

- (2) X (water-cement ratio) for Blast furnace cement B-grade, Fly-ash cement B-grade and Silica cement B-grade shall be tested, referred to dependable data or referred to the above stated fomula with approval of the supervisor.
  - (3) X (water-cement ratio) for other cements shall be tested or referred to dependable data.
- B. Scope of water-cement ratio shall refer to the following table 2.5 B.

Table 2.5 B Scope of water-cement ratio

<u>Cement</u>	<u>Water-cement Ratio (°/WT)</u>
High-early-strength Portland cement	40-70
Ordinary Portland cement	
Blast furnace cement A-grade	
Fly-ash cement A-grade	
Silica cement A-grade	
Blast furnace cement B-grade	40-65
Fly-ash cement B-grade	
Silica cement B-grade	

- C. The above water-cement ratio shall be refered only to the actual water-cement ratio and in case AE (Air-Entraining) agent or crushed aggregate is in use, mixing of cement and aggregates shall be rectified.  
In case durability and uniformity of concrete is especially called for, water-cement ratio shall be otherwise specified or directed by the supervisor.

5.2.6 Standard of Mixture

- A. Mixture of concrete shall be decided with water-cement ratio stated above and to obtain the designated slump, Table 2.6 Standard mixtures shall be refered and test mixing shall be performed.
- B. Guidance for Table 2.6 Standard mixtures;
  - (1) Size of aggregate shall be refered to Table 1.2.
  - (2) Mixture not shown on the table shall be presumed from nearest two values.
  - (3) Mixture by weight and volume measurement on site was determined by following values.
    - (a) Density
      - Cement (ordinary portland cement) ..... 3.15
      - Aggregate (dry density) ..... 2.60
    - (b) Weight of unit volume and ratio of unit volume and ratio of absolute volume shall be refered to following Table 2.6 B.

Table 2.6 B Weight of unit volume and ratio of absolute volume for Table 2.6 B Standard Mixtures.

Measurement Method	Item	Aggregate and Size of Aggregate				
		Gravel		Sand		
		Less 25mm	Less 20mm	Less 5mm	Less 2.5mm	Less 1.2mm
Value of volume mea- suring on site.	Weight of unit volume (kg/l)	1.70x0.95 =1.62	1.65x0.95 =1.57	1.75x0.80 =1.40	1.70x0.78 =1.33	1.60x0.76 =1.22
	Ratio of absolute volume (°/V1)	62.3	60.4	53.8	51.2	46.9
Value of standard measuring.	Weight of unit volume (kg/l)	1.70	1.65	1.75	1.70	1.60
	Ratio of absolute volume (°/V1)	65.4	63.5	67.3	65.4	61.5

(4) Unit weight of aggregate is shown as volume of standard measuring.

(5) Air contained in concrete is calculated as 1°/1V.

C. Rectification for using crushed stone and surface active agent.

(1) Standard rectification of standard mixtures, in case crushed stone or AE (Air-Entraining) Agent is in use, shall be referred to the following Table 2.6 C. In case AE (Air Entraining) agent is in use, standard of air contained in the concrete shall be 4°/1V.

Table 2.6 C Rectification value of Standard mixture in case crushed stone or AE (Air Entraining) agent is in use. (per 1 m<sup>3</sup> of concrete)

<u>Concrete</u>	<u>Volume of Cement</u>	<u>Volume of Fine Aggregate (Absolute Volume)</u>	<u>Volume of Coarse Aggregate (Absolute Volume)</u>	<u>Volume of Water</u>
Sand, gravel, AE concrete	No rectification	Less 15 ℓ	No rectification	Less 8%
Sand, crushed stone concrete	Ditto	Add. 25 ℓ	Less 10%	Add. 8%
Sand, crushed stone, AE concrete	Ditto	Add. 10 ℓ	Less 10%	No rectification

(2) In case surface active agent in use, method of rectification shall be tested or determined from dependable data.

- D. In case size of coarse aggregate is less than 30 mm or 40 mm standard rectification as shown below shall be applied to standard mixtures with coarse aggregate of less than 25 mm.  
 (1) In case of gravel, rectification shall refer to the following Table 2.6 D;

Table 2.6 D Rectification value of standard mixture for size of coarse aggregate smaller than 30 mm or 40 mm in use. (per 1 m<sup>3</sup> of concrete)

<u>Size of Coarse Aggregate</u>	<u>Volume of Cement</u>	<u>Volume of Fine Aggregate (Absolute Volume)</u>	<u>Volume of Coarse Aggregate (Absolute Volume)</u>	<u>Volume of Water</u>
Smaller 30 mm	Less 3%	Less 15 ℓ	Add. 5%	Less 3%
Smaller 40 mm	Less 6%	Less 25 ℓ	Add. 10%	Less 6%

(2) In case crushed stone or AE (Air-Entraining) agent in use, rectification stated above on Table 2.6 D in addition to Table 2.6 C shall be applied.

- E. Mixture different from Table 2.6 Standard Mixtures shall be tested and approved by the supervisor.

5.2.7 Mixture Control A.

Concrete mixture shall be constantly controlled to obtain required workability and mixed strength.

- B. Volume of sand and grading of aggregate shall be adjusted without adding AE (Air-Entraining) agent in case designated volume of air-contains is not obtained.

- Volume of AE (Air-Entraining) agent shall be reduced in case air-contains more than 4%.
- C. Tests stated in 2.1 D shall be performed for main concreting or when directed by the supervisor.  
Test pieces shall be more than 3 pieces at once.
- 5.2.8 Measuring
- A. Methods, machineries and equipments for measuring materials shall be planned and submitted for approval of the supervisor.
- B. Measuring of all materials for mixing shall be indicated for each batching by weight or volume. However, cement shall be measured by number of bags unless automatic cement weigher is in use.
- C. Volume of water for mixing shall be adjusted by considering surface moisture and water absorption of aggregates and additives to obtain designated water-cement ratio.
- 5.3 Batching and Placing of Concrete
- 5.3.1 Preparation
- A. Concreting process and division shall be planned.
- B. Form work shall be cleaned and properly sprayed with water to avoid absorption of water from concrete, unless there is danger of freezing.
- C. Area for concreting shall be inspected and approved by the supervisor.
- 5.3.2 Batching
- A. Batching machine shall be prepared with water-measuring-device for mixing of concrete.
- B. All concrete mixed in batching machine shall be disposed before next mix. All materials for concrete shall be put in batching machine at once or in following order; Water-cement-fine aggregate-coarse aggregate.
- C. Time for mixing shall be enough for all material to be mixed uniformly as directed by the supervisor.
- D. Any concrete or its portion starting to harden shall not be used.
- 5.3.3 Transportation
- A. Mixed concrete shall be carried immediately from batching machine to designated place to avoid segregation or leakage.
- B. Segregated concrete shall be re-mixed for use.
- 5.3.4 Concrete Placing
- A. Concrete placing shall be proceeded to keep the surface of placed concrete as horizontal as possible.
- B. Concrete shall be continuously poured to complete the portion as planned.
- C. Concrete hopper or other equipments shall be used to pour concrete as close as possible to the designated place.
- D. Concrete shall be properly placed and compacted around reinforcing bars and corners of form work.

Vibrating of concrete and tapping of form work shall be performed to wall, column and other places difficult for concrete to proceed. Proper number of workers for placing and compacting concrete shall be arranged.

- 5.3.5 Tapping and Vibrating
- A. Equipment and place of tapping shall be approved or directed by the supervisor.
  - B. Vibrator shall be operated for concrete called for water tightness, difficult portion for concrete to proceed and other cases directed by the supervisor. However, vibrator shall not be touched reinforcing bar and shall not be operated more than 30 seconds at same spot.
  - C. Concrete shall be placed 0.3-0.6 m in thickness at once in case vibrator is performing. In case flexible-insert-vibrator is called for, concrete shall not be placed thicker than the length of the insert or vibrator at one pouring.
- 5.3.6 Concrete Pouring Joint
- A. Concrete pouring joint shall be planned minimum. Appentice, cantilever and etc. shall not have concrete pouring joint.
  - B. Concrete pouring joint shall be jointed horizontally or vertically, and beam or slab shall be jointed in middle of its span. Column and roof parapet shall be jointed heigher than the slab to avoid laitance to accumulate.
  - C. Concrete pouring joint shall be cleaned of laitance, and rich mix of mortar shall be poured immediately before subsequent concrete placing. Concrete pouring joint shall be roughened if directed by the supervisor.
- 5.3.7 Concrete Curing
- A. Concrete shall be sprayed with water, avoided from direct sun, cared for sudden dryness and coldness within 5 days from pouring. However, high-early Portland cement concrete shall be cured within 3 days from pouring.
  - B. Concrete shall be kept completely free from load 24 hours from pouring. Further, concrete shall not be loaded with heavy machineries, tools and materials during hardning period.
  - C. In case presumed average temperature is below 10°C within 28 days from concrete placing, first-stage against frost action shall be provided to protect concrete as stated in JASS 5.11.6.
- 5.4 Form Work
- 5.4.1 Material and Structure
- A. Structure of form work shall be firmed as to bear all live load and other external forces, and harmless deformation is only allowed. Wood shuttering shall be planned and placed tight to avoid leakage of cement paste.
  - B. Shuttering shall be properly cleaned for reuse.
- 5.4.2 Assembling form work and inspection.
- A. Form work shall be assembled correctly for required size and volume of concrete.
  - B. Support of shuttering for concrete soffit shall be supported on rigid and suitable base and thoroughly braced both horizontally and diagonally.

- C. Temporary opening shall be provided for inspection and cleaning at lower portion of shuttering for column, beam and wall.
- D. Form work shall be inspected and approved by the supervisor before concreting.
- 5.4.3 Form Oil
  - A. Form oil for shutterings shall be reported for direction and approval of the supervisor.
  - B. Form oil shall be applied to shuttering and dried before assembling.
- 5.4.4 Removal of Form Work
  - A. Form work shall be retained until concrete is adequately set to support own weight and live load. Retaining period shall refered to Item 5.4.5.
  - B. Retaining period may be changed with direction of the supervisor according to cement, weather, temperature, load, curing condition and etc.
- 5.4.5 Retaining Period of Form Work
  - A. Retaining period shall be decided according to cement, mixture, size of element, concrete age, compressive test, load, temperature, curing condition and with approval of the supervisor.
  - B. Shuttering shall be dismantled according to the concrete age shown on Table 4.5 B unless confirmed of greater strength than Table 4.5 B by testing stated on Item 1.5.C.
  - C. Supports for slab soffit shall be retained according to the concrete age shown on Table 4.5 B and confirmed of greater strength than Table 4.5 B by compressive test stated on Item 5.1.5C.
  - D. Supports for beam soffit shall be retained longer than 28 days and confirmed of greater strength than design standard strength by compressive test stated on Item 5.1.5C.
  - E. Support for cantilever beam, Appentice, long-span beam and slab, and portion with large live load shall be retained according to the instruction of the supervisor.

Table 4.5 B Minimum retain period of form work

Retaining period	Average temperature	Shuttering board for foundation, side of beam wall, column		
		High-early strength Portland cement	Ordinary Portland cement	Blast furnace cement B-grade
			Blast furnace cement A-grade	Fly-ash cement B-grade
			Fly-ash cement A-grade	Silica cement B-grade
			Silica cement A-grade	
Days	15°C up	2	3	5
	5°C up	3	5	7
Compressive strength			50 kg/cm <sup>2</sup>	

Table 4.5 B Minimum retain period of form work - continued -

		<u>Shuttering board for floor slab soffit</u>		
Retaining period	Average temperature	High-early strength Portland cement	Ordinary Portland cement	Blast furnace cement B-grade
			Blast furnace cement A-grade	Fly-ash cement B-grade
			Fly-ash cement A-grade	Silica cement B-grade
			Silica cement A-grade	
Days	15°C up	4	6	8
	5°C up	6	10	12
Compressive strength		50% of designed strength		
		<u>Support for floor slab</u>		
Retaining period	Average temperature	High-early strength Portland cement	Ordinary Portland cement	Blast furnace cement B-grade
			Blast furnace cement A-grade	Fly-ash cement B-grade
			Fly-ash cement A-grade	Silica cement B-grade
			Silica cement A-grade	
Days	15°C up	8	17	28
	5°C up	12	25	28
Compressive strength		85% of designed strength		

5.5 Ready-Mixed Concrete

A. Ready mixed concrete shall conform to JIS A5308 (Ready-Mixed Concrete) and mixed strength of concrete, minimum amount of cement, size and class of coarse aggregate, required slump, amount of air for AE (Air-Entraining) agent and etc. shall be stated in the particular specification or approved by the supervisor.

5.6 Exposed Concrete

5.6.1 General

A. The word "Exposed Concrete" refers to concrete without any finish applied after form work is removed.  
 B. Exposed concrete shall conform to item 5.6 which has priority over other items stated in this chapter.

