mode of Measurements

K.3.1 All the wood and wood based surfaces shall be measured under this item.

K.3.2 All the work shall be measured net, in the decimal system as executed, subject to the following limits unless otherwise stated herein after

a) Dimensions shall be measured to the nearest 0.01 m.

b) Areas shall be worked out to the nearest 0.01 m².

K.3.3 No deductions shall be made for openings not exceeding 0.1 m² each and no addition shall be made for painting to beading, mouldings, edges, iambs, soffits etc. of such opening.

K.3.4 The different surfaces shall be grouped into one general item, areas of uneven surface being converted into equivalent plain areas in accordance with the relevant I.S. code for payment.

K.3.5 The rate shall include the cost of all materials, labour, scaffolding, protective measures, etc. required for the above specified operations, at all floors, at all height, in any position.

K.3.6 The rate shall include the sand papering of surface, removal of all kinds of spots treatment for infection, the cost of wood fillers, etc.

K.3.7 The rate shall also include conveyance, delivery, handling, loading, storing, etc

K.3.8 The unit rate shall be for a unit of one m²

1.2 ACTION SUBMITTALS

E. Qualification Data for:

- 4. Manufacturer.
- 5. Installer.
- 6. Testing Agency.

F. Product Data: For each type of product. Include preparation requirements and application instructions.

G. Samples: For each type of paint system and in each colour and gloss of topcoat.

H. Product List: For each product indicated. Include printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.3 MAINTENANCE MATERIAL SUBMITTALS

B. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- 2. Paint: 5 percent, but not less than 3.8 L of each material and colour applied.

1.4 QUALITY ASSURANCE

- B. Mockups: Apply mockups of each paint system indicated and each colour and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
3. Design Consultant will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 9 sq. m.
 - b. Other Items: Design Consultant will designate items or areas required.
 4. Final approval of colour selections will be based on mockups.

If preliminary colour selections are not approved, apply additional mockups of additional colours selected by Design Consultant at no added cost to Owner.

Section No: 12 FAÇADE WORK

(12.01 to 12.06)

1.1 General Project Information:

The proposed development is located at Sabarmati River-Front Amdavad.

This specification covers the entire façade work in the development as mentioned above. The Technical Specifications shall be read along with all the relevant documents that covers the façade work contract.

The Technical Specification shall be read and understood in conjunction with the following documents:

- Contract conditions documents from Owner/Developer/Architect/QS.
- Bill of Quantity (BOQ) & Make list for the façade work from façade Consultant.
- Façade Concept drawings/Design Intent drawings from Façade Consultant.
- Relevant or conjecture drawings related to façade.
- Architectural elevation from Architect.

1.2 Scope of Work:

The Scope of work includes complete in all meaning Design, Procurement, Fabrication, Proper Stacking, Supply, Testing, Installation, Cleaning and Handover of the Façade Contract work in accordance with the Technical Specification & BOQ. Term Façade or Façade Systems mentioned in the Contract documents and Technical Specification include all the items mentioned below:

- Sky-light with Laminated glass above MS Structure
- Auto Sliding Doors

The Façade Contract shall include fixings, fixtures, air-tightness, water tightness, vapor barriers, copings, sub frames, weather seals, smoke seal, spandrel panel materials, appropriate coatings as mentioned in the specifications, provision for façade lighting (if any), fire stop, maintenance manual, deployment of skilled, semi-skilled and labor, applicable installation equipment's, flashings, openings accessories, cleaning systems provisions (if Applicable), insulation, protection tape during transportation/ installation and all other items which comprises of the entire façade work contract.

1.3 Terms Defined:

In the entire tender documentation the following terms defined shall be read and recognized as following:

S/No.	Terms Defined	Documented as
1.	Developer/Client/Employer/Owner	AMDAVAD Municipal Corporation
2.	Architect	Scarlett Designs - Ahmedabad
3.	PMC	
4.	Façade Consultant	Façade Engineering Services
5.	Façade Contractor/Contractor	Façade Contractor Bidding for the façade work contract.
6.	Shall	Obligatory.
7.	Approved/Accepted/Selected	Acceptance by Architect/ Client/ Consultant.
8.	Should	Recommended.
9.	Provide	Supply & Install.

1.4 Coordination:

The Façade Contractor shall ensure and take responsibility that Contract work carried shall be properly interfered and coordinated with all other services & elements of the building which are related to the proper and quality work façade design and installation. Provisions shall be made as per the other services requirements and site conditions as and when required.

1.5 TenderDrawings:

The tender drawings enclosed with the tender documents are concept drawings / indicative drawings representation of architectural intent, System requirements, performance, façade elements, other buildings restrictions / limitations, interference / relationship with other services and elements of the buildings. The façade tender drawings should be read along with other drawings as well (Architectural & Structural drawings) which are the schematic representation of the design intent. At no point of time shall be the tender drawings considered as the Good for Construction (GFC) drawings by the Façade Contractor without prior confirmation from the Façade Consultant. The Tender drawings shall be read along in conjunction with the Technical specifications and BOQ.

It's a duty and responsibility of the Façade Contractor to comply his designs and drawings with the Tender drawings. If the Façade Contractor is facing issue to follow the Tender drawings same shall be brought to the notice and take the acceptance of the Façade Consultant before any change from the Tender drawings design is made.

1.6 Inspections:

The Physical Inspections of the Façade Contractors facility shall or may be required as a part of technical evaluation prior to the award of the Façade Contract Work to know about the facility, operations, quality procedures and project handling capabilities.

Provisions shall also be made for facility visits of vendors of the Façade Contractors for successfully carrying out the Façade Contract work.

The following facilities necessarily need to be visited and not limited after the finalization of the Façade Contractor.

- Aluminum Extrusion Facility with System supplier or specific profile extruder

- Glass Processing and Manufacturing Plant.
- Coating Plant.
- Façade Contractors Plant
- Testing Facility. (If Applicable)

1.7 Site Particulars:

The Façade Contractor shall also inspect and examine the site in all manners (i.e. loading and unloading, Stacking, installation, access, accommodation and cleaning) which are necessary for the completion of the works and shall satisfy himself before submitting his tender and in general shall himself obtain all necessary information as to risk, contingencies and other circumstances which may influence or affect his tender at its own cost. Non-familiarity with the site conditions will not be considered a reason either for extra claims or for not carrying out the work in strict conformity with the drawings and specifications. The Façade Contractor shall also submit letter of compliance with the tender.

1.8 Site Cleaning:

The Façade Contractor shall handover the site clean to the Client on Completion. The Site clean means cleaning of façade, removal of the protection tapes, temporary works of all kinds, rubbish, extra materials and if the Façade Contractor fails to do so same will be done by some external agency and all the costs & risks incurred will be borne by the Contractor.

1.9 Submittals:

The Façade Contractor shall provide all the submissions for the following:

- Technical Assessments - Concept Drawings and Shop Drawings
- To verify the system proposed - Sample Board OR Small Prototype Mockup
- To Assess Performance Requirements as specified
- Approval from Client/Architect/Façade Consultant
- Construction Method Statements as well as Detail Project Completion schedule
- Materials Registry Record
- Site Inspections Records
- Quality Control Records - Factory and Site
- Material performance Record

The submittals shall include without fail the following items as mentioned below; the exclusion of any of the items mentioned below will not be accepted. During the bidding stage any documents missing or not provided on said time, the Façade Consultant/Architect/Owner holds every right not to accept the bid from the Façade Contractor and his bid will be considered as null and void.

1.9.1 Tender Submission:

The Tenderer shall submit tender within 12 days from Issue date along with all the required documents as mentioned below along with his bid without any obligation and justifications.

- The Tenderer shall submit all the Preliminary Façade Tender Drawings & Supporting calculations showing his technical capabilities, system proposed and design understanding strictly complying with the specifications and Façade Tender Drawings as provided by the Façade Consultant. (If Applicable)

-
- Letter of Compliance to tender specification provide by the façade consultant.
 - OrganizationChart
 - Factory Location and list of equipment's
 - Projectreferences.
 - ExecutionProgram
 - Quality Assurance / Installation MethodologyStatement.
 - Letter of compliance to site visit and familiarizing with site conditions including all risks, contingencies and circumstances that will have bearing on thework.

1.9.2 SamplesSubmission:

After the finalizations of the Contract the Assigned Façade Contractor shall and hold responsibility without fail to submit the material samples as mentioned below prior to installation and get Approvals for the same from Approving Authority (Client/Architect/Façade Consultant) and should make a same board of the approved materials and submit to Employer for records and keep one duplicate for his own records and reference. Samples shall be properly labeled in the Particular format as per **Appendix-A**

The samples that the Façade Contractor needs to submit prior to the start of work are as followings:

a) Aluminum:

- Alloy and Temper Certificate from thesupplier
- Aluminum ProfileSample
- Finish of AluminumProfiles
- Color of AluminumProfiles
- Fabricated sample of the Proposed System (If needed byClient)

b) Glass:

- Performance (Thermal & Visual Characteristics)Certificates
- Glass Type-Monolithic orDGU
- GlassColor

c) Gaskets:

- Certificates from theSuppliers
- Types
- Color

d) Accessories:

- Performance Certificates from theSuppliers
- Types
- Color

e) Coatings for the Aluminum:

- Certificates from the processors
- Types
- Color

f) Fasteners and Fixtures:

- Structural performance certificates or Technical Manuals from the suppliers.

g) Miscellaneous Items:

- Waterproofing membrane
- Packing Shims
- Silicone
- Insulation
- Bracket
- Glasswool
- Side Rise ORHILT
- Hardware etc.

Samples shall be accompanied with technical specifications / manufacturer's catalogues.

Note – All Material must be from approved vendor list only.

1.9.3 Site mock- Applicable & Site Test

The Façade Contractor shall submit mock-up drawings with supporting calculations complying with the Technical Specifications and Façade Tender Drawings within 10 days from the awards of the Façade Contract Work to the Façade Consultant for the review and comments if any. A full scale Glazing visual mock-up needs to be installed at site without any extra cost at location confirmed by the Employer in with approved material samples. The Contractor shall hold the responsibility to get the drawings approved from the Façade Consultant. Sufficient time frame should be given prior to mock-up installation to get the drawings reviewed & approved by the Façade Consultant.

All the Submittals shall be on A-3 paper as well as a soft copy of the same to be provided to the Client; Architect & Façade Consultant. The drawings should be made to scale and the scale needs to be mandatory mentioned on the drawing sheets. No drawings without scale will be accepted.

Mock-Up drawings without the structural stability calculation of all the elements for the façade will not be accepted. The calculations should be detailed one.

1.9.4 Shop Drawing & Calculations Submission:

Submission of complete and comprehensive shop drawings showing all the aspect of the façade, detailed drawings of each and every element of the façade, fixing details, corner details, coping details, the drawings should also include the interference details with the building elements and other building services.

Shop drawings shall be up to scale with scale used for a particular drawing mentioned mandatory on the drawings sheet itself. The shop drawings shall

include all the complete drawings of each and every items/element of the Façade WorkContract.

Shop drawings shall clearly mention the sizes of members, sizes and make, finish and properties of each and every element associated with the façade work. The size shall be clearly supported and mentioned with the structural calculations as per the technical specifications and referred codes and standards.

There shall not be limitations for the submittals. The Architect & Façade Consultant holds every right to ask for any kind of extra details if and when required.

The approvals of shop drawings shall be for the member's sizes, structural stability, and performance. The Façade Consultant holds no responsibility for the fabrication or installation errors or omission which may directly or indirectly influence the performance of thefaçade.

All the drawings submitted for review and approvals should be on A-3 sheet there should not be any limitations for the no of copies required or asked by the Employer.Allthedrawingsshouldbeasperthestandardsanduptoscale.

The drawings submitted shall be accompanied by the structural calculations, and shall not be limited to the members only but each and every element, fixtures as well. The Façade Consultant holds every right to ask for any corresponding calculations related to the Façade Work Contract if and when required and the Contractor need to provide the same at the earliest in order to avoid any kind of delay in theapprovals.

All the submissions for the Façade Work Contract Shall made completely. By parts or bifurcated submissions will not be entertained. No Approvals shall be given if any required information asked by the Architect & Façade Consultant not beingprovided.

The Façade Contractor holds the responsibility to execute the Façade Contract Work while adhering to the Technical Specification and getting all kind of Approvals from the Façade Consultant/Architect/Owner.

The Façade Contractor shall verify all designs as per their proposed system along with the site conditions. The variations that may occur or subjected to occur at site need to be properly coordinated. For that an initial site survey should be conducted before start of the fabrication or GFC drawings for façade work after the award of the contract. The Façade contractor shall bring to notice of Client/ Architect/Façade Consultant for any sitevariations.

All designs shall be sent for Approval prior to the start of the façade work. The Façade Contractor holds the responsibility for the structural stability and performance of the façade for the system proposed by him and should adhere to all the clause of the technicalspecification.

The days required for review of the submissions by the Architect & Façade Consultant are maximum of 21 days subjected to the availability of all the required documents for approvals.

1.9.5 Submission of Manufacturer's Literature, Including Catalogue, Catalogue Cuts, Brochures, Charts, Test Data, and SimilarInformation:



Manufacturer's literature will receive consideration only when accompanied by the transmittal form, and listing each item of literature, as well as the Specification Section and paragraph numbers describing such materials. Any deviations from contract requirements shall be stated on the above form or attached to it.

Facade Contract Work: Submit six (6) copies of manufacturer's literature to the Facade Consultant for acceptance. If accepted, the Facade Consultant will return four (4) copies stamped "No Exceptions Taken" or "Make Corrections Noted". In the event the Facade Consultant returns the literature stamped "Make Corrections Noted, Resubmit Specified Items" or "Rejected", he will return two (2) copies only. The contractor shall resubmit six (6) copies of correct or corrected literature of all submissions stamped by the Facade Consultant "Make Corrections Noted, Resubmit Specified Items" or "Rejected".

All copies of manufacturer's literature required to be resubmitted hereunder shall be original printed material. Reproductions of printed material will be received with facade contractor stamp with signature of the authorized person.

1.9.6 Coordination of Submittals:

Prior to submittal for Facade Consultant's review, use all means necessary to fully coordinate all material, including the following procedures:

- Determine and verify all field dimensions and conditions, materials, catalogue numbers and similar data.
- Coordinate as required with all trades and with public agencies involved.
- Clearly indicate all deviations from the Contract Documents.

Unless otherwise specifically permitted by the Facade Consultant, make all submittals in groups containing all associated items; the Facade Consultant may reject partial submittals as not complying with the provisions of the Contract Documents.

1.9.7 Request for Information (RFI):

All questions shall be originated by the specific Vendor and forwarded to the Vendor (who shall forward to the Architect & Facade Consultant) via a Request for Information (RFI) form acceptable to the Facade Consultant.

Develop a project numbering system, as approved by the Facade Consultant, for use in coordinating and filing RFI's.

The Vendor shall log all RFI's.

Reference the specific shop drawing, construction drawing, sketch, and/or specification section that is impacted by the RFI.

Note the date of submission and requested response date.

Upon receipt, the Architect & Facade Consultant shall provide a response within 5 business days. The Contractor/Sub-Contractor shall coordinate the submission of all correspondence shall be copied to the Owner, the Facade Consultant, and the relevant Design Consultant (MEP, Structural, etc.).



1.9.8 Project Management Documents:

Project Management specified shall be in accordance with the requirements of the Contract Documents.

The duties to be performed under this Section are those of the Façade Contractor (in coordination with its Trade Vendors, as applicable). In the event of any inconsistency between this Section and the General Conditions, and unless the Owner directs otherwise, provisions of the General Conditions shall prevail.

Work of this Section includes administrative and procedural requirements for documenting the project management during performance of the work, including but not limited to, the following:

- **Preliminary Installation Schedule.**
- **Submittals Schedule.**
- **Daily Installation reports.**
- **Material Availability reports.**
- **Field condition reports.**
- **Special reports, including task tracking reports.**

The project management includes preparation of preliminary installation schedules of the areas as mentioned or prioritized by the Client/Owner or consider key or critical by the Façade Contractor, Which should followed by a complete bar chart showing installation period, manpower requirements and other requirements for the complete Façade Work Contract.



Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.

Indicate completion in advance of date established for Substantial Completion, and allow time for Facade Consultant's administrative procedures necessary for certification of Substantial Completion.

At monthly intervals, prepare a comprehensive list of materials delivered to and stored at Project site along with copies of invoices and entry passes. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.

Prepare a daily report recording the following information concerning events at Project site:

- Approximate count of personnel at Project site.
- High and low temperatures and general weather conditions.
- Accidents.
- Minutes of meeting.
- Storage and protection of materials on site.
- Stoppages, delays, shortages, and losses.
- Emergency procedures.

1.9.9 Quality Procedures and Requirements:

The Façade Contract Work shall comply with all the requirements of the Contract documents and specifications. This section includes the administrative and procedural requirements for quality assurance and quality control.

Prepare, submit and implementation of a detailed quality plan. Submit quality assurance documentation for all bought-in products.

Quality Control Procedures shall require the followings:

- A professional engineer who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar to those indicated for this Project in material, design, and extent.
- Qualified quality assurance representative having knowledge and experience of all the quality procedures and documentations pertaining to the kind of work indicated shall be responsible for all quality of work at site as well at the factory and preparing the report for the same.



- The Façade Contractor shall provide test specimens and assemblies representative of proposed materials and construction. Provide sizes and configurations of assemblies to adequately demonstrate capability of product to comply with performance requirements. He shall submit all specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
- An agency with the experience and capability to conduct testing and inspecting indicated, as documented by ASTM E548
- Testing agency shall perform preconstruction testing for compliance with specified requirements for performance and test methods.
- The Testing agency shall submit a certified written report of each test, inspection, and similar quality-assurance service to Façade Consultant with copy to Owner. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- Submit a certified written report of each test, inspection, and similar quality-assurance service to Façade Consultant with copy to Owner. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents. Unusual events (refer to special reports).
- A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance.
- Full-size, physical example assemblies to illustrate finishes and materials. Mock-ups shall be done before the actual work starts it is used to verify selections made under Sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Mock-ups establish the standard by which the Work will be judged. (Can be Part of Project before proceeding further fabrication)
- The Contractor shall provide access to the representative of Façade Consultant to verify the quality of work during and after installation, on the basis of the site verifications a site visit report will be submitted by the Façade Consultant to the Owner and a copy will be marked to the Contractor. If any deviation from the quality assured by the Contractor is found, the Contractor is liable to rectify all the defects without any extra charged to the Owner.
- The factory inspections as mentioned in the above clause will be a part of quality procedure during the fabrication stage.
- Contractor shall provide the certificate of performance of the façade and its elements.

2. SYSTEM REQUIREMENTS:

2.1.1 General Requirements:

The Façade Contract Work Shall comply with all the codes and standards and other relevant & authorized documents.

The Façade systems under the Façade Contract Work shall comply with all the principals of the Façade design, fabrication, Installation & Maintenance as mentioned below.

Design Principals Requirements:

■ WeatherTightness:

The Façade system shall be design to withstand the air & water infiltrations. The system shall be complete water drained, pressure equalized, rain screened systems.

■ Adaptability:

The system shall be designed to adjust itself without causing any degradation of performance as per the site conditions.

■ Stability:

Structural stability of members and all associated members against all loadings subjected to the façade and its elements (i.e. wind load, seismic load, live load, dead load, impact loadings etc.)

■ LifePeriod:

Designed to withstand the service life without breakage and failure of individual members and components.

2.2 DesignParameters:

The Façade Contract Work Shall comply and design each type of system as per guidelines provided below.

