THE ISLAMIC REPUBLIC OF PAKISTAN

DETAILED DESIGN STUDY
ON
WEST WHARF
THERMAL POWER PLANT PROJECT

FINAL REPORT-II

LOT I (VOLUME 5)

JANUARY 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

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PART-III

SECTION I

GENERAL SPECIFICATIONS

PART III

SECTION I

GENERAL SPECIFICATIONS

CONTENTS

1. SCOPE

1.1 GENERAL

The specifications cover the design, manufacture, shipping, transportation, erection, construction, and testing of the buildings, structures, foundations and facilities for 2 x 200 MW West Wharf Thermal Power Plant.

1.2 SCOPE

The works to be done under this Contract include, but are not limitted to the following principal items.

(1) Site preparations and grading for Power plant compound and outside area including the areas for discharge water lines.

(2) Civil and building works for the following items.

(a) Powerhouse, and boiler substructures including indoor equipment foundation and T/G pedestals

(b) Stack and gas line including forced draft fans, induced draft fans, gas ducts, and house boiler

(c) Transformer yard and cable tunnel to the Substation

(d) Dismanthing of the existing Pump Pit

(e) Cooling water way

i) Intake water way

ii) Intake open channel

iii) Screen and c.w. pump pit

iv) Discharge tunnel

v) Outlet

(f) Outdoor equipment foundation

i) Pipe support

ii) Unit make up tank foundation

iii) Demineralized storage tank

iv) Raw water storage tank

v) Waste water storage pond

vi) City water receiving facility

vii) Unit neutralizing pit

viii) Stack drainage pit

ix) Oil separator

x) Chlorination feed water pump pit

xi) Storage box for stop logs

xii) Dust box

xiii) Cable ducts

xiv) Other facilities

(g) Water treatment and potable water supply system including water treatment room, water pretreatment facilities, treatment facilities, filterized water tank, demineralized water tank, potable water pump and tank

(h) Fuel and lubrication oil system including heavy oil tanks, fuel oil transfer pump area and lubrication oil storage tank

(i) Auxiliary buildings such as H_2 generating station, workshop, warehouse, administration building, and others

(j) Building facilities comprising of air conditioning, ventilation, potable water supply, hot water supply, sanitary and drainage including purification tanks for the powerhouse and auxiliary buildings

(3) Civil works for access roads, intra site roads and yard storm

drainage system

(4) Site perimeter fence and landscaping

(5) The assistant work for the work of the Owner that is to make applications for taking the permissions issued by the administrator.

1.3 OUT OF SCOPE

(1) 220 kV/132 kV substation building and its transformer yard.

2. DESIGN BASIS

2.1 GENERAL

All works to be done under this Contract shall comply with the design basis specified herein.

2.2 APPLICABLE STANDARDS

All works shall be carried out in accordance with the requirement of Clause 5 of "Applicable Standards and Codes in Part I and the following applicable standards or other approved applicable standards:

(1) Architectural Institute of Japan (AIJ)

- (a) Standards for Design of Steel Pile Foundations for Buildings
- (b) Standards for Structural Design of Building Foundations
- (c) Standards for Design of Steel Structures
- (d) Standards for Design of Reinforced Concrete Structures

(2) Heating, Air Conditioning and Sanitary Standards (HASS)

(3) Japan Water Works Association (JWWA)

(4) Japan Road Association (JRA)

(5) Japan Architectural Standard Specifications (JASS)

(6) Japan Society of Civil Engineers

- (a) Standard for Caluculation of Reinforced Concrete Structures
- (b) Design Standards for Steel Structures
- (c) Standards for Structural Design of Building Foundations

(7) Japan Port and Harbour Research Institute

Technical Standards for Port and Harbour Facilities

(8) Japan Industrial Standards (JIS)

(9) Japan Electro-technical Committee (JEC)

2.3 DESIGN LOADS

The following design loads, unless otherwise specified, shall be used in the design.

2.3.1 DEAD LOAD

The dead loads based upon the building finishes shall be calculated in accordance with the building finishes and material densities.

2.3.2 LIVE LOAD

All vertical live loads shall, in principle, be considered as uniform loads. However, equipment loads which are heavy and of which the supported area is concentrated in a small area, shall be treated as concentrated loads. As for the civil design, the live loads shall be as follows.

1) The surcharge load --- 1 t/m^2

2) Truck load (T-20) --- The gross weight : 20 ton
   A front wheel weight : 2 ton
   A rear wheel weight : 8 ton

3) The impact coefficient --- i = 0.3

2.3.3 WIND FORCE

The design wind pressure shall be determined by the following formula.

$$P\ (kg/sq.m) = C \times q \times A$$

Where: C = Shape factor as indicated in the attached sheet

q = Wind velocity pressure (kg/sq.m)

A = Projected area (sq.m)

The wind velocity pressure, unless otherwise specified, shall be calculated as follow:

$$q = 45\sqrt{H} \text{ (kg/sq.m)}$$

The shape factor shall be in accordance with Table hereinafter.

2.3.4 SEISMIC FORCE

(1) General

The seismic force shall be determined in accordance with the Ministry of Construction Notification, Cabinet Order Article conforming to Section 8 of Chapter 3 of the Building Standard Law Enforcement Ordinance.

(2) Seismic force for elastic design

The seismic force for the elastic design shall be determined by the story shear coefficient calculated according to the following equation:

$$Ci = Z \times Rt \times Ai \times Co$$

Where: Ci = Story shear coefficient on respective floor

Z = Zone factor

Z = 1.0

Rt = Vibration characteristics of building (0.4)

Ai = Story shear distribution coefficient

Co = Standard shear coefficient

Co = 0.1

Seismic story shear shall be calculated according to the following equation:

$$Qi = Ci \times Wi$$

Where: Qi = Seismic story shear on respective story

Ci = Story shear coefficient on respective story

Wi = Weight above the respective story

(3) Seismic force for elasto-plastic design

The seismic lateral force for elasto-plastic design shall be as given in the following formula.

$$Qud = Z \times Rt \times Ai \times Co \times W$$

Where: Qud = Required ultimate resistance in horizontal direction

Co = Standard shear coefficient

$C \geqq 1.0$

W = Weight of story

The potential horizontal strength required on the respective floor shall satisfy the following equation:

$$Qun \geqq Ds \times Fes \times Qud$$

Where: Qun = Potential horizontal strength required on the respective floor

Ds = Coefficient of structural characteristics

Fes = The computed a value expressing the shape characteristics of the respective floor depending upon the stiffness ratio and eccentricity ratio of the respective floor

Qud = Horizontal force arising on respective floors due to seismic force

(4) Method of calculation

The method of calculations of the items described herein

shall be in accordance with "The Guideline for Structural Calculation and Explanation Thereof" (1981 edition) published by The Building Center of Japan and supervised by the Ministry of Construction Building Research Institute Housing Bureau, Ministry of Construction.

2.3.5 CRANE LOAD

The vertical force on crane runways shall be not less than 120% of the maximum wheel loads of the crane.

The lateral force on crane runways acting in the perpendicular direction of runways shall be not less than 10% of the maximum wheels loads of the crane.

The lateral force on crane runways acting in direction of travel shall be not less than 15% of the maximum wheel loads of the crane.

All lateral forces shall be applied at the top of the rail.

2.3.6 LAYDOWN LOAD

Periodical inspection of turbine and generator shall be carried out once yearly or at specified intervals. A portion of the equipment shall be overhauled and laid down on the operating floor. The laydown load shall be considered in the design as the permanent load.

In general, the laydown load is considered to be the uniform distributed load.

2.3.7 INSTALLATION LOAD

When heavy equipment is brought in and installed in place, the carrying load is imposed on the floor which is used for temporary storage or as a portion of the carrying in route.

This installation load shall be considered as corresponding with the approved installation plan, and shall be treated as a temporary load.

2.3.8 DESIGN LOAD COMBINATIONS

Structures and structural members shall be designed for maximum resistance to the following load combinations.

(1) Long term

D.L + L.L + M.L + L.D + P.L + C.D.L

(2) Short term

D.L + L.L + M.L + P.L + C.D.L + W.L

D.L + L.L + M.L + P.L + C.D.L + S.L

D.L + L.L + M.L + P.L + C.D.L + I.L

Where: D.L = Dead load

L.L = Live load

M.L = Machine load

L.D = Laydown load

P.L = Piping load

C.D.L = Crane dead load

C.O.L = Crane operating load

W.L = Wind load

S.L = Seismic load

I.L = Installation load

3. DESIGN CONCEPT

3.1 GENERAL

(1) All works and design to be done under this Contract shall comply with the design concept specified herein.

