9.1.2 Material

Material shall conform to the following standard and manufacture shall be stated in the particular specification.

A. Asphalt;

(1) Quality of asphalt compound and blown asphalt shall conform to the following Table 1.2 A (1).

Table 1.2 A (1) Quality of asphalt

Test Items		Asphalt Compound 1-Class	Asphalt Compound 2-Class	Asphalt Compound 3-Class	Blown Asphalt
Degree of Penetration	25°C 100g 5 sec.	20-30	20-30	30-40	20-30
	0°C 200g 60 sec.	Over 12	Over 15	Over 18	Over 10
	46°C 50g 5 sec.	Under 60	Under 60	Under 60	Under 70
Softening Point		Over 85°C	Over 100°C	Over 100°C	Over 80°C
Ductility		Over 3.5cm	Over 2.0cm	Over 3.5cm	Over 2.0cm
Flash Point		Over 260°C	Over 260°C	Over 290°C	Over 200°C
Freezing Point		Under -3°C	Under -3°C	Under -15°C	-
Weather Resistance		Over 600hr	Over 600hr	Over 1200hr	-
Viscosity		Over 40c.p.	Over 40c.p.	Over 150c.p.	-

(2) Grade of asphalt compound and blown asphalt shall conform to the following Table 1.2 A (2) according to locality, climate, structure and other effective conditions.

Table 1.2 A (2) Selection of asphalt

Type / Zoning	Asphalt Compound 1-Class	2-Class	3-Class	Blown Asphalt
Extremely Cold	○	-	◎	-
Cold	○	-	◎	△
Cold and Wet	○	○	◎	△
Warm	○	○	○	△
Warm and Wet	○	○	○	-
Type of Use	Capable of walking on covered w/ gravel interior	Exposed	General	Interior
Type of Structure	Reinforced concrete Steel	Reinforced concrete	Reinforced concrete	Reinforced concrete

Note: ◎ Best ○ Good △ Fair

B. Asphalt Roofing;

(1) Asphalt felt, asphalt roofing and sanded roofing shall conform to requirement of JIS A 6005 (Asphalt felt), JIS A 6006 (Asphalt roofing) and JIS A 6007 (Sanded roofing). Generally, felt shall be 30 kg and roofing shall be 35 kg.

(2) Grade and quality of special roofing refer to the following Table 1.2 B (1) and Table 1.2 B (2).

Table 1.2 B (1) Grade of special roofing

Type		Special Roof A	Special Roof B	Special Roof C	Special Roof D	Special Roof E
	ABBR.	A	B	C	D	E
Contents	Name	Roofing for Insulation	Roofing for Base	Roofing with Bitumen Powder	Synthetic Fiber Roofing	Sanded Synthetic Fiber Roofing
	Note	Punched roofing to isolate bedding from water proofing layer.	Moisture proofed roofing for bedding of exposed water proofing layer.	Special bitumen powder roofing of bonding capacity with heat dissolved asphalt. For medium layer.	Roofing with loose synthetic fiber as a base material large expansion type.	Sanded roofing with synthetic fiber as a base material.

Table 1.2 B (2) Quality of special roofing

Items	ABBR. A	B	C	D	E
Weight of 1 Roll (Kg)	30.4	29.1	36.6	35.6	41.3
Length of 1 Roll (m)	21.2	21.2	21.7	21.0	10.7
Width (m)	1.004	1.004	1.004	1.00	1.00
Unit Weight of Product (g/m^2)	1,430.0	1,370.0	1,696.0	1,660.0	3,870.0
Unit Weight of Raw Material (g/m^2)	190.0	210.0	290.0	115.0	198.5
Permeability of Asphalt (%)	150	141	151	720	810
Tensile Strength (Kg) Vertical	12.0	13.0	12.0	9.7	23.5
Width 2cm 25°C (Kg)	6.0	8.5	7.8	3.4	15.5
Folding Test 25°C	No Cracks	No Cracks	No Cracks	No Cracks	No Cracks
Heat Resisting Test 80°C 5hrs.	Pass	Pass	Pass	Pass	Pass
Permeable Conditionof Asphalt	All Permeable	All Permeable	All Permeable	All Permeable	All Permeable

C. Supplementary Material;

(1) Asphalt Primer;

(a) Manufacturing of asphalt primer shall conform to the following Table 1.2 C (1).

Table 1.2 C (1) Quality of asphalt primer

Raw-Material	Mixing Ration(Weight)	Requirement
Blown Asphalt	40 - 50%	Penetration 10 - 20
Solvent Naphtha.	30 - 35%	Refined Material
Essential Oil	25 - 30%	40 - 50 Baume's Hydrometer

(b) Special primer shall be applied in case bedding of asphalt water-proofing is A.L.C. (Air Entrained Light-Weight Concrete Panel) of steel structural construction. Special primer as the above stated shall conform to the following Table 1.2 C (2).

Table 1.2 C (2) Special primer (2-liquid-agent reaction type)

	A-Agent	B-Agent
Component	Main-Agent	Hardner
Color	Dark Brown	Black
Mixing-Ratio	1	2
Mixing Viscosity	10°C: 2650 cps. 20°C: 1350 cps.	
Amount Apply.	$0.7kg/m^2$	1st $0.4kg/m^2$ 2nd $0.3kg/m^2$
Hardening	5°- 10°C: More Than 24 Hours 10°- 20°C: More Than 18 Hours 20°C or More: More Than 12 Hours 5°C or Less: More Than 24 Hours	

(2) Manufacturing of asphalt roofing coating shall conform to the following Table 1.2 C (3).

Table 1.2 C (3) Asphalt roofing coating

Raw-Material	Mixing Ratio (Weight)	Requirement
Blown Asphalt	40 - 50%	Penetration 20 - 30
Essential Oil	30 - 35%	40% Industrial Gasoline (Baume's 40-50)
Solvent Naphtha		60% Refined (Baume's More Than 50)
Asbestos	8 - 12%	Quality of Grade 5 - 6
Powder	10 - 15%	Sieve Through 0.074 mm
Resin	2%	

D. Miscellaneous Material;
Materials not stated in this section shall be submitted for approval of the supervisor before use.

E. Manufacturer shall be appointed by the supervisor unless otherwise specified.

F. Test and Inspection;
Manufacturer's quality certificate of material for asphalt water-proofing shall be submitted for approval of the supervisor and following test shall be provided;
Approximately 2 kg test sample for each grade or 4000 kg. of asphalt shall be tested for quality stated in Section A (1) and (2) and C (2). However, certain tests and test for minor scale of water-proofing work may be omitted with approval of the supervisor.

9.1.3 Performance

A. Asphalt water-proofing work shall be performed with care for climate condition and with direction of the supervisor.

B. Position of asphalt solution pit shall be considered for handling, transporting, fire proofness and damage protection, and shall be approved by the supervisor.
In case asphalt solution pit is placed on concrete slab or roof, concrete shall be protected by heat isolating layer. Solution pit shall not be placed on completed water-proofing in any case.

C. Bedding for asphalt water-proofing shall be inclined toward water drainage and shall be steel trowell planed for roughness less than ±14 mm within 2 m. Mixture of mortar bedding shall be 1:3 (volume ratio of cement to sand) and thickness shall be 15 mm unless otherwise specified.

D. Bedding shall be cleaned and confirmed of no obstacle for application of asphalt primer. Primer shall be dried for more than 24 hours.

E. Application of Asphalt;
(1) Asphalt shall be melted in solution pit at temperature of 140°C-240°C. Asphalt solution shall be applied immediately and shall not be heated for long period. Asphalt Grade-3 shall be melted with temperature of 30°-50°C more than temperature stated above.
(2) Performance of application of asphalt as follows;
(a) Apply by brush; 0.8-1.0 kg/m^2 of asphalt shall be applied by brush to uniform asphalt coating.

Asphalt may be spread-on with standard thickness at warm-climate with approval of the supervisor.

(b) Mesh of reticulated roofing sheet shall be properly filled and coated with asphalt.

(c) Spot roofing shall be applied with asphalt properly as designated.

F. Placing asphalt roofing;

(1) Asphalt roofing shall be cleaned from sand dirt and others disturbing complete binding.

(2) Asphalt roofing shall be uniformly spread and placed together with asphalt in case asphalt is spread-on. Asphalt roofing shall be completely bounded to bedding and any cavity, air, wrincle or crack shall be immediately mended.

(3) Asphalt roofing shall be wrapped more than 100mm with each other at both sides and ends and placed right-angle to water slope, and wrap of each layer shall not be on each other. Asphalt poured out from wrapping joint shall be spread-out immediately.

(4) Around roof drain, elbow gutter, anchor bolt, rise corner, corner and rise end shall conform to the followings;

(a) All places stated above shall be covered with reticulated roofing and applied with asphalt, and additional two layers shall be placed according to direction of the supervisor. End of additional layer for projected bolts and pipes shall be tightened with copper wire.

(b) Corner of rise and corner of roofing shall be additionally covered with reticulated roofing of 300 mm width and applied with asphalt according to direction of the supervisor.

(c) End of asphalt roofing rise shall be covered with reticulated roofing of 75 mm width. End of any asphalt roofing shall be applied of asphalt coating.

(d) In case of exposed asphalt roofing, rise shall be precovered with a layer of asphalt roofing extended 75 mm to horizontal face. End of the asphalt roofing shall be also applied of asphalt coating.

(e) Wrap of sanded roofing shall be carefully bound with asphalt, and asphalt overflowed shall be rolled and covered with same color sand.

(f) In case water-proofing layer is covered with lath and mortar, joiner together with roofing (size 600x600 mm) for lath shall be bound by asphalt at 200 mm on center both horizontally and vertically.

9.1.4 Guarantee

Joint surety of contractor and water-proofing sub-contractor shall be prepared. Period of guarantee shall be stated in the particular specification. Material shall be delivered together with quality certificate (tested chart) as directed by the supervisor.

9.2 Water-Proofed Concrete Roof

9.2.1 Structure and Scale

A. Structure shall be principally rectangler and shall be less than 14 m by width and 50 m by length, and span of beam supporting roof shall be less than 7 m.
B. Thickness of structural concrete roof shall be more than 15 cm with slope more than 1/30.
C. Water-proofed concrete shall be reinforced with wire-mesh stated in the following Item C of Section 2.2 Corner shall be reinforced with 3 pcs. of 2 m reinforcing bar ϕ13 mm and center portion shall be reinforced with reinforcing bar ϕ13 mm @300 mm (300 mm O.C. in both way).

9.2.2 Material

A. Material shall conform to Chapter 5 Concrete and Form work.
B. Principally, surface active agent shall be added. Any additive agent promote reinforcing bar rusting and concrete shrinking and cracking shall not be added. Other additive agents shall be stated in the particular specification.
C. Wire mesh shall conform to JIS G 3551 (wire-mesh) and as follows;

Classification	Bar	Mesh Size
Square Mesh	ϕ3.2mm	100 x 100 mm

9.2.3 Mixture

A. Water-cement ratio shall be less than 50%.
B. Slump shall be less than 120 mm.
C. Proportion of fine and coarse aggregate shall be planned with slightly more fine aggregate than maximum densed proportion of fine and coarse aggregate. Maximum densed proportion shall refer to following Section 2.6 (maximum density test of aggregate).
D. (1) Viscosity and uniformity of concrete shall be determined by test mix, and mixture shall be decided.
(2) Mixture shall be determined by the following Table 2.3 D in case mixture is not determined by above stated Item C.

Table 2.3 D (1) Mixture of river-sand, river-gravel

Slump (cm)	W/C (%)	Percentage of Sand (%)	Effective Amount of Water (kg/m³)	Absolute Volume (ℓ/m³)			Weight (kg/m³)			Field Measured Volume (per 1 m³)			Amount of Air (%)
				Cement	Sand	Gravel	Cement	Sand	Gravel	Cement (bag)	Sand (m³)	Gravel (m³)	
9	50	34.7	140	89	257	484	280	668	1,292	5.60	0.514	0.792	3-4
12	50	34.7	146	92	254	477	293	660	1,274	5.86	0.508	0.781	3-4

Table 2.3 D (2) Mixture of river-sand, crushed stone, AE (Air-Entraine) Agent

Slump (cm)	W/C (%)	Percentage of Sand (%)	Effective Amount of Water (kg/m^3)	Absolute Volume (ℓ/m^3)			Weight (kg/m^3)			Field Measured Volume (per 1 m^3)			Amount of Air (%)
				Cement	Sand	Gravel	Cement	Sand	Gravel	Cement (bag)	Sand (m^3)	Gravel (m^3)	
9	50	37.0	143	91	272	464	287	707	1,239	5.74	0.544	0.815	3-4
12	50	37.0	148	94	269	459	296	699	1,226	5.92	0.538	0.807	3-4

9.2.4 Placing and Finishing

A. Water-proofed concrete shall be placed after structural concrete is hardened.
B. Concrete shall be placed until reinforcing bars are buried and wire mesh shall be placed and concrete shall be placed again up to designated hight from lower part and surface shall be planed.
C. Concrete shall not have any pouring joint and in case pouring joint is unavoitable, water-proofing treatment shall be provided according to direction of the supervisor unless other-wise specified.
D. Tamping and finishing shall conform to Chapter 5 Concrete and form work.

