2. EARTH WORK

2.1 SCOPE

The Specifications herein cover the performance of all works in connection with the required excavation for the foundation of structures and equipment, gravals layers and sand mats for foundations, and all other excavation that may be necessary during the progress of works, including the removal, use or disposal of all excavated materials.

2.2 EXCAVATION

(1) Excavation under this section shall consist of the removal, hauling, dumping, and satisfactory disposal of all materials from areas of required excavation.

(2) Before starting excavation work, the Contractor shall submit for approval by the Engineer a program indicating the equipment, the work organization and the scheduled monthly progress. In the actual execution of the work, the Contractor shall conform to such programs as approved by the Engineer.

(3) The excavated slope surface shall be protected against any erosion due to heavy rains and ground water during the construction period.

(4) Excavation shall be carried out by adopting an excavation method suitable for the ground so as not to loosen the ground outside the excavation. If required, sheathing shall be provided.

(5) During excavation, work shall be performed carefully so as not to cause any damage to adjacent structures and buried structures.

(6) Excavated materials shall be directly disposed of at designated areas. If the excavated material is to be temporarily stockpiled, designated spaces shall be kept from the shoulder of the road while considering the earth pressure at the excavated surface and the working space. Temporary shoring or other such structures, if required, shall be provided so that the stockpile can be protected from damage or from being washed away.

(7) After completion of excavation, excavated widths and bottoms shall be subject to inspection by the Engineer. Excavations shall be inspected by the Engineer upon partial and/or total completion.

2.3 DEWATERING

Adequate pumping facilities shall be provided, maintained and ready for immediate use at any time during the progress of the construction work up until backfilling. All drainage pits, trenches and hoses necessary for the execution of construction shall be provided according to drawings approved by the Engineer or as directed by the Engineer.

2.4 SHORING

Shoring shall be of the type that is safe and suitable to the conditions of foundation and ground water. If sheet piles or retaining piles are to be driven, buried structures at piling locations and in the vicinity shall be investigated and confirmed as being made safe by manual trench excavation, etc., prior to piling so as to protect these structures from damage.

When piles are to be pulled out, care shall be taken not to cause any damage to buried structures.

2.5 DECKING WORK

For decking work requiring execavation, the Contractor shall submit shop drawings for the work and obtain approval from the Engineer. In case of public road area, the Contractor shall make all necessary arrangements with and obtain permission from the authorities or land owners concerned before constructing decking works, and he shall obtain the approval of such works from the Engineer. However, such approval will not relieve the Contractor of his responsibility should any damage occur.

2.6 PROTECTION AND RESTORATION OF RAILWAY

Protection and restoration plans for the existing railway shall be submitted to the Engineer for approval.

2.7 BACKFILLING

(1) No work shall be covered up or put out of view without the approval of the Engineer or the Engineer's representative, and the Contractor shall afford full opportunity for the Engineer or the Engineer's representative to examine and measure any work which is about to be covered up or put out of view, and to examine foundations before permanent work is placed thereon. The Contractor shall give due notice to the Engineer's representative whenever any such work or foundations is or are ready or about to be ready for examination, and the Engineer's representative shall, without unreasonable delay, unless he

considers it unnecessary and advises the Contractor accordingly, attend for the purpose of examining and measuring such work or examining such foundations.

(2) Backfilling shall be executed as construction proceeds along with the removal of shoring and other materials at the backfilling site.

(3) Backfilling shall be performed with suitable soil from excavation or other suitable soil approved by the Engineer. Backfill material shall be well compacted by means of rammers or other equipment.

(4) If the inflow of water exists at the site of backfilling, it shall be appropriately treated.

(5) In backfilling, the layer of spreading shall be about 50 cm or less per lift. It shall be graded as horizontally as possible, and shall be sufficiently compacted by hydraulic filling or by use of an appropriate compactor, such as a rammer.

(6) Extent of consolidation shall be such that it will prevent future settlement and such that the designated bearing capacity can be obtained. If necessary, the extent of consolidation shall be measured by a cone-penetrometer, etc., and the record shall be submitted to the Engineer for approval.

(7) For backfilling adjacent to a structure, compaction and filling shall be carried out so as to prevent damage to the structure.

In particular, backfilling for buried pipes, culverts and the like shall be uniform and the same level for all directions so as to preclude the possibility of non-ununiform earth pressure.

No stones or the like shall be used for backfilling.

(8) Ground level after backfilling and compaction shall be kept at EL + 4,800 mm, unless otherwise specified or directed by the Engineer.

2.8 DISPOSAL OF EXCAVATED MATERIAL

(1) Excavated material shall be disposed of outside of the site.

(2) In transporting the soil, care shall be taken so as to neither hamper traffic nor cause trouble to the third party by scattering the soil over the road.

(3) Suitable material obtained from required excavation as determined by the Engineer may be used as backfill. The material excavated and required for further use shall not be stockpiled in the construction site.

(4) Disposal of excavated material shall be the responsibility of the Contractor.

2.9 RUBBLE STONE

(1) Gravel and rubble produced locally shall be used. Rubble stone shall, in principle, be laid in a single layer with no large gaps. Stand on ends and interstices shall be filled with gravel.

(2) The compaction shall be executed by a machine compact method (rammer or tamper), and shall be inspected by the Engineer. Tamping with rammers shall be performed more than 3 times.

2.10 SLOPE PROTECTION OF EXCAVATED SURFACE

So that all constructions progress smoothly and safely, the Contractor shall maintain and protect slopes of excavated surfaces. In case slopes are damaged, the Contractor shall repair them immediately.

3. PILING WORK

3.1 GENERAL

This clause covers the performance of all works in connection with the required piling for the foundation of structures and equipment as shown in the Drawings, or any other piling that may be necessary during the progress of works.

3.2 APPLICABLE STANDARDS

Piling work shall be designed and executed in accordance with the requirements of Clause 5 of "Applicable Standards and Codes" in Part I and Subclause 2.2 of "Applicable Standards" in Section I, Part III.

3.3 MATERIALS OF STEEL PIPE PILES

All materials to be supplied by the Contractor shall be in accordance with the following Japanese Industrial Standards or equipment:

Materials	JIS
Steel Pipe Piles	G3444 Class 2 (SKK41)
Backing Plate and Pile Tip Reinforcement	G3101 Class 2 (SS41)
Welding Rods	Z3211

All materials shall be the best quality of their kind, well graded and within allowable tolerances as specified in JIS A5525, or equivalent.

The Contractor shall submit the mill sheets to the Engineer for approval prior to starting the fabrication.

3.4 SHOP DRAWINGS

The Contractor shall submit the complete shop drawings to the Engineer for approval prior to starting the fabrication.

3.5 WORKMANSHIP

3.5.1 GENERAL

Each steel pile shall be supplied in a set of several pieces in accordance with the approved drawings.

Each piece of a pile, excluding the lower part, shall have the backing plate of 6 mm thickness at the bottom end, and each piece of a pile shall have the stopper of 16 mm thickness at the top end for field welding.

3.5.2 TIP REINFORCEMENT

The lowest piece of each pile shall have a reinforcing band of the thickness indicated in the attached pile list, and a 300 mm length connected to the pile at the tip end by shop welding.

3.5.3 CUTTING AND GROOVE FACE FINISH

Cutting and groove face finish shall be done by automatic gas cutting machine.

Anti-corrosive paint shall be coated on the portion which undergoes edge preparation for field welding. Moreover, any bead on the internal surface of steel pipe to be field welded shall be removed so as to obtain a smooth surface by as much as 50 mm from the end.

3.5.4 WELDING

Welding shall be done by welders having qualification A-2F and/or A-2V as specified in JIS Z3801 or equivalent, and having more than 6 months experience.

3.5.5 SHOP TEST AND INSPECTION

Material tests shall be carried out in the manner as specified in JIS G3444.

All welding lines shall be tested by an ultrasonic inspection device.

The Contractor shall, before shipment of the materials, submit the test results to the Engineer for approval.

3.5.6 OTHERS

(1) 50 mm length seam reinforcement on inner face from the top of each pile shall be ground flat so as to set the backing plate.

(2) Each steel pile piece shall be marked with the following symbols.

. Pile mark

. Pile size; diameter and length

. Level indicating line
(every 50 cm)

3.6 DRIVING

3.6.1 PILE DRIVING

(1) Piles shall be driven by a pile driver suitable for the type and size of the piles, geological conditions and construc-

tion environment. The capacity of piling hammer shall be as follows.

Capacity of Minimum Piling Hammer

Piles type and size	Capacity of minimum piling hammer (t)
Steel Pile ϕ 609.6 mm	3.2
" ϕ 406.4 mm	2.2

(2) Unless otherwise specified by the Engineer, all piles for foundations shall be determined based on the penetrated depth of the tested pile.

(3) Piles shall be driven vertically and at the exact locations as indicated in the Drawings, and driving shall be continuous without interruption to avoid deviation of pile head.

(4) Caps and other suitable materials shall be used as a cushion to protect the head of piles.

(5) Toward the end of driving, the amount of penetration shall be measured for each pile as directed by the Engineer.

(6) Method and equipment of pile driving to be employed for civil work shall be subject to approval of the Engineer prior to execution.

(7) In case the required amount is attained before reaching the estimated depth or the required amount is not attained even after driving the scheduled length, steps shall be taken in accordance with the instructions of the Engineer.

(8) When driving a group of piles, driving shall begin from the center and gradually moved outward.

(9) When eccentric error exceeds the allowable values shown in

the table below or when a pile is damaged or cracked during piling operation, it shall be reported to the Engineer, and the pile shall be replaced or an additional shall be driven.

Type of Foundation	Allowance
Large raft foundation	10 cm or less
Foundation of columns, piers and others	5 cm or less

(10) After attaining a pile penetration of 50 cm by 25 drops of hammer and/or when final pile penetration is less than 5 mm per 10 drops of hammer, driving shall be stopped to obtain the Engineer's approval.

3.6.2 SHEET PILING DRIVING

(1) Driving of sheet pile shall be performed in accordance with Clause 3.1 "Pile Driving" of these Specifications.

(2) The driving of sheet piles shall be guided properly to prevent twisting or sloping.

(3) The allowable tolerance of driving of sheet piles shall be as follows:

. Stretch of sheet pile wall : Width of sheet pile for
(+) side
0 for (-) side

. Top level of sheet piles : ± 10 mm for steel sheet pile

. Alignment of center line of wall: ± 10 mm

- Slope of sheet pile in the direction of center line : 1/100 for steel sheet pile

(4) If damage or mis-joining of the joint of sheet pile occurs, the sheet pile shall be pulled out and redriven. If it is impossible to pull out the pile, the direction of the Engineer shall be required.

(5) If the slope of sheet pile in the direction of center line of wall exceeds the dimension of width of sheet pile at the level of sheet piles, a modified sheet pile shall be ued.

(6) If tie rods are to be attached to sheet piles, they shall be as follows.

(a) Tie rods shall be treated for corrosion protection prior to their connection.

(b) Tie rods shall be installed so that they shall be even after backfilling and compaction.

The tie rods shall be tensioned by turnbuckles after compaction around the anchor plates and tie rods.

In this case, pile driving shall be stopped and the work shall await the instructions of the Engineer.

3.7 FIELD JOINING OF PILES

(1) Field joining of piles shall be carried out by arc welding.

(2) Welders shall have not less than 6 months continuous experience in welding of pile, and shall be qualified by JIS Z-3801, "Standard Qualification Procedures for Welding Technique", or equivalent.

Prior to execution, the Contractor shall submit to the Engineer for approval the list of welders showing the name,

age, length of experience, types of test passed, qualifications and employment particulars.

(3) Arc welding rods shall be the standard items specified in JIS E-3211, "Covered Electrodes for Mild Steel", or equivalent. Welding rods shall be completely dry prior to use.

(4) The welding surface of parent metal shall be carefully cleaned of slag, moisture, dust, rust, oil, paint or other foreign matter.

(5) The root face of steel pile shall be 2 mm.

(6) Welding shall be performed carefully by selecting welding current and welding speed which ensure complete penetration of welding rod to avoid cracks in any portion of the weld.

(7) Welding shall not be performed when the parent metal is wet or when strong winds are blowing. However, when the portion to be welded in suitably protected, welding may be performed upon approval of the Engineer.

(8) If harmful defects or cracks have been found in the weld, the deposited metal shall be carefully chipped off and the affected part shall be rewelded and then inspected by the Engineer.

(9) All joint sections of H-section steel piles shall be reinforced with steel plate by welding.

3.8 TREATMENT OF PILE HEAD

(1) After completion of driving, the heads of steel pipe piles shall be cut to the specified height designated in the Drawings, and reinforcing steel bars shall be welded or anchored to them as designated in the Drawings.

(2) After completion of driving, the heads of H-section steel piles shall be cut to the specified height specified in the Drawings. All adjacent steel piles shall be connected by using steel materials so as to avoid inclination of driven piles and to maintain constant interval of the respective piles.

(3) In case of retaining sheet pile, before completion of backfilling work, the head of sheet pile shall be cut to the specific height to keep package of under ground water.

3.9 TRANSPORTATION AND HANDLING

Care shall be taken in transportation and handling of piles so as to prevent damage.

If the pile is damaged or deformed to the extent that it is impractical for the intended use, the Contractor shall repair it prior to driving, and it shall be inspected and approved by the Engineer.

3.10 REPORTS OF PILING

The Contractor shall submit the forms of piling data as shown hereafter.

Bearing capacity of pile shall be computed in accordance with the formula below.

$$Ra = \frac{1}{6} \times \frac{0.5\,F}{S + \frac{K}{2}}$$

Where; Ra : Allowable bearing capacity for long term (ton)

S : Penetration (cm)

K : Rebound (cm)

F : Blow Energy (t, cm)

FORM 1

PILING DATA Dated _____

POWER PLANT LOCATION .....

PILE MARK AND NO. ..... PERSON IN CHARGE .....

WEATHER ..... WELDER .....

TYPE OF PILE ..... SHAPE OF JOINT .....

SHAPE OF TIP ..... WEIGHT OF HAMMER .....

DRIVING MACHINE .....

		LOWER	MIDDLE	UPPER	ADDITIONAL
Dimension	Outside Diameter				
	Thickness				
	Length				
Ground level			EL+		
Curing time (R.C. Pile)					
Driving length					
Starting & finishing time	Preparation	:	:	:	
	Erection	:	:	:	
	Welding	:	:	:	
	Driving	:	:	:	
Working times	Preparation (min.)				
	Erection (min.)				
	Welding (min.)				
	Driving (min.)				
	Total (min.)				
Level of inner soil					
Level of inner water					
Displacement					
Inclination					
Damages					

REMARKS:

Type of soil	N-Value	Ground level EL+	Penetration m.	EVERY 500m: Number of strike	EVERY 500m: Penetration per strike	EVERY 500m: Total strike	NUMBER OF STRIKE/50Cm: Penetration / Strike	CALCULATED LOADING CAPACITY: High of hummer drop	Penetration strike	Rebound	Weight of hammer	Calculated bearing capacity

level of tip GL+ m
DEPTH OF PENETRATION GL- m

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FORM 3

WELDING DATA

	Project: WEST WHARF THERMAL POWER PLANT		
Pile	Dimension		
	Pile Mark and Number		
Weather Conditions	Month, Date, Year		
	Weather		
	Wind Velocity and Direction	m/sec	
	Temperature	^{o}C	
Joint	Level (Above ground)	cm	
	Root	mm	
Welding Conditions	Temperature of Weld Portion (Preheated)		
	Welding Machine		
	Situation		
	Voltage, Electric Current	V	A
	Welding Rod or Wire		
Welding Record	Name of Welder		
	Qualification No. of Welder		
	Time of Welding	minutes	

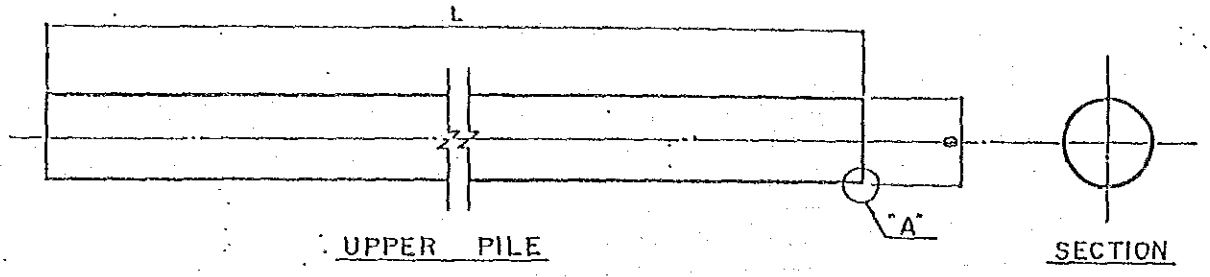
Results of Inspection:

Remarks:

SHEET NO.

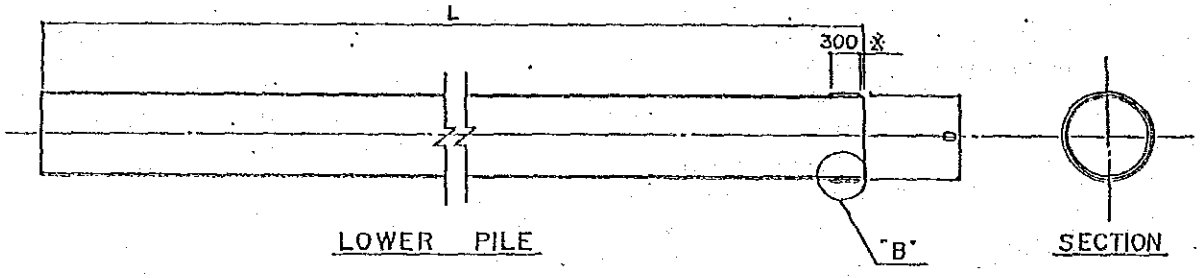
STANDARD DETAIL PLATE

PLATE NAME	PLATE NO.
STEEL PIPE PILE	SDP — —



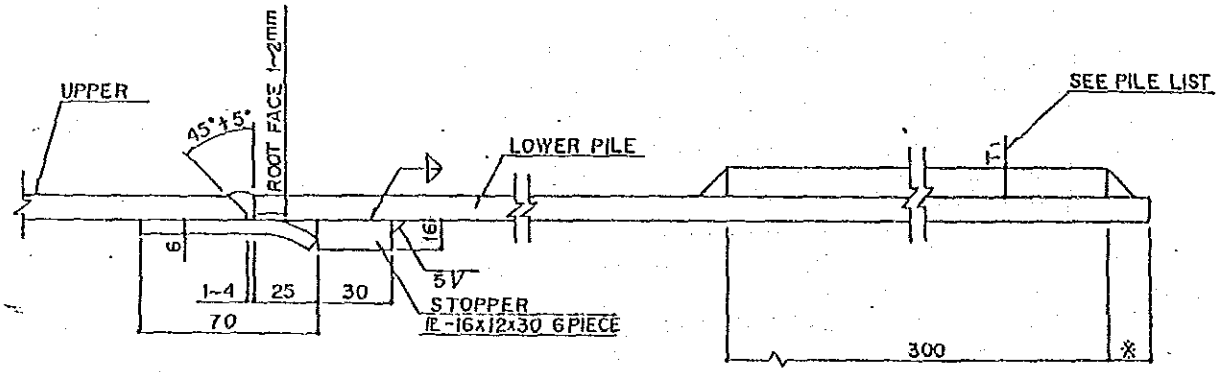
UPPER PILE

SECTION



LOWER PILE

SECTION



DETAIL "A"

DETAIL "B"

NOTES

1. SURFACE TO BE WELDED AT FIELD SHALL BE APPLIED WITH ONE COAT OF STRIP PAINT IN SHOP.
2. THICKNESS OF TIP REINFORCEMENT(T1) SHALL BE INDICATED IN THE ATTACHED PILE LIST.
3. LENGTH OF ※ MARK SHALL BE TWICE OF PILE THICKNESS.