(2) Design and/or redesign

Even after viewing the Owner's Drawings, the Contractor, if necessary, may redesign the structural framings and foundation of each structure based upon his arrengement of equipment, loads, sizes and other pertinent matters regarding the furnishing of machines, provided that the Engineer approves the redesign.

The Contractor shall design equipment foundations in the Main Powerhouse such as turbine-generator pedestal, BFP and so on.

All equipment foundations design and piling, structural framings and stack redesigns, if any, shall be carried out so as to resist all expected loads, such as dead load, vibration load, seismic load, wind load and load at the time of carry in of heavy equipment in accordance with the design concepts specified hereinafter.

The design documents, such as drawings and calculation sheets and certification reports shall be submitted to the Engineer for approval.

The basic design shall, in principle, not be changed, however the Contractor shall, in accordance with the requirements of the third parties or the permitted conditions directed by the administrators, have to change the basic design, and be

responsible for the changed basic design. Provided that no variations shall be approved by the Engineer as for increase or decrease in the quantity of any work relating with the above change.

3.2 POWERHOUSE

3.2.1 OUTLINE

(1) Height of ground floor: GL + 200 mm

(2) Structure

Mat foundation: Reinforced concrete mat foundation (Raft foundation)

Framing: Steel structure

Floor and roof: Reinforced concrete on galvanized metal decking

(3) Elevator facilities

The Contractor shall design, furnish and install an elevator with a cylinder type steel shaft which shall be laterally supported by the each boiler structure.

3.2.2 DESIGN CONCEPT

(1) Superstructure

Structural steel shall be provided for the superstructure of the main power house. The structure shall be of braced frame or open frame type.

Each floor shall be considered as rigid against horizontal forces, and shall be provided with horizontal braces, even if there is a concrete slab.

The location of vertical braces shall be determined in consideration of the eccentricity and stiffness ratio against horizontal forces.

The location of the structural members and the installation method of equipment or finishing materials shall be determined so that each structural member will not receive eccentric forces.

The deflection of the structural members shall be less than the allowable deflection. Particular care shall be taken so that the crane girder does not exceed the allowable deflection.

The relative story horizontal deflection angle shall be less than 1/200 against horizontal forces.

The column of braced frame shall be considered as the pin support, except for the main column (such as the column supporting the crane girder).

The shearing force of the column bottom shall be supported by the key plate under the column base plate.

(2) Foundation

The thickness of the mat foundation shall be calculated in accordance with the loads of the superstructure and the bearing capacity of the pile. Moreover, differential settlement of the foundation shall be 1/15,000 for the design.

The mat foundation of main power house and boiler shall be separated. However, the mat foundation of the main power house and T/G pedestal shall not be separated.

(3) Miscellaneous considerations

(a) For the ground floor column line <G>-<H>, no vertical brace shall be arranged in consideration of passage of vehicles and persons.

Moreover, monorails shall be installed in the area for installation and maintenance of boiler feed pump.

(b) On the ground floor, floor drains shall be provided at intervals of about 200 m^2.

(c) The pedestal foundation for heavy equipment and rotary equipment shall be raised from mat concrete.

(d) The ground floor in the boiler area shall have a slope of about 1/200. A trench for floor drain (to be covered by checkered plate) shall be provided in the surrounding area.

(e) The walls from the ground floor through to the level of operating floor shall be constructed of concrete panels, which shall be fabricated at the project site.

Precast concrete panels between 104 and 105, 204 and 205 of the Column Line <A> from the ground floor to the mezzanine floor shall be constructed so as to be easily dismounted.

(f) A 1.1 m high handrail made of steel shall be erected around all opening sections on the floor. A removable type handrail shall be erected around the opening section in the unloading area. Around each opening section, a toe plate with a height of FL + 100 mm shall be fixed securely to structural steel.

(g) The air intake louver along row 101 and 208 shall be constructed so as to close automatically at the time of fire accident.

(h) A cable treatment area (steel framed checkered plate floor) shall be provided under the central control room.

(i) An observation window of double construction shall be provided in the central control room along row <H> so as to make it possible to observe the turbine room from the central control room. A part of the walls in the central control room shall be of temporary installation so as to carry in the BTG board for Unit 2.

(j) Noise level in central control room and office rooms:
The Contractor shall ensure that the noise level in the central control room and office rooms does not exceed 60 dB(A) (maximum).

(k) An access way shall be provided to permit direct access from the T/G room through boiler structure of the elevator.

(l) Catwalks made of grating shall be arranged on each side (Rows A and G) along the overhead crane girder level.
Handrails shall be attached outside the respective catwalks.

(m) The entire floor in the computer room and PABX room shall be of a free access type.

(n) The walls and ceiling in all air conditioned rooms

shall consist of heat-insulation materials.

(o) The effective width of all main staircases shall at least be 900 mm.

(p) Hanger hooks (steel rings) shall be attached to the back side of parapets on the roof to facilitate maintenance of exterior walls and windows.

(q) Elevator Facilities

Travel shall be from the ground floor to the platform at drum level of the boiler structure. The car shall be automatically returned to the operating floor.

The elevator machine room and its access stairway shall be mounted at the top of the shaft.

To prevent heat accumulation, the Contractor shall provide glass wool insulation of 50 mm thickness with wire mesh and an exhaust fan.

(r) The battery room shall be designed for air tightness and shall have an air tight door, air tight wall and air tight ceiling.

(s) The precast concrete panel shall be designed so as to minimize the number of openings wherever possible after confirming the number and positions of the penetration holes.

(t) Weather protection cover(roofing and siding) of Boiler hanger structure Weather protection covers shall be designed and provided at the boiler top (to drum level platform) so as to protect the person, equipment and structure from sunshine, rain and sandy wind.

Technical specifications for the materials to be used for the roofing and siding shall conform to Clause 11 METAL WORK/SIDING AND ROOFING in SECTION II TECNICAL SPECIFICATIONS.

3.3 STACK

3.3.1 OUTLINE

(1) Reinforced concrete windshield

(a) Dimension:

Height	GL + 137 m

(b) Materials:

Reinforced concrete	Fc = 270 kg/cm^2, strength after 28 days
Reinforced bar	Conforming to ASTM A615 Gr.40 or equivalent

(2) Inner flues with lining and insulation

(a) Dimension:

Height	GL + 140 m

(b) Materials:

. Steel plate for flue	Conforming to JIS G 3114-SMA 41A (Anticorrosion) Conforming to JIS G 3101 SS41
. Stainless steel plate for top nozzle	Conforming to JIS G 4304 - SUS 304
. Lining	Gunite type castable lining
. Insulation	Fiberglass or equivalent, 50 mm

in thickness with 3.5 mm ϕ Nelson type stud and wire mesh of 20# x 26 mm

(3) Foundation

(a) Shape

Octagonal foundation

(b) Materials

Concrete	Fc = 270 kg/m^2 strength after 28 days
Reinforcing bar	ASTM A615 Gr.40

(4) Electrical equipment

. Aircraft warning light with automatic flicker device

. Fluorescent lamps and fixtures

. Lightning rod

(5) Platform and ladders

Platforms for the ladder shall be provided at every 6 m or less.

3.3.2 DESIGN CONCEPT

The Contractor shall design the dimension of flues based upon his gas conditions, and shall submit the results to the Engineer for approval.

The stack shall consist of a reinforced concrete windshield, 2 (two) barrels of inner flues with lining and insulation, ladder, stage and other pertinent electrical equipment. Gunite lining and fiberglass insulation shall be furnished. The flues shall be connected with framed steel girders and beams for platforms located approximately

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every 35 m in height. Connection between the flues and the girders shall consist of a sliding hinge against vertical force (thermal expansion of flue) and a fixed hinge against horizontal force (seismic force).

(1) Superstructure

The stack shall be designed against static and dynamic loads. Loads which shall be considered are as follows.

(a) Dead load

(b) Live load

(c) Static seismic load

(d) Dynamic seismic load

(e) Static wind load

(f) Resonant wind load

Among the design loads indicated in the above, stack sections shall be calculated for those loads which maximize stress. Sections near openings shall be calculated for partial stress.

(2) Foundation

Footing sections and stability of bearing ground shall be sufficient to resist design bending moment at the time of earthquake. Each value shall be calculated as follows.