9.2.5 Wire-Mesh

Wire-Mesh shall be wrapped more than one mesh and jointed at every five mesh with binding wire thicker than 0.8 mm. Wire-Mesh shall be jointed to reinforcing bar if necessary.

9.2.6 Maximum Density Test of Aggregate

A. Test sample shall be aggregate of air-dried condition. Amount of sample shall be approxi-mately 15 kg for fine aggregate and 35 kg for coarse aggregate. Mixing ratio of fine aggregate against coarse aggregate as 1.5, 1.7, 1.9 and 2.1 and unit volume weight of each mixture shall be tested.
B. Testing method shall conform to JIS A 1104 (Method of unit volume weight of aggregate).
C. Maximum unit volume weight of aggregate mixture shall be called as maximum density, and proportion of fine and coarse aggregate of maximum density shall be determined according to above stated Item B.

9.3 Miscellaneous Water-Proofing

A. Water-proofed mortar, water-proofed synthetic resin, water-proofed sheet and other water-proofing and caulking shall be otherwise specified or performed by manufacturer with surety.
B. Joint surety of contractor and water-proofing sub-contractor shall be submitted.

9.4 Caulking

9.4.1 Scope

A. Caulking shall be applied around opening of exterior wall, joint for coping of parapet and pipes and gutter extended through exterior wall.
B. Caulking shall be applied on the above stated location and other places designated on draw-ings.

9.4.2 Materials — Material shall be stated in the particular specification or directed by the supervisor. Consistency shall be approved by the supervisor.

9.4.3 Performance
A. Joint or space for caulking shall be free from dirt, cement paste, paint and other obstacles, and proper pump shall be prepared to insert and compact caulking material.
B. Any agent shall not be added to caulking material to adjust consistency.
C. In case caulking applied is damaged or affected, that caulking material shall be replaced.

9.5 Expansion Joint — Expansion joint shall be provided at concrete pouring joint, large area of water-proofing and others stated otherwise or indicated on drawings. Material and performance shall conform to the particular specification or direction of the supervisor.

10. Masonry Work

10.1 Stone and Marble

10.1.1 Materials

A. Sample of materials shall be submitted and approved for quality, color tone and finish in accordance with the drawings or the particular specification.
B. Materials shall be free of rust, spot, damage, stain, etc. Marbles shall be of good quality without spots in color and marking.
C. Type, shape and size of hardware shall be as follows.

Stone

Type	Materials		Shape and Size
Metal Ties	Brass	Galvanized Round Bar	Over 6ϕ Bent at Both Ends
Tenons	"		Over 9ϕ 80mm Long Clamp
Clamps	"		9ϕ 150mm Long

Marbles

Brass wire #12 - #8 shall be used in all types.
Material for hanger rod for lintel or other designated area shall be face nuts in compliance with the above description.
D. Mixing ratio by volume of mortar shall be as follows.

Stone

Type of Use		Cement	Hydrated HME	Sand
Hard Stone	Masonry	1	0.2	3
	Tooled Joint	1	-	0.5
	Bed Mortar	1	-	3
	Grout	1	-	2
Soft Stone	Masonry	1	0.2	3
	Tooled Joint	1	-	1
	Bed Mortar	1	-	3
	Grout	1	-	2

Marble

Type of Use	Cement	Sand	Plaster	White Cement	Note
Joint Surface	1	-	1	-	-
Grout	1	3	-	-	-
Joint	-	1	1	1	Coloring

Portland cement shall be qualified in JIS R 5210 (Portland cement). White cement or other admixtures shall be used with direction of the supervisor.

10.1.2 Shop Drawing.

A. Course drawing, full size drawing, mounting drawing shall be prepared in accordance with design drawings and approved by the supervisor.

B. Scale model shall be made with oily clay or plaster where specified and approved by the supervisor.

10.1.3 Process

A. Size and shape of face and joint surface shall be properly finished according to course drawing and full size drawing. Process shall be all done in plant. Adjusting of joint surface in the field shall not be allowed.

B. Mould shall be of thick steel type. Face of mould shall be aligned for proper finish.

C. Type of finish and work schedule shall be as in the table below.

Tapping finish of hard stone

Type of Finish		Work Schedule: Frosted Work	Removing Lumps Knobbing or Masons Hammer	Chiseled Work	Bush-Hammer Work: 25 Sq.	64 Sq.	100 Sq.	Dabbed Finish: 1	2	3	Note
Frosted Work											Size of lumps shall be specified in the particular specification.
Chiseled Work	Rough		1 ⟶ 2								Chiseled mark at every 60mm.
	Medium		1 ⟶ 2								Chiseled mark at every 50mm.
	Fine		1 ⟶ 2								Chiseled mark at every 30mm.
Bush-Hammer Work	25 Sq.		1 ⟶ 2 ⟶ 3								Care shall be taken not to damage stone.
	64 Sq.		1 ⟶ 2 ⟶ 3 ⟶ 4								
	100 Sq.		1 ⟶ 2 ⟶ 3 ⟶ 4 ⟶ 5								
Dabbed Finish	1		1 ⟶ 2 ⟶ 3 ⟶ 4 ⟶ 5* ⟶ 6								25 dabbing per 50mm. Chiseled mark shall not be remained.
	2		1 ⟶ 2 ⟶ 3 ⟶ 4 ⟶ 5 ⟶ 6 ⟶ 7								33 dabbing per 50mm. Fine dabbing shall be done in order so
	3		1 ⟶ 2 ⟶ 3 ⟶ 4 ⟶ 5 ⟶ 6 ⟶ 7 ⟶ 8								50 dabbing per 50mm. that no bush-hammering is remained.

Note: * Omitting of this process shall be stated in the particular specification.

Types of polish finish of hard stone and work schedule.

Type of Finish			Work Schedule: Bedding	Work Schedule: Polish by Machine
Polish	One Piece	Rough Polish	Bush Hammer 100 Sq.	Grinded with #60 iron sand or carborundom.
		Water Polish		Grinded with #180 carborundom.
		Matted Finish		Grinded with # F carborundom.
		Luster Finish		Grinded with # F carborundom and finished with polishing powder by buffing.
	Cut Piece	Rough Polish	Cut Face	Finished with iron sand by disk.
		Water Polish		Grinded by #180 carborundom.
		Matted Finish		Grinded by # F carborundom.
		Luster Finish		Grinded with # F carborundom and finished with polishing powder by buffing.

Types of polish finish of soft stone and work schedule.

Type of Finish	Work Schedule: Hammering	Scraping 1	Scraping 2	Work Schedule: Pointed Hammering	Work Schedule: Frosted Work	Work Schedule: Bush Hammering	Work Schedule: Dabbing	Work Schedule: Sawing	Work Schedule: Polishing	Remarks
Hammering	1									
Scraping: Rough Scraping		1								
Scraping: Scraping		1→2								
Pointed Hammering		1	→ 2							
Frosted Work					1					
Bush Hammering		1	→			→ 2				
Dabbing		1				2	→ 3			2 shall be omitted by quality of stone

- continued -

Type of Finish	Work Schedule: Hammering	Scraping 1	Scraping 2	Pointed Hammering	Frosted Work	Bush Hammering	Dabbing	Sawing	Polishing	Remarks
Sawing								1		
Polishing		1→2				3	4		5	3 shall be omitted by quality of stone
								1	2	

Types of marble finish and work schedule.

Type of Finish	Work Schedule: Bedding — Flat	Bedding — Molded	Method of Polishing
Rough Polish	Polished with #80 carborundom and stone	Polished with #40 and #80 carborundom and stone	Polished with #180 carborundom.
Water Polish			Polished with #220 carborundom and stone and for molded bedding, polished with polishing stone approved by the supervisor.
Finish Polish			Polished with polishing stone and chacoal approved by the supervisor and finished with polishing powder by buffing.

D. Finish of width shall be more than 20 mm for abutment and blind side. Finish of width 50 mm for underground and penetrating side shall be as the same degree of finish as exposed side.

10.1.4 Placing of Stone

A. Galvanized round steel bar of 9 mm ϕ shall be tied in line with vertical or horizontal joint to 2 galvanized iron wires of 6 mm ϕ embedded in the wall according to shop drawing.

B. Bed shall be cleared and basis for layout such as internal corner and external corner shall be correctly located. Designated fixing hardware shall be attached and bed mortar shall be placed after vertical and horizontal alignments are checked.

C. Materials of wedge shall be of lead. Care shall be taken to be no voids in grout space by

stuffing clean cloths in joint when placing mortar. Placing of mortar shall be devided into 2 - 3 times depending on the size of stone. Cloths in joints shall be removed after mortar shall be properly set.

D. External and internal angles shall be clamped. Proper fasteners shall be provided at least 2 for each stone.

E. Joint shall be filled with mortar, and tooled joint shall be finished with tooled joint mortar after washed with water. Specified water proof agent shall be mixed in joint mortar.

F. Size of joint shall be 6 mm both vertically and horizontally.

10.1.5 Placing of Marbles

A. Treatment on bed shall conform to that of masonry work.

B. Wedge shall be placed at the bottom edge of baseboard, and the position of baseboard shall be temporarily secured before tied down to bed by hardware at the top edge and abutments at both ends.

C. Grout shall be poured up to a height of baseboard or 100 mm of the lowest masonry panel in order to be secure against masonry loads.

D. Masonry panel shall be tied to 2 - 4 tieing wires, of which number depend on the size of stone, placed at horizontal joint, and band mortar of 100 mm shall be filled at top and bottom abutments at both ends.

E. Vertical abutments shall be fixed by tenon, metal ties and clamp. Internal corner and external corner shall be fixed with clamp.

F. In case of large plate, grouts shall be applied to random spots up to a floor height of 2 m and allow enough space between bed and plate to avoid damage from shock and pressure.

G. Backfilling mortar shall be all grouted at exterior places exposed to rain or other places specified.

H. Care shall be taken not to have irregular or uneven placing.

I. Joint shall be closed joint unless otherwise specified.

J. Work shall be stopped when temperature drops below 2°C.

10.1.6 Curing

In order to avoid stain on finished surface, stained surface shall be cleaned immediately after placed and cured with a heavy building paper. Outer angle, window sill and flat parts shall be properly cured with a heavy building paper.

10.1.7 Cleaning

A. Masonry surface shall be cleaned off mortar or other attachments by chisel, wire brush with water at the time supervisor specifies.

B. Water shall not be used on marbles. Marbles shall be wiped with dried clean cotton cloth or felt and finished with wax. A little water shall be allowed to take off glue. Marbles shall be polished right before delivery to the owner.

C. Hydrochrolic acid or similar items shall not be used in cleaning of masonry as a rule.

10.2 Terrazzo Block and Immitation Stone.

10.2.1 Materials

A. Sample of materials shall be submitted and approved for variety of broken stone chips, size of chips, color tone and finish in accordance with the drawing.
B. Quality, brass and galvanized iron wire shall comply to those of marble work.
C. Mixing ratio by volume of mortar shall comply to that of masonry and marble works. Mixing volume ratio of mortar for abutment of immitation stone shall be cement 1 to sand 2.

10.2.2 Shop Drawing and Scale Model

Shop drawing and scale model shall comply to those of masonry and marble works.

10.2.3 Production of Terrazzo Block

A. Type of finish and work schedule shall comply to those of marble work.
B. Standard process of preparation shall be as follows.
(1) Dry mortar with mixing volume ratio of cement 1 to coarse sand 3 shall be spread into a thickness of first half of bed thickness (20-25 mm) in a mold of specified size. And then #10 iron wires shall be placed both ways at every 200 mm. Second half of mortar shall be spread on top of those wires and packed tight or pushed tight with vibrator. All necessary metal ties shall be applied at this stage.
(2) Dry mixture with mixing volume ratio of white cement (with paint of specified color) 1 to marble chips (less than 12 mm) 3 shall be spread into a thickness of 10-15 mm on top of prepared bed and packed tight for marbles to fix and leveled by roller or trowel.
(3) Mixing of finish coat shall be a machine mixing as a rule. New finish coating agent shall not be mixed with those already mixed.
(4) The surface shall be properly moisture-cured to avoid abrupt drying after molded. Terrazzo block shall be cured in the water for more than 5 days after removing from mold.
(5) After curing in the water terrazzo block shall be dryed completely and finished. Care shall be taken not to receive direct sunlight when drying.

10.2.4 Production of Immitation Stone

A. Type of finish and work schedule shall be as in the table below.

	Work Schedule	
Type of Finish	Bed	Method of Polish and Tapping
Rough Polish	Rough polish by a disk grinder with river sands or similar items or bush-hammer of 100 sq.	With minimum #40-60 river sands by a disk
Water Polish		With minimum #180 carborundum by grinder
Dabbed Finish		Shall comply to masonry work

B. Standard process of preparation shall be as follows.
(1) Stiff concrete with mixing volume ratio of cement 1 to fine gravel 5 shall be spread into a mold of specified size and packed tight. #8 Iron wires shall be placed both ways at every 150 mm at half thickness of bed concrete (35 mm) and the rest of concrete shall be spread and packed tight to make a flat bed of thickness 35 mm. All necessary metal ties shall be applied at this stage.
(2) Dry mixture with mixing volume ratio of cement 1 to broken stone chips (less than 6 mm unless otherwise specified) 2 shall be spread to a thickness of 10 mm on top of bed and packed tight for chips to fix and leveled and properly cured from abrupt drying.
(3) Curing and drying after application of mixture shall comply to 10.2.3.
(4) Proper amount of white cement and paint shall be used in finish coating when necessary.

10.2.5 Placing

A. Placing method of terrazzo and immitation stone shall comply to that of marble work and masonry work respectively.
B. Backfilling mortar shall be all grouted where exposed to rain.

10.2.6 Joint

A. Terrazzo joint shall be closed joint unless otherwise specified.
B. Immitation stone joint shall comply to that of masonry work unless otherwise specified.

11. Tile Work

11.1 Tile Work

11.1.1 Materials

A. Ceramic tile shall be standard quality, meeting the minimum requirements of JIS A 5209 (ceramic tile). Samples of material shall be submitted and approved for manufacturer, product name by areas of use, class, shape and size, color tone, body, glaze and quality in accordance with the drawing and the particular specification.
B. Portland Cement shall conform to the requirements of JIS R 5210 (Portland cement). Mortar shall be used by adding water to machine mixed dry grout. It shall not be used that has been over an hour after water is added. Mixing volume ratio of mortar shall be as follows:

Areas of Use	Cement	Sand
Setting and Paying Mortar	1	3
Setting Mortar for Tile of High Permeability	1	2.5
Joint Filler	1	1

Pure cement shall be used in case of joint width less than 3 mm. For use of white cement

for joint filler, color hue, mixing ratio, etc. shall be in accordance with direction of the supervisor.

C. The use of water proof agent and admixture for setting bed mortar joint in accordance with the particular specification shall conform to the requirements of Section 3.2 E and F in Chapter 15 Mortar and plaster.

11.1.2 Tile Layout — Joint plan shall be made in accordance with the design drawings and approved by the supervisor.

11.1.3 Tile Preparation — Color tone, distortion, size, etc. shall be checked and sorted out before preparing tile, and areas of use shall be decided. Tiles with uniform thickness shall be selected for bond setting. Tiles with high permeability shall be soaked without fail before setting.

11.1.4 Setting

A. Standard Tile

(1) Preparation of setting bed-leveling mortar (with water-proof agent in case of exterior work) shall be applied and scratched. Mortar shall be applied in several times where leveling is need, however foreign objects such as debris of brick or tile shall not be spread. Tile shall be set after mortar has been set for more than 5 days.

(2) Setting bed shall be cleaned and wetted. Leveling string shall be provided in accordance with joint layout, and tiles are set after checking for distortion, joint widths, etc. Backfilling mortar shall be spread into every corner, but care shall be taken not to sprinkle fresh cement. Raking shall be done up to the depth of 5 mm after tile has been set for 3 hours, and tile surface shall be cleaned with cloth or its equivalent. Care shall be taken not to apply external force or vibration for 7 days after tile has been set.

(3) The use of water-proofing agent, admixture or special joint filler for joint fill after setting mortar has been hardened shall be in compliance with the particular specification.

B. Mosaic Tile

(1) Preparation of setting bed shall comply with that of standard tile.

(2) Setting bed shall be cleaned and wetted. Dry mortar shall be spread to a thickness of 10 mm and tapped with wood trowel until a surface becomes wetted and then screeded to get a level surface. Water pitch shall be provided as necessary. After dry mortar has been set for more than 24 hours, wet mortar with mixing ratio of cement 1 to sand 1 shall be spread to a thickness of 4 mm, and tiles shall be layed after leveling strings shall be provided in accordance with joint layout.
Tile top shall be tapped with wood trowel until mortar shows up in joints and then papers shall be taken off after wetting the surface. Tile joint shall be aligned. Glue shall not be used on the above mortar.

(3) Wet neat cement shall be applied to joint after tiles have been set for more than 24 hours.

Tile surface shall be cleaned with sawdust, cloth, etc. and further washed with water after more than 24 hours have passed.

11.1.5 Bond Setting

A. Setting surface shall be cleaned and wetted, and mortar shall be applied after leveling. Then first coat (Mixing ratio of cement 1 to sand 2.5) and second coat (Mixing ratio of cement 1 to sand 3) shall be subsequently applied. The surface shall be screeded and pressed with wood trowel and become sufficiently firm. Resin for mixing with first coat and second coat mortar shall be stated in the particular specification.

B. Second coated mortar surface shall be cleaned and applied with specified resin thinned by 8 to 10 times by brush.
On top of that, resin mixed mortar shall be applied by trowel to an area which shall be layed with tiles within 30 minutes and that surface shall be screeded both ways and finished with 6 mm to 10 mm thickness.
Tiles shall be layed by distribution drawing. Leveling string shall be placed first and tiles are layed from top to bottom and pressed until mortar squeezing out of joint. After tiles are set all extra mortar shall be scraped off and correct levelness by straight edge. When correcting a tiled area after it has been set for more than 30 minutes, tiles in that area shall be taken out and reset by applying mortar in the back of tiles.

11.1.6 Curing

Work shall be properly cured or stopped temporarily in tile setting when temperature drops below 2°C, temperature might drop below 5°C within one day after execution of work or conditions of direct sunshine, wind, rain, etc. are injurious to work.
Work already executed shall be properly cured depending on place and weather.

11.1.7 Cleaning

Tiled surface shall be cleaned with water as a rule after joint has been filled for more than a week. When acid solution is used to clean the surface, tiles already watered shall be washed with approval of the supervisor by thinner thinned 20 times and soon washed with water so that there is no acids left in joints. In acid washing, care shall be taken not to leave acid on adjacent finishes such as sash, aluminium, stone, marble, terrazzo, accessories on sanitary equipment, etc.

11.1.8 Reinforcing Hardware

Large tiles used in parapet or lintel shall be set with approval of the supervisor by tenon, copper wire, etc. and concrete mortar shall be backfilled.

11.1.9 Expansion Joint

Expansion joint shall be provided with direction of the supervisor when the drawing or the particular specification specifies or tiles are set in large area. Method and materials shall be as directed by the supervisor unless otherwise specified.

11.2 Terra-Cotta Work

Terra-cotta work shall be as stated in the particular specification.

12. Carpentry

12.1.1 Scope — Carpentry work shall conform to this specification unless otherwise specified.

12.1.2 Shop Drawing — Samples, shop drawings, full scale drawing and other required drawings shall be submitted for the approval of the supervisor according to the drawings.

12.1.3 Standard of Material — Material shall be suitably dried and conform to required standard and requirement concerned.

12.1.4 Material

A. Name and grade of structural lumber, fixture and wood board shall be otherwise specified.
B. Material for fixture shall not be center of wood.
C. Dimension specified shall be size of sawn lumber, however dimension specified for fixture shall be size actually finished.
D. Diameter of log specified shall be maximum diameter.
E. Exposed surface of lumber shall be planed according to following Table 1.4 (1) grade of planer. Unless otherwise specified, grade of planer shall be B-Grade. Floor joist and furring strips for board shall be medium planed.

Table 1.4 (1) Grade of planer

Grade	Process 1	2	3	4
A-Grade	Rough Plane (Machine)	Medium Plane	Medium Plane	Finish Plane (Perfectly)
B-Grade	Ditto	Ditto	Finish Plane	-
C-Grade	Ditto	Ditto	-	-

12.1.5 Laminated Lumber

A. Scope:
The use of laminated lumber stated in the particular specification shall conform to this specification.
B. Definition:
Core and finish (sliced lumber) shall be pressure bonded with synthetic resin adhesive to produce equivalent texture of natural lumber.
C. Standard:
(1) Designated dimension shall be size actually finished.
(2) Lumber shall be artificially dried and moisture content shall be less than 15%.

(3) In case sectional area of laminated lumber is less than 15 cm^2, core and finish splice shall be same lumber or equivalent.

D. Standard of core and finish splice:
(1) Core shall be conifer lumber and shall not be with decay, knot (more than ϕ 30 mm) and other defects. Core shall be approximately 15 mm thick and 450 - 1000 mm length.
(2) Core shall not be center of wood.
(3) Finish splice shall be with no knot and approximately 3 mm thick, however for sill 6 mm thick.
(4) Adhesive shall be synthetic resin (phenol resin, melamine resin, urea resin) of required adhesive strength.

E. Manufacturing:
(1) Core shall be jointed at approximately 1 m length and core adjoined to each other shall not be jointed closer than 150 mm. Core shall be laminately bonded with fibre of lumber paralleled.
(2) Core shall be bonded with pressure more than 7 kg/cm^2 and adhesive shall be applied approximately 220 g/cm^2 for both sides.
(3) Finish splice shall be perfect plained with all corner plained off for finish.
(4) Laminated lumber shall be waxed.
(5) Groove shall be plained and waxed.

12.1.6 Joint

A. Structural lumber shall be jointed at random, however purlin projected over 2 m may be jointed at same position.
B. Sill, girder and other unavoidable short lumber structure shall be approximately 1 m length and others 2 m length.
C. Joint and other connection shall be approved by the supervisor.

12.1.7 Hard-ware

A. Quality and dimension of hard-ware shall conform to JIS A 5508 (Round iron nail), JIS B 1135 (Wood screw), JIS A 5531 (Hard-ware for wood structure), JIS G 3101 (Roll steel for general structure) and JIS G 3131 (Hot drawn roll mild steel plate and band).
B. Dimension and quality of hard-ware shall meet the requirements and shall not be rusted, deformed or defected.
C. Steel plate and steel bar shall be arc-welded unless otherwise specified.
D. Nailing for structural members shall be specified or directed by the supervisor.
E. Nailing for fixture members shall be provided at every 450 - 600 mm in case member is paralleled or every junction in case member is crossed. Nailing for board shall be provided at each end and approximately every 100 mm in same interval.
F. Dimension of clamps shall be specified or directed by the supervisor.
G. Hard-ware shall be refined tar baked unless covered with concrete. Any exposed hard-ware painting finish shall conform to Chapter 19 Painting.

12.1.8 Wood-Plug — Size and dimension of wood-plug shall suit the requirements and wood-plug shall be dried and applied with preservatives. Material shall be specified or directed by the supervisor.

12.1.9 Preservation of Material — Preservatives shall conform to the requirements of JIS K 2470 (creosote) and applying member as follows;

A. Structural member adjoined to concrete, bricks, masonry, earth and other moistured portion.
B. Frame work of mortared wall (sill, post, brace) determined for moisturing. 1 m from ground for exterior and 1 m from floor for interior.
C. Other places affected by water. However, omission may be allowed by approval of the supervisor.

12.1.10 Protection — All exposed surface of structural and fixture work shall be protected from contamination and injury by covering with vinyle sheet, wood-board, paper and other proper method. Especially exposed fair finished wood panels shall be protected with special care.

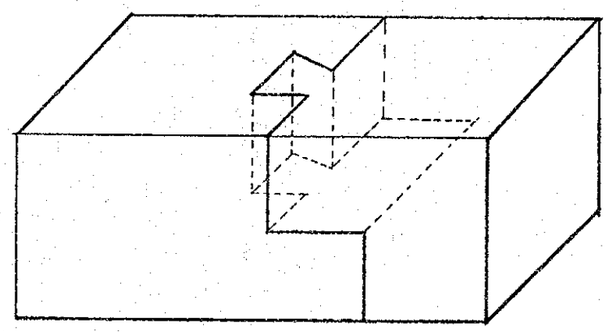
12.2 Frame Work for Partition of Reinforced Concrete Structure.