- C. Exposed concrete shall not be chipped, grinded or repaired unless directed by the supervisor.
- D. Exposed concrete with only painting finish shall refer to this Item 5.6.
- 5.6.2 Material
- A. All cement shall be produced by the same manufacturer's factory. Factory shall be selected to produce the designated color and texture of concrete.
- B. Size of aggregate shall be selected to suit exposed concrete.
- 5.6.3 Mixture
- A. Mixture of exposed concrete shall be specially cared for workability, durability and uniformity, and segregation and breathing shall be avoided. Strength and slump shall be referred to the items already stated.
- B. Amount of cement shall be 320 kg/m<sup>3</sup>, unless otherwise specified.
- C. Gravel-sand ratio shall be minimum as possible.
- D. Sample concreting may be directed by the supervisor to decide mixture and color.
- 5.6.4 Preparation for concrete placing
- A. Division, procedure, concrete pouring joint shall be planned and submitted with pouring volume for the approval of the supervisor on time.
- B. One concrete placing area shall be planned with no pouring joint unless approved by the supervisor.
- C. Pouring joint shall be properly cared and other necessary joint directed by the supervisor shall be provided.
- D. Plan and arrangement of workers and foremen in charge of adjusting reinforcement, form work, measuring, batching, concrete placing, compacting, vibrating, and tapping form work shall be submitted for approval of the supervisor. Performance of concrete placing shall be suspended by the supervisor in case the preparation is uncomplete.
- 5.6.5 Finish of exposed concrete
- A. Exposed surface of concrete shall be set according to the designated line and measurement. Honey combing, contamination and other defects shall not be allowed.
- B. Any defect shall be immediately remedied according to instruction of the supervisor.
- 5.6.6 Covering Reinforcement
- A. Reinforcement for exposed concrete shall be covered with concrete according to the following Table 6.6 A, unless otherwise specified or noted on the drawings.

Table 6.6 A Thickness of covering concrete

<u>Portion of Structure</u>	<u>Thickness of Covering Concrete (from Exterior Surface of Reinforcement Bar)</u>
Slab soffit, wall	More than 30 mm
Ditto (Fire-proofed)	More than 45 mm
Column, beam, wall beam	More than 55 mm



- B. Reinforcing bar shall be complied to setting and bending diagram and cared to obtain designated thickness of covering concrete with proper spacer.

## 5.6.7 Form Work

- A. Detail and full-scale execution drawing of shuttering boards, tie devices and supports for approval of the supervisor. Sample of shuttering joint shall be submitted for approval of the supervisor.
- B. Shuttering material;
  - (1) Shuttering board and joint shall be stated in the particular specification or directed by the supervisor.
  - (2) Rail and bead of shuttering shall be suitably strengthened with no defect. Quality and size shall be stated in the particular specification or directed by the supervisor.
- C. Preparation;
  - (1) Surface of shuttering board shall be planned and side joint of boards shall be tongued and grooved and straight joint of boards shall be tightened at random with no space and irregularity.
  - (2) Rail and bead shall be properly provided as stated in the particular specification.
  - (3) Joiner shall be provided at position of concrete pouring joint.
- D. Assembling;
  - (1) Concrete or mortar shall be placed according to detail and full-scale drawing of plan for form work at the bottom of column to guide form work. Water out-let shall be properly provided.
  - (2) Tie devices shall be prepared according to approval of the supervisor.
  - (3) Shuttering for column shall be assembled firmly not to be displaced or deformed.
  - (4) Support for soffit of beam and slab shall be provided at 900 mm on center and assembled firmly and secured from displacement and deformation.
  - (5) Shuttering joint of column to beam, wall to beam, and column to wall shall be jointed firmly on designated line.
  - (6) Joint beam shall be placed at required position in suitable manner as approved by the supervisor.

## 5.6.8 Inspection

Form work and reinforcement shall be inspected immediately after assembled and placed.

5.7 Light-Weight  
Concrete

## 5.7.1 Scope

- A. This section refers to concrete of light-weight aggregate.
- B. Light-weight concrete shall conform to Section 1.4 of this chapter unless otherwise stated in this section.

- 5.7.2 Classification of light-weight aggregate and light-weight concrete.
- A. Class of light-weight concrete, light-weight aggregate, air-dried density and  $F_o$  (Design Standard Strength) shall be stated in the particular specification.
- B. Class of light-weight concrete shall be referred to Table 7.2.

Table 7.2 Class of light-weight concrete

Class of Light-Weight Concrete		Scope of Air-Dried Density (Ton/m <sup>3</sup> )	Maximum Value of $F_o$ (kg/cm <sup>2</sup> )
Light-Weight Concrete for Structure	Grade-1	1.7-2.0	225
	Grade-2	1.4-1.7	210 (1)
	Grade-3	1.8-2.0	180
	Grade-4	1.6-1.8	135 (4)
	Grade-5	1.2-1.6	90

- 5.7.3 General Light-weight concrete adjoined to earth or water shall be grade-1 or grade-2 unless otherwise specified or directed by the supervisor.

- 5.7.4 Aggregate of Light-weight concrete for structure.
- A. Material quality:
- (1) Light-weight coarse and fine aggregate shall conform to requirement of JIS A5002 (Aggregate of light-weight concrete for structure).
  - (2) Absolute-Dry density of light-weight fine aggregate shall be less than 2.0.
  - (3) Grading of light-weight aggregate for light-weight concrete grade-1 and grade-2 shall be referred to Table 7.4 B. Fine and coarse grain shall be mixed properly.
  - (4) Light-weight coarse aggregate of light-weight concrete for structure grade-1 and grade-2 of slump less than 15 cm shall conform to requirement of JASS 5.20.4C and grain grading ratio shall be less than 10°/wt.
  - (5) Sand for light-weight concrete shall refer to Section 1.2.
- B. Handling and storing:
- (1) Stock yard for aggregate shall be provide at place where water does not accumulate.
  - (2) Aggregate shall be stored not to disturb suitable mixture of fine and coarse.

Table 7.4 B Grading of light-weight aggregate for light-weight concrete grade-1 and grade 2

Aggregate	Size of sieve						
	Percentage of weight passing through (%)						
	25	20	10	5	2.5	1.2	0.3
Fine aggregate	-	-	100	90-100	75-100	50-70	20-40
Coarse aggregate	100	90-100	35-65	0-5	-	-	-

5.7.5 Mixture of Light-weight concrete for structure.

- A. General:
  - (1) Mixing of light-weight concrete shall be determined to obtain required strength, workability, consistency and durability.
  - (2) Surface active agent shall be added to light-weight concrete and air shall be contained 3-6°/vl as standard, however, minimum air contain shall be specified against frost action. Other additives for light-weight concrete shall be stated in the particular specification.
  - (3) Mixture shall conform to the following Item B and test mix shall be performed to examine workability, unit cement weight, strength, density and etc. Result of test mix shall be reported for adjustment or approval of the supervisor.
- B. Determination of mixture:
  - (1) Determination of mixed strength shall refer to Item 2.2, however the following Table 7.5 B(1) shall take precedence of Table 2.2 C.

Table 7.5 B(1) Rectification value of light-weight concrete strength affected by temperature (kg/cm<sup>2</sup>).

Class of Cement	Grade of Light-Weight Concrete	Assumed Average Temperature During 28 Days from Placement of Concrete		
		10°C-15°C	5°C-10°C	2°C-5°C
High-early strength Portland cement	Grade 1-3	15	30	40
	Grade 4	10	20	30
	Grade 5	10	15	20
Ordinary Portland cement Blast furnace cement A-grade	Grade 1-3	20	40	50
	Grade 4	15	30	40
	Grade 5	10	20	30
Fly-ash cement A-grade				
Silica cement A-grade				

- (2) Determination of K (Cement Strength) shall refer to Table 2.5 B.
- (3) Determination of water-cement ratio.
  - (a) Water-cement ratio shall be determined with the following theory and consideration of F (Mixed Strength) and K (Cement Strength) stated above.
    - (i) Water-cement ratio for light-weight concrete with cement shown on Table 7.5 B(1) and AE (Air-Entraining) agent shall refer to the following fomula;

$$X = \beta \frac{61}{\frac{F}{K} + 0.34} \text{ (°/wt) } \dots\dots\dots (7.5 B)$$

- X: Water-Cement Ratio ( $^{\circ}$ /wt)  
 F: Mixed Strength ( $\text{kg}/\text{cm}^2$ )  
 K: Cement Strength ( $\text{kg}/\text{cm}^2$ )  
 $\beta$ : Rectification value of water-cement ratio for grading of light-weight concrete as shown on the following Table 7.5 B(3)(a). Reduction of light-weight concrete strength caused by AE (Air Entraining) agent inclusive.

Table 7.5 B(3)(a)  $\beta$ (Rectification value) for water cement ratio of light-weight concrete

Light-Weight Concrete	Standard Value of $\beta$
Grade-1 and 2	0.90
Grade 3	0.85
Grade 4	0.75
Grade 5	0.65

- (ii) Water-cement ratio for light-weight concrete with other cement and additives shall be determined from dependable data approved by the supervisor.  
 (b) Scope of water-cement ratio shall be complied with the following Table 7.5 B(3)(b).

Table 7.5 B(3)(b) Scope of water-cement ratio for light-weight concrete ( $^{\circ}$ /wt)

Grade of Light-weight Concrete	Class of Cement	
		High-early strength Portland cement
	Ordinary Portland cement Blast furnace cement A-grade	Fly-ash cement B-grade Silica cement B-grade
	Fly-ash cement A-grade	
	Silica cement A-grade	
Grade 1-3	40-65	40-60
Grade 4	40-67	40-62
Grade 5	40-70	40-65

- (c) Water-cement ratio of light-weight concrete adjoined to earth or water shall be less than  $55^{\circ}$ /wt.

- (d) Water-cement ratio of light-weight concrete specially required durability and consistency shall be stated in the particular specification.
- (4) Determination of mixture for test mix shall be conformed to above mentioned manner and referred to the followings:
  - (a) Mixture of light-weight concrete Grade 3-5 with slump exceed 15 cm shall be refered to the Table 7.5 reference of mixture for light-weight concrete Grade 3, Grade 4 and Grade 5. Light-weight concrete with slump less than 15 cm shall be refered to dependable data approved by the supervisor.
  - (b) Mixture for light-weight concrete grade 1-2 shall be approved by the supervisor.
  - (c) Unit cement weight of light-weight Item (a) and (b) shall be complied with the following Table 7.5 B(4). Unit cement weight shall be greater than 340 kg/cm<sup>3</sup> for light-weight concrete adjoined to earth or water.

Table 7.5 B(4) Minimum value of unit cement weight for light-weight concrete. (kg/m<sup>3</sup>).

Grading of Light-Weight Concrete	Slump 10-18 cm	Slump Lager Than 18 cm
Grade 1 and 2	300	320
Grade 3 and 4	310	330
Grade 5	320	340

5.7.6 Mixture Control A.  
of Light-Weight  
Concrete for  
Structure. B.

General:

Concrete mixture shall be controlled to constantly obtain required workability, weight of unit volume, mixed strength and designated quality.

Mixture adjustment of light-weight concrete:

- (1) Mixture adjustment for controlling weight of unit volume as follows.
  - (a) Test mix shall be performed according to JIS A1116 (Method of Testing Weight of Unit Volume of Concrete and method of air contained by weighting) to determine weight of unit volume of light-weight concrete. In case test resulting in failure, reason shall be confirmed and mixture shall be adjusted with direction of the supervisor.
  - (b)  $\rho_0$  (Air-Dried Density) of specified light-weight concrete shall conform to the following fomula. W (Assumed Value) of Air-Dried Weight of Unit Volume shall be determined by the theory stated in JASS 5.20.8.

$$W \leq 1000 \rho_0 + 60 \dots\dots\dots (7.6.b)$$

W: Assumed value of air-dried weight of unit volume of light-weight concrete.

$\rho_0$ : Air-dried density of specified light-weight concrete.

- (2) Mixture adjustment for controlling unit cement weight as follows.
  - (a) In case unit cement weight is more than  $10 \text{ kg/m}^3$  of planned mixture, the reason shall be confirmed and mixture shall be adjusted.
  - (b) In case unit cement weight is less than  $10 \text{ kg/m}^3$  of planned mixture, mixture shall be adjusted with approval of the supervisor.
- (3) Mixture adjustment for controlling air-contained as follows:
  - (a) In case air contained exceeding  $8 \text{ }^\circ/\text{vl}$ , mixture shall be adjusted by increasing volume of surface active agent or other additives.
  - (b) In case air-contained is less than  $1 \text{ }^\circ/\text{vl}$  of designated minimum air-contained, volume of surface active agent or other additives shall be adjusted.
  - (c) Adjustment of air-contained shall be performed until designated air-contained is obtained in continuous three mixes (Batchings).
- (4) Mixture adjustment for mixer strength of light-weight concrete shall conform to JASS 5.3.7.
- (5) In case change in quality of material for concrete is recognized, mixture shall be determined according to above stated Section 7.5.

5.7.7 Batching and  
Placing of  
Light-Weight  
Concrete for  
Structure.

- A. Light-weight aggregate of great water absorption during batching and placing shall be saturated of water and surface dried for batching. These aggregates shall be sprayed with water for a few days.
- B. Light-weight aggregate of less water absorption shall be air-dried for use.
- C. In case light-weight aggregate is measured in weight, volume shall be examined and amount and water contained shall be adjusted.
- D. In case workability is changed during batching and placing, measurement method of aggregate, surface water and water absorption shall be examined, and amount of aggregate and water shall be adjusted.
- E. Concrete for beam and slab shall be poured after concrete poured in wall and column is settled.

5.7.8 Covering  
Reinforcement  
of Light-  
Weight  
Concrete for  
Structure.

- A. Reinforcement shall be covered with concrete according to grade, quality, execution method and finishing of concrete to obtain fire-proofness, durability, strength and etc.
- B. Minimum covering thickness of reinforcement shall conform to the following Table 7.8.