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3.11 CAST-IN-PLACE CONCRETE PILES WORK

3.11.1 CONSTRUCTION METHOD

The Contractor shall submit a detailed description of the method of construction for the piling work, including the construction schedule, to the Engineer for approval prior to commencement of the work.

3.11.2 MATERIALS

Concrete and reinforcing steel shall conform to the requirements as specified in Clause 3 "REINFORCED CONCRETE WORK".

3.11.3 BORING

(1) Boring

Boring shall be carried out by either rotary or percussion equipment, grabbing equipment or by reverse or direct mud circulation method. Walls of borehole shall be stabilized by using casing/liners with or without drilling fluid depending upon the soil conditions. In soils likely to flow, the bottom of casing/liners shall be kept ahead of the boring in all cases to prevent the entry of soil into the bore. Formation of cavities or settlements in the adjoining ground shall be avoided.

The Contractor shall be responsible for prompt removal from the site of all spoil resulting from the boring to places specified by the Engineer.

Foundation elevation of each pile shall be individually approved by the Engineer on the basis of his observations and the data at his disposal in regard to the soundness

of the end bearing stratum.

Piles shall be socketed at a minimum of one diameter into the stratum or as directed by the Engineer.

(2) Drilling fluid

The specific gravity and composition of the fluid shall be such as to suit the requirements of the ground conditions and to maintain the fine materials from boring in suspension. When water is used as drilling fluid, the fluid level in the boring shall be maintained at a level not less than 2.0 m above the level of the ground water or high water level, as the case may be, until concreting is completed.

When bentonite or other approved material is used in drilling fluid, it shall be mixed thoroughly with clean fresh water to create a suspension which will maintain the stability of pile excavation for the period necessary to place concrete and complete construction.

Quality control tests shall be carried out on bentonite suspension using suitable apparatus. The frequency of testing the drilling fluid and the method and procedure of sampling shall be as directed by the Engineer. The density of freshly mixed bentonite suspension shall be measured daily as a check on the quality of the suspension being formed.

(3) Concreting

Each cast-in-place pile shall be filled with concrete to ensure sound concrete at cut-off elevation. The space to be filled shall be free of mud, trash, and other foreign

matter. After cleaning pile shells, if water remains, concrete shall be placed by bottom-dump buckets on tremies through a funnel by pump or other means, so that splashing or segregation does not occur. The concreting of the piles shall be brought up to a minimum of 60 cm above the cut-off level of the pile to allow for complete removal of slush and other foreign materials, etc., from the main pile and thus obtain sound and uniform concrete. The concreting procedure shall be sufficiently strong to withstand, without injury, all stresses and pressures to which the piles are to be subjected during placing, concreting or driving. Shells which are damaged or have collapsed during installation shall be replaced.

4. CONCRETE WORK

4.1 GENERAL

This section covers the performance of all concrete work for permanent structures in accordance with the Drawings and these Specifications.

The Contractor shall furnish all materials, equipment and labor for the performance of concrete work.

Unless otherwise specified, all concrete work shall comply with JASS-5 (JSCE), or equivalent.

4.2 APPLICABLE STANDARDS

All concrete work for permanent structures shall be designed and furnished in accordance with the requirements of Clause 5 of "Applicable Standards and Codes" in Part I and Subclause 2.2 of "Applicable Standards" in Section I, Part III.

4.3 CLASSES OF CONCRETE AND USAGE

4.3.1 STRENGTH REQUIREMENTS

Concrete of the various classes required shall be proportioned and mixed for the following strengths:

Class	Minimum Allowable Compressive Strength at 28 days (kg/cm^2)	Class of Aggregate
A	350	Class I
B	270	Class I
C	240	Class II
D	210	Class II
E	180	Class II
F	150	Class II

Remarks: Concrete made with high-early-strength cement shall have a 7-day strength equal to the specified 28-day strength for concrete of the class specified made with ordinary Portland cement.

4.3.2 USAGE

Unless otherwise specified, concrete of the various classes shall be used as follows:

(1) Class A Concrete

Not used

(2) Class B Concrete

Not used

(3) Class C Concrete

Not used

(4) Class D Concrete

For all concrete work in the buildings and structures of the substation, grid station and underground cable tunnel, unless otherwise specified.

(5) Class E Concrete

For slabs on grade, unless otherwise specified.

(6) Class F Concrete

For lean concrete as specified and for all concrete not reinforced, unless otherwise specified.

4.4 MATERIALS

The following materials shall conform to the respective specifications and requirements stipulated below.

4.4.1 CEMENT

(1) Description

Cement shall be ordinary Portland cement or high-early-strength Portland cement conforming to JIS R 5210, or equivalent. Minimum compressive strength at 28 days shall be 300 kg/cm^2 or more for ordinary Portland cement and 330 kg/cm^2 or more for high-early-strength Portland cement.

(2) Samples and testing

Cement shall be sampled either at the mill or at the site of the work in an approved manner and tested as prescribed in JIS R-5201 and R-5202. Tests shall be made by a cement manufacturer, a recognized laboratory, or a testing agency

approved by the Engineer. No cement shall be used until notice has been given by the Engineer that the test results are satisfactory. Cement that has been stored, other than in the bins at the mills, for more than four (4) months after being tested shall be retested before use. Cement delivered at the site of the work and later found under test to be unsuitable shall be removed from the work and its vicinity.

4.4.2 AGGREGATE

(1) Description

Coarse and fine aggregate shall consist of clean, hard, strong and durable particles free of coatings of clay or other fine material that may affect bonding of cement paste. Dust, dirt or silt shall be removed by adequate washing. Aggregate shall be Class I and Class II conforming to JASS-5, or equivalent.

(2) Quality

Coarse and fine aggregate shall conform to the following quality requirements.

Quality of Gravel, Sand and Crushed Stone

Aggregate type	Material quality classification	Oven-dry spec. gravity	Percentage of water absorption (%)	Percentage of solid volume for the evaluation of particle shape (%)	Clay lump (%)	Loss in washing test (%)	Organic impurity	Water soluble chloride (%)
Gravel and crushed stone	Class I	≧2.5	≦2.0	≧57	≦0.25	≦1.0(1)	-	-
	Class II	≧2.5	≦3.0	≧55	≦0.25	≦1.0(1)	-	-
	Class III	≧2.4	≦4.0	≧53	≦0.5	-	-	-
Sand	Class I	≧2.5	≦3.0	-	≦1.0	≦2.0	Color of test solution not to be darker than standard solution	≦0.04
	Class II	≧2.5	≦3.5	-	≦1.0	≦3.0		≦0.1
	Class III	≧2.4	≦4.0	-	≦2.0	≦5.0		≦0.1

Note: (1) With crushed stone, if the lost substance in the washing test is crushed stone powder, the value then should be read "not more than 1.5%".

Quality of Blast Furnace Slag

Material quality classification	Items			
	Classification according to JIS A 5011 (ovendry specific gravity, water absorption, unit weight)	Percentage of solid volume for the evaluation of particle shape (%)	Loss in Washing (%)	Allowable range of fineness modulus
Class II	A or B(2)	≧55	≦5.0	±0.3
Class III	A or B	≧53	-	±0.3

Note: (2) When the design strength of not less than 225 kg/cm^2 is specified for blast furnace slag concrete, Classification B shall be used.

(3) Grading

Coarse and fine aggregate shall conform to the follows grading requirements.

Standard Grading of Gravel and Sand

Agg.	Max. size (mm)	Material quality classification	Percentage passing each sieve, by weight (%) — Nominal sieve size (mm): 50	40	25	20	15	10	5	2.5	1.2	0.6	0.3	0.15
Gravel	40	Class I	100	95-100	-	40-65	-	10-30	0-5	-	-	-	-	-
		Class II	100	95-100	-	35-70	-	10-30	0-5	-	-	-	-	-
		Class III	100	90-100	-	25-75	-	5-40	0-10	-	-	-	-	-
	25	Class I	-	100	95-100	65-85	-	25-45	0-10	0-5	-	-	-	-
		Class II	-	100	90-100	60-90	-	20-50	0-10	0-5	-	-	-	-
		Class III	-	100	90-100	50-90	-	10-60	0-15	-	-	-	-	-
	20	Class I	-	-	100	90-100	(55-80)	25-50	0-10	0-5	-	-	-	-
		Class II	-	-	100	90-100	(55-80)	20-55	0-10	0-5	-	-	-	-
		Class III	-	-	100	90-100	(40-85)	10-60	0-15	-	-	-	-	-
Sand		Class I	-	-	-	-	-	100	90-100	80-100	55-85	30-55	15-30	2-10
		Class II	-	-	-	-	-	100	90-100	80-100	50-90	25-65	10-35	2-10
		Class III	-	-	-	-	-	100	-	-	30-100	20-70	-	0-20

Note: Values in ( ) are for reference.

(4) Maximum size of coarse aggregate

The maximum size of coarse aggregate shall be as given in the following table.

Maximum Size of Coarse Aggregate by Place of Use

Place of use	Maximum size of coarse aggregate (mm)	
	Gravel	Crushed stone, blast furnace slag
Column, beam, floor slab, roof slab, wall	20, 25	20
Foundation	20, 25, 40	20, 25, 40

As a rule, the maximum size of coarse aggregate shall not be larger than the minimum cover nor larger than 4/5 of the minimum clear spacing between reinforcing bars. The coarse aggregate for floor slabs on grade shall be of maximum size not greater than 1/3 of the slab thickness. However, in no case shall the nominal size of aggregate exceed 40 mm.

For parts of reinforced concrete members of large cross sections, having a small quantity of reinforcement and where clearance between reinforcing bars is large, the maximum size of coarse aggregate may be larger than those specified in the above Table, and this shall be approved by the Engineer.

(5) Testing

Coarse and fine aggregate shall be tested as prescribed in JIS A1102, A1103, A1104, A1105, A1109, A1110 and A1137.

4.4.3 WATER

(1) Water shall be clean, fresh, and free from injurious amounts of minerals and organic substances.

Water shall conform to the following requirements.

Quality Requirement of Water

Item	Requirement
Amount of suspended solids	≦ 2 g/l
Amount of soluble evaporation residue	≦ 1 g/l
Difference in setting time of cement	Initial set within 30 minutes. Final set within 60 minutes.
Ratio of flexural strength and compressive strength of mortar against those of control mortar	Not less than 90% at the age of 7 days.

(2) Testing

Water shall be tested as specified in JASS 5 T-301, "Method of Test for Quality of Water for Reinforced Concrete".

4.4.4 ADMIXTURES

Admixtures shall be air-entraining agents or air-entraining and water-reducing agents conforming to JIS A6204.

Admixture shall be used only after written approval by the Engineer has been obtained. The required air content of concrete using agents shall be between 3 and 6 percent, and this shall be approved by the Engineer.

Air content shall be based on measurements made on concrete mixture at point of discharge from the mixer.

4.4.5 REINFORCEMENT

(1) Reinforcing bar

Reinforcing bars shall confirm to ASTM A615 Gr.40, or equivalent.

Certified copies of mill reports shall accompany deliveries of reinforcing bar.

(2) Mesh reinforcement

Mesh reinforcement shall be of low carbon steel wires conforming to JIS G3532, or equivalent.

The mesh reinforcement shall be fabricated in accordance with JIS G3551, or equivalent.

4.4.6 FORM

Forms shall be plywood pannels of approved standard or metal panels conforming to JIS A 8652, or equivalent.

4.4.7 STORAGE

(1) Cement

Cement shall be stored in a dry weather-tight and properly ventilated structure with adequate provisions for the prevention of absorption of moisture.

The cement shall be stored in a manner so as to permit easy access for proper inspection and identification. Cement which has been stored for a period of 30 days or more after delivery shall not be used unless the Contractor proves the

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usability of the said cement by certified tests and receives permission for its use from by the Engineer.

Bagged cement shall not be stacked higher than thirteen (13) bags at any time during its storage.

(2) Aggregate

Storage piles of aggregate shall be located so as to assure good drainage, to preclude inclusion of foreign matter, and to preserve the gradation. Sufficient live storage shall be maintained to permit segregation of shipments from different sources, and to assure placement of concrete at the required rate.

(3) Admixtures

Admixtures shall be stored so that the quality shall not be changed.

(4) Reinforcement

Reinforcements shall not be stored directly on the ground. Particular attention shall be paid to the storage of reinforcements so as to prevent the occurrence of rust and adhesion of injurious substances which will decrease bonding between concrete and reinforcements.

4.5 PROPORTIONING OF CONCRETE MIXES

4.5.1 MIX DESIGN

The design of the concrete mixture, to meet strength requirements of the class or classes of concrete specified, shall be the responsibility of the Contractor.

Adequate quantities of the concrete ingredients proposed for use shall be supplied for making trial design mixes.

The mix proportion shall be designed in due consideration of variance in the quality of concrete under anticipated working conditions so that the required workability, strength, durability and other properties will be obtained.
The design mix proportion shall be proven satisfactory through trial mix and testing for 7 or 28 days compressive strength, and shall be approved by the Engineer well in advance of commencement of the work.

4.5.2 STUMP TEST

Consistency will be determined by the stump test, in accordance with JIS A 1101. The stump shall fall within the following limits:

Type of Structure	Stump for Vibrated Concrete
General construction, unless otherwise specified	8 cm
Column and wall	12 cm
Massive concrete	max 8 cm

Non-vibrated concrete shall be placed only upon written approval by the Engineer.

4.5.3 PROPORTIONING STRENGTH

Proportioning strength shall be determined in consideration of the following factors in accordance with JASS-5, or equivalent.

a - Specified design strength

b - Correction factor of concrete strength due to anticipated mean air temperature during 28-day curing period after placement.

c - Standard deviation of concrete strength

4.5.4 WATER-CEMENT RATIO

The maximum water-cement ratio shall be 65% for Class A and B concrete and 70% for Class C, D, E and F concrete.

4.5.5 UNIT CEMENT CONTENT

The minimum unit cement content shall be 270 kg/m^3 for Class A and B concrete and 250 kg/m^3 for Class C, D, E and F concrete.

4.6 READY-MIXED CONCRETE

Where ready-mixed concrete is proposed for use, the mixing plant, transporting equipment and the method of placement shall be subject to approval by the Engineer. Except for materials herein specified, ready-mixed concrete shall conform to JIS A 5308, or equivalent.

The time limits from start of mixing to completion of placing of a batch shall be 90 minutes when the temperature is less than $25^{o}C$ and 60 minutes when not less than $25^{o}C$.

4.7 FIELD-MIXED CONCRETE

4.7.1 TYPE OF BACKING AND MIXING PLANT

All batching and mixing equipment shall be subject to approval by the Engineer as to location, type, capacity, design, construction and manner of operation, and as to physical and

mechanical conditions.

The batching and mixing plant shall have a sufficient capacity to complete the work within the established construction schedule.

4.7.2 ARRANGEMENT

Separate bins or compartments shall be provided for fine aggregate, for the different sizes of coarse aggregate, and for bulk cements when used. The compartments shall be of ample size and so constructed that the materials will remain separate under all working conditions. Aggregates may be weighed cumulatively in one weight batcher on one scale in a manual plant, and in a semiautomatic plant may be weighed cumulatively in one weight batcher on one scale or in separate weight batchers with individual scales. In a semiautomatic plant, bulk cement shall be weighed on a separate scale in a separate weight batcher. In a manual plant, bulk cement shall be weighed in a separate hopper, which may be attached to a separate scale for individual weighing, or may be attached to the aggregate hopper for cumulative weighing provided there are separate dials for cement and aggregates. If cement is weighed on the same scale as the aggregates, the cement shall be weighed first and an interlock shall be provided to ensure that all hoppers are empty and that the scale is in balance before the weighing of the cement is begun. Water may be measured by weight or by volume. In a semiautomatic plant, the batching controls shall be so interlocked that a new batching cycle cannot be started until all batchers are completely empty. The plant shall be so arranged as to facilitate the inspection of all operations at all times.

Suitable facilities shall be provided for obtaining representative samples of concrete for uniformity tests. Delivery of materials from the batching equipment shall be within the following limits of accuracy:

Cement	1 percent
Water	1 percent
Aggregate	2 percent
Air-entraining admixture	3 percent

4.7.3 WATER-BATCHER AND DISPENSER FOR ADMIXTURE

Equipment for batching water and the air-entraining admixture or air-entraining and water reducing admixture shall be provided at the batching plant or included with the mixer, as required for the type of plant used. A suitable water-measuring device shall be provided which enables accurate of measuring the mixing water within the specified requirements for each batch. The mechanism for delivering water to the mixers shall be such that leakage will not occur when the valves are closed. The filling and discharge valves for the water batcher shall be so interlocked that the discharge valve cannot be opened before the filling valve is fully closed. Where the admixture is added at the mixer, a suitable device for measuring and dispensing the admixture shall be provided. The device shall be capable of ready adjustment to permit varying the quantity of admixture to be batched. The dispenser for admixture shall be interlocked with the batching and discharging operations of the water so that the batching and discharging of the admixture will be automatic. When use of truck mixers makes this requirement impracticable,

the admixture dispenser shall be interlocked with the sand batcher.

4.7.4 MOISTURE CONTROL

The free moisture content of the fine aggregate and the smallest size group of coarse aggregate, as delivered to the mixers, shall be controlled so as not to exceed 4 and 2, percent respectively, and shall be expressed as percentage by weight of the saturated surface dry be aggregate. In addition, the limits on the maximum amounts of free moisture in the fine aggregate and the smallest size of coarse aggregate, the moisture content shall be controlled so that the variation in the percent of free moisture will not be more than 0.5 percent during any one hour of mixing plant operation. The the variation in moisture content shall not be more than 2.0 percent during any eight hour period of mixing plant operation. The moisture content of the other sizes of the coarse aggregate shall be controlled so that the aggregates are delivered to the mixers with the least amount of free moisture and the least variation in free moisture practicable under job conditions. Under no circumstance shall other sizes of coarse aggregate be delivered to the mixing plant bins "dripping wet". The Contractor shall consider the required moisture control by use of free drainage storage, mechanical dewatering devices, or any other satisfactory means or combination of means.

A semiautomatic plant shall be capable of ready adjustment for the varying moisture contents of the aggregates and to change the weights of the materials being batched.