Skydome with laminated DGU Glass

- Façade fabricator to install Conventional capped Skylight system designed to with stand the wind pressure based tender drawingconcept.
- Façade fabricator to submit shop drawings and calculation based on parameters given inBOQ.
- Structural steel framework in line with design drawings made out of MS box pipe sections / End Fixing Plates of approved make make of first quality confirming to IS standard. The steel design shall accommodate thermal stresses resulting from thermal expansion due tosurface temperatures.
- SteelstructurecoatingshallbedonebasedonspecificationsgiveninBOQ.

- Skylight Glass : 8mm Thk. Reflective HS Glass + 16mm Air Gap + 6mm Thk. Clear HS + 1.52mm Santry Glass Lamination (SGP) + 6mm Clear HS Glass. as per architect approved design.
- The extruded aluminum sections of Alloy 6063 T5 / T6 & tolerances conforming to DIN / EN standard from the approved extruder. The structural profiles shall have a minimum 2 mm wall thickness. All the internal & External (IN/outside) visible surfaces shall have high Durability (Akzonobel) / Super durable (Jotun) Powder coating of 60 - 80 micron conforming to AAMA 2604 & non-visible aluminum surfaces shall have minimum chromating treatment.

Auto Sliding Door

- Façade Fabricator to Install Auto Sliding Door Top motor make by OZONE / PORTALP / GEZE, including Hardware & accessories fitting for door as per supplier requirement with 12mm thick fully tempered (FT) glass.
- Façade fabricator to work on tender drawings and specification.

3. PERFORMANCE REQUIREMENTS:

3.1 General:

The Façade Contractor shall design façade & all components of the Façade Contract Work, including fixtures, anchors, structural sealants, supporting structures where ever required to maintain the structural stability, claddings, louvers, etc. and not limited, which shall be able to carry all temporary and permanent design loads, individually and in combination without causing failure, including failure which may be due to one or more over-stresses, including cracking, bowing, distortion and looseness, lack of rigidity, dislodgement by wind or seismic forces, excessive deflection or defects which would cause damage to adjacent or applied work by others or may be dangerous impact to human. The performance & structural integrity of the façade work shall not get deteriorated and shall be able to remain intact for its designed lifetime.

3.2 Design Life:

The structural components shall be based upon design life of 50 years.

Durability of design life of façade with routine maintenance will be around 25 years. It may be that some materials may require a replace over a period of 10-15 years to achieve the desired performance.

3.3 Structural Requirements:

The façade system and all associated components and elements shall be designed and able to resist all structural loads coming over a period of design life without any breakage or degradation in performance or visual appearance of façade system and façade components under the Façade Contract Work and not limited. The loads to be considered while designing a façade system or associated components are as followings:

3.3.1 DeadLoad:

Dead load shall be computed by considering the self weight of the façade system and the associated components including the glass, Fixtures, accessories, etc.

3.3.2 LiveLoad:

Facade System and associated components shall be designed for a Minimum live load as followings and in combinations with other load as mentioned in load combinations.

- Point loading of 1.15 KN on all horizontal projection like canopy, sills, Sunshades, louvered profiles acting downwards.
- Uniform distributed load of 0.75 KN/m acting on any direction on at the window sill, transom levels at 1.5 m above finished floor levels.
- A minimum live load or maintenance load of 0.75 KN/m² on horizontal surfaces.

3.3.3 WindLoad:

Facade System and associated components shall be for a minimum designed wind pressure as per the IS: 875-Part-3 and SP-64. The wind pressure shall be taken considering all the parameters associated as per the required standards and codes. The Façade Contractor shall solely be responsible for calculating the exact wind pressure acting on a façade or components. But the wind pressure shall not be less than as defined below.

Estimated Wind Pressure:

**Framing Member = As Mentioned in
BOQ Glass Panels = As Mentioned**

Corner condition occurs from edge corner of the building to a distance of 20% of the dimension of the longest side of the building, or 25 % of the dimension of the shortest side of the building, whichever is greater.

3.3.4 SeismicLoad:

Facade System and associated components shall be designed for a minimum seismic load in accordance with required standards and codes as per IS: 1893 Part-1-2002. The Façade Contractor/Sub-Contractor shall solely be responsible for calculating the exact seismic load acting on a façade or components.

Seismic Zone Considered	II

3.3.5 LoadCombinations:

Facade System and associated components shall be designed to carry applied loads without causing overstress or slipping of anchors or associated members. The total dead load shall be used in combination with wind load and live loads in the design of all members as follows:

1.5 Dead Load + 1.5 Wind Load	Brackets, Anchors, Cast in Channels
1.0 Dead Load + 1.0 Wind Load	All Elements of Façade
1.0 Dead Load + 1.0 Live Load + 0.75 Wind Load	All Elements of Façade

3.3.6 OtherLoad:

Facade System and associated components shall be designed to carry following additional loads:

- Temporary and Installation Loads: The Façade systems and associated components shall be designed to carry all the additional loads temporary and installation apart from the loads mentioned above without causing failure or overstressing of any component and member.
- BMU Loads: The Façade system and associated components shall be designed to carry loads for BMU restrain points in consultation with the BMU consultant or BMU vendor.

3.3.7 LoadSharing:

If the Facade System members are designed with composite materials the load sharing factor shall be computed by considering the relative stiffness of each material.

3.3.8 ThermalStresses:

All the Facade System members and associated shall be designed for an ambient temperature range from 5 degrees to 50 degrees and not limited to the values. The thermal movements within the building shall not cause any critical buckling, tearing of seals, and undue stress of any fixtures or glass. No façade system or associated components or fixtures shall or subjected to undue stresses or induced loadings due to the thermal movements.

3.3.9 BuildingMovements:

The Façade Contractor shall design the Façade system to accommodate all the building movements without any failure or buckling or undue induced stresses. The Façade system joints shall accommodate the worst possible load combinations and also prevent the opening of any joints that may result in failure of weather or air-tightness. Design movement joint and select sealant products to accommodate all required expansion and contraction.

All movement allowances shall be consistent and applied across all junctions and/or components for each expansion joint system or assembly.

In general the followings Building Movements shall be considered and made allowance in the Façade System Design:

Lateral Displacement of Building	+/- 8mm or H/500 or As specified by the Structural consultant.
Long term building Movements	Differential Live load & Concrete Creep
Edge beam or slab deflection	+/- 16 mm or as specified by the structural consultant
Column Shortening	1-2mm per floor
Axial Shortening of edge beam	0.4 mm per meter length
Building Expansion joints	Provision shall be provided for building understorey expansion without causing an undue stress in the members, fixtures, sealants in case of stick system provision shall be made for building expansion joints by providing sleeve or splice joints at floor levels and in case of unitized system by designing a proper stack joint to take care of building expansion.

All the above mentioned building movements shall be coordinated with the structural engineers report.

3.3.10 Deflection Limits:

The permissible deflection limits are as follows:

Vertical Deflection of Aluminum member under dead load	L/300 or 3 mm whichever is less
Horizontal Deflection of Aluminum members under wind load	L/175 or 19 mm whichever is less
Glass Deflection-Monolithic	L/60
Glass Deflection-DGU	L/60
Aluminum Composite Panels	L/90 or 19 mm whichever is less
Aluminum Solid Panels	L/90 or 19 mm whichever is less
Fixing Brackets	Not more than 1mm
Steel Structure	L/325 or 19 mm whichever is less.

Above "L" refers to span

- In case of aluminum member the span is the distance between the two restraint points.
- In case of the four side supported glass or aluminum panel will be shorter length of the panel.
- In case of two side supported glass or aluminum panel the free edge will be considered as span.



3.4 Other Requirements:

The façade system and all associated components apart from the structural requirements shall comply and satisfy the followings requirements:

3.4.1 Fire Requirements:

All the Façade Contract Work includes all labor, materials, equipment and services necessary to complete the fire stops and smoke seals as shown on the drawings and/or specified herein, including but not limited to, the following:

- Provide fire stopping systems that are produced and installed to resist the spread of fire and the passage of smoke and other gases vertically.
- Penetrations through fire-resistance-rated floor and roof construction including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.
- Penetrations through fire-resistance-rated walls and partitions including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.
- Penetrations through smoke barriers and construction enclosing compartmentalized areas involving both empty openings and openings containing penetrating items.
- Sealant joints in fire-resistance-rated construction.
- Penetrations at each floor level in shafts and/or stairwells.
- Construction joints, including those between top of fire rated walls.
- Fire stopping materials shall conform to Flame (F) and Temperature (T) ratings as required by local building code or as tested by accepted test agencies per ASTM E 814 or UL 1479. The F rating must be a minimum of one (1) hour but not less than the fire resistance rating of the assembly being penetrated. T rating, when required by code authority, shall be based on measurement of the temperature rise on the penetrating item(s). The fire test shall be conducted with a minimum positive pressure differential of **0.01 inches of water column.**
- Do not proceed with installation of fire stop products when temperatures are in excess or below the manufacturer's recommendations.
- Provide components for each fire stopping system that are needed to install fill materials. Use only components specified by the fire stopping manufacturer and approved by the qualified testing and inspecting agency for the designated fire-resistance-rated systems.
- All the fire safety guidelines shall be in accordance of NBC and the codes mentioned there.

3.4.2 Acoustical Requirements:

All the Façade Contract Work shall be designed to meet the external noise intrusion criteria contained in BS 8233. The Contractor shall provide the acoustic performance specified. Reference shall be made to the Acoustic Specification for full details of the acoustic performance criteria. The Façade work shall be designed in such a way that the thermal movement noise is unnoticeable under normal condition. The Air-Movements along the façade or window or cladding shall not create any rattling sound or other attention catching sounds inside. Acoustic rating values shall be calculated in accordance with BS EN ISO 717: Part 1. The façade shall provide following minimum laboratory sound insulation performance.

Façade Wall	Exterior	Octave band centre Frequency (Hz)
25		125
27		250
31		500
35		1000
34		2000
29		4000

For project noise levels shall be checked at the actual site location for proper assessment of the Acoustical Performance of façade.

3.4.3 Thermal Requirements:

The Façade System shall be designed and selected to have appropriate thermal requirements and shall not lead to excessive heat gain through the façade which may lead to the increase in the overall HVAC load requirements. The Thermal Requirement of the façade shall be as per given in ECBC latest editions or as specified or recommended by the Façade Consultant or HVAC consultant.

As per ECBC the air leakage for doors shall not exceed $2.01/\text{s.m}^2$, which may unnecessarily increase the cooling costs.

The recommended values for SHGC & U-values for Climatic conditions as described in NBC 2005 & respective values provided for the two in ECBC can be considered.

3.4.4 Air & Water Tightness Requirements:

The Façade system shall be drained joint or pressure equalized system & shall be 100% water-tight and air tight allowing no water or air to penetrate into the interior of the building. The system shall be designed such that water being drained in the system shall not cause any damage to the permanent works. The system shall not be face sealed and shall not rely on wet seals.

Sealants and gaskets which are inaccessible in the installed system shall remain effective for the service life of the system.

3.4.5 Fixing Brackets Requirements:

The façade system interference with the main structure shall be through the fixing brackets only. The brackets shall be designed in such a way that the entire load occurring on to the façade shall get directly transferred to the

main structure through the fixing brackets without causing any overstress or fatigue or damage of any components of the brackets.

The brackets shall be designed in such a way that the edge tolerance and installations tolerances shall be accommodated in it. The bracket fixing plan shall be submitted prior to installation the exact location of the reinforce location shall be coordinated with the structural drawings.

4. TOLERANCES:

The façade system and all associated components designed and allowance shall be made for the followings tolerances:

4.1 Building Tolerances:

The Façade System shall be designed to accommodate the primary structural tolerances in consultation with the project engineer or structural engineer or Façade Consultant. The maximum construction tolerances shall be following unless otherwise noted:

Façade system from the building edge	+/- 25 mm
Soffit and Slab Surface	+/- 25 mm
Vertical deviation of slab edge	< 50 mm

All these values shall be verified during the initial survey of the building before design, installation if the values are found are higher than the given, shall be bring to the notice of the project manager, Façade Consultant.

4.2 Fabrication Tolerances:

The tolerance at joints and critical junction details shall be followings:

Misalignment of surfaces	+/- 0.5 mm
Diagonals of major components	+/- 2 mm
Joint width	+/- 1 mm
Cut length of major components	+/- 0.5 mm

4.3 InstallationTolerances:

All the Façade Contract Work shall be within the following tolerances during and after the complete installation any deviation apart from the tolerances mentioned shall be considered as under quality work.

Misalignment of Levels	+/- 1 mm
Deviation in alignment	+/- 1 mm
Deviation in plumb	+/- 1 mm

5. PRODUCTS:

5.1 Aluminium:

Design, supply & Installation of aluminum sheet, extrusion of alloy of suitable grade and structural performance. The alloy and temper designation shall be as per the relevant standards and codes. The finish, durability and strength shall be as per the specification in accordance with the standards and codes. Also submit the vendor's certificate mentioning the grade, temper designation, mechanical properties specific to project forApproval

The Façade Contractor shall provide the quality certificate from the Aluminum manufacturer and ensure that the quality of aluminum is maintained through the project execution stage and get Approvals of the aluminum as well from the Façade Consultant prior to the start of project. All the aluminum products shall comply with the technical specifications laid for theproduct.

5.1.1 AluminiumExtrusions:

Design & provide aluminum extrusions of alloy of suitable grade and structural performance. The alloy and temper designation shall be as per the relevant standards and codes. The finish, durability and strength shall be as per the specification in accordance with the standards and codes. Also submit the vendors certificate mentioning the grade and temper designation for Approval. The source of Aluminum extrusions shall be Indian only. The manufacturer of Aluminum Extrusions shall be approved by the Façade Consultant.

In no case shall the use of recyclable aluminum alloys be used unless tested for the structural performance under lab conditions.

All the structural member aluminum extrusion alloys shall be of 6063 grade and temper designation shall be T6 and all non-structural member Aluminum extrusion alloys shall be of 6063 grade and temper designation shall be T5 unless specified by the Façade Consultant. The surface of the extrusions shall be suitable for PVDF, Powder Coatings, or Anodizing and same surface shall provide the uniformity of the same. No extrusion marks or undulated surface of the extrusions shall be accepted by the FaçadeConsultant.

Local thickness shall be provided in extrusion equal of twice the diameter of the screw where required to have a proper engagement of the screw in the extruded profiles and bearing of screw in the profiles and screw flutes wherever required.

The minimum wall thickness shall not be less than 2 mm and sharp radius in the profiles shall be avoided.

5.1.2 Coatings for Aluminium:

All the coatings shall comply with the specifications and not limited and shall be as per the relevant codes and standards. Coating samples needs to be approved from Façade Consultant. The Coatings shall be from Manufacturer as Approved by the Façade Consultant.

a) Powder Coating:

Powder coatings shall be sourced from India from an Approved Manufacturer and Coatings shall be done at the Approved Coating plant approved by the Powder Manufacturer.

■ Color & Finish:

Approved samples for Color, By Architect.

There shall be two sets of samples 600mm in each set. Approved shade color will be accepted for use on the project.

Surfaces to be finished shall be free from imperfections, scratches, scrapes and dents. When the finish is applied, all coatings when cured shall be visibly free of spots, stains and streaks.

■ Grade and Thickness:

External: 65 microns with minimum thickness.

b) Paint Coating (PVDF): If Applicable

Aluminum PVDF coating shall be Kynar 500 or Architect Approved Equivalent. Oven cured 3-coat system is required with 70% minimum Kynar 500 fluoropolymer resin formulated and applied in strict accordance with the manufacturer's requirements.

■ Color & Finish:

Approved samples for Color, Gloss, texture and like.

There shall be two sets of samples 600mm in each set representing both the degree of specular gloss and the lightest, median and darkest shades of that color to be accepted for use on the project.

Surfaces to be finished shall be free from imperfections, scratches, scrapes and dents. When the finish is applied, all coatings when cured shall be visibly free of spots, stains and streaks.

The paint film shall not show flow marks, crack, peel or blister for the warranty period

■ Grade and Thickness:

Unless otherwise required, paint grade and average thickness shall be:

Exposed - External: 40 microns with local thickness not less than 35 microns.

Exposed - Internal: 40 microns with local thickness not less than 25 microns.

The dry film thickness according to ASTM D1400 shall be not less than 33 microns.

The paint finish shall comply with AAMA 605.2-1980

Chalking shall not exceed No. 8 rating in accordance with ASTM D659-44

All non-exposed Aluminum shall be achromatized.

5.2 Glass:

Design, supply & Installation of glass. The designed thickness of glass shall be as per the relevant standards and codes. The type of glass shall be based upon the thermal performance of the building or as Specified by the Façade Consultant in the **Appendix-B**. The color or tint shall be approved by the Architect based on the visual checking of the samples. Provide the glass samples of 300 x 300 with all the visual and thermal performances to the Façade Consultant and Architect for Approvals.

The Façade Contractor shall provide the quality certificate from the glass manufacturer mentioning the Thermal and visual performance of the glass. The Façade Contractor shall be responsible to have a same tint and flatness of the glass in the respective façade any variation in the tint or flatness of the glass will be rejected. Also any visible distortion shall be under acceptable limits. The Façade Contractor shall provide necessary glass thickness to prevent the visible distortion from occurring.

The Façade Contractor shall be responsible to determine the structural stability of the glass as per the relevant codes under the designed loading conditions. The structural stability limitations of glass shall be as per the specifications.

The glass thickness shall not be less than as mentioned in the Appendix-B of the technical specifications.

Submit the FEA (Finite Element Analysis) computational reports suggesting the stress induced in the plane and edges of glass under full loading conditions. In any case shall not be the difference in the surface temperature of the glass surface more than 19 degrees.

The façade system shall be designed in such a way that there is minimum disturbance to the existing or local area under damaged glass replacement.

certain quantity of glass shall be always available cut to the size on size under immediate replacement of damaged glass. The quantity shall be decided by the Client and Façade Contractor under the Façade Contract Work.

5.2.1 Heat Strength and Fully Tempered Glass:

Heat strengthened glass and fully tempered glass, shall be manufactured using the process in accordance with AS 2208, ASTM 1048.

All toughened glass shall have belt arise edges. All heat strengthened glass shall have clean cut edges. Cutting and marking of glass post process is not permitted.

Surface compression stress of toughened glass shall be not less than 96.8 MPa. Roller wave distortions shall not exceed requirements for annealed glass, refer to relevant section of this specification.

100% heat soak testing will be required for all glass with edge stress exceeding 7500 psi. If same is being asked by the Facade Consultant.

5.2.2 Laminated Glass:

Laminated glass shall be in accordance with ASTM C1172 and GANA Glazing Manual. Submit details for review and Acceptance. The Interlayer Manufacturer shall be approved by the Façade Consultant.

All laminated glass shall have clean cut edges, or polished edges if required to eliminate thermal stress breakage risk. During and after installation there shall be no delamination's and discolorations of interlayer.

5.2.3 Glass Coatings:

Glass coatings shall conform to ASTM C1376 & BS EN 1096 but not limited.

Inspection shall be made at a distance of three meters from the glass for scratches and chips, viewing perpendicular to the glass plane, with any natural light for which flaws are clearly visible. All other imperfections will be viewed at a distance of 300mm.

The central area is a square or rectangle concentric with the daylight opening and having width and height respectively equal to 80 percent of the daylight opening width and height.

The outer area extends from the border of the central area to the edges of the daylight opening.

Pinhole diameter shall not exceed 0.8mm in the central area, and 1.5mm in the outer area.

Within any 300mm diameter circle, there shall be no more than one pinhole with diameter in the range 0.8mm to 1.6mm.

Scratches, rub marks or other gaps in the coating are not permitted where any portion thereof could include a circle with diameter exceeding 0.8mm. Where the included circle is 0.8mm or less, length of the scratch, rub marks or other gap shall not exceed 25mm in the central area and 75mm in the outer area.

Streaks or splotches resulting from non-uniformity of the coating that appears visible from the building interior or exterior are not permitted.

Color range must fall within the limits established by Accepted samples.

5.3 Glass Glazing Products:

Design, supply & Installation of non-cellular elastomeric profiles including gaskets, silicones, seals and other accessories required for complete installation and completion. Compatibility tests of the glazing products with the adjacent components shall be carried out prior to installations and the report submitted to the Façade Consultant. Location, grade, type, thickness, makes, size shall be clearly mentioned in the drawings but not limited.

Glazing accessories, including spacers, setting blocks, wedges, and the like, shall comply with AS 1288 & BS 6262.

Extruded profiles or glazing materials shall not cause bleeding or staining of the adjacent components and shall remain intact under the UV radiations. They shall be able to withstand temperature variations without cracking or breakage in seals.

Products may be manufactured from EPDM (ethylene-propylene-diene monomer), Neoprene, or Accepted equivalent.

5.3.1 Gaskets:

The elastomeric materials shall be made from high quality ozone resistance material and properly cured.

The cured compound shall be suitable for use where resistance to sunlight, weathering, oxidation & permanent deformation are of prime importance.

The performance gaskets shall be free from porosity, surface Defects, dimensional irregularities that may affect the serviceability.

▪ Hard profiles:

Where required or indicated, provide dense profiles including flashings, wiper seals and the like, complying with ASTM C864 & BS 4255, as follows:

Class	Hardness	Type of Profile
Shore-A	80	Solid
Shore-A	60	Hollow

Tested in accordance with ASTM D2240.

Compression set 100% (168 hrs): Not greater than 40% when tested in accordance with ASTM D395.

▪ Softprofiles:

Where required or indicated, provide soft profiles including bulb seals, sponge seals and the like, complying with ASTM C509, as follows:

Class	Hardness	Type of Profile
Shore-A	45	Bulb

Tested in accordance with ASTM D2240.

Compression set (168 hrs): 30% +/- 5% when tested in accordance with ASTM D395.

5.3.2 Setting Blocks and SideBlocks:

The Setting blocks and side blocks shall be provided at the locations indicated in the drawings and not limited to. The blocks are used to prevent the direct contact of the glass edge and the metal component. The thickness, grade, length shall comply as specified.

▪ SettingBlocks:

Where required or indicated, provide the type of setting blocks as mentioned below.

Class	Hardness	Type of Profile
Shore-A	85	Flat

Compression set (168 hrs): Not greater than 25% when tested in accordance with ASTM D395 for Approvals.

Location of setting blocks shall be quarter to distance from the support or unless otherwise mentioned but not less than 150 mm. Shims used shall be of same material as that of the setting blocks. The setting blocks shall be secured to prevent dislodgement.

Setting block length shall not be less than 80 mm and shall be designed as per BS 6262.

▪ SideBlocks:

Where required or indicated, provide the type of side blocks as mentioned below.

Class	Hardness	Type of Profile

Shore-A	60	Flat

Compression set (168 hrs): Not greater than 25% when tested in accordance with ASTM D395.

Install side block with 3 mm clearance between block and bearing surface. Block shall be of sufficient length to prevent point loading on the glass.

Side blocks are not required where glass is supported along the vertical edges with structural silicone.

Side blocks of extruded silicone may be accepted for DGUs with silicone edge seals. Neoprene or EPDM side blocks may be accepted only if recommended by the IGU manufacturer.

5.3.3 Shims:

Provide shims where necessary up to but not exceeding the limits specified on the drawings and designed for in the engineering calculations.

Shims which transfer shear forces shall be steel plates, set in a staggered pattern and fillet welded to each other and adjacent steel surfaces. Design shims and welds to support the applied loads.

Polypropylene shims may be accepted at static connections where shims transfer only compressive loads.

5.3.4 Structural Silicone:

Design and provide structural sealant glazing systems where indicated on the Drawings, or otherwise. The structural sealant shall be from the Manufacturer as Approved by the Façade Consultant.

All glazing shall be done as per the manufacturer's standards and manuals. And be tested at a regular intervals or when asked by the Façade Consultant.

Comply with minimum dimensional requirements for edge clearance, edge cover, front clearance, back clearance, and as required by AS 1288/BS6262 and as recommended by the sealant manufacturer.

▪ Structural Requirements:

Structural sealant shall be designed to resist not more than 138 kPa of tensile loads.

Structural sealant shall be designed to resist not more than 7 kPa of shear loads.

The minimum bite shall be calculated for the imposed loads and get verified by the Façade Consultant.

▪ Quality:

The glazing shall be done under the supervision of an experienced glaze

The areas of glazing shall be under proper glazing conditions as required and recommended by the manufacturer and quality check.

All the surfaces shall be properly cleaned prior to glazing.

The compatibility check of the silicon with the other materials shall be done prior to glazing.

The structural silicon shall be free from any Volatile organic compound & Façade Contractor needs to submit the certificate of amount of VOC levels from the manufacturer.

5.3.5 Weather Silicon:

Design, supply & Install elastomeric sealant joints as required or indicated by the Façade Consultant. The sealant shall be from the Manufacturer as Approved by the Façade Consultant. All required accessories recommended by sealant manufacturer, including backing rods, bond breaker tape shall be adapted during the installation wherever required.

Sealant type and installation method shall be in accordance with manufacturer's recommendations suitable to the location, function, substrates and performance requirements including movement, air infiltration, fire and acoustic requirements.

All sealants shall be of Non-satin and Non-bleeding grade and shall be compatible with the adjacent materials.

Where sealants are used to seal movement joints, movement capability of sealant shall be appropriate to expected maximum deflection or movement.

Fire-rated sealant and joint fillers where indicated or required. All fire rated products shall comply with the Relevant Indian Standards.

Fire rated fillers may include elastomeric sealants and rigid dry foam fillers.

Colored or in accordance with Accepted samples. Sealants shall be resistant to staining due to dirt or pollution, and shall be capable of cleaning.

5.3.6 Backer Rods:

Backer rods shall be silicone compatible & non-staining. The material used for backer rods shall be Polyurethane Foam. They are to be compressed to limits specified by the Manufacturer and shall be located in a manner which prevents them from dislodging from the rebate that is being sealed. The backer rods shall be supplied by Manufacturer as Approved by the Façade Consultant.

5.3.7 Tapes

Tapes shall be from Manufacturer as Approved by the Façade Consultant. They are to be silicone compatible & non-staining.

Where tapes are exposed in glazing rebates they shall be continuous and of uniform color. They shall align with the glass edge to within +/- 1mm. They shall be held by sealant or a captive edge so as to be prevented from dislodging in the event of a breakdown to the adhesivesurfaces.

Tapes (including double-sided adhesive tapes) shall not be used to permanently hold any building envelope components inposition.

Tapes are not accepted to form as a part of the permanent weather seals.

5.4 Buildinginterface:

5.4.1 SupportBrackets:

Design, Supply & Install interfacing brackets supporting façade of material and locations as provided in concept drawings and not limited, for the structural integrity of façade system. The supporting bracket shall include all fixing assemble like anchors, bolts and install work in a neat, secure manner, including bolts, washers, screws, rivets, welds, proprietary fasteners, and the like, templates and other accessories of Accepted types for a complete installation.

Brackets shall be of the type and size appropriate for the purpose and location as per the design requirements. The brackets shall be of sufficient stiffness to transfer all the imposed loads to the main structure without the failure and any undue increase ofstresses.

Brackets shall be corrosion resistant, to adjacent work.

Details of bracket fixings shall comply with the Façade Tender Drawings as well shall be properly concealed otherwise mentioned.

Detailed Calculations with shop drawings mentioning clearly the load path, load estimation, size, thickness, material, grade and spacing's shall be submitted to Façade Consultant for review & Approval.

Co-ordinate with the Main Contractor to ensure that anchorage is provided and accurately built into base-structure without delay or disruption to the Civil works. Provide set-out drawings, templates and installation instructions as required.

Ensure that all bolts and similar fixings are tight at completion of installation. All bolts, nuts, washers in any given assembly shall be of the same material. Apply an Accepted nut locking compound or device to all nuts.

5.4.2 Nut &Bolts:

- Bolts, Nuts andWashers:

All bolts, nuts and washers shall be galvanized High Strength Grade 8.8 to BS 3692, unlessspecified.

- Stainless Steel Bolts, Nuts and Washers:

Stainless steel bolts and nuts shall comply with BS 6105, strength A4, class 80. Stainless steel washers shall comply with BS1449:Pt2, Grade 316 S 31. Unless specified.

5.4.3

Anchors:

- Masonry Anchors:

Mechanical masonry anchors shall form Manufacturer as Approved by the Façade Consultant. All anchors shall be installed in accordance design requirements and Manufacturers manual. The Contractor shall be responsible for confirming that all edge distance, spacing and embedment requirements, design are satisfied. The Façade Contractor needs to submit the calculations & manufacturers manual for review & Approval.

- Expansion anchors:

Expansion anchor shall be designed to carry all the imposed loads without failure by the Contractor/Sub-Contractor and the computation to be provided for the same to the Façade Consultant for Acceptance. All the Parameters of the anchor (e.g. edge distances, spacing, etc.) shall be considered while designing. Expansion anchors shall be of the make as approved by the Façade Contractor. Stainless steel bolts and nuts shall comply with BS 6105, strength A4, class 80. Stainless steel washers shall comply with BS1449:Part-2 or relevant Indian codes, Grade 316S

301 or hot dip galvanized or unless specified. Holes drillings for expansion anchors are not permitted for PT structures unless the location of the tendons are verified from the Structural Consultant/Civil Contractor and written permission be taken onto the layout plan of the brackets from them.

Normally the expansion anchors not recommended for PT slabs due to the threat of damage to the tendons if any mistake in coordination happens.

5.5 Other Products:

5.5.1 Flashing:

Provide all required thickness of flashings, baffles, trims, copings and the like to prevent the entry of water and weather tightness, and make neat and clean junctions with the base-structure and adjoining work. Where visible, provide matching materials and finishes. Include all fixings and sealing.

All flashings shall be cut and folded to Accepted profiles out of non-corrosive materials, with protective coatings as required. Flashing shall be factory fabricated in long lengths where practical, and pre-painted on visible surfaces.

Flashing shall be of adequate stiffness to retain shape and to resist lifting by the wind. Make provision for differential movements and for separation of dissimilar materials.

Continuous flashings shall be welded or mechanically fixed to form continuous uninterrupted lengths. Corners shall be accurately scribed and mitered. If the flashing is concealed, flashing joints shall be lapped at least 100mm and sealed.

Where flashings are fitted to pre-formed rebates, co-ordinate cast-in grooves or reglets as required.

Construct weep-holes as required to enable the passage of moisture to the outside of the building. Lap and seal all flashings by Accepted methods.

Flashing thickness shall not be less than 1.5 mm.

he vent in either closed or open positions.

5.6 SteelWorks:

5.6.1 General:

Design, supply, fabrication, surface treatment, storage, delivery and erection of all the steelwork required to support the Façade System as show in the tender drawings as part of the Contractors works. This also includes the supply and installation of trims used to support the steelwork, the grouting of base plates, the provision of cleats and drilling of holes for the attachment of the cladding system, and repairs to damage surfaces during construction.

Structural steelwork shall comprise weldable structural steel to mild Steel or high yield steel, unless otherwise indicated.

Dimensions, mass, tolerances and rolling margins are to comply with the relevant Indian Standards for the following:

Hot Rolled Sections

- Universal beams, columns, tee sections and channels
- Hollow sections
- Angles
- Flats, plates, round bars and square bars

The rolling or manufacturing tolerances shall be such that the actual weight of sections does not differ from the theoretical weight by more than - 2.5% or + 2.5%. Sections of sizes or thickness outside of these specifications shall be subject to the tolerance clauses of an equivalent nominal size.

Members shall be free from twists and localized deviations from true line

- Cold Formed Sections

Dimensions, mass, tolerance of cold rolled sections to be in accordance with Indian standards. Cold rolled sections are not permitted unless specifically nominated on the Engineer's drawings.

5.6.2 Storage:

The storage of the steel members (tubular sections) shall be such that so as to prevent the way-in of water into the tube which may cause initiate rusting of members. The steel members shall be placed in dry conditions as far as possible and the stacking shall be such that it shall not cause twisting or damage to the profile of themembers.

5.6.3 Fabrication:

Fabrication of the steel work shall be done as per the relevant standards. All the members shall be factory cut & fabricated to size with tolerance for site installations no gas cutting is permitted. All the end plates shall be designed to the loadings. The edges of the profiles shall be cleaned and grinded after cut so as to have a smooth surface for joinery. The joinery shall be as smooth as possible for perfect joinery of the members filler weld is recommended. Members shall be market mentioning their length and locations as per the bar chart drawings for installation.

No variation of the number, type or position of the joints or connections shown on the approved drawings shall be made without the consent of the Façade Consultant.

Contractor shall make sure to do accurate site survey prior to installation and incorporate all the site variations in the drawings.

Members shall be cut accurate to the dimensions mentioned in drawings to achieve proper connections.

Holes in plates shall be as per the drawings no adjustment in the hole will be permitted on site. The holes shall be twice the diameter of the designed anchor and bolts. Where site adjustment is required for alignment of the steel work oblong holes shall be used which need to tack welded to plate to the desired locations. No gas cuttings for holes are permitted it needs and shall be drilled only.

5.6.4 Welding:

All welding of structural steel shall comply with Indian standards as mentioned in the Appendix D. welding consumables used in fusion welding. Welding consumables used in metal arc welding of austenitic stainless steel.

Welding consumables and the procedures used shall ensure that the mechanical properties of the deposited weld metal shall not be less than the parent metals.

Surfaces must be dry. Warm the surfaces if required to remove condensation.

Remove welding slag by chipping before depositing subsequent runs. Tack welding may only be used with express approval. Tack welds to be minimum 50mm long.

Butt welds shall be full penetration welds between prepared fusion faces, unless otherwise specified. Carry out back chipping, grinding or gouging of the deposited weld as required to obviate imperfections in the root run. Grind butt welds flush without loss of parent metal.

Deposit fillet welds to the required length, throat thickness and with partial or full penetration as specified.

The type & thickness of weld shall be designed as per the loading conditions as submitted for review and Approval

5.6.5 Protective Coatings:

All steelwork is to be provided with a protective coating system with a 25 year minimum design life. The coatings shall be provided over the full surface area of steelwork. Exposed edges and site weld areas are to be coated with an Accepted coating system for site applications. Protective coatings are to be as outlined below for normal internal and external applications. For more aggressive environments, higher performance paint systems shall be used.

- Exposed Steelwork:
 - Primer Coat:
2-coats of epoxy zinc phosphate primer, minimum thickness 70 microns.
 - Finish Coat:
2-coats of high build polyurethane, minimum thickness 100 microns. To be applied in two 50 micron layers.

Paint samples, technical catalogues and Manufacturer's Application Procedures shall be submitted for Acceptance before commencement of paint application. The application of coat shall be done as per the recommendations of the Manufacturer.

- Concealed Steelwork:

Internal steelwork shall be Hot Dip Galvanized with a minimum dry film thickness of 70 microns.

The steelwork shall be chemically descaled and cleaned, so that rust, mill scale, oil, grease and other foreign matter are removed immediately prior to galvanizing. Tubular sections are to have bleed holes as necessary. The size and location of bleed holes is to be shown on shop drawings.

The contractor shall ensure the steelwork does not distort as a result of galvanizing. The size of components, preheating requirements, and dipping method are to be reviewed to achieve minimal distortion and maintain steelwork Tolerances.

Hot dip galvanizing shall be carried out in accordance relevant Indian standards

Following galvanizing, the steelwork is to be left to cure for 48 hours before transportation to site.

All abrasions site welds etc are to be repaired by grinding (wire brushing) the surface back to a sound substrate and batch coating with an inorganic zinc silicate primer equivalent in quality to 110 micrometers dry film thickness of Dimetcote 6.

5.6.6 Safety Considerations:

The Contractor/Subcontractor shall take full responsibility for the Safety and Stability of the steelwork during erection and until such time as it is finally completed and handed over, must take all precautions including temporary bracings necessary to ensure stability of the partially assembled structure against wind forces, and those stresses exerted due to erection equipment and its operation tending to distort or deform the framework.

The Contractor/Subcontractor shall adopt an erection procedure such that all members can be placed and fixed in position without distortion

The Contractor/Subcontractor shall allow for the cost of temporary erection bracing required and any professional advice required in connection with such bracing.

As each section of steel is erected, all members shall be line, levelled and plumbed before final bolting up or welding commences. The ties, jacks braces, etc, used in lining, levelling and plumbing the steelwork shall be left in position until all bolts have been finally tightened.

5.6.7 Stainless Steel: If Applicable

Provide all stainless steel in the required profiles, finishes, sizes and grades.

Stainless steel shall be of Grade 304 or 316. Grade 302 shall not be used. Structural applications and all exposed stainless steel works shall be Grade 316.

Unless otherwise indicated on Drawings, exposed stainless steel shall be finished to match Accepted samples.

Grain shall be vertical in all locations, unless otherwise indicated on the Drawings.

Flatness of Architectural stainless steel shall be not less than "stretcher level" grade. Submit manufacturer's specifications.

Where indicated on the Drawings to be colour finished, stainless steel be colour treated by an Accepted permanent process to match Accepted colour samples. Submit details.

Submit certificate of compliance or test report and properly identify each batch of stainless steel in accordance with the relevant Standard.



5.6.8 Installation:

The site installations shall be done as per the installation drawings. All the members shall be lined, levelled & positioned to the designed location prior to bolting or welding. In case of bolt connections temporary bolt positioning bolts shall be used prior to the final adjustment and fixing of desired no of bolts. Tack weld shall be used for positioning of members prior to final welding.

Site fabrication of members shall not be permitted. All members shall be cut to size from factory only.

6. FABRICATION:

The fabrication shall be in accordance with the technical specifications and relevant codes and standards and not limited. The fabrication of the façade components shall be done under the strict quality control. The fabricated components shall be marked, packed and transported to the site. The fabrication drawings shall be done after the acceptance of the shop drawings by the Façade Consultant and complete and proper site survey.

6.1.1 Aluminium fabrication:

Tolerances at joints and junctions shall take precedence over tolerances for components or assemblies.

Submit a schedule of fabrication tolerances for all major cladding system components for review and Acceptance. Indicate extremes of allowable base-structure tolerances on shop drawings.

Provide holes and connections for site assembly and to accommodate work of others as required. Holes shall be drilled, or punched and reamed, perpendicular to the surface.

Provide suitable clear marking to enable correct setting out, and installation. Marking shall be of a type that can be removed with water or solvents after assembly. Markings should be positioned on unexposed surfaces where possible.

Where two or more sections of aluminum are used in built-up members, contact surfaces shall be smooth, true and even, and secured so that the joints are tight without the use of filling materials.

Steel reinforcement of aluminum members shall be completely enclosed and separated from aluminum. Steel reinforcement to be hot dip galvanized. Submit details for review and Acceptance.

Glazing rebates shall be of adequate size to hold the weight and size of glass required, with necessary clearances and tolerances, and to withstand the specified loading.

Where required, provide snap-on cover-strips to secure glass. Meeting corners of cover-strips shall be mitered. Cover-strips shall exclude water in driving rain conditions.



Moving parts shall operate freely and smoothly, without binding or sticking, at correct tensions or operating forces, lubricated where appropriate.

Protect finished aluminum surfaces to prevent damage during transportation, storage, installation, and until the completion of the subcontract works.

Provide factory applied protective film, tape or coatings which will not bond to the aluminum surfaces when exposed to sunlight or weather.

6.2 Aluminium Frame Assembly:

Fabricate aluminum in accordance with Accepted shop drawings and prototypes.

Cut edges, drilled holes, riveted joints and flat sheets shall be clean, neat, and free from burrs and indentations. Remove sharp edges without excessive rounding off or chamfering.

6.2.1 Joints and junctions:

All visible joints shall be fixed by concealed means, unless otherwise indicated on the shop drawings or Approved in writing.

Fit exposed joints accurately to provide close continuous contact to a fine hairline. Ensure continuity of finish colour and texture without surface variations at joints.

Make junctions with concealed mechanical connectors so that no fixings, pins, screws, pressure indentations and the like are visible on exposed faces.

Sections shall be sized to eliminate edge projection or misalignment at joints.
Where required, joints shall be watertight and weather tight.

Joints between fabricated assemblies may be concealed with suitable aluminium extruded covers or clip-ons.

7. EXECUTION:

Start of installation will be considered as complete acceptance of site conditions, including acceptance of reference lines and marks, and embedment in base-structure by the Contractor/Sub-Contractor. No excuse pertaining to the site conditions shall be considered as a cause of delay in the project.

Detailed site inspection during design period shall be done and any site variation shall be communicated to the employer and the Façade Consultant in writing and Approval for the same taken which may be required for designing.

7.1 Installation Tolerances:

Comply with manufacturer's recommendations and install work within the tolerances given in Section 4



7.2 Sealant Installation:

Prepare joints and install all sealants strictly in accordance with sealant manufacturer's recommendations and Accepted shop drawings.

Comply with the sealant manufacturer's recommendations regarding surface preparation, priming, pot-life, sealant bead application, and the acceptable range in surface temperature at time of application and for a period at least eight hours following sealant application.

Joints shall be prepared and sealed on the same working day.

7.2.1 Cleaning:

Clean joint surfaces immediately before installation of backing rod and again before applying the sealant as recommended by sealant manufacturer. Remove all foreign matter such as dust, oil, grease, dirt, laitance, insecure coatings, moisture and other substances which could interfere with bond of sealant.

Remove protective tape or removable films and ensure that no residue remains.

Joint areas to be protected with masking shall be cleaned before application of tape or film.

7.2.2 Glass and aluminium:

Cleaning compounds shall be applied with clean lint-free cloths. A two-wipe method of application shall be employed, where one cloth is used to wipe the surface dry and clean, and the second is used to apply the cleaning compound. The cleaning compound shall not be allowed to air-dry on the substrate.

7.2.3 Priming, etching and sealing:

Prime or seal joint surfaces where recommended by sealant manufacturer. Do not allow primer/sealer to spill or migrate onto adjoining surfaces. Areas adjacent to joints to be sealed shall be protected where there is a likelihood that contamination by cleaning compound, primer or sealant could occur.

If recommended by the sealant manufacturer, roughen surfaces to remove protective coatings or imperfections which may prohibit provision of clean, sound base surface for sealant adhesion.

7.3 Installation of sealant accessories:

7.3.1 Backer rod:

Install sealant backer rod for sealants, except where otherwise indicated, or not recommended by sealant manufacturer, at a proper depth to provide sealant bead profiles indicated on Approved shop drawings. Backer rods shall be an accepted non gassing type.

7.3.2 Sealant proportions:

Install sealant to depths as recommended by the sealant manufacturer and indicated on the Accepted shop drawings.

Provide elastomeric sealant of depth not greater than the joint width and not less than half the joint width or 6 mm, whichever is the greater.

7.3.3 Installation of sealants:

Install sealants during ambient temperature and humidity conditions recommended by the manufacturer.

Employ only proven installation techniques which will ensure that sealants are deposited in uniform, continuous ribbons without gaps or air pockets, and with complete "wetting" of joint surfaces equally on opposite sides.

Unless otherwise indicated on the Accepted shop drawings, fill vertical joints to a slightly concave surface, slightly below adjoining surfaces, and fill horizontal joints to a slightly convex profile, so that joint will not trap moisture and dirt.

Apply sealant under pressure using a hand or power actuated gun or other appropriate means. The application tools shall have nozzles of size and shape as necessary to ensure that sealant beads are formed to the designed profiles. The surface of each joint shall be tooled so as to ensure the formation of a compacted bead, free from cavities and flow irregularities. A lubricant (tooling aid) shall not be used unless the use of such a compound is expressly approved by the relevant manufacturer.

Remove excess sealant and leave surfaces neat, smooth and clean, without smears on surrounding work. Tool joints where recommended by manufacturer or required. Remove all cartons and debris from site as the work progresses.

Remove any masking material immediately application of sealant bead is complete and "clean-down" adjacent surfaces as work progresses. All finished work shall be left in a neat clean condition.

Provide weep holes where indicated or required.

7.4 Façade Installation:

Install the façade system in accordance with shop drawings and prototypes to comply with all performance requirements, Codes and Standards and the requirements of the relevant Regulatory Authorities.

Install the facade system plumb, level and true to line within required tolerances, and suitably anchored to the base-structure.

7.4.1 Loads:

Ensure that no loads from, due to or generated by the base-structure are transferred to the cladding system, including loads resulting from short or long term structural deflection or shortening of slabs or beams.

7.4.2 Trim:

Install all required flashings, trim and seals to ensure the finished work are weatherproof and waterproof.

7.4.3 Sitemodifications:

Finished work which contains unauthorized site modifications, or work not in accordance with the Accepted shop drawings, may be required to be removed and replaced.

Unauthorized work may be Approved subject to additional computations and testing at the Consultants sole discretion. If requested, carry out and pay for all such testing, and submit all computations, test results and any other information required.

7.4.4 Stagedcompletion:

Façade shall be installed in an orderly sequence. Where practical, facade shall be completed and closed off on a floor-by-floor basis.

Provide temporary flashings at completion of each stage to waterproof and weatherproof the enclosed work. Remove temporary flashing before proceeding with subsequent work.

Sections of façade which are left open for any reason shall be designed in accordance with the design wind serviceability load with an allowance for wind funneling through the base-structure.

7.4.5 Hardware:

Install all hardware and accessories including but not limited to latches, locks, openers and remote controllers.

Fit insect screens where supplied.

Opening units shall be checked to ensure that operation is full, free and smooth, and that all operable hardware, locks and controllers are operating properly and smoothly.

7.4.6 Exposedsealants:

Exposed sealants will not be accepted, except where indicated on Accepted shop drawings.

7.4.7 Temporarymarking:



Provide temporary marking of glass (if necessary). Use a soluble marking compound and remove all traces on completion. Do not use lime or advertising stickers.

7.5 Protection & Cleaning:

7.5.1 Progressive cleaning:

Clean the work area and progressively remove debris, waste, excess materials and the like from the work area on a daily basis and maintain the works areas allocated for this contract in a state of cleanliness at all times.

7.5.2 Field Testing:

Field testing needs to be carried out by the Façade Contractor in presence of representative form Façade Consultant/Architect or Owner in accordance with AAMA 501.2.83 prior to handover to check any defects incurred during installation.

7.5.3 Final cleaning:

At completion of installation, clean the work area thoroughly and clean the interior and exterior of the finished work to remove all marks, soiling, stains and the like. Exterior final clean should include a pre-rinse water spray to remove any abrasive particles prior to the use of T-bars for cleaning with mild detergent solution.

Finished work shall be free from defects and mechanical imperfections such as scratches, scrapes, dents, and abrasion.

7.5.4 Adjacent work by others:

At the completion of all adjacent work by others, including services work, attend the Site, inspect the work areas generally, and repair all damage, complete or make good finishing, trimming and sealing, and replace any damaged or dislodged work.

7.5.5 Handover:

At completion of installation, commission, test and adjust as required, all manual and mechanical operating components in all functional modes.

7.5.6 Architectural finishes:

At completion of installation, wrap or cover Architectural finishes to avoid soiling, damage, or wear and tear during subsequent building activities. Otherwise, clean and maintain finished work as frequently as necessary through-out remainder of construction period. Protection shall be designed for removal without damage to finished surfaces.

7.5.7 Glass:

Remove and replace glass which is broken, cracked, abraded, chipped, scratched, etched, stained, or damaged in other ways before or during installation.

7.6 FieldTesting:

General Field Water Testing per AAMA-501.2-83:

- a) Field water testing shall be carried out periodically during the facade installation. This is to ensure that leaks are identified and repaired prior to installation of internal linings and finishes.
- b) Each test shall cover an area of not less than 30sqm and not less than 5 linear m of work.
- c) The tests shall be included in the Testing program by the Façade Subcontractor, with specific locations as selected by the Consultant.
- d) Should problems arise during any of the above testing, the Consultant may instruct that further testing be carried out at no additional costs. Locations and times shall be nominated by the Consultant.
- e) Water Testing of Flashings, EPDM Closures, and Other Interfaces: Field water testing shall be carried out periodically during the facade installation. This is to ensure that leaks are identified and repaired prior to installation of internal linings and finishes.

8. WARRANTY:

The Contractor/Sub-Contractor shall be responsible for and warrant for the warranty period of 10 years all functional and performance design requirements of the complete building All envelope systems, including all relevant testing. Glass processing warranty for minimum period of 10 years.

Provide a warranty for materials and workmanship of the building envelope from Date of Completion of the subcontract works for a period of 10 years. Provide all manufacturers' product warranties. Also provide a warranty to cover all the costs of materials, labour and equipment to remove any defective components of the building envelope and replace them. This warranty shall also cover the costs associated with removing and replacing internal finishes trims and services so that remedial works can be carried out. The content of each warranty shall be Accepted and Endorsed.

8.1 Accessories:

All products shall be warranted for the warranty period. The warranty shall include specific provisions and terms for failure of, or due to, the following:

- Cracking due to any reason.
- Sustaining growth of mildew, mould, fungi and the like.
- Excessive discolouration due to exposure to sunlight and weathering.
- Excessive deformation under load.
- Excessive ageing, detrimental increase in hardness or change in tensile strength and elongation more than allowable under ASTM C864.

8.2 Sealants:

All sealants shall be warranted for the warranty period for failure of, or due to, the following:

- Cohesion and adhesion.
- Change in hardness by more than ± 5 points on the Shore A durometer scale.
- Fade or change in colour by more than five Hunter Colour Difference Units as measured by any spectrometer or colorimeter in accordance with ASTM D 2244 on an exposed coated surface which has been cleaned of external deposits with clear water and a soft cloth.
- Stain due to corrosion or bleeding of sealant.

8.3 Coatings

All preparation and coating work shall be warranted for the warranty period. Works shall be warranted against fading or colour change in excess of 5 NBS units when calculated from measurements on spectrophotometer or colorimeter capable of colour measurement by reflectance readings in accordance with ASTM D3344-90.

Works shall also be warranted against chalking in excess of #8 chalk rating when measured in accordance with ASTM D659-74.

9. APPENDIX-A :SAMPLE SUBMISSION FORMAT :

The Contractor shall submit the samples in the format as mentioned below:

For Glass Sample:

Name of the Vendor:		Date of Submission:	
Product:		Manufacturer:	
Item Code:		Type of glass	
Tint of Glass		Coating if any	
Glass thickness		Refractive	
Strengthening Process:		Type of Coating	
Thermal Properties		Visual Properties	

For Coating:

Name of the Vendor:		Date of Submission:	
Product:		Manufacturer:	
Item Code:		Type of Coating	

Coating Thickness

For Extrusions:

Name of the Vendor:		Date of Submission:	
Product:		Extruder:	
Item Code:			
Alloy Type:			

For Hardware:

Name of the Vendor:		Date of Submission:	
Product:		List of items:	
Item Code:			
Type:	PROPERTIES		

General Requirements:	
Façade system	
Glass Type	
Glass Thickness	
Glass Make	

Thermal Performance		Visual Performance		
Solar Factor(SF)	U-Value(W/m ² /°K)	Internal Reflection	External Reflection	Visible Light Transmission

11. APPENDIX-C:APPROVED VENDORS LIST

- Kindly Refer Technical Qualification Sheet

12. APPENDIX-D:LIST OF STANDARDS

(a) Indian Standards

- NBC – 2005: Bureau of Indian Standards, the National Building Code of India,
- IS: 875(Part 1) -1987: Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures - Unit Weights
- IS: 875(Part 2) -1987: Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures – Imposed Loads
- IS: 875(Part 3) -1987: Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures - Wind Loads
- IS: 875(Part 5) -1987: Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures – Special Loads and Load



Combinations

- IS: 800 – 1984: Code of Practice for General Building in Steel
- IS: 1893(Part-1) – 2002: Indian standard criteria for Earthquake Resistant Design of Structures (Part-1 General provisions and

Buildings) Fifth Revision.

- IS: 808 – 1989: Dimensions for hot rolled steel beams, columns, channels and angle sections.
- IS: 801 – 1975: Code of practice for use of cold formed section light gauge steel structural member's in general building construction.
- IS: 2062: Hot Rolled Low, Medium and High Tensile Structural Steel
- IS: 816: Code of practice for use of metal arc welding for general construction in mild steel
- IS: 3757: Specification for High Strength Structural Bolts
- IS: 3139: Dimensions for screw threads for bolts and nuts (dia range M42 to M150) [covered in IS 4218: Part 5]
- IS: 2016: Specification for Plain Washers
- IS: 4000: Code of practice for high strength bolts in steel structures
- IS: 1477: Code of Practice for Painting of Ferrous Metals in Buildings and Allied Finishes
- IS: 806: Code of Practice for Use of Steel Tubes in General Building Construction.
- IS: 7215: Tolerances for Fabrication of Steel Structures.
- IS: 1161: Steel Tubes for Structural Purposes – Specification
- IS: 811: Cold formed light gauge structural steel sections
- IS: 6610: Specification for Heavy Washers for Steel Structures
- IS: 12843: Tolerances for erection of steel structures
- IS: 8147: Code of Practice for Use of aluminium alloys in structures.

(b) American Standards:

• ASTM A743	Stainless Steel Castings
• ASTM A744	Stainless Steel Castings
• ASTM C509	Specification for Cellular Elastomeric Pre- Formed Gasket and Sealing Material
• ASTM C794	Test Methods for Adhesion – in Peel of Elastomeric Joint Sealants
• TT-S-0227E	Sealing Compound Elastomeric Type, Multi- Component (US Federal Interim Specification Board).
• ASTM D523	Test Method for Specular Gloss
• ASTM D4214	Test Method for Evaluating Degree of Chalking of Exterior Paint Films
• ASTM D714	Test Method for Evaluating Degree of Blistering of Paints
• ASTM D968	Test Method for Abrasion Resistance of Organic Coatings by the Falling Abrasive Tester
• ASTM D1654	Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
• ASTM D2244	Method for Instrumental Evaluation of Colour Differences of Opaque Materials
• ASTM D2247	Method for Testing Coated Metal Specimens at 100% Relative Humidity
• ASTM D3363	Test Method for Film Hardness by Pencil
• ASTM G23	Recommended Practice for Operating Light and Water Resistant Exposure Apparatus (Carbon Arc Type) for Exposure of Non-Metallic

Materials.

- AAMA2604 Voluntary Specification, Performance **Requirements and Test Procedures for High Performance Organic Coatings on Aluminium Extrusions and Panels.**
- AAMA2605 Voluntary Specification, Performance **Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminium Extrusions and Panels.**
- ASTM E283 Test Method for Rate of Air Leakage through **Exterior Windows, Curtain Walls and Doors.**
- ASTM E330 Test Method for Structural Performance of **Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.**
- ASTM E331 Standard Test Method for Water Penetration of **Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.**
- ASTM E547 Test Method for Water Penetration of **Exterior Windows, Curtain Walls and Doors by Cyclic Static Air Pressure Differential.**
- AAMA501.1 Standard Test Method for **Exterior Windows, Curtain Walls and Doors for Water Penetration using Dynamic Pressure.**
- AAMA501.2 Specification for Field Testing of Metal **Curtain Walls: Field Check of Water Penetration through Installed Exterior Windows, Curtain Walls and Doors by Uniform Air Pressure Difference.**
- AAMA2604-02 Voluntary Specification, Performance **Requirements and Test Procedures for High Performance Organic Coatings on aluminium Extrusions and Panels.**
- AAMA2605-02 Voluntary Specification, Performance **Requirements and Test Procedures for High Performance Organic Coatings on aluminium Extrusions and Panels.**

(c) British Standards:

- BS6399.1 Code of Practice for Dead and Imposed Loads
- BS6399.2 Code of Practice for Wind Loads
- BS5588 Fire Precautions in Design, Construction and **Use of Building**
- BS5588 Part 3: 1983 Code of Practice for Office Buildings
- BS5750 Quality Systems
- BS7543 Guide to the Durability of Buildings and **Building Elements, Products and Components**
- BS EN288 Specification and Approval of Welding **Procedures for Metallic Materials**
- BS4870 Specification for Automatic Fusion Welding of **Materials, Including Welding Operator Approval**
- BS4871 Specification for Testing of Welders Working to **Accepted Welding Procedures**
- BS3019 TIG Welding
- BS3571 MIG Welding
- BS EN287 Approval Testing of Welders for Fusion Welding

• BS7475	Specification for Fusion Welding of Austenitic Stainless Steel
• BS8118	Structural Use of Aluminium (British Standard)
• BS5950	Structural Use of Steel in Buildings
• BS7613	Specification for Hot Rolled Quenched and Tempered Weldable Structural Steel Plates
• BS7668	Specification for Weldable Structural Steels. Hot Finished Structural Hollow Sections in Weather Resistant Steel
• BSEN10029	Specification for Tolerance on Dimensions, Shape and Mass for Hot Rolled Steel Plates 3mm Thick and Above
• BSEN10113	Hot-Rolled Products in Weldable Fine Grain Structural Steel
• BS2994	Specification for Cold Rolled Steel Sections
• BS4848	Hot Rolled Structural Steel Sections
• BS5950.5	Code of Practice for Design of Cold-Formed Steel Sections
• BS729	Specification for Hot-Dip Galvanised Coatings on Iron and Steel Articles
• BS1449.2	Specification for Stainless and Heat-Resisting Steel Plate, Sheet, Strip
• BS6105	Specification for Corrosion Resistant Stainless Steel Fasteners
• BSEN485	Aluminium and Aluminium Alloys. Sheet Strip and Plate.
• BSEN515	Aluminium and Aluminium Alloys. Wrought Products. Temper Designations.
• BSEN573	Aluminium and Alum. Alloys. Chemical Composition and Form of Wrought Products.
• BS1474	Specification for Wrought Aluminium and Aluminium Alloys for General Engineering purposes: Bars, Extruded Round Tubes and Sections.
• BS1706	Method for Specifying Electroplated Coatings of Zinc and Cadmium on Iron and Steel AMD 6731, May 1991 (Gr O).
• BS2569	Specifications for Sprayed Metal Coatings
• BSEN22063	Metallic and Other Inorganic Coatings. Thermal Spraying. Zinc, Aluminium and Other Alloys.
• BSEN10143	Continuously Hot Dip Metal Coated Steel Sheet and Strip. Tolerances on Dimension and Shape.
• BS4190	Specification for ISO Metric Black Hexagon Bolts, Screws and Nuts.
• BS6338	Specifications for Chromate Conversion Coatings on Electroplated Zinc and Cadmium Coatings.
• BS3100	Steel Castings for General Engineering Purposes
• BS952	Glass for Glazing
• BS5889	One-Part Gun Grade Silicone-Based Seals
• BS6206	Specification for Impact Performance Requirements for Flat Safety Glass and Safety Plastics for Use in Building



- BS6262 Code of Practice for Glazing for Buildings
 - BS6375 Performance of Windows
 - CP153 Code of Practice for Windows and Roof-Lights
- (British Standard)**
- BS4254 Specification for Two-Part Polysulphide Based
- Sealants**
- BS4255 Rubber Used in Pre-Formed Gaskets for
- Weather Exclusion From Buildings.**
- BS4255 Part 1: Specification for Non-Cellular Gaskets
 - BS5215 Specification for One-Part Gun Grade Polysulphide Based Sealants.
 - BS476 Fire tests on Building Materials and Structures.
 - CP3012 Code of Practice for Cleaning and Preparation of
- Metal Surfaces**
- BSEN12373-1 Specification for Anodised Aluminium
 - BS6161 Methods for Testing Anodised Aluminium
- Finishes**
- BS5493 Code of Practice for Protective Coating of Iron
- and Steel Structures against Corrosion**
- BS6496 Specification for Powder Organic Coatings for
- Application to Aluminium**
- BS4842 Specification for Liquid Organic Coatings for
- Application to Aluminium Alloy Extrusions, Sheet, and Pre-Formed Sections for External Architectural Purposes, and for the Finish on Aluminium Alloy Extrusions, Sheet and Pre-Formed Sections Coated With Liquid Organic Coatings.**
- BS5411 Method of Test for Metallic and Related Coatings.
 - BS6161 Part 8: Determination of the Fastness to
- Ultraviolet Light of Coloured Anodic Oxide Coatings**
- BS6497 Specification for Powder Organic Coatings for
- Application and Stoving to Hot-Dip Galvanised Hot-Rolled Steel Sections and Pre-Formed Steel Sheet for Windows and Associated External Architectural Purposes and for the Finish on Galvanised Steel Sections and Pre-Formed Sheet Coated with Powder Organic Coatings.**
- BS6651 Code of Practice for the Protection



of Structures

Against Lightning

(d) Australian Standard

- AS/NZS 1288 and Installation.