(a) Design stress

Design bending moment is calculated according to the following equation.

$$MF = Mo + Qo \times hf + K \times Wf \times h$$

Where MF: Moment of foundation bottom

Mo: Moment of foundation top

Qo: Shear force of foundation top

hf: Depth of foundation

K : Seismic intensity in underground portion

Wf: Weight of foundation

h : Height of the point where the seismic force is imposed on the foundation from the foundation bottom

(b) Stability of bearing ground

Stability of the bearing ground is calculated according to the following equation.

$$\frac{Ws+WF}{Ao} + \frac{MF}{ZF} < R \text{ and } > 0$$

where Ws: Weight of superstructure

WF: Weight of foundation (including weight of of soil)

MF: Moment of foundation bottom

Ao: Area of foundation bottom

ZF: Section modulus of pile (arrangement)

R: Allowable support force of pile

3.4 TURBINE-GENERATOR PEDESTAL

3.4.1 OUTLINE

(1) Structure

Mat foundation: Reinforced concrete mat foundation (connected with mat foundation of main powerhouse)

Framing and floor: Reinforced concrete structure (Fc = 270 kg/cm^2, reinforcing bar

ASTM A615 Gr.40

Framing shall be separated from the main powerhouse.

3.4.2 DESIGN CONCEPT

(1) Loads

T/G pedestral shall be designed to withstand the following loads. These loads shall be combined appropriately.

(a) Dead load

(b) Machine dead load

(c) Machine load under installation

(d) Vacuum load of condenser

(e) Machine dynamic load

(f) Short circuit load

(g) Thermal stress

(h) Seismic load

(2) Resonance

The natural period of the T/G pedestal should be greater or smaller than the range of 20% of the rotary period of equipment so as to prevent the pedestal from resonating.

3.5 AUXILIARY BUILDINGS

3.5.1 OUTLINE

(1) Structure

The types of structure shall be determined according to the equipment to be housed in the respective structures.

(a) Superstructure

Type A: Steel structure

Type B: Reinforced concrete

Type C: Reinforced concrete with light weight roof

(b) Foundation

Reinforced concrete, independent footing with tie beam

(2) Loads

Loads to be used shall be the same as those of the main powerhouse.

(3) Future extension

Future extension shall not be considered for the design.

3.5.2 DESIGN CONCEPT

For the steel structure, the design concept shall be the same as that of the main powerhouse.

For the reinforced concrete structure, the following items shall be considered.

Shear walls shall be provided in the structural frames wherever possible. In this case, eccentricity and the stiffness ratio shall be taken into account.

For the analysis of rigid frame, each member shall be considered as a structural member of one line, and the rigid zone may not be considered.

3.6 COOLING WATERWAY

3.6.1 INTAKE OPEN CHANNEL

Vertical alignment and cross section shall be determined by taking

into account the following items.

- . Quantity of cooling water
- . Water levels at intake mouth
- . Water level at pump house
- . Wave height
- . Optimum flow velocity
- . Hydraulic conditions

3.6.2 PUMP PIT (2 units)

The structure shall be of reinforced concrete rigid frame.
The bottom level of the pump pit shall be EL.-3.0 m and shall have suitable dimensions for installation of pumps and auxiliary equipment such as bar screens, travelling screens, stop logs, lifting beam, washing water pit, pipe trench and manholes.
The approaching flow velocity to the screens shall be less than 0.375 m/sec.

3.6.3 INTAKE TUNNEL

The intake tunnel shall be made use of the existing intake tunnels (box culvert and concrete piper).

3.6.4 DISCHARGE TUNNEL AND OUTLET

The discharge tunnel shall consist of reinforced concrete culvert.
The average discharge water velocity shall be less than 0.5 m/sec.
The Contractor shall study about the slide of Outlet will be occurred by the horizontal force at Earthquake in consideration of the station of a construction joint of Outlet, and immediately after

the study of the slide of Outlet, the Contractor shall submit the calculation sheets for the study to the Engineer for approval.

3.7 OTHER STRUCTURES AND FOUNDATIONS

3.7.1 REINFORCED CONCRETE STRUCTURES

Based upon the system design specified in these Specifications in Part II, requirements of the respective structures such as capacity and dimensions shall be determined, and the arrangement, size, loading and all necessary pertinents shall be provided.

The design of the structural system shall be carried out so as to withstand all expected loads such as dead load, equipment load, seismic load and wind load as specified in 2.4 "DESIGN LOAD".

Materials to be used shall be as follows, unless otherwise specified.

Concrete : 210 kg/cm^2 strength after 28 days.

Reinforcing bar: ASTM A615 Gr.40

Acid and alkali proof lining as specified in TS19.1 "Acid and alkali proof lining" shall be applied to the inside surface of the following structures.

(1) Acid and alkali proof lining (Class A)

. Unit neutralizing pit

(2) Acid and alkali proof lining (Class B)

. Chemical tank and pump foundation

. Waste water storage pond

. Coagulation sedimentation tank

. Sludge enrichment tank

. Purified waste water tank

. Clear water pit and other pits

. Chemical feed pumps and tanks foundation

. Chemical storage tank and pump foundation

. Waste water pit for stack cleaning

. Water treatment equipment & control room

. Chlorination equipment area & control room

Water proof coating as specified in TS 19.2 "Water proof coating" shall be applied to the inside surface of the following structures.

. Raw water receiving pond

3.7.2 FOUNDATIONS OF OUTDOOR EQUIPMENT

Based upon the system design specified in the Specifications in Part II, requirements of the respective foundations such as dimensions shall be determined, and the arrangement, size, loading and all necessary pertinents shall be provided.

The design of the structural system shall be carried out so as to withstand all expected loads such as dead load, equipment load, seismic load and wind load as specified in 2.4 DESIGN LOAD.

Materials to be used shall be as follows.

Concrete : 210 kg/cm^2 strength after 28 days

Reinforcing bar: ASTM A615 Gr.40

Noise level at the site boundary shall not exceed 70 dB(A) (maximum) as specified in Part II, however, in case that the noise level is not able to decrease by equipment side such as transformers and so forth, noise protection wall(s) for the equipment shall be designed and provided by the Contractor.

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3.8 BUILDING SERVICE FACILITIES

(1) Water supply plumbing and equipment

The water supply plumbing and equipment implied herein is intended to supply drinking water (See Part II) after pressure reduction to the required points in the respective buildings.

The methods of water supply to the respective buildings and the tie-in points with PART II shall be as given in the table below.

Building	Water supply methods	Tie-in points with PART II
Main power house	Water shall be supplied by gravitational system from an elevated water tank to be installed on the roof of the main power house.	The position of valve for pumping up pipe onto elevated water tank.
Administration building	Water shall be supplied by gravitational system from an elevated water tank.	The position of valve for water supply pipe one (1) meter outside the building.
Water treatment equipment and control room	Water shall be supplied by a direct water supply system.	The position of valve for water supply pipe one (1) meter outside the building.
Guard house	Same as above	Same as above.

(2) Hot water supply plumbing and equipment

The electric storage heaters and instantaneous heaters of the hot water supply plumbing and equipment shall be designed at the positions of the respective kitchenettes and shower rooms of the respective buildings for the purpose of hot water supply.

(3) Sanitary facilities

Sanitary fixtures and devices shall be designed at the positions required in lavatories, kitchenettes, shower rooms, etc., in the respective buildings.

Service sinks shall be designed at the positions required in battery room.

(4) Waste water plumbing and equipment

Waste water and miscellaneous plumbing water from the respective buildings shall be led outdoors separately, and sent into the sewer pipes to be laid by another contractor through septic tanks (independent type or combined type).

Waste water from the analysis room shall be sent independently into a waste water tank and discharged into a sewerage system after dilution.

(5) Air conditioning system

(a) Main powerhouse

For air conditioning of the main powerhouse, chilled water will be produced in the air cooled chiller and supplied to the respective air conditioning systems. The capacity of the major equipment shall be as follows: 50% capacity x three (3) air cooled chiller sets [one (1) set for standby]; primary chilled water pump [100% x one (1) set for the respective air cooled chillers]; secondary chilled water pumps [100% x two (2) sets for CPU and 50% x two (2) sets for the other rooms]: and air conditioners [100% x two (2) sets for CPU and 50% x two (2) sets respectively for the other rooms].

The air conditioning system shall be of a low speed duct type, and divided into the following four (4) systems:

(i) Computer room

(ii) Control equipment room

(iii) Central control room

(iv) Laboratory room

(b) Administration building

Air conditioning of the administration building shall be performed by dividing the air conditioning system into the two east and west systems.

The capacity of the respective equipment shall be 100% x one (1) set.

(c) Other building

The other buildings requiring air conditioning shall be air-conditioned by the air cooled packaged air conditioner.