4.7.5 SCALES

Adequate facilities shall be provided for the accurate measurement and control of each of the materials entering each batch of concrete. The accuracy of the weighing equipment shall conform to the applicable requirements for such equipment. The Contractor shall provide standard test weights and any other auxiliary equipment required for the operation of each scale or other measuring device. Periodic tests shall be made in the presence of the Engineer in such a manner and at such intervals as may be directed. Upon completion of each check test and before use of the indicating, recording and control devices, the Contractor shall make such adjustments, repairs or replacements as may be required to secure satisfactory performance. Each weighing unit shall include a visible springless dial that will indicate the scale load at all stages of the weighing operation, or shall include a beam scale with a beam-balancing indicator that will show the scale in balance at zero load and at any beam setting. The indicator shall have an over and under travel equal to at least 5 percent of the capacity of the beam. The weighing equipment shall be arranged so that the plant operator can conveniently observe all dials or indicators.

4.7.6 RECORDERS (FOR SEMIAUTOMATIC TYPE)

Not more than two accurate recorders shall be provided for a semiautomatic plant. Each recorder shall be housed in a cabinet that is capable of being locked, and shall be in a position convenient for observation by the plant operator and the Engineer. One recorder shall produce a printed or autographic

record on a single visible chart or tape of the weights of all of the aggregates as batched, and after the batcher is discharged shall return to zero. One recorder shall produce a printed or autographic record on a single visible chart or tape of the weight of the cement as batched, and after the batcher has been discharged shall return to zero. The weight or volume of water shall likewise be recorded if batched at a central batching plant. The charts or tapes shall clearly indicate the different types of mixes used by stamped letters, numerals, colored ink or other suitable means, and shall be so marked that variations in batch weights of each type of mix can be readily observed. The charts and tapes shall show time of day (stamped or preprinted) at intervals of not more than 15 minutes.

4.7.7 PROTECTION

All weighing, indicating, recording and control equipment shall be protected against exposure to dust and weather.

4.7.8 CONCRETE MIXERS

Concrete mixers may be stationary mixers or truck mixers of approved design. The mixers shall have sufficiently rated capacity of mixed concrete. Mixers shall be capable of combining the materials into a uniform mixture and of discharging this mixture without segregation. Stationary and paving mixers shall be provided with an acceptable device to lock the discharge mechanism until the required mixing time has elapsed. Truck mixers shall be equipped with accurate revolution counters. The mixers or mixing plant shall include a device for automatically

counting the total number of batches of concrete mixed. The mixers shall be operated at the drum speed designated by the manufacturer on the name plate. The mixers shall be maintained in satisfactory operating condition, and mixer drums shall be kept free of hardened concrete. Mixer blades shall be replaced when worn down more than 10 percent of their depth. The use of any mixer that at any time produces unsatisfactory results shall be promptly discontinued until the mixer is repaired.

4.7.9 STATIONARY MIXERS

The type of stationary mixers shall be non tilting drum type in accordance with JIS A 8601, or equivalent.

4.7.10 TRUCK MIXERS

Truck mixers may be used when the equipment and methods are approved in writing by the Engineer. Concrete so manufactured shall conform in every respect to the requirements of these Specifications. When a truck mixer is used either for complete mixing (transit-mixed) or to finish the partial mixing done in a stationary mixer, each batch of concrete shall be mixed not less than 35 nor more than 75 revolutions of the drum for horizontal-discharge-type mixers and not less than 50 nor more than 100 revolutions of the drum for high-discharge-type mixers, both at the rate of rotation designated by the manufacturer of the equipment as the mixing speed. Any additional mixing shall be done at the speed designated by the manufacturer of the equipment as the agitating speed. When necessary for proper control of the concrete, mixing of transit-mixed concrete will

be disallowed until the truck mixer is at the site of the concrete placement.

4.7.11 MIXING TIME

The standard mixing time for each batch, after all solid materials are in the mixer drum and provided that mixing water is introduced before 1/4 of the mixing time has ellapsed, shall be as follows.

Capacity of mixer (m^3)	Mixing time (minute)
1.5 or less	1.5
3 or less	2.5
4.5 or less	3

4.8 PLACING

4.8.1 PREPARATION FOR PLACING

Before depositing concrete, all debris shall be removed from the space to be occupied by the concrete. Forms shall be thoroughly wetted or oiled as required. Reinforcement and anchoring and embedding of items shall be firmly secured in position, and approval by the Engineer shall be obtained before concrete is placed. Workmen engaged in concreting operations shall not step directly on reinforcing steel but shall use plank walkways.

4.8.2 INSTALLATION OF ANCHORAGE ITEMS

Adequate slots or inserts shall be provided for anchoring members at openings. Slots shall be provided for anchoring ends of masonry partitions abutting concrete.

Inserts for piping hangers and mechanical fixtures shall be as specified in the relative section, but shall be installed under this section in accordance with the requirements in the specified section.

4.8.3 CONCRETE PLACING

The Contractor shall submit to the Engineer a schedule of placing concrete. Any change in schedule shall be reported at least 24 hours in advance of placing concrete. The use of belt conveyors, chutes or other similar equipment will not be permitted unless written approval is obtained from the Engineer. Concrete shall be handled from mixer to transport vehicle to place of final deposit in a continuous manner, as rapidly as practicable, and without segregation or loss of ingredients until the approved unit of operation is completed. Concrete that has attained its initial set or has contained its mixing water for more than 45 minutes shall not be placed in the work. Placing will not be permitted when the sun, heat, wind or limitations of facilities furnished by the Contractor prevent proper finishing and curing of the concrete. Concrete shall be placed in the forms in uniform layers as nearly as practicable in final position. Forms or reinforcement splashed with concrete shall be cleaned in advance of pouring subsequent lifts. Immediately after placing, concrete shall be compacted by thoroughly agitating it in an approved manner. Tapping or other external vibration of forms shall not be permitted. Concrete shall not be placed on concrete sufficiently hard to cause formation of seams and planes of weakness within the section. Concrete shall not be allowed to

drop freely more than 1.5 m in unexposed work nor more than 1.0 m in exposed work; where greater drops are required, a tremie or other approved means shall be employed. The discharge of the tremies shall be controlled so that the concrete may be effectively compacted into horizontal layers not more than 30 cm thick, and the spacing of the tremies shall be such that segregation does not occur. Concrete to receive other construction shall be screeded to the proper level to avoid excessive shimming or grouting.

4.8.4 EARTH-FOUNDATION PLACEMENT

Concrete footings shall be placed upon undisturbed clean surfaces, free from mud and water. When the foundation is on dry soil or pervious material, waterproof paper, clear polyethylene sheeting 0.1 mm thick, or polyethylene-coated waterproof paper or polyethylene-coated burlap shall be laid over the surfaces to receive concrete. The above materials shall be of the type specified for curing concrete, except that the polyethylene film may be clear.

4.8.5 CHUTE OR CONVEYOR PLACEMENT

Concrete may be conveyed by chute or conveyor if written approval is obtained from the Engineer. The chute shall be of metal or metal-lined wood with sections set at approximately the same slope to assure a continuous uniform flow throughout the length of the chute. The slope of the chute shall be not less than one vertical to three horizontal nor more than one vertical to two horizontal. The conveyor shall be designed and operated to

prevent segregation of the aggregate and loss of mortar. The discharge of the chute or conveyor shall be provided with a baffle plate or other device to prevent segregation. The chute and conveyor shall be thoroughly clean before and after each run. Waste material and flushing water shall be discharged outside the forms.

4.8.6 PUMP PLACEMENT

Concrete pump shall be either piston or squeeze type. Use of any other type of concrete pump shall require approval by the Engineer.

Selection of pump type and pipe diameter, where necessary, shall be made after test runs are conducted.

Pipeline shall be laid in a manner so as not to disturb nor cause adverse effects on formwork, arranged reinforcements and previously placed concrete.

Operation of pump shall be such that a continuous stream of concrete without air pockets is produced. Concrete of which the quality has changed due to plugging, or concrete contaminated with water in the pump or pipeline, shall not be used. When pumping is completed, concrete remaining in the pipeline shall be ejected without contamination of concrete or separation of ingredients. After each operation, the equipment shall be thoroughly cleaned, and debris and water shall be flushed outside the forms.

4.8.7 BUCKET PLACEMENT

For large substructures which involve the continuous placement of considerable quantities of concrete, bottom dump buckets may be used subject to the following conditions: that the bucket shall be of an approved type and adequate in capacity; and that the bucket capacity shall conform to the size of the batch or a multiple thereof so that no splitting of batches in loading buckets occurs.

The bucket shall be designed so as to allow the discharge of a portion of a bucket as needed, and shall be controllable to avoid damage to or misalignment of forms. The discharge shall be sufficiently large and the operation of the discharge gates such that there will be no delay in dumping concrete of the lowest slump that can be successfully worked and vibrated into place. Buckets shall be filled and discharged without noticeable separation of the coarse aggregate. Buckets shall not be used whenever they have to be hauled for long a distances during which time a noticeable separation or bleeding occurs.

Buckets shall be placed so that their bottom shall be less than 50 cm in height from the depositing surface.

4.9 CURING

All concrete shall be kept moist and at a moderate temperature for at least 5 days after placing. The unformed top surfaces of formed concrete shall be kept moist by wet burlaps or other effective means as soon as the concrete has hardened sufficiently to prevent damage.

These surfaces as well as steep or vertical formed surfaces shall

be kept completely and continuously moist prior to and during form removal by applying water to the top surfaces and allowing it to run down between the forms and the concrete.

4.10 FORM

4.10.1 GENERAL

Prior to the execution of each concrete structure, the Contractor shall submit the detailed design of the form which he intends to use to the Engineer for approval. The Contractor shall take entire responsibility for the stability of the forms. The forms shall have sufficient strength to withstand pressure resulting from placement and vibration of the concrete, and shall be rigidly fixed in correct positions.

Exposed concrete edges or corners shall be provided with 2cm x 2cm chamfer, unless otherwise indicated.

4.10.2 SHOP DRAWINGS

The Contractor shall prepare and submit the detailed shop drawings to the Engineer for approval.

4.10.3 INSPECTION OF FORM ERECTION

Prior to erection of forms, necessary marking shall be performed, and important markings shall be subject to inspection by the Engineer.

Form work shall be properly carried out in accordance with the location, shape and dimensions of the concrete structure.

Piping, boxes and metal fixtures to be arranged inside forms shall be secured so that they will not move at the time of

concrete placement.

Prior to placing concrete, embedded metal in concrete, such as sleeves, anchor bolts, anchor plates and so forth, shall be checked with extreme care.

4.10.4 REMOVAL OF FORMS AND SUPPORTS

Removal of form for side of beam, column and wall ..... 4 days

Removal of form for bottom of slab and beam ..... 8 days

Removal of support for slab ..... 14 days

Removal of support for beam ..... 21 days

In the case of shortening the supporting period less than 21 days, the Contractor shall submit the certified calculation sheets for strength of beam to the Engineer for approval.

4.10.5 FORM OIL

Form oil shall be light colored paraffin oil or other acceptable non-staining material.

Forms in contact with concrete shall be given a uniform light spray coating of the specified form oil coating in accordance with the manufacturer's recommendations.

Form coating shall be applied to the forms before they are set.

4.10.6 FORM TIES

Form ties shall have sufficient strength, stiffness and rigidity to support and maintain the form in proper position and alignment without the use of auxiliary spreaders.

The type of form ties used shall be submitted to the Engineer for approval.

4.10.7 CONCRETE SURFACES TO BE EXPOSED

Form surfaces that will be in contact with concrete shall be of material that is nonreactive with concrete and that will produce concrete surfaces equivalent in smoothness and appearance to that produced by new plywood panels.

Smaller size panels shall be used only where required by openings or joint details, with each area less than 120 cm wide formed with a single panel accurately cut to the required dimensions.

Cut surfaces shall be smooth and treated with form coating.

Panel joints that will be in contact with concrete shall be smooth and free of offset.

Form materials with defects that will impair the texture and appearance of finish surfaces shall not be used.

Column forms shall be made with a minimum number of joints.

4.11 STEEL REINFORCEMENT

4.11.1 GENERAL

Prior to fabrication of reinforcing steel, the Contractor shall submit detailed construction drawings, including bar bending schedules, to the Engineer for approval.

Reinforcing steel shall be placed wherever indicated in the Drawings. The details of steel reinforcement, such as hooks and bends, cleaning placing, spacing, welding, splices and concrete protection, unless otherwise shown in the Drawings and the Specifications, shall conform to Standard for Structural Calculations for Reinforced Concrete of AIJ.

4.11.2 CLEANING REINFORCING BARS

Prior to concrete placing, reinforcing steel shall be cleaned, and loose flaky rust, oil, grease, dust and/or other matter likely to reduce bond with concrete shall be removed.

4.11.3 PLACING REINFORCING BARS AND INSPECTION

(1) Reinforcing bars shall be arranged at the proper locations and assembled in a secure manner so as to prevent displacement during placing concrete. For this purpose, important points at which bars cross shall be tied with steel wire of a diameter not less than 0.8 mm, and spacers, chairs, hangers, etc., shall be used at suitable locations.

(2) The required clearance between reinforcement bars and forms shall be properly secured through the use of spacers, chairs, etc.

(3) Clearance between bars not designated in the Drawings shall, in principle, be not less than 1.25 times the maximum size of coarse aggregate, not less than 25 mm, and not less than 1.7 times the nominal bar diameter. Wherever there is a lapped splice, the clearance between the bars in the lapped splice and the adjoining bars shall be increased to the values specified above.

(4) Prior to placing concrete, reinforcement shall be inspected with respect to the above items.

4.11.4 LAPPED SPLICES IN REINFORCEMENT

(1) Location of splices

Splices at points of great stress shall be avoided whenever

possible, and care shall be exercised to avoid concentration of splices at one place.

(2) Length of lap

The lengths of laps in lapped splices shall be in accordance with the Drawings and as indicated below.

Length of anchorage of lapped splices

40 d without hook

35 d with hook

The length of lap in a lapped splice of reinforcing bars of different diameters shall be based on the nominal diameter of the smaller bar.

4.11.5 ANCHORAGE OF REINFORCEMENT

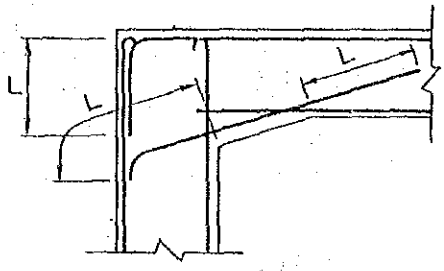
The length of anchorage of reinforcement shall be determined in accordance with the type of reinforcing bar, the grade of concrete and type of stress acting on the reinforcement, and shall be as indicated in the table below, unless otherwise indicated.

Length of Anchorage of Reinforcement

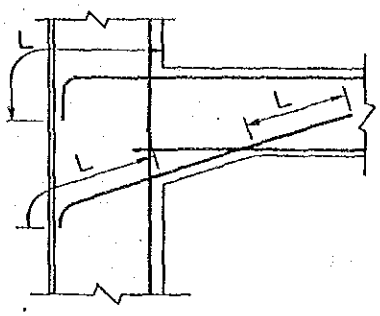
Re-Bar	Strength of concrete	Length of anchorage		
		Orindary	Lower bar	
			Beam	Floor, roof
ASTM A615 Gr.40	210 kg/cm^2	35 d or	25 d or	10 d and
	270 kg/cm^2	25 d with hook	15 d with hook	15 cm or more

Note: "d" denotes nominal diameter of reinforcing bar.

The length of anchorage shall be in accordance with the sketch below.



End of Beam at Top of Structure



End of Beam at Intermediate Floor

4.11.6 CONCRETE PROTECTION FOR REINFORCEMENT

The thickness of concrete cover for reinforcement shall be determined to provide necessary fire resistance, durability and bearing strength of the member. Minimum concrete cover shall be provided in accordance with the table below.

Table Minimum thickness of Concrete Cover for Reinforcement

Item	Structural Element		Covering thickness (cm)
Part not contacting ground	Floor, wall	Covered finish	3
		Uncovered	4
	Column, beam, wall	Interior finish	4
		Uncovered	4
		Exterior; covered finish	4
		Uncovered	5
	Bearing wall		5
Part contacting ground		Wall, column, beam, floor	5
		Foundation, retaining wall	7

4.11.7 DOWELS

Dowels shall be installed at right angles to construction joints.

Dowels shall be accurately aligned parallel to the finished surface and shall be rigidly held in place and supported during placing of the concrete.

4.12 JOINTS

4.12.1 CONSTRUCTION JOINTS

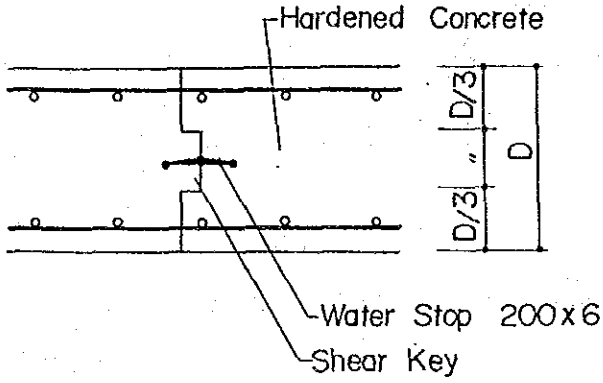
Location of vertical and horizontal construction joints shall be provided in accordance with the approved construction drawings, the construction scheme of placing concrete and where directed

by the Engineer.

Regarding the construction joints for mat foundation, the Contractor shall submit the mat placing scheme concerning the position of the construction joints of the mat foundation to the Engineer for approval prior to deciding the said positions.

Shear keys and water stops shall be provided for all construction joints.

The shape of construction joints shall be in accordance with the following diagram, unless otherwise specified.



CONSTRUCTION JOINT

4.12.2 CRACK-CONTROL JOINT

Crack-control joint in steel troweled floor slabs shall be provided at every 3.0 - 4.0 meters as indicated in the Drawings.

Crack-control and pointed joint in uncovered concrete walls shall be provided for both vertical and horizontal.

Horizontal joints shall be provided at every floor level.

4.12.3 WATER STOP

Unless otherwise shown in the Drawings, all construction joints which contact soil shall be provided with water stops.

The concrete shall be carefully placed and vibrated around the water stops so as to form a complete bond between the concrete and all embedded areas of the water stop.

4.13 TOLERANCES FOR CONCRETE CONSTRUCTION

Concrete structure shall be constructed to the lines shown in the Drawings.

Any structure which does not conform to such lines within the tolerances listed below shall be repaired, removed and made anew by the Contractor.

Tolerances limits of concrete structure shall, in principle, be in accordance with the table below.

Tolerance Limits

Type	Item		Tolerances against base line (mm)
Column, wall	A. Form	Architecturally formed	3
		Others	5
	B. Concrete surface		7
Beam, slab	A. Form		6
	B. Deflection		3
	C. Concrete surface		7
	A. Column line		3

4.14 REPAIR OF CONCRETE SURFACES

In principle, concrete surface shall be adequately constructed within the tolerance specified in 3.9 "TOLERANCES FOR CONCRETE CONSTRUCTION".