Glass in Buildings – Selection



**TECHNICAL SPECIFICATIONS
FOR
PLUMBING WORK**



GENERAL TECHNICAL SPECIFICATION FOR PLUMBINGWORK

1.0 GENERAL:

- 1.1 The work shall be carried out in the accordance with the drawings and design as would be issued to the Contractor by the Design Consultant duly signed and stamped by him. The Contractor shall not take cognizance of any drawings, designs, specifications etc. **not** bearing Design Consultant signature and stamp. Similarly the Contractor shall not take cognizance of instructions given by any other Authority except the instructions given by the Client's Representative in writing.
- 1.2 The work shall be executed and measured as per metric dimensions given in the Bill of Quantities, drawings etc.
- 1.3 The Contractor shall acquaint himself fully with the partial provisions for supports that may or may not be available in the structure and if are available then utilize them to the extent possible. In any case the Contractor shall provide all the supports regardless of provisions that they have been already made. Nothing extra shall be payable for situations where insert plates (for supports) are not available or are not useful.
- 1.4 Shop coats of paint that may be damaged during shipment or erection shall be cleaned off with mineral spirits, wire brushed and spot primed over the affected areas, then coated with paint to match the finish over the adjoining shop painted surface.
- 1.5 The Contractor shall protect / handle the material carefully and if any damage occurs while handling by the Contractor then the sole responsibility shall be of the Contractor. Such damages shall be rectified/recovered by the Contractor at no extra cost whatsoever.
- 1.6 The Contractor shall, within twenty one (21) days of receipt of the Notice of Award for the Project, where applicable, complete the submission of shop drawings to the Client's Representative for approval by the Design Consultants in order to conform to the contract schedule.
- 1.7 MEASUREMENTS:

All measurements shall be taken in accordance with relevant IS codes, unless otherwise specified.

2.0 APPLICABLE CODES AND STANDARDS:

All equipment, supply, erection, testing and commissioning shall comply with the requirements of Indian Standards and code of practice given below as amended up to the date of submission of Tender. All equipment and material being supplied shall meet the requirements of BIS and other relevant standard and codes.

Plumbing Works:

Vitreous Chinaware	- IS: 2556 - 1974 (Part - I) -IS: 2556 - 1981 (Part - II) -IS: 2556 - 2556 (Part - III)
Ball Valve	-IS: 1703 - 1977
Cistern Brackets	-IS: 775 - 1970
Toilet Seat Cover	-IS: 2548 - 1983
Vitreous China Cistern	-IS: 2326 - 1987
Sand Cast Iron Pipes and Fittings	-IS: 1729 - 1979



Spun Cast Iron Pipes and Fittings	-IS: 3989 - 1984
GI Pipes	-IS: 1239 - 1979
Galvanizing for GI Pipes	-IS: 4736 - 1986
Pipe Threads	-IS: 554 - 1985
Malleable Iron Fittings	-IS: 1879 - 1987
Cast Iron Sluice Valves	-IS: 780 - 1984
Full Way Valves	-IS: 778 - 1984
Brass Ferrule	-IS: 2692 - 1978
Stone Ware Gully Trap	-IS: 651 - 1980
RCC Pipes	-IS: 458 - 1971
Cast Iron Class LA Pipes	-IS: 1536 - 1989
Cast (Spun) Iron Fittings	-IS: 1538 - 1976
Pig Lead	-IS: 782 - 1966
Induction Motors	-IS: 4691
Code for Measurements	-IS: 1200
UPVC Pipes and Fittings	-IS: 4984
Specification for Caulking Lead	-IS: 782
Code of Practice for laying of concrete	-IS: 783

3.0 QUALITY ASSURANCE AND QUALITY CONTROL:

- 3.1 The work shall conform to high standard of design and workmanship, shall be structurally sound and aesthetically pleasing. Quality standards prescribed shall form the backbone for the quality assurance and quality control system.
- 3.2 At the site, the Contractor shall arrange the materials and their stacking/ storage in appropriate manner to ensure the quality. Contractor shall provide equipment and manpower to test continuously the quality of material, assemblies etc. as directed by the Client's Representative. The test shall be conducted continuously and the result of tests maintained. In addition the Contractor shall keep appropriate tools and equipment for checking alignments, levels, slopes and evenness of surface.
- 3.3 The Client's Representative shall be free to carry out such tests as may be decided by him at his sole direction, from time to time, in addition to those specified in this Document. The Contractor shall provide the samples and labour for collecting the samples. Nothing extra shall be payable to the Contractor for samples or for the collection of the samples.
- 3.4 The test shall be conducted at Standard Laboratory selected by Client's Representative. Contractor shall keep the necessary testing equipment such as hydraulic testing machine, smoke testing machine, gauges and other necessary equipment required.
- 3.5 The Client's Representative shall transport the samples to the laboratory.
- 3.6 Testing charges shall be borne by the Client's Representative.
- 3.7 Testing may be witnessed by the Contractor or his Authorised Representative. Whether witnessed by the Contractor or not, the test results shall be binding on the Contractor.

4.0 SANITARY FIXTURES & C.P. FITTINGS:

4.1 SCOPE

- 4.1.1 Work under this section shall consist of transportation, furnishing, installation, testing and commissioning and all labour as necessary as required to completely install all



sanitary fixtures, brass and chromium plated fittings and accessories as required by the drawings and specified hereinafter or given in the Bill of Quantities.

4.2 GENERAL REQUIREMENTS

- 4.2.1 All fixtures and fittings shall be fixed with all such accessories as are required to complete the item in working condition whether specifically mentioned or not in the Bill of Quantities, specifications, drawings or not.
- 4.2.2 All fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per architectural design requirements. Wherever necessary the fittings shall be centered to dimensions and pattern desired.
- 4.2.3 Fixing screws shall be half round head chromium plated brass with C.P. washers wherever required as per directions of Client's Representative.
- 4.2.4 All fittings and fixtures shall be fixed in a neat workmanlike manner true to levels and heights shown on the drawings & in accordance with the manufacturer's recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, wall or ceiling surfaces shall be made good at Contractor's cost.
- 4.2.5 All fixtures of the similar materials shall be by the same manufacturers.
- 4.2.6 All fitting shall be of the chromium plated materials.
- 4.2.7 Without restricting to the generally of the foregoing the sanitary fixtures shall include all sanitary fixtures, C.P. fittings and accessories etc. necessary and required for the building.
- 4.2.8 Whether specifically mentioned or not all fixtures and appliances shall be provided with approved fixing devices, nuts, bolts, screws, and hangers as required. These supports shall have the necessary adjustment to allow for irregularities in the building area construction.
- 4.2.9 For the installation of the CP fittings, Teflon tape shall be used.

4.3 EUROPEAN W.C.

- 4.3.1 European W.C. of glazed vitreous china shall be wash down, single or double symphonic type, floor or wall mounted set, flushed by means of flush valve as specified in Bill of Quantities. Flush pipe / bend shall be connected to the W.C. by means of suitable rubber adopter. Wall hung W.C. shall be supported by C.I. floor mounted chair.
- 4.3.2 Each W.C. seat cover shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C. Seat cover shall be of white solid plastic, elongated open front with heavy duty hinges. Exposed fixture trims shall be Chrome plated, and trims of similar function shall be by the same manufacturer.
- 4.3.3 Flush valves shall be of the best approved quality procurable with C.P. control valve and C.P. flush pipe.
- 4.3.4 The flush pipe/bend shall be connected to the WC by means of a suitable rubber adopter.
- 4.3.5 Alternatively if flushing cistern to be used shall conform to the requirements of IS: 774-



1971. High level cisterns shall be of cast iron unless otherwise specified. Low level cistern shall be of the same material as the water closet or as instructed by the Owner/Architect/ Consultant. The cisterns shall be mosquito proof & shall fulfill the requirements of the local Authority.

- 4.3.6 The levels of the WC should be checked by placing spirit level on the W.C. W.C. should be tested on completion of fixing by putting small paper balls and flushing out. If all the paper balls are not flushed out. The fixing will have to be rectified / re-aligned.

4.4 KITCHEN / PANTRY SINKS

- 4.4.1 Sinks shall be of stainless steel material as specified in the Bill of Quantities/Drawings.
4.4.2 Each sink shall be provided with R. S. brackets and clips and securely fixed. Counter top sinks shall be fixed with suitable angle iron clips or brackets as recommended by the manufacturer. Each sink shall be provided with 40 mm dia Chromium Plated waste with chain and plug or P.V.C. waste with Escutcheon plates. Fixing shall be done as directed by Client's Representative.
4.4.3 Supply fittings for sinks shall be mixing fittings or C.P. taps, angle cocks etc. all as specified in the Bill of Quantities/Drawings.

4.5 WASH BASINS

- 4.5.1 Wash basin shall be of white vitreous china of best quality manufactured by an approved firm and sizes as specified in the Bill of Quantities.
4.5.2 Wash basin shall be of under counter drop in type shall be supported on a pair of rolled steel brackets of approved design and shall be mounted on a countertop. So that rim and basin bowl is exposed from top.
4.5.3 Wash basin shall be provided with single lever mixer with chain and rubber plug, chromium plated brass bottle trap of approved quality, design and make where hot water required. Single tap where hot water is not required.
4.5.4 Wash basin shall be fixed at proper location and height and truly horizontal as shown on drawing or as directed by Client's Representative.

4.6 HOSE BIBB'S

- 4.6.1 Hose Bib of Chromium Plate tap is draw off tap with horizontal inlet and free outlet knurling on outer face to fix the hose pipe. Hose bib shall be of specified size and shall be of screw down type and shall conform to IS: 781-1984. The closing device shall work by means of a disc carrying a renewable non-metallic washer which shuts against the water pressure on a seating at right angle to the axis of the threaded spindle which operate it. The handle shall be either crutch or butterfly type securely

4.7 URINALS

Half stall wall hung urinals of glazed vitreous china shall be provided with 15mm dia, C.P. brass spreader, 32mm dia C.P. domical waste and C.P. cast brass bottle trap with pipe and wall flange and shall fixed to wall by one C.I. bracket and two C.I. clips as recommended by manufacturers complete as directed by the Client's Representative.

Urinals shall be flushed by means of "NO-TOUCH" infrared operated flush valves.



Waste pipes for urinals shall be any one of the given material as directed by the Client's Representative:

- a) G.I. Pipes
- b) Rigid PVC/High density polyethylene.

Waste pipes may be exposed on wall or concealed in chase as directed by the Client's Representative.

4.8 BATH TUB

Bath tub & panel shall be white enameled cast iron or pressed steel as specified in the Bill of Quantities of guaranteed quality and specifications.

Each bath tub shall be provided with 40mm dia CP brass waste with 32mm C.P. brass overflow, 40mm dia cast brass overflow-cum-waste trap with pop-up waste assembly.

Bath tub shall be provided with four Nos. C.P. brass concealed stop cocks, bath spout and overhead shower or as specified in the Bill of Quantities.

Bath tubs shall be fixed true to level firmly fixed to another or supports provided by the manufacturer. Edges touching the wall shall be slightly recessed in the wall finishing so as ensuring water tightness. The fixing shall be perfectly done so that the wall behind does not tend to get damp or patchy.

Contractor shall during the entire period of installation and afterwards protect the bathtub by providing suitable cover or any other protection so as to absolutely prevent any damage to the bathtub until handing over.

4.9 MEASUREMENTS

- 4.9.1 Rate for providing and fixing of sanitary fixtures, accessories, urinal partitions shall include all items and operations stated in the respective specifications and Bill of Quantities, and nothing extra is payable.
- 4.9.2 Rates for all items under specifications para above shall be inclusive of cutting holes and chases and making good the same, C.P. screws, nuts, bolts and any fixing arrangement required.

5.0 WATER SUPPLY:

5.1 SCOPE

- 5.1.1 Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified hereinafter and given in the bill of quantities.
- 5.1.2 Without restricting to the generality of the foregoing, the water supply system shall include the following:-
 - i. Pipe protection & painting.
 - ii. Connections to all plumbing fixtures, tanks, pump etc.
 - iii. Providing hot water pipe lines and supply point with isolation valves, wherever required.



- iv. Control valves, masonry chambers and other appurtenances.
- v. Connections to all plumbing fixtures, tanks and appliances.
- vi. Excavation and refilling of pipe trenches, wherever necessary.
- vii. Internal galvanized water supply piping inside the toilets shaft/plant room/terrace.
- viii. Testing all line and fixtures as specified.

5.2 GENERAL REQUIREMENTS:

5.2.1 All materials shall be new of the best quality and shall be furnished, delivered, erected, connected and finished in every detail conforming to specifications and subject to the approval of Client's Representative.

5.2.2 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

5.2.3 Short or long bends shall be used on all main pipe lines as far as possible. Use of elbows shall be restricted for short connections.

As far as possible all bends shall be formed by means of hydraulic pipe bending machine for pipes up to 65mm dia.

5.2.4 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc. and shall be selected and arranged so as to fit properly into the allocated building space.

5.2.5 Pipes shall be securely fixed to walls by suitable clamps at intervals specified.

5.2.6 Valves and other appurtenances shall be located to provide easy accessibility for operation, maintenance and repairs.

5.2.7 Connection between dissimilar materials.

5.2.8 All G.I. pipes jointing shall be with white lead and spun yarn.

5.2.9 Drawings illustrating block out and penetration of pipes in the wall/floor/slab.

5.2.10 UNIONS:

Contractor shall provide adequate no. of unions on all pipes to enable dismantling later and for servicing. Union shall be provided near each gunmetal valve.

5.3 INTERNAL WORKS

5.3.1 MATERIALS:

5.3.1.1 G.I. PIPES

i. The pipes shall be galvanised mild steel threaded pipes conforming to the requirement of IS: 1239 Part-I for heavy grade upto 150mm dia and IS: 3589 for pipes above 150mm dia. They shall be of the dia (nominal bore) specified in the description of the item. Galvanising shall conform to IS: 4736.

ii. The pipes shall be clearly finished, well galvanised in and out and free from



cracks, surface flow, laminations and other defects. All screw threads shall be clean and well cut. The ends shall be cut cleanly and square with axis of the tube.

- iii. All screw tubes shall have pipe threads conforming to the requirements of IS: 544-1955 (or revised).

5.3.1.2 G.I. FITTINGS

- i. All fittings shall be conforming to IS: 1239 Part II (or as revised). All fittings shall have manufacturer's trade mark stamped on it. Fittings in G.I. pipe lines shall include elbows, tees, bends, reducers, nipples, union, G.I. Clamps / Steel structural supports of approved design, nuts, bolts, washers, etc. All fittings shall be tested at manufacturer's works. Contractors may be required to produce certificate to this effect from the manufacturers.
- ii. The fittings shall have screw threads at the ends conforming to the requirements of IS: 544-1955 (or revised). Female threads on fittings shall be parallel and male threads (except on running nipples and collars of unions) shall be tapered.

5.3.1.3 CUTTING AND JOINTING:

- i) The pipes and fittings shall be inspected at site before use to ascertain that they conform the specification given in para no. 5.3.1.1 above. The defective pipes shall be rejected. Where the pipes have to be cut or re-threaded, the ends shall be carefully filled out so that no obstruction to bore is offered. The end of the pipes shall then be threaded conforming to the requirements of IS: 544-1955 with pipe dies and taps carefully in such a manner as will not result in slackness of joints when the two pieces are screwed together. The taps and dies shall be used only for straightening screw threads which have become bent or damaged and shall not be used for turning of the threads so as to make them slack, as the later procedure may not result in water tight joint.
- ii) The screw threads of pipes and fittings shall be protected from damage until they are fitted.
- iii) The pipes shall be cleaned and cleared of all foreign matter before being laid. In jointing the pipes, the inside of the socket and the screwed end of the pipes shall be oiled and rubbed over with white lead and a few turns of spun yarn wrapped round the screwed end of the pipe. The end shall then be screwed in the socket. Care should be taken that all pipes and fitting are properly jointed so as to make the joints completely water tight and pipes are kept at all times free dust and dirt during the fixing. Burr from the joint shall be removed after laying. The open ends of the pipes shall be temporarily plugged to prevent access of water, solid or any other foreign matter.

5.3.2 INSTALLATION OF G.I.:

Tender drawings indicate schematically the size and location of pipes. The Contractor on the award of the work, shall prepare detailed coordinated with other trades working drawings, showing the cross-section, longitudinal sections, details of fittings, locations of isolating and control valves, drain valves and all pipe support, structural supports. He must keep in view the specific openings in buildings and other structures through which pipes are designed to pass.

- i. Piping shall be properly supported on or suspended from connection clamps, hangers as specified and as required. Install pipes in a manner to avoid strain on



equipments connections. The Contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers, and be responsible for their structural sufficiency.

- ii. Pipe supports shall be of steel, adjustable for height and primer coated with rust preventive paint and finish coated back. Where pipe and clamps are of dissimilar materials a dielectric fitting shall be provided in between. Spacing of pipe supports shall not exceed the following:

Pipe Size		Spacing between Supports
Upto 12 mm	1.5 meter	
15 to 25 mm	2.0 meter	
32 to 150 mm	2.0 meter	
150 mm and over	2.5 meter	

Upto 12 mm	1.5 meter
15 to 25 mm	2.0 meter
32 to 150 mm	2.0 meter
150 mm and over	2.5 meter

- iii. Vertical risers shall be parallel to walls and column lines and shall be straight and plumb. Risers passing from floor to floor shall be supported at each floor by clamps or collars steel structural supports attached to pipe and with a 15 mm thick rubber pad or any resilient material. Where pipes pass through the terrace floor, suitable flashing shall be provided to prevent water leakage. Risers shall have a suitable clean out at the lowest point and air vent at the highest point.
- iv. Pipe sleeves, 50 mm larger diameter than pipes, and 50mm above F.F.L. Shall be provided wherever pipes pass through walls and slabs, and annular space filled with fire proof materials like putty, fire seal etc.
- v. All pipe work shall be carried out in workmen like manner, causing minimum disturbance to the existing services, buildings, roads and structure. The entire piping work shall be organized in consultation also coordinated with other Contractors work so that particular area work shall be carried out in one stretch.
- vi. Cut outs in the floor slab for installing the various pipes are indicated in the drawings. Contractor shall carefully examine the cut outs provided and clearly point out wherever the cut outs shown in the drawings, do not meet with the requirements.
- vii. The Contractor shall make sure that the clamps, steel structural supports, brackets, clamp saddles and hangers provided for pipe supports are adequate. Piping layout shall take due care for expansion and contraction in pipes, and include expansion joints where required.
- viii. All pipes shall be accurately cut to the required sizes in accordance with relevant BIS codes and burrs removed before laying. Open ends of the piping shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reducers shall be used for the piping to drain freely. In other locations, concentric reducers may be used.
- ix. All buried pipes shall be cleaned and coated with zinc chromate primer and bitumen paint, then wrapped with bitumen faced hesian.
- x. In case the pipe is embedded in walls or floors, it should be painted with two coats of anti corrosive bitumastic paint of approved quality, covered with one layer of fiberglass tissue and finally painted with one coat of bitumen paint. The pipe should not come in contact with cement mortar or cement concrete as the pipe will be affected by cement. Under the floors, the pipes shall be laid in layer of filling under concrete floors.



- xi. For pipes 15mm to 25mm dia, the holes in the walls and floors shall be made by drilling with chisel or jumper and not by dismantling the brick work or concrete. However, for bigger dimension pipes the holes shall be carefully made of the smallest size as directed by the Client's Representative. After fixing the pipes the holes shall be made good with cement mortar 1:3 (1 cement: 3 coarse sand) properly finished to match the adjacent surface.
- xii. All pipes above ground shall be painted with one coat of red lead and two coats of synthetic enamel paint of approved shade and quality. Pipes shall be painted to standard colour code/or as specified by the Client's Representative.
- xiii. Springing or forcing pipe into place will not be permitted. Protect piping at all times from dirt and moisture. During storage at construction site, keep end plugged to prevent dirt and moisture entering.
- xiv. Carefully grade all pipes to eliminate traps and pockets. Where air pockets or water traps can not be avoided provide means of drainage with valved hose connection for water traps and valved automatic air vents for air pockets.
- xv. Below grade piping shall be installed in such a manner that it does not appear directly on ground.
- xvi. Any location where pipes/valves through or closed to basement walls shall be protected from direct contact of concrete block.
- xvii. Pipes passing through building walls shall be protect by cast iron sleeves large enough to permit changes size eccentric fittings shall be used except where branch pipes connect into mains and in domestic system.

5.3.3 INSULATION:

- All the Hot Water supply & Hot Water return pipe shall be insulated in the manner specified hereinafter.
- Insulating material shall be rigid performed sections of mineral/rock wool with a "K" value of not more than 0.036 W/MK at 100 Deg. C mean temperature and of density 140 Kg/Cu.m
- No insulation shall be applied until the pipe is satisfactorily pressure tested.
- Pipes shall be insulated with rigid performed pipe sections of the following thickness:

Pipe Diameter (mm)	Thickness (Mineral Wool) mm
80-150	50

- Pipe insulation shall be applied as follows:
- Pipe shall be thoroughly cleaned with wire brush and rendered free from all rust and grease and applied with two coats of anti-rust paint.
- Pipes in Shaft:
 - i) Fix rigid performed sections of insulation with adhesive between all points (transverse and circumferential).



- ii) The insulation shall be tied with GI chicken wire mesh.
- iii) The insulation shall be provided with 24 gauge aluminium cladding screwed at the joints with cadmium coated self tapping screws. Joints shall be overlapped minimum 12mm wide.
- Pipes exposed to weather:
 - i) Same as (b) (i) to (ii)
 - ii) Provide polythene based hessian (500 gauges) overlapping 100mm on all joints (transverse and circumferential) and stitched at the joints.
 - iii) The hessian shall be covered with 15mm x 20mm hexagonal chicken wire mesh.
 - iv) Over the wire mesh the surface shall be covered with two layers of tarfelt grade-II and type-II with bitumen between layer overlapping 100mm on all joints (transverse & circumferential).
 - v) Over the second layer of tarfelt final coat of hot bitumen not less than 6mm thick shall be applied.
 - vi) Over the final layer of tarfelt and hot bitumen coat aluminium cladding shall be provided with 24 gauge aluminium shut screwed at the joints with cadmium coated self-tapings screws. Joints shall be overlapped minimum 25mm wide.
- d) Pipes Buried Underground:
 - i) Rigid pipe sections of insulation shall be fixed tightly to the surface taking care to seal all joints with 50mm wide aluminium adhesive tape (transverse and circumferential).
 - ii) The insulation shall be tied with aluminium band not less than 6mm width and 24 gauge 4 bands per meter or equivalent plastic band using G.I. sheet clamp crimped at the joints.
 - iii) Wrap the insulation with polythene sheet 400 gauges. Polythene sheet shall be tied with 6mm, 24 gauge, aluminium band 4 bands per meter or equivalent plastic tape using GI sheet clamp crimped at the joint.
 - iv) The polythene surface shall be covered with two layers of tarfelt grade – II, type – II with bitumen between layers overlapped 100mm on all joints (transverse and circumferential).
 - v) Over the second layer of tarfelt final coat of hot bitumen not less than 6mm thick shall be applied.

5.3.4 TESTING:

After laying and jointing, the pipes and fittings shall be inspected under working condition of pressure and flow. Any joint found leaking shall be redone and all leaking pipes removed and replaced without extra cost. Use of any compound or stop leak compound will not permit.

The pipes and fittings after they are laid shall be tested to hydraulic pressure of 1.5



times the working pressure or 7.5 Kg/Sq.cm whichever is more. The pipes shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock or water hammer. The draw of taps and stop cocks shall then be closed and specified hydraulic pressure shall be applied gradually. Pressure gauge must be accurate and preferably should have been recalibrated before the test. The test pump having been stopped, the test pressure should be maintained without loss for at least two hours. The pipes and fittings shall be tested in sections as the work of laying proceeds, having the joints exposed for inspection during the testing.

5.3.5 PAINTING:

The pipes shall be finally provided with synthetic enamel paint of approved quality for exposed pipes after the Hydrostatic test pressure. The cost of such painting should be included to the Contractor's quote.

5.3.6 MEASUREMENTS:

The length above ground shall be measured in running meter correct to a cm for the finished work, which shall include G.I. pipe and G.I. fittings such as bends, tees, elbows, reducers, crosses, plugs, sockets, nipples and nuts, unions etc... Deductions for length of valves shall be made. Rate quoted shall be inclusive of all fittings, clamps, cutting holes chased and making good the same and all items mentioned in the specifications and Bill of Quantities.

5.4 EXTERNAL WORKS:

5.4.1 MATERIALS:

5.4.1.1 G.I. PIPES

- i. The pipes shall be galvanised mild steel threaded pipes conforming to the requirement of IS: 1239 Part-I for heavy grade upto 150mm dia and IS: 3589 for pipes above 150mm dia. They shall be of the dia (nominal bore) specified in the description of the item. Galvanising shall conform to IS: 4736.
- ii. The pipes shall be clearly finished, well galvanised in and out and free from cracks, surface flow, laminations and other defects. All screw threads shall be clean and well cut. The ends shall be cut cleanly and square with axis of the tube.
- iii. All screw tubes shall have pipe threads conforming to the requirements of IS: 544-1955 (or revised).

5.4.1.2 G.I. FITTINGS

- i. All fittings shall be conforming to IS: 1239 Part II (or as revised). All fittings shall have manufacturer's trade mark stamped on it. Fittings in G.I. pipe lines shall include elbows, tees, bends, reducers, nipples, union, G.I. Clamps / Steel structural supports of approved design, nuts, bolts, washers, etc. All fittings shall be tested at manufacturer's works. Contractors may be required to produce certificate to this effect from the manufacturers.
- ii. The fittings shall have screw threads at the ends conforming to the requirements of IS: 544-1955 (or revised). Female threads on fittings shall be parallel and male threads (except on running nipples and collars of unions) shall be tapered.
- iii. Contractor shall provide adequate number of unions on all pipes to enable



dismantling later. Unions shall be provided near each gunmetal valve, stop cocks, or check valves and on straight runs as necessary at appropriate locations as required and/or directed by Client's Representative.

5.4.1.3 CUTTING AND JOINTING:

- i) The pipes and fittings shall be inspected at site before use to ascertain that they conform the specification given in para no. 5.4.1.1 above. The defective pipes shall be rejected. Where the pipes have to be cut or re-threaded, the ends shall be carefully filled out so that no obstruction to bore is offered. The end of the pipes shall then be threaded conforming to the requirements of IS: 544-1955 with pipe dies and taps carefully in such a manner as will not result in slackness of joints when the two pieces are screwed together. The taps and dies shall be used only for straightening screw threads which have become bent or damaged and shall not be used for turning of the threads so as to make them slack, as the later procedure may not result in water tight joint.
- ii) The screw threads of pipes and fittings shall be protected from damage until they are fitted.
- iii) The pipes shall be cleaned and cleared of all foreign matter before being laid. In jointing the pipes, the inside of the socket and the screwed end of the pipes shall be oiled and rubbed over with white lead and a few turns of spun yarn wrapped round the screwed end of the pipe. The end shall then be screwed in the socket. Care should be taken that all pipes and fitting are properly jointed so as to make the joints completely water tight and pipes are kept at all times free dust and dirt during the fixing. Burr from the joint shall be removed after laying. The open ends of the pipes shall be temporarily plugged to prevent access of water, solid or any other foreign matter.

5.4.1.4 INSTALLATION:

i) Trenches :

The galvanised iron pipes and fittings shall be laid in trenches. The widths and depths of the trenches for different diameters of the pipes shall be as in Table below:-

Dia of pipe	Width of trench	Depth of trench
15 mm to 50 mm	30 cm	60 cm
65 mm to 150 mm	45 cm	75 cm

At joints the trench width shall be widened where necessary. All G.I. / C.I. pipes below ground in trenches minimum cover over pipes shall be 60cm. Cover shall be measured from top of pipe to the surface of ground. The bed of the trench if in soft or made up earth, shall be well watered and rammed before laying the pipes and depressions if any shall be properly filled with earth and consolidated in 20cm layers.

If the trench bottom is extremely hard and rocky or loose stony soil, the trench shall be excavated at least 150mm below the trench grade. Rocks, Stone or other hard substances from the bottom of the trench brought back the required grade by filling with selected fine earth or sand and compacted so as to provide smooth bedding for the pipe. When excavation required blasting operation, it shall be ensured that no pipes have be stacked in the vicinity and completed pipe in the vicinity has already been covered before starting of blasting operations; this is necessary to prevent damage to the exposed pipe in the vicinity by falling stone as result of blasting.

After the excavation of the trench is completed, hollows shall be cut at the required



position to receive the socket of the pipes and these hollows shall be of sufficient depth to ensure that the barrel of the pipes shall rest throughout their entire length on the solid ground and that sufficient spaces left for jointing the under side of the pipe joint. These socket holes shall be refilled with sand after jointing the pipe.

Roots of tree within distance of about 0.5 meter from the side of the pipe line shall be removed or killed.

The excavated materials shall be placed within 1 meter or half of the depth of the trench, whichever is greater, from the edge of the trench. The material excavated shall be separated and stacked so that in refilling they may be re-laid and completed the same order to satisfaction of the Client's Representative.

The filling shall be done in layers not exceeding 15mm in depth. Each layer shall be watered, rammed and consolidated. Ramming shall be done with iron rammers where possible and with blunt end of the crow brass where rammers can not be used. Special care shall be taken to ensure that no damage is caused to the pipes, drains, masonry or concrete in the trenches.

Filling in trenches shall be commenced soon after the joints of pipes, cables; conduits etc. have been tested and approved by Client's Representative. The space around the pipes shall be cleared of all debris where the trenches are excavated in hard/soft soil. The filling shall be done with earth on the sides and tops of pipes in layers not exceeding 15mm in depth. Each layer shall be watered rammed and consolidated. The clods and lumps of earth exceeding 8cm in any direction shall be broken or removed before the excavated earth is used for filling. Generally no test is done to determine the instrument diversity of filled earth but on the discretion of Client's Representative the 95 proctor's compaction test may be done to ensure the in situ density after filling. Consolidation is removal of water from the pores and compaction is the explosion of air from the pores. In case of refilling consolidation places most important role as the watering of the each layer is being done properly. If required by the Client's Representative proctors needle may also be used for the proper checking of the refilling items of in situ density.

ii) Pipe Protection:

For underground G.I. pipes following treatment will be given:

Coat of hot bitumen R 85/25

- a) Wrapping of fiberglass tissue.
- b) Coat of hot bitumen R 85/25 over fiberglass tissue.

The pipes shall be laid on a layer of 7.5 cm sand and filled upto 15 cm above the pipes. The remaining portion of the trench shall then be filled with excavated earth. The surplus earth shall be disposed off as directed.

iii) Jointing :

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



after screwing. After laying, the ends of the pipes shall be temporarily plugged to prevent access of water, soil or any other foreign matter.

iv) Thrust Blocks :

In case of bigger pipes (80 mm dia and above), thrust blocks of cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate of 20 mm nominal size) shall be constructed on all bends as directed by the Client's Representative.

5.4.1.5 TESTING:

- i. All external water supply pipes shall be tested by hydrostatic pressure of 1.5 times the working pressure or 7.5 Kg/Sq.cm whichever is more.
- ii. Pressure shall be maintained for a period of at least 180 minutes without any drop in the pressure after fixing at site.
- iii. In addition to the sectional testing carried out during the construction. Contractor shall test the entire installation after connections to the hydropneumatic system or pumping system. He shall rectify all leakages, and shall replace all defective materials in the system. Any damage done due to careless will has to be replaced by the Contractor.
- iv. The initial back fill shall be placed evenly in a layer of about 100mm thick. This shall be properly consolidated and this shall be continued till there is a cushion of at least 300mm of cover over the pipe.
- v. The joint or coupling during the testing of mains shall be left exposed for inspection before cover-up, sufficient back fill shall be placed on the pipe to resist the movement due to pressure while testing. In this way if any error if workmanship will be found shall immediately corrected at a minimum cost.

5.4.1.6 MASONRY CHAMBER:

- i) All masonry chambers for stop cocks, sluice valves and meter etc. shall be built as per supplied drawings.
- ii) The excavation for chambers shall be done true to dimension and level indicated on plans or as directed by the Client's Representative.
- iii) Concrete shall be having cement concrete 1:2:4 (1 cement: 2 fine sand: 4 graded stone aggregate 40mm nominal size).
- iv) Brick shall be in 1st class bricks in cement mortar 1:5 (1 cement: 5 fine sand).
- v) Plastering not less than 12mm/15mm thick shall be done in cement mortar 1:3 (1 cement: 3 coarse sand) finished with a floating coat of neat cement for inside plaster and same for outside but with Rough plaster.

5.4.1.7 MEASUREMENTS:

All G.I pipes below ground shall be measured per linear meters (to the nearest cm) and shall be inclusive of all fittings e.g. coupling, tees, bends, elbows, unions, deduction for valves shall be made rate quoted shall be inclusive of all fittings, excavation, back filling and disposal of surplus earth, cutting holes and chase and making good all item mentioned in Bill of Quantities.



All C.I. class (LA) pipes below ground level shall be measured per linear meter (to the nearest cm) and shall be inclusive of all fittings e.g. tees, elbows, bends, deduction for valves shall be made. The portion of the pipe within the collar at the joints shall not be included in the length of the pipe work. Rate quoted shall be inclusive of all fittings, excavation, back filling of surplus earth including consolidation and compaction of earth.

5.5 VALVES:

5.5.1 BUTTERFLY VALVES:

All the isolation valve 50cm and above on the equipment and water lines, where specified or shown on drawings shall be wafer type butterfly valves. They shall be designed to fit without gaskets, the water tight seal being obtained by EPDM seat projection at the faces compressed between the flanges. The valves shall be supplied inclusive of M.S. pipe flanges and high tensile steel bolts of dimensions recommended by suppliers of valves. The valves shall comply with following specifications:

a)	Test Pressure	: Body 24 Bar, Seat 16 Bar
b)	Valve Component	: Material of Construction
i)	Body	: Cast Iron, Gr. FG 260, IS:210
ii)	Disc Gr, FG 260	: Nylon or Epoxy powder coated high duty iron,
iii)	Stem	: Stainless Steel or carbon steel IS: 1570, Part-II.
iv)	Seat	: EPDM
v)	Hand Lever	: Cast Iron (Mechanical Memory Stop)
vi)	Bearings stem and pivot.	: PTFE or Nylon covered S.S. bush bearings at
vii)	Primary Seal	: Reinforced PTEE slide bearings
viii)	Temperature	: 80 Degree C (max.)

5.5.2 INSTALLATION:

Valve shall be installed in a manner that allows future removal and service of the valve.

Packing and gasket shall not contain asbestos.

The valve shall be of the same size as the pipe to which they are installing.

Valve above 150mm diameter shall be self locking worm gear type water proof and protory lubricated.

Provide chain operators with chain cleats for all valves more than 2.4 meters above floor.

5.5.3 NON RETURN VALVES:



All non-return valves shall be provided as shown in the drawings conforming to relevant Indian Standards and in accordance with the following specifications.

Size Construction Ends

Up to 50 mm. Gun metal Screwed
65 mm and above Gun metal/cast iron flanged

Non-return valves shall be of approved make. Flap type non-return valve shall be used and tested to 15 Kg. / Sq.cm. pressure.

5.5.4 BALL VALVES (FLOAT VALVE):

The ball valve shall be of high pressure class and shall be confirm to IS: 1703 of sizes as specified. The nominal size of a ball valve shall be that corresponding to the size of the pipe to which it is fixed. The ball shall be of brass or gun metal as specified and the float shall be of polythene sheet. The minimum gauge of copper sheet used for making the float shall be 0.45mm for float upto 115mm dia and 0.55mm for float exceeding 115mm dia and shall be special in shape. The valve shall be constructed to permit replacing without console of the valve body from the valve line and the system shall not blow out under pressure. The jointing of the float shall be made by efficiently burnished, lapped and soldered seam or by bracing. Plastic float may also be used if specified. The body of ball valve when assembled in working conditions with the float immersed to not more than half of its volume shall remain closed against a test pressure of 10.5 Kg/Sq.cm. All ball valves shall be capable of withstanding a pressure of 14 Kg/Sq.cm.

The ball valve shall generally conform to IS specifications No. 1703-1962.

5.5.5 BALL VALVES:

The ball valve shall be of Brass or Gunmetal as specified conforming to IS: 1703. The ball valve shall be as given below:

High Pressure:

Indicated by the abbreviation 'HP' for use on mains having pressure. These shall remain closed at a test pressure of 10.5 Kg/Sq.cm.

SL. NO.	NOMINAL SIZE OF BALL VALVE					
	15 mm	20m	25m	32m	40m	50mm
1. Diameter of spherical float (mm)						
High Pressure	127	152	203	229	254	305
Low Pressure	114	127	178	203	203	254
Minimum weight of ball valve including back nut, body and piston (gms)	283	446	823	1149	1589	1852

The ball valves shall be of following nominal sizes 15mm, 20mm, 25mm, 32mm, 40mm and 50mm. The nominal size shall correspond with the nominal bore of the inlet shanks.

5.5.6 AIR VALVES:

Air valves shall be provided in all high points in the system to prevent air locks as



shown on the drawings or directed by Client's Representatives.

5.5.7 TESTING:

All valves shall be tested while installed in pipe by hydrostatic pressure of 1.5 time of the working pressure 7.5 Kg/Sq.cm which ever is more.

5.5.8 MEASUREMENTS:

All valves as mentioned in Bill of Quantities shall be measured by numbers and shall include all items mentioned in the Bill of Quantities.

5.6 CHLORINATION OF DOMESTIC WATER LINES:

5.6.1 After the completion of all the hot and cold water service piping, disinfect all the fresh water supply work and water reservoirs using a chlorine solution.

5.6.2 CHLORINATED SYSTEMS SHALL INCLUDE:

- i. Domestic fresh water tanks
- ii. Fire water tanks
- iii. All pipe work systems receiving suction from the above mentioned tanks apart from the fire systems.

5.6.3 Before handover of the system, submit to the consultant copies of the certification of performance and laboratory report (if required)

5.6.4 Under no circumstances the use of any portion of the fresh water system until it is properly disinfected, flushed and certified shall be permitted.

5.6.5 During the Chlorination work the Contractor shall take all necessary precautions to prevent site staff from drinking the system water. Such precautions shall include locking doors to 'wet' areas and providing warning signs in English and Hindi.

5.7 CPVC PIPES & FITTINGS:

- i. The pipes and fittings chemically known as Chlorinated Poly Vinyl Chloride [CPVC] shall be produced in Copper Tube Size [CTS] from ½" to 2" with two different standard dimensional ratios – SDR 11 and 13.5. The fittings shall be produced as per SDR 11. All the CPVC pipes and fittings in SDR 11 and SDR 13.5 shall be made from the identical CPVC compound having the same physical properties. Pipes and fitting shall be produced as per SDR 11 & shall meet the requirement of ASTM D 2846 where as the pipes produced with SDR 13.5 shall meet the requirement derived from ASTM F 442, specific to CPVC in Iron Pipe Size[IPS] dimension, which also shall be applied to CPVC pipes in Copper Tube Size[CTS] dimension.

5.7.1. CUTTING AND JOINTING AND INSTALLATION OF CPVC PIPES & FITTINGS:

i. CUTTING:

In order to make a proper and neat joint, the pipe length shall be measured accurately and make a small mark. Ensure that the pipe and fittings are size compatible. It shall be easily cut with a wheel type plastic pipe cutter or hacksaw blade. Cutting tubing as squarely as possible shall provide optimal bonding area within a joint.



ii. DEBURRING / BEVELING:

Burrs and filings shall prevent proper contact between tube and fitting during assembly and should be removed from the outside and inside of the pipe. A pocket knife or file shall be used for this purpose. A slight bevel on the end of the tubing shall ease the entry of the tubing into the fitting socket.

iii. FITTING PREPARATION:

Using a clean, dry rag, wipe dirt and moisture from the fitting sockets and tubing end. The tubing should make contact with the socket wall 1/3 to 2/3 of the way into the fitting socket.

iv. SOLVENT CEMENTS APPLICATION:

Use only CPVC cement or an all – purpose cement conforming to ASTM -493 or joint failure may result. When making a joint, apply a heavy, even coat of cement to the pipe end. Use the same applicator without additional cement to apply a thin coat inside the fitting socket. Too much cement can cause clogged water ways.

v. ASSEMBLY:

Immediately insert the tubing into the fitting socket, rotate the tube ¼ to ½ turn while inserting. This motion will ensure an even distribution of cement within the joint. Properly align the fittings. Hold the assembly for approximately 10 seconds, allowing the joint to set-up.

vi. SET AND CURE TIMES:

Solvent cement set and cure times are a function of pipe size, temperature and relative humidity. Curing time is shorter for drier environments, smaller sizes and higher temperatures. It requires 10 to 20 minutes for perfect joint.

vi. CEMENTING:

- Verify the cement is the same as the pipes and fittings being used.
- Check the temperature where the cementing will take place.
 - Cement takes longer time to set up in cold weather. Be sure to allow extra time for curing. Do not try to speed up the cure by artificial means – this could cause porosity and blisters in the cement film.
 - Solvents evaporate faster in warm weather. Work quickly to avoid the cement setting up before the joint is assembled. Keep the cement as cool as possible. Try to stay out of direct sunlight.
- Keep the lid on cements, cleaner and primers when not in use. Evaporation of the solvent will affect the cement.
- Stir or shake cement before using.
- Use ¾" dauber on small diameter pipes, 1 ½" dauber up through 3" pipe, and a natural bristle brush, swab or roller ½ the pipe diameter on pipes 4" and up.
- Do not mix cleaner or primer with cement.
- Do not use thickened or lumpy cement. It should be like the consistency of syrup or honey.



- Do not handle joints immediately after assembly.
- Do not allow dauber to dry out.
- Maximum temperature allowable for CPVC pipe is 180° F.
- All colored cements, primers and cleaners will have a permanent stain. There is no known cleaning agent.
- Use according to the step outline in ASTM D – 2846, joining of pipe and fittings.

5.7.2 TESTING

After laying and jointing, the pipes and fittings shall be inspected under working condition of pressure and flow. Any joint found leaking shall be redone and all leaking pipes removed and replaced without extra cost. Use of any compound or stop leak compound will not permit.

The pipes and fittings after they are laid shall be tested to hydraulic pressure of 1.5 times the working pressure or 7.5 Kg/Sq.cm whichever is more. The pipes shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock or water hammer. The draw of taps and stop cocks shall then be closed and specified hydraulic pressure shall be applied gradually. Pressure gauge must be accurate and preferably should have been recalibrated before the test. The test pump having been stopped, the test pressure should be maintained without loss for at least two hours. The pipes and fittings shall be tested in sections as the work of laying proceeds, having the joints exposed for inspection during the testing.

5.7.3 MEASUREMENTS

The length above ground shall be measured in running meter correct to a cm for the finished work, which shall include G.I. pipe and G.I. fittings such as bends, tees, elbows, reducers, crosses, plugs, sockets, nipples and nuts, unions etc... Deductions for length of valves shall be made. Rate quoted shall be inclusive of all fittings, clamps, cutting holes chased and making good the same and all items mentioned in the specifications and Bill of Quantities.

5.8 COMPOSITE PIPES & FITTINGS :

- (a) The pipe shall conform to IS 15450 2004 having welded aluminium tube reinforcement between inner & outer polyethylene layers being bonded to aluminium tube by a melt adhesive with welded aluminium tube. The pipe dimensional detail shall be :

Nominal pipe size	Equivalent NB size	Wall thickness in mm	
ID : OD	In inch.	Minimum	Maximum
12:16	½	1.75	2.00
16:20	¾	2.00	2.25
20:25	1	2.45	2.70
25:32	1x1/4	2.80	3.20
32:40	1x1/2	3.40	3.80

- (b) The test pressure rating shall be as below :

Nominal pipe size	Minimum Burst Pressure



Nominal pipe size	Minimum Burst Pressure
ID : OD	in kg per sq.cm
12:16	60
16:20	50
20:25	40
25:32	40
32:40	35

- (c) The internal test pressure rating for fittings shall be as below :

Nominal pipe size	Minimum Burst Pressure
ID : OD	in kg per sq.cm
12:16	34.30
16:20	26.70
20:25	26.70
25:32	23.00
32:40	22.30

- (d) The fittings shall withstand the following condition & the manufacturer shall submit the test certificate for the following :

Test Temperature:83 deg Celcius
 Test Pressure:3.5 kg per sq.cm.
 Test duration:3000 hrs.

- (e) Jointing :

Jointing shall be done by using proper fittings. Proper tools shall be used for the same

- (f) Installation :

The pipe bending shall be done by using proper supports springs, either internal or external. The bending radius shall not be less than 5 times the OD of the pipe.

For concealed piping no supports shall be required but for exposed piping, the spacing of supports shall be as below :

The test pressure rating shall be as below :

Nominal pipe size	Support spacing for horizontal pipe lines	Support spacing for vertical pipe lines
ID : OD	in mtr.	In mtr.
12:16	0.80	1.00
16:20	0.80	1.00
20:25	1.00	1.00
25:32	1.20	1.20
32:40	1.20	1.20

5.8.1 INSULATION

- 5.8.1.1 All the Hot Water supply & Hot Water return pipe shall be insulated in the manner specified hereinafter.

- 5.8.1.2 Insulating material shall be rigid performed sections of mineral/rock wool with a "K"



value of not more than 0.036 W/MK at 100 Deg. C mean temperature and of density 140 Kg/Cu.m

5.8.1.3 No insulation shall be applied until the pipe is satisfactorily pressure tested.

5.8.1.4 Pipes shall be insulated with rigid performed pipe sections of the following thickness:

Pipe Diameter (mm)	Thickness (Mineral Wool) mm
80-150	50

5.8.1.5 Pipe insulation shall be applied as follows OR AS SPECIFIED IN BOQ:

Pipe shall be thoroughly cleaned with wire brush and rendered free from all rust and grease and applied with two coats of anti-rust paint.

a) Pipes in Shaft:

- i) Fix rigid performed sections of insulation with adhesive between all points (transverse and circumferential).
- ii) The insulation shall be tied with GI chicken wire mesh.
- iii) The insulation shall be provided with 24 gauge aluminium cladding screwed at the joints with cadmium coated self tapping screws. Joints shall be overlapped minimum 12mm wide.

b) Pipes exposed to weather:

- i) Same as (a) (i) to (ii)
- ii) Provide polythene based hessian (500 gauges) overlapping 100mm on all joints (transverse and circumferential) and stitched at the joints.
- iii) The hessian shall be covered with 15mm x 20mm hexagonal chicken wire mesh.
- iv) Over the wire mesh the surface shall be covered with two layers of tarfelt grade-II and type-II with bitumen between layer overlapping 100mm on all joints (transverse & circumferential).
- v) Over the second layer of tarfelt final coat of hot bitumen not less than 6mm thick shall be applied.
- vi) Over the final layer of tarfelt and hot bitumen coat aluminium cladding shall be provided with 24 gauge aluminium shut screwed at the joints with cadmium coated self-tappings screws. Joints shall be overlapped minimum 25mm wide.

c) Pipes Buried Underground:

- i) Rigid pipe sections of insulation shall be fixed tightly to the surface taking care to seal all joints with 50mm wide aluminium adhesive tape (transverse and circumferential).
- ii) The insulation shall be tied with aluminium band not less than 6mm width and 24 gauge 4 bands per meter or equivalent plastic band using G.I. sheet clamp crimped at the joints.
- iii) Wrap the insulation with polythene sheet 400 gauges. Polythene sheet shall be tied with 6mm, 24 gauge, aluminium band 4 bands per meter or equivalent plastic tape using GI sheet clamp crimped at the joint.



- iv) The polythene surface shall be covered with two layers of tarfelt grade – II, type – II with bitumen between layers overlapped 100mm on all joints (transverse and circumferential).
- v) Over the second layer of tarfelt final coat of hot bitumen not less than 6mm thick shall be applied.

5.8.1.6 TESTING

After laying and jointing, the pipes and fittings shall be inspected under working condition of pressure and flow. Any joint found leaking shall be redone and all leaking pipes removed and replaced without extra cost. Use of any compound or stop leak compound will not permit.

The pipes and fittings after they are laid shall be tested to hydraulic pressure of 1.5 times the working pressure or 7.5 Kg/Sq.cm whichever is more. The pipes shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock or water hammer. The draw of taps and stop cocks shall then be closed and specified hydraulic pressure shall be applied gradually. Pressure gauge must be accurate and preferably should have been recalibrated before the test. The test pump having been stopped, the test pressure should be maintained without loss for at least two hours. The pipes and fittings shall be tested in sections as the work of laying proceeds, having the joints exposed for inspection during the testing.

5.9. Copper Pipes & Fittings

The pipes shall be hard tempered copper pipes and tubes confirming to requirements of BS 2871 Table 'X' Part -1-1971 and the fittings shall confirm to BS 864 Part 2. The fittings shall be as follows:

- a. Internal Solder Ring (ISR) fitting: For pipes from 15 mm to 35 mm dia.
- b. Endex Fittings: For pipes from 42 mm to 54 mm dia.
- c. End brazes Fittings: For pipes from 67 mm dia and above.

Fabricated fittings in NO case shall be allowed. Fittings of all types such as Tees, Crosses, Elbows, Reducers, Unions, Off Sets etc. shall be used on the pipes. Suitable fittings of approved type and make shall be used for jointing copper pipes to GI pipes and for jointing copper pipes to CP fittings etc. shall be used. Use of DZR fitting shall be made for all connections.

Laying: and Jointing: Of Copper Pipes and Capillary Fittings

The copper" pipes and fittings shall run in wall chase or ceiling or as specified, The fixing shall be done by means of standard pattern holder bat clamps keeping the pipes about 1.5 mm clear of the wall where to be laid on surface. Where it is specified to conceal the pipes, chasing may be adopted. For pipes fixed in the shafts, ducts, etc. there should be sufficient space to work on the pipes with the usual tools. As far as possible, pipes inlays are buried for short distances provided adequate protection is given against damage and where so required special care to be taken at joints. Where directed by the Owner's Site Representative I Architect, pipe sleeves shall be fixed at a place the pipe is passing through a wall or floor for reception of the pipe and allow freedom for expansion and contraction and other movements. In case of pipe is embedded in walls or floors it shall be covered with a protective tape wrapped around the pipes and fittings.

Copper pipes shall be jointed with approved above mentioned fitting conforming to BS 864 Part 2. Care shall be taken to remove any burr from the end of the pipes after



cutting. Only fittings of the size suitable to the pipe shall be used. The ends of the tube shall be cut to the correct size using a tube cutter or a fine blade hacksaw. Care shall be taken to ensure that the ends of the tube are cut perpendicular to the axis of the tube and that the ends remain undamaged and free of burrs. Any burrs remaining shall be removed with a smooth file. Clean the outside surface of the tube that shall go into the fitting. Flux shall be applied on the pipe surface ensuring even and uniform application. Insert the tube into the fittings and push home until the stop is reached. Wipe off excess flux with a soft cloth. Now the assembled joint shall be heated with a blow torch or any similar appliance that emits a clean, blue, soot free flame. The heat shall be turned off once a complete ring of solder has appeared around the mouth of the fitting.

The joint shall be allowed to cool without disturbance.

All copper pipes to G.I. pipe and connection with the valves and faucets shall be with De-zincified Resistance fittings (DZR).

5.10. ASTM - PVC PIPES & FITTINGS

5.10.1 SCOPE:

This specification covers the requirements for manufacture, supplying, lowering, laying, jointing, testing and commissioning of ASTM solvent welded PVC pipe with fittings for the conveyance & distribution system for above ground as well as below ground installation with required civil work.

5.10.2 CODES & STANDARDS:

The manufacturing, testing, supplying, jointing and testing at work sites of PVC pipes shall comply with all currently applicable statutes, regulations, standards and codes. in particular, the following standards, unless otherwise specified herein, shall be referred.

5.10.3 MATERIALS

ASTM D 1785 SCH	-	Specification for Poly Vinyl Chloride (PVC) Plastic Pipes, 40 & SCH 80.
ASTM D 2466	-	Socket type Vinyl Chloride Plastic Pipe Fittings SCH 40
ASTM D 2467	-	Socket type Vinyl Chloride Plastic Pipe Fittings SCH 80
ASTM D 2564	-	Solvent Cement for Plastic Pipes & Fittings

ASTM D 2774 5.10.4	-	Underground installation of Thermo plastic Pipes DESIGN

Design of uPVC pipes shall be according to ASTM D-1785 & fittings shall be made according to ASTM D-2467 (for Schedule 80). The pipe shall have socketed solvent welded fittings.

5.10.5 TRENCHING



5.10.6 THE WIDTH OF THE TRENCH AT THE CROWN OF THE PIPE SHALL BE NOT LESS THAN THE OUTSIDE DIAMETER OF PIPE PLUS 300 MM TO ALLOW PROPER COMPACTION OF THE SIDE FILLS & AT A 225 MM ABOVE THE CROWN OF THE PIPE. THE TRENCH WIDTH SHALL BE AS BELOW :

NOMINAL PIPE SIZE (IN MM)	TRENCH WIDTH MIN. (IN MM)	TRENCH WIDTH MAX. (IN MM)
110	450	600
160	450	600
200	600	700
225	600	700
250	600	700
315	700	850
355	750	900
400	800	950
450	850	1000

5.10.7 The minimum trench depth shall be width plus outer diameter of pipe or 0.75 mtr. above crown of pipe whichever is more.

5.10.8 The trench shall be backfilled as soon as possible.

5.10.9 The excavated material shall be deposited at a sufficient distance away from the edge of the trench to avoid damage to the pipes through falling stones & debris.

5.10.10 Pipe shall be laid with a cover, measured from the top of the pipe to the surface of the ground of not less than 1.2 mtr. under roads

5.10.11 The pipe bedding shall be with a granular material & backfilling shall be performed in layer of 6 inch WITH EACH LAYER & SHALL BE SUFFICIENTLY COMPACTIONED TO 85% TO 95% COMPACTION.

5.10.12 A mechanical compaction shall be carried out for compacting sand & gravel backfill. Optionally manual compaction shall be carried out.

5.10.13 A trench shall be completely filled & backfilling shall be palced & spread in uniform layers to prevent any unfilled spaces or voids. Large rocks, stones, etc. shall be removed. Heavy tampers or rolling EQUIPMENT SHALL BE USED FOR FINAL BACKFILLING ONLY.

5.11 PIPE HANDLING & STORAGE :

5.11.1 The pipe shall not be pushed or dragged from the truck bed. Pallets for pipe shall be removed with a fork lift. Loose pipe can be rolled down on timber.

5.11.2 The pipe shall be stored in open ground which shall be dry & free from sharp objects.

5.11.3 The pipe shall be protected from the sun & shall be in area with proper ventilation.

5.11.4 If the pipe shall be stored in racks or it shall be supported throughout its length with the spacing not more than 3 feet.