12.2.1 Material — Material shall be directed by the supervisor or otherwise specified.

12.2.2 Performance

A. Sill and plinth;
(1) Joint;
Avoid position of column, stud and anchored bolt and cramped and jointed as following sketch 2A (1);

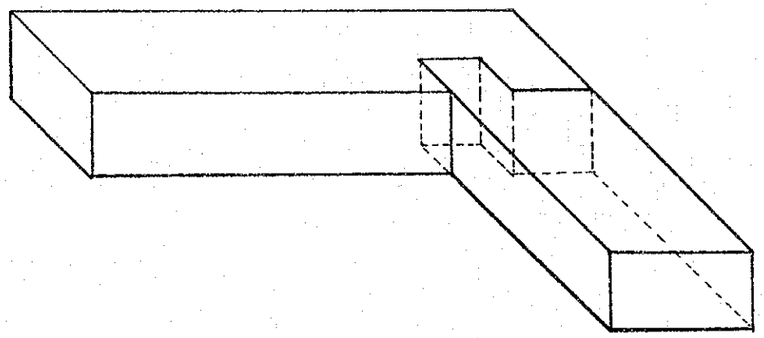
Sketch 2A (1)



Joint of strips shall be clamped and jointed as tongue and groove.

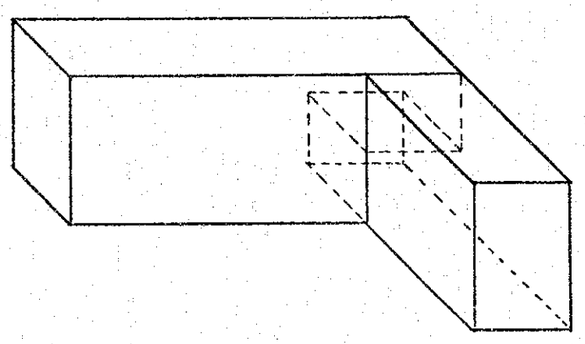
(2) Connection;
Corner shall be horizontally clamped and jointed as following sketch 2A (2)-1;

Sketch 2A (2)-1



Corner of strips (Hight and width less than 8 x 24 cm) shall be horizontally clamped and jointed as following sketch 2A (2)-2;

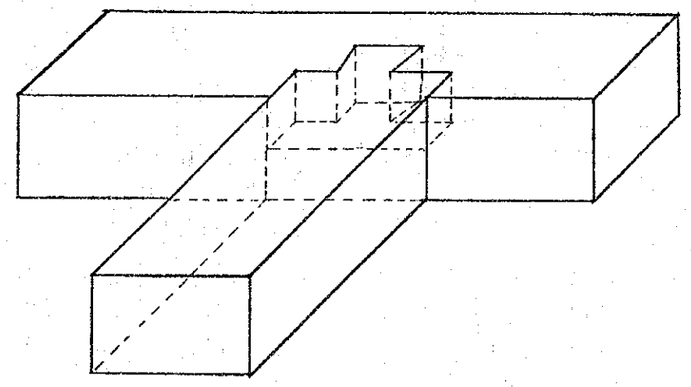
Sketch 2A (2)-2



(Halving Joint)

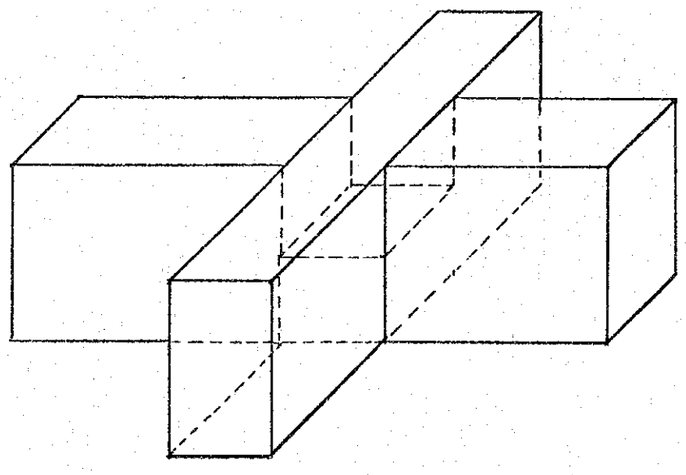
Crossing shall be horizontally clamped jointed as following sketch 2A (2)-3;

Sketch 2A (2)-3



Crossing of strips shall be nailed and jointed as following sketch 2A (2)-4;

Sketch 2A (2)-4

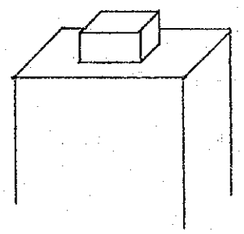


(3) Installation;
Each end and approximately every 2 m shall be tightened by anchor bolt ϕ 9 mm.

B. Post:

(1) Connection
Top of post shall be nailed and jointed with following sketch 2B (1)-1;

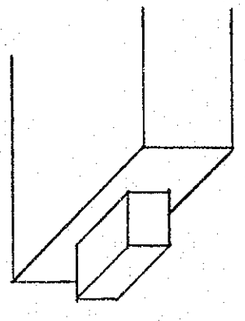
Sketch 2B (1)-1



Mortise-and-tenon joint

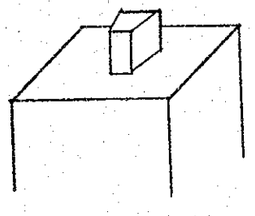
Bottom of post shall be nailed and jointed with following sketch 2B (1)-2;

Sketch 2B (1)-2



Side tenon joint

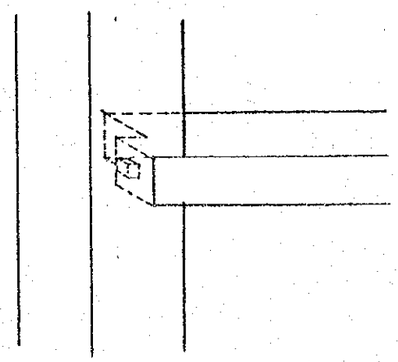
Top of post for corner shall be nailed, clamped and jointed with following sketch 2B (1)-3;



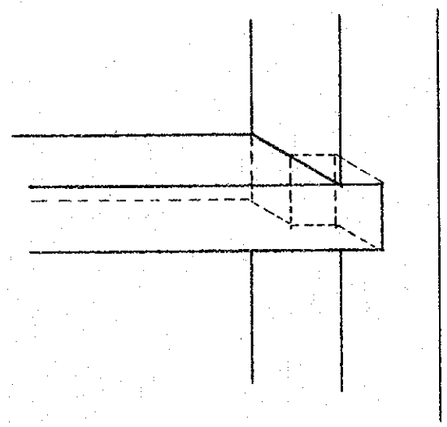
Sketch 2B (1)-3

C. Lintel and window-sill:
Lintel and window-sill shall be connected to column or stud at both end. One end shall be clamped both side and another end shall be nailed and clamped, and both end shall be jointed as following sketch 2D-1 and sketch 2D-2;

Sketch 2D-1



Sketch 2D-2



D. Brace:
Brace shall be nailed from both side.

E. Wedging:
All member attached to concrete floor, wall, ceiling and beam shall be wedged at both end and approximately at every 900 mm. Wedge shall be nailed to prevent moving. However, area below sill may be filled with mortar (volume ratio 1:3).

12.3 Floor Framing

12.3.1 Material — Material shall be specified or directed by the supervisor.

12.3.2 Performance

A. Floor Post:
Bottom shall be butted to footing and top shall be nailed and jointed to sleeper according to sketch 2B (1)-1.

B. Sleeper:
(1) Joint;
Joint of sleepers shall be approximately 150 mm away from floor post and clamped or nailed and jointed according to sketch 2A (1).
(2) Connection;
Sleeper shall be placed on floor post and nailed. Sleeper shall be placed on side-sleeper and nailed.

C. Bridging batten of floor post:
(1) Joint;
Batten shall be jointed at random and nailed.
(2) Connection;
Batten shall be attached to floor post and nailed.

D. Ledger strip or board:
(1) Joint;
Ledger board shall be butted at center of post.
Ledger;
Ledger strip shall be jointed tongue and groove at center of post.
(2) Connection;
Ledger board shall be attached and double nailed to each post or stud, and bracket shall be provided for joist. Ledger strip shall be cogged jointed to post and diagonal brace and stud shall be cogged for strip to connect. All junction shall be double nailed.
(3) Connection to concrete;
Ledger strip or board shall be attached to concrete wall and tightened by anchor bolt at each end and approximately at ever 1.2 m.

E. Floor joist:
(1) Joist shall be butted at center of ledger strip and other bracket and nailed.
(2) Connection;
In case thickness of joist is more than 90 mm, floor joist shall be cogged and nailed. Smaller floor joist shall be placed on ledger strip and other bracket and nailed.

F. Additionally strengthened joist above ground floor:
(1) Joint;
Joist shall be butted at center of ledging strip and clamped from top.
(2) Connection;
Ledging strip shall be cogged at junction with joist and nailed.
(3) Position;
Joist shall be provided at every 1.8 - 2.0 m.

12.4 Flooring

12.4.1 Material — Material shall be otherwise specified or directed by the supervisor.

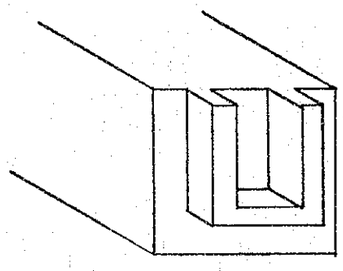
12.4.2 Performance

A. Bedding board:
Dimension of bedding board shall be less than 17.4 mm thick and approximately 180 mm wide. Side of board shall be shiplapped, and each end shall be butted at random on center of joist and nailed.

B. Flooring board:
Dimension of flooring board shall be thicker than 17.5 mm and approximately 100 mm wide. Side of board shall be tongued and grooved and each end shall be tongued and grooved at random on center of joist and blind nailed.

C. Rail:
Rail shall be grooved for tongue of flooring board and each end shall be dado jointed and blind nailed to column or stud. Joint of rail shall be as following sketch 5C.

Sketch 5C



D. Inspection hatch:
Frame, rail around and cover shall be the same material as floor board. Frame shall be grooved for cover board and flooring board and clamped and nailed to floor joist or ledge strip and tenoned at corner joint. Rail around cover shall be grooved for cover board and tenoned at corner joint. Back strip for cover board shall be provided at approximately every 300 mm and grooved to rail. Cover board shall conform to floor board. Handle hardware shall be carved on rail.

12.5 Wall and Ceiling Framing

12.5.1 Material — Material shall be otherwise specified or directed by the supervisor.

12.5.2 Performance

A. Performance shall conform to the following items and furring strips directly covered by finishing board and other finishing material shall be planed with planer machine.

B. Wall furring strip:

(1) Size;
17.5x110/2 mm for wood and fibre board
17.5x110 mm for strips at joint of above board.
30x110/2 mm for asbestos board.
30x110 mm for strips at joint of above board.

(2) Interval;
@300 mm for excelsior, plaster and asbest board.
@450 mm for others.

(3) Connection;
Post and stud shall be grooved to strips and strips shall be nailed for fibre, plywood and plaster board and space between board and post or stud shall be filled with extra wedging strips. Strips for panel board shall be butted and nailed between post and stud or butted and nailed directly on face of post or stud.

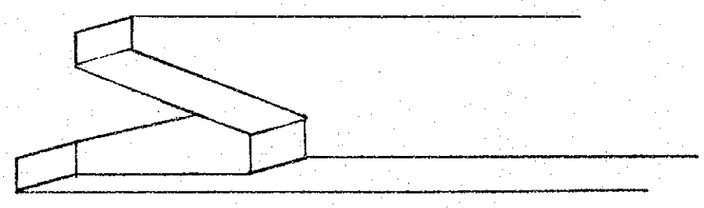
C. Ceiling joist for furring strips of ceiling:

(1) Size;40x50 mm.

(2) Interval; approximately @900 mm

(3) Connection;
Nailed at junction with furring strips. Joint of joist shall be avoided from junction and nailed and jointed at random as following sketch 7C.

Sketch 7C



In case grill type furring strips of ceiling is specified, ceiling joist shall be neglected. End of furring strips shall be nailed also to joist.

D. Furring strips for ceiling:

(1) Size;
40x50mm however 40x60 mm for joint of asbestos and plaster board.

(2) Joint;
Joint of furring strips shall be avoided from junction and nailed and jointed as sketch 7C or butted and nailed with reinforcing strips at both side.
(3) Interval;
Approximately @360 mm for plastering
Approximately @450 mm for others.
(4) Connection;
Furring strips shall be grill type (450x450 mm) and nailed for fibre, plywood, plaster, excelsior and asbestos board finish.

E. Furring board:
(1) Size;
40x50 mm strips
17.5x100 mm board for joint of finish
17.5x100/2 mm board for center
(2) Joint;
Strips shall be jointed as above stated.
Boards shall be jointed at random on center of strip but not on joint of strips.
(3) Interval;
Strips shall be approximately every 450 mm.
Board shall be determined from finishing material, however approximately 300 mm or 450 mm.
(4) Connection;
Board shall be nailed to strips.
In case furring strip or board is exposed as joiner, exposed surface shall be painted before covering with finishing material.

F. Ceiling hanger:
(1) Size;
30x40 mm (Bolt-hanger shall be ϕ 9 mm)
(2) Interval;
Approximately 900 mm.
(3) Connection;
Hanger shall be nailed and jointed according to sketch 2A (2)-3 to strips.
Hanger shall be attached and nailed to joist and carrying rod.

G. Carrying rod:
(1) Size;
80x80 mm
(2) Interval;
Approximately every 900 mm.
(3) Connection;
Carrying rod shall be tightened by anchor bolt ϕ 9 mm at both end and every 1.8 m.

H. Bedding for mortar finish:

(1) Excelsior board;
Quality and dimension shall conform to JIS A 5404 (Excelsior board) and thickness 15 mm. Board shall be nailed every 100 mm of attached strip and spaced 10 mm with adjoining board.

(2) Lath;
Bedding board shall be approximately 12.5x80 mm. Asphalt felt shall be one-roll of weight 20 kg. Wall lath shall conform to JIS A 5504 (wire-lath) or JIS A 5505 (metal-lath) with approval of the supervisor. For ceiling, lath shall conform to JIS A 5505 (metal-lath). Reinforcing wire shall conform to JIS G 3532 (steel wire) of 3.4 m (B.W.G.#10).

(3) Installation;
Bedding board shall be butted at random on center of strip and nailed. Asphalt felt shall be vertically placed with least 90 mm wrapped and nailed every 300 mm both ways. Wire lath shall be reinforced by steel wire at every 450 mm both ways and nailed with stapler. Metal lath shall be wrapped 45 mm both ways and nailed at every 150 mm both ways.

I. Bedding for plaster finish:

(1) Wood lath bedding;
Wood-lath shall be 7x40 mm and spaced 8 mm at strips and double nailed and jointed at random.

(2) Lath-board;
Lath-board shall conform to JIS A 6906 (plaster lath board) of punched lath-board or plain lath-board 7 mm thick with direction of the supervisor. Board shall be nailed with galvanized nail, and joint shall be spaced 180 mm or 90 mm at both ends.

J. Bedding for galvanized or other metal sheet finish:
Bedding board shall be 15 mm thick and butted and nailed.

12.6 Wall and Ceiling Finish

12.6.1 Material

Material shall be otherwise specified or directed by the supervisor.

12.6.2 Performance

A. Flushing:
Joint shall be blind tongued and grooved at center of post, and corner shall be jointed with tongue and groove mitre joint. Flushing thinner than 17.5 mm shall be butted at center of post and stud. Post and stud shall be grooved for flushing and corner shall be mitre jointed.

B. Corner bead:
Bead shall be blind tongued and grooved at center of post or stud and grooved to wall board. Corner shall be jointed with mitre joint.

C. Base board:
Joint shall be blind tongued and grooved at center of post and bottom shall be plough grooved at floor board connection to door fitting and projected post shall be also plush grooved and blind nailed.

D. Coping:
Joint shall be blind tongued and grooved at center of post. Corner shall be blind nailed with mitre joint.

E. Bead and wood panel:
Both side of wood panel shall be plough grooved, and both ends shall be butted at center of post or stud. Wood panel shall be nailed to furring strip at approximately every 200 mm. Both ends of bead shall be tenon jointed and bead shall be blind nailed to panel.

F. Ceiling bead:
Ceiling bead shall conform to Item B Corner bead.

G. Other portions shall be stated in the drawing, particular specification, or directed by the supervisor.

12.7 Staircase

12.7.1 Material

Material shall be otherwise specified or directed by the supervisor.

12.7.2 Performance

A. Main post:
The bottom shall be long plough grooved. In case post is connected to wood baluster, joint shall be tongue and grooved. In case post is connected to wall, joint shall be grooved.

B. Pilaster:
The bottom shall be short plough grooved connections shall be the same as stated in A.

C. Stringer:
Connection shall be properly grooved, bolted, or otherwise directed by the supervisor.

D. Intermediate stringer:
Both ends shall be firmly grooved and bolted.

E. Bolt:
Bolt of 13 mm ϕ shall be provided at every 1.8 m to prevent stringers from moving.

F. Tread:
Tread shall be properly wedged and nailed at every 450 mm.

G. Riser:
Riser shall be properly wedged and nailed at every 450 mm. Connection to tread shall be tongue and grooved.

H. Base:
Base shall be firmly short plough grooved and bolted to main post, pilaster and balusters.

I. Baluster:
Top and bottom shall be short plough grooved.

J. Handrail:
Proper grooved joint, bolt and other hard-ware shall be provided.

12.8 Miscellaneous — Other carpentry work shall be otherwise specified and performance shall conform to B-Grade specified in JASS.

13. Roofing

13.1 Bedding of Roof Finish

13.1.1 Material — Material shall be otherwise specified or directed by the supervisor with reference to the following Table 1.1 Bedding material.

Table 1.1 Bedding material

Material	Specification	Remark
Shingle Roofing	Otherwise specified	
Asphalt Roofing	More than 22 kg	Vinyle sheet may be directed by the supervisor.
Asphalt Felt	More than 20 kg	

13.1.2 Performance

A. Shingle roofing:
(1) Nail shall be roofing nail of 1 mm diameter and longer than 16 mm.
(2) Shingle roofing shall be placed fully lapped at eave on standard exposing gauge as 75 mm.
(3) Shingle roofing shall be triplly placed and folded by strips on ridge.
(4) Shingle roofing shall be turned more than 240 mm on hip and valley of roof.

B. Asphalt roofing, asphalt felt and vinyle sheet:
(1) Nail shall be approximately 20 mm length and flat-head with washer. In case of galvanized sheet iron washer, it shall be approximately 20 mm diameter and 0.3 mm thick.
(2) Standard interval of nailing shall be every 300 mm however wrapped portion shall be nailed lengthwise every 120 mm and widthwise every 90 mm. Additional 21G2AG nailing shall be performed to required position.
(3) Ridge shall be folded.

13.2 Galvanized Sheet Iron Flat Seam Roofing.

13.2.1 Classification — Classification and dimension shall refer to the following Table 2.1 Classification and dimension.

Table 2.1 Classification and dimension

Classification	Dimension
Dutch-Lap Method	600 x 450
Hexagonal Method	450 x 450
Ribbed Seam Method	900 x 100

13.2.2 Material — Galvanized sheet iron shall be flat-type and conform to JIS G 3302 (Galvanized sheet iron). Thickness shall be refered to the following Table 2.2 Thickness of galvanized sheet iron unless otherwise specified.

Table 2.2 Thickness of galvanized sheet iron

Portion	Thickness	Remark
General	0.32 mm	Nail shall be galvanized
Valley	0.40 mm	and 24 - 30 mm length.

13.2.3 General Method

A. Folding:
(1) Material shall be bended with care not to damage surface.
(2) Corner of boxing shall be properly folded.
(3) Particular corner shall be reinforce by sheet and soldered.

B. Connecting:
(1) Connection shall be grooved seam (Hock lock).
(2) Particular connection for firmness and security for water-seeping shall be double grooved seam.
(3) Hock for grooved seam shall be more than 12 mm wide.
(4) Method of connection, wrapped, nailed and nail head soldered instead of grooved, seam shall be stated in the particular specification.

C. Tieing method:
(1) Clip shall be used for installation of bedding sheets.
(2) Clip shall be both continuous and spot as indicated in Table 2.3.

Table 2.3

Type	Shape	Note
Clip	Approx. 25 mm in width	Double tile pins
Continuous Clip	Approx. 900 mm in length	Butt jointed and nailed at every 200 mm.
Spot Clip	20 mm in width (40 mm folded)	Double nailed at every 250 mm.

D. Cap rolling:
(1) Roll cap sheet shall be 450 - 900 mm and joint shall be grooved seam and tightened by clip.
(2) Number of clip shall be determined from width of roll cap sheet.
(3) End of roll cap shall be grooved and nailed for approval of the supervisor.

13.2.4 Particular Performance

A. Hexagonal and dutch-lap method:
(1) Standard dimension of galvanized sheet iron for hexagonal method shall be 450x450 mm and dutch-lap method shall be 600x450 mm.
(2) Clip and additional sheet for eave and verge shall be also grooved seam.
(3) Each sheet shall be clipped at all corners and interval of approximately 300 mm.
(4) Joint shall be at random.
(5) Hexagonal sheet shall be bended and wrapped to each other and triangle sheet shall be provided at eave.

B. Ribbed seam method:
(1) Standard dimension of galvanized sheet for flat-portion shall be 500x450 mm and rib shall be 100x450 mm.
(2) Interval of rib shall be approximately 450 mm.
(3) All joint of rib and flat-portion shall be double grooved seam.
(4) Sheet for rib and flat-portion shall be grooved to each other and cliped at every 300 mm.
(5) End of rib sheet shall be grooved and folded and grooved to flat-portion sheet.
(6) Eave and vally corner shall be reinforced, grooved seam and clipped with sheet approximately 100x900 mm.
(7) Performance for ridge shall conform to section 2.5 performance for particular portion, Item A Ridge.

C. Extended galvanized sheet iron rib seam method:
(1) Interval of rib shall be approximately 400 mm.
(2) Height of rib shall be 40 mm in case interval of purlins is 600 mm and no bedding batten.

(3) Clip for rib shall be galvanized sheet iron and thicker than 0.48 mm or thickness of finishing sheet and nailed approximately ever 200 mm.
(4) Channel for rib shall be galvanized sheet iron and thicker than 0.95 mm and double nailed to each purlin.
(5) Clip for flat-portion shall be galvanized sheet iron and thicker than 0.48 mm and interval of less than 500 mm.
(6) All joint of rib and flat-portion shall be double grooved seam.
(7) Flat-portion and rib shall be extended and bent on ridge, in case ridge-cover is not provided.
(8) Other performance shall conform to above stated Item B Ribbed seam method.

13.2.5 Performance for Particular Portion

A. Ridge:
(1) Sheet covering both side of ridge-rib shall be grooved to flat and rib sheet.
(2) Ordinary ridge shall be covered with holded sheet and grooved to flat and rib sheet.

B. Connection to wall:
(1) Rain gutter of wider than 90 mm shall be provided at connection of eave and wall. Butter sheet shall be raised more than 60 mm, inserted in wall at least 60 mm and nailed approximately at every 45 mm to wall.
(2) Roof covering sheet at connection of verge and wall shall be raised more than 60 mm, inserted in wall at least 60 mm and nailed approximately every 45 mm to wall.

C. Eave and verge:
(1) Covering sheet of eave and verge shall be grooved to flat and rib sheet.

D. Gutter:
(1) Standard dimension of gutter shall be 450 mm x 900 mm.
(2) Gutter sheet shall be clipped and grooved seam at every connection.
(3) Gutter sheet connected to ridge shall be raised more than 50 mm, inserted at least 100 mm and nailed or clipped.

13.3 Corrugated Galvanized Sheet Iron Roofing

13.3.1 Material

Dimension of corrugated galvanized sheet iron as follows:
Thickness of sheet; 0.32 mm, 0.40mm or 0.49 mm.
Large corrugation; 76.2 mm.
Small corrugation; 31.8 mm.

13.3.2 General Performance

A. Lap for joint as in the following Table 3.2 Lap for joint.

Table 3.2 Lap for joint

	Large Corrugated		Small Corrugated	
Inclination	2/10	3/10	4/10	5/10
Vertical Direction	200 mm	150 mm	120 mm	100 mm
Corrugation	76.2 mm		31.8 mm	
Horizontal Direction	More than 1.5 corrugation		More than 2.5 corrugation	

B. Tieing method:
(1) Sheet shall be hooked with washer and packing at top of corrugation to purlin.
(2) Sheet shall be hooked to every purlin in vertical direction and two places in horizontal direction.
(3) Sheet shall be hooked to steel-bedding by galvanized hook-bolt ϕ 6 mm or tied to wood-bedding by galvanized screw.
(4) Steel plate bead of 20 mm x 4 mm shall be vertically placed on hook-bolts or screws.
(5) Joint of beads shall be lapped at least 60 mm and tied with ϕ 6 mm bolt or two screws.