(6) Ventilation system

The ventilation systems shall be provided to enable ventilation for removing heat and odors generated in the turbine room, analysis room, lavatories, storage rooms, battery room, kitchenettes, electric machine room, air conditioning equipment rooms, etc., as well as for supplying oxygen required for combustion.

(7) Secondary electrical and automatic control

(a) Power supply to the respective equipment shall be as follows.

. Main power house and Administration Building

The power source to be supplied (See PART II) shall be connected to the respective equipment in the buildings through switchboards.

(b) The automatic control system shall be designed and installed so as to ensure smooth operation of air conditioning, ventilation and sanitary equipment in the respective buildings.

(c) Alarms shall be integrally connected at necessary positions for each control panel in the respective buildings.

Alarms on the water levels in the elevated water tanks and waste water tanks shall be provided at the necessary positions, but shall function independently.

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(i) Computer room

(ii) Control equipment room

(iii) Central control room

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4. OUTLINE OF WORKS AND FACILITIES

4.1 MAIN BUILDING

4.1.1 DIMENSIONS

		Unit-I	Unit-II
Floor area:	Ground floor	2,850.1 m^2	1,522.0 m^2
	Mezzanine floor	2,291.6 m^2	1,068.6 m^2
	Operating floor	2,710.5 m^2	1,487.4 m^2
	4th floor	1,462.5 m^2	360.4 m^2
	Penthouse	51.1 m^2	25.6 m^2
	Total area	9,365.8 m^2	4,464.0 m^2
Height of each floor:	Ground floor	GL + 0.2 m (EL + 5.0 m)	
	Mezzanine floor	GL + 5.7 m	
	Operating floor	GL + 11.2 m	
	4th floor	GL + 16.2 m	
	Deaerator roof	GL + 21.2 m	
	Roof	GL + 27.1 m	
	Top of parapet	GL + 28.3 m	

Building Volume	Unit-I	Unit-II
	68,218.5 m^3	38,906.3 m^3

4.1.2 STRUCTURE

Piling	Steel pipe pile ϕ609.6 x 9.0
Mat foundation:	Reinforced concrete raft foundation
	Thickness: 2.5 m (under T/G pedestal)
	1.5 m (remaining area)
Framing:	Steel structure
Floor and roof:	Reinforced concrete on galvanized metal decking

4.1.3 INTERIOR AND EXTERIOR FINISHES: As indicated in the Drawings.

4.1.4 ELEVATOR FACILITIES

The Contractor shall design, furnish and install a 600 kg capacity elevator with stops at five (5) or more floors, and a cylinder type steel shaft which shall be laterally supported by the boiler structure.

Travel shall be from the first floor to the platform at drum level of the boiler structure. The car shall be automatically returned to the operating floor.

The elevator machine room and its access stairway shall be mounted at the top of the shaft.

To prevent heat accumulation (indoor temperature in the elevator machine room shall be less than 40^{o}C), the Contractor shall provide glass wool insulation of 50 mm thickness with wire mesh and an exhaust fan as indicated in the Drawings.

4.2 STACK (CHIMNEY)

The stack (chimney) shall consist of a reinforced concrete windshield, 2 (two) barrels of inner flues with lining and insulation, ladder, stage and other pertinent electrical equipment.

Gunite lining and fiberglass insulation shall be furnished.

The flues shall be connected with framed steel girders and beams for platform located approximately every 35 m in height.

Connection between the flues and the girders shall consist of a sliding hinge against vertical force (thermal expansion of flue) and a fixed hinge against horizontal force (seismic force).

Dimension and materials.

(1) Reinforced concrete windshield

(a) Dimension:

Height	GL + 137 m	
Top outside diameter	10.2 m	Wall thickness 25 cm
Bottom outside diameter	13.7 m	Wall thickness 50 cm

(b) Materials:

Reinforced concrete	Fc = 270 kg/cm^2, strength after 28 days
Reinforcing bar	Conforming to ASTM A615 Gr.40 equivalent

(2) Inner flues with lining and insulation

(a) Dimension:

Height	GL + 140 m
Flue diameter (effective)	3.5 mφ x 2

(b) Materials:

Steel plate for flue	Conforming to JIS G 3114-SMA 41A or equivalent (Anticorrosion) Conforming to JIS G 3101 SS41 or equivalent
Stainless steel plate for top nozzle	Conforming to JIS G 4304 - SUS 304 or equivalent
Lining	Gunite type castable lining
Insulation	Fiberglass or equivalent 50 mm in thickness with 3.5 mmφ Nelson Type stud and wire mesh of 20♯ x 26 mm

(3) Foundation

(a) Dimension:

Octagonal foundation	25 m in width, 4.5 m in depth

(b) Materials:

Concrete	Fc = 270 kg/m^2 strength after 28 days
Reinforcing bar	Conforming to ASTM A615 Gr.40 or equivalent

(4) Electrical equipment

Aircraft warning light with automatic flicker device

Fluorescent lamps and fixtures

Lightning rod

(5) Platform and ladders

Platforms for the ladder shall be provided at every 6 m or less.

4.3 TRANSFORMER FOUNDATIONS

Main transformer	Unit I and Unit II
Auxiliary transformer	Unit I and Unit II
Starting transformer	Unit I only
Fire walls	The fire wall shall be 1.5 m higher than the highest part of the main transformer.
Material	Concrete shall be 210 kg/cm^2 strength, and reinforcing bar shall conform to ASTM A615 Gr.40 or equivalent.

4.4 DISMANTLING WORK

The List of the existing structures to be dismantled shall be as follows:

(1) C.W Pump House for "A" Station

(2) C.W Pump House and Screen for "B", "BX" Station

(3) Discharge Sump for "A" Station

(4) Sewer Sump and Pumping Station

(5) Discharge Water Pipes

i) from "A" Station (i.e. Concrete Pipes between Discharge Sump and the boundary wall of Plant)

ii) from "B" Station (i.e. Cast Iron Pipes above Cable Tunnel)

iii) from "BX" Station (i.e. Cast Iron Pipes above Cable Tunnel)

The Contractor shall, in particular, take care of the following items.

1) In the case of dismantling the reinforced structures, the Contractor shall, in principle, break the concretes about 50 cm cube to boad them on the truck easily, and shall dispose of the broken concretes outside Plant.

2) As the foundation of the existing Pump Pit is embedded to the ground deeply, the sheathing sheet piles shall be setted up by the Contractor to excavate the foundation of Pump Pit. The Contractor shall take a suitable way for the dismantling work at the connecting portion between the existing Intake Water Ways (culverts and concrete pipes) and the wall of Pump Pit, in order to construct the side wall of Intake Open Channel easily.

3) In the case of dismantling discharge water pipes, the Contractor shall, after the completion of the dewatering of the internal water of the pipes, set up the permanent cut-off walls of the

existing discharge pipes at the designated places by the Engineer. If it is necessary for the dismantling of the dischage pipes to destroy the boundary wall, the Contractor shall set up the temporary boundary wall and the safety facilities against the third party during the dismantling work, and shall reconstruct the boundary wall that has an original structure immediately after the dismantling work.

As to the above items 2) and 3), the Contractor shall submit the actual working plans and the schedule tables to the Engineer for approval before the commencement of those works.

4.5 COOLING WATER WAY

The Contractor shall submit the hydraulic calculation note for the cooling water way to the Engineer for his approval.

4.5.1 INTAKE WATER WAY

The existing intake water ways shall be made use of intake water ways for this design.

The dimensional data of the existing intake water ways are as follows.

Intake water way No.1 (box culvert at the side of Unit I)

- 3,000 mm x 3,000 mm x 1 line

Intake water way No.2 (Concrete pipelines at the side of Unit II)

1,500 mm dia x 3 lines

As the existing intake culvert tunnel had not been used for a few decades, the Contractor shall carry out the maintenance work after the diving investigation by the Contractor, and the Contractor shall manufacture stop logs to be permanent structures, in order to close

the entrances of the existing intake water ways (culverts and concrete pipes), and the Contractor shall, before the commencement of the maintenance work and the manufacturing work of stop logs, submit the actual working plans, the drawings and the structural calculation note (for stop logs) to the Engineer for approval. Intake Open Channel shall be constructed to balance the water quantity for the two existing water ways, so the Contractor shall submit the construction design sheets (the structural calculation note and the construction drawings) for the connecting portion between the existing intake water ways and Intake Open Channel to the Engineer for approval before the commencement of the work.

4.5.2 INTAKE OPEN CHANNEL

1) Intake open channel shall consist of reinforced concrete and shall be designed to balance the water quantity (= 9.5 m^3/sec at one unit) at each Pump Pit.

2) The elevation at the top of retaining wall shall be located EL. + 5.00 m, and dimensional data are as follows.

The inside width : B = 3.0 m

The bottom floor level : EL.- 3.0 m

Stop log shall be setted up around the intermediate point of channel, and the outline of stop logs and a lifting beam shall be as follows.

a) The materials

Stop logs	:	Prestressed concrete (pieces)
The outer frame of stop logs	:	Stainless steel
Gate sheets	:	Cast iron
A lifting beam	:	Main structure shall consist

of channel steels, and a few metal fittings and rollers shall be made of stainless steel (1 set).

The water stop rubbers shall, at the front side of a stop log, be fitted up with three sides of a stop log to the exclusion of a top side of it. A lifting beam shall be automatically disconnected from stop log in the water after setting and shall be automatically connected to the hook of the next stop log in the water for lifting.

4.5.3 PUMP PIT

1) Pump pit shall be constructed the same two units and have 2-span reinforced concrete box culverts as the rigid frame structure. The structure of pump pit shall be divided into three blocks, that is, screen room, connected culvert and pump room, and the approach water velocity to screens shall be less than 0.375 m/sec.

The dimensional data of pump pit (one unit) is as follows.

a) The total width : B = 12.0 m

b) The inside width: b = 4.5 m
at one span (b'= 4.8 m at the connecting culvert)

c) The bottom floor level : EL.- 3.0 m to EL.- 4.2 m

2) Auxiliary facilities

Auxiliary facilities for one unit shall consist of pre-stressed concrete stop logs, washing pump pit and pipe trench.

a) Washing pump pit (two pit holes at one unit)

the inside diameter: ϕ 700 mm

b) Pipe trench for wash water and chlorination

the width: B_1 = 0.5 m (2 lanes)

B_2 = 0.8 m (1 lane)

the depth: H = 0.5 m

c) Stop logs and a lifing beam

The materials and the structures of stop logs and a lifting beam shall be all the same as those of Intake Open Channel, however, the quantities of stop logs shall be 12 pieces.

4.5.4 DISCHARGE TUNNEL

Discharge tunnel shall consist of a box culvert placed by the reinforced concrete and steel pipes. Steel pipes shall be setted up at the section between the outlet of condenser and the fitting portion of box culvert.

The dimensional data are as follows.

The inside diameter of steel pipe:	ϕ 2000 mm
The inside width of box culvert :	B = 2.2 m
The inside height of box culvert :	H = 2.2 m

4.5.5 OUTLET

Outlet shall consist of box culverts as the reinforced concrete structure. The 2-span box culverts (1 unit has one box culvert) shall be constructed at the entrance of outlet and the 8-span box culverts (1 unit has 4-box culverts) shall be constructed at the exit of outlet by the Contractor. The Revetment shall be constructed to retain the back-filling on the exit portion of Outlet, and the steel sheet piles shall be setted up at both ends of Revetment as the future extension to seawall, and shall be setted up

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as the cut-off wall so as to retain the foundation of Outlet. The average discharge water velocity shall be less than 0.5 m/sec in the consideration of a bad influence to the controlling of boat.

The principal dimension data are as follows.

1) Outlet

The outside width : B_1 = 5.6 m (at the entrance)

B_2 = 21.2 m (at the exit)

The outside height: H = 3.0 m

2) Revetment

Revetment shall consist of L type retaining wall supported by the buttresses.

The outside width : B = 21.2 m

The outside height: H = 4.8 m

After the detailed geological and topographic survey for the construction area due to the Contractor, if necessary, the Contractor shall redesign the structure of Outlet and shall design the temporary structures that is necessary for the construction of Outlet, so the Contractor shall submit the design drawings with the calculation sheets for those structures to the Engineer for approval. After the completion of the dewatering work for exposing a full view of the sea bottom surface within the foundation area of Outlet, as to the embankment for the foundation of Outlet, shall be executed by way of spreading the materials by each layer that the thickness is 30 cm, and shall be compacted by each layer (the thickness is 30 cm) by the use of appropriate compactors, so the Contractor shall submit the actual working plan and schedule table (including the temporary works) to the Engineer for approval before

the commencement of the work. As to the materials for the embankment, shall have a fine quality, so the Contractor shall submit the sample of the materials with the certificate of the quality to the Engineer for approval before the commencement of the work. The Contractor shall set up the safety lights on the top of the temporary structure at the sea area during the construction of Outlet, in order to ensure a safety navigation of a boat, and shall set up the reflection boards the top of Revetment immediately after the completion of the construction of Revetment, then, as to the detail of the reflection board, the Contractor shall consult with the Owner/Engineer before the setting work of it. At the time of the structural calculation of the cut-off steel sheet piles, the Contractor shall take account of the corrosion-thickness of steel sheet piles which shall be 2 mm.

4.6 OUTDOOR EQUIPMENT FOUNDATION

4.6.1 PIPE SUPPORT

Rack foundation shall consist of reinforced concrete to support the outdoor pipings and cables.

4.6.2 The foundations for raw water tank, demineralized water tank and make-up water tank

The structure of these foundations shall consist of the reinforced concrete slab supported by the cast-in-situs concrete piles.

The principal dimensions are as follows.

Structures	The size of cast-in-situs concrete piles (The deameter)		(The length)	The diameter of the foundations
Raw water tank	ϕ 400 mm	x	17.0 m	D = 13.6 m
Demineralized water tank	ϕ 400 mm	x	17.0 m	D = 11.6 m
Make-up water tank	ϕ 400 mm	x	17.0 m	D = 6.8 m

4.6.3 WASTE WATER STORAGE POND

The structure shall consist of the reinforced concrete pond as the storage for waste water and the foundation of waste water treatment, and the principal dimension data shall be as follows.

The width : B = 16.0 m

The length : L = 31.0 m

The depth : H = 6.5 m

The bottom floor level: EL.- 0.5 m

The inside surface shall be protected from acid and alkali corrosion by the proof coating.

4.6.4 WASTE WATER TREATMENT SYSTEM

1) Waste water treatment system on the upper slab of waste water storage pond shall consist of reinforced concrete pits, ponds and tanks.

The principal dimension data shall be as follows.

Items	Dimensions (inside)			Remarks
	Width	Length	Depth	
Purified waste water pit	5.0 m	8.0 m	3.0 m	The inside surface shall be protected from acid and alkali by the proof coating
Coagulated sedimentation tank	The diameter (inside) ϕ 9.0 m		4.05 m	DITTO
Sludge enrichment tank	The diameter (inside) ϕ 9.0 m		4.0 m	DITTO
Clear water pit and other pits	6.3 m	7.0 m	3.0 m	DITTO
Chemical feed pumps and tanks foundation	3.3 m	8.5 m	—	DITTO
Filter foundation	0.5 m	2.2 m	—	

2) Chemical storage tank and pump foundation shall consist of reinforced concrete placed apart from waste water storage pond.

The principal dimension data shall be as follows.

The inside width : B = 5.5 m

The inside length: L = 6.4 m

The protection wall shall be setted up at the surroundings of the foundation.

The inside surface shall be protected from acid and alcali corrosion by the proof coating.

4.6.5 CITY WATER RECEIVING FACILITY

1) The structures shall consist of reinforced concrete, and the principal dimension data shall be as follows.

Items	Dimensions (inside)			Remarks
	Width	Length	Depth	
Raw water receiving and drinking water equipment foundation	4.0 m	16.4 m	3.8 m	
Chemical tank and pump foundation	4.0 m	4.0 m	—	
Drinking water pump foundation	2.1 m	3.4 m	—	
Drinking water tank foundation	4.4 m	4.4 m	—	

4.6.6 OTHER FOUNDATION

1) Unit neutralizing pit (2 units)

The structure shall consist of reinforced concrete pit for waste water treatment.

The principal dimension data shall be as follows.

The inside width : B = 5.0 m

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The inside length : L = 10.0 m

The inside depth : H = 4.5 m (5.0 m)

The bottom floor level: EL. + 0.5 m to EL. + 0.0 m

The inside surface and the surface of slab shall be protected from acid and alcari corrosion by the proof coating.

2) Stack drainage pit (1 unit)

The structure shall consist of reinforced concrete pit, and the principal dimension data shall be as follows.

The inside width : B = 3.0 m

The inside length : L = 5.0 m

The inside depth : H = 4.0 mm (4.5 m)

The bottom floor level: EL. + 1.0 m to EL. + 0.5 m

3) Storage box for stop logs

Storage box shall consist of reinforced concrete and shall have ability to reserve stop logs for intake open channel and pump pit.

4) Dust box

The structure of dust box shall consist of reinforced concrete and one side wall made of the wood can be pulled out for carrying the dusts out.

5) Chlorination feed water pump pit

The structure shall consist of reinforced concrete pit and shall be setted up at the vicinity of pump pit for Unit I.

The principal dimension data shall be as follows.

The inside width : B = 3.0 m

The inside length : L = 5.5 m

The inside depth : H = 7.9 mm

The bottom floor level: EL. - 2.9 m

Stop logs shall be made use of stop logs for intake open channel.

6) Oil separator (2 units)

The structure shall consist of reinforced concrete and the principal dimension data shall be as follows.

Items	Dimensions (inside)			Remarks
	Width	Length	Depth	
For fuel oil service tanks	2.0 m	4.0 m	1.9 m to 2.1 m	EL. + 3.1 m to EL. + 2.9 m

7) Cable ducts

The structure shall consist of the covering reinforced concrete, sheath pipes and the reinforced concrete box culverts.

The principal dimension data for cable tunnel shall be as follows.

The inside width : B = 2.2 m

The inside height : H = 2.0 m

The bottom floor level: EL. + 1.5 m to EL. + 1.1 m

The drain-ditch (B = 10 cm, H = 5 cm) shall be setted up at the bottom floor of culvert tunnel. The contractor shall dismantle the temporaly end wall (concrete wall) constructed by Lot II-A contractor at the terminal point of cable tunnel to be between Lot I and Lot II-A.

8) Other facilities

Other facilities shall be fire hydrant system, house boiler and

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air form equipment, etc.

4.7 OTHER ANCILLARY FACILITIES

4.7.1 DRAINAGE SYSTEM

The drainage system shall consist of centrifugal reinforced concrete pipes, side ditches and catch basins.

The Contractor shall design the site drainage system and submit the construction drawing of the drainage system to the Engineer for approval.

4.7.2 ROADS

The pavement structure shall consist of asphalt pavement.

The cross-gradient is from the center of road to the edge of that shall be setted up 2 %.

The principal dimension data shall be as follows.

Type	The width of Road (m)	The thickness of asphalt (cm)	The thickness of crushed stone (cm) [20-0]	The thickness of crushed stone (cm) [40-0]
I	6 m	5 cm	5 cm	25 cm
II	4 m	5 cm	5 cm	25 cm
III	2 m	5 cm	5 cm	25 cm

If the Contractor remove the pavement of public road for the civil work, after the completion of the work, the Contractor shall reconstruct the public road that has the original structure.

4.8 AUXILIARY BUILDINGS AND OUTDOOR EQUIPMENT FOUNDATIONS

4.8.1 CHLORINATION EQUIPMENT AREA AND CONTROL ROOM (Unit-I)

(1) Dimensions

Building area	315.0 m^2
Maximum height	GL + 70.5 m
Building volume	1,930.5 m^3

(2) Structure

Piling	Cast in Situ RC
Substructure	Reinforced concrete
Superstructure	Reinforced concrete
Roof and floor	Reinforced concrete
Wall	Concrete hollow block

4.8.2 WATER TREATMENT CONTROL ROOM (Unit-I)

(1) Dimensions

Building area	480.0 m^2
Total floor area	690.0 m^2
Maximum height	GL + 13.7 m

(2) Structure

Piling	Cast in situ RC
Substructure	Reinforced concrete
Superstructure	Reinforced concrete (Partialy structural steel)
Floor and Roof	Reinforced concrete With acid and alkali proof coating as specified

4.8.3 FUEL OIL TRANSFER PUMP AREA (Unit-I)

(1) Dimensions

Building area	40.0 m^2
Maximum height	GL + 4.0 m

(2) Structure

Piling	Cast in situ RC
Substructure	Reinforced concrete
Superstructure	Reinforced concrete
Roof	Reinforced concrete
Floor	Reinforced concrete

4.8.4 FUEL OIL HEATER AREA (Unit-I and Unit-II)

(1) Dimensions

Building area	126.0 m^2
Maximum height	GL + 7.5 m

(2) Structure

Piling	Cast in situ RC pile
Substructure	Reinforced concrete
Superstructure	Reinforced concrete
Roof	Reinforced concrete
Floor	Reinforced concrete

4.8.5 FLUE GAS DUCT FOUNDATION (Unit I and Unit II)

The work shall consist of cast in situ reinforced concrete pile and concrete foundations which support the support structures for the flue gas duct.

4.8.6 FUEL OIL SERVICE TANK FOUNDATION (Unit I and Unit II)

(a) Foundations of fuel oil service tanks shall be constructed.

(b) The tank foundations shall be constructed by reinforced concrete slab of 8.9 m in diameter, and supported by cast in situ RC pile of 450 mm in diameter and 16 m in length for each pile.

(c) The Contractor shall furnish and install drainage pipings, valves and pits to the oil separator.

4.8.7 TURBINE OIL STORAGE TANK FOUNDATION (Unit I)

The foundation of 5.0 x 8.0 x 0.3 m thick of reinforced concrete for turbine oil storage tank shall be provided.

The 0.7 m high reinforced concrete dike surrounding the tank shall be provided.

Piling ----- Cast in situ RC pile

Drainage system from the foundation to oil separator shall be provided.

4.8.8 H_2 GAS GENERATING EQUIPMENT ROOM (Unit II)

(1) Dimensions

Building area	45.0 m^2
Maximum height	GL + 5.35 m

(2) Structure

Piling	Cast in situ RC pile
Substructure	Reinforced concrete
Superstructure	Reinforced concrete and structural steel
Roof	Corrugated cement sheet
Floor	Reinforced concrete

4.8.9 WAREHOUSE (Unit II)

(1) Dimensions

Building area	480 m^2
Total Building are	912 m^2
Building volume	4,800 m^3
Maximum height	GL + 10.8 m

(2) Structure

Piling	Cast in situ RC pile
Substructure	Reinforced concrete
Superstructure	Reinforced concrete
Roof and floor	Reinforced concrete
Wall	Concrete hollow block

4.8.10 GUARD HOUSE (Unit II)

(1) Dimensions

Building area	108 m^2
Maximum height	Gl + 3.8 m
Building volume	388.8 m^3

(2) Structure

Piling	Cast in situ RC pile
Substructure	Reinforced concrete
Superstructure	Reinforced concrete
Roof and floor	Reinforced concrete
Wall	Concrete hollow block

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4.9 ADMINISTRATION BUILDING (Unit II)

(1) Dimensions

Floor area:	Ground floor	711.8 m^2
	First floor	711.8 m^2
	Second floor	711.8 m^2
	Third floor	711.8 m^2
	Penthouse	42.3 m^2
	Total area	2,889.5 m^2
Height of each floor:	Ground floor	GL + 0.2 m
	First floor	GL + 5.2 m
	Second floor	GL + 9.2 m
	Third floor	GL + 13.2 m
	Roof	GL + 17.2 m
	Top of parapet	GL + 18.05 m
	Top of penthouse	GL + 21.4 m
Building volume		12,278.3 m^3

(2) Structure

Piling	Cast in situ RC pile
Foundation	Reinforced concrete
Framing	Reinforced concrete
Floor and Roof	Reinforced concrete
Wall	Reinforced concrete and concrete hollow block

(3) Interior and exterior finishes

As indicated in the Drawings

4.10 BUILDING SERVICE FACILITIES

The building service facilities for main powerhouse and auxiliary buildings shall be as indicated in the table below.

	Main power-house Unit-I -II	Administ-ration Building Unit-II	Water treatment equipment and control room Unit-I	Ware-house Unit-II	Cholori-nation equipment area and control room Unit-I	Guard house Unit-II
1.Air conditioning equipment work	o	o	o	---	---	o
2.Ventilation equipment work	o	o	o	o	o	o
3.Secondary electrical and automatic control work	o	o	o	o	o	---
4.Water supply equipment work	o	o	o	---	---	o
5.Sewage and aeration equipment work	o	o	o	---	---	o
6.Hot water supply equipment work	o	o	---	---	---	---
7.Sanitary equipment work	o	o	o	---	---	o
8.Clarification tank equipment work	o	o	o	---	---	o

4.11 DISMANTLING WORKS OF "B AND BX STATION" SUBSTRUCTURE

The Contractor shall dismantle the foundations/structures, piping, facilities and so on of "B and BX Station" below the ground floor level, including pulling-out of cast-in-situ reinforced concrete piles.

Boiler room "B" Station

Main substructure	: Reinforced concrete footing foundations, tie beams and slab Cast-in-situ reinforced concrete piles
Area	: 46.0 m x 22.0 m

Turbine room "B" Station including Transformer room

Main substructure	: Reinforced concrete footing foundations, tie beams and slab Cast-in-situ reinforced concrete piles 2 T/G concrete foundations
Area	: 46.0 m x 22.0 m

Stack "B" Station

Main substructure	: Reinforced concrete foundation Cast-in-situ reinforced concrete piles
Dimensions	: Unknown

Misc. foundations and wall of "B" station

Main substructure	: Reinforced concrete foundation
Dimensions	: Area 49 m x 9 m

Boiler room "BX" Station

Main substructure	: Reinforced concrete footing foundations, tie beams and slab Cast-in-situ reinforced concrete piles

Area : 13.6 m x 7.2 m x 2 structures

Turbine room "BX" Station

Main substructure : Reinforced concrete footing foundations, tie beams and slab

Cast-in-situ reinforced concrete piles

2 T/G concrete foundations

Area : 31.0 m x 56.0 m

Stack "BX" Station

Main substructure : Reinforced concrete foundation

Cast-in-situ reinforced concrete piles

Dimensions : 25'-0" Dia. 5'-0" Depth

Transformer yard foundations of "BX" Station

Main substructure : Reinforced concrete foundations

Cast-in-situ reinforced concrete piles

Area : 41.0 m x 9.0 m

5. THE MEASURES AGAINST THE SAFETY

5.1 THE SAFETY FOR THE WORK AT THE VICINITY OF THE RAILROAD

1) The Contractor shall submit the working plans to the Engineer about the following items before the commencement of this work.
   - i) The plan for supporting the railroad during the civil work.
   - ii) The definite plan for the implimentation of the regulation related to the administrator of the freight train.
   - iii) The definite plan for the implimentation of the regulation related to the working time.
   - iv) Other working plans for the preservation of the railroad.
2) The Contractor shall keep the working plan after approved by the Engineer.

5.2 THE PRESERVATION OF THE BURIED STRUCTURES

1) The Confirmation of the buried structure

   The Contractor shall make sure of the location of the buried structure by the test-pit digging at the prospective place for the existing buried structures.

2) The shaft sinking and the trench excavation

   In the case of driving piles and drillings on the road, the Contractor shall research the buried structure as far as the prospective depth (about 2 m) to the exclusion of the case that the buried structures are nothing, and the Contractor shall expose the buried structures by way of the shaft sinking or the trench excavation when they were confirmed. Furthermore, after confirmed by the administrator and the Engineer, the Contractor shall remove or replace the buried structures on his

responsibility.

3) The Preservation of the exposure buried structure

The Contractor shall prevent the exposure buried structures and the important buried structures around the excavation area from the injury and the public disaster, in particular, the dangerous and important buried structures shall be inspected regularly by the Contractor during the civil work.

4) The Excavation at the vicinity of the buried structure.

The Contractor shall prevent the buried structure from the ground relaxation and the ground settlement by the excavation at the vicinity of the buried structure.

5) Fire

The Contractor shall not use welder and other instruments with fire at the vicinity of the combustible buried structures.

5.3 THE SAFETY MEASURES TO TRAFFIC

1) Information to the neighborhood

The Contractor shall take care of the intention of the neighborhood during the civil work and shall contact with the Engineer frequently. Furthermore, if it is necessary to carry out the safety control, the Contractor shall prevent the passengers from any obstruction as much as possible, and the Contractor shall fully inform the passengers of the traffic control condition.

2) The way to be setted up the movable barricades

a) If the Contractor set up the movable barricades continuously, in principle, the interval of barricades shall be less than the length of a barricade, and the safety lamps and the safety cones shall be setted up at the intervals of the barricades to

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clear the working area.

b) If the movable barricades shall be setted up so as to have the bend area, this area shall not have an interval, and if the barricades shall be setted up at the area in the face of the traffic flow, in principle, the barricades shall be setted up so as to have the approach area and so as not to have an interval.

c) At the pathway for the pedestrians and the bicyclists along the barricades, and the contractor shall set up the barricades so as not to make a clearance by way of stringing the safety ropes.

3) The Entrance of the working area

a) At the entrance of the working area, in principle, the Contractor shall set up a sliding gate and close the gate if unnecessary to open, furthermore the Contractor shall put up a sign based to prevent the entrance of a third person to site. However, if the working vehicles are busy for incoming and outgoing at the gate, the Contractor shall dispose the guard man for the guidance of the vehicles.

b) The Operators of the working vehicles shall take care of the structures belonged to the public roads and the safety facilities for the traffic, if any injury to the road facilities will be occurred, the Contractor shall repair them as soon as possible in accordance with the order of the road administrator.

c) If other works are executed at the vicinity of the working

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area, the Contractor shall adjust the guidance way for the working vehicles by consulting with other Contractors.

4) The road sign

a) The Contractor shall take suitable measures to prevent a traffic accident, a traffic jam and a trouble to a passenger during the civil work on the public road, accordingly, after the study of the smooth traffic flow during the work, the Contractor shall set up the necessary road marks and the sign boards in accordance with the order of the road administrator and a chief police officer concerned.

b) If necessary to set up the facilities for the work at the visual field that has the height is between 0.8 m and 2.0 m from the road surface, the Contractor shall take suitable measures so as not to prevent the passengers from their visual field.

c) The road marks and the sign boards to be informed the work shall be setted up on the place to be easy to see from the road side or the roadcenter where is located between a distance of 50 m and 500 m ahead of the working area.

5) The safety light

In the case of the night work on the road, the Contractor shall set up the safety lights along the barricade, which has the height is about 2.0 m and the brightness can be recognized it from a distance of 150 m ahead of the working area. In this case, an interval of the safety lights shall be setted up about 2.0 m at a portion in the face of the traffic flow, and shall

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be setted up less than 4.0 m at other portions, in particular, the Contractor shall take care of setting up the safety lights at the corner of the barricade.

6) The Maintenance work for the road surface

The Contractor shall, in principle, after the completion of the backfilling work at the excavation area, take a step to carry out the work for the temporary pavement or the lining, at this case, those works shall be carried out so as not to cause the difference in level between the excavation area and the surrounding road surface. If it is occurred by an inevitable reason, the Contractor shall set up the approach portion to the difference in level by the grade to be less than 5 percent, and if it is impossible, the Contractor shall notify the traffic vehicles of the difference in level by the sign boards.

7) The Road way width

The Contractor shall, if it is necessary to carry out the restriction of the traffic on the public road for the civil work, obey the order of the road administrator and a head police officer concerned. If no order, the Contractor shall keep the following items during the work.

a) If the traffic lane becomes one lane after the restriction of the traffic, the roadway width shall be more than 3.0 m, and in the case of the two traffic lanes, all roadway width shall be more than 5.5 m.

b) If the traffic lane becomes one lane, after the restriction of the traffic, the Contractor shall set up the restriction area as small as his possible, and shall take a step so as not to

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cause a traffic jam nearby the restriction area, if necessary, the Contractor shall dispose the guard man for the guidance of traffic vehicles.

8) The Measures to the pedestrians

The Contractor shall set up the pathway that has the width shall be more than 0.75 m in order to keep the safety passage of the pedestrians.

9) The roadway drainage

The Contractor shall set up the drainage facilities (pipes, pits, etc.) at the working area on the public road in order to keep the safety passage for passersby and traffic vehicles.

5.4 THE MEASUREMENT TO THE NEWLY AND THE EXISTING MAIN STRUCTURES

If the Contractor carries out the work at the vicinity of the newly and the existing main structures, for example, fuel oil tanks, etc., the Contractor shall submit the actual working plan to the Engineer for approval before the commencement of the work, and shall carry out the measurement of the ground settlement for the foundation of the aforesaid structures at the commencement of the work, during the work and at the completion of the work, and after measurements, the Contractor shall inform the Engineer of the results of the measurements in writing as required by the Engineer.

PART-III

SECTION II

TECHNICAL SPECIFICATIONS

PART III

SECTION II

TECHNICAL SPECIFICATIONS

CONTENTS

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1. TEMPORARY WORK

1.1 GENERAL

This clause covers the furnishing of all appliances, labor, materials, tools, transportation and services required to perform and complete all preliminary work and temporary construction.

The items of temporary work are not paid items.

1.2 THE SHEATHING WORK

1) The Excavation with the sheathing work

The Contractor shall carry out the sheathing work if the excavating depth is beyond 1.5 m or if impossible to retain the ground slope. In this case, the Contractor shall carry out the sheathing work by the use of the driving piles and steel sheet piles if the excavating depth is beyond 4.0 m.

2) The structure of the sheathing work

The design calculation of the sheathing wall shall be carried out by the Contractor in accordance with the authorized technical guideline and standard, and the structure of the sheathing wall shall be fully applied to the calculation results during the work in consideration of the bad condition due to the rainfall and other climatic conditions. The Contractor shall submit a sheathing work plan and a structural calculation note for the sheathing wall to the Engineer for approval before the commencement of the sheathing work.

3) The embedded depth of a pile and a sheet pile

The embedded depth of a pile and a sheet pile shall, in principle, be setted up more than 1.5 m from the designed excavation level.

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4) The dimension of the sheathing piles

I section steel and H section steel shall be adopted for the standard sheathing piles that have the frange shall be more than 15 cm length, the sectional area is more than 30 cm^2/m and the inertia moment is more than 5000 cm^4/m.

5) The dimension of the sheathing plate

The standard sheathing plate shall have the thickness shall be more than 3 cm and the clearance of the length can be extended about 4 cm on the franges of sheathing piles at both ends.

6) The dimension of the sheathing sheet piles

The standard sheathing sheet piles shall, per 1 m wall width, have the sectional area shall be more than 180 cm^2/m and the inertia moment shall be more than 16000 cm^4/m.

7) Fitting the sheathing plate to sheet piles

Fitting the sheathing plates to sheet piles shall be setted up right away after the excavation so as not to make an opening. However, if the opening will be occurred, the back filling and the wedge shall be setted up in the opening.

8) Wale

a) Wale shall be setted up to attach the inside of the sheathing wall by the penetration of packing if any opening occurred between the sheathing wall surface and wale, and the Contractor shall use the wale has the rigidity to be fully endured against the external force by the use of the supporting metal fitting and the suspended wire.

b) The length of wale shall, in priciple, be more than 6 m.

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c) The vertical distance of wale shall be about 3 m, and the upmost wale shall be setted up about 1 m from the top of the sheathing piles and the sheet piles.

9) Strut

a) Strut shall be setted up firmly to wales by the use of wedges, if the looseness occurred, strut shall be supported by the metal fitting and the suspended wire so as not to fall.

b) Strut shall have a sufficient sectional area and the rigidity not to be caused the buckling.

c) Strut shall, in priciple, not have a joint. However, if the width of the excavation is too large, or in the inevitable case, the joint can be setted up in the strut. In this case, the structure of the strut shall be provided by the following items.

i) The joint of strut shall have the fully structural strength against the safety and have the reinforced connecting member (vertical and horizontal) against the buckling.

ii) If the intermediate pile is setted up, the alignment of the intermediate piles shall be connected by the member applied similary to wale, and this member shall be connected to the strut firmly by the use of U-bolt or other metal fittings.

iii) If the intermediate piles are setted up to the strut at the one direction, the member applied to wale shall be tied up to both ends of piles, which is similar to strut is setted up between wale and this member.

iv) If the struts shall be setted up at the two directions, the intermediate piles shall be setted up to tie up with both struts at the intersection points of the struts, and the joints of the struts shall be setted up at the points to be within 1 m from the intersection points of the struts, and shall be reinforced by the diagonal members so as not to expect the rigidity of the intermediate piles.

d) Strut shall, in principle, be setted up at the horizontal interval which shall be less than 5 m and at the vertical interval which shall be less than 3 m in accordance with the process of the excavation.

10) The Deformation of the pile and the sheet pile

If the driving piles and sheet piles can not be penetrated on account of the hardness of soil or the deformation of piles occurred by the obstraction in soil, the Contractor shall submit the appropriate reinforcing plan for piles to the Engineer for approval.

11) The Superintendence for the sheathing work

a) The Contractor shall dispose the superintendent during the sheathing work, in order to inspect the site everyday for the early detection of the deformation of the sheathing members and the looseness of the fitting portion, which is excecuted from the standpoint of the prevention of accident.

b) The Contractor shall, if necessary, constantly record the survey data for the ground water level, and the ground settlements and the ground movement during the sheathing work, if the upheaval, the settlement or other abnormal

conditions are occurred in the site, after taking suitable measures to protect the buried structures, the Contractor shall inform this matter to the Engineer and the administrator of the buried structures.

12) The special excavating work

The Contractor shall take care of the upheaval of the ground and the ground settlement in the case of using the chemical grouting work and the well point method, if it is possible to do harm to the circumstance by the use of those methods, the Contractor shall take suitable measures to protect the harm in accordance with the provisions of subclause 11) in this clause.

1.3 The lining

1) The design load and the allowable stress for the main members

The Contractor shall use the design load and the allowable stress for the main members approved by the Engineer for the design of the lining facilities.

2) The lining plate

The steel lining plate or the reinforced concrete lining plate shall be commonly adopted for the lining plate. In this case, the Contractor shall take care of the exhaustion of the underground area.

3) The surface of the lining area

a) The lining plate shall be setted up so as not to cause the difference in level at the surface, if it is impossible, the difference in level shall be limited less than 20 mm.

b) The lining plate shall be setted up so as no to cause an opening among the lining plates at these surface.

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4) The fitting portion

The opening at the fitting portion shall, if it between the lining area and the road area, be filled up with the cement concrete or asphalt concrete or other materials approved by the Engineer.

5) The slip protection

The slip protection shall be fitted up at the surface of the lining plates.

6) The setting of the lining plates

a) The lining plates shall be setted up so as not to cause the bound by the traffic vehicles and the slip to the horizontal direction by the brake.

b) The spring washer shall be fitted up to the supporting beam by the use of bolts, and the location of the bolt-hole shall be separated a suitable distance from the end of the lining plate, in order to protect the damage by the horizontal force to the lining plate, and a head of bolt shall not be appeared on the surface of the lining plate.

c) If the steel lining plates are supported by the two points on the beam, the steel lining plate shall be tied up to the beam by bolts and shall have the rubber for the slide protection as the cushion to the beam.

7) The supporting area for the lining plate

The supporting area for the lining plate on the beam shall be taken up sufficiently to protect the damage.

8) The supporting beam for the lining plate

a) The steal beam shall, in principle, be commonly adopted for

the supporting beam for the lining plate, and not be combined with the suspending beam for the transport pipes.

b) The above mentioned beam shall have the required strength and the displacement occurred by the living load, which the displacement shall be commonly less than the four hundredths of the maximum span length or 2.5 cm at the intermediate point.

9) The supporting portion for the supporting beam of the lining plate

a) The supporting beam for the lining plate shall, if necessary, be fixed firmly so as not to cause the settlement and the slide at the both ends or at the intermediate point.

b) Relating to the above item, if the stress at the fixed point shall be supported by the sheathing piles, the sheathing sheet piles and the intermediate piles, the top of the sheathing piles shall be tied up with the channel steel or the angle steel at the two sides of piles, and the supporting beam for the lining plates shall be fixed to the channel steel or the angle steel.

c) The channel steels or the angle steels shall be tied up to the supporting beam at the longitudinal direction in order to distribute the load due to the supporting beam to the sheathing piles as many as possible.

10) Carrying the members for the lining

a) When the members for the lining are carried, if a few lining plates are removed, the Contractor shall set up the movable barricade at the circumference and dispose the guard man to prevent the entrance by a third man.

b) If the work for carrying the members is finished, the Contractor shall reset the lining plates.

11) Maintenance

At the lining area, the Contractor shall dispose the maintenance personal to maintain the function of the lining plates by the regular inspection and shall, in principle, take care of the following items.

a) The Contractor shall take care of the decrease of the strength for the lining plate by the wear or the deficit to the supporting beam, and the Contractor shall maintain the required strength of a lining plate at any case.

b) The Contractor shall carry out the regular maintenance and the regular exchange so as not to induce the decline of the function caused by the detachment of the slip protection or the wear of it.

c) The Contractor shall maintain so as not to cause the relaxation at the fixed point by the looseness of bolts and nuts.

d) The Contractor shall commonly ready the spare lining plates during the lining work.

1.4 LEVELING AND CENTERING

The Contractor shall confirm the conditions of the building site and shall mark the location of the buildings by staking out, and this shall be subject to approval by the Engineer.

After marking, batterboards shall be strictly set at the corners of the buildings and at other necessary locations. The batterboards shall indicate clearly the location and level of the building and

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shall be subject to inspection and approval by the Engineer.

1.5 TEMPORARY ENCLOSURES

The Contractor shall provide temporary enclosