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.

Materials for elevator shaft shall conform to JIS G 3106-SM41A.

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 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^{o}C or lower).

5.4.9 SURFACE FINISHING

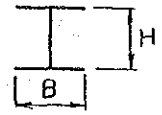
Surface of joints of columns and contacted surfaces between column and column bases shall be plane finished to ensure proper tightness.

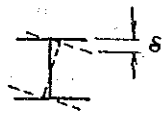
5.4.10 TOLERANCE LIMITS OF FABRICATION

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

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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

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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

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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 by visually inspected.

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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.

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.

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

Safety nets shall be used for bolting, painting and other roof work of turbine-generator room.

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

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Item	Contents
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 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 and health committee, etc. 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 ERECTION PRECAUTIONS

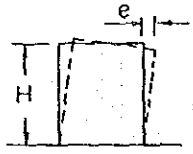
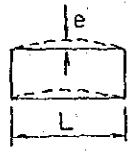
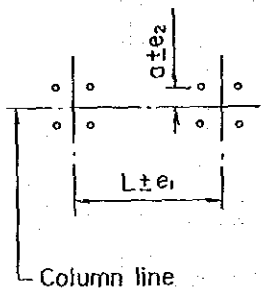
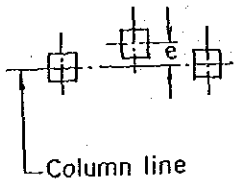
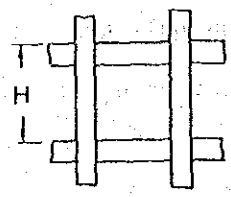
If during erection, various heavy objects such as materials or machinery are to be loaded on members or large compressive loads are to be applied to columns, prior approval of the Engineer shall be obtained, and necessary reinforcement shall be applied.

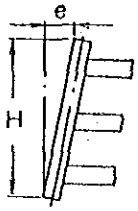
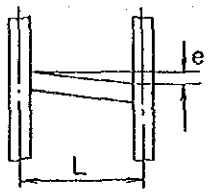
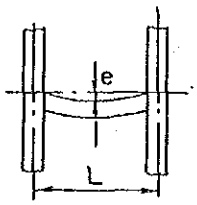
The Contractor shall provide proper temporary bracing so as to resist wind force or seismic force during construction.

5.10.5 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.
(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

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

5.10.6 X-RAY EXAMINATION FOR FIELD WELDED PARTS

The Contractor shall carry out X-ray examination for field welded parts of stack flues and elevator shaft.

Examination method shall be as specified in Clause 4.6.1 "INSPECTION OF WELDED PARTS".

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 and shower room.

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 $230^{\circ}C$ 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 m intervals in light weight concrete block area of roof.

Control joint shall consist of elastight and asphalt-mortar.

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6.5 SHEET ROOFING

6.5.1 MATERIALS

Sheet roofing shall be used for the roof of the stack. The Contractor shall submit samples of the sheet roofing and adhesives to the Engineer for approval.

The sheet roofing shall be covered with lath mortar having a thickness of 3 cm so as to protect the roofing.

(1) Sheet roofing

The sheet roofing shall be 1.0 mm in thickness and shall be in accordance with or equivalent to "Class 1 Vulcanized Synthetic Rubber Sheet Roofing" in JIS A 6008 "Synthetic Polymeric Rubber Sheet".

(2) Roofing for reinforcement

The lapped joints and ends of roofing shall be reinforced by additional roofing so as to ensure water-tightness of such sections. Moreover, terminal points, such as roof drains, goosenecks and corners at riser sections shall be reinforced by additional roofing wherever required. The materials for a additional roofing for reinforcement shall be in accordance with or equivalent to JIS A 6008 "Synthetic Polymeric Roofing Sheets." Prior to use, the sheet shall be cut into a width of 100 - 150 mm.

(3) Polyethylene film

Polyethylene film, which shall be 0.15 mm in thickness and in accordance with or equivalent to JIS K 6781 "Polyethylene Films for Agriculture", shall be used for protection coating of the roofing.

6.5.2 WORKMANSHIP

All sand, dust, oil or other foreign matter on roofing surfaces shall be thoroughly removed by cleaning. Then, primer shall be coated uniformly by using a brush or spray, and shall sufficiently penetrate into the concrete.

The polyethylene film shall be laid uniformly over the water-proofing layer without any wrinkle or sag. Then, the protective layer (lath mortar) shall be carefully laid over the film so as not to cause any damage to the roofing.

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 coatecl 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 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

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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.

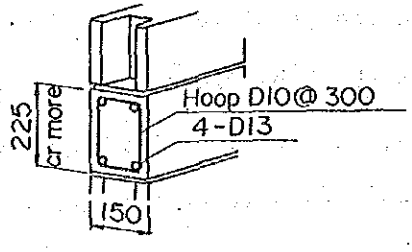
8.1.5 LINTEL

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.

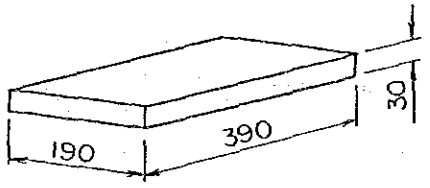
Specific gravity of coarse aggregate shall be 2.7 or more, unless otherwise specified.

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

8.2.2 LIGHTWEIGHT CONCRETE BLOCK FOR ROOFING

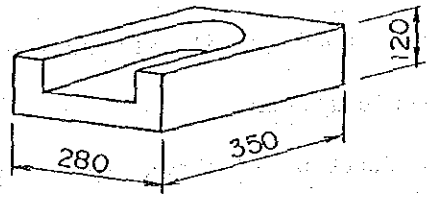
Specific gravity of coarse aggregate for lightweight concrete shall be 1.7 - 1.9.

The dimensions shall be as indicated below.



8.2.3 SPLASH BLOCK

The dimensions shall be as indicated below.



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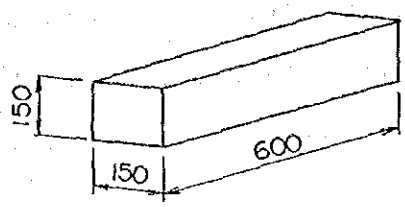
8.2.4 CONCRETE BLOCK AT CORNER ROOFING (For protection of built-up roofing)

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

8.4 MARBLE WORKS

8.4.1 MATERIALS

Pakistani Marble of selected figures in slab and tiles obtained from a quqrry approved by the Engineer.

8.4.2 SAMPLES

All the materials used for marble shall be approved by the Engineer. If the Engineer desires to get the material tested, this will be got done by the Contractor at his own cost from laboratry approved by the Engineer.

8.4.3 WORKMANSHIP

(1) Wall

The surface over which the marble slabs are required to be fixed wall be cleared of all dirt and dust. Each marble slab should be laid in 1:2 cement mortar properly buttered at the

back before laying truly in plumb.

(2) Floor

The marble shall be bedded in cement sand mortar in ratio of 1:2 and coating of neat cement. The joints shall be filled with white cement putty with an addition of five percent of gum and regin in equal parts.

(3) Curing

The surface of marble slabs when laid shall be perfectly true, level projected or sloped as shown on the Drawings. During the progress of work and seven days after the laying, the walls shall be cured with water.

(4) Finishings

When properly set and at the time of final finishing the walls and floor shall be rubbed with carborandum stone. When the surface is finally finished it shall be polished with mansion polish so as to attain a smooth uniform surface. No mortar filling of any cort shall be allowed on finished surfaces.

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 CLINKER TILE FOR FLOOR FINISH

Clinker tile shall be provided on the floor of kitchen.

Clinker tile shall be of 180 mm x 180 mm x 22 mm, colored, glazed and manufactured by qualified manufacturer as approved by the Engineer.

9.2.4 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.

10. CARPENTRY WORK

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 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 WORK/SIDING AND ROOFING

11.1 GENERAL

This clause covers all metal work for siding and roofings of main powerhouse and boiler structure. 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

Sectional property of metal roofing shall be as indicated below.

Thickness	1.0 mm
Ix	770 cm^2 /m or more
Sx(Zx)	75 cm^3 /m or more

Fixing frame shall be galvanyzed flat bar conforming to JIS G3101 SS41 or equivalent, and firmly welded to the steel structure.

Roofing sheet shall be fixed with galvanyzed bolts, nuts and washers.