Table 7.8 Minimum covering thickness of reinforcement for light-weight concrete (mm)

Structure Member and Condition	Class of Cement			
	Portland cement Fly-ash cement A-grade Blast furnace cement A-grade Silica cement A-grade	Blast furnace cement B-grade Fly-ash cement B-grade Silica cement B-grade	Blast furnace cement C-grade Fly-ash cement C-grade Silica cement C-grade	
Not Adjoined to Earth	Floor Slab, with Finish	20	30	-
	Wall not Bearing Forces	40	40	-
	Column, In-door	30	40	-
	Beam, with Finish			
	Bearing Out-door,	50	60	-
	Wall In-door with-out Finish			
Adjoined to Earth	Column, Wall, Beam, Slab	60	70	80
	Foundation, Earth Bearing Wall	70	80	90

- C. Covering thickness of reinforcement called for special durability and fire-proofness shall be stated in the particular specification.

## 5.8 Lean Concrete

### 5.8.1 Lean Concrete

- A. Mixture of lean concrete as follows and amount of water shall be minimum to obtain required workability:

Cement: Sand: Gravel = 1:3:5  
(Volume Ratio)

- B. Thickness of lean concrete shall be approximately 50 mm and surface shall be suitably plained and extended for marking and assembling form work.

5.9 Plain Concrete  
(Not Reinforced,  
Miscellaneous  
Concrete)

- 5.9.1 Material
- A. Cement, Aggregate and water shall conform to Section 1.1-3.
  - B. Maximum grain size of coarse aggregate shall be 40 mm approved by the supervisor according to performance condition and character of its use. NaCl contents shall not be regulated.
- 5.9.2 Mixture
- A. Mixture and performance of plain concrete required by the particular specification for particular strength and durability shall conform to Section 2.1-8 and 3.1-7.
  - B. Mixture of plain concrete of no strength and durability requirement, such as simple foundation, water-proof covering and machinery base, shall refer to the following Table 9.2, unless otherwise specified.

Table 9.2 Mixture list (Volume ratio)

<u>Grade</u>	<u>Cement: Sand: Gravel</u>	<u>Designated Position</u>	<u>Remark</u>
A	1 : 2 : 4 (Cinder concrete)	Water-proof covering, floor leveling.	Cinder size about 15 mm and cleaned.
B	1 : 2 : 4 (Pea gravel concrete)	Roof water-proof covering, apron.	Pea gravel size about 15 mm.
C	1 : 2.5 : 3.5	Simple foundation, pit.	
D	1 : 3 : 5	Drainage gutter.	
E	1 : 3 : 5 (Concrete with stone)	Replacing weak earth.	Stone volume less than 30%.

## 5.10 Ground Slab Concrete

- 5.10.1 General
- A. Cement, Aggregate and Water shall conform to Section 1.1-3.
  - B. Mixture of Ground Slab concrete as follows and water-cement ratio shall be approximately 60% or minimum as possible to obtain required workability. Test mix shall be performed, if necessary, for approval of the supervisor.
    - A-Grade: Cement: Sand: Gravel = 1:2.5:3.5  
(Volume ratio)  
Designated slump: 8-14 cm.
    - B-Grade: Cement: Sand: Gravel = 1:3:5  
(Volume ratio)



Designated slump; 10-15 cm. Mixture of Reinforced concrete slab shall be A-Grade and plain concrete slab shall be B-Grade unless otherwise specified.

- 5.10.2 Concrete Joint
- A. Plain concrete slab shall be provided with joint less than 6 m in length and breadth.
  - B. Joint for broad slab concrete or pavement slab concrete shall be filled with asphalt compound 25 mm width at every 12 m.
- 5.10.3 Performance
- A. Suitable tamping equipment shall be operated to bury coarse aggregate in concrete and surface shall be planned for approval of the supervisor.
  - B. Surface of concrete shall be finished with trowel or finishing machine approved by the supervisor.
- 5.10.4 Curing
- A. Concreted slab shall not be loaded or walked until required strength is recognized and sprayed water to cure for a few days after 12 hours from pouring. Further, concrete surface shall be protected from direct sun in proper manner.
  - B. In case of mortar finishing surface, mortar shall be applied immediately after surface of concrete is suitably hardened.

5.11 Prefabricated Light-weight  
Air-entrained Concrete Panel.

- 5.11.1 Scope
- Light-weight Air-entrained concrete panel cured with high-temperature high-pressure steam for floor, roof and wall.
- 5.11.2 Material
- Material shall conform to the Standard of Japanese Construction Ministry (No.288 Chapter 1 Design Standard of ALC and Commentary) unless otherwise specified.
- 5.11.3 Size and Measurement
- Size and Measurement of light-weight Air-Entrained concrete panel shall be referred to the following Table 11.3.

Table 11.3 Size and measurement of light-weight air-entrained concrete panel.

Structural Member and Weight of Load	Concrete Grade-1		Concrete Grade-2	
	$\ell$ (Span sup- ported) (m)	Thickness of panel	$\ell$ (Span sup- ported) (m)	Thickness of panel
Roof wall		Thicker than $\ell/35$ and 7.5cm		Thicker than $\ell/40$ and 7.5cm
Floor	Weight of load less than $300\text{kg/m}^2$	$\ell \leq 1.5$	Thicker than 7.5cm	$\ell \leq 2.0$ Thicker than 7.5cm
		$\ell > 1.5$	Thicker than $\ell/25$ and 10cm	$\ell > 2.0$ Thicker than $\ell/30$ and 10cm
	Weight of load more than $300\text{kg/m}^2$	$\ell \leq 2.5$	Thicker than 10cm	$\ell \leq 3.0$ Thicker than 10cm
		$\ell > 2.5$	Thicker than $\ell/25$ and 12cm	$\ell > 3.0$ Thicker than $\ell/30$ and 12cm

Concrete Grade-1 shall be arranged of absolute dry specific gravity between 0.5-0.7 and compressive strength greater than  $30\text{ kg/cm}^2$  at Air-dried condition. Concrete Grade-2 shall be arranged of absolute dry specific gravity between 1.0-1.2 and compressive strength greater than  $120\text{ kg/cm}^2$ .

- 5.11.4 Execution Drawing Execution drawing for assembling method and procedure of light-weight air entrained concrete panel shall be prepared and submitted for approval of the supervisor before fabrication.
- 5.11.5 Manufacturer and Inspection Manufacturer of light-weight air entrained concrete panel may be stated in the particular specification. Inspection and test shall be replaced with manufacturer's guarantee, unless otherwise specified.
- 5.11.6 Guarantee Light-weight air entrained concrete panel work shall be guaranteed by the contractor.
- 5.11.7 Assembling
- Performance shall be conform to the Standard of Japanese Construction Ministry (No.288 Chapter 14 Assembling Panel).
  - Spot-joint shall be avoided not to produce partial force on panel, and suitable line-joint shall be provided.
  - Damaged panel affect required strength of panel shall be rejected.
- 5.11.8 Protection Care shall be taken during transportation and performance.

- 5.11.9 Miscellaneous Panel wall structure and other miscellaneous light-weight air-entrained concrete panels shall conform to the Standard of Japanese Construction Ministry.
- 5.12 In-site Air-Entrained Concrete. In-site Air-entrained concrete for covering water-proof or heat insulation shall be stated in the particular specification.

Table 2.6 Standard mixture (1)  
Sand less than 1.2mm, gravel less than 20mm.

Water-Cement Ratio (°/wt)	Slump (cm)	Fine Aggregate (°/V1)	Unit Water Volume (kg/m <sup>3</sup> )	Absolute Volume (ℓ/m <sup>3</sup> )			When Postulated Value in 5.2.6.A.(3) in Used Weight (kg/m <sup>3</sup> )			Volume Measured at Site (per/m <sup>3</sup> )			Unit Coarse Aggregate Volume (m <sup>3</sup> /m <sup>3</sup> )
				Cement	Sand	Gravel	Cement	Sand	Gravel	Cement (bag)	Sand (m <sup>3</sup> )	Gravel (m <sup>3</sup> )	
45	8	33.8	176	124	233	457	391	606	1,188	7.82	.497	.757	.720
	12	32.1	186	131	216	457	413	562	1,188	8.26	.461	.757	.720
	15	30.5	195	137	201	457	433	523	1,188	8.66	.429	.757	.720
	18	32.5	205	145	208	432	456	541	1,122	9.12	.443	.715	.680
	21	34.7	221	156	213	400	491	554	1,040	9.82	.454	.662	.630
50	8	35.3	174	110	249	457	348	647	1,188	6.96	.530	.757	.720
	12	34.0	182	116	235	457	364	611	1,188	7.28	.501	.757	.720
	15	32.7	190	121	222	457	380	577	1,188	7.60	.473	.757	.720
	18	34.8	200	127	231	432	400	601	1,122	8.00	.493	.715	.680
	21	37.2	216	137	237	400	432	616	1,040	8.64	.505	.662	.630
55	8	36.3	173	100	260	457	315	676	1,188	6.30	.554	.757	.720
	12	35.3	180	104	249	457	327	647	1,188	6.54	.530	.757	.720
	15	34.1	188	109	236	457	342	614	1,188	6.84	.503	.757	.720
	18	36.2	198	114	246	432	360	640	1,122	7.20	.525	.715	.680
	21	38.8	213	123	254	400	387	660	1,040	7.74	.541	.662	.630
60	8	37.1	172	91	270	457	287	702	1,188	5.74	.575	.757	.720
	12	36.2	179	95	259	457	298	673	1,188	5.96	.552	.757	.720
	15	35.3	186	98	249	457	310	647	1,188	6.20	.530	.757	.720
	18	37.4	196	104	258	432	327	671	1,122	6.54	.550	.715	.680
	21	40.0	211	112	267	400	352	694	1,040	7.04	.569	.662	.630
65	8	38.6	172	84	283	451	265	736	1,172	5.30	.603	.746	.710
	12	40.2	179	87	303	451	275	788	1,172	5.50	.646	.746	.710
	15	36.7	186	91	262	451	286	681	1,172	5.72	.558	.746	.710
	18	39.1	196	96	273	425	302	710	1,106	6.04	.582	.704	.670
	21	41.9	211	103	283	393	325	736	1,023	6.50	.603	.652	.620
70	12	39.2	179	89	286	444	256	744	1,155	5.12	.610	.736	.700
	15	38.4	185	84	277	444	264	720	1,155	5.28	.590	.736	.700
	18	40.6	196	89	286	419	280	744	1,089	5.60	.610	.694	.660
	21	43.3	211	96	296	387	301	770	1,007	6.02	.631	.641	.610
*(75)	15	38.3	190	80	276	444	253	718	1,155	5.06	.589	.736	.700
	18	40.6	200	85	286	419	267	744	1,089	5.34	.610	.694	.660
	21	43.6	214	90	299	387	285	777	1,007	5.70	.637	.641	.610

Table 2.6 Standard mixture (2)  
Sand less than 2.5mm, gravel less than 20mm.

Water-Cement Ratio (°/wt)	Slump (cm)	Fine Aggregate (°/V1)	Unit Water Volume (kg/m <sup>3</sup> )	Absolute Volume (ℓ/m <sup>3</sup> )			When Postulated Value in 5.2.6.A.(3) in Used Weight (kg/m <sup>3</sup> )			Volume Measured at Site (per/m <sup>3</sup> )			Unit Coarse Aggregate Volume (m <sup>3</sup> /m <sup>3</sup> )
				Cement	Sand	Gravel	Cement	Sand	Gravel	Cement (bag)	Sand (m <sup>3</sup> )	Gravel (m <sup>3</sup> )	
45	8	39.1	171	121	273	425	380	710	1,106	7.60	.534	.704	.670
	12	37.3	183	129	253	425	407	658	1,106	8.14	.495	.704	.670
	15	35.8	192	136	237	425	427	616	1,106	8.54	.463	.704	.670
	18	37.9	203	143	244	400	451	634	1,040	9.02	.477	.662	.630
	21	40.3	219	155	248	368	487	645	957	9.74	.485	.610	.580
50	8	40.3	170	108	287	425	340	746	1,106	6.80	.561	.704	.670
	12	39.2	178	113	274	425	356	712	1,106	7.12	.535	.704	.670
	15	37.9	187	119	259	425	374	673	1,106	7.48	.506	.704	.670
	18	40.1	197	125	268	400	394	697	1,040	7.88	.524	.662	.630
	21	42.7	213	135	274	368	426	712	957	8.52	.535	.610	.580
55	8	41.3	169	97	299	425	307	777	1,106	6.14	.584	.704	.670
	12	40.2	177	102	286	425	322	744	1,106	6.44	.559	.704	.670
	15	39.3	184	106	275	425	335	715	1,106	6.70	.538	.704	.670
	18	41.3	195	113	282	400	355	733	1,040	7.10	.55	.662	.630
	21	44.2	210	121	291	368	382	757	957	7.64	.569	.610	.580
60	8	42.0	168	89	308	425	280	801	1,106	5.60	.602	.704	.670
	12	41.1	176	93	296	425	293	770	1,106	5.86	.579	.704	.670
	15	40.1	183	97	285	425	305	741	1,106	6.10	.557	.704	.670
	18	42.4	193	102	295	400	322	767	1,040	6.44	.577	.662	.630
	21	45.2	209	110	303	368	348	788	957	6.96	.592	.610	.580
65	8	43.4	168	82	321	419	258	835	1,089	5.16	.628	.694	.660
	12	42.6	175	85	311	419	269	809	1,089	5.38	.608	.694	.660
	15	41.7	182	89	300	419	280	780	1,089	5.60	.586	.694	.660
	18	44.2	192	94	311	393	295	809	1,023	5.90	.608	.652	.620
	21	46.8	208	102	318	362	320	827	941	6.40	.622	.599	.570
70	12	43.9	175	79	323	413	250	840	1,073	5.00	.632	.683	.650
	15	43.0	182	83	312	413	260	811	1,073	5.20	.610	.683	.650
	18	45.6	192	87	324	387	274	842	1,007	5.48	.633	.641	.610
	21	48.4	208	94	333	355	297	866	924	5.94	.651	.589	.560
* (75)	18	46.1	191	81	331	387	255	861	1,007	5.10	.647	.641	.610
	21	48.9	207	88	340	355	276	884	924	5.52	.665	.589	.560