However, in the following faulty cases, the Contractor shall submit the scheme for repair to the Engineer for approval within 2 days after discovery.

(1) Surface imperfections due to faulty placing of concrete.

(2) Cuts on the structures due to removal of excess over the lines shown in the Drawings.

(3) Additional placing due to defaults on the lines shown in the Drawings.

Such repairs shall be made immediately after receiving the Engineer's approval.

4.15 PRECAST CONCRETE PANEL FOR EXTERIOR WALL

4.15.1 GENERAL

Prior to making precast concrete panels, the Contractor shall submit the detailed drawings of reinforcement, surroundings of doors and openings, connections to main frames, embedded metal and so forth to the Engineer for approval.

4.15.2 MATERIAL

(1) Cement, aggregate, water and reinforcing bars shall comply with these Specifications.

(2) The maximum size of aggregates shall not exceed 18 mm.

(3) Steel to be used for mounting shall conform to Class 2 (SS41) in JIS G 3101, or equivalent.

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(4) The design strength of concrete shall be Fc28 = 210 kg/cm^2, or more.

4.15.3 DESIGN

The precast concrete panel shall be designed so as to minimize the number of openings wherever possible after confirming the number and positions of the penetration holes. Places around the openings shall be reinforced sufficiently by using concrete rib or steel frame.

The reinforcing steel frame and the fittings to be used shall be in accordance with the following.

Reinforcing steel frame

Opening:	L-75 x 75 x 6
Fitting pad:	FB-9 x 100
	= 150

Fitting

Insert:	22ϕ bolt
Piece:	L-120 x 120 x 8

The backup materials for caulking shall be filled over the front and back of the joint. In this case, the width of the joint shall be 20 mm.

4.15.4 MANUFACTURING (CONCRETING WORK)

The concrete that has been placed shall be cured in a wet condition for at least three days prior to removal of the forms. The panel shall neither be moved nor transported, and shall be kept in a wet condition. In principle, forms and beds shall be made of steel plate.

Tolerance limits of concrete panel shall be in accordance with the table below.

Item	Tolerance (mm)
a. Length	±5
b. Thickness	±3
c. Location of embedded metal	±3
d. Distortion	5
e. Unevenness	6
f. Crookedness	5
g. Difference of diagonal lines	10

4.15.5 CHECKING

The Contractor shall check the items of strength of concrete, dimensions, cracks, damages, finish and location of embedded materials, and shall submit the results to the Engineer for approval.

The Contractor shall repair any/all defects at his own expense.

4.15.6 INSTALLATION

Immediately after completion of the erection of steel structure, the Contractor shall install the precast concrete panels.

4.16 LIGHTWEIGHT CONCRETE

Cinder concrete shall contain 150 kg Portland cement per 1 cubic meter of concrete. The specific gravity of cinder concrete shall be 1.8 or less.

This concrete shall be placed on the built-up waterproofing layers of the lavatory floor.

4.17 STEEL TROWEL FINISH

After the placing of concrete has been completed, steel trowel finish shall be applied to interior concrete floors, such as bed of vinyl asbestos tile and exposed steel trowel finish floor, as indicated in the Drawings.

The finished floor surfaces shall be true plane surfaces with no deviation in excess of 3.0 mm when tested with a 300 mm straight-edge.

Surfaces shall be pitched to drains where indicated in the Drawings.

Instead of hand finishing, the Contractor may use an approved power finishing machine provided that the finished surfaces are free of machine marks or ridges.

5. STRUCTURAL STEEL WORK

5.1 GENERAL

This section covers all structural steel works for permanent structures in accordance with the Drawings and these Specifications. The Contractor shall furnish all materials equipment, and labor for the performance of the structural steel work, including temporarily used materials necessary for erection.

5.2 APPLICABLE STANDARDS

Structural steel works for permanent structure shall be designed and fabricated in accordance with the requirements of Clause 5 of "Applicable Standards and Codes" in Part I and Subclause 2.2 of "Applicable Standards" in Section I, Part III.

5.3 MATERIALS

5.3.1 STRUCTURAL STEEL

Unless otherwise specified, structural steel shall conform to Clause 2 (SS-41) in JIS G 3101 "Rolled Steel for General Structure", or equivalent.

However, when steel plate of 25 mm thickness or more is used, its quality shall conform to Clause 1 (SM-41A) in JIS G 3106, "Rolled Steel for Welded Structure", or equivalent.

Dimensions, weight and permissible variations shall conform to JIS G 3191, G 3192, G 3194 for "Hot Rolled Bars, Hot Rolled Steel Sections and Hot Rolled Steel Flats".

5.3.2 HIGH STRENGTH BOLTS, NUTS AND WASHERS

High strength bolts, nuts and washers shall conform to JIS B 1186 "Sets of High Strength Hexagon Bolt, Hexagon Nut and Plain Washers for Friction Grip Joints", or equivalent.

5.3.3 UNFINISHED BOLTS, NUTS AND WASHERS

Unfinished bolts, nuts and plain washers shall conform to JIS B 1180, B 1181 and B 1256, respectively, or equivalent.

5.3.4 ANCHOR BOLTS AND NUTS

Anchor bolts and nuts shall conform to SS-41 in JIS G 3101 for material and JIS B 1180 and B 1181 for dimensions.

5.3.5 ARC WELDING RODS

Arc welding rods shall conform to D4301, D4303, D4316 in JIS Z 3211 "Covered Electrodes for Mild Steel", or equivalent.

5.3.6 SAMPLES AND TESTING

(1) Mill reports

The Contractor shall submit all mill sheets and mill reports covering the chemical and physical properties of the steel used to the Engineer for approval.

(2) Samples and testing

Materials not specified by JIS or equivalent or materials not indicated by the Engineer shall be subject to the following tests.

(a) - Chemical tests

(b) - Physical tests

(c) - Shape and size tests

Testing method shall be in accordance with JIS G0303, or equivalent.

The number of test specimens for steel shall be one for each different cross section with one specimen to be added for every additional 10 tons or fraction thereof when the total weight exceeds 10 tons.

5.4 FABRICATION

5.4.1 SELECTION OF STEEL STRUCTURE FABRICATION SHOP

In selecting the steel structure fabrication shop, the Contractor shall check the following items, submit the results to the Engineer, and obtain the Engineer's approval for selection of the fabrication shop.

(1) Equipment, machinery and monthly production capacity (work force)

(2) Number and personal history of engineers

(3) Number of special technicians and qualification of their skills (welders, etc.)

(4) System and method for inspection

(5) Achievement records (Examples of manufacturing achievement records in case of power plant)

5.4.2 FABRICATION SCHEME

Prior to starting fabrication of steel structures, the Contractor shall submit the fabrication scheme to the Engineer for approval. The Contractor shall dispatch an instructor(s) to the fabricator of steel structures and have the instructor(s) supervise the

fabrication during the period from preparation of fabrication drawings and full size drawings up to fabrication and shipping of any/all steel structures.

The fabrication scheme shall indicate detailed contents of fabrication and the specifications for the work in accordance with the design documents.

Item	Contents
1. General	Scope of application, applicable standards, etc.
2. Outline of work	Outline of building, scope of work and outline of construction (types of materials and method of joining)
3. Organization of fabrication shop (Equipment and machinery)	Organization, engineers and personnel in charge, list of special technicians, equipment and machinery
4. Materials	Materials to be used, identification, test and inspection
5. Machining	Respective provisions
6. Inspection	Standards and methods for inspection (Method, quantity, time period and reporting format)
7. Separate lists	Personal history of engineers and instructors in charge, list of welders, etc.

5.4.3 SHOP DRAWINGS AND FULL SIZE DRAWINGS

The shop drawings shall be drawn based on the design drawings and these Specifications, and shall be submitted to the Engineer for approval.

Drawings shall include all shop and erection details, including cuts, copes, connections, holes, bolts, and welds in structural steel. All welds, both shop and field type, shall be indicated by standard welding symbols. Drawings shall show the size, length, and types of each weld.

Full-size drawings may be replaced partially by shop drawings. Full-size drawings and templates in shop shall be subject to inspection by the Engineer.

The detailing shall be in accordance with "Design Standards for Steel Structure" established by the Architectural Institute of Japan, or equivalent.

5.4.4 MARKING

Prior to fabrication, such as cutting, bending, welding, all required markings for fabrication shall be exactly inscribed on the materials.

The or chisel shall not be used for marking of high tensile steel and the outer face of steel to be bent.

The location of the markings shall be determined in consideration of the shrinkage and deflection during fabrication and finishing.

5.4.5 CUTTING

(1) Cut surfaces of materials shall be normal to the axis, unless otherwise specified in the Drawings.

(2) In principle, cutting for the shapes (wide flange, angle, channel and so on) shall be applied by the saw cutting method, and cutting plates shall be applied by the semi-automatic gas cutting method.

(3) Cut surfaces formed by gas cutting shall be made smooth and free from notches.

The degree of roughness of cut surfaces shall be 50S or less in case of metal touch section and 200S or less in case of other sections.

(4) Distortions which occur during cutting shall be corrected.

5.4.6 DRILLING AND PUNCHING

Drilling machine shall be used for making holes. However, punching may be used in case of plate thickness of 6 mm or less.

The holes shall be kept at right angles to the plate surface and at the correct points.

Subsequent to drilling or hole cutting, all burrs shall be removed.

5.4.7 CORRECTION

Distortions that occur during fabrication shall be corrected unless they are in the indicated precision of the products.

Correction shall be performed under normal or hot temperature conditions.

In case of hot temperature, care shall be taken so as not to damage the quality of the material.

5.4.8 BENDING

Bending shall be done under normal or hot temperature conditions. In case of hot bending, work shall be performed in the red condition (650°C or lower).

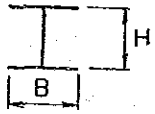
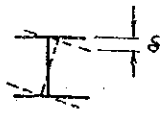
5.4.9 SURFACE FINISHING

Surface of joints of columns and contacted surfaces between column and column bases shall be plane finished to ensure proper tightness.

5.4.10 TOLERANCE LIMITS OF FABRICATION

The tolerance limits shall be, in principle, in accordance with the following table.

Unit: mm

	Column	Beam	Bracing	Remarks
Length	±2.0	2.0	2.0	
Depth	±1.5	1.5	1.5	
Width of flange	±2.0	2.0	2.0	
Right angle	3/1000	-	-	
Distortion	±3.0	3.0	3.0	
Crook	±3.0	3.0	3.0	
Location of connection	±2.0	2.0	2.0	
Bolts pitch	±1.0	1.0	1.0	
Anchor bolt pitch	±1.5			
Anchor bolt hole	±1.0			

5.5 ASSEMBLY

(1) Preparation of materials

Prior to assembly, materials to be assembled shall be corrected so that no bracing, warping or twisting of finished material will occur.

Materials to be assembled shall be set in the proper positions and at precise angles to each other by use of jigs.

(2) Assembly

Assembly shall be performed in such a manner that distortion by welding is minimized in consideration of structural style, welding method and welding order.

Tack welds shall be kept to minimum points so as to assure precise assembly.

Short bead shall not be used for tack weld.

5.6 WELDING

5.6.1 WELDERS

Welders shall be those persons who qualify by the examination specified in JIS Z 3801, and have more than 6 months continuous experience in welding, or equivalent.

5.6.2 PREPARATION OF MATERIALS

Bevels of joints shall be accurately shaped by automatic gas cutting or chipping. When manual gas cutting is unavoidable, the cut surface shall be closely inspected and finished smoothly with a grinder.

5.6.3 ASSEMBLY OF PIECES TO BE WELDED

Pieces to be welded shall be securely brought together by suitable means, such as the use of jigs.

Parts to be fillet welded shall be made to ensure contact with each other as closely as possible.

The shapes of bevels for butt welding shall be strictly formed in accordance with the approved shop drawings, and shall be assembled in a manner so as not to produce gaps or misalignment of materials.

When welding materials together, care shall be taken to avoid deformation caused by type of structure, welding method and welding order. To complete accurate shape of the structure upon completion of welding, reverse distortion or a suitable restraining method shall be employed whenever required. To maintain members in accurate position, suitable temporary bolting or tack welds shall be provided.

Tack welds shall be limited to a minimum and, if they form a part of the permanent weld, they shall be free of defects.

5.6.4 WELDING EQUIPMENT AND ACCESSORY FACILITIES

The welding equipment shall have suitable capacity for the welding method to be adopted, and shall be remote controlled so that the electric current can be readily adjusted from the welding location.

5.6.5 CLEANING OF MEMBERS

Steel surface to be welded shall be carefully cleaned. All slag, moisture, dust, rust, oil, paint and other foreign matter shall

be removed.

5.6.6 WELDING METHOD

Shop welding shall be performed by using rotary jigs, and/or positioners, and shall be carried out in a downward position whenever practicable.

Holding of the welding rod shall be done in such a manner that a suitable arc length and angle are maintained. Rod manipulation shall be carefully performed to secure adequate melting in while preventing defects, such as inclusion of air bubbles and slag, undercuts, misalignment of legs and overlaps.

The shape of weld surfaces shall achieve a ripple form, and shall be as smooth and regular as practicable.

When exchanging welding rods or when welding in more than one layer, previously formed slag shall be thoroughly removed before proceeding with the next weld.

All slag shall be thoroughly removed upon completion of welding.

(1) Butt welding

For butt welding, the thickness of the minimum reinforcement shall not exceed 3 mm, unless otherwise specified.

When welding from both sides, welding of the back side shall be performed after back gouging. When welding is not performed from both sides, a backing bar shall be used, and special care shall be exercised to obtain a good weld at the root.

(2) Fillet welding

The thickness of reinforcement in fillet welding shall be not more than $0.1S + 1$ mm (where; S is the specified leg).

Surface of fillet welds shall be as smooth as practicable. The lengths of intermittent welds shall be more than twice the size of fillets plus the designated length.

(3) Weather Condition

Welding shall not be performed when surfaces of steel to be welded are wet or when strong winds are blowing, unless the welder and the portion to be welded are suitably protected.

5.7 INSPECTION AND REPAIR

5.7.1 INSPECTION OF WELDED PARTS

(1) The following checks shall be done after welding: leg, undercut, pit, overlap, crater, sputter, crack, bead, etc.

(2) X-ray examination

The Contractor shall carry out X-ray examination of 20% of the welded length or more in tensile parts of butt welding, and 10% or more in compressive parts of butt welding.

Allowance of the X-ray examination shall be Class 2 in JIS Z 3104, or more.

(3) Ultrasonic test

Ultrasonic tests shall be applied on the welded parts for which X-ray examination can not be carried out.

5.7.2 INSPECTION OF FINISHED GOODS

The Contractor shall submit the check results of all finished goods to the Engineer for approval.

5.7.3 REPAIR

(1) Cracks shall be removed by arc air gouging and then rewelded.

(2) Undercuts shall be adequately filled with molten metal. Beads shall be smoothed down by a grinder.

(3) Pit, blowhole

Pit and blowhole shall be removed by arc air gouging and/or chipping and then rewelded.

(4) Overlaps

Overlaps shall be finished by grinder.

5.8 HIGH STRENGTH BOLTS

5.8.1 GENERAL

The tightness of high strength bolt, such as PI, TC or equivalent, shall be able to be visually inspected.

5.8.2 BOLT, NUT AND WASHER

The combination of classes and grades of bolts, nuts and washers shall be in accordance with the table below.

Classes of Sets		Combinations			Remarks
	Classes of torque (k)	Bolt	Nut	Washer	
Class-2	A	F10T	F10	F35	M22 or more
	B				M20 or less
Class-3	A	F11T	F10	F35	M22 or more
	B				M20 or less

In the above table, torque coefficient (K) shall be 0.13 and 0.17 for Class A and Class B, respectively.

$$\text{Where; Coefficient (K)} = \frac{\text{Torque moment (T)}}{\text{Outside diameter of bolt(d)} \times \text{Axial force of bolt(N)}}$$

5.8.3 BOLT LENGTH

Bolt length shall be in accordance with the table below.

Nomenclature	Length added to tightening length (mm)
M16	Not less than 30
M20	Not less than 35
M22	Not less than 40
M24	Not less than 45

5.8.4 HANDLING OF PRODUCTS

In transportation and storage of products, damage to the products shall be avoided, adherence of dust and other matter shall be prevented, and care shall be exercised in protection against rusting.

5.8.5 ASSEMBLY

(1) Distortion, warping and bending of contact surfaces (friction surfaces) shall be corrected.

(2) In case members to be bolted are of considerable thickness, or in case there is a multiple number of layers to be bolted, or in case there are gaps tending to lower sliding

resistance, filler strips shall be inserted or other means shall be provided for correction of the condition.

5.8.6 FRICTION SURFACE

(1) Friction surfaces prior to assembly shall be thoroughly cleaned, and mill scale, loose rust, dust, oil, paint and other foreign matter likely to reduce friction shall be removed.

(2) Friction surfaces shall be subject to inspection by the Engineer prior to assembly, and adequate control of the friction surfaces shall be maintained after inspection.

5.8.7 TIGHTENING OF BOLTS

(1) Initial tension of bolts shall be performed by providing washers under the bolt heads and nuts. In case the contact surfaces of bolt heads and nut bottoms with members to be joined are inclined more than 1/20, tapered washers shall be used.

(2) Tightening of groups of bolts shall be carried out so that all bolts attain effective tightness.
Bolts shall first be tightened to about 60-80% of standard bolt tension. Final and complete tightening shall be carried out by the second tightening operation.

5.8.8 INSPECTION AND EXAMINATION

The manufacturer shall carry out inspection and examination of bolt friction and confirm the designated allowable strength.

5.9 PAINTING (SHOP)

Chemical treatment of phosphoric acid shall, in principle, be applied on the steel surface. Steel surfaces shall be given two priming shop coats (60 - 80u) of a synthetic polymeric resin blended type of protective coating.

Finish painting and painting methods shall be as specified in Clause "PAINTING".

No painting shall be applied on the surfaces described below.

(1) Parts in contact with or embedded in concrete

(2) Surfaces of metal touching other metal.

(3) Parts welded in field

(4) Friction surfaces of high strength bolts

5.10 ERECTION

5.10.1 EXECUTION SCHEME

Prior to starting erection of steel structures, the Contractor shall submit the execution scheme to the Engineer for approval.

The Contractor shall have the fabricator dispatch an instructor(s) and have the instructor(s) supervise erection of the steel frames at the project site.

The work execution scheme shall indicate the detailed specifications for work execution and all detailed matters relating to execution of field work.