11.3 FITTING

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

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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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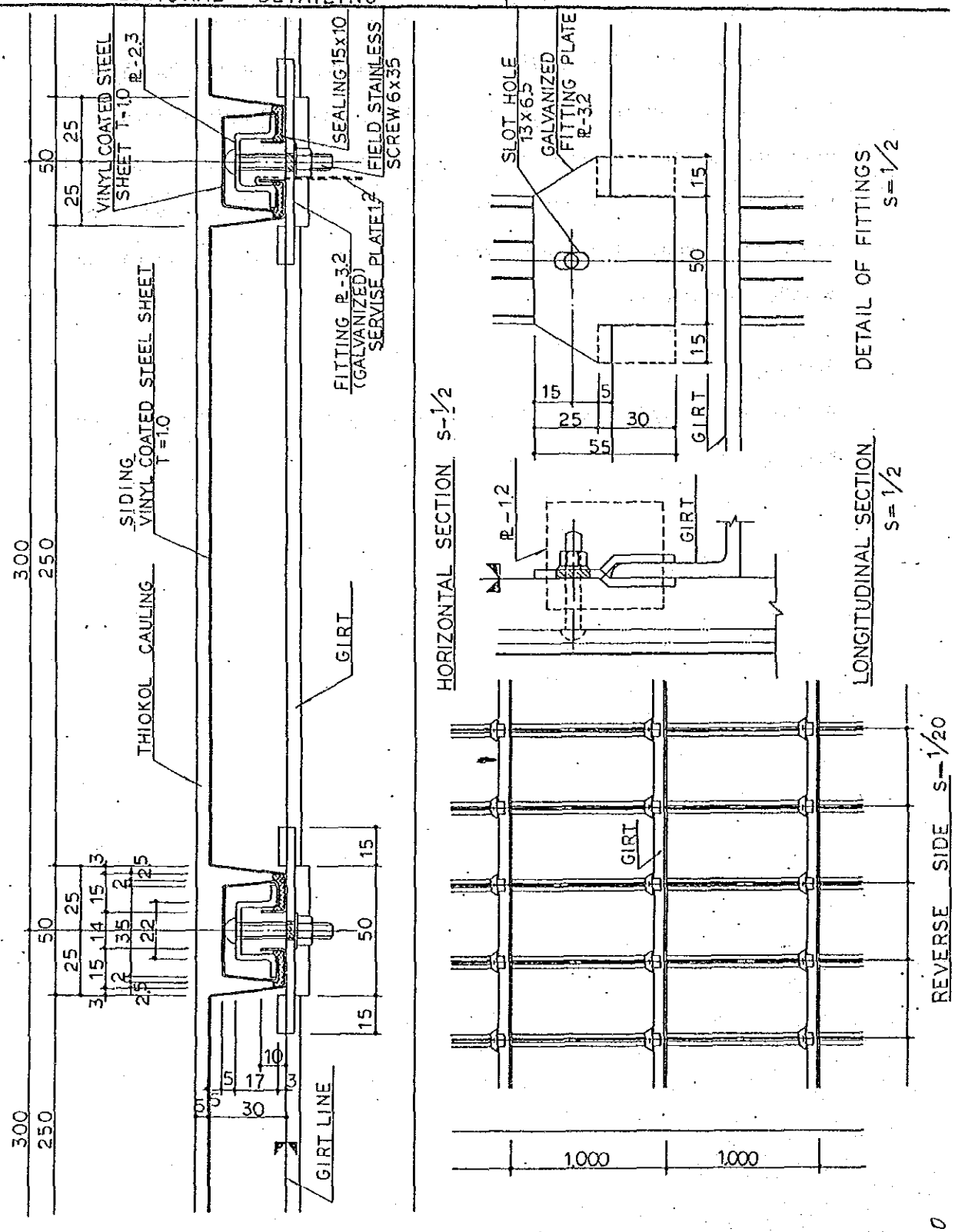
SHEET NO.

STANDARD DETAIL PLATE

PLATE NAME SIDING SECTIONAL DETAILING

PLATE NO. SDP — —



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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, catwalk for crane access and platform ..... 32 mm

for tread of stair .....19 or 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

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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.

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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 CORNER GUARDS

Where directed by the Engineer, corner guards for jambs, and sills of openings and edges of concrete column and wall shall be of steel angles or steel plates, conforming to JIS G 3101-SS41 or equivalent, anchored into concrete with welded steel straps or end-weld stud anchors.

12.7 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.

12.8 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.

12.9 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 burns 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

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

12.10 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.

12.11 DIVIDER STRIPS

Divider strips shall be half-hard brass and shall be placed between different types of floorings as indicated. Divider strips shall be secured to floors by strip anchors or by flat-head countersunk brass screws set in lead plugs.

12.12 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.

12.13 CORNER BEAD

Corner bead shall be half-hard brass, and shall be placed at edges of columns and walls where mortar or plaster is applied.

12.14 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.

12.15 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.

12.16 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.

12.17 BORDER STRIP FOR SURROUNDING OF T/G PEDESTAL

Border strip shall be provided on concrete for surrounding of T/G pedestal, and shall be of stainless steel as stipulated in JIS G 4304-SUS 304 or JIS G 4305, or equivalent.

12.18 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.

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12.19 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.

12.20 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.

12.21 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.

12.22 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.

12.23 PAINTERS TROLLEY FOR STACK

Painter trolleys and rails shall be provided at the level of each

platform of the stack for maintenance of windshield surface. Details of trolleys, rails and brackets shall be as indicated in "Standard Detail Plates" attached herein.

12.24 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 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.

12.25 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.

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12.26 FREE ACCESS FLOOR OF

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

12.27 STAINLESS STEEL SLEEVE

The Contractor shall provide four (4) stainless steel pipe sleeves on the interior walls around central control room so as to pull temporary wires for communication at the time of test operation of the computer, central control panel and so forth.

The sleeves shall have round edges and metal caps at both ends.

12.28 HOOKS ON OPERATING FLOOR

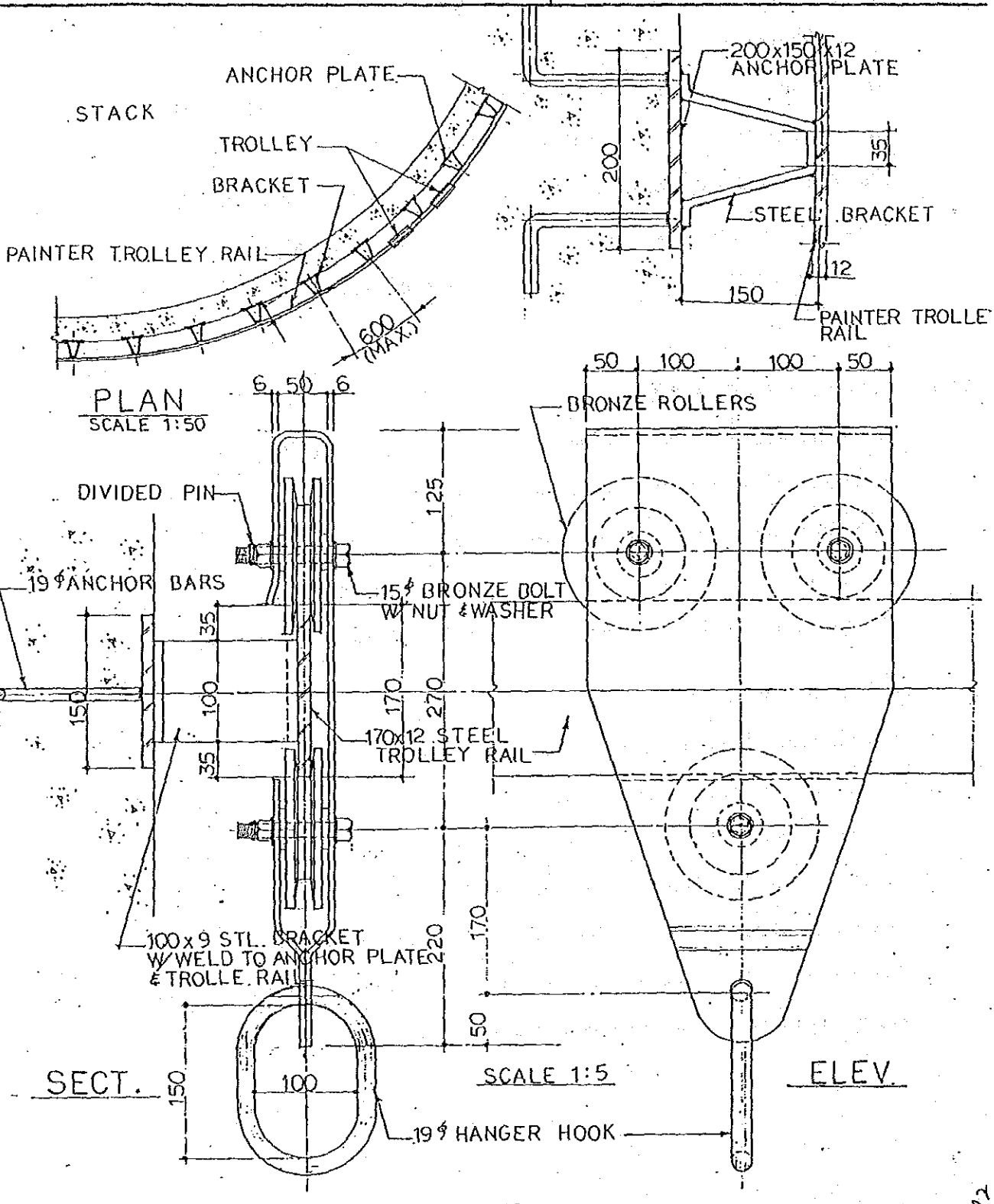
The Contractor shall provide the hooks for pulling out the generator rotor of Units I and II.