Table 2.6 Standard mixture (3)  
Sand less than 5mm, gravel less than 20mm

Water-Cement Ratio (°/wt)	Slump (cm)	Fine Aggregate (°/V1)	Unit Water Volume (kg/m <sup>3</sup> )	Absolute Volume (l/m <sup>3</sup> )			When Postulated Value in 5.2.6.A.(3) in Used Weight (kg/m <sup>3</sup> )			Volume Measured at Site (per/m <sup>3</sup> )			Unit Coarse Aggregate Volume (m <sup>3</sup> /m <sup>3</sup> )
				Cement	Sand	Gravel	Cement	Sand	Gravel	Cement (bag)	Sand (m <sup>3</sup> )	Gravel (m <sup>3</sup> )	
45	8	44.2	168	118	311	393	373	809	1,023	7.46	.578	.652	.620
	12	42.6	179	126	292	393	398	759	1,023	7.96	.542	.652	.620
	15	41.2	189	133	275	393	420	715	1,023	8.40	.511	.652	.620
	18	43.3	200	141	281	363	444	731	957	8.88	.522	.610	.580
	21	45.8	216	152	285	337	480	741	875	9.60	.529	.557	.530
50	8	45.4	165	105	327	393	330	850	1,023	6.60	.607	.652	.620
	12	44.2	175	111	311	393	350	809	1,023	7.00	.578	.652	.620
	15	43.0	184	117	296	393	368	770	1,023	7.36	.550	.652	.620
	18	45.2	195	124	303	368	390	788	957	7.80	.563	.610	.580
	21	47.9	210	133	310	337	420	806	875	8.40	.576	.557	.530
55	8	46.2	164	95	338	393	298	879	1,023	5.96	.628	.652	.620
	12	45.2	173	100	324	393	315	842	1,023	6.30	.601	.652	.620
	15	44.3	181	104	312	393	329	811	1,023	6.58	.579	.652	.620
	18	46.4	192	111	319	368	349	829	957	6.98	.592	.610	.580
	21	49.2	207	119	327	337	376	850	875	7.52	.607	.557	.530
60	8	46.8	164	87	346	393	273	900	1,023	5.46	.643	.652	.620
	12	45.9	172	91	334	393	287	868	1,023	5.74	.620	.652	.620
	15	45.0	180	95	322	393	300	887	1,023	6.00	.598	.652	.620
	18	47.4	190	101	331	368	317	861	957	6.34	.615	.610	.580
	21	50.1	205	109	339	337	342	881	875	6.84	.629	.557	.530
65	8	48.2	163	80	360	387	251	936	1,007	5.02	.669	.641	.610
	12	47.4	171	83	349	387	263	907	1,007	5.26	.648	.641	.610
	15	46.5	179	87	337	387	275	876	1,007	5.50	.626	.641	.610
	18	48.8	190	93	345	362	292	897	941	5.84	.641	.599	.570
	21	51.8	205	100	355	330	315	923	858	6.30	.659	.546	.520
70	15	47.8	179	81	349	381	256	907	990	5.12	.648	.631	.600
	18	50.3	190	86	359	355	271	933	924	5.42	.666	.589	.560
	21	53.2	205	93	368	324	293	957	842	5.86	.684	.536	.510
*(75)	18	50.5	192	81	362	355	256	941	924	5.12	.672	.589	.560
	21	53.2	209	89	368	324	279	957	842	5.58	.684	.536	.510

Table 2.6 Standard mixture (4)  
Sand less than 1.2mm, gravel less than 20mm

Water-Cement Ratio (°/wt)	Slump (cm)	Fine Aggregate (°/V1)	Unit Water Volume (kg/m <sup>3</sup> )	Absolute Volume (l/m <sup>3</sup> )			When Postulated Value in 5.2.6.A.(3) in Used Weight (kg/m <sup>3</sup> )			Volume Measured at Site (per/m <sup>3</sup> )			Unit Coarse Aggregate Volume (m <sup>3</sup> /m <sup>3</sup> )
				Cement	Sand	Gravel	Cement	Sand	Gravel	Cement (bag)	Sand (m <sup>3</sup> )	Gravel (m <sup>3</sup> )	
45	8	30.4	173	122	211	484	384	549	1,258	7.68	.450	.777	.740
	12	28.6	183	129	194	484	407	504	1,258	8.14	.413	.777	.740
	15	27.1	191	135	180	484	424	468	1,258	8.48	.384	.777	.740
	18	30.3	201	142	196	451	447	510	1,173	8.94	.418	.724	.690
	21	32.6	217	153	202	418	482	525	1,088	9.64	.430	.672	.640
50	8	31.8	171	109	226	484	342	588	1,258	6.84	.482	.777	.740
	12	30.5	180	114	212	484	360	551	1,258	7.20	.452	.777	.740
	15	29.4	186	118	202	484	372	525	1,258	7.44	.430	.777	.740
	18	32.5	197	125	217	451	394	564	1,173	7.88	.462	.724	.690
	21	35.0	212	135	225	418	424	585	1,088	8.48	.480	.672	.640
55	8	33.0	170	98	238	484	309	619	1,258	6.18	.507	.777	.740
	12	31.7	178	103	225	484	324	585	1,258	6.48	.480	.777	.740
	15	30.9	184	106	216	484	335	562	1,258	6.70	.461	.777	.740
	18	34.1	194	112	233	451	353	606	1,173	7.06	.497	.724	.690
	21	36.7	209	121	242	418	380	629	1,088	7.60	.516	.672	.640
60	8	33.8	169	90	247	484	282	642	1,258	5.64	.526	.777	.740
	12	32.9	176	93	237	484	293	616	1,258	5.86	.505	.777	.740
	15	32.0	182	96	228	484	303	593	1,258	6.06	.486	.777	.740
	18	35.2	192	102	245	451	320	637	1,173	6.40	.522	.724	.690
	21	37.9	207	110	255	418	345	663	1,088	6.90	.543	.672	.640
65	8	35.4	169	83	261	477	260	679	1,241	5.20	.557	.766	.730
	12	34.5	176	86	251	477	271	653	1,241	5.42	.535	.766	.730
	15	33.7	182	89	242	477	280	629	1,241	5.60	.516	.766	.730
	18	36.8	192	94	259	445	295	673	1,156	5.90	.552	.714	.680
	21	39.6	207	101	270	412	318	702	1,071	6.36	.575	.661	.630
70	12	35.8	176	80	263	471	251	684	1,224	5.02	.561	.756	.720
	15	35.2	181	82	256	471	259	666	1,224	5.18	.546	.756	.720
	18	38.4	192	87	273	438	274	710	1,139	5.48	.582	.703	.670
	21	41.2	207	94	284	405	296	738	1,054	5.92	.605	.651	.620
*(75)	18	38.4	196	83	273	438	261	710	1,139	5.22	.582	.703	.670
	21	41.4	210	89	286	405	280	744	1,054	5.60	.610	.651	.620

Table 2.6 Standard mixture (5)  
Sand less than 2.5mm, gravel less than 25mm.

Water-Cement Ratio (°/wt)	Slump (cm)	Fine Aggregate (°/V1)	Unit Water Volume (kg/m <sup>3</sup> )	When Postulated Value in 5.2.6.A.(3) in Used									Unit Coarse Aggregate Volume (m <sup>3</sup> /m <sup>3</sup> )
				Absolute Volume ( <sup>l</sup> /m <sup>3</sup> )			Weight (kg/m <sup>3</sup> )			Volume Measured at Site (per/m <sup>3</sup> )			
				Cement	Sand	Gravel	Cement	Sand	Gravel	Cement (bag)	Sand (m <sup>3</sup> )	Gravel (m <sup>3</sup> )	
45	8	35.9	168	118	253	451	373	658	1,173	7.46	.495	.724	.690
	12	34.2	179	126	234	451	308	608	1,173	7.96	.457	.724	.690
	15	32.6	188	133	218	451	418	567	1,173	8.36	.426	.724	.690
	18	35.8	199	140	233	418	442	606	1,088	8.84	.453	.672	.640
	21	38.0	215	152	237	386	478	616	1,003	9.56	.463	.619	.590
50	8	37.1	167	106	266	451	334	692	1,173	6.68	.520	.724	.690
	12	35.8	176	112	251	451	352	653	1,173	7.04	.491	.724	.690
	15	34.7	183	116	240	451	366	624	1,173	7.32	.469	.724	.690
	18	37.9	194	123	255	418	388	663	1,088	7.76	.498	.672	.640
	21	40.4	209	133	262	386	418	681	1,003	8.36	.512	.619	.590
55	8	38.0	166	96	277	451	302	720	1,173	6.04	.541	.724	.690
	12	37.0	174	100	265	451	316	690	1,173	6.32	.518	.724	.690
	15	36.1	180	104	255	451	327	663	1,173	6.54	.498	.724	.690
	18	39.3	191	110	271	418	347	705	1,088	6.94	.530	.672	.640
	21	42.0	206	119	279	386	375	725	1,003	7.50	.545	.619	.590
60	8	38.9	165	87	287	451	275	746	1,173	5.50	.561	.724	.690
	12	37.9	173	91	275	451	288	715	1,173	5.76	.538	.724	.690
	15	37.0	179	95	265	451	298	689	1,173	5.96	.518	.724	.690
	18	40.4	189	100	283	418	315	736	1,088	6.30	.553	.672	.640
	21	43.1	204	108	292	386	340	759	1,003	6.80	.571	.619	.590
65	8	40.2	165	81	299	445	254	780	1,156	5.08	.586	.714	.680
	12	39.4	172	84	289	445	265	751	1,156	5.30	.565	.714	.680
	15	38.6	178	87	280	445	274	731	1,156	5.48	.550	.714	.680
	18	42.0	188	92	298	412	289	775	1,071	5.71	.583	.661	.630
	21	44.8	204	100	307	379	314	798	986	6.28	.600	.609	.580
70	15	40.1	178	81	293	438	254	762	1,139	5.08	.573	.703	.670
	18	43.5	188	85	312	405	269	811	1,054	5.38	.610	.651	.620
	21	46.3	204	92	321	373	291	835	969	5.82	.628	.598	.570
*(75)	21	46.8	203	86	328	373	271	853	969	5.42	.641	.598	.570



Table 2.6 Standard mixture (6)  
Sand less than 5mm, gravel less than 25mm.

Water-Cement Ratio (°/wt)	Slump (cm)	Fine Aggregate (°/V1)	Unit Water Volume (kg/m <sup>3</sup> )	Absolute Volume (ℓ/m <sup>3</sup> )			When Postulated Value in 5.2.6.A.(3) in Used Weight (kg/m <sup>3</sup> )			Volume Measured at Site (per/m <sup>3</sup> )			Unit Coarse Aggregate Volume (m <sup>3</sup> /m <sup>3</sup> )
				Cement	Sand	Gravel	Cement	Sand	Gravel	Cement (bag)	Sand (m <sup>3</sup> )	Gravel (m <sup>3</sup> )	
45	8	41.0	165	117	290	418	367	754	1,088	7.34	.539	.672	.640
	12	39.4	176	124	272	418	391	707	1,088	7.82	.505	.672	.640
	15	38.1	185	130	257	418	411	668	1,088	8.22	.477	.672	.640
	18	41.2	196	138	270	386	436	702	1,003	8.72	.501	.619	.590
	21	43.8	212	150	275	353	471	715	918	9.42	.511	.567	.540
50	8	42.3	162	103	307	418	324	798	1,088	6.48	.570	.672	.640
	12	41.0	172	109	291	418	344	757	1,088	6.88	.541	.672	.640
	15	39.9	180	114	278	418	360	723	1,088	7.20	.516	.672	.640
	18	43.1	191	121	292	386	382	762	1,003	7.62	.542	.619	.590
	21	45.9	206	131	300	353	412	785	918	8.24	.557	.567	.540
55	8	43.2	161	93	318	418	293	827	1,088	5.86	.591	.672	.640
	12	41.9	171	99	302	418	311	785	1,088	6.22	.561	.672	.640
	15	41.2	177	102	293	418	322	762	1,088	6.44	.544	.672	.640
	18	44.3	188	109	307	386	342	798	1,003	6.84	.570	.619	.590
	21	47.3	203	117	317	353	369	824	918	7.38	.589	.567	.540
60	8	43.8	161	85	326	418	268	848	1,088	5.36	.606	.672	.640
	12	42.8	169	90	313	418	282	814	1,088	5.64	.581	.672	.640
	15	42.0	176	93	303	418	293	788	1,088	5.86	.563	.672	.640
	18	45.3	186	98	320	386	310	832	1,003	6.20	.594	.619	.590
	21	48.3	201	106	330	353	335	858	918	6.70	.613	.567	.540
65	12	44.3	168	82	328	412	258	853	1,071	5.16	.609	.661	.630
	15	43.6	175	85	318	412	269	827	1,071	5.38	.591	.661	.630
	18	46.8	186	91	334	379	286	868	986	5.72	.620	.609	.580
	21	49.8	201	98	344	347	309	894	901	6.18	.639	.556	.530
70	15	45.0	175	79	331	405	250	861	1,054	5.00	.615	.651	.620
	18	48.2	186	84	347	373	266	902	969	5.32	.644	.598	.570
	21	51.3	201	91	358	340	287	931	884	5.74	.665	.546	.520
* (75)	18	48.3	188	80	349	373	251	907	969	5.02	.648	.598	.570
	21	51.3	205	87	358	340	273	931	884	5.46	.665	.546	.520