5.12 LAYING & JOINTING :

5.12.1 Pipe shall be cut square with the special tool.

5.12.2 The inside & outside edges shall be cleaned from any burrs with file or deburring tool.



- 5.12.3 The surface shall be cleaned with a clean dry cloth.
- 5.12.4 With light pressure, pipe should go one third to one half of the way into the fitting socket.
- 5.12.5 Pipes & fittings that are too tight shall not be used. Use an applicator having size equal to one half the pipe diameter.
- 5.12.6 For jointing, full even layer of cement shall be provided on external surface of the pipe & medium layer of cement shall be provided to the inside of a fitting
- 5.12.7 Pipe & fittings shall be assembled & pipe shall give a quarter turn.
- 5.12.8 The piping (for sch. 40) shall be supported by the means of hangers having recommended spacing as below :

NOMINAL PIPE SIZE (MM)	TEMPERATURE IN DEG. C				
	15.5	26.6	37.7	48.8	60
15	4.5 MTR.	4.5 MTR.	4 MTR.	2.5 MTR.	2.5 MTR.
20	5 MTR.	4.5 MTR.	4 MTR.	2.5 MTR.	2.5 MTR.
25	5.5 MTR.	5 MTR.	4.5 MTR.	3 MTR.	2.5 MTR.
32	5.5 MTR.	5.5 MTR.	5 MTR.	3 MTR.	3 MTR.
40	6 MTR.	5.5 MTR.	5 MTR.	3.5 MTR.	3 MTR.
50	6 MTR.	5.5 MTR.	5 MTR.	3.5 MTR.	3 MTR.
63	6.5 MTR.	6 MTR.	5.5 MTR.	4 MTR.	3 MTR.
75	7 MTR.	7 MTR.	6 MTR.	4 MTR.	3.5 MTR.
100	7.5 MTR.	7 MTR.	6.5 MTR.	4.5 MTR.	4 MTR.
150	8.5 MTR.	8 MTR.	7.5 MTR.	5 MTR.	4.5 MTR.

- 5.12.9 The pipe joint setting & curing time shall be recommended as :

5.12.10 SET TIME :

Temperature	Pipe size	Pipe Size	Pipe Size
Range	15 mm to 32 mm	40 mm to 75 mm	100 & 150 mm
15.5-37.7 deg C	15 minute	30 minute	60 minute
4.4-15.5 deg C	60 minute	120 minute	240 minute

5.12.11 CURE TIME :

Temperature	Pipe size	Pipe Size	Pipe Size
Range	15 mm to 32 mm	40 mm to 75 mm	100 & 150 mm
15.5-37.7 deg C	6 hrs.	12 hrs.	24 hrs.
4.4-15.5 deg C	12 hrs.	24 hrs.	48 hrs.

- 5.12.12 To compensate the expansion & contraction, suitable means shall be provided by expansion loops with 90 deg elbows / bellows subject to the application for the above ground installation



- 5.12.13 For underground application, the compensation for expansion & contraction shall be done by anaking the pipe in trench.

5.13 TESTING :

- 5.13.1 The pipe shall be tested with water. Before testing, it shall be properly anchored.
- 5.13.2 Thrust blocks shall be provided at dead ends, at change in direction & at cahnge in size.
- 5.13.3 The piping shall be slowly filled with water with velocity not exceeding 1ft./sec.
- 5.13.4 Vents shall be provided at high points & air shall be release before testing.
- 5.13.5 All valves & vents shall kept open during testing to release the air.
- 5.13.6 The piping shall be tested for 125% of design working pressure for one hour maximum
- 5.13.7 During testing, if any joint is leaking, it shall be cut & replaced.

6.0 INTERNAL DRAINAGE (SOIL, WASTE, VENT AND RAIN WATER PIPES):

6.1 SCOPE:

- 6.1.1 Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install all soil, waste, vent and rainwater pipes as required by the drawings, specified hereinafter and given in the Bill of Quantities.
- 6.1.2 Without restricting to the generality of the foregoing, the soil, waste, vent and rainwater pipes system shall include the followings:-
- i. Cast Iron / UPVC vertical and horizontal soil waste and vent pipes, rainwater pipes and fittings, joints clamps and connections to fixtures.
 - ii. Floor traps, floor drain clean out plugs, inlet fittings and rainwater roof drain, area/local drains, trench drain...
 - iii. Waste pipes connections from all fixtures e.g. wash basins, sinks, kitchen equipment.
 - iv. Testing of all pipes.
 - v. Connection of main.

6.2 GENERAL REQUIREMENTS

- 6.2.1 All materials shall be new of the best quality conforming to specifications and subject to the approval of Client's Representative.
- 6.2.2 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- 6.2.3 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.
- 6.2.4 Pipes shall be securely fixed to walls by suitable clamps at intervals specified.



- 6.2.5 Access doors for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.
- 6.2.6 All works shall be executed as directed by Client's Representative.

6.3 CAST IRON PIPES & FITTINGS

- 6.3.1 Soil, waste, vent and anti-siphonage pipes shall be cast iron pipes with socket and spigot. All pipes shall be straight and smooth and inside free from irregular bore, blow holes, cracks and other manufacturing defects. Pipes shall be centrifugally spun iron soil pipes conforming to sand cast I.S. 1729-1967.
- 6.3.2 STANDARD WEIGHT DIMENSIONS AND PIG LEAD REQUIRED FOR JOINTS SHALL BE AS FOLLOWS:-

For conforming to I.S. 1729-1967 (sand cast iron soil pipes and fittings)

Diameter	Thickness	Overall	Internal	Depth
Weight	diameter of			
6'length or 1.83 M	of socket lead			
50	5	11.41	7.62	5
75	5	16.52	10.12	5
100	5	21.67	12.92	5
150	5	31.91	18.13	2

- 6.3.3 TOLERANCE
Acceptable tolerance for pipes to I.S. 1729 shall be as follows:-

- a) Wall thickness -15%
- b) Length ± 20 mm
- c) Weight $\pm 10\%$

6.3.4 FITTINGS

Fittings shall conform to the corresponding Indian Standard as for pipes. Contractor shall use pipes and fittings of matching specification.

Access door shall be secured air and water tight with 3mm thick insertion rubber washer and white lead. The bolts shall be lubricated with grease or white lead for easy removal.

6.3.5 JOINTING:

All soil, waste and vent pipes including fixture connections between traps and soil pipes shall be jointed with refined pig lead conforming to IS: 27-1977 sufficient sken of jute rope shall be caulked to leave a minimum space for the pig lead as given in **6.3.2** to be poured in. After pouring the lead shall be caulked into the joint with caulking tool and hammer. All surplus lead shall be cut and joint left flush with the rim of the socket neatly.

- 6.3.6 Vent pipes penetration through roof shall be by means of sleeves. The sleeve will be kept 100mm higher the finish roof level and annular space filled with fire proof materials like putty, fire seal etc.

6.3.7 PIPE, HANGERS, SUPPORT, CLAMP, BRACKE ETC.:

All vertical pipes shall be fixed by M.S. Clamps truly vertical. Branch pipes shall be connected to the stack at the same angle as that of the fittings. No collars shall be



used on vertical stacks. Each stack shall be terminated at top with a cowl (terminal guard).

Inclined pipes running along ceiling shall be fixed on M.S. adjustable hangers of special design shown on the drawings or as directed. Pipes shall be laid to uniform slope and the hangers adjusted to the proper levels so that the pipes fully rest on them.

M.S. clamps shall be of standard design and fabricated from M.S. flat 40mm x 3mm x 3mm thick. They shall be painted with two coats of black bitumen paint before fixing.

Structural clamps shall be fabricated from M.S. structural members e.g. rods, angles, channels, flats, as per detailed drawing or as directed. Contractor shall provide all nuts, bolts, welding and paint the clamps with one coat of red oxide. Wooden saddles shall be provided free of cost.

Slotted angle/channel supports on walls shall be provided wherever shown on drawings or as required. Angles/channels shall be fixed to brick walls and bolts embedded in cement concrete blocks and to RCC walls with suitable anchor fasteners. Holes required in RCC walls shall be neatly drilled by electric drills and no manual chiseling will be allowed. The spacing of supports horizontally shall not exceed 1.8 M.

Wherever M.S. clamps are required to be anchored directly to brick walls, concrete slabs, beams or columns, nothing extra shall be payable for clamping arrangement and for making good with cement concrete 1:2:4 (mix 1 cement :2 coarse sand :4 stone aggregate 20mm nominal size) as directed by the Client's Representative.

6.3.8 TESTING:

All pipe work shall be tested before connecting any appliances and then again after connection of appliances. Pipe shall be tested after installation by one of the test given below as directed by the Client's Representative.

Before use at site, all C.I. soil pipes shall be tested by filling up with water for at least 10 minutes at 3 meter head. After filling, pipes shall be struck with a hammer and inspected for blow holes and cracks. All defective pipes shall be rejected and removed from the site within 48 hours.

Water Test:

Pipes shall be tested after installation by filling up the stack with water. All openings and connections shall be suitable plugged. The total head in the stack shall however not 3 M exceed. The level of water in the stack shall not drop within 8 hours. If there is a drop in level of water the leak shall be detected and rectified and test shall be re-conducted until satisfactory result is achieved.

Smoke Test:

Contractor may test all soil and waste stacks by a smoke testing machine. Smoke shall be pumped into the stack after plugging all inlet and outlet connections.

The stack shall then be observed for leakages and all defective pipes and fittings removed or repaired as directed by the Client's Representative.

6.3.9 UPVC PIPES AND FITTINGS (RAIN WATER):



The pipes shall be round and shall be supplied in straight lengths with socketed ends. The internal and external surfaces of pipes shall be smooth, clean, and free from grooving and other defects. The ends shall be cleanly cut and square with the axis of the pipe. The pipes shall be designated by external diameter and shall conform to IS: 4985-1981.

OUTER DIA. (MM)	PRESSURE (KG/CM ²)	INNER DIA. (MM)	WEIGHT/MT (KG.)
110	4	104.5	1.315
125	4	118.7	1.712
140	4	133.0	2.131
160	4	152.0	2.783
180	4	175.9	3.560
200	2	190.1	4.526
225	4	213.8	5.480

Fittings:

Fittings shall be of the same make as that of pipes, injection moulded and shall conform to Indian Standard.

Laying and Jointing:

The pipes shall be laid and clamped to wooden plugs fixed above the surface of the wall. Alternatively plastic clamps of suitable designs shall be preferred. Provision shall be made for the effect of thermal movement by not gripping or disturbing the pipe at supports between the anchors for suspended pipes. The supports shall allow the repeated movements to take place without abrasion.

Jointing for UPVC pipes shall be made by means of solvent cement for horizontal lines and 'O' rubber ring for vertical line. The type of joint shall be used as per site conditions/direction of the Client's Representative. Where UPVC pipes are to be used for rain water pipes, the pipe shall be finished with G.I. adopter for insertion in the R.C.C. slab for a water proof joint complete as directed by Client's Representative.

Supports:

UPVC pipes require supports at close intervals. Recommended support spacing for unplasticised PVC pipes is 1400 mm for pipes 50 mm dia and above. Pipes shall be aligned properly before fixing them on the wooden plugs with clamps. Even if the wooden plugs are fixed using a plumb line, pipe shall also be checked for its alignment before clamping, piping shall be properly supported on, or suspended from clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers and be responsible for their structural sufficiency. Pipe supports shall be primer coated with rust preventive paint.

Repairs:

While temporary or emergency repairs may be made to the damaged pipes, permanent repairs should be made by replacement of the damaged section. If any split or chip out occurs in the wall of the pipe, a short piece of pipe of sufficient length to cover the damaged portion of the pipe is cut. The sleeve is cut longitudinally and heated sufficiently to soften it so that it may be slipped over the damaged hard pipe.

Testing:



All lengths of PVC rain water pipes shall be fully tested for water tightness by means of water test maintained for not less than 30 minutes. All pipes shall be subjected to a test pressure of at least 1.5 meter head of water head. The test pressure shall, however, not exceed 6 meter head at any point. The pipes shall be plugged preferably with standard design plugs with rubber plugs on both ends. The upper end shall, however, be connected to a pipe for filling with water and getting the required head.

6.3.10 WASTE PIPE FROM APPLIANCES:

- i) Waste pipe from appliances e.g. wash basins, sinks, urinals, chrome plate where seen water coolers shall be of galvanised steel (heavy class) conforming to IS:1239-1979.
- ii) All pipes shall be fixed in gradient towards the outfalls of drains. Pipes inside a toilet room shall be in chase unless otherwise shown on drawings. Where required pipes may be run at ceiling level in suitable gradient and supported on structural clamps. Spacing for clamps for such pipes shall be as follows:-

Vertical	Horizontal	
G.I. Pipes	300 cms	240 cms
P.V.C. Pipes	180 cms	120 cms

6.3.11 PAINTING

Soil, waste vent and rainwater pipes in exposed location, in shafts and pipe spaces shall be thoroughly cleaned to remove dirt, rust and other contamination, and painted with two or more coats of synthetic enamel paint to give an even shade.

Paint shall be of approved quality and shade, where directed pipes shall be painted in accordance with approved pipe colour code.

Waste pipes in chase shall be thoroughly cleaned to remove dirt, rust and other contamination, and painted with two coats of bitumen paint, covered with polythene tape and a final coat of bitumen paint. Exposed pipes shall be painted with two or more coats of synthetic enamel paint.

C.I. soil and waste pipes below ground and covered in cement concrete shall not be painted.

6.3.12 MEASUREMENTS:

C.I. / UPVC/ G.I. waste/soil, waste, vent and rain water pipes shall be measured over all along the center line correct to a centimeter including all fittings along its length. The rate for these pipes shall be inclusive of all fittings, holder bat clamps, lead caulked joint for C.I. and cement joints for UPVC and all other items described in the Bill or Quantities. The portion of the pipe within the collar for C.I./UPVC pipe at the joint shall not be included in the length of the pipe work.

6.4. SWR UPVC PIPES AND FITTINGS :

- 6.4.1 Soil, waste, vent SWR Ring Fit pipes with socket and spigot. All pipes shall be straight and smooth and inside free from irregular bore, blow holes, cracks and other manufacturing defects. These pipes conform to Indian Standard IS: 4985 – 2000 and are designed to withstand continuous internal hydraulic pressure of 4 Kgf/cm so as to ensure life-long trouble free working. The pipes are provided with an integral rubber ring type socket at one end while the other end is kept plain, smooth and free from



burrs. Rubber ring type socket ends provide easy push – fit type jointing. Simultaneously, allowance for thermal expansion can also be provided during installation. Pipes shall be centrifugally spun iron soil pipes conforming to sand cast I.S. 1729-1967.

6.4.2 FITTINGS:

Fittings shall conform to the corresponding Indian Standard as for pipes. Contractor shall use pipes and fittings of matching specification.

Access door shall be secured air and water tight with 3mm thick insertion rubber washer and white lead. The bolts shall be lubricated with grease or white lead for easy removal.

6.4.3 JOINTING:

Rubber Seal Rings for Joints & Access Doors : Manufactured in accordance with IS : 5382 for 75 mm / 90 mm / 110 mm sizes. These are made out of natural rubber with a shore 'A' hardness of 40 × 5. Provide superior resistance to biological attack. Special design of cross section ensures perfect sealing.

Lubricant: Available in 100 gms, 250 gms & 500 gms packing. Specially formulated for compatibility with rubber seal as well as PVC. Does not support the growth of bacteria or fungi.

6.4.4 PIPE, HANGERS, SUPPORT, CLAMP, BRACKET ETC.:

Supports:

UPVC pipes require supports at close intervals. Recommended support spacing for unplasticized PVC pipes is 1400 mm for pipes 50 mm dia and above. Pipes shall be aligned properly before fixing them on the wooden plugs with clamps. Even if the wooden plugs are fixed using a plumb line, pipe shall also be checked for its alignment before clamping, piping shall be properly supported on, or suspended from clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers and be responsible for their structural sufficiency. Pipe supports shall be primer coated with rust preventive paint.

6.4.5 TESTING:

Before the system is put into use, it should be tested for leakages by air test, hydraulic test or smoke test.

6.5 TRAPS:

6.5.1 NAHANI TRAP OR FLOOR TRAPS:

Nahani traps or floor traps shall be cast iron/ PVC / , deep seal with an effective seal of 50 mm. The trap and waste pipes shall be set in cement concrete blocks firmly supported on the structural floor. The blocks shall be in 1:2:3 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) mixed with water proof compound and extended to 40 mm below finished floor level. Contractor shall provide all necessary shuttering and centering for the blocks. Size of the block shall be 30 x 30 cms of the required depth. The trap shall be installed at lowest point ensure no ponding occurs at perimeters of the drain.

6.6 FLOOR TRAP INLET



Bath room traps and connections shall ensure free and silent flow of discharging water. Where specified, the Contractor shall provide a special type galvanised iron inlet fitting without or with one, two or three inlet sockets to receive the waste pipe. Joint between waste and fitting shall be connected to a C.I. 'P' or 'S' trap with at least 50mm seal (Hopper and traps shall be paid for separately). Floor trap inlet fittings and the trap shall be set in cement concrete blocks.

6.7 C.P./STAINLESS STEEL GRATINGS

Floor and Urinal traps shall be provided with 100-150mm square or round C.P./Stainless steel grating as approved by Client's Representative with rim, of approved design and shape. Minimum thickness shall be 4-5mm or as specified in the Bill of Quantities.

6.8 CLEANOUT PLUGS

Contractor shall provide cast brass cleanout plugs in all horizontal run more than 15 meter length required one cleanout plugs shall be threaded and provided with key holes for opening. Cleanout plugs shall be fixed to the pipe by a G.I. socket and lead caulked joint.

6.9 PIPE SLEEVES

Pipe sleeves 50mm larger diameter than pipes shall be provided wherever pipes pass through walls and slabs and annular space filled with fire proof materials like putty, fire seal etc. All pipes shall be accurately cut to the required sizes in accordance with relevant BIS codes and burs removed before laying. Open ends of the pipe shall be closed as the pipe is installed to avoid entrance of foreign matters. Vertical sleeve shall finish 50mm above finish floor level.



LIST OF APPROVED MAKES:

Sr. No.	Item	Approved Make
1	SWR PVC PIPE & FITTINGS 6 KG CM ² ; FITTINGS : 6 KG CM ² ECO. DRAIN PIPE & FITTINGS	FINOLEX / SUPREME/ SUPREME/ ASTRAL
2	STONE WARE PIPES FOR INTERNAL UNDER GROUND DRAIN PIPE	GIRCO / TIRUMALA / SONIA
3	C.I. PIPE & FITTINGS	NECO OR EQ.
4	CPVC PIPES FITTINGS	ASTRAL/ASHIRVAD
5	M.S/G.I. PIPES FOR WATER SUPPLY	TATA / JINDAL/ ASIAN
6	ASTM/CPVC PIPE & FITTINGS FOR WATER SUPPLY	ASTRAL / SUPREME/ASHIRWAD / FINOLEX
7	COMPOSITE PLUMBING PIPE & COMPOSITE FITTINGS	KITEC
8	G.I. PIPES FITTINGS WATER SUPPLY	DRP-M / R-BRAND / ZOLOTO
9	GI TO GI JOINTS	CHAMPION / EQUIVALENT
10	SOLVENT CEMENT	ASTRAL / SUPREME/ASHIRWAD / FINOLEX
11	BALL VALVES	ZOLOTO / AUDCO/R.B.
12	WHEEL VALVES	ZOLOTO / AUDCO/R.B.
13	DCV / NRV	ZOLOTO/SPIREX/AUDCO
14	TAR	SHALIBIND / TIKIBOND-BS
15	VALVES	ZOLOTO / AUDCO/R.B.
16	CP. & BATH FITTINGS	JAQUAR.
17	SANITARY FIXTURES	HINDWARE / PARRYWARE / CERA
18	METALLIC BELLOWS	BELLOW FLEX / PRICISION / DHRUV / B.D. ENGR.

NOTE : (1) Equivalent makes shall be approved by PMC before procurement
(2) Make & Model No. of Sanitary & Bath Fixtures will be finalized by the Architect.