13.3.3 Performance for Particular Portion

A. Ridge shall conform to one of the followings:
(1) End of corrugated sheet shall be raised at least 100 mm and covered by ridge covering sheet.
(2) End of corrugated sheet shall be lapped by corrugated ridge covering sheet at least 100 mm.

B. Connection to wall:
Refer to section 2.5.

C. Verge shall conform to one of the followings:
(1) Verge shall be covered by folded flushing sheet.
(2) Verge shall be covered by folding side of corrugated sheet.

D. Performance for other portion shall refer to section 2.1 - 2.5.

13.4 Copper Sheet Roofing

13.4.1 Material

A. Material shall conform to the requirement of annealed sheet 0.3 mm thick stated in JIS H 3103 (touch-pitch copper sheet).
B. Tieing nail shall be copper nail 24 - 30 mm.
C. Clips and tacks shall be all copper.

13.4.2 Performance

Performance shall conform to section 2.3 - 2.5.

13.5 Light-Metal Sheet Roofing

13.5.1 Material

A. General:
Material shall conform to requirement of JIS H 4000 (Aluminium and aluminium alloy sheet) and JIS H 4010 (Corrugated aluminium and aluminium alloy sheet). Thicker plate and sheet shall be otherwise specified.

B. Fastener:
(1) Nail shall be light-metal, brass or galvanized iron and 24 - 30 mm in length.
(2) For wood-purlin and steel-purlin, refer to following Table 5.1 (1) Metal fittings for wood-purlin and Table 5.1 (2) Metal fittings for steel-purlin.

Table 5.1 (1) Metal fittings for wood-purlin

	Small Corrugated	Moulded Sheet and Large Corrugated
Nail	3.5 ϕ x 40 mm	4 ϕ x 50 mm
Wood-Screw	4 ϕ x 30 mm	5 ϕ x 40 mm

Table 5.1 (2) Fastener for steel-purlin

Nail for Purlin	ϕ 4 mm
Hook-Bolt	ϕ 4 - 5 mm
Hanger	1.2 mm thick x 20 mm width
Clip	2.0 mm thick x 25 mm width

13.5.2 General Performance

A. Folding:
(1) Material shall be bended with bending radius according to quality and thickness.
(2) Joint of additional sheet shall be hock lock or grooved seam with width of 12 mm - 15 mm.
(3) End of sheet shall be grooved seam.

B. Lapping:
(1) Vertical lapping shall refer to section 3.2.
(2) Horizontal lapping shall be 2.5 Corrugation for small corrugated sheet and 1.5 Corrugation for large corrugated sheet. Lapping for molded sheet shall be otherwise specified.

C. Inclination:
(1) Inclination shall be more than 4/10 in case joint is single grooved seam and more than 3/10 in case joint is double grooved seam. Joint shall be also applied with waterproofing paint.

(2) In case inclination is less than 3/10, joint shall be brazed and provided of batten plate.
(3) Hole for nail or hook to tie roofing sheet shall be adjusted or sheet shall be considered to avoid damage from shrinkage or expansion caused by temperature.
(4) Side of sheet shall be jointed to light-metal clip and nailed at ever 450-500 mm by two of light-metal or galvanized iron nail.

13.5.3 Particular Performance

A. Flat seam roofing:
(1) Four sides of roofing sheet shall be additionally jointed at every 450 mm to 500 mm with flat sheet or band sheet.
(2) Joint of roofing sheet shall be double grooved seam and applied with water-proofing paint or single grooved seam and applied with water-proofing paint.

B. Hexagonal roofing:
Dimension of exposed roofing sheet shall be 450 mm length and joint shall be lapped more than 20 mm, double grooved seam and applied with water-proofing paint.

C. Rib seam roofing:
(1) Joint of roofing sheet shall be grooved seam.
(2) Height of rib shall be more than 40 mm and suitable for water-proofing.

D. Corrugated or molded sheet:
(1) Corrugated sheet and molded sheet with rib shall be nailed or hooked at the highest portion of sheet. (Top of corrugation of rib).
(2) Interval for nail or hook shall conform to the following Table 5.3 Interval for nail or hook.

Table 5.3 Interval for nail or hook

Thickness of Sheet 0.5 mm

Vertical Interval (mm)		Approximately 450		Approximately 600	
Horizontal Interval (mm)	Large Corrugated	"	300	"	230
	Small Corrugated	"	250	"	190
	Moulded Sheet		200		150
Thickness of Sheet 0.7 mm		Above multiplied by 1.3			
Thickness of Sheet 0.3 mm		Above multiplied by 0.65			

13.5.4 Performance for Particular Portion

A. Ridge:
(1) Joint shall be hock locked and clipped.
(2) Corrugated or molded sheet shall be covered by ridge plate at least 100 mm.

(3) In case of flat seam roofing, sheet of flat portion shall be raised more than 20 mm and jointed grooved seam to ridge cover sheet.
(4) In case of ribbed seam roofing, sheet shall be raised 40 mm, provided water-proofing and lapped more than 75 mm and jointed grooved seam.

B. Connection to wall: (eave)
(1) In case of corrugated or molded sheet roofing, flushing sheet shall be raised more than 120 mm at wall.
(2) In case of flat seam roofing, end of sheet shall be raised more than 40 mm and jointed grooved seam to clips at wall.
(3) In case of ribbed seam roofing, refer to method stated above for ridge.

C. End of roofing sheet: (gable)
(1) In case of corrugated or molded sheet roofing, flushing sheet with more than 1.5 corrugation shall be lapped more than 100 mm and clipped. In case gable-board is provided, flushing shall be folded around gable-board, lowered more than 15 mm and provided of throating.
(2) In case of flat seam roofing, flushing sheet with more than 1.5 corrugation for large-corrugated sheet and more than 3.0 for small-corrugated sheet shall be lapped. Suitable slope shall be provided to end of flushing and shall be folded and clipped to gable-board.
(3) In case of rib seam roofing, covering sheet of rib shall be jointed grooved seam with gable-board sheet and clipped.

D. Gutter:
(1) In case gutter is provided at connection of wall and roofing, gutter sheet shall be raised more than 60 mm and inserted below roofing sheet. Roofing sheet shall be lowered more than 25 mm and clipped. Gutter sheet shall be raised more than 100 mm and covered more than 75 mm by wall-board.
(2) In case of corrugated sheet roofing, sheet shall be folded over gutter side for more than 1.5 corrugation for small-corrugated sheet or 50 mm for large-corrugated sheet. In case flushing sheet is provided, flushing shall be lapped more than 2.5 corrugation for small-corrugated sheet or 1.5 corrugation for large-corrugated sheet.

13.6 Asbestos Cement Slate Roofing

13.6.1 Material

A. Asbestos cement slate shall conform to the following requirements:
(1) JIS A 5403 (Corrugated asbestos cement slate).
(2) Slate for gable shall be channel or gable type and quality shall be otherwise specified.

B. Fastener shall conform to the following Table 6.1 Fastener.

Table 6.1 Fastener

Nail	Flat-head galvanized nail 35 mm length.
Washer-Nail	Galvanized nail 30 mm length, washer ϕ 25 mm.
Binder	Galvanized iron or copper wire.

13.6.2 General Performance

A. Slate shall be cut with steel-saw or grinder and hole shall be drilled.
B. Width of slate shall be wider than exposed gauge multiplied by 1.5, in case slope is less than 5/10.
C. Overlap shall conform to the following Table 6.2 Overlap.

Table 6.2 Overlap

Slope	4/10	5/10	6/10	7/10	8/10
Overlap	85 mm or more	75 mm or more	65 mm or more	60 mm or more	55 mm or more

13.6.3 Performance for Particular Portion

A. Gutter connection to wall refer to Section 2.5.
B. Placing and tieing:
(1) Slate shall be placed from lower portion of roof and nailed at top. However for hexagonal roofing, slate shall be nailed with washer.
(2) Verge shall be triply over-lapped as standard.

13.7 Corrugated Asbestos Cement Slate Roofing

13.7.1 Material

A. Corrugated asbestos cement slate shall conform to the following requirements:
(1) Large-corrugated and small-corrugated slate stated in JIS A 5403 (Corrugated asbestos cement slate).
(2) Gable cover shall be channel tile, end-covered channel tile and foam roof tile.
(3) Verge cover shall be corrugated sheet with wing or seam.
B. Fastener and miscellaneous shall conform to the following Table 7.1 Fastener and miscellaneous.

Table 7.1 Fastener and miscellaneous

	Diameter (ϕ)	Length	Remark
Wood-Purlin	Galvanized nail 5 mm Galvanized screw 6 mm	Longer than 75 mm	1.6 mm thick, 25 mm diameter galvanized washer and packing.
Steel-Purlin	Galvanized hook-bolt 6 mm	"	
Binder	Galvanized iron or copper wire		
Packing Mortar	Mixing ratio in volume 1:3		

13.7.2 General Performance

A. Cutting and drilling shall be refered to Section 6.2.
B. Overlap shall conform to the following Table 7.2 Overlap.

Table 7.2 Overlap

Portion	Corrugation	Overlap Tieingmetal Horizontal (Corrugation)	Vertical (mm)	Each Sheet for Each Purlin (No.)
Roof	Small Large	1.5 1.5	Longer than 150	2
Addentice	Small Large	1.5 1.5	Approximate 150	2

C. Tieing method shall be refered to Section 3.2.

13.7.3 Performance for Particular

A. Ridge shall be lapped with corrugated covering slate or flushing slate for more than 100 mm and void shall be packed with mortar.
B. Gutter and connection to wall shall conform to Section 2.5.

13.8 Pressed Cement Slate Roofing

13.8.1 Material

Pressed cement slate shall conform to the following requirements:
A. JIS A 5402 (Pressed cement slate) and pressed to groove thicker than 3 mm.
B. Slate for eave shall be provided with throating wing. Slate for verge shall be provided with groove. Both shall be standard material with drill-hole provided for tieing.

13.8.2 Performance

Placing and tieing shall conform to the following methods.

A. Each pressed cement slate shall be tied with two nails.
B. Each gutter slate shall be placed on leveling mortar and tied with nail or galvanized wire.
C. Each ridge covering slate shall be placed on leveling mortar, tied to ridge joist with wire and nail and packed with mortar.

13.9 Natural-Slate Roofing

13.9.1 Material

A. Natural slate shall conform to JIS A 5102 Natural-Slate.
B. Tieing metal shall conform to the following requirements:
(1) Nail shall be galvanized iron nail or coal-tar-baked iron nail and approximately 35 mm length.
(2) Binding wire shall be galvanized wire of iron or copper and approximately 0.9 mm diameter.

13.9.2 General Performance

A. Exposed gauge shall conform to the following Table 9.2 Exposed gauge.

Table 9.2 Exposed gauge

	Length of Slate	Inclination 5/10	6/10	7/10	8/10	10/10
Exposed Gauge	A (400 mm)	120	135	150	165	180
	B (300 mm)	90	100	110	120	130

B. Placing and tieing:
Each slate shall be tied with two nails.

13.9.3 Performance for Particular Portion

A. Gutter and wall connection shall conform to Section 2.5.
B. Eave shall be lapped and batten board shall be provided.
C. Verge and ridge shall be triplly lapped.

13.10 Asphalt Shingle Roofing

13.10.1 Material

A. Asphalt felt shall conform to JIS A 6005 (Asphalt felt) unless otherwise stated in the particular specification or directed by the supervisor.
B. Asphalt shingle shall conform to the following requirements:
(1) JIS A 6007 (Sanded roofing) and dimension shall be standard dimension of manufacturers.

(2) Asphalt shingle shall be water resisting, heat resisting and durable. Surface shall be densely covered with colored sand or other mineral grains.

C. Asphalt roofing:
(1) Refer to Chapter 9 Water proofing Section 1.2.
(2) Special felt shall be stated in the particular specification or directed by the supervisor and good quality and less shrinkage.

D. Adhesive shall conform to the following requirements:
(1) Refer to Chapter 9 Water proofing, Section 1.2.
(2) Resin type adhesive JIS A 5751 (Oil-caulking for architectural work), JIS A 5754 (Polysulfide sealing for architectural work), JIS A 5755 (Silicon sealing for architectural work). Adhesive shall be durable and suitable for asphalts. Nail shall be galvanized flat-head, 10 mm diameter and length as following Table 10.1 Length of nail.

Table 10.1 Length of nail

	Diameter	Length
For Preriminary Roofing	2.6 mm	20 mm
For Finish Roofing	2.6 mm	25 mm

Note: Bedding board shall be thicker than 15 mm as standard. Nailing with compressor to water-proofed plywood shall be stated in the particular specification.

E. Concrete nail shall conform to JIS and JES and approved by the supervisor.
F. Nail for A.L.C. panel (air-entrained light-weight concrete panel) shall conform to the requirements of manufacturer's and approved by the supervisor.

13.10.2 General Performance

Process, inclination and classification of asphalt shingle roofing shall conform to the following Table 10.2 (1) Wood bedding and Table 10.2 (2) Mortar bedding.

Table 10.2 (1) Wood bedding (able to nail)

Inclination		2.0/10 - 2.9/10	3.0/10 - 4.9/10	5.0/10 - 10.0/10	More than 10.1/10
Mark		W-21	W-22	W-23	W-24
Weight		13 kg/m^2	12 kg/m^2	12 kg/m^2	12 kg/m^2
Process	1	Special roofing	Special roofing	Special roofing	Special roofing
	2	Special roofing	Asphalt shingle	Asphalt shingle	Asphalt shingle
	3	Asphalt shingle	Adhesive	Adhesive	Adhesive
	4	Adhesive	-	-	-

Table 10.2 (2) Mortar bedding (unable to nail)

Inclination		0.5/10 - 3.0/10	3.1/10 - 4.5/10	More than 4.6/10
Mark		C-21	C-22	C-23
Weight		22 kg/m^2	22 kg/m^2	12 kg/m^2
Process	1	Primer	Special adhesive	Special adhesive
	2	Asphalt compound	Special roofing	Asphalt shingle
	3	Special roofing	Special adhesive	Adhesive
	4	Asphalt compound	Asphalt shingle	-
	5	Special roofing	Adhesive	-
	6	Asphalt compound	-	-
	7	Asphalt shingle	-	-
	8	Adhesive	-	-

Note: For A.L.C. panel bedding, special primer shall be applied at first.

13.10.3 Performance

A. Bedding treatment:
(1) Material and condition of bedding shall refer to;
(a) Wood-bedding;
Chapter 12 Carpentry and Chapter 20 Finishes.
(b) Mortar-bedding;
Chapter 15 Mortar and plaster and Chapter 9 Water-proofing.
(c) Other bedding shall conform to specification of manufacturer with approval of the supervisor.
(2) Batten board shall be placed butted of dried wood thicker than 15 mm and 90 - 120 mm width. Butted joint shall not be irregular or deformed.
(3) Plywood for batten board shall be water-proofed plywood of thicker than 12 mm.
(4) Flushing shall be nailed at every 200 mm and joint shall be lapped.
(5) Knot and crack of board shall be covered with metal sheet.

B. Preliminary roofing (Roofing bed):
(1) Wood-bedding shall conform to section 1.2 asphalt roofing and others concerned.
(2) Asphalt-compound and other adhesives for joint shall be secured for water-tightness.
(3) Mortar-bedding shall conform to Chapter 18 Glass and plastic, section 1.2.
(4) Bedding shall be selected for deformation of asphalt shingle of special adhesive applied.

C. Finish roofing:
(1) Horizontal joint of asphalt shingles shall be butted and vertical joint shall be lapped more than 175 mm.
(2) Each asphalt shingle shall be nailed at four corners and nailes shall comply with Table 10.1 Length of nail, however length shall be determined according to thickness of bedding.
(3) Nail-head shall be always applied with adhesives.

(4) Asphalt shingle, applied to dull-inclination concrete or light-weight concrete bedding, shall conform to Chapter 9 Water-proofing or the particular specification.
(5) Gutter and connection to wall shall conform to Section 2.5 and nail-head shall be applied with adhesive. In case copper-sheet is stated in the particular specification, it shall also conform to the above.

13.10.4 Performance for Particular Portion

A. Eave:
(1) Multiple lapping of eave shall be stated in the particular specification.
(2) In special case asphalt-shingle folded around eave, asphalt-shingle shall be hidden nailed at the back to secure from rebounding.

B. Ridge:
(1) In case ridge is covered with asphalt shingle with adhesive and nail, nail-head shall be also applied with adhesive.
(2) In case of special ridge cover is required and standard asphalt shingle is not suitable, colored sand roofing may be accepted.
(3) Colored sand roofing may be in use in case of through-ridge.

C. Gutter:
(1) Gutter shall be provided of special roofing and adhesive or blown asphalt.
(2) Gutter asphalt shingle shall be nailed at both ends and lapped portion shall be applied with adhesive.

D. Verge:
(1) Asphalt shingle shall be cut along verge flushing board and applied with adhesive.
(2) Multiple-lapping shall be stated in the particular specification.

E. Raise:
(1) Corner of roof and raise shall be round.
(2) Raise shall be at least 200 mm height.
(3) In case raise is less than required height, additional gutter shall be provided.
(4) End of asphalt shingle shall be secured tight with bead.

F. Snow-stopper:
(1) Snow-stopper metal shall be provided in snow-fall-local.
(2) Snow-stopper shall be complied with the drawing or the particular specification.

13.11 Glass Roofing

13.11.1 Material

Glass shall conform to Chapter 18 Glass and plastic or the particular specification. Fastener shall conform to the drawing or the particular specification.

13.11.2 Performance

A. Flat-glass plate:
(1) Wire-glass shall be used unless otherwise specified.
(2) Lap shall be 150 mm.

B. Lapped corrugated glass:
(1) Vertical lap shall be more than 150 mm and horizontal lap shall be 1.5 corrugation for small-corrugated glass and special cover cap shall be provided for large-corrugated glass.
(2) In case more than 3 corrugated sheet are lapped, corner of sheet shall be cut at factory.
(3) Lap joint shall be tightened with rope-putty or flat-felt and connection to purlin shall be tightened with animal-hair-felt.
(4) Each glass shall be tightened with cromed iron plate of approximately 2 mm thick at two places.

C. Flat roofing:
(1) Vertical lap shall be more than 150 mm and purlin shall be covered with animal-hair-felt.
(2) Horizontal lap shall be covered with special cover cap and nailed or hook-bolted.
(3) Lap of glasses and joint of glass to cover-cap shall be applied and tightened with rope-putty without irregularity.

13.12 Plastic Roofing

13.12.1 Material and Performance — Refer to Chapter 18 Glass and plastic or the particular specification.

13.13 Metal Gutter (Excluding Light Metal)

13.13.1 Material

A. Non-ferrous metal excluding light metal shall conform to this section and the following standards and requirements:
JIS G 3302 (galvanized iron sheet)
JIS G 3112 (reinforcing steel bar)
JIS G 3452 (carbon steel pipe for piping)
JIS G 3444 (carbon steel pipe for structure)
JIS G 5501 (gray cast iron)
JIS B 1180-
1181 (hexagonal bolt and nut)
JIS B 1213 (ribet)
JIS B 1101 (small-screw)
JIS B 1135 (wood-screw)
JIS B 1351 (wadge)
JIS G 3532 (steel wire)
JIS H 4301 (lead plate)
JIS H 4341 (solder)

B. Gutter fastener:
(1) Steel wire shall be 1.2 mm diameter for joint of eave-gutter and 3.4 mm diameter for end.
(2) Gutter hanger shall conform to the following Table 13.1 Gutter hanger.

Table 13.1 Gutter hanger

Dimension of Eave Gutter			125 mm	125 - 150 mm	Fastening interval
Dimension of Leader			Less than 75 mm	75 - 90 mm	
Eave Gutter	Ring Fastener		13 x 3	19 x 4	Less than 900 mm
	Hanger	Concrete / Steel	13 x 3	19 x 4	
		Wood	6 x 6	9 x 9	
Rain Leader	Ring Fastener		13 x 3	19 x 4	Less than 1,200 mm
	Hanger	Concrete / Steel	13 x 3	13 x 3	
		Wood	6 x 6	6 x 6	

(3) Sample of gutter fastener shall be submitted, according to the drawing or the particular specification, for approval of the supervisor.
(4) All gutter fasteners shall be galvanized.

13.13.2 General Performance

A. Joint of metal sheet excluding leader shall be rivetted at interval of approximately 30 mm. In case sheet is lapped more than 30 mm, joint shall be rivetted in zigzag pattern (staggered arrangement). When gutter is less than 100 mm diameter, joint shall be soldered and brazed.
B. Any exposed end of metal shall be folded back.

13.13.3 Performance for Particular Portion

A. Eave gutter:
(1) Eave gutter shall be semi-circular and depth shall be half of diameter.
(2) End of eave gutter shall be wound with wire approximately 150 mm length. Joint shall be lapped more than 20 mm and corner shall be mitre-jointed.
(3) End cover plate of gutter shall be folded and lapped with gutter for more than 100 mm and soldered and brazed. Gutter less than 100 mm may be closed without end cover plate.
(4) Water-dispose-opening of gutter shall be cut in required size and additional plate of throating approximately 60 mm shall be soldered and brazed.
(5) Water-shuttering plate shall be rivetted to side of eave gutter at connection to verge gutter and others.

(6) Gutter shall be cut in suitable length for eave and joint shall be provided of additional plate folded in U-shape and soldered and brazed to one end.
(7) Inclination of eave gutter shall be 1/100 and tied to hanger by binding wire.

B. Verge gutter:
Verge gutter shall be U-shape and folded into eave gutter. Both ends shall be stopped with plate and tie plate of 25 mm. width shall be revetted at approximately every 900 mm.

C. Elbow:
(1) Elbow shall be box-shape and joint of plate shall be lapped more than 10 mm. Joint to eave gutter shall be folded tight and rivetted or bolted and more than 60 mm inserted in leader.
(2) Elbow for flat roof of reinforced concrete structure shall be deeply inserted under water proofing layer and joint of plate shall be lapped more 20 mm.

D. Leader head-box:
(1) Joint of plate shall be lapped more than 20 mm. Box shall be reinforced with steel and provided of cleaning-hatch at top.
(2) Large box shall be rivetted and small box shall be soldered.

E. Leader (Leading pipe):
(1) Joint of plate shall be grooved seam and joint of leaders shall be lapped more than 30 mm and soldered. Slip-proof plate shall be provided at every hanger.
(2) Leader shall be cut-out on one side to joint with drainage and free-covering-plate shall be provided.

F. Ring:
Ring shall be thrusted to wood or bolted to concrete or steel.

G. Hanger:
(1) Hanger for eave gutter shall be nailed or bolted to eave.
(2) Hanger for leader shall be trusted more than 60 mm to wood-structure, bolted or welded to steel-structure or inserted more than 60 mm to concrete-structure.
(3) Hanger shall be clipped to galvanized iron sheet or asbestos cement slate by galvanized fastener with two-bolt and packing (asphalted animal-hair-felt).

H. Steel pipe leader:
(1) Same diameter of steel pipe shall be screwed tight with roof-drain and exposed approximately 150 mm to joint with lead pipe elbow.
(2) Top of elbow shall be soldered to above mentioned steel pipe and bottom shall be inserted more than 100 mm to leader.
(3) All joints shall be socket joint and thread shall be packed.
(4) Each steel pipe shall be welded to steel at two places.

13.13.4 Miscellaneous

A. Dust-net:
(1) Water-outlet of flat-roof shall be covered with dust-proof-net.
(2) Dust-net shall be galvanized iron wire mesh. Wire 0.88 mm diameter, mesh approximately

15 mm of hexagonal-shape, cross-reinforced with steel and folded to wire 3.4 mm diameter at around.

B. Rust-proof:
Refined coal-tar shall be applied to inside of all gutters, leaders and elbows.

C. Roof-drain:
Roof-drain shall be cast iron and rust proofed.

13.14 Light-Metal Gutter

13.14.1 Material

A. Gutter plate shall conform to JIS H 4000 (aluminium and aluminium alloy) and thickness shall be otherwise specified.

B. Wire shall be light-metal wire 4 mm diameter.

C. Hanger shall be cast light-metal plate as the following Table 14.1 Light-metal hangers, however special hangers shall be galvanized iron and isolating varnish applied to portion in contact with aluminium:

Table 14.1 Light-metal hangers

Diameter of Eave Gutter	Less than 125 mm	More than 125 mm	Fastening interval
Diameter of Leader	Less than 80 mm	More than 80 mm	
Hanger for Eave Gutter	25 x 5	36 x 6	Less than 900 mm
Hanger for Leader	25 x 5	30 x 6	Less than 1200 mm

13.14.2 Performance for Particular Portion

A. Joint of eave gutter:
(1) End of eave gutter shall be wound with light-metal wire approximately 200 mm length and corner shall be mitre-jointed.
(2) Joint require water-tightness and strength shall be lapped more than 120 mm, Tar-paper inserted between, rivetted with light-metal rivet 2 mm diameter for ever 15 mm on two parallel line and water-proofed around joint.

B. Ordinary joint shall be lapped more than 30 mm, rivetted and applied with water-proof paint.

C. Leader (Leading pipe):
(1) Joint of plate for leader shall be grooved seam. Joint of leader shall be inserted more than 60 mm to each other. Leader shall be tightened to hanger by light-metal wire.
(2) Bottom of leader shall be bended to dispose water or free joiner provided for connection to drainage pipe.

D. Rust-proof shall be isolating varnish unless otherwise specified.

E. Leader head-box shall conform to the following Table 14.2 Leader head-box.

Table 14.2 Leader head-box

Leader (mm)	Head-Box (mm)		
	Length	Width	Depth
50 x 75 75 ϕ	230	140	190
75 x 100 100 ϕ	250	150	190

F. Ring shall be fastened by screw in case of wood structure.

13.14.3 Miscellaneous — Dust-net shall be light-metal wire of 1 mm diameter, mesh approximately 15 mm of hexagonal-shape and cross-reinforced with steel and wire approximately 4 mm diameter.

13.15 Plastic Gutter — Plastic gutter shall conform to Chapter 18 Glass and plastic.

14. Metals

14.1 General

14.1.1 Scope — This chapter applies to metal, non-ferrous metal, ready-made products made of these metals and order-made products by drawing or the particular specification.

14.1.2 Material

A. Material and product shall conform to JIS or approved by the supervisor.
B. Sample or full-scale drawing of order-made product shall be submitted for approval of the supervisor (ready-made product excluded).
C. Quality analysis, strength and other required tests of material shall be performed if directed by the supervisor.

14.1.3 Fastener and Others

A. Dimension of inserts, anchor-bolts, anchor-screws, sleeves and other fasteners shall be suited for the purpose and sample shall be submitted and approved by the supervisor for quality and strength.
B. Performance and storing of explosives, such as drive-rivets, shall be approved by the supervisor.
C. Quality and strength certificates of adhesive shall be submitted for approval of the supervisor.

14.1.4 Rust-Proof

A. Rust-proof varnish for steel products shall be approved by the supervisor unless otherwise

stated in the particular specification, and portion inserted in concrete, exposed out door and placed in moisture shall be galvanized and applied of rust-proof varnish unless otherwise stated in the particular specification.

B. Corrosion-proof shall be applied to portion of non-ferrous metal product in contact with other corrosive material according to the particular specification or direction of the supervisor.

C. Damage to rust-proof shall be immediately remedied.

14.1.5 Protection and Cleaning

A. Proper protection shall be provided after installation according to direction of the supervisor.

B. At the time of completion, protection shall be removed and product shall be cleaned with care.

14.2 Installation

14.2.1 Install before Concreting

Position of product or material shall be accurately marked and properly supported according to dimension and weight without obstructing other works such as form work. Level shall be checked and welded, bolted, rivetted or other means to secured. Proper attention shall be paid for replacement during concreting.

14.2.2 Install after Concreting

Fastener and other jointers shall be placed in position and interval strictly according to drawing and suitable for installation. Product shall be firmly installed in designated position by wedging, supporting-packing and other means. Inserted portion of fastener and other jointers shall be packed with mortar 1:3 volume mixture.

14.3 Ready-Made Product

14.3.1 Non-Slip

A. Quality and dimension of non-slip shall conform to drawing and the particular specification.

B. Quality of exposed screws and other fasteners shall be equalled to non-slip.

C. Insert-fastener of non-slip shall be 15 mm. wide, 3 mm thick, and 80 mm long. Each insert-fastener shall be screwed to non-slip by two small-screws. Insert-fasteners shall be provided at both ends and approximately every 300 mm of non-slip.

D. Insert-fastener shall be compacted in concrete with mortar, and position of non-slip shall be adjusted.

E. Non-slip for wood-structure shall be firmly screwed direct to step according to drawing.

F. Adhesive to install non-slip shall be approved by the supervisor.

14.3.2 Floor Jointer

A. Quality and dimension of floor jointer shall be stated in the particular specification. In case not specified, brass shall be used.

B. Joint plan shall conform to drawing.

C. Jointer shall not be deformed and shall be placed in straight line.
D. Insert-fastener shall be provided at both ends and approximately every 450 mm of jointer and firmly mortared.

14.3.3 Corner-Bead

A. Quality and dimension of corner-bead shall be stated in the particular specification. In case not specified, brass shall be used and 1.8 m length from floor.
B. Corner-bead shall be placed on vertical straight line. Insert-fastener shall be provided at both ends and approximately every 300 mm and firmly mortared.

14.3.4 Punching-Metal

A. Quality and dimension of punching-metal shall be stated in the particular specification. In case not specified, not deformed cool-pressured steel plate 0.6 mm thick shall be used.
B. Care shall be taken for deformation and pattern and nailed both sides at approximately every 200 mm.

14.3.5 Manhole Cover

A. Manhole cover shall be cast iron applied with baked coal-tar and required strength. Dimension and manufacturer shall be stated in the particular specification.
B. Outdoor manhole cover shall be provided with chain for theft-proof.
C. Frame of manhole cover shall be installed before concreting in case water-tightness and air-tightness is required. In case of special manhole cover, shop drawing shall be submitted for approval of the supervisor.

14.3.6 Dust-Chute Dispose-Hatch

A. Dimension, quality and manufacturer of dispose-hatch shall be stated in the particular specification.
B. Dispose-hatch shall be installed after concreted.

14.3.7 Miscellaneous

Miscellaneous ready-made metal products shall conform to the particular specification.

14.4 Order-Made and Other Products

14.4.1 Hand-Rail

A. Quality and dimension shall conform to drawing or the particular specification.
B. Hand-rail shall be produced from one piece of material and if joint of material is unavoidable, joint shall be firmly welded, brazed or reinforced with additional plate and bolted.
C. Baluster shall be provided in accordance with drawing. Baluster shall be welded, solder, brazed or bolted to hand-rail or bottom-rail, and in case bottom-rail is not provided, baluster shall be firmly secured to structural member.
D. Bottom-rail shall be firmly assembled and welded, brazed, screwed or bolted to baluster.
E. Exposed surface of welding and brazing shall be grinded or sanded even.

F. Expansion and shrinkage joint shall be provided to hand-rail which may be affected by temperature.

14.4.2 Grill

A. Quality and dimension shall be stated in the particular specification.
B. Surrounding frame shall be mitre jointed or butted and hidden weld or brazed.
C. Interval of grill shall conform to drawing and cross joint shall be lapped and screwed from back and each member shall be welded or soldered to surrounding frame.
D. Exposed surface of welding and brazing shall be grinded or sanded even.

14.4.3 Ladder

A. Quality and dimension shall conform to drawing or the particular specification. In case not specified, material shall be mild steel.
B. Step of steel ladder shall be round-bar or moulded steel and punched through both-side-hand-rail and jointed according to drawing or direction of the supervisor.
C. Hanger or fastener shall be provided according to drawing and inserted 60 mm depth to concrete-structure or welded or bolted to steel-structure.
D. Hanger and fastener shall be firmly welded or bolted to side-hand-rail.

14.4.4 Miscellaneous

Stair-case and other order-made products shall conform to drawing or the particular specification.

14.5 Lath

14.5.1 Metal-Lath (Mortar Bedding)

A. Metal-lath shall conform to JIS A 5505 (metal-lath) and 0.40 mm unless otherwise stated in the particular specification or indicated on drawing.
B. Joint of asphalt-felt shall be lapped more than 90 mm and nailed. Joint of metal-lath shall be lapped more than 50 mm and zigzag stapled at approximately every 300 mm or 150 mm for ceiling.
C. Connection of metal-lath to frame of window or door shall be stapled at every 150 mm and rectangular-metal-lath shall be provided to reinforce.

14.5.2 Wire-Lath (Mortar Bedding)

A. Wire-lath shall conform to JIS A 5504 (wire-lath) and 1.2 mm and 50 mm mesh unless otherwise stated in the particular specification or indicated on drawing.
B. Bedding shall conform to Metal-lath. Wire-lath shall be jointed or reinforced at every 450 mm by 3.4 mm wire and zigzag stapled at approximately every 300 mm.
C. Additional 150 mm width wire-lath shall be provided and stapled at all corners to reinforce.

14.6 Light-Weight Gauge Steel

14.6.1 Ceiling Frame

A. Light-weight gauge steel for ceiling frame shall conform to JIS G 3350 (cooled moulded light-weight gauge steel for architectural structure) and sample or catalog shall be submitted and approved by the supervisor for quality and dimension.

B. Execution drawing of lay-out shall be prepared, according to drawing and the particular specification, for approval of the supervisor.
C. Insert-fastener shall be concreted at every 900 mm. Bolt-hanger shall be 9 mm diameter unless otherwise specified.
D. Main-frame shall be provided at every 900 mm and jointed to bolt-hanger. Sub-frame shall be provided at approximately every 400 mm and jointed to main-frame.
E. Joint of rib-lath shall be lapped more than 70 mm at end and one-rib-interval for sides. Joint shall be tied with 1.2 mm wire at every 100 mm.
F. Additional 150 mm width rib-lath shall be tied with 1.2 mm wire at every 100 mm for connection of ceiling to concrete wall.
G. Ceiling frame shall be reinforced at opening.

14.6.2 Wall-Frame

A. Execution drawing of lay-out shall be prepared, according to drawing and the particular specification, for approval of the supervisor.
B. Stud shall be provided at approximately every 400 mm and brace shall be provided at both ends and every 900 mm of stud. Wall-frame shall be reinforced at opening in accordance with instruction of the supervisor.
C. Joint of rib-lath shall be lapped 90 mm at end and one-rib-interval for sides. Joint shall be tied with two 1.2 mm wire at every 100 mm. Additional 150 mm width rib-lath shall be tied with two 1.2 mm wire at every 100 mm for corner.
D. Metal-lath shall be provided at connection to concrete. Wall-frame shall be reinforced at opening..

14.7 Aluminium

14.7.1 Material — Aluminium plate, tie-plate, corrugated-plate, pipe, bar, wire and other products shall conform to requirements of JIS and aluminium alloy according to requirements.

14.7.2 Performance — Refer to Chapter 15 Metal sash and door section 3 Aluminium sash and door.

15. Mortar and Plaster

15.1 General

15.1.1 Storage of Materials — Plaster materials already inspected shall be stored in order to avoid stain, etc. Pigments shall be especially handled with care. Those materials which are affected by moisture such as plaster and cement shall be stored properly.

15.1.2 Preparation of Setting Bed

A. Deformation, unevenness on wall or floor of concrete or concrete block shall be corrected.
B. Concrete surface which is too smooth to plaster shall be roughened with chisel, etc.
C. Base coat for plaster board backing shall be plaster board base coat.

15.1.3 Cleaning and Wetting of Backing and Base Coat

A. Dry backing of concrete or concrete block or dry base coat of cement mortar or plaster shall be properly wetted. Backing and base coat shall be cleaned thoroughly before plastering.
B. Looseness on backing or plastering face shall be immediately corrected.

15.1.4 Protection against Cracks

A. Around grooves of casing, base board, coping, stile, etc. shall be left unfilled by thickness of a trowel.
B. Those places likely to be cracked such as corners at opening joints of lath, excelsior plate, plaster board shall be applied with cloth in plastering and metal lath in cement mortar.
C. Protection against cracking at joints of concrete and wood or concrete block shall be properly dealt with direction of the supervisor.

15.1.5 Sample Application

Sample shall be submitted or sample application shall be conducted and approved by the supervisor for those require sample for color tone and special surface finish.

15.2 Backing

15.2.1 Type Material Method

Table 2.1 Type, material and method of backing

Type	Material	Method
Wooden Lath	In Compliance with	Wood Work
Metal Lath Wire Lath	) In Compliance with	Metal Work
Excelsior Plate Board	In Compliance with	Wood Work
Bamboo Lathing	Shall be Otherwise Specified	

15.3 Cement Mortar Plastering

15.3.1 Scope

This section shall apply to cement mortar made principally of cement, sand and water for application of building. Mortar with water-proof agent shall be stated in the particular specification. Fire-proof mortar plastering shall conform to JIS A 7801 (Method of fire-proof cement mortar plastering for wood buildings).