The hooks shall be firmly welded on the steel beam and/or girder at the operating floor and concealed in the slab by using steel box-out. The hooks shall be covered with steel plate.

The steel plate shall be covered with vinyl asbestos tile and the edges shall have a stainless steel border.

STANDARD DETAIL PLATE

LATE NAME STACK PAINTER TROLLEY | PLATE NO. SDP — —



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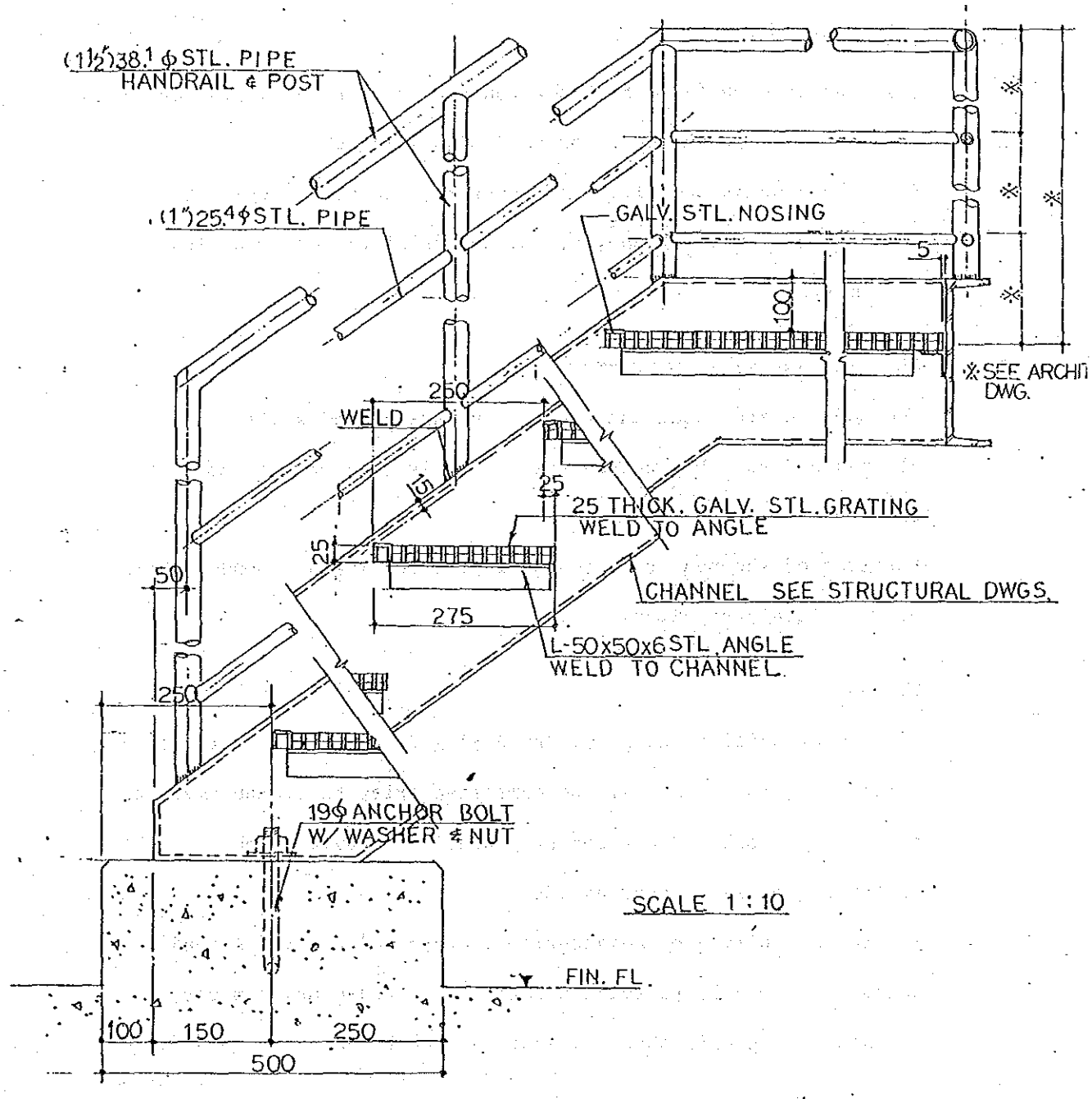
SHEET NO.

STANDARD DETAIL PLATE

PLATE NAME	PLATE NO.
STEEL STAIR	SDP — —



13. PLASTER WORK

13.1 GENERAL

13.1.1 TREATMENT OF BED

(1) Concrete surface 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.

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13.2 MORTAR PLASTERING

13.2.1 MATERIALS

(1) Cement shall conform to JIS R 5210, Ordinary Portland Cement, 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, sulpher and other organic matter, and shall be as specified in the Clause "CONCRETE WORK".

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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

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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) Metallic hardened floor finish

Metallic hardened floor finishes shall be applied to areas in front of M/C on the mezzanine floor.

(a) Material

Metallic hardener shall be of finely divided, tough, ductile, specially processed, size-graded metallic aggregates combined with a dispersing agent, and shall be free from white-metals, oil and all foreign matter. When incorporated in monolithic floor at the time of installation, metallic hardener shall produce a smooth, dense and steel-like surface, highly resistant to wear.

Metallic hardener shall be delivered to the job in the manufacturer's original unopened containers with the manufacturer's brand and name clearly made thereon.

Metallic hardener to be used shall be submitted to the Engineer for approval.

(b) Application

The freshly poured floor slab shall be tamped to force the coarse aggregate away from the surface and shall be screeded and floated to the required finish level.

Metallic hardener shall be applied as per manufacturer's specifications.

(6) Bed for tile fixing

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

13.3 PLASTERING

13.3.1 MATERIAL

Plaster shall comply with JIS A 6904 (Gypsum Plaster) or equivalent.

Cement which is more 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 LOUVERS 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. Materials shall,in principle, be locally produced. 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, 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 40 mm thick dummy louvers (blind by precast concrete panel) for fire prevention.

Louvers facing boiler sides shall be equipped with fire detectors and a control system for automatic opening and 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.

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 shape and sheet 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, 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.

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

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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

16.2.3 AIRCRAFT WARNING PAINTING FOR STACK

(1) Color

The color of painting shall be determined by the Owner.

(2) Paint

Polyurethane resin or vinyl resin paint.

(3) Painting

	Polyurethane resin paint	Vinyl resin paint
1. First coat	Epoxy resin and red lead First coat 2 coats (250 g/m^2/once)	Vinyl resin prime coat 2 coats (250 g/m^2/once)
2. Second coat	Polyurethane resin paint one coat (150 - 180 g/m^2/once)	Vinyl resin paint one coat (220 - 260 g/m^2/once)
3. Finish coat	Polyurethane resin paint one coat (150 - 180 g/m^2/once)	Vinyl resin paint one coat (150 - 180 g/m^2/once)

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 show 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 by the painter's work, shall be replaced at the Contractor's expense.

Hardware and other unpainted metal surface 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) Acidproof vinyl tile

(3) Vinyl base

(4) Board

(5) Acoustic board

(6) Suspended ceiling

(7) Ceiling access

(8) Insulation

(9) Name plate for rooms

(10) Vinyl cloth

(11) Vinyl curtain

(12) 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 in JIS A 6901 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

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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

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outdoors, corridors and other rooms.

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

17.12 VINYL CLOTH

Vinyl cloth shall be provided on asbestos cement board of walls as indicated in the Drawings.

Vinyl cloth shall be made of printed or pressed vinyl chloride film.

The weight of vinyl cloth shall be 400 g/m^2 or less.

17.13 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.

18.1 ACID AND ALKALI PROOF LINING

18.1.1 GENERAL

The surface of concrete shall be coated to protect the concrete from harmful effects of acid or alkali in the water.

The pH - value of the water is 1 to 13.

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

18.1.2 SPECIFICATIONS OF LINING

(1) Acid and alkali proof lining on the concrete surface shall consist of one layer of glass wool cloth and epoxy resin, as specified in the following table, or equivalents.

Specificate of epoxy resin

Item	Test method	CLASS A	CLASS B
		Epoxy resin, heat resistant type (Non solvent)	Epoxy resin, normal type (Non solvent)
Viscosity (CPS)	JIS K 6901 or JIS K 6833	Base 800 - 30,000 Hardener 1,500 - 2,500	
Specific gravity	JIS K 6901 or JIS K 6833	Base 1.1 - 1.7 Hardener 0.8 - 1.7	
Pot life (minutes)	20°C 100g	Not less than 40 - 50 minutes	
Apparent setting (hours)	25°C	Not less than 24 hours	
Tensile strength (kg/cm^2)	JIS K 6911	Not less than 200 kg/cm^2	
Temperature of waste water(°C)	——	maximum 90°C	maximum 60°C

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(2) For the concrete expansion joints, the polyethylene materials shall be filled into the concrete joints. And the end surface of the joint filler materials shall be coated by silicon sealam or equivalents, as specified in the following.