Item		Contents
1.	General	Scope of application, applicable standards, etc.
2.	Outline of work	Outline of building, scope of work, outline of construction and conditions surrounding the work site
3.	Personnel in charge of work and organization	Organization, engineers and personnel in charge of work, list of special technicians
4.	Scheme of temporary facilities	Transportation method and temporary road within the work site, unloading pier, etc. Preparation of sorting, storage and on-ground assembly areas Temporary reinforcement for construction equipment, scaffolding, all necessary temporary enclosures, anchoring of foundation for guy ropes, and those pertinents for painting Temporary electric power and water facilities
5.	Man-month schedule (scheme)	Man-month scheme of technicians for erection work, framing work, welding and other special works
6.	Erection scheme	Types and capacity of construction machines, and method and sequence of erection

Item	Contents
	Inspection of erection, curing and plumbing
7. Joining scheme	Types and quantity of joining equipment Types and quantity of inspection equipment, and method of inspection Inspection method (method, quantity, time period and reporting format)
8. Relation with other works	Painting, setting of exterior wall panels and other works
9. Safety control	Safety and health control system, list of personnel in charge of work, qualified persons, etc., for controlling the work Safety net Accident, hazard, mishaps, etc., prevention measures, safety and health measures

5.10.2 ERECTION DRAWINGS

Erection drawings, including schemes of erection and schedule, shall be submitted to the Engineer for approval.

For erection, truck cranes and/or crawler cranes of adequate capacity shall be used.

5.10.3 FIELD CONNECTION

(1) Unless otherwise specified, field connections shall be done with friction type high strength bolts.

For removable grating floor, as indicated in the Drawings, the

Contractor shall provide unfinished bolts for connection of removable beams.

The Contractor shall prepare the erection bolts (unfinished) so as to erect the structure in an orderly and safe manner.

(2) For girts and small miscellaneous steel framings, field connections may be made with M-20 unfinished bolts.

(3) In principle, field weld connection shall not be permitted.

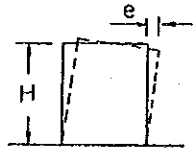
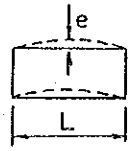
(4) Special care shall be paid grouting when installing columns. After grouting, at least one week shall be required before commencement of tightening anchor bolts by wrench.

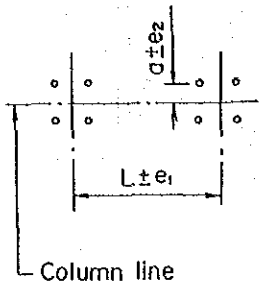
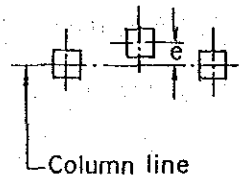
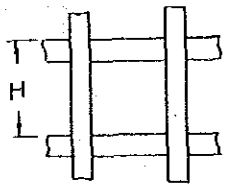
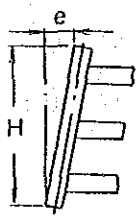
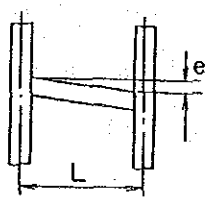
The Contractor shall prepare packer plates for erection.

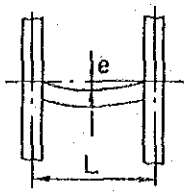
5.10.4 TOLERANCE LIMITS OF ERECTION

The tolerance limits shall be, in principle in accordance with the table below.

TOLERANCE LIMITS OF ERECTION

Items	Diagram	Tolerance
(1) Incline of building (e/H)		1/500 By the same, e shall be 25 mm or less.
(2) Deformation of building (e/L)		1/2,000 By the same, e shall 30 mm or less.

	Items	Diagram	Tolerance
(3)	Elevation of column base plate and position of anchor bolts		Error of the height of column installation from the reference height shall be 3 mm or less. Error of center distance between adjacent column, e_1 shall be within ±3 mm. Error from the column line, e_2 shall be 2 mm or less.
(4)	Displacement from column center		Error from the column line shall be 5 mm or less.
(5)	Story height (H)		±3 mm
(6)	Incline of column (e/H)		Less than 25 mm
(7)	Horizontality of beam (e/L)		1/1,000 By the same, e shall be 5 mm or less.

	Items	Diagram	Tolerance
(8)	Bending of beam (e/L)		1/1,000

5.11 EMBEDDING OF ANCHOR BOLTS

For foundations in which anchor bolts are to be embedded, form work shall be reinforced, and bolt centers shall be determined according to the column center by using templates and anchor frames.

Bolts shall be securely tightened so as to prevent vibration.

Locations shall be accurately maintained by using steel support anchor frames.

5.12 GROUTING FOR COLUMN BASE

5.12.1 MATERIALS

(1) Non-shrink mortar shall be used.

(2) Cement shall conform to JIS R 5210 (Portland Cement), or equivalent.

(3) Sand shall consist of inert, well graded materials having clean, hard and durable qualities.

(4) The Contractor shall submit the material list to be used to the Engineer for approval.

5.12.2 MIXING

(1) The Contractor shall decide and submit the mix proportion

of non-shrink mortar to the Engineer for approval.

(2) The design compressive strength of grout mortar shall be not less than 300 kg/cm^2 at 7 days and 400 kg/cm^2 at 28 days.

6. WATERPROOFING AND DAMPPROOFING WORK

6.1 GENERAL

This clause covers all waterproofing, dampproofing, built up roofing and mortar waterproofing work.

6.2 BUILT-UP ROOFING

6.2.1 MATERIALS

(1) Asphalt primer

Asphalt primer shall be applied by spraying or brushing. The quality of material shall be in accordance with the table below.

Drying time	Not less than 8 hours
Remainder after drying	Not less than 35%
Specific gravity	less than 1.0

The method for the above shall comply with JIS K 5400.

(2) Asphalt compound

The quality of material shall conform to JIS K 2207, and shall in accordance with the table below.

	Asphalt Compound
Penetration ($25^{o}C$, 100 gr, 5 sec.)	20 - 30 (2.0 - 3.0 mm)
Softening point ^{o}C	Not less than $90^{o}C$
Malleability ($25^{o}C$)	Not less than 2.5 cm
Volume of evaporation	Less than 0.5%

	Asphalt Compound
Penetration after Evaporation	Not less than 70%
Flashing point (Open cup method)	Not less than 230°C
Specific gravity	1.01 - 1.04

(3) Asphalt roofing

Asphalt roofing shall comply with JIS A 6006, Asphalt Roofing Felts, or equivalent, and shall be 45 kg - item (21.0 m x 1.0 m per roll).

The Contractor shall submit samples of asphalt roofing to the Engineer for approval.

(4) Special roofing shall, in principle, consist of copper mesh (ϕ0.14 mm) coated with asphalt, and the weight of standard item shall be 55 kg.

The Contractor shall submit the samples of special roofing to the Engineer for approval.

(5) Perforated roofing

Quality of material shall comply with JIS A 6006.

The Contractor shall submit the sample to the Engineer for approval.

6.2.2 GRADES OF WATERPROOFING

Working Process	Class A	Class B
1	Asphalt primer ($0.3\ l/m^2$)	Asphalt primer ($0.3\ l/m^2$)
2	Perforated roofing with thin layer of sand	Asphalt ($1.0\ kg/m^3$)
3	Asphalt ($1.2\ kg/m^2$)	Asphalt roofing
4	Special roofing	Asphalt ($1.0\ kg/m^2$)
5	Asphalt ($1.0\ kg/m^2$)	Special roofing
6	Special roofing	Asphalt ($1.0\ kg/m^2$)
7	Asphalt ($1.0\ kg/m^2$)	Asphalt roofing
8	Asphalt roofing	Asphalt ($2.0\ kg/m^2$)
9	Asphalt ($2.0\ kg/m^2$)	

Class A shall be applied for the roof of the buildings.

Class B shall be applied for the lavatory, etc.,

Inclination of the base concrete shall, in principle, be more than 1/100.

6.2.3 APPLICATION METHOD

Asphalt primer shall be evenly sprayed over the base concrete or roof insulation board. Asphalt compound shall then be evenly poured and spread over the asphalt primer. Compound heated to a temperature exceeding 230°C shall not be used.

In the case of Class A, perforated roofing shall be laid between asphalt primer and asphalt compound.

Asphalt felt, roofing and special roofing shall be flatly laid over each respective asphalt compound. The sides and ends of these sheets shall be provided with an overlap of at least 9 centimeters. The joints shall be completely water tight and not concentrated.

Prior to commencement of the work, the Contractor shall submit to the Engineer for approval the personal histories of the water-proofing workers, who shall have 5 years experience or more.

Care shall be taken for roofing work surrounding anchor bolts, parapets and roof drains to prevent any leakage.

6.3 MORTAR WATERPROOFING

The waterproofing agent shall be used for mortar waterproofing of roof concrete.

Cement and sand to be used for waterproofing mortar shall be as specified in the Clause "PLASTER WORK".

The catalogue and mix proportion shall be submitted to the Engineer for approval.

The application method of mortar shall be as specified in the Clause "PLASTER WORK".

6.4 CONTROL JOINT FOR ROOF

Control joint shall be provided between mortar finish and light weight concrete block, and at about 4.0 of intervals in light weight concrete block area of roof.

Control joint shall consist of elastight and asphalt-mortar.

7. CAULKING AND SEALING WORK

7.1 GENERAL

The Contractor shall furnish all materials, labor and equipment necessary to complete the caulking and sealing work as specified or as directed by the Engineer.

The Contractor shall submit the catalogues and work procedures to the Engineer for approval.

7.2 MATERIAL

(1) Oil caulking compound shall conform to JIS A 5751, Oil Based Caulking Compound Buildings, or equivalent.

Oil caulking compound shall be used as joint filler for the inner side of concrete panels.

(2) Thiokol caulking shall conform to JIS A 5754, Polysulfide Sealing Compounds for Buildings, or equivalent.

Thiokol caulking shall be used as joint filler for all surroundings of exterior doors, windows, louvers, vinyl coated metal and concrete panels.

7.3 WORKMANSHIP

All joint surfaces to be filled shall be sound, clean and dry. All concrete surfaces shall be fully cured before application of caulking.

Joint surfaces to be filled shall be primed with the manufacturer's recommended primer, compatible with the Thiokol base sealing compound and appropriate for the surfaces to be sealed.

Mixing and application of filling compound shall be in accordance

with the manufacturer's standards, and shall be submitted to the Engineer for approval.

All filler work shall be done by skilled workmen.

8. MASONRY WORK

8.1 CONCRETE BLOCK MASONRY

8.1.1 GENERAL

This clause covers concrete block masonry work for walls, partitions and lintels constructed with precast concrete hollow blocks reinforced with steel bars.

8.1.2 MATERIALS

(1) Concrete hollow blocks

Concrete hollow blocks shall conform to JIS A 5406, or equivalent, and shall be as approved by the Engineer.

Dimensions: 390 x 190 x 150

: 390 x 190 x 100

Concrete hollow blocks shall have no harmful distortions, cracks or defects.

(2) Cement, sand and aggregate

Cement, sand and aggregates to be used in the concrete hollow block shall be as specified in the Clause "REINFORCED CONCRETE WORK". Coarse aggregate for blocks shall not be larger than one-fifth (1/5) of the narrowest width of hollow block section.

(3) Slaked lime

Slaked lime shall conform to JIS A 6902, or equivalent.

(4) Reinforcing bar

Reinforcing bars shall be as specified in Clause "REINFORCED CONCRETE WORK".

(5) Cement mortar and concrete

Standard mix proportion shall be as follows, unless

otherwise indicated.

	Work	Mix proportion (by volume) Cement : (slaked lime) : sand
Cement mortar	For masonry joint	1 : 3
	For tamping	1 : 3
	For painted joint	1 : 1
Concrete	For tamping	1 : (2.5) : 3.5

8.1.3 WORKING DRAWINGS

Working drawings of the block laying plan, including reinforcing for arrangements and the places of anchor bolts, shall be submitted to the Engineer for approval.

8.1.4 APPLICATION METHOD

(1) Reinforcing bars

Unless otherwise specified, reinforcing bars shall be of D10 and shall be placed at three (3) block intervals horizontally and every one (1) block interval vertically. Intersections of the bar shall be securely tied with wire. The extra reinforcing bars to be used for the perimeters of the opening shall be of D13.

(2) Laying

The concrete surface to receive blocks shall be cleaned and thoroughly wetted prior to laying the masonry units. All masonry units shall be clean and free from surface dust before laying, and shall be laid by using cement mortar. Fractional parts of units shall not be permitted where whole

units can be used. Joints shall be 10 mm thick and as uniform as possible.

All exposed joints shall be raked 10 mm deep and tooled firmly so as to produce a smooth tight surface. All cells where reinforcing bars are inserted and blocks jointed shall be compactly filled with specified mortar (tamping mortar).

Laying of blocks shall not exceed 1.2 meters per day in height.

Pipes and conduits to be inserted in the concrete hollow block walls shall be embedded in a manner so as not to cause any damage to the block. The Contractor shall coordinate placing of all items embedded in masonry, and shall be responsible for any changes in position.

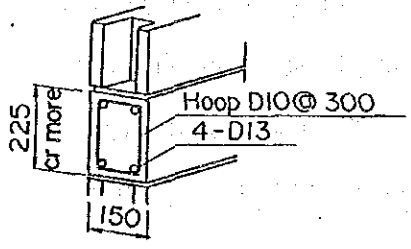
8.1.5 LINTEL

Lintels for opening shall be of reinforced concrete and extended to a length of at least 20 cm into the adjoining walls.

All cells of the blocks directly below the extended lintels shall be filled with mortar.

8.1.6 BOND BEAM

When the height of concrete block wall exceeds 30 times the wall thickness, reinforced precast or pour in place concrete bond beam shall be provided at every height of 30 times the wall thickness.



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8.2 PRECAST CONCRETE BLOCK

8.2.1 GENERAL

Materials, such as cement, aggregate, reinforcing bars, etc., shall be as specified in the Clause "REINFORCED CONCRETE WORK".

Maximum size of coarse aggregate shall be less than 5 mm.

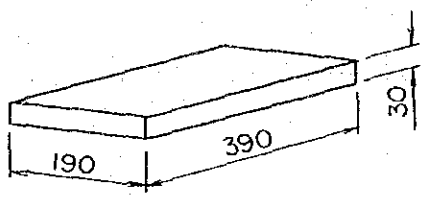
Specific gravity of coarse aggregate shall be 2.7 or more, unless otherwise specified.

Mix proportion of cement:sand:coarse aggregate shall be 1:2:4, respectively.

8.2.2 LIGHTWEIGHT CONCRETE BLOCK FOR ROOFING

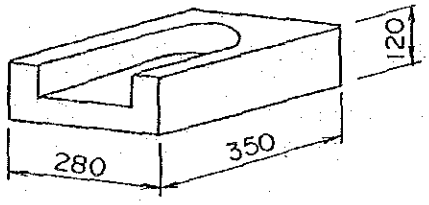
Specific gravity of coarse aggregate for lightweight concrete shall be 1.7 - 1.9.

The dimensions shall be as indicated below.



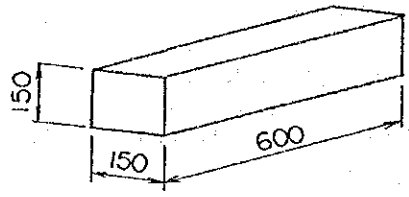
8.2.3 SPLASH BLOCK

The dimensions shall be as indicated below.



8.2.4 CONCRETE BLOCK AT CORNER ROOFING (For protection of built-up roofing)

The dimensions shall be as indicated below.



8.2.5 APPLICATION METHOD

The bed coat shall be of 20 mm thick 1 : 3 cement mortar in which steel wire of 3.4 mm diameter shall be provided in each 200 mm section each way.

Then finish coat shall be applied so that granules can be well tamped.

The surface shall be polished with grinders, sandpaper or a suitable polisher.

Curing of the terrazzo block shall be by means of moistening for more than five (5) days.

8.3 TERRAZZO BLOCK

8.3.1 MATERIAL

(a) Cement shall conform to JIS R 5210, or a locally produced equivalent.

(b) Sand shall be of good quality and free of salts, mud, dirt and other organic matter.

The gradation shall be as shown below.

	Percentage passing sieve
Sand	Passing 5 mm sieve 100%
	Passing 0.15 mm sieve ..... not more than 10%

(c) Water shall be clean and free of salts, iron, sulfur and other organic matter.

(d) Type of marble shall be submitted to the Engineer for approval.

The size of marble granules shall be 12 mm or smaller.

8.3.2 MIX PROPORTION

Mix proportion (by volume)

Layer	Cement	Sand	Cement or white cement	Marble granules	Thickness
Bed coat	11	3	-	-	20 mm
Finish coat	-	-	-	3	15 mm

9. TILE WORK

9.1 GENERAL

This clause covers all works required for mosaic tile, ceramic tile and others applied on floors and walls.

Working drawings shall be submitted to the Engineer for approval.

Prior to starting the work, the Contractor shall submit samples of tile to the Engineer for approval.

9.2 MATERIALS

9.2.1 MOSAIC TILE FOR FLOOR FINISH

Mosaic tile shall be of 25 mm x 25 mm, colored, and manufactured by qualified manufacturer as approved by the Engineer. Materials to be used in the works shall be of high quality, high grade and good appearance.

9.2.2 CERAMIC TILE FOR INTERIOR WALL FINISH (G.W.I.)

Ceramic tile shall be of 108 mm x 108 mm x 9.5 nominal size, colored, and manufactured by qualified manufacturer as approved by the Engineer. Materials to be used in the work shall be of high quality, high grade and have good appearance.

9.2.3 SETTING MATERIALS

(1) Cement and sand to be used for mortar bed shall be as specified in the Clause "REINFORCED CONCRETE WORK".

(2) Bedding mortar shall be mixed with one part Portland cement and three parts sand.

9.3 SETTING

(1) Mosaic tile

The mortar setting bed shall be floated to a uniform plumb and level surface to bring the finish surface to the required plane.

Thickness of mortar shall be about 10 millimeters.

Mosaic sheets shall be placed in position on the pure coat and freshly combed into the mortar setting bed with a trowel. Sheets shall be tamped firmly into place, and made true and even with the finished surface line or plane.

Expansion joints or control joints at 6 meters on center shall continue through the mortar bed and mosaic tile, and shall be kept free from mortar and grout. The joints shall be filled with an approved calking compound, and shall be as close as possible to the color of the grout mortar. All joints, after removal of the paper, shall be grouted leaving then completely and uniformly filled. At no time shall sand or any abrasive be used that will damage the natural sheen of the mosaic tile. All excess grout and glue shall be removed from the face of the tile so as to leave the finished surface clean.

(2) Ceramic tile

Laying of ceramic tile shall comply with the specifications for "Mosaic Tile". For floors, tile laying work shall begin from the center lines of areas to eliminate use of half tiles. For walls, tile laying work shall begin form the top of the wall and proceed downward.

Tile shall be soaked in clean water for at least one hour prior to setting and applied to setting beds within five

minutes after soaking.

(3) Protection

The Contractor shall provide and install barriers or other forms of protection and covering to prevent damage.

(4) Cleaning

Tiles shall be thoroughly cleaned after the grouting and painting have sufficiently set. All traces of cement or foreign matter shall be covered with vaseline during tile setting. Vaseline shall be removed and the metal shall be cleaned and polished.

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10. CARPENTRY

10.1 GENERAL

This clause covers the furnishing of all materials and equipment and the performing of all works required to complete carpentry, and all cases and cabinet works, mop racks, wooden sinks and closets, including installation of finish hardware.