Table 7.5 Reference of mixture for light-weight concrete grade-3 (1)

Water-Cement Ratio (°/wt)	Slump (cm)	Sand of less than 1.2mm						Sand of less than 2.5mm						Sand of less than 5mm					
		Absolute Volume( $\ell/m^3$ )						Absolute Volume( $\ell/m^3$ )						Absolute Volume( $\ell/m^3$ )					
		Fine Aggregate (°/Vl)	Unit Water Volume( $kg/m^3$ )	Weight of Cement( $kg/m^3$ )	Cement	Sand	Light-Weight Aggregate Volume	Fine Aggregate (°/Vl)	Unit Weight Volume( $kg/m^3$ )	Weight of Cement( $kg/m^3$ )	Cement	Sand	Light-Weight Aggregate Volume	Fine Aggregate (°/Vl)	Unit Water Volume( $kg/m^3$ )	Weight of Cement( $kg/m^3$ )	Cement	Sand	Light-Weight Aggregate Volume
56	15	42.2	197	352	111	275	377	46.9	193	345	110	308	349	51.4	190	339	108	340	322
	18	44.3	208	371	117	281	354	48.7	205	366	116	311	328	53.1	201	358	114	343	302
	21	46.4	223	398	125	284	328	50.8	221	395	125	312	302	55.5	217	388	123	344	276
58	15	42.7	196	338	106	281	377	47.4	192	331	105	314	349	51.8	189	326	103	346	322
	18	44.8	207	357	112	287	354	49.2	203	350	111	318	328	53.6	200	345	109	349	302
	21	46.8	222	383	121	289	328	51.5	219	376	119	321	302	55.9	216	372	118	350	276
60	15	43.1	195	325	102	286	377	47.6	192	320	102	317	349	52.0	189	315	100	349	322
	18	45.2	206	343	108	292	354	49.5	203	333	107	322	328	54.0	199	332	105	354	302
	21	47.2	222	370	117	293	328	51.8	218	363	115	325	302	56.2	215	358	114	355	276
62	15	43.9	195	315	100	292	373	48.2	192	310	98	323	347	(52.4	189	305	97	353	321)
	18	45.8	206	332	105	297	352	(50.1	203	327	104	327	326)	(54.5	199	321	102	359	300)
	21	48.0	222	358	113	300	325	52.5	218	351	111	331	300	56.9	215	347	110	361	274
64	18	(46.6	206	322	101	304	349)	(50.9	202	315	100	335	323)	(55.0	199	311	99	364	298)
	21	48.6	222	317	109	306	323	53.0	218	340	108	336	298	57.5	215	336	107	367	271

Note: Value in ( ) shall indicate that foil rectification during process.

Table 7.5 Reference of mixture for light-weight concrete grade-4 (2)

Water-Cement Ratio(°/wt)	Slump (cm)	Sand of less than 1.2mm						Sand of less than 2.5mm						Sand of less than 5mm					
		Absolute Volume( $\ell/m^3$ )						Absolute Volume( $\ell/m^3$ )						Absolute Volume( $\ell/m^3$ )					
		Fine Aggregate (°/V1)	Unit Water Volume( $kg/m^3$ )	Weight of Cement( $kg/m^3$ )	Cement	Sand	Light-Weight Aggregate Volume	Fine Aggregate (°/V1)	Unit Weight Volume( $kg/m^3$ )	Weight of Cement( $kg/m^3$ )	Cement	Sand	Light-Weight Aggregate Volume	Fine Aggregate (°/V1)	Unit Water Volume( $kg/m^3$ )	Weight of Cement( $kg/m^3$ )	Cement	Sand	Light-Weight Aggregate Volume
56	15	38.2	188	336	107	254	411	43.2	184	329	104	290	382	47.8	181	323	103	323	353
	18	40.2	198	354	112	261	389	45.0	195	348	111	294	360	49.8	192	342	109	328	331
	21	42.7	212	379	120	268	360	47.5	210	375	119	300	331	52.4	207	370	117	333	303
58	15	38.7	187	322	102	260	411	43.6	183	316	100	295	382	48.2	180	310	98	329	353
	18	40.6	197	339	108	266	389	45.5	194	334	106	301	360	50.2	191	330	105	333	331
	21	43.2	211	364	115	274	360	48.1	209	360	114	307	331	52.8	206	355	113	338	303
60	15	(39.2	186	310	98	265	411)	(44.1	183	305	97	300	380)	(48.5	180	300	95	332	353)
	18	(41.1	196	327	104	271	389)	(46.3	193	322	102	308	357)	(50.6	190	317	101	338	331)
	21	43.6	211	352	111	278	360	48.8	208	347	110	313	329	53.1	205	342	109	343	303
62	18	(41.8	196	317	101	277	386)	(47.0	193	312	99	314	354)						
	21	44.3	211	340	108	284	357	49.3	208	336	107	318	327	53.7	205	331	105	349	301
64	21	45.1	211	330	105	290	354	(49.8	208	325	103	323	326)						

Note: Value in ( ) shall indicate that foil rectification during process.

Table 7.5 Reference of mixture for light-weight concrete grade-5 (3)

Water-Cement Ratio(°/wt)	Slump (cm)	Sand of less than 1.2mm						Sand of less than 2.5mm						Sand of less than 5mm					
		Absolute Volume( $\ell/m^3$ )						Absolute Volume( $\ell/m^3$ )						Absolute Volume( $\ell/m^3$ )					
		Fine Aggregate (°/V1)	Unit Water Volume(kg/m <sup>3</sup> )	Weight of Cement(kg/m <sup>3</sup> )	Cement	Sand	Light-Weight Aggregate Volume	Fine Aggregate (°/V1)	Unit Weight Volume(kg/m <sup>3</sup> )	Weight of Cement(kg/m <sup>3</sup> )	Cement	Sand	Light-Weight Aggregate Volume	Fine Aggregate (°/V1)	Unit Water Volume(kg/m <sup>3</sup> )	Weight of Cement(kg/m <sup>3</sup> )	Cement	Sand	Light-Weight Aggregate Volume
56	15	41.0	205	366	116	262	377	46.0	201	359	114	297	348	50.5	197	352	112	329	322
	18	43.0	216	386	123	267	354	47.7	212	379	120	300	328	52.2	209	374	119	330	302
	21	45.1	231	412	131	270	328	49.8	229	410	130	299	302	54.5	225	402	128	331	276
58	15	41.5	204	352	112	267	377	46.5	200	344	109	303	348	51.0	196	338	107	335	322
	18	43.7	215	370	117	275	354	48.3	211	363	115	306	328	52.7	208	359	114	336	302
	21	45.7	230	397	126	276	328	50.4	228	393	125	305	302	55.0	224	386	123	337	276
60	15	42.0	203	338	107	273	377	47.0	199	332	105	308	348	51.3	196	326	104	338	322
	18	44.1	214	357	113	279	354	48.7	210	350	111	311	328	53.1	207	345	110	341	302
	21	46.0	230	384	122	280	328	50.7	227	379	120	311	302	55.6	223	372	118	343	276
62	15	42.8	203	327	104	280	373	47.3	199	322	102	312	347	(51.7)	196	316	100	344	320)
	18	44.7	214	345	109	285	352	49.2	210	340	108	316	326	(53.7)	207	334	106	347	300)
	21	46.9	230	371	118	287	325	51.4	227	366	116	317	300	56.1	223	360	114	349	274
64	18	(45.5	214	334	106	291	349)	(49.9	209	327	104	323	324)	(54.2	207	324	103	352	298)
	21	47.5	230	360	114	293	323	52.0	227	354	112	323	298	56.8	223	348	111	355	271
66	18	(46.1	214	324	103	296	347)												
	21	48.2	230	348	110	299	321	52.5	227	344	109	328	296						

Note: Value in ( ) shall indicate that foil rectification during process.

6. Steel Reinforcement Work

6.1 Materials

6.1.1 Reinforcing Steel

- A. Steel reinforcement shall be an equivalent of SR 24 which complies with JIS G 3112 (Steel Bar for Reinforcement) and shall be a round steel with a yield point of more than 24 kg/mm<sup>2</sup>.
- B. Deformed Bar shall be SD 24, SD 30, SD 35 or SD 45 which complies with JIS G 3112. Diameter of Deformed Bar shall be its indicated value.
- C. All other reinforcing steels shall be used with approval of the supervisor, unless otherwise specified.
- D. Steel reinforcement shall be placed so that it does not touch directly with the ground and shall be covered by appropriate means to protect it from rain, dew, etc. It shall be stored by type.

6.1.2 Material Test

Test for steel reinforcement shall be as indicated in Table 1.2.

Table 1.2

<u>Materials</u>	<u>Test Items</u>	<u>Number of Test</u>
Steel Reinforcement	Allowable tolerance in dimension, tension test and bending test in compliance with JIS G3112 (Steel Bar for reinforcement).	Once in every different diameter of reinforcement or different manufacturer (6 pieces) length of reinforcement to be tested shall be at the direction of testing laboratory.

6.2 Reinforcement Process

6.2.1 Working Drawing

Detail drawings of process and assembly of reinforcement shall be prepared from design drawings and approved by the supervisor.

6.2.2 Reinforcement Cleaning

Steel reinforcement shall be cleaned before use so that it is free from rust, oil, dirt or other coatings that reduce the bond.

6.2.3 Reinforcement Process

- A. Reinforcement shall be bent properly at normal temperature in size and shape directed in the drawings.
- B. Unless otherwise specified, Bending Method of reinforcement shall be as directed in Table 2.3.

Table 2.3 Bending method of reinforcement

- (1) End Portion
  - (a) 180-degree bend
  - (b) 90-degree bend  
(for slab and wall reinforcement)
  - (c) 135-degree bend  
(for stirrup)  
But reinforcement with diameter less than 9mm shall be in accordance with (b) or (c).
- (2) Middle Portion
  - (a) 90-degree bend
  - (b) Less than 90-degree bend
  - (c) More than 90-degree bend at middle portion of main reinforcing bar with diameter of more than 16mm shall be done with approval of the supervisor.

Table 2.4 Minimum radii of bend

<u>Location</u>	<u>Reinforcement Size</u>	<u>Radii of Bend on The Inside (R)</u>	
End Portion	SR24 SD24	Minimum	1.5d
	SR30 SD30	"	2d
	SD35 SD40 SDC40	"	2.5d
Middle Portion	SR24 SD24	"	6d
	All other bars	"	8d

6.2.4 Assembly

- A. Reinforcement shall be accurately placed and secured so as not to be displaced when pouring concrete. Cross point of reinforcements shall be tied with diameter of more than 0.8mm (#21) bars. Reinforcement shall be adequately supported by spacers, hangers or other approved chairs.
- B. Spacing between reinforcements shall not be less than 1.25 times the maximum size of the coarse aggregate, nor 25 mm and shall be 1.5 times the nominal diameter of reinforcement, unless otherwise specified in the drawings.

- C. Bar arrangement test shall be conducted by the supervisor before pouring of concrete on the above items, joint splicing and anchorage.
- 6.2.5 Splices and Anchorage
- A. Splices of reinforcement not indicated on the drawing shall comply to 6.2.1.
- B. Splices at points of maximum stress shall be avoided. Care shall be taken to avoid concentration of splices in one area.
- C. Length of lapped splices and anchorage shall be as indicated in Table 2.5. Length of hook is not included.
- D. A basis of measurement for anchorage length shall comply to drawing 2.5 D.

Table 2.5 Anchorage and length of splice

<u>Size of Reinforcement</u>	<u>Hook</u>	<u>Tensile Reinforcement</u>	<u>Compressive Reinforcement or Low Tensile Stress Reinforcement</u>
Round Bar SR24 SR30	Yes	40d	30d
Deformed Bar	SD24 Yes	25d	20d
	No	35d	30d
	SD30 Yes	30d	25d
	SD35 No	40d	35d
	SD40 Yes	35d	25d
	No	45d	35d

Concrete strength shall be over  $180 \text{ kg/cm}^2$ .

Drawing 2.5 C.

d

Lapped length  
of splice

Drawing 2.5 D. Anchorage  
Anchorage of beam reinforcement

(A) Top Floor

(B) Typical Floor

Stirrup of One Size  
Larger

Cantilever Beam and Beam

Girder and Beam

Anchorage of Cantilever  
Beam at Beam

Anchorage at Ground Beam

Anchorage at Footing

Independent  
Footing

- E. Splices of different bar diameters shall be made with smaller diameter as reference.
- F. The end of deformed reinforcement shall have hooks in case of the following.
  - (1) Reinforcement at four corners of column and external corner of wing wall.
  - (2) Splice or end of reinforcement at the bottom of beam, slab and roof slab.



- (3) Reinforcement along exterior corner of the wall.  
 (4) Reinforcement of chimney.

6.2.6 Covering  
Depth of  
Reinforcement

- A. Grade and quality of concrete, size of aggregate, construction method, type of finish, etc. shall be checked and approved by the supervisor for covering depth of reinforcement in order to gain fire resistancy, durability and strength.  
 B. Minimum covering depth of reinforcement shall comply to Table 2.6. Covering depth of reinforcement for bearing wall, column, beam not directly in contact with the ground and exposed finishes shall be more than 30 mm with approval of the supervisor, checking with quality of concrete and method of construction.

Table 2.6 Minimum covering depth of reinforcement

<u>Classification of Structural Members</u>			<u>Covering Depth (cm)</u>
Members	Floor, Bearing	With Finish	2
Constructed	Wall Others	Exposed	3
to the	Bearing Wall,	Indoor, Outdoor with Finish	3
Ground	Column, Beam	Outdoor Finished	4
Members Contacted to the		Wall, Column, Beam Floor	4
Ground. Chimney		Foundation & Retaining	6
		Wall, Except Subslub	

- C. Minimum covering depth of reinforcement shall be increased by 10 mm to the values in Table 2.6 in case of Portland Blast Furnace Cement B Grade, Silica Cement B Grade or Flyash Cement B Grade. That increase shall not be needed when surface active agent is used.  
 D. Minimum covering depth of reinforcement shall be increased by 10 mm to the values in Table 2.6 and surface active agent shall be used when Portland Blast Furnace Cement C Grade, Silica Cement C Grade or Flyash Cement C Grade is used to the part directly in contact with the ground.  
 E. Minimum covering depth of retaining wall at surfaces not in contact with the ground shall be 40 mm.

6.2.7 Minimum  
Covering  
Depth and  
Concrete  
Quality at  
Special Places.

- A. Minimum covering depth of reinforcement and concrete quality at place affected by wearing and chemicals shall be as stated in the particular specification.  
 B. Minimum covering depth of reinforcement and concrete quality where special fire resistance is required shall be as stated in the particular specification.

- 6.2.8 Joint Bar
- A. Joint bars shall be placed with direction of the supervisor to partition walls, brickwork, block work and asphalt roofing parapet.
  - B. Joint bars shall be placed with direction of the supervisor to construction joints.
- 6.2.9 Splice of Reinforcement by Gas Pressure Welding.
- A. General
    - (1) Contractor shall be appointed in the particular specification.
    - (2) Structural reinforcement shall be welded by heating and pressurizing with oxygen and melting acetylene.
    - (3) (a) Pressure welding points shall not be aligned.
    - (b) Pressure welding shall be applied to straight regions of minimum stress.
    - (c) Pressure welding shall not be used when standard type or manufacturer of bars is different or difference of diameter of bars is more than 6 mm except when the supervisor finds it safe to use by testing.
  - B. Materials
    - (1) Base metal for gas pressure welding shall be material of size and quality as directed in Table 2.9 B. and be recognized by JIS Standards.

Table 2.9 B Gas pressure welding and available material for use.

Quality		Size		Note
JIS G3112 (Steel Bar for Reinforced Concrete)				
Ordinary Reinforcement	Deformed Reinforcement	Standard	Equivalent to Standard	
SR24	SD24	9mmφ - 25mmφ	9mmφ - 22mmφ	
SR30	SD30	9mmφ - 25mmφ		
	SD35	D13 - D28		
	SD40	D13 - D32		

\* Additional test listed in Section C shall be conducted and the same welder who passed that test shall be employed throughout the work.

- (2) Gas for pressure welding
  - (a) Oxygen shall conform to JIS K 1101.
  - (b) Acetylene shall conform to JIS K 1902.
- (3) Equipment
  - (a) Pressure welding machine shall be such that does not break or offset at welding points.
  - (b) Increasing pressure equipment shall be such that creates bulge smoothly without moving steel bars around.

- C. Welder
- (1) Welder shall be selected with approval of the supervisor.
  - (2) Welder shall be discharged with approval of the supervisor if he finds the welder's working attitude and performance to be insufficient.
- D. Assembly
- (1) Reinforcement shall be pressure welded with enough allowance at welding points so that pressure welded reinforcement matches with that in the design drawings.
  - (2) Welding points of materials shall be perfectly cleaned right before pressure welding with grinder, file, etc. so that they are free from rust, oil, paint, cement or other injurious coatings.
  - (3) Shape of surface to be pressure welded shall be high in the center so that it forms 70° - 90° against center axis of steel bar.
  - (4) Void around pressure welded surface shall be less than 4 mm when steel bars to be pressure welded are placed at designated spot by pressure welding machine.
- E. Work
- (1) Temperature and Weather -
    - (a) Work shall be stopped when temperature is under 0°C or care shall be taken so that welded parts do not get immediately cooled off after pressure welded.
    - (b) Work shall be stopped in raining, snowing or strong wind unless there is appropriate protection to complete the work.
  - (2) Burner -

Burner nozzle shall be a multiple type unless otherwise specified. Burner shall be at least binary-nozzle type when diameter of steel bars is less than 13 mm.
  - (3) Pressure welding -
    - (a) Proper bearing temperature, heating range, time of pressure welding and pressure shall be determined and approved by the supervisor.
    - (b) Welding parts shall be smoothly expanded to more than 1.2 times the original diameter of steel bars.
    - (c) Work shall be stopped when flame was extinguished or different from standard flame during welding. In that case, pressure welded section shall be removed and rewelded.
    - (d) Welded section shall not be cooled off by rain water or as such during or right after the work.
- F. Inspection and Correction
- (1) Allowable amount of eccentricity -

Eccentric distance of steel bars at welded section shall be less than 1/10 of diameter. Welded section shall be removed and rewelded when exceeding the above amount.
  - (2) Expansion -

Reinforcement shall be rewelded when diameter of welded section after pressure welded is less than 1.2 times the original diameter.

- (3) Random sampling test -
- (a) Random sampling test shall be conducted on welded bars.
  - (b) Five pieces shall be tested for tension unless otherwise specified. Additional five shall be tested for bending with direction of the supervisor.
  - (c) Test for tensile strength shall conform to JIS Z 2241 (method of test for tensile strength of metals) and test for bending test to JIS Z 2248 (method of test for bending). Tests shall be done without delay and the results shall be reported as well.
  - (d) Judgement on qualification shall be based on the following.
    - Tensile strength test  
Qualified piece shall be one that does not give in at the welded joint and of that shear strength is more than the standard value of base metal.
    - Bending test  
Qualified piece shall be one that does not crack by bending 180° as 5 times diameter of steel bars.  
The number of test pieces shall conform to the chapter 3 of "Skill Qualification Test" established by Japan Pressure Welding Association. The number of pieces to be tested shall be directed by the supervisor.

## 7. Structural Steel

7.1 Scope This section shall apply to the work involved with structural steels. All incidental items of structural steel shall be stated in the particular specification.

### 7.2 Materials

#### 7.2.1 Steel

- A. Shape of steel shall be precise and straight and free of injurious scratches and rust.
- B. Dimensions of steel section shall conform to standard dimension of steel regulated in

- JIS G3191 (Shape, dimension, weight and tolerance of heat drawn rolled steel bar and bar-in-coil)
- JIS G3192 (Shape, size weight and tolerance of heat drawn rolled steel shape)
- JIS G3193 (Shape, size, weight and tolerance of heat drawn rolled steel plate)
- JIS G3194 (Shape, size, weight and tolerance of heat drawn flat steel)
- JIS G3350 (Cold drawn formed light weight steel shape for structure)
- JIS G3444 (Carbon steel pipe for structure)
- JIS G3466 (Angular pipe for structure)

and tolerance of dimension shall conform to section 5 in JIS G3101 (rolled steel for structure), 3106 (rolled steel for welded structure) and 3444 (carbon steel pipe for structure) and section 6 in JIS G3350 (cold drawn formed light weight steel shape for structure).

- C. Quality of steel shall be selected from the following chart and by the particular specification. Quality shall be in accordance with 2nd class (SS41) of JIS G3101 (Structural rolled steel) unless otherwise stated in the particular specification.

JIS G3101	2-class	(SS41)
JIS G3101	3-class	(SS50)
JIS G3101	4-class	(SS55)
JIS G3106	1-class	(SM41A, SM41B, SM41C)
JIS G3106	2-class	(SM50A, SM50B, SM50C)
JIS G3106	3-class	(SM50YA, SM50YB)
JIS G3106	4-class	(SM53B, SM53C)
JIS G3106	5-class	(SM58)
JIS G3444	2-class	(STK41)
JIS G3444	4-class	(STK50)
JIS G3350		(SSC41)
JIS G3466	1-class	(STKR41)
JIS G3466	2-class	(STKR50)

- 7.2.2 Wrought Steel and Cast Steel. Wrought steel and cast steel shall be in accordance with JIS G3201 (Carbon wrought steel), 5101 (Carbon cast steel).

- 7.2.3 Rivet
- A. Shape of rivet shall be roundhead rivet specified in JIS B 1213 (cold-drawn rivet), JIS B 1214 (hot-drawn rivet). Countersunk rivet, flathead rivet and round countersunk rivet shall be used as directed.
- B. Quality of rivet shall be equal to standard of 2nd class (SV41) specified in JIS G 3104 (rolled steel for rivets).

- 7.2.4 Bolt
- A. Shape of bolt, nut, washer shall be in accordance with JIS B 1180 (Hexagonal bolt) 1181 (Hexagonal nut) 1256 (flat washer) shape of high strength bolt shall be specified elsewhere.
- B. Degree of bolt shall be a medium bolt of JIS B 1180 (Hexagonal bolt). Accuracy of high strength bolts and nuts shall be 2nd class in JIS B 0210 (Tolerance of unified thread of screw). Bolt screw shall be spinning processed and have a special designation on head.
- C. Quality of bolt shall be equal to 2nd class (SS41) specified in JIS G 3101. Quality of high strength bolt shall be in accordance with JIS B 1186 (High strength hexagonal bolt, nut and washer for friction joint).

## 7.2.5 Welding Rod

Arc welding rod shall be equal to standard of JIS Z 3211 (Coating arc welding rod for mild steel), 3212 (Coating arc welding rod for high tensile steel), 3311 (Wire for submerge arc welding). Gas welding rod shall be equal to standard of CA46, CA43 in JIS Z 3201 (Gas welding rod for mild steel). Center line and flux of automatic and semi-automatic welding shall be determined as case arises.

## 7.2.6 Material Test

- A. Material test shall be omitted with approval of the supervisor for standard materials with JIS designation or certificate.
- B. Tension and flexure tests shall be conducted on materials except the above in accordance with JIS G 0303 (Inspection regulation of steel), Z 2201 (Metal tension test piece), Z 2241 (Metal tension test method), Z 2204 (Metal tension test method), Z 2248 (Metal bending test method).
- C. Material test shall be held at government and public laboratory approved by the supervisor.
- D. Number of steel materials to be tested shall be one in every different section. Number shall be increased by one in every 20 ton or a fraction of it. Number of rivets to be tested shall be one in every different diameter. Number shall be increased by one in every 2 ton or a fraction of it.

## 7.3 Fabrication

- A. Full scale drawings of each section shall be drawn prior to fabrication and checked by the supervisor.
- B. Section of each material shall be cut perpendicular to axis unless otherwise directed in the drawing.
- C. Automatic gas cutter shall be used for gas cutting, and a cut section shall be free of any noticeable defect.
- D. Automatic steel pipe cutter shall be used for pipe cutting as a rule and a cut section shall be completely processed.
- E. Deformation caused by cutting shall be corrected.
- F. Bending process shall be done by normal temperature or hot drawn process. Steel shall be red heat in hot drawn process.
- G. Those directed in the drawing shall be chiselled finish and completely attached.
- H. Materials shall be checked for bend, distortion, warp, etc. before fabrication.

## 7.4 Rivet

## 7.4.1 Rivet

- A. Spacing of rivet holes shall be as directed in Table 4.1.

Table 4.1 Standard rivet hole

<u>Diameter of Rivet</u>	<u>Standard Pitch</u>	<u>Minimum Pitch</u>	<u>End Distance</u>	<u>Edge Distance</u>
16	60	48	35	25
17	70	57	40	30
22	80	66	45	35
25	90	75	50	40

Minimum pitch and end distance for light weight steel shape shall be more than 3 times and 2.5 times a rivet diameter respectively.

- B. Diameter of a rivet hole shall be 10mm larger than that of a rivet with diameter 16mm or less and 1.5mm larger than that of a rivet with diameter between 19mm and 28mm.
- C. Rivet hole shall either be drilled open or reamed after sub-punching. Punching shall be sufficient for a material thickness less than 13mm.
- D. Rolled edge around a hole shall be removed.
- E. Position of a rivet hole shall be precise so that the center of all holes aligns.

#### 7.4.2 Connection

- A. Rivet shall be driven after all connections are aligned with bolts or pins.
- B. Rivet holes shall be finished with reamer if necessary in order to have all holes aligned. Driftpin shall not be used to align holes.

#### 7.4.3 Rivet Driving

- A. Rivet shall be machine-driven.
- B. Rivet shall be heated to no more than 1100°C and shall not be driven if it cools off below 600°C.
- C. Rivet shall be driven completely until its hole is filled with rivet. Rivet head shall be a button rivet as specified in JIS B 1214 unless otherwise specified.
- D. Rivet shall be free of looseness, crack, deformation in shape or other defects.
- E. Driven rivet shall be inspected by the supervisor. That found imperfect shall be removed with care not to impare in and around the hole and redriven.
- F. Welding or bolting shall take in place with approval of the supervisor where rivet driving is difficult to perform.

### 7.5 Bolt

#### 7.5.1 Bolt Hole

- A. Diameter of bolt hole shall not be over 0.5mm larger than bolt diameter. However, for anchor bolt 5mm clearance shall be allowed between bolt diameter and diameter of hole unless otherwise specified.
- B. Installation of bolt hole shall comply to that of rivet hole.

- 7.5.2 Protection Against Loosing of Nuts Nuts shall be protected against loosing by concrete covering, double nuts or other proper means.
- 7.5.3 Shear Bolt Shear bolt shall be provided with washers to keep the nut outside of grip.
- 7.5.4 Pin and Roller
- A. Pin and roller shall be machine-finished.
  - B. Pin hole which is a little larger than diameter of pin shall be bored after materials are welded or riveted.
- 7.5.5 High Strength Bolts
- A. Maximum loading test, guarantee loading test and torque coefficient test shall be held on high strength bolt with attendance of the supervisor. Torque value for tightening shall be determined at the result of those test.
  - B. Friction face shall be free of paint, oil, mill scale rust, dust or others injurious to friction force.
  - C. The field tightening tools shall be decided with prior approval of the supervisor and studied for their characteristics.
  - D. Coefficient of torque shall be measured and tightening torque shall be inspected at least once in every floor.
  - E. 10% of bolts shall be inspected with attendance of the supervisor for final tightening.
  - F. Inspection shall be done by means of torque-wrench those bolts with torque value at final tightening exceeding more than 10% of regulated value and nuts not moving shall be accepted.
- 7.6 Welding
- 7.6.1 Welding
- A. Welder qualification requirements shall conform to JIS Z 3801, unless otherwise directed by the supervisor.
  - B. Other tests shall be conducted to confirm welders skill in accordance with type of work.
  - C. Tuck welding shall be carried out by the welder approved by the supervisor.
- 7.6.2 Welding Machine
- A. Arc welding machine shall be alternate or direct current type which provides sufficient and adequate current.
  - B. The field arc welding machine shall be provided with remote control for easy control of current.
- 7.6.3 Preparation
- A. Welding shall be done as much downward as possible using a GIG such as Rotary frame.
  - B. Welding rod shall be always kept in a dry area and if necessary, dried by drying equipments.
  - C. Welding surface shall be free of water, scale or others injurious to welding work. Slag appeared on the creater surface in the middle of welding shall be cleaned before starting again.



- 7.6.4 Fabrication
- A. Color coding or other means shall be used to identify steel when different steels are used together.
  - B. Welding edge shall be smoothed by automatic gas cutting or other proper finishes.
  - C. Chisel shall not be used to mark off for high strength steel over SM 50.
  - D. When difference of thickness or diameter of base metal in butt welding exceeds 4 mm, thicker or bigger base metal shall have a slope of less than 1:5.
- 7.6.5 Built-Up
- A. Jig shall be used to keep mutual position of materials in assembly.
  - B. Temporary bolt hole for assembly shall be bored with approval of the supervisor.
  - C. Proper amount of contraction, predistortion or restraint shall be added to welding parts to attain precise finish dimensions and shape.
  - D. Welding materials shall be properly met in fillet welds.
  - E. In butt welding spacing of root shall be precisely kept and backing strip shall be carefully attached.
- 7.6.6 Tack
- A. Short bead shall be avoided for tack welding. The minimum length of tack welding shall be as follows. Plate thickness under 3.2 mm - Bead length over 30 mm, 3.2~25 mm - 40 mm, over 25 mm - 50 mm.
  - B. The end of joint, corner angle, beginning and ending point of final welding shall be avoided for tack welding.
  - C. Tack welding as a part of final welding shall be perfectly done.
  - D. Low hydrogen welding rod shall be used for tack welding of SM 50 and thick plate with a thickness of over 25 mm.
- 7.6.7 Work
- A. Type of welding rod, rod diameter, current, voltage and welding speed shall be selected in accordance with type of welding work.
  - B. Order of welding and movement of rod shall be determined so that there shall be no deformation after welds.
  - C. Welding shall precede riveting when they are used in combination.
  - D. In butt welding, one side shall be welded first and back side shall be welded after back chipping. Back stripping shall be used when back chipping is difficult to perform.
  - E. Both ends of butt welding shall use end tab which is the same beveling for splice.
  - F. Fillet welds for the solid angle shall use rotating welds or end tab.
  - G. Proper preheating shall be required for type of materials or thickness of plate.
  - H. Welding shall not be performed when temperature is below 0°C.
  - I. Welding shall be carefully done in concealment in raining, snowing and strong wind.
- 7.6.8 Finishes
- A. Surface of welds shall be as smooth as possible and size and length of welds shall not be less than designed dimensions.
  - B. Reinforcement of weld shall not exceed 3 mm in butt welds and  $0.1S + 1$  mm (S: Designated size) in fillet welds.
  - C. Welded parts shall be free of undercut, overlap, crack, blow hole, lack of welds, lack of

- weld settlement, rolled up slab or other defects.
- D. Crater at the end of bead shall be carefully heaped up and slag, sputter, etc. shall be completely removed after welds.
- 7.6.9 Safety
- A. Safe scaffoldings shall be provided for the field welds work.
- B. Welding facilities shall be such that there shall be no electric leakage or electric shock. There also shall be sufficient protection for fire.
- C. Electric shock protection device shall be used and also care shall be taken not to get suffocated or intoxicated by gas when welding in small area.
- 7.6.10 Inspection
- A. Welding parts shall be inspected before, during and after welding in accordance with work schedule.
- B. X-ray inspection through inside of welded parts shall conform to JIS G 0581, 2nd class shall be a passing mark unless otherwise specified.
- 7.6.11 Correction
- A. Welding parts having injurious defects shall be removed and rewelded.
- B. When deposited metal gets cracked, at least 50 mm from the edge of crack shall be cut off and rewelded.
- C. When base metal gets cracked, it shall be replaced.
- D. Under cut parts shall be corrected by attaching deposited metal.
- E. That is refected at the result of X-ray transmitted test shall be chiselled off, rewelded and retested.
- F. Injurious deformation left on welding material shall be corrected or reinforced.
- 7.6.12 Gas Welding
- A. Steel materials allowed to be gas-welded shall be JIS G 3101 (General rolled structural steel) 2nd class (SS41) and JIS G 3350 (L.G. steel) (SSC41).
- B. Oxygen and acetylene gas used in gas used in gas welding shall comply to JIS K 1101 and JIS K 1902 respectively.
- C. Oxygen and acetylene gas used in gas welding shall comply to JIS K 1101 and JIS K 1902 respectively.
- D. Gas welding machine and facilities shall comply to JIS B 6801 (low pressure gas welder), 6803 (pressure adjuster for welder), 6805 (rubber hose joint for welder) and also labor safety and sanitation regulations.
- E. Welder, fabrication, assembly and welding execution shall comply with respective items in arc welds.
- 7.6.13 Automatic Weld
- A. Automatic or semi-automatic welding by use of machine or other means shall be done with prior approval of the supervisor.

- B. A person shall be selected to take care of the machine in case of automatic or semi-automatic welding. Care shall be taken to keep welding condition constant.
- C. Fabrication, assembly, welding execution, inspection, etc. shall comply with respective items in arc welds.

## 7.7 Shop Painting and Shipping

### 7.7.1 Shop Painting

- A. Mill scale, rust, spatter, slab, oil, etc. shall be cleaned off and anti-corrosive paint shall be applied once before shipping.
- B. Those unable to be painted after fabrication shall be shop painted twice. No paint shall be used on lapping face unless otherwise specified. It shall be just cleaned thoroughly before fabrication.
- C. No paint shall be used on parts covered with concrete.
- D. No paint shall be used within 200 mm of welding line in case of the field welds. Light application of boiled oil shall be used instead of paint.
- E. Crease shall be applied to contacting face of pin roller or machine chiselled finish of sliding face.
- F. Anti-corrosive paint in the above section shall be applied twice when required in the particular specification.
- G. Paints and painting specification shall comply with Chapter 19 Paint work.

### 7.7.2 Shipping

- A. Steels shall be temporarily fabricated and inspected by the supervisor before shipping when required in the particular specification.
- B. Materials shall be marked for easy fabrication.
- C. Small items such as rivets, bolts, etc. shall be packed in adequate size, and the contents shall be identified.
- D. Material list shall be made before shipping so that material number, quantity, etc. shall be easily identified.
- E. Shipping shall be orderly made with direction of the supervisor after his inspection on products.

## 7.8 Erection and Field Painting

### 7.8.1 Erection

- A. Erection shall be orderly carried out by method and order approved by the supervisor.
- B. Materials shall be placed on appropriate counter in order not to get distortion, twist or other defects. Correction shall be made to those distorted or twisted before erection.
- C. Horizontal reinforcement and bracing shall be placed and bolts are temporary tightened as columns are put up.

- D. Connection of materials by rivets, etc. shall be made after distortion on plumb is thoroughly corrected.
- E. Temporary bracing or other reinforcement shall be placed to resist wind pressure or other loads during erection.
- F. Lifting of truss or other materials or plumbing shall be reinforced by log, etc.
- G. When heavy objects are placed on a horizontal element or tensile load is applied on column in the course of erection, they shall be reinforced with prior approval of the supervisor.
- H. Care shall be taken on all facilities so that there is no accident.

7.8.2 Field  
Painting

Field painting shall comply with Chapter 19 paint work. Painting specification, however, shall comply with No.5, No.6 and No.7.

7.9 Miscellaneous

7.9.1 Anchor  
Bolt

- A. Anchor bolts shall be provided with templates to insure the accurate placing of the bolts and afterwards poured with concrete for firm fixing.
- B. The method and others for movable burying shall be as directed by the supervisor.

7.9.2 Base Plate

Concrete shall be placed 30 mm below the base plate at column base or truss rest and concrete surface shall be finished with mortar by either methods described below after surface is roughened thoroughly.

- (1) Small area at the center of plate shall be finished with mortar, and mortar shall be filled around by appropriate means after erected. Stiff consistency mortar with mixing ratio by volume 1:1 shall be used.
- (2) Area formed by 3 mm outside of the perimeter of plate including plate area shall be finished with mortar. Stiff consistency mortar with mixing ratio by volume 1:2 shall be used.

8. Concrete Blocks and Bricks

8.1 General

8.1.1 Execution  
Drawing

Work shall be complied with this specification unless otherwise stated on the particular specification or drawings. Any work not specified shall be discussed and directed by the supervisor. Execution drawing of block alignment (inclusive of indication for hanging bolt, wood-plug and conduit pipe), detail reinforcement, window opening, door opening, and other requirement shall be prepared and submitted for approval of the supervisor.

- 8.1.2 Performance at Cold Climate. Mortar and concrete for filling shall conform with Chapter 5 Concrete and Form work. In case temperature is below 2°C, performance shall be instructed by the supervisor.
- 8.1.3 Stake-Board Stake-board shall be provided at each 5 m in length and shall be inspected by the supervisor for the accuracy, firmness and secureness. However, suitable ruler, plumb-bob and hand leveler shall be provided for minor performance of concrete block and bricks.
- 8.1.4 Transportation and Storing Care shall be taken for damage during transportation of material and any defect of natural finished concrete blocks or bricks shall be rejected. Different size of material shall be stored separately and protected from dirt and other impurities.
- 8.1.5 Curing Any shock or load shall not be applied until concrete mortar or other fills hardened. Corner, projection and top of concrete block or brick work shall be protected from rain, dryness, cold, damage and stain by covering. Void between blocks or bricks shall not be intruded by rain water.
- 8.2 Reinforced Concrete Blocks
- 8.2.1 Material
- A. Reinforced concrete blocks and structure concrete blocks shall conform to requirements of JIS A 5406 (Hollow concrete block) and shall be 1st class with no defect.
  - B. Concrete blocks shall comply with JIS A 5406 (Hollow concrete block) C-Grade unless otherwise specified.
  - C. Maximum grain of coarse aggregate for concrete fill shall be less than 1/5 width of maximum void of block. Sand for mortar for joint of block shall be passed through sieve 2.5 mm clean and hard.
  - D. Reinforcement bar and binding wire shall conform to Chapter 6 Steel reinforcement. Deformed bar and other special steel shall be stated in the particular specification.
  - E. Water-proof agent for water-proofed mortar shall conform to Chapter 9 Water-proofing.
  - F. Mixture of concrete and mortar shall be referred to the following Table 2.1.

Table 2.1 Mixture of concrete and mortar for concrete blocks (volume ratio)

		<u>Less Than 2 Stories</u>				<u>Remark</u>
		<u>Slaked</u>		<u>Sand</u>	<u>Gravel</u>	
		<u>Cement</u>	<u>Lime</u>			
Mortar	Joint	1	0.2	2.8		10 mm joint unless specified.
	Fill	1		3		Consider C.B. water absorption for hardness.
	Exposed Joint	1		1		Water-proofing agent added for exterior joint.
Concrete	Fill	1		2.5	3.5	Slump 20 - 23 cm.
	Structure	1		2.5	3.5	Slump 15 - 20 cm.
	Lean	1		3	6	Minimum water to required workability.
		<u>3 Stories</u>				<u>Remark</u>
		<u>Slaked</u>		<u>Sand</u>	<u>Gravel</u>	
		<u>Cement</u>	<u>Lime</u>			
Mortar	Joint	1	0.2	2.5		10 mm joint unless specified.
	Fill	1		2.5		Consider C.B. water absorption for hardness.
	Exposed Joint	1		1		Water-proofing agent added for exterior joint.
Concrete	Fill	1		2		Slump 20 - 23 cm.
	Structure	1		2.5	3.5	Slump 15 - 20 cm.
	Lean	1		3	6	Minimum water to required workability.

## 8.2.2 Reinforcement A.

Vertical reinforcement for concrete block bearing wall;

- (1) In case of bearing block wall, vertical reinforcing bar shall not be jointed and shall be anchored 40D (40 x diameter of the bar) at both end as in beam and foundation. However, when joint of bar is not avoidable, joint shall be located at random and shall be 25D (25 x diameter of the bar) with 90° hook at both end.
- (2) In case reinforcing bar for opening is called at end of block wall, 70 mm thickness of mortar or concrete shall be filled. Reinforcing bar shall be covered with minimum 20 mm of mortar or concrete.
- (3) Vertical reinforcing bar for bearing block wall shall be 9  $\phi$  @400 mm (400 mm on center) and reinforcing bar for opening shall be 13  $\phi$  unless otherwise specified.

## B.

Horizontal reinforcement for concrete block bearing wall;

- (1) Horizontal reinforcement shall be provided with 180° hoop at both end and covered with more than 20 mm in thickness of mortar or concrete.

Cross of horizontal and vertical reinforcement shall be tightened with binding wire. Horizontal reinforcement at end of wall shall be jointed with vertical reinforcement for at least 40D (40 x diameter of the bar).

- (2) Horizontal reinforcing bar for structural block wall shall be 9  $\phi$  @800 mm (800 mm O.C.) and reinforcing bar for opening shall be 13  $\phi$  unless otherwise specified.

8.2.3 Placing  
Blocks

- A. Concrete blocks shall be saturated with water and joint shall be cleaned.  
 B. Bonding mortar shall be used immediately after mix, and mixed mortar left for more than one hour shall be rejected.  
 C. Vertical and horizontal joint of blocks shall be filled completely and suitably with mortar on line and shall not be moved or rearranged. Joint and surface of block of exposed finished block wall shall be cleaned immediately after joint is filled.  
 D. In case reinforced concrete block bearing wall is attached to structural concrete, block bearing wall shall be placed before concreting structure.  
 E. Excluding concrete block bearing wall, mortar for joint shall be touched with steel trowel before hardened and exposed joint shall be finished with uniform width and planed without roughness or cavity.  
 F. Height for placing blocks per day shall be maximum 1.2 m unless otherwise specified.  
 G. Blocks shall be placed with large cavity side on top.

8.2.4 Mortar and  
Concrete Fill

- A. Mortar or concrete for filling blocks shall be compacted well with rod, and care shall be taken for reinforcing bar and its covering.  
 B. Vertical and horizontal cavities which reinforcing bars inserted shall be filled with mortar or concrete.  
 C. Pouring joint of mortar or concrete shall be approximately 50 mm below top of block.

8.2.5 Lintel

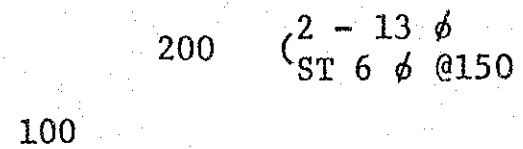
- A. Lintel shall be reinforced concrete as follows, unless otherwise specified, or approved or directed by the supervisor.  
 (1) Concrete block size 200x200x400 and 150x200x400;  
 (Section of lintel)

200

(4 - 13  $\phi$   
ST 6  $\phi$  @150

200  
or  
150

- (2) Concrete block size 100x200x400;  
(Section of lintel)



- (3) Lintel referred in (1) and (2) shall be provided in the following manner;

- B. Main reinforcing bar shall be anchored more than 40 D (40 x diameter of the bar) at both end.
- C. In case lintel is prefabricated, shop drawing shall be submitted for approval of the supervisor.
- A. In case frame is temporarily installed before placing of blocks, frame shall be firmly placed and joiner shall be bonded with mortar as placing each block at side and top of frame.

8.2.6 Frame of  
Opening



8.2.7 Piping

- B. In case frame is installed after placing of blocks, joiner shall be bonded with additional mortar at space of every two blocks or more.
- C. Back of frame shall be filled and compacted with mortar by providing shuttering board.
- D. Wood plug and anchor bolt shall be covered with mortar or concrete.
- A. Principly, pipe shall not be placed in block wall unless piping block is in use.
- B. In case electric conduit pipe is placed in cavity of concrete blocks, care shall be taken not to obstruct reinforcing bar, and cavity shall be completely filled.
- C. In case chipping and piping on face of blocks is unavoidable, performance shall be conformed to instruction of the supervisor.
- D. Joiner and supporter for exposed piping shall be buried at joint which back is filled or otherwise approved by the supervisor.

8.3 Brick and Block Work

8.3.1 Material and Joint

- A. Bricks shall be without cracks, deformation, and any other defects, and sample shall be submitted for approval of the supervisor. Fire brick shall be stored and protected from water. Bricks shall conform to the following Table 3.1 A, unless otherwise stated in the particular specification. Shamott for brick shall be equivalent to fire resisting degree, and grain shall be approximately 2.5 mm or less. Sample of kaolin, pigment and color sand for bricks shall be submitted for approval of the supervisor.

Table 3.1 A Classification of bricks

Grade of Bricks		Use	Standard
Ordinary Bricks	Ordinary- Grade-1	Exposed Brick Work	JIS R 1350 (Ordinary Bricks)
	Tempered Grade-2	Un-Exposed Brick Work	
	Well- Grade-1	Place Moistured Back	
	Tempered Grade-2	of Smoke-Stack	
Insulated Fire Brick	Fire-Resisting Seger Cone More Than SK26 (1590°C)	Furnace	JIS R 2611 (Insulated Fire Brick)
	Fire-Resisting Seger Cone More Than SK30 (1670°C)	Smoke-Stack	

Note: Particular fire-resisting bricks shall be otherwise specified.

- B. Mixture of mortar and width of joint of brick and concrete block work shall conform to the following Table 3.1 B unless otherwise specified.

Table 3.1 B Mixture of mortar (volume ratio) and width of joint.

Use	Slaked				Joint Width
	Cement	Lime	Sand	Shamott Kaolin	
Ordinary Bricks and Blocks	1	0.2	2.8		10
Exposed Bricks and Blocks	1		2		
Exposed Cavitied Blocks	1		1		
Furnace and Smoke Stack	1	0.5	3		6
Fire-Bricks				7 3	3

- C. Grade, measurement and weight of concrete blocks shall be specified otherwise and sample shall be submitted for approval of the supervisor. Performance shall conform to Section 2 (Reinforced concrete blocks).

### 8.3.2 Placing

- A. Bricks and blocks shall be cleaned and suitably saturated in water before use, however fire-bricks shall not be saturated or moistured.
- B. Binding mortar shall be placed and sufficiently compacted.
- C. Bricks and blocks shall be placed in order to proceed in horizontal level and shall not be placed more than 1.5 m in difference of height. Maximum height of placement per day shall be less than 1.2 m in height.
- D. Bricks covering rise of water-proofing shall be provided with approximately 20 mm of space from water-proofing layer and compacted with mortar.

### 8.4 Light-Weight Concrete Blocks

#### 8.4.1 Material

Material shall be specified otherwise.

#### 8.4.2 Performance

Performance shall conform to Section 2 (Reinforced concrete blocks) unless otherwise specified.

### 8.5 Precasted Concrete Work.

- A. Strength calculation sheets and drawing, of reinforcement, installation method and any other necessary details, shall be submitted for approval of the supervisor.
- B. Precasted concrete shall be prepared in factory unless otherwise specified.
- C. Form work shall conform to Section 6.7 Form work of Chapter 5 Concrete and Form work unless otherwise specified. Quality of form shall be reported and approved by the supervisor before hand. Concrete shall be reinforced to obtain required strength.
- D. Joiner and anchor shall be bound with mortar according to instruction of the supervisor.
- E. Face of concrete shall conform to Section 6.5 Finish of exposed concrete of Chapter 5 Concrete and Form work unless otherwise specified.

9. Water-Proofing9.1 Asphalt  
Water-  
Proofing

Classification and method of asphalt water-proofing shall conform to followings and drawings.

9.1.1 Classification  
and Method

Table 1.1 (1) Roof water-proofing not exposed.

Spec. No.	Pitch	Bedding Material	Durable Period	Method of Covering	1	2	3
KP-1	1/100 - 1/12	Concrete	12	1:3:6 Concrete Thickness 90mm	0.3ℓ of primer rubber brushed once or sprayed twice	Insulation roofing layer Asphalt compound 0.2kg (spot)	Roofing for base B A
KP-2	1/100 - 1/12	Concrete	15	Gravel Concrete Thickness 90mm	0.3ℓ of primer rubber brushed once or sprayed twice	Insulation roofing layer Asphalt compound 0.2kg (spot)	Roofing for base B A
KP-3	1/100 - 1/12	Light- weight bedding		Light weight block	0.3ℓ of primer rubber brushed once or sprayed twice	Insulation roofing layer Asphalt compound 0.2kg (spot)	Roofing for base B A

Table 1.1 (1) Roof water-proofing not exposed. - continued -

4	5	6	7	8	9	10	11	12
1.2kg of Asphalt compound spread-coated	Synthetic fiber roofing D	1.5kg of Asphalt compound brush coated once and spread-coated once	Synthetic fiber roofing D	1.8kg of Asphalt compound brush coated twice				
1.2kg of Asphalt compound spread-coated	Synthetic fiber roofing D	1.5kg of Asphalt compound brush coated once and spread-coated once	Synthetic fiber roofing D	1.5kg of Asphalt compound brush coated once and spread-coated once	Special powder roofing 35kg C	1.8kg of Asphalt compound brush coated twice		
1.2kg of Asphalt compound spread-coated	Synthetic fiber roofing D	1.5kg of Asphalt compound brush coated once and spread-coated once	Synthetic fiber roofing D	1.5kg of Asphalt compound brush coated once and spread-coated once	Synthetic fiber roofing D	1.5kg of Asphalt compound brush coated once and spread-coated once	Synthetic fiber roofing D	1.8kg of Asphalt compound brush coated twice

Table 1.1 (2) Roof water-proofing exposed.

Spec. No.	Pitch	Bedding Material	Durable Period	Method of Covering	1	2	3
KS-1	Over 1/50	Concrete	10	Sanded silverlite sprayed or colored sand	0.3ℓ of primer rubber brushed once or sprayed twice	1.5kg of asphalt compound brush coated once and spread-coated once	Roofing for base B
KS-2	Over 1/50	Concrete	15	Sanded silverlite sprayed or colored sand	0.3ℓ of primer rubber brushed once or sprayed twice	1.5kg of asphalt compound brush coated once and spread-coated once	Roofing for base B
KS-3	Over 1/50	Light-weight bedding		Sanded silverlite sprayed or colored sand	1) 0.3ℓ of primer rubber brushed once or sprayed twice 2) 0.7kg of primer rubber brushed twice	1.5kg of asphalt compound brush coated once and spread-coated once	Synthetic fiber roofing D

Table 1.1 (2) Roof water-proofing exposed. - continued -

4	5	6	7	8	9	10
1.5kg of asphalt compound brush coated once and spread-coated once	Synthetic fiber roofing D	1.5kg of asphalt compound brush coated once and spread-coated once	Sand(lap) 40kg or Colored sand 40kg	Sprayed SP silverlite		
1.5kg of asphalt compound brush coated once and spread-coated once	Synthetic fiber roofing D	1.5kg of asphalt compound brush coated once and spread-coated once	Special powder roofing 35kg C	1.5kg of asphalt compound brush coated once and spread-coated once	Sand(lap) 40kg or Colored sand 40kg	Sprayed SP silverlite
1.5kg of asphalt compound brush coated once and spread-coated once	Synthetic fiber roofing D	1.5kg of asphalt compound brush coated once and spread-coated once	Synthetic fiber sanded roofing E lite sprayed or colored sand			

Table 1.1 (3) Interior and basement water-proofing.

Spec. No.	Bedding Material	Portion	1	2	3	4
KID-1	Concrete	Toilet Laboratory floor	Primer 0.3ℓ one rubber-brush-coat or two spray-coat	Asphalt compound 1.5kg one brush-coat one spread-coat	Asphalt-felt 30kg	Asphalt compound 1.5kg one brush-coat one spread-coat
KID-2	Concrete	Toilet Kitchen bath	Primer 0.3ℓ one rubber-brush-coat or two spray-coat	Asphalt compound 1.5kg one brush-coat one spread-coat	Asphalt-felt 30kg	Asphalt compound 1.5kg one brush-coat one spread-coat
KBH-1	Concrete	Basement floor	Primer 0.3ℓ one rubber-brush-coat or two spray-coat	Asphalt compound 1.5kg one brush-coat one spread-coat	Asphalt-felt 30kg	Asphalt compound 1.5kg one brush-coat one spread-coat
KBV-1	Concrete	Basement wall	Primer 0.3ℓ two spray-coat	Asphalt compound 2.0kg	Asphalt-felt 30kg	Asphalt compound 2.0kg

Table 1.1 (3) Interior and basement water-proofing. - continued -

5	6	7	8	9	10
Synthetic fiber roofing D	Asphalt compound 1.5kg two brush-coat				
Synthetic fiber roofing D	Asphalt compound 1.5kg one brush-coat one spread- coat	Special powder roofing 35kg C	Asphalt compound 1.5kg two brush-coat		
Synthetic fiber roofing D	Asphalt compound 1.5kg one brush-coat one spread- coat	Special powder roofing 35kg C	Asphalt compound 1.5kg one brush-coat one spread- coat	Special powder roofing 35kg C	Asphalt compound 1.5kg one brush-coat one spread- coat
Synthetic fiber roofing D	Asphalt compound 2.0kg	Special powder roofing 35kg C	Asphalt compound 2.0kg	Special powder roofing 35kg C	Asphalt compound 2.0kg