Quality of joint sealing material (Silicon sealam)

Specific gravity (after set)		1.2 ± 0.1	JIS K6911
Time of set to touch		24 hours	JIS A5754
Hardness		20	ditto
Contactness	Strength	5 kg/cm^2	
	Elongation	400%	
Slump test		1 mm or less	
Contraction		3% or less	JIS A5751
Tension Recovery		10 mm	JIS A5754

18.1.3 APPLICATION PROCEDURES

Process	CLASS A		CLASS B	
	Epoxy resin, heat resistant type (Non solvent)		Epoxy resin, normal type (Non solvent)	
	Material	Consumption per m^2	Material	Consumption per m^2
Prime coat	Epoxy resin primer	300 g	Epoxy resin primer	300 g
Sealing	Epoxy resin (Heat resistant type)	1600 g	Epoxy resin	1630 g
First coat	Epoxy resin (Heat resistant type)	1100 g	Epoxy resin	1100 g
Glass cloth lining	Glass wool cloth #200	1.1 m^2	Glass wool cloth #200	1.1 m^2
Sealing glass cloth	Epoxy resin (Heat resistant type)	400 g	Epoxy resin	400 g
Finish coat No.1	Epoxy resin (Heat resistant type)	200 g	Epoxy resin	200 g
Finish coat No.2	Epoxy resin (Heat resistant type)	200 g	Epoxy resin	200 g

(1) Prime coat

Primer shall be applied by a roller or equivalents onto the entire bed surfaces.

(2) Sealing

Sealing paste comprised of epoxy resin and powder shall be applied by using a steel trowel to seal the surface of concrete where pin holes are exposed.

(3) First coat

First coat shall be applied by a roller or equivalents onto the sealing.

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(4) Glass cloth lining

Upon completion of first coat process, glass wool cloth shall be placed on the fresh first coat without leaving any wrinkles.

Glass cloth shall be overlapped a minimum of 50 mm at each adjacent area.

Special area shall be take so that entrapped air is removed by this operation.

(5) Sealing glass cloth

After the specified curing time, Sealing paste comprised of epoxy resin and powder shall be applied by using a steel trowel to seal the surface of grass cloth where pin holes or mesh of the cloth are exposed.

(6) Finish coat No.1

Before applying the finish coat No.1, any extruded glass fiber overlapping at adjacent areas shall be removed with a disc grinder or equivalents to obtain a smooth surface.

Finish coat No.1 shall be applied by roller onto or equivalents glass cloth.

(7) Finish coat No.2

Finish coat No.2 shall be applied by a roller or equivalents onto the finish coat No.1.

18.1.4 WORKMANSHIP

(1) Substrate conditions

(a) Concrete substrate shall have a curing period of more than 4 weeks, and cement mortar shall be cured for 2 weeks or more.

(b) Compressive strength of the substrate shall not be less than 180 kgs/cm^2.

(c) Irregularity from level line shall not exceed 3 mm in a straight line of 3 meters.

(2) Substrate preparation

(a) Cement laitance, dusts and protruded parts shall be removed by using an electric disc grinder or a wire brush.

(b) When grease is embedded on the substrate, it must be removed by a disc grinder and solvent-soaked cloth, or burnt by a torch burner or a propane gas burner.

(c) In case moisture is noticed due to rain or some other reasons, the substrate surface shall be made dry by a light projector or a compressed air.

(d) Damages or honeycombs exceeding the above range shall be filled with cement mortar or other appropriate materials. Such surfaces shall be made flat by a steel trowel or a disc grinder.

(3) Lining

(a) The direction of lining shall be vertical and horizontal alternatively.

(b) The working hour interval of each layer shall be 24 hours or less, after the set to touch of the previous lining.

(c) Adequate ventilation shall be maintained during the lining works using fan or other ventilation devices.

(d) All lining works shall be done by skilled workmen.

18.1.5 TEST

The test of lining shall be executed as follows:

(1) A plate of steel (- 100 mm x 100 mm x 1.6 mm) embeded in surface of concrete shall be placed on the lining thickness measuring meter for measuring thickness of lining.
The measuring test shall be executed once for each 50 m^2 or less of lining surface.

(2) Average thickness of lining shall be computed in accordance with the formula below.

$$T = \frac{Q}{G \times A}$$

T : Average thickness of lining (mm)

Q : Using quantity of lining materials (kg)

G : Specific gravity

A : Constructed lining area (m^2)

(3) If pin holes or exposed mesh are not evident by visual inspection, this lining work shall be eliminated.

18.2 WATER PROOF COATING

18.2.1 GENERAL

The water proof coating shall be used to coat the surface of concrete from water repellence.
Coated film shall release no toxicity and odor after it has cured.
The Contractor shall submit the catalogues and work procedures to Engineer for approval.

18.2.2 MATERIAL

The water proof coating on the concrete surface shall consist of epoxy resin, as specified in the following table, or equivalents.

Specifical of Epoxy resin

Item	Test method	Epoxy resin (solvent)
Viscosity (CPS)	JIS K 6901 or JIS K 6833	Base 800 - 30,000 Hardener - 2,500
Specific gravity	JIS K 6901 or JIS K 6833	Base 1.1 - 1.7 Hardener 0.8 - 1.7
Pot life (minutes)	20°C 100g	Not less than 40 - 50 minutes
Apparent setting (hours)	25°C	Not less than 24 hours

18.2.3 APPLICATION PROCEDURES

Process	Epoxy resin (Solvent)	
	Material	Consumption per m^2
Prime coat	Epoxy resin primer	300
First coat	Epoxy resin	400
First coat	Epoxy resin	200

(1) Prime coat

Primer shall be applied by roller or equivalents onto the entire bed surfaces.

(2) First coat

First coat shall be applied by roller or equivalents onto the prime coat.

(3) Finish coat

Finish coat shall be applied by roller or equivalents onto the first coat.

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18.2.4 WORKMANSHIP

(1) Substrate conditions

(a) Concrete substrate shall have a curing period of more than 4 weeks, and cement mortar shall cure for 2 weeks or more.

(b) Compressive strength of the substrate shall be more than 180 kgs/cm^2.

(c) Irregularity from level line shall not exceed 3 mm in a straight line of 3 meters.

(2) Substrate preparation

(a) Cement laitance, dusts and protruded parts shall be removed by using an electric disc grinder or a wire brush.

(b) When grease is embedded on the substrate, it must be removed by a disc grinder and solvent-soaked cloth, or burnt by a torch burner or a propane gas burner.

(c) In case moisture is noticed due to rain or some other reasons, the substrate surface shall be made dry by a light projector or a compressed air.

(d) Damages or honeycombs exceeding the above range shall be filled with cement mortar or other appropriate materials. Such surfaces shall be made flat by a steel trowel or a disc grinder.

(3) Coating

(a) The direction of coating of first, middle and finishing layers shall be vertical and horizontal alternatively.

(b) The working hour interval of each layer shall be 24 hours or less, after the set to touch of the previous coating.

(c) Adequate ventilation shall be maintained during the coating works using fan or other ventilation devices.

(d) All coating works shall be done by skilled workmen.

18.2.5 TEST

The test of coating shall be executed as follows:

(1) A plate of steel (- 100 mm x 100 mm x 1.6mm) embeded in surface of concrete shall be placed on the coating thickness measuring meter for measuring thickness of coating.
The measuring test shall be executed once for each 50 m^2 or less of coating.

(2) Average thickness of coating shall be computed in accordance with the formula below.

$$T = \frac{Q}{G \times A}$$

T : Average thickness of coating (mm)

Q : Using quantity of coating materials (kg)

G : Specific gravity

A : Constructed coating area (m^2)

(3) If pin holes or exposed mesh are not evident by visual inspection, this coating work shall be eliminated.

19. STACK WORK

19.1 INSULATION

Fiber-glass or equivalent insulation shall be provided on all external surface of steel flues. Insulation material having 50 mm in thickness shall be firmly affixed on the flues by means or 3.5 mmϕ nelson type studs, and shall be covered by 20♯ x 26 mm wire mesh, except for areas to be covered by aluminum sheet lagging. The lagging shall be provided on areas within 3 m height from each platform finishing level. The characteristics of insulation shall be as follows.

Heat transmission ratio	:	= 0.025 + 0.00018 θg
Heat durability	:	more than 350°C
Weight	:	more than 30 kg/m^3
Lagging	:	aluminum sheet 0.5 mm in thickness

19.2 LINING

Gunite type castable lining having 50 mm in thickness shall be provided on all interior surfaces including those in bottom hoppers of the steel flues.

The lining material shall be of acidproof type and have the following characteristics.

Cement	:	Acidproof cements
Heat durability	:	more than 1000°C
Chemical component	:	Al_2O_3 25-30%
		SiO_2 50-55%
Specific gravity after gunning	:	1.65 - 1.75

Flexural strength	:	60 kg/cm^2 or more at 110^{o}C
		50 kg/cm^2 or more at 1000^{o}C
Minimum cement requirement	:	2.15 T/m^3
Heat transmission ratio	:	= 0.38 + 0.00042 θg or less

19.3 LIGHTING

19.3.1 GENERAL

The Contractor shall furnish and install the lighting system for the stack as indicated in the Drawings.

The lighting system shall comprise fluorescent lamps and fixtures, aircraft warning light, wiring, conduit tubes and all other necessary pertinents.

19.3.2 MATERIALS

(1) Aircraft warning light

OM-6 : 500W x 2 1ϕ 2W 100V JIS C 7512

OM-7 : 500W x 1 1ϕ 2W 100V JIS C 7512

(2) Control board

Type : Outdoor

Power voltage : 1ϕ 2W 220V, 50Hz

Flicker cycle : 20-60 times/minute

Automatic flicker device (with built-in photo tube system)

Transformer : 220V/100V

(3) Fluorescent lamp and fixtures

Fluorescent lamp : 220V 40W JIS C 7601

Lighting fixture : FL 40W x 1 JIS C 8306

Ballast and starter: JIS C 8108, JIS C 7603

(4) Conduit

Heavy gauge conduit tube: JIS C 8305

(5) Wiring

600V cross-linked polyethylene insulated cable as stipulated in JIS C 3605.

19.4 LIGHTNING SYSTEM

19.4.1 GENERAL

The Contractor shall furnish and install the lightning system for the stack as indicated in the Drawings.

The lightning system shall comprise elevation rods, lightning conductor, support posts and all other necessary pertinents.

The Contractor shall provide a temporary lightning system during the erection of wind shield and inner flues.

19.4.2 MATERIALS

(1) Elevation rod

Material : Copper

Type : LARGE-TYPE

12 mm minimum diameter,

460 mm length

(2) Support posts

Material : Stainless steel pipe post conforming to JIS G 3459-SUS304 TP

Length : 8.0 m or more

(3) Lightning conductor

Material : Annealed copper wire JIS C 3102

Size : 60 mm^2

19.4.3 WORKMANSHIP

The Contractor shall provide the foundation of the pipe post for elevation rod on the roof slab of stack.

The Contractor shall submit the catalogue, sample and mix proposition design and execution method of lining to the Engineer for approval.

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20. ROAD WORK

20.1 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 roads (including 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 specified in these Specifications and the Drawings.

20.2 ROADS (EXCLUDING PUBLIC ROADS)

20.2.1 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 more than 5 cm from the planned elevation.

20.2.2 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 more than 5 mm higher or 10 mm lower from the planned elevation.

20.2.3 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 placingt of concrete, unless the waterproofing work is applied.

(c) The surface of the concrete pavement shall be finished so as not to deviate 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 adequate amount of covering gravels.

(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.

(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 more than 5 mm from a 3 m long straight edge when applied in parallel with the center line of the road.

20.3 PUBLIC ROADS

20.3.1 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.

20.3.2 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 hindrace to traffic.

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

21. STORM DRAINAGE WORK

21.1 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.

21.2 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 Specification.

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

21.3 SAMPLES, TESTING AND CERTIFICATES

(1) Samples: 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".

21.4 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.

21.4.1 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 necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Owner.

21.4.2 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.

21.4.3 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 in paragraph "BACKFILLING PIPE" hereinafter.

21.4.4 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 bedded 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.

21.5 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, and no pipe shall 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

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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.

21.6 PIPE JOINTS

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

21.6.1 CEMENT-MORTAR BELL-AND-SPIGOT JOINT

The first pipe shall be bedded 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 or bandaged with cheesecloth to hold the mortar in place.

21.6.2 CEMENT-MORTAR TONGUE-AND-GROOVE JOINT

The first pipe shall be bedded 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.

21.7 BACKFILLING PIPE

21.7.1 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 insure 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 contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

21.7.2 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.

21.7.3 MOVEMENT OF CONSTRUCTION MACHINERY

In compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury 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 rick. Any pipe damaged thereby shall be repaired or replaced at the expense of the Contractor.

21.7.4 COMPACTION

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

elevation at which the requirements for pavement subgrade materials and compaction shall control.

(b) Under turfed and nontraffic areas:

Twelve-inch layers, to at least 85 percent CE 55 maximum density for cohesive material and 90 percent CE 55 maximum density for cohesionless material.

(2) Determination of density

Laboratory tests for moisture-density relations will be made in accordance with Military Standard MIL-STD-621, test method 100, compaction effort designation CE 55, except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper. The soil density will be measured in the field in accordance with AASHO Standard T 147, except that the oil alternate will not be used. Laboratory and field tests for each area will be made by the Government in accordance with SECTION "TESTING OF MATERIALS AND CERTIFICATES". Areas with inadequate compaction will be retested after corrective measures have been made.

21.8 EXCAVATION AND BACKFILLING FOR DRAINAGE STRUCTURES

Excavation and backfilling for drainage structures shall conform to the applicable requirements specified in para-graphs "ESCAVATION, TRENCHING, AND BEDDING FOR PIPE CULVERTS AND STORM DRAINS" and "BACKFILLING PIPE" hereinbefore.

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21.9 DRAINAGE STRUCTURES

Drainage structures shall be of the following types, constructed of the materials specified for each type and in accordance with the indicated details.

21.9.1 INLETS

Inlets shall be constructed of reinforced concrete, with frames and covers or gratings, and with fixed galvanized steel ladders where indicated.

21.9.2 WALLS AND HEADWALLS

Walls and headwalls shall be constructed of reinforce concrete or plain concrete, as indicated.

21.9.3 MORTAR-EMBEDDED-STONE STRUCTURES

Mortal-embeded-stone structures shall be as specified in paragraph "STONE PROTECTION".

21.10 MATERIALS FOR DRAINAGE STRUCTURES

21.10.1 CONCRETE

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for Class A concrete in Clause 4 "CONCRETE WORK". The concrete covering over steel reinforcing shall be not less than 1 inch thick for covers and not less than 1-1/2 inches thick for walls and flooring. Concrete covering deposited directly against the ground shall have a thickness of at least 3 inches between the steel and the ground. Expansion-joint filler material shall conform to ASTM Specification D 1751 or D 1752 or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM Specification D 1752.

21.10.2 MORTAR

Mortar for pipe joints and connections to other drainage structures shall be composed of one part by volume of portland cement and two parts of sand. The cement and sand shall be as specified in Clause 4 "CONCRETE WORK" Hydrated lime may be added to the mixture of sand and cement in an amount equal to 20 per cent of the volume of cement used. Hydrated lime shall conform to Federal Specification SS-L-351, type M, or ASTM Specification C 141, type B. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar, but shall in no case exceed 6 gallons of water per sack of cement. Water shall be clean and free of harmful acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes from the time the ingredients are mixed with

water. The inside of the joint shall be wiped clean and finished smooth. In pipe too small for a man to work inside, wiping may be done by dragging a suitable swab or long-handled brush through the pipe as work progresses. The mortar bead on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

21.10.3 MANHOLE FRAME AND COVER

Manhole frame and cover shall be cast iron conforming to Federal Specification QQ-I-652, with tensile-strength test not less than Class 25 and shall be of the shape and size shown.

21.10.4 INLET FRAME AND GRATINGS

Sizes and spacing of bearing and cross bars shall be as indicated. Materials, construction welding, and workmanship shall be in accordance with Federal Specification RR-G-661. Frame shall be constructed of steel angles conforming to Federal Specification QQ-S-741 to size and design shown. After fabrication, frame and gratings shall be hot-dip galvanized in accordance with ASTM Specification A 123 or A 153, as applicable, except that the weight of coating shall be not less than 2.0 ounces per square foot of surface. The frame and gratings shall be anchored to concrete as shown.

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22. WATER SUPPLY, SEWAGE AND SANITARY EQUIPMENT WORK

22.1 GENERAL

22.1.1 SCOPE

This clause covers the performance of all water supply, sewage and sanitary equipment works to be executed according to the Drawings and these Specifications.

(1) Water supply equipment work

(2) Sewage and aeration equipment work

(3) Hot water supply equipment work

(4) Sanitary equipment work

(5) Clarification tank equipment work

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

22.1.2 DESIGN BASIS OF WATER SUPPLY, SEWAGE AND SANITARY SYSTEM

(1) Design criteria

(a) Water supply system

. Water supply quantity: 120 lit./day.one person

(b) Hot water supply system

. Hot water supply quantity

: 300 lit./hr.one shower

.: 0.4 lit./day.one person

(2) System description

(a) Main powerhouse

1. Sanitary and Sewage System

The sanitary and sewage system shall be installed in the lavatory, kitchenette, etc. in the main powerhouse

1.1 System Description

(i) Potable water shall be supplied to respective positions by gravitational means from an elevated water tank to be installed on the roof of the main powerhouse. Pumping up of water into the elevated water tank shall be supplied up to the position one (1) meter in front of the elevated water tank from the plant side. The tie-in point shall be at the position of the gate valve.

(ii) Miscellaneous drainage and sewage shall be led outdoors through individual systems, joined into one system outdoors and sent to a clarification tank. After clarification, such drainage and sewage shall be emptied into the unit neutralizing pit. The BOD of such drainage and sewage shall be 90 ppm.

(iii) Water closets, urinals, lavatories and other sanitary fixtures shall be installed at all required positions.

(b) Administration Building

1. Sanitary and Sewage System

The sanitary and sewage system shall be installed in the lavatory, kitchenette, etc. in the administration

building.

1.1 System Description

(i) Potable water shall be supplied to respective positions by gravitational means from an elevated water tank to be installed on the roof of the administration building.
Pumping-up of water into the elevated water tank shall be supplied up to the position one (1) meter in front of the building from the plant side.
Meanwhile, the tie-in point shall be at the position of the gate valve.

(ii) Miscellaneous drainage and sewage shall be led outdoors through individual system, joined into one system outdoors, and sent to a clarification tank. After clarification, such drainage and sewage shall be emptied into the unit neutralizing pit.
The clarification tank shall be of a composite type, and the BOD of poured water shall be 90 ppm.

(iii) Hot water shall be heated by electric heaters and supplied only into the shower rooms.

(iv) Water closets, urinals, lavatories and other sanitary fixtures shall be installed at all required positions.

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(c) Guard house, water treatment equip and control room

1. Sanitary and Sewage System

The sanitary and sewage system shall be installed in the lavatory, kitchenette, etc.

1.1 System Description

(i) Potable water shall be supplied to the respective positions by a direct water supply system from the plant side.

Potable water shall be led to the position one (1) meter in front of the fuilding from the plant side. The tie-in point shall be at the position of the gate valve.

(ii) Miscellaneous drainage and sewage shall be led outdoors through individual systems, jointed into one system outdoors, and sent to a clarification tank. After clarification, such drainage and sewage shall be emptied into the unit neutralizing pit.

The clarification tank shall be of a composite type, and the BOD of poured water shall be 90 ppm.

(iii) Water closets, urinals, lavatories and other sanitary fixtures shall be installed at all required positions.

22.2 EQUIPMENT AND MATERIALS

22.2.1 ELEVATED WATER TANKS

(1) Elevated water tanks

(a) Type of elevated water tanks

Elevated water tanks shall be made of steel plate with anti-corrosive treatment.

(2) Accessories

The elevated water tank shall be provided with the following accessories.

a.	Water inlet pipe connections	1 set
b.	Water outlet pipe connections	1 set
c.	Drainage pipe connections	1 set
d.	Connections for overflow hole and overflow pipe with insecticide nets (The insecticide nets shall be made of stainless steel.)	1 set
e.	Air passage and air vent with insecticide nets (The insecticide nets shall be made of stainless steel vent shall be made of steel.)	1 set
f.	Locking type manhole (Plastic)	1 set
g.	Reinforcing materials, support metals and stands for elevated water tank (Rolled steel having properties in accordance with JIS G 3101 and with dimensions and shapes in accordance with JIS G 3192)	1 set
h.	Steel ladder	1 set
i.	Electrode mount	1 set
j.	Breakwater cover	1 set

(3) Shapes, dimensions and performance

The shapes and dimensions of the elevated water tank shall be in accordance with the manufacturer's specifications,

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and the performance shall be as specified in "List of Equipment" in the Design Drawings.

22.2.2 INSTANTANEOUS ELECTRIC WATER HEATER

(1) Instantaneous electric water heater

(a) Type

The instantaneous electric water heater shall consist of three (3) sets of instantaneous heating type electric heaters built in a self-standing type steel plate casing.

(b) Materials

The heater tubes shall be of deoxidized copper tubing having a nickel plate finish. The casing shall be made of rolled steel plate.

(c) Power source: 3-phase, 360 V, 50 Hz

(2) Accessories

The instantaneous electric water heater shall be provided with the following accessories.

(a)	Heater operation pumps	3 sets
(b)	Power source pilot lamps	3 sets
(c)	Leakage circuit breakers	3 sets
(d)	Transformers	3 sets
(e)	Fuses	3 sets
(f)	Safety valve (blowoff at 5 kg/cm^2; made of bronze)	3 sets
(g)	Drainage pipe	3 sets
(h)	Thermostat	9 sets
(i)	Flow switch	3 sets
(j)	Cooling fan	1 set

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(k)	Temperature switch	3 sets
(l)	Electromagnetic contactor	9 sets
(m)	Control switch	1 set
(n)	Water supply holes and connecting pipes	3 sets
(o)	Hot water supply holes and connecting pipes	3 sets

(3) Shapes, dimensions and performance

The shapes and dimensions of the instantaneous electric water heater shall be in accordance with the manufacturer's specifications, and the performance shall be as specified in "List of Equipment" in the Design Drawings.

22.2.3 HOT WATER STORAGE HEATER

(1) Hot water storage heater

(a) Type

The hot water storage heater shall consist of a hot water storage tank and an electric heater built in a wall hanging type casing made of stainless steel.

(b) Materials

The hot water storage tank and the casing shall be made of stainless steel.

(c) Power source

Single phase, 220 V, 50 Hz

(2) Accessories

The hot water storage heater shall be provided with the following accessories.

(a)	Ball tap (15 mm)	1 set
(b)	Drainage hole	1 set

(c) Water level (Made of glass with protective metal) 1 set

(d) Thermometer 1 set

(e) Overflow hole 1 set

(f) Thermostat 1 set

(3) Shapes, dimensions and performance

The shapes, dimensions and performance of the hot water storage heater shall be in accordance with the manufacturer's specifications.

22.2.4 SANITARY EQUIPMENT AND ACCESSORIES

(1) General

(a) All sanitary wares shall be of high quality and of a PAKISTAN manufacture, or equivalent to JIS A 5207.

(b) All fittings for sanitary wares shall be in accordance with JIS A 5514, or equivalent.

(c) All accessories and visible sanitary wares such as faucets, flush valves and flushing pipes shall be nickel-chromium-plated.

(2) Water closet

(a) Water closet

Vitreous china (V.C.), siphonic washdown.

(b) Flush valves

The flush valves shall be in accordance with JIS A 5521 "Flush Valves for Closet".

The diameter of the connection hole to the flushing pipe shall be 32 mm, and the flushing operation mechanism shall be of a handle type.

(c) Flushing pipe

The flushing pipe shall be made of brass with a minimum plate thickness of 0.6 mm.

(d) Accessories

(a)	Water closet seat and cover (Plastic)	1 set
(b)	Water closet floor flange	1 set
(c)	Seat bumper	1 set
(d)	Paper holder (Brass)	1 set

(3) Stool

(a) Stool

V.C., Western type with S trap

(b) Low tank

(c) Accessories

(a)	Ball tap	1 set
(b)	Angle type stop cock (13 mm) with water supply pipe	1 set
(c)	Flushing pipe (32 mm)	1 set
(d)	Rubber joint	1 set

(4) Urinal

(a) Urinal

V.C., wall hanging type

(b) Flush valve

Push button type urinal (Brass)

(c) Accessories

(a) Urinal pad

(b) Wall flange

(5) Wash basin (for lavatory)

(a) Wash basin

V.C., 6.5 , wall hanging type

(b) Accessories

(a)	Pillar cock (13 mm)	1 pc
(b)	Angle type stop cock (13 mm) with water supply pipe	1 set
(c)	Washer basin trap	1 set
(d)	Back hanger	1 set
(e)	Liquid soap holder (Vertical type, 350 cc)	1 set

(6) Wash basin (for battery room)

(a) Wash basin

V.C., 9.5 , counter-top type

(b) Accessories

(a)	Pillar cock (13 mm)	1 pc
(b)	Eye bath (Vertical flexible type, 13 mm)	1 set
(c)	Angle type stop cock (13 mm) with water supply pipe	1 set
(d)	Wash basin trap	1 set
(e)	Back hanger	1 set
(f)	Liquid soap holder (Push button type, 360 cc)	1 set

(7) Hand wash basin

(a) Hand wash basin

V.C., 2.7 , wall hanging type

(b) Accessories

1)	Pillar cock (13 mm)	1 pc
2)	Angle type stop cock (13 mm) with water supply pipe	1 set
3)	Hand wash basin trap	1 set
4)	Liquid soap holder (Vertical type, 350 cc)	1 set

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(8) Janitor's sink

(a) Janitor's sink

V.C. with back

(b) Accessories

1)	Sink faucet (20 mm with feed seat)	1 pc
2)	Trap (S type)	1 pc
3)	Trap connection fixtures	1 set
4)	Chain and stopper	1 set
5)	Back hanger	1 set
6)	Rim cover	1 set

(9) Mirror

The mirror shall be frameless and moistureproof. Glass for mirror shall be 5 mm thick and 360 x 455 mm in size, and in accordance with JIS R 3202 (Float, Polished Plate Glass).

(10) Shower set, water cock and similar items

The quality shall be in accordance with JIS A 5514, or equivalent.

22.2.5 SEPTIC TANK

The main structures constituting the septic tank shall be made of fiberglass reinforced plastic (F.R.P.) having appropriate shape, dimensions and capacity. The structures shall have sufficient strength against soil pressure, water pressure, load, etc., and shall be of a construction permitting easy inspection and cleaning. In the case of a building with an accommodation capacity of fifty (50) persons or less, an independent treatment septic tank capable of reducing BOD (biological oxygen demand) into 90 ppm shall be

installed, but in case the capacity exceeds fifty (50) persons, a combined treatment septic tank capable of reducing BOD into 60 ppm shall be installed.

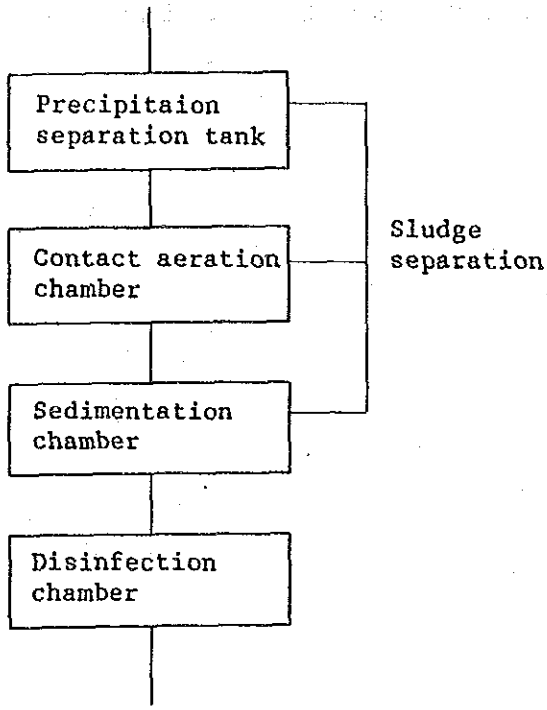
The treatment process flow diagrams of the respective types of septic tanks shall be as indicated below.

TREATMENT PROCESS

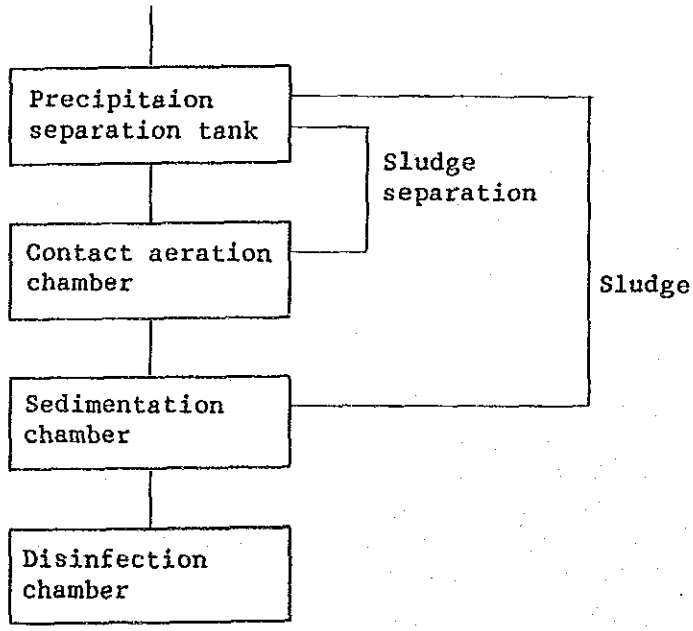
OF

SEPTIC TANK

(a) Independent treatment septic tank



(b) Combined treatment septic tank



22.2.6 PIPING MATERIALS AND PIPE FITTINGS

(1) Pipe

(a) Water supply pipes

The water supply pipe shall be galvanized steel pipe in accordance with JIS 3452.

(b) Hot water supply pipes

The hot water supply pipe shall be M-type copper seamless pipe in accordance with JBMA-0002 and JIS H 3300.

(c) Drainage and air vent pipes

The drainage and air vent pipes shall be the galvanized steel pipe in accordance with JIS G 3452, rubber joint type cast iron pipe in accordance with JIS G 5525 and HASS-210, and the centrifugal reinforced concrete pipe as specified in JIS A 5303.

(2) Pipe joint

(a) Water supply pipe joints

The water supply pipe joints shall comprise screwed type pipe joints in accordance with JIS B 2301, and shall have flange type pipe joints. The flange type pipe joints shall be made by welding the flange to the end surface of the steel made joints as stipulated in JIS B 2211 or JIS B 2212.

(b) Hot water supply pipe joints

The hot water supply pipe joints shall be copper alloy steel pipe in accordance with JCDA-0001.

(c) Drainage and air vent pipe joints

The drainage and air vent pipe joints shall be

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malleable cast iron pipe joint in accordance with JIS B 2301 and screwed type drainage pipe joint in accordance with JIS B 2303.

(3) Gate valves

(a) The gate valves with a nominal diameter of 50 mm or less shall be the 10 kg/cm^2 bronze screwed type gate valve as stipulated in JIS B 2023.

(b) The gate valves with a nominal diameter of 65 mm or more shall be the 10 kg/cm^2 cast iron flanged gate valves (outside screw type) as stipulated in JIS B 2044.

(4) Check valves

(a) The check valves with a nominal diameter of 50 mm or less shall be the 10 kg/cm^2 bronze screwed swing check valve as stipulated in JIS B 2025.

(b) The check valves with a nominal diameter of 65 mm or more shall be the 10 kg/cm^2 cast iron flanged swing check valve as stipulated in JIS B 2045.

(5) Automatic air release valves (air vent valve)

The automatic air vent valve shall be of a float type with a function to automatically relieve air, and shall be actuated precisely. This valve shall be designed so that it withstands the maximum service pressure.

(6) Ball tap

The main parts of the ball tap(s) shall be made of bronze, and the ball shall be brazed to a copper plate. In case the nominal diameter of ball is 50 mm or less, the ball tap shall be of a screwed type. However, in case the diameter

of the ball is 65 mm or over, the ball tap shall be of a flanged type.

The ball tap shall be designed so that it will be actuated precisely without being affected by water hammering at the time of opening and closing.

(7) Flexible joint

The flexible joints shall be of a bellows type, and shall have sufficient flexibility and resistance against pressure. The bellows and protective steel band shall be made of cold rolled stainless steel plate/sheet (SUS-304) as stipulated in JIS G 4305.

The length of one flexible section shall be 400 mm.

(8) Strainer

The strainers shall be of a Y-type. In case the nominal diameter is 50 mm or less, the strainer shall be of a screwed type made of bronze, but in case the diameter is 65 mm or over, the strainer shall be of a flanged type made of cast iron.

The clean out plug shall be made of brass, and the strainer shall be made of stainless steel.

(9) Pipe washer

The pipe washers shall be made of nickel chromium coated brass or stainless steel.

(10) Pipe sleeve

The pipe sleeves shall be made of steel pipe or steel plate with a thickness of 0.4 mm or over (0.7 mm or over in case the nominal diameter exceeds 200 mm). However, the non-water-proofed floor pipe sleeve to be used indoors shall be

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made of laminated cardboard.

(11) Pipe support fittings

(a) The pipe support fittings shall be resistant to contraction and expansion, rolling, etc., of pipe, and shall be of a construction having sufficient bearing strength against load of pipe when liquid is contained inside. The materials to be used shall be in accordance with JIS G 3101 (Rolled Steel for General Structure). All steel fittings shall be finished by galvanizing.

(b) The inserts shall have sufficient strength for supporting the pipe and shall have a construction suitable for connecting hangers, etc. All inserts shall be made of cast iron, press-formed malleable cast iron or steel plate.

(12) Cementing/bonding materials

(a) Thread sealing material

1) The thread sealing tapes shall be in accordance with JIS K 6885 (Unsintered Polytetrafluoroethylene Tapes for Thread Sealing (Raw Tapes)), and shall neither be hazardous to human health nor cause adverse effects upon drinking water.

2) The paste sealing agent shall not be affected by the liquid in pipe, and shall consist of contents applicable to the purpose of use. In case an agent is used for sealing of piping for drinking water, it shall not be hazardous to health nor cause any adverse effect upon drinking water.

(b) Packing

The packing(s) shall be in accordance with JIS K 6353 (Rubber Goods for Water Works Service), JIS R 3433 (Compressed Asbestos Sheets), etc., and have sufficient durability applicable to the respective quality of water, water pressure, temperature, etc.

(c) Caulking lead

The caulking lead shall, in principle, be the 5th Class of those stipulated in JIS H 2110 (Pig Lead).

(d) Caulking hemp

The caulking hemp shall, in principle, be the jute of #130 single thread which, when tied in a bundle, has a diameter or about 25 mm.

22.2.7 DRAINAGE PIPE FITTINGS

(1) General

(a) The water sealing depth of trap shall be 50 mm or more, and the effective area of the drainage hole for strainer shall not be less than the sectional area of the drainage pipe.

(b) The materials for drainage pipe fittings shall be Grade 2 or higher as stipulated in JIS G 5501 (Grey Iron Castings) in case of cast iron materials. However in case of brass casting, the materials shall be Grade 2 or higher as stipulated in JIS H 5101 (Brass Castings).

(c) All iron castings shall be cold-painted having a synthetic resin finish containing refined bituminous material.

(d) The nickel chromium plated section of the drainage pipe fittings shall be equivalent to or higher than Class 1 of Grade 2 in JIS H 8617 (Electroplated Coatings of Nickel and Chromium).

(2) Floor drain trap

The floor drain traps shall be made of Cast iron, and the strainer shall be nickel chromium plated brass. The floor drain trap for asphalt waterproofed floor shall be of a waterproofing type, but that for other floors shall be of the standard type.

(3) Sink trap

The sink traps shall be made of cast iron and shall be furnished with an inside basket made of brass or stainless steel (SUS 304). The strainer shall be made of brass having a nickel chromium plating finish.

(4) Floor clean-out

The floor clean-out shall be of a screwed type made of brass having a nickel chromium plating finish. The floor clean-out for asphalt waterproofed floor shall be of a waterproofing type, but that for other types of floors shall be of the standard type.

(5) Under-floor clean-out

The under-floor clean-out shall be of a screwed type made of brass.

(6) Drainage pipe fittings

The drainage pipe fittings shall be made of brass having a nickel chromium plating finish, and the chain and stopper shall be made of stainless steel.

22.2.8 PIT AND PIT COVER

(1) General

(a) The materials for iron castings shall be equivalent to or higher than Grade 3 as stipulated in JIS G 5501 (Grey Iron Castings).

(b) The iron castings shall be baked with refined tars in accordance with JIS K 2439 (Processed Tars) to which more than 2% of linseed oil or drying oil is mixed, or shall be cold painted with refined bituminous materials to which synthetic resin finish is added.

(2) Invert pit

(a) The invert pit shall be of a concrete construction and all visible portions shall be finished by mortar coating. The pit shall be furnished with a cover, and an invert applicable to the pipe diameter shall be provided on the bottom of the pit.

(b) The cover shall be made of cast iron with chain, and shall be of an odorproof type able to withstand the weight of 2,500 kg.

(3) Storage pit

(a) The storage pit shall be of concrete construction, and all visible portions shall be finished by mortar coating. The pit shall be furnished with a cover.

(b) The cover shall be made of cast iron with chain, and shall be of an odorproof type able to withstand the weight of 2,500 kg.

(4) Valve box

The valve box shall be of a circular type made of cast iron with a cover.

(5) Garden house valve box

The garden hose valve box shall be of a box type made of cast iron and furnished with a cover. The bottom of the box shall be designed so as to facilitate drainage of water.

22.3 EXECUTION

22.3.1 FOUNDATION WORKS

(a) The foundation shall be of reinforced concrete construction able to withstand the weight of equipment and external forces and having sufficient bearing surface for installation of equipment. The foundation shall be built on the floor or ground having sufficient bearing capacity.

(b) Cement to be used shall be the ordinary Portland cement in accordance with JIS R 5210 (Portland Cement).

(c) Regarding the sizes of aggregate, the size of gravel shall be 25 mm or less, that of crushed stone shall be 20 mm or less, and that of sand shall be 2.5 mm or less.

Any other requirements other than specified above shall be in accordance with the Specifications for "Architectural Works".

22.3.2 ERECTION WORKS

(1) Elevated water tank

(a) The elevated water tank shall be firmly fixed with anchor bolts having sufficient strength so that the

tank will not slide laterally move in any way due to horizontal seismic force.

(b) The elevated water tank shall be installed on a horizontal plane on the foundation having a steel made base, and the foundation shall have an even bearing surface against the load. The elevated water tank and the steel base shall be fixed firmly with anchor bolts to withstand wind pressure and other loads.

(c) After installation, the elevated water tank shall be cleaned and washed with water. Then, the tank shall be sterilized by using solution of hypochlorous acid, etc.

(d) The piping for the elevated water tank shall be supported so that weight of the piping will not be applied to the tank.

Flexible joints shall be provided for all respective connecting pipes to the water tank except for the drain pipe and air vent pipe.

(2) Self-standing type electric water heater

The self-standing type electric water heater shall be fixed firmly on the floor by using suitable fixtures so that the heater will not move due to seismic force, etc.

(3) Wall hanging type electric water heater

The wall hanging type electric water heater shall be set firmly on the wall by using expansion joints.

(4) Sanitary ware, accessories and fittings

(a) General

1) In case wall hanging fittings are fixed on a concrete wall or brick wall, expansion bolts

shall, in principle, be used.

2) In case a metal panel or lightweight steel framed board wall is set, steel plate and worked angle materials or hardwood patch shall be fixed to the sanitary ware in advance.

3) In case a part of the sanitary ware is embedded in concrete, the portion of the sanitary ware that comes into contact with concrete or mortar shall be covered with asphalt having a thickness of 3 mm or more. However, the bottom contact surface of sanitary ware, such as that for standing type urinals, shall be filled with sand.

(b) Water closet

1) The upper end of the water closet shall be set horizontally in place in accordance with the precise setting position.

2) Prior to connecting the water closet to the drain lead pipe, the connecting end of the lead pipe shall be flared up to the diameter of the flange, and after inserting the non-drying sealing materials between the external surface of the flange and connecting end, the water closet shall be connected to the drain lead pipe by nuts and fastened from above by flange fittings and bolts. The plate thickness of the external end of the flared lead pipe shall be not less than 2 mm. The end of the flange for the lead pipe to be connected to the water closet shall be supported sufficiently with hangers, etc., so that

no load of drain pipe, etc., will act directly on the water closet.

(c) Urinal

1) The urinal shall be set precisely in place without misalignment.

2) Connection of urinal with drain pipe shall be carried out in accordance with the procedures for connecting the water closet in (b).

3) The setting height of urinal shall be 530 mm from the floor surface to the upper front end of the urinal.

(d) Wash basin and hand wash basin

1) The bracket or back hanger/s shall be firmly set in place, and the wash basin shall be fixed carefully so that the upper surface of the basins will be kept horizontal without exhibiting looseness. To eliminate leakage of water, heat-resistant non-drying sealing materials shall be filled around drain holes of the basins and around openings between the drain pipe fittings.

2) The setting height of basins shall be 800 mm (approximate) from the floor surface to the upper front end of the basin.

(e) Slop sink

The trap shall be set in place without any misalignment, and the connection of slop sink to the drain pipe shall be carried out in accordance with the procedures for connection of water closet in (b).

Setting of back hanger/s and connection between drain holes of the slop basin and drain pipe fittings shall be carried out in accordance with the procedures for the above wash basins in (d).

(f) Water cock

The water cock shall be fixed firmly after precise centering by fully taking into account the convenience of use and harmony with the surrounding facilities. A sufficient space for the spout shall be provided between the end of the spout of water cock and the flood level rim of the drain receptacle.

(g) Mirror

The setting height of the upper end of the mirror shall be 1,800 mm from the floor surface.

(5) Septic tank

Reinforced concrete foundation shall be provided, and the tank shall be firmly fixed to the foundation so as to withstand upward water pressure.

22.3.3 CONNECTION OF PIPES

(1) General

(a) All pipes shall be carefully cut at a right angle against the axial center of the pipes so as to avoid any deformation of the sections, and the cut end shall be finished smoothly.

(b) Pipes shall be connected after removing all chips, dust and other foreign matter and after confirming that such foreign matter has been completely removed form inside the pipes.

(c) In case piping work is temporarily suspended, all pipes shall be sufficiently protected to avoid entry of any foreign matter.

(2) Water supply piping

(a) No water supply piping shall, in principle, be connected according to an insertion system, unless specified otherwise.

(3) Hot water supply piping

(a) No water supply piping shall be connected according to an insertion system. In the case of piping which is required to be removed, flare fittings shall be used having a normal diameter of 1-1/4 or less and flange couplings having a nominal diameter of 1-1/2 or more. Prior to connection of the piping, the external surface of all pipes and the internal surface of all joints shall be cleaned thoroughly. The pipe shall then be inserted properly into the joint while heating the pipes and joints to an appropriate temperature and applying soft solder alloy.

(4) Drainage and air vent piping

(a) Prior to connecting the galvanized steel pipes, the pipes shall be correctly threaded so that a slight clearance is provided between the end face of pipes and the recess of joints in order to obtain the tapered threaded pipe portion. The steel pipes shall then be screwed tightly into the joints.

(b) All cast iron pipes shall be connected by using rubber rings. In this case, the pipes shall be inserted into the

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