The Contractor shall submit shop drawings and samples of all hardwoods, plywoods and other materials to be used to the Engineer for approval.

10.2 MATERIALS

Each piece of lumber shall be grade-marked, classified and measured according to the respective code and grade requirements. The materials to be used for interior finish shall be high quality and have good appearance, and shall be as follows.

Finish work	Frame and trim	
Structural work	Nail block, base for wall finish	
Wall plate		Teak or Plywood

10.3 WORKMANSHIP

All wood finish, millwork and cabinet work shall be true to details, clean and sharply defined.

Panels shall be set to allow for free movement in case of swelling or shrinkage.

(1) Interior finish

Lumber shall be machine sanded at the mill and hand sanded smooth at the job site where required. Interior trim set

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against plaster or wood shall have cutouts at such places of contract to facilitate plaster bonding. Joints shall be made tight and in a manner so as to conceal shrinkage. Trim shall be finished with nails, screws or glue where required. Door trim shall be of one length pieces.

(2) Storage and protection

Millwork shall be protected against dampness during and after delivery.

All interior finishes, including doors, shall not be installed until plaster is thoroughly dried. All measurements for millwork shall be checked and verified at the site prior to fabrication.

(3) Hardware installation

All finish hardware shall be accurately fixed and installed. If surface applied hardware is fitted and applied before painting, all items, except butts, shall be removed and then reinstalled after painting work is completed.

(4) Finish

All interior wood finish and cabinet work shall be dressed, sanded and cleaned before priming coats are applied. All materials showing machine, sandpaper or other defacing marks shall not be accepted.

(5) Clean-up

Upon completion of the work, all surplus and waste materials resulting from the operation shall be removed from the premises, and the entire structure and related portions of the site shall be left in a neat, clean and acceptable condition.

11. METAL SIDING AND ROOFING WORK

11.1 GENERAL

This clause covers all metal work for siding of substation. The Contractor shall submit fabrication and installation drawings to the Engineer for approval.

11.2 MATERIALS

Steel plate for metal sidings and roofing, including flushing and coping, shall conform to JIS G 3302, and shall be treated with phosohoric acid.

Steel plate shall be 1.0 mm thickness for siding and roofing and 1.2 mm thickness for coping, and coated with vinyl.

Thickness of vinyl coat: for outside ..... 0.30 mm
for inside ..... 0.15 mm

Galvanized coat shall be as follows:

Thickness of steel sheet 1.0 mm ..... 305 g/m^2 or more
1.2 mm ..... 381 g/m^2 or more

11.3 FITTING

Stainless steel shall be used for fitting of siding. Details shall be as indicated in "Standard Detail Plates."

By no means shall any work such as cutting and punching of siding and parapet be carried out at the work site. Any penetration holes into siding for piping, etc., shall be cut or punched at the fabrication shop in accordance with the Owner's Drawings after obtaining prior approval from the Engineer. No saw-cut or punched surfaces of the vinyl coated metal edges shall be coated by using

the same or equivalent color materials so as to prevent corrosion of the base metal.

11.4 COLOR

Sample of colored steel siding shall be submitted to the Engineer for approval.

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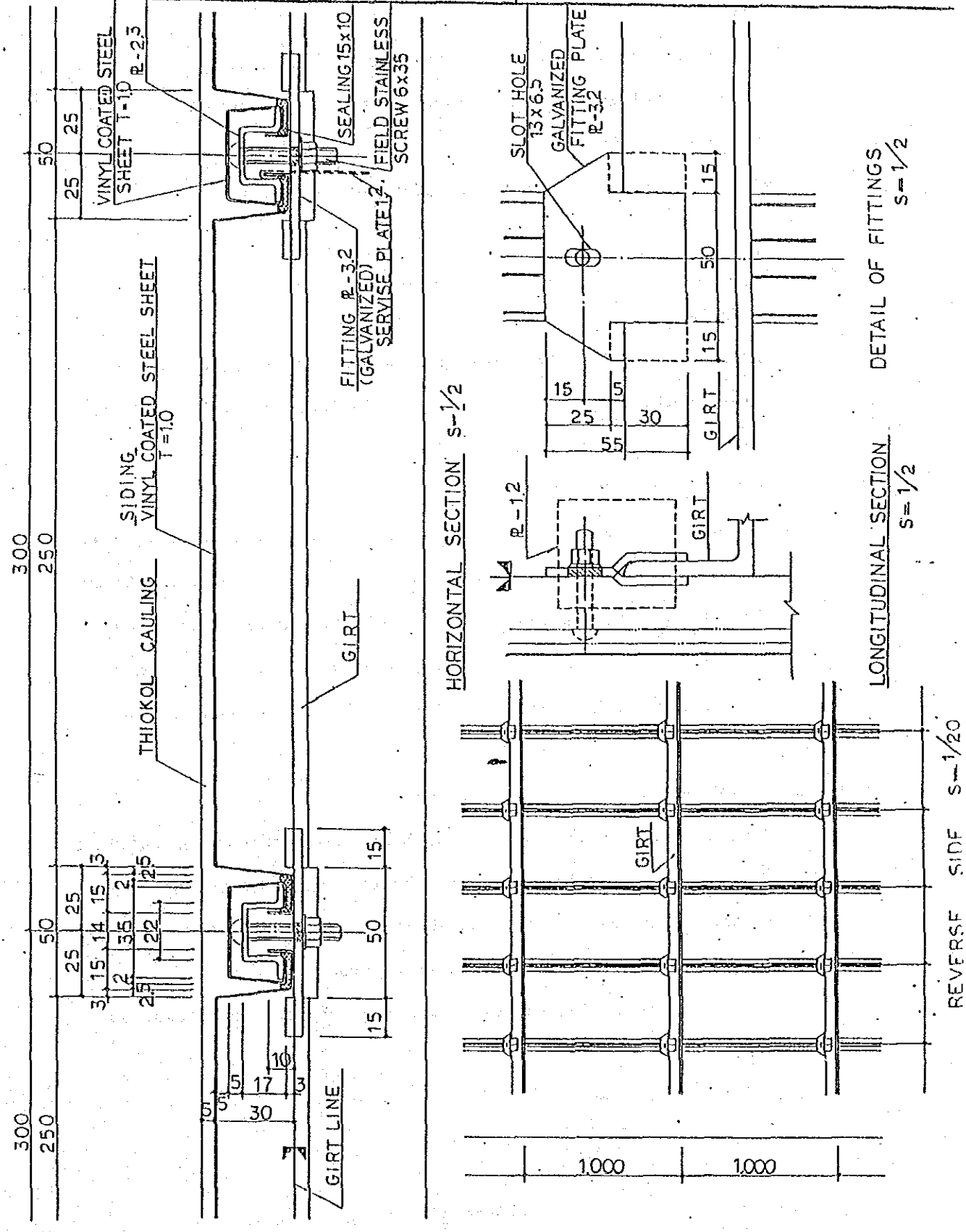
STANDARD DETAIL PLATE

PLATE NAME SIDING SECTIONAL DETAILING

PLATE NO. SDP — —



12. MISCELLANEOUS METAL WORK

12.1 GENERAL

This clause covers all metal works for flooring, walls, flushings, railings, riser, plumbing and other pertinent fixtures. The Contractor shall submit fabrication and installation drawings to the Engineer for approval.

12.2 GRATING

12.2.1 MATERIAL

Twisted closed-end type grating (galvanized) manufactured by DAIKURE K.K. of Osaka, Japan, or equivalent, shall be used, and shall be approved by the Engineer.

Thickness of grating:

for floor ..... 32 mm

for tread of stair ..... 25 mm

Maximum span of grating shall be 1,800 mm for 32 mm thickness.

The design load shall be 150 (L.L.) + 50 (D.L.) = 200 kg/m^2.

The maximum deflection of grating shall be less than 1/300.

12.2.2 INSTALLATION

Grating frames shall be fixed with welded-on anchors or shall be fixed to structural members with bolts, toggle bolts, or expansion shields and bolts. In the case of removable grating, expansion shields and bolts shall be used.

The fixing bolts for removable gratings shall be of stainless steel.

12.2.3 FIELD FABRICATION OF GRATING

In principle, field fabrication, such as cutting and punching, shall not be allowed.

Field fabrication of grating after delivery to the site, necessitated by change of location or increase in the number of pipe ducts, shall be performed under direction of the Engineer.

Wherever bearing bars shall be cut, closed-end bars shall be provided.

12.2.4 REPAIRING AND COATING

Grating damaged during field fabrication or installation shall be repaired or changed at the responsibility of the Contractor, and shall be approved by the Engineer.

Painting for damaged portions in the field shall be touched up with anticorrosive paint and finish paint.

The type and quality of anticorrosive paint shall conform to JIS K 5621, and shall be approved by the Engineer.

The finishing coat shall be silver zinc paint.

12.3 STEEL DECK

12.3.1 MATERIAL

Steel deck conforming to JIS G 3352-Class 2, or equivalent, shall be used for floors and roof as indicated in the Drawings, and shall be galvanized.

Galvanizing coat shall be not less than 0.38 kg/m^2, and shall conform to the method in JIS H 8641, HDZ40. Dimensions of metal decking shall be BQ-12 in JIS 3352 (614 mm x 50 mm x 1.2 mm).

12.3.2 INSTALLATION

Unless otherwise specified, steel deck shall be welded to supporting beams and/or girders. Spot welding machines shall be used for welding of steel decks.

Decking units shall be applied only over supports which have been accurately aligned and secured in position. Joints and laps shall be tight and free from stretching.

End laps shall be 50 mm or more and shall be made over supports.

12.3.3 DELIVERY AND STORAGE

Materials shall be delivered to the site in a dry and undamaged condition, and shall be stored free from contact with the ground and under a weathertight covering permitting good air circulation.

12.4 HANDRAILS

12.4.1 STEEL RAILINGS

Steel railings, including pipe inserts to be embedded in concrete, shall conform to JIS G 3452, and shall be galvanized, unless otherwise specified.

Pipe shall be of the size indicated in "Standard Detail Plates" attached herein.

Galvanizing coat damaged by bolting, welding or other field works shall be repaired and painted with two coats of silver zinc paint.

12.4.2 FABRICATION

Mitered and welded joints shall be made by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and ground smooth.

Railings may be bent at corners instead of joined, provided that the bends are made in suitable jigs and that the pipe is not crushed or damaged.

12.4.3 INSTALLATION

Rails shall be installed by means of steel pipe sleeve inserts which shall be set and anchored in the concrete as indicated in the "Standard Detail Plate" attached herein.

Posts shall be inserted into the galvanized steel pipe sleeves embedded in concrete, or shall be welded to the stringer, beam or toe plate, made level, perpendicular and aligned.

The space between pipe posts and pipe sleeve inserts, except those marked "Removable Handrail" as indicated in the Drawings, shall be filled solid with molten lead or shall be welded.

12.5 STEEL LADDERS

Material to be used for steel ladders shall conform to JIS G 3101-SS41, or equivalent, unless otherwise specified.

Steel ladders shall be fabricated of 16 mm x 50 mm steel plate stringers and 19 mm diameter steel bar rungs. Rungs shall be spaced 350 mm apart and shall be inserted into the stringers and welded thereto. Details shall be indicated in the "Standard Detail Plates".

Ladders installed outdoors, including welded-on brackets, shall

be galvanized.

If a steel ladder is higher than 4.0 m, a safety cage shall be provided.

Safety cage shall start at a point 2.0 m above the ground or floor, and shall extend the full height of the stringers with an unobstructed inside diameter of 65 cm.

Cage shall be constructed with 50 mm x 6 mm steel bar hoops bent to the specified radius and spaced uniformly and horizontally at a maximum of 1.8 m per space, with seven equally spaced 40 mm x 6 mm vertical steel bars placed on the inside face of hoops, riveted thereto with rivets countersunk on the inside or welds ground smooth and snag-free on the interior of the cage.

12.6 STAIR SAFETY NOSING

Stair safety nosing shall be of extruded bronze with cross-hatched nosing.

Safety nosing shall be provided with integrally cast or bent anchors for embedding into mortar.

12.7 STEEL STAIR

(1) General

Stair work shall be furnished and installed with all stringers, treads, dowels, hangers, handrail, toe plates and all appurtenant members. Construction shall be rigid and substantial throughout, and all joints shall be closely fitted. Rivets, bolts and screws shall be concealed where practicable or dressed flush. Members shall be punched, drilled and tapped as required for installation of furring, applied or

abutted materials. Stair construction framed to structural steel supports shall follow the erection of steel work as closely as practicable, and shall be securely bolted to the steel framing. All stair work shall be fully protected by temporary board treads.

(2) Stringers

Face and wall stringers shall be fabricated of steel channel sections, framed in complete units with all joints welded in the unit channels. Face stringers shall be carried around intermediate landings with the top not less than 100 mm above the landing surface. Stringers for grating tread shall be punched to receive tread bolting. All stringers shall be suitably cross-braced on underside of members, making runs reasonably rigid.

(3) Treads and intermediate landings

Threads shall be formed of steel gratings, with angle connections to stringers. No risers shall be used. Treads shall have punched and slotted side plates for bolting to stringers.

12.8 TRENCH COVERS AND FRAMES

Frames and anchors shall be of all welded construction and of structural steel angles. Covers shall be of checkered plate. Frame construction shall be such that tops of frames and cover plates are finished flush with the floor.

Slots shall be provided for lifting. All sharp edges and burrs shall be removed from cover plates and exposed edges of frames.

Size of cover plate shall be determined so as to enable easy removal.

The thickness of checkered plate shall be as follows.

Width of cover	450 mm or less	t=4.5 mm
	450 mm or more	t=6.0 mm with steel angle stiffener

The material shall conform to JIS G 3101-SS41, or equivalent.

12.9 WATERTIGHT MANHOLE FRAMES AND COVERS

Watertight manhole frames and covers shall be installed where indicated in the Drawings. Frames shall have flanges at base and top, rubber gaskets, and a stainless steel cap with air vent valve.

12.10 ROOF DRAINS

Roof drains shall be of cast iron baked with refined tar, and shall conform to JIS A 5522, or equivalent. The size shall be in accordance with the Drawings.

12.11 TOE PLATE (KICK PLATE)

Material to be used for steel toe plates shall conform to JIS G 3101-SS41, or equivalent. Toe plate shall be fabricated of 6.0 mm thick steel plate and securely connected to beams by bolting, welding or anchoring into concrete.

The height of toe plates from the finished floor shall be 100 mm. Toe plate shall be provided at all edges of floors, openings such as stairs, pipe openings and penetrations, and other necessary places.

12.12 DOORSILL

Prior to commencement of floor finish work, doorsills shall be provided at places between different types of flooring, unless otherwise indicated, and shall be of stainless steel conforming to JIS G 4305-SUS 304, or equivalent.

12.14 FLASHING PLATE

Flashing plates shall be of 2.3 mm galvanized or vinyl coated steel plate conforming to JIS G 3131, G 3141, as indicated in the Drawings.

Flashing plates shall be provided at wall and roof openings for piping, and at surrounding areas of windows, louvers, rolling doors and doors facing outdoors.

12.14 EMBEDDED PLATE, HOOK AND SLEEVE

The Contractor shall provide plates, hooks and sleeves to be embedded in concrete as required.

Embedded plates, hooks and sleeves shall have sufficient thickness, diameter and anchorage so as to secure equipment, piping and other necessary items. Painting shall be applied on the plates and hooks after securing the equipment and piping.

The materials to be used for plates, hooks and sleeves shall conform to JIS G 3101-SS41, or equivalent.

12.15 JOINER

Joiners shall be provided at surrounding spaces of suspended ceilings, and shall be of aluminum conforming to JIS H 4000, or equivalent.

Small screws shall be of stainless steel or of high strength aluminum alloy.

12.16 DOWNSPOUT

Downspouts to be used for drains shall be steel pipe conforming to JIS G 3442, or equivalent.

Metal brackets shall be of 50 mm x 4.5 mm steel plate conforming to JIS G 3101-SS41, or equivalent, and shall be galvanized.

Downspouts shall be fixed with metal brackets at a maximum 2.0 m per space.

12.17 STEEL RING

Steel rings shall be provided at parapets at every 3.0 m for maintenance of the building facade, and shall be of 19ϕ bar in 100 mm circles grasped by 12 mm x 60 mm steel plate conforming to JIS G 3101-SS41, or equivalent.

Steel plate shall be well anchored into concrete or welded to structural steel.

12.18 BIRD SCREEN

Bird screen shall be provided behind louvers facing outdoors.

Bird screens shall be of 18 gauge stainless steel wire of 25 mm square mesh conforming to JIS G 4309-SUS 304, or equivalent.

12.19 METAL FOR PARAPET (REAR SIDE)

All metal to be used for parapet shall be in accordance with or equivalent to JIS G3114 "Hot Rolled Atmospheric Corrosion Resisting Steel for Welded Structure" as indicated in the

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Drawings.

The thickness of such metal shall be 1.2 mm. The metal (backing frame: L-25 x 10 x 1.6) shall be installed on the side of the roof surface, and the lower angle material (L-50 x 50 x 6) shall be embedded in mortar. The metal shall then be fixed with concrete block at corner roofing.

The metal shall thereafter be finished by applying three (3) coats of oil painting.

12.20 LIGHTWEIGHT STEEL BED FOR WALL

Lightweight studs and blocks shall be provided as steel bed, and wall boards shall be screwed in place for interior wall.

The studs and blocks shall be of zinc bonded lightweight channel steel (c-100x50x20x2.3) conforming to JIS G3350, or equivalent.

The studs and blocks shall be installed 90 cm on centers and fixed to slab concrete by using expansion bolts at 90 cm intervals.

All studs and blocks shall be properly aligned and shall hold so as to enable plumb placement of boards.

Hardware fixtures for asbestos cement boards shall have countersunk screws of stainless steel.

12.21 FREE ACCESS FLOOR

The Contractor shall supply and install the free access floor to the computer room.

The floor shall be of earthquakeproof and loadproof type, and shall be made of aluminum alloy die cast.

The panel and earthquakeproof reinforced frame lined with static electricityproof tile shall be fixed on the floor slab.

Dimensions:	450 x 450 x 40 m
Live load :	500 kg/m^2

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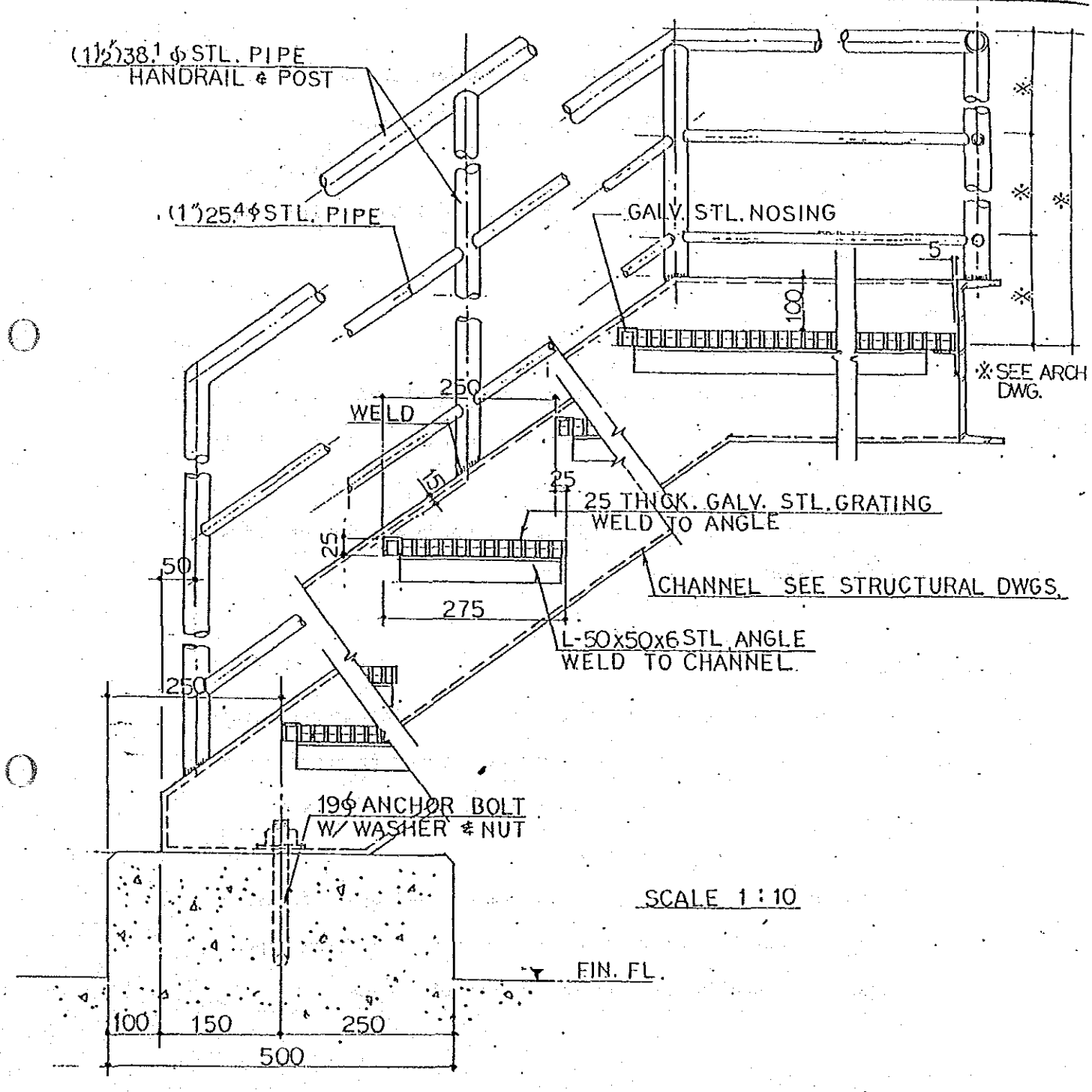
STANDARD DETAIL PLATE

PLATE NAME	PLATE NO.
STEEL STAIR	SDP — —



2-4-83

13. PLASTER WORK

13.1 GENERAL

13.1.1 TREATMENT OF BED

(1) Concrete surfaces which are too smooth to receive plastering shall be roughened beforehand with chisels.

(2) Where walls and floors of concrete, concrete block, etc., are distorted or uneven, the bed shall be repaired with mortar.

13.1.2 CLEANING AND WETTING OF BED

The bed, scratch coat and treated surface of bed shall be cleaned and suitably wetted before application of the subsequent coat.

Portions of the bed or coated surface which are not bonded shall be immediately repaired.

13.1.3 CURING

To prevent soiling and premature drying of plastered surfaces, window and door work shall be completed prior to commencement of the plaster work. Sheet covering shall be provided and sprinkling of water carried out.

To prevent soiling of neighboring members and other finished surfaces, suitable protection shall be provided using paper, boarding, tarpaulin sheet or other suitable means.

13.2 MORTAR PLASTERING

13.2.1 MATERIALS

(1) Cement shall conform to JIS R 5210, Ordinary Portland Cement,

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or locally produced equivalent.

(2) Sand shall be of good quality and free of salts, mud, dirt and other organic matters. The gradation shall be in accordance with the table below.

Table Gradation of Sand

Gradation (by weight)	Type of Mortar Plastering
Passing 5 mm sieve ..... 100% Passing 0.15 mm sieve ..... not more than 10%	First and second coat
Passing 2.5 mm sieve ..... 100% Passing 0.15 mm sieve ..... than 10%	Finish coat

(3) Water shall be clean and free of salts, iron, sulphur and other organic matter, and shall be as specified in the Clause "CONCRETE WORK".

13.2.2 MIXING

The mix proportions of mortar shall be of the standard type in accordance with the table below.

Table Mix Proportion (by volume)

Base	Portion to be plastered	First Coat C : S	Second Coat C : S	Finish Coat C : S : Slaked
Concrete	Floor	-	-	1 : 2
	Interior wall	1 : 2	1 : 3	1 : 3 : 0.3
	Ceiling	1 : 2	-	1 : 3 : 0.3
Concrete Block	Exterior wall and others	1 : 2	1 : 3	1 : 3
Wire Lath	Interior wall	1 : 3	1 : 3	1 : 3 : 0.3
Metal Lath	Ceiling	1 : 2	1 : 3	1 : 3 : 0.3
	Exterior wall and others	1 : 3	1 : 3	1 : 3

In the above table, abbreviated C and S represent cement and sand, respectively.

13.2.3 PLASTERING THICKNESS

The thickness of application shall be in accordance with the standards indicated in the table below.

Table Plastering Thickness

Bed	Portion to be plastered	Plastering Thickness mm				
		First Coat	Dubbing Out	Second Coat	Finish Coat	Total
Concrete Concrete Block	Floor	-	-	-	30	30
	Interior wall	6	5	6	3	20
	Exterior wall	6	7	6	6	25
	Ceiling, others	4.5	-	4.5	3	12
Wire Lath	Interior wall	7.5	-	7.5	3	18
	Exterior wall	6	-	6	3	18
Metal Lath	Ceiling, Eaves	4.5	-	4.5	3	12

13.2.4 APPLICATION METHOD

(1) First Coat and Dubbing Out

Mortar shall be traweled on adequately to leave no conspicuous hollows. The surface of the first coat shall be roughened with tools such as metal combs.

The first coat shall be left standing for not less than 10 days, allowing cracks to be fully developed before applying the next coat.

Dubbing out for concrete and concrete block shall be performed by roughening with tools, such as metal combs, and shall be left standing for not less than 5 days.

(2) Second coat

For the second coat, a ruler shall be applicable at external

corners, internal corners and edges so as to obtain an even finish.

(3) Finish coat

The finish coat shall be applied in a manner so as to be blemish-free by watching the degree of drying of the brown coat and by paying special attention to the surface, angles and edges.

The finish shall be either steel troweled, wood troweled or brushed as directed by the Engineer.

For the exterior wall, the mortar shall first be troweled on with a wood trowel, then burnished with a steel trowel, and finally brushed. The use of water shall be avoided wherever practicable.

(4) Floor mortaring

In the case of concrete which is several days old, concrete paste shall be buttered on in adequate quantity and spread out with brooms and the like after which application of mortar shall be started.

Application of mortar shall be performed using still mortar containing a minimum of water, and the mortar shall be tamped to bring moisture to the surface. The mortar shall be screeded while paying attention to the grade and troweled smooth.

Crack control joints shall be provided at intervals of approximately 3.0 m, and the joints shall be tooled.

(5) Bed for tile fixing

In the case of using adhesives of wall tile or mozaic tile, mortar application shall be to the second coat.

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13.3 PLASTERING

13.3.1 MATERIAL

Plaster shall comply with JIS A 6904, Gypsum Plaster, or equivalent.

Cement which is less than six (6) months aged shall be used.

13.3.2 MIX PROPORTION

The mix proportions shall be as follows.

Bed	Layer	Plaster		Sand	White Fiber (g)/25kg	Applied Thickness	
		For Finish	For Bed			Ceiling	Wall
Concrete and concrete block	2nd coat	-	1	2.0	250	6.0	7.5
	Finish coat	1	-	-	-	1.5	1.5

13.3.3 APPLICATION METHOD

The surface to receive gypsum plastering shall be leveled with a coat of cement mortar of which the mix proportion of cement and sand is 1:2 prior to the application of plaster, and the leveled surface shall be scratched to ensure satisfactory adhesion of the plaster.

Before applying plaster, the receiving surface shall be prepared by removing all foreign matter and shall be dampened.

14. DOORS, WINDOWS AND LOUVER WORK

14.1 WOODEN DOORS AND FRAMES

14.1.1 GENERAL

This clause covers wooden doors and wooden frames, including finish hardware such as butts, hinges, locks, knobs, stops, strikes, holders, door chains and closers.

14.1.2 MATERIALS

All doors shall be flush type and of sizes shown in the Drawings. Standard flush doors shall be double panelled door of 6 mm thick plywood and shall have stiffening ribs spaced at intervals of 15 cm. Plywood shall be bonded to the frames with suitable adhesives which shall conform to JIS K 6801 and 6803, or equivalent.

Waterproofed plywoods shall be used for wooden doors for the lavatory.

The waterproof plywood shall be of 6 mm thickness and five (5) ply. The weight shall be 4.79 kg/m^2.

The each layer shall be completely pressed and adhered by using phenolic resin adhesives, and the plywood shall pass a boiling test and a dry and wet repeating test.

All wooden doors and frames shall be painted as specified in Clause "PAINTING", unless otherwise specified.

14.1.3 SHOP DRAWINGS

The Contractor shall submit shop drawings of fabricated items to the Engineer for approval. The shop drawings shall clearly show the details of fabrication, installation, dimensions, sizes, operation, methods of anchoring and all other pertinent details required for the installation thereof.

14.1.4 WOODEN DOOR FRAMES

All frames shall be accurately set and made plumb and level, and shall be securely nailed to the wooden blocks embedded in the concrete or mortar.

14.1.5 INSTALLATION

Each door shall be accurately cut, trimmed and fitted to its frame and hardware, with allowance for paint finish and possible swelling or shrinkage.

The clearance at the top shall not exceed 3 mm, and at bottom shall not exceed 6 mm.

14.1.6 HARDWARE FOR WOODEN DOORS

Hardware for wooden doors shall, in principle, be stainless steel confirming to JIS G 4304, G 4305 and G 5121 or chromium plated brass conforming to JIS H 3201, or equivalent.

14.2 STEEL FITTINGS

14.2.1 GENERAL

This clause covers steel fittings, including finish hardware such as butts, hinges, locks, knobs, stops, strikes, holders,

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door chains and closers.

14.2.2 MATERIALS

Steel sheet shall conform to JIS G 3131, G 3141, or equivalent. The thickness of steel plates shall be as designated below, unless otherwise specified.

Door frame	Frame	1.6 mm
	Architrave	1.2 "
	Threshold	2.3 "
Door leaf	Frame and flush plate	1.6 "
	Stiffener and anchor plate	2.3 "

Machine screws and rivets shall conform to JIS B 1101-1106, JIS B 1201-1205 and JIS B 1131-1133, or equivalent.

14.2.3 STEEL DOORS

Steel doors shall be single or double hollow core, single or double swing type or sliding type, and with the dimensions and locations indicated in the Drawings. All doors shall be complete with door frames, hardwares and all necessary accessories.

Shop fabricated frames without threshold shall be provided with temporary spreaders at bottom to preserve proper shape during transportation and erection.

All metal surfaces shall be thoroughly cleaned and given two coats of rust inhibitive paint after being zinc plated in shop. Field paint for finish shall be provided as specified in the Clause "PAINTING".

14.2.4 SOUNDPROOF DOORS

The steel doors located in the central control room shall be soundproof.

The doors shall be constructed of two flush plates of not less than 2.3 mm steel sheet, continuously welded, and with no seams on face or edges, and shall bear a minimum sound transmission class rating of 40 decibels.

Shop drawings, catalogues and certified sound transmission loss data shall be submitted to the Engineer for approval prior to fabrication.

The thickness of door shall be 60 mm. The hollow part shall be filled with glass wool conforming to JIS A 9505, or equivalent.

The door shall be of airtight type.

14.2.5 ROLLING STEEL DOORS

Unless otherwise specified in the Drawings, doors shall be electric ~~power~~ operated with auxiliary chain-gear operation, and shall conform to JIS A 4705 120-1.6S-P.R-Class 2, "Fireproof Shutter". The thickness of steel sheet shall be as in the table below.

Type	Thickness
Slat	1.6 mm
Guide rail	2.3 "
Case (Housing)	1.6 "

Other material intended for use shall be subject to approval by the Engineer. Anchors and inserts for guides, brackets, and all other work shall be accurately provided. Upon completion, doors

shall be properly adjusted to operate smoothly and with unnecessary strain.

14.2.6 STEEL LOUVER

Steel louvers shall be of 45^{o} slits, 100 mm thick and frame assembled.

The sizes shall be as indicated in the Drawings.

Louvers facing transformer sides shall be equipped with fire detectors and a control system for automatic closing of flexible slits.

14.2.7 SHOP DRAWINGS

The Contractor shall submit shop drawings of fabricated items to the Engineer for approval. The shop drawings shall clearly show the details of fabrication, installation, dimensions, sizes, operation, methods of anchoring and all pertinent details required for satisfactory installation.

14.2.8 INSTALLATION

All frames shall be erected plumb, square and true to line and level, with secure fastening to structures and anchors.

Door frames shall be installed by authorized representatives of the manufacturer. The time of door frame installation shall be subject to approval by the Engineer.

14.2.9 HARDWARE

Hardware for all doors shall be furnished and installed by the door manufacturer.

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All locks shall require different keys, and the Contractor shall furnish three keys for each lock. Hardware for steel fittings shall, as a rule, be stainless steel conforming to JIS G 4034, G 4305 and G 5121, or chromium plated brass conforming to JIS H 3201, or equivalent.

14.3 ALUMINUM FITTINGS

14.3.1 GENERAL

This clause covers all types of aluminum doors, windows, and casements, as well as doors and windows of the swing, sliding, pivoted, projected, fire and combination type, including operating hardware.

14.3.2 MATERIALS

Extruded aluminum materials shall conform to JIS H 4100 and H 4000, respectively, or equivalent.

Reinforcing strips, reinforcing struts, anchors, etc., shall be of zinc-plated steel plate conforming to G 3101-SS41.

Small screws shall be of stainless steel conforming to JIS G 5121 SUS304, or of high strength aluminum alloy conforming to JIS-H 4040, or equivalent.

14.3.3 SHOP DRAWINGS

The Contractor shall submit shop drawings of fabricated items to the Engineer for approval.

The shop drawings shall clearly show the details of fabrication, installation, dimensions, sizes, operation, methods of anchoring and all pertinent details required for satisfactory installation.

14.3.4 INSTALLATION

All aluminum windows shall be installed by the manufacturer or his authorized representative, and shall be set plumb, square, level and true to line.

Frames shall be set and securely anchored to the structure. Aluminum surfaces in contact with mortar, concrete or other masonry materials shall be provided with one heavy brush coat of bituminous paint. Upon completion of the work, the Contractor shall remove and clean all surplus materials from these areas.

14.3.5 HARDWARE

Hardware for all doors shall be furnished and installed by the door manufacturer.

All locks shall require different keys, and the Contractor shall furnish three keys for each lock. Hardware for aluminum fittings shall, in principle, be stainless steel conforming to JIS G 4034, G 4305 and G 5121, or chromium plated brass conforming to JIS H 3201, or equivalent.

15. GLASS AND GLAZING WORK

15.1 GENERAL

The Contractor shall furnish and install all glass required in doors and windows in accordance with the Drawings and/or by direction of the Engineer.

15.2 MATERIALS

(1) Ordinary sheet glass shall conform to JIS R 3201 (Sheet Glass), or equivalent.

(2) Polished plate glass shall conform to JIS R 3202 (Polished Plate Glass), or equivalent.

(3) Figured glass shall conform to JIS R 3203 (Figured Glass), or equivalent.

(4) Wired glass shall conform to JIS R 3204 (Wired Glass), or equivalent.

(5) Laminated glass shall conform to JIS R 3205 (Laminated Glass), or equivalent.

(6) Tempered glass shall conform to JIS R 3206 (Tempered Glass), or equivalent.

(7) Multiple glass shall conform to JIS R 3209 (Multiple Glass), or equivalent.

(8) Putty shall conform to JIS A 5752 (Putty for Metal Sash Glazing) and JIS A 5753 (Putty for Wooden Fittings).
For putty for steel fittings, the quality shall be Class 1; for aluminum fittings, Class 2 as specified in JIS A 5752.

(9) A thickness of 3.0 mm shall be used for sheet glass and polished plate glass, 4.0 mm for figured glass and 6.8 mm for wired glass, unless otherwise specified in the Drawings.

15.3 WORKMANSHIP

No glazing work shall be carried out during rain or when the frames or glass is wet.

Frames shall be thoroughly cleaned before application of glazing compound.

All glass in windows and doors, except wooden doors, shall be set in full beds of glazing compound and pressed to a firm and even bearing without springing or forcing. Glass in windows shall be held firmly in place with snap-type glazing beads, and in doors with glazing channels or beads. Upon completion of construction work, all dirt, stains and misapplied glazing compound shall be removed, and all glass shall be thoroughly cleaned on both faces.

16. PAINTING WORK

16.1 GENERAL

This clause covers all painting applied to surface of plaster, wood and metal as indicated in the Drawings. No painting shall be applied to surfaces of stainless steel, copper, bronze, brass or any steel in contact with concrete. Painting work shall be performed by skilled workmen. Selection of color shall be as determined by the Engineer, unless otherwise specified.

16.2 MATERIALS AND PAINTING COAT

16.2.1 MATERIALS

Materials to be used in this clause shall be as follows, and shall conform to JIS, or equivalent.

Item	Type	JIS
Primer for steel	Rust preventive paint	JIS K 5621
	Lead cyanamide anticorrosive paint	JIS K 5625
Primer for galvanized steel	Etching primer	JIS K 5633
Primer for wood	Wood primer	JIS K 5506
Primer for concrete, plaster and board	Vinyl chloride putty	JIS K 5584
Finish for steel	Ready mixed oil paint	JIS K 5515
	Ready mixed paint (Alkyd resin type)	JIS K 5516
Finish for concrete, plaster and board	Vinyl chloride resin enamel	JIS K 5582
Acidproof finish		JIS K 5582 (Class-2)
Silver paint	Aluminum paint	JIS K 5492

Item	Type	JIS
Putty for oil paint	Oil putty	JIS K 5592
Boiled oil	Boiled oil	JIS K 5421
Drier	Liquid paint drier	JIS K 5691

16.2.2 PAINTING COAT

Number of coats shall be as indicated in the table below.

Material to be painted		Number of coats		
		Primary	Secondary	Finishing
Steel	Outdoor	2	2	1
	Indoor	2	1	1
Wood	Outdoor	1	2	1
	Indoor	1	1	1
Concrete, plaster and board	Outdoor	1	2	1
	Indoor	1	1	1
Acidproof	Indoor	1	3	1
Galvanized steel	Outdoor	2	1	1
	Indoor	1	1	1
Touch up of galvanized steel		1	1	1

16.3 WORKMANSHIP

(1) Painting shall be applied by spraying, brushing or rolling.

(2) Surfaces to be painted shall be smooth, dry and free from dirt, loose mill scale, rust, grease, or other deleterious material.

(3) The Contractor shall submit the samples and catalogue of paint to the Engineer for approval.

16.4 PROTECTION

Drop cloths shall be furnished and placed to fully protect all parts of work during execution of the work. The Contractor shall be held responsible for paint droppings on floors, equipment, etc.

Paint droppings shall be entirely removed, and damaged surfaces shall be repaired in a manner satisfactory to the Engineer.

No work shall be accepted which shows laps, stains, flat or glossy spots or imperfections in surface over which paint or other finish is applied.

All rubbish, waste or surplus materials shall be removed from time to time, and all woodwork, hardware, floors or other adjacent areas shall be cleaned.

All glass throughout the building shall have all paint or varnish spots and brush marks removed, and upon completion of the painting work, all glass that is scratched or damaged during the work shall be replaced at the Contractor's expense.

Hardware and other unpainted metal surfaces shall be cleaned.

17. INTERIOR AND EXTERIOR FINISH WORK

17.1 GENERAL

This clause covers the performance of all works in connection with the following.

(1) Vinyl tile

(2) Vinyl base

(3) Gypsum board

(4) Acoustic board

(5) Suspended ceiling

(6) Ceiling access

(7) Insulation

(8) Name plate for rooms

(10) Vinyl curtain

(11) Toilet partitions

Prior to starting work, samples of interior finish materials and shop drawings shall be submitted to the Engineer for approval.

Types and sizes of nails, screws, bolts, and quality of adhesives for fixing of interior finish shall correspond and match to characteristics of the interior finish materials, and shall be subject to approval by the Engineer.

17.2 FIXING

Fixing shall not commence until after drying and cleaning of the base.

Fixing method of specified materials shall be in accordance with the manufacturer's specifications, and shall be submitted to the Engineer for approval.

When performing fixing work, adequate precautions shall be provided to avoid offsets, gaps or uneveness.

Suitable protection measures shall be provided for interior finishes until all finishing works are completed.

17.3 VINYL TILES FOR FLOOR FINISH

Sizes of vinyl tile shall be 300 mm x 300 mm x 3 mm thick confirming to JIS A 5705, or equivalent.

The tiles shall be resistant to alkali, grease and oils.

Vinyl tiles shall be bonded with asphalt adhesives.

17.4 ACIDPROOF VINYL TILE FOR BATTERY ROOM FLOOR

The tiles shall be of acidproof type. The shape and dimensions shall be the same as those of vinyl asbestos tile.

17.5 VINYL BASE

Vinyl base shall conform to the manufacturer's recommendation of vinyl asbestos tile for flooring, unless otherwise indicated. The height of the base shall be 100 mm.

17.6 GYPSUM BOARD

Material shall conform to JIS A 6910, or equivalent.

When necessary, chamfering shall be carried out so as to facilitate the making of joints and prevent their irregularity.

Hardware fixings shall be of countersunk screws of stainless steel.

17.7 ACOUSTIC BOARD FOR CEILING

(1) The material shall be of incombustible rock wool and

perforated. The thickness of board shall be 12 mm.

Acoustic boards shall be fixed on the base board with suitable adhesives or nails so as to facilitate the making of joints and prevent their irregularity.

(2) Base board for ceiling

Base board shall be plaster boards conforming to JIS A 6901 (Gypsum Board) Grade 2, or equivalent.

The thickness of board shall be 9 mm.

17.8 SUSPENDED CEILING

The Contractor shall provide a lightweight suspension system. The system shall have the means to properly support the entire ceiling when it is in place.

17.8.1 MAIN RUNNER

Main runners for all suspension systems, unless otherwise specified, shall be of cold rolled zinc bonded light channel steel ([-38 mm x 15 mm x 1.6 mm) conforming to JIS G 3350.

The channel runner shall be installed 90 cm on centers and suspended by steel bars of 6 mm diameter, and shall have hangers with level adjustable nuts at 90 cm intervals.

The grid shall be leveled to within 1/500.

17.8.2 CROSS-FURRING

Cross-furring for ceiling shall be of cold-rolled zinc bonded steel (M-23 mm x 23 mm).

The M-furring shall be installed 30 cm on centers and at right angles to the main runner by wire clips.

All M-furring shall be straight in alignment and hold so as to enable level placement of plaster board on the suspension system.

17.8.3 WORKMANSHIP

The installation and workmanship shall be in strict accordance with the manufacturer's specifications, and shall be carried out by skilled workmen.

17.9 INSULATION FOR AIR CONDITIONED AREA

To prevent heat transmission, insulation material shall be provided on walls and ceilings facing outside of air conditioned rooms, unless otherwise specified in the Drawings.

The material shall be 50 mm thickness glass wool conforming to JIS A 9505, or equivalent.

The insulation material shall be set in place with wire mesh only after cable, cable tray and duct installations are completed.

17.10 CEILING ACCESS

Ceiling access shall be located at suitable places for maintenance of the lighting system and air conditioning ducts and shall be the size of 600 mm x 600 mm.

The material of the frame for reinforcement of access board shall be made of the same material as the ceiling, and shall be of aluminum conforming to JIS H 4100.

17.11 NAMEPLATES FOR ROOMS

Nameplates shall be provided on all doors of rooms facing outdoors, corridors and other rooms.

The size, material and name on the name plates shall be designated by the Engineer.

17.12 TOILET PARTITIONS

Melamine coated plywood toilet partitions shall be furnished and installed at the locations indicated in the Drawings and/or as described herein.

Toilet partitions shall be supported by stainless steel standing supporters anchored into the floor and by head connection.

Partitions shall be flush type consisting of two sheets of waterproof plywood. The plywood shall be coated with melamine.

All partitions and screens shall be erected plumb, level and in perfect alignment, with hardware fully equipped for proper operation.

18. ROAD WORK

18.1 GENERAL

Except for items specified in these Specifications or in the Drawings, the construction of roads shall be carried out in accordance with the Ministry of Construction, Japan, "Ordinance on Road Structure", Japanese Society of Civil Engineers, "Standard Specifications for Concrete" and Japanese Highway Association, "Guide Line of Cement Concrete Pavement" and "Guide Line of Asphalt Pavement".

The laying of pipe or other such kind of works at or near public and private roads shall be carried out in accordance with the specifications and the directions given by the administrator of the road, except for the breaking and recovery of the road as specified in these Specifications and the Drawings.

18.2 ROADS (EXCLUDING PUBLIC ROADS)

18.2.1 SUBGRADE

(1) The excavation and the banking for the subgrade shall be performed in accordance with the relevant clauses in Section "Earthwork" of these Specifications.

(2) The materials for banking or replacement shall be spread so that the depth of each layer does not exceed 20 cm after compaction.

(3) The surface of the subgrade shall be finished by proof-rolling of three passages or more by using a rubber tire roller with a double wheel load of not less than 5 tons The roller shall have a load intensity on the surface of

not less than 5.6 kg/cm^2.

Should any finished portion of the surface of the subgrade prove unacceptable, it shall be reconstructed.

(4) The finished surface of the subgrade shall not deviate by more than 5 cm from the planned elevation.

18.2.2 SUBBASE

(1) The materials to be used for the subbase shall be in conformity with the requirements specified in the Drawings. The quality and the obtainment methods of the material shall be reported to Engineer well in advance of the commencement of work.

(2) The materials for the subbase shall be spread and graded uniformly so that the depth of each layer does not exceed 20 cm after compaction.

(3) The degree of the compaction shall not be below the value directed by the Engineer.

(4) The surface of the subbase shall be finished by proof-rolling of three passages or more using a rubber tire roller with a double wheel load of not less than 8 tons. The roller shall have a load intensity on the surface of not less than 7.0 kg/cm^2. Should any portion of the surface of the subbase prove unacceptable, it shall be reconstructed.

(5) The finished surface of the subbase shall not deviate by more than 5 mm higher or by 10 mm lower then the planned elevation.

18.2.3 PAVEMENT

(1) Concrete pavement

(a) Concreting in the concrete pavement shall be in accordance with the relevant Clauses in Section "Concrete" of these Specifications.

(b) The surface of the forms and the base for the concrete pavement shall be kept wet until the placing of concrete, unless waterproofing work is applied.

(c) The surface of the concrete pavement shall be finished so as not to deviate by more than 5 mm from a 3 m long straight edge when applied in parallel with the center-line of the road.

(2) Crushed stone pavement

(a) Each layer shall be compacted and finished evenly by a roller to the designated depth, with the main aggregate being spread uniformly together with the proper amount of covering gravel.

(b) Compaction by a roller shall be conducted in parallel with the direction of the road.

The sequence of the passages shall be from the shoulder to the center of the road, and more than 10 cm or one third of the wheel width of the previous passage shall be recompacted.

The standard speed of the roller shall be 3 km an hour.

(3) Asphaltic concrete pavement

(a) Prior to placing the asphaltic concrete, the side faces of concrete stoppers, manholes and others shall be coated with melted asphalt or the equivalent.

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(b) Prior to applying the prime coat, irregularities on the surface of the base course shall be leveled and all loose stones, dust or any other foreign materials shall be completely removed, and the surface of the base course shall be cured and dried.

Should the surface of the base course be dried excessively, a small quantity of water shall be sprayed on the surface, and the bituminous materials shall not be applied until the free water disappears from the surface of the base course.

(c) The surface on which the seal coat is to be applied shall be cleaned, and loose stones, dust and any other foreign materials shall be removed from the surface.

(d) The asphaltic concrete mixture shall be spread uniformly and compacted to the designated depth. The finished surface shall not deviate by more than 5 mm from a 3 m long straight edge when applied in parallel with the center line of the road.

18.3 PUBLIC ROADS

18.3.1 BREAKING OF PAVEMENT

Breaking of the cement, concrete or asphalt pavement shall be conducted carefully so as not to cause any damage to the surrounding pavement after making a slit in the surface of the pavement by such equipment as a concrete cutter.

18.3.2 REARRANGEMENT OF UNDERGROUND UTILITY FACILITIES

When arrangement of underground utility facilities such as exsisting water, electrical, communications and gas facilities is required, the Contractor shall submit shop drawings for the work and obtain approval from the Engineer or utility owner.

18.3.3 PROTECTION OF OVERHEAD UTILITY CABLES

When protection of existing utility cables is required, the Contractor shall submit shop drawings for the work and obtain aproval from the Engineer or utility owner.

18.3.4 FLAGMAN

The Contractor shall provide a sufficient number of competent traffic flagmen for the works listed below.

(1) Dismantling of existing pipes and manholes.

(2) Work adjacent to railways and gas pipes.

(3) Work which may cause danger or injury to workers, pedestrians, vehicles or surrounded facilities.

(4) Inspection work of gas pipelines.

18.3.5 ROAD FACING AND RECOVERY

(1) The road facing shall have a structure suitable to the site conditions, and shall be executed correctly so as not to cause any danger or hindrance to traffic.

(2) The Contractor shall submit the structural drawings of the road facing to the Engineer.

(3) The surface of the road facing shall be finished evenly so as not to have any slits or irregularity. The border

between the road facing and the existing surface of the road shall be smoothly adjusted so as to be without gaps. The facing boards shall be tightly connected with one another and carefully layed so as not to cause any deviation.

(4) The Contractor shall constantly patrol and maintain the road facing so as not to cause any disruption of traffic.

(5) After the replacement of the road facing, the Contractor shall maintain the road until acceptance of the road is received by its administrator from the Owner.

18.3.6 MEDIAN STRIPS OF THE ROAD

Median strips of the road shall be completely restored. Should any difficulty be encountered during the restoration works the Contractor shall submit alternative solutions to the Engineer for the approval prior to the work.

18.3.7 TEMPORARY TRAFFIC SIGNS

The Contractor shall erect all necessary traffic lights and signs and maintain public road safety. All traffic signs arriers, etc., necessary for the direction, protection and control of traffic shall be provided. The size of all signs and barriers and the lettering and wording thereon shall be approved by the Engineer before erection. Such approval, however, will not relieve the Contractor of his responsibility for the adequacy of their number, position, etc.

The signs and barriers shall be illuminated at night either by flares or by some other suitable wears.

18.3.8 MAINTENANCE OF FLOW

The Contractor shall be responsible for the maintenance of continuous flow of water in the irrigation and drainage channels, if necessary, and shall make arrangements with the proprietors and users upon consultation with the Engineer.

19. STORM DRAINAGE WORK

19.1 APPLICABLE STANDARDS

Storm drainage work shall be designed and constructed in accordance with the requirements of Clause 5 of "Applicable Standards and Code" in Part I and Subclause 2.2 of "Applicable Standards" in Section I, Part III.

19.2 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall be bell-and-spigot or tongue-and-groove type, and shall conform to the requirements for the following pertinent types.

(1) Reinforced concrete pipe shall conform to ASTM Specifications.

(2) Nonreinforced concrete pipe shall be standard strength and shall conform to ASTM Specifications.

19.3 SAMPLES, TESTING AND CERTIFICATES

(1) Suitably sized samples of materials proposed for use shall be submitted to the Engineer for approval sufficiently in advance of need to allow thirty (30) days for testing. All test samples shall be supplied by and at the expense of the Contractor.

(2) Testing of materials and certificates of compliance shall be as specified in Clause "TESTING OF MATERIAL AND CERTIFICATES".

19.4 EXCAVATION, TRENCHING AND BEDDING FOR PIPE CULVERTS AND STORM DRAINS

Excavation of trenches, bedding and backfilling for culverts and storm drains shall be in accordance with the applicable portions of Clause 2 "EARTH WORK" and the following requirements.

19.4.1 TRENCHING

The width of trenches at any point below the top of the pipe shall be such that the clear space between the barrel of the pipe and the trench shall be not less than 4 inches nor more than 8 inches to permit satisfactory jointing and thorough tamping of the bedding material under and around pipe. Sheeting and bracing where required shall be placed within the trench width as specified. Care shall be taken not to overexcavate. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures shall be provided. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Owner.

19.4.2 REMOVAL OF ROCK

Rock in either ledge or boulder formation shall be removed and replaced with satisfactory materials to provide a compacted earth cushion having a thickness between unremoved rock and the pipe of at least 8 inches or 1/2 inch for each foot of fill over the top of the pipe, whichever is greater, but not more than three-fourths the nominal diameter of the pipe. Where bell-and-spigot pipe is used, the cushion shall be maintained under the bell as well as under the straight portion of the pipe.

19.4.3 REMOVAL OF UNSTABLE OR UNSATISFACTORY MATERIAL

Where wet or otherwise unstable or unsatisfactory soil incapable of properly supporting the pipe is encountered in the bottom of the trench, such material shall be removed to the depth required and replaced to the proper grade with satisfactory material, compacted as provided for in paragraph "BACKFILLING PIPE" hereinafter.

19.4.4 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe. The pipe shall be carefully embedded in a soil foundation that has been accurately shaped and rounded to conform to the lowest one-fourth of the outside portion of circular pipe for the entire length of the pipe. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall be only of such length, depth and width as required for properly making the particular type joint.

19.5 PLACING PIPE

Each pipe shall be carefully examined before being laid, and defective or damaged pipe shall not be used. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe be laid in water, nor shall pipe be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. All pipe in place

shall have been inspected before backfilling. Pipe laying shall proceed upgrade with the spigot ends of bell-and-spigot pipe and the tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

19.6 PIPE JOINTS

The following methods of jointing for bell-and-spigot and tongue-and-groove pipe shall be used.

19.6.1 CEMENT-MORTAR BELL-AND-SPIGOT JOINT

The first pipe shall be laid to the established gradeline, with the bell end placed up-stream. The interior surface of the bell shall be carefully cleaned with a wet brush and the lower portion of the bell filled with mortar to such depth as to bring the inner surfaces of the abutting pipes flush and even. The spigot end of each subsequent pipe shall be cleaned with a wet brush and uniformly matched into the bell so that the sections are closely fitted. After each section is laid, the remainder of the joint shall be filled with mortar, and a bead shall be formed around the outside of the joint with a sufficient amount of additional mortar. The cement mortar, finish, and protection of joints shall be as specified in paragraph "MORTAR" hereinafter. If the mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint shall be wrapped with cheesecloth to hold the mortar in place.

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19.6.2 CEMENT-MORTAR TONGUE-AND-GROOVE JOINT

The first pipe shall be laid carefully to the established gradeline with the groove upstream. A shallow excavation shall be made underneath the pipe at the joint and filled with mortar to provide a bed for the pipe. The grooved end of the first pipe shall be carefully cleaned with a wet brush, and a layer of soft mortar applied to the lower half of the groove. The tongue of the second pipe shall be cleaned carefully with a wet brush, and while in a horizontal position, a layer of soft mortar shall be applied to the upper half of the tongue. The tongue end of the second pipe shall then be inserted in the grooved end of the first pipe until mortar is squeezed out on the interior and exterior surfaces. Sufficient mortar shall be used to fill the joint completely and to form a bead on the outside. The cement mortar, finish and protection of joints shall be as specified in paragraph "MORTAR" hereinafter.

19.7 BACKFILLING PIPE

19.7.1 BACKFILLING PIPE IN TRENCHES

After the bedding has been prepared and the pipe installed, satisfactory material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of the pipe in layers not exceeding 6 inches in compacted depth. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of

filling and compacting shall continue until the fill has reached an elevation of at least 12 inches above the top of the pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding the thickness specified hereinafter. Each layer shall be compacted to the minimum density applicable for the particular area specific in subparagraph "COMPACTION" hereinafter. Where it is necessary, any sheeting and/or portions of bracing used shall be left in place, and the contact shall be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

19.7.2 BACKFILLING PIPE IN FILL SECTIONS

For pipe placed in fill sections, the backfill material and the placement and compaction procedures shall be as specified above and in subparagraph "COMPACTION" hereinafter. The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 6 inches in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 12 inches above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 12 feet, whichever is less. After the backfill has reached at least 12 inches above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding 8 inches.

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19.7.3 MOVEMENT OF CONSTRUCTION MACHINERY

In compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or damage to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of the construction shall be at the Contractor's risk. Any pipe damaged thereby shall be repaired or replaced at the expense of the Contractor.

19.7.4 COMPACTION

Cohesionless materials shall include gravel, gravelsand mixtures, sand and gravelly sand. Cohesive materials shall include clayey and silty gravel, gravel-silt mixtures, clayey and silty sand, sand-clay mixtures, clays, silts and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils shall show straight lines or reverse-shaped moisture-density curves, and cohesive soils shall show normal moisture-density curves.

(1) Minimum density

Backfill over and around the pipe and backfill around and adjacent to all other drainage structures shall be compacted at the approved moisture content to the following applicable minimum densities which will be determined as specified hereinafter in subparagraph "Determination of Density".

(a) Under paved roads including adjacent shoulder areas: Six inch layers, to at least 90 percent CE 55 maximum density for cohesive material and 95 percent CE 55 maximum density for cohesionless material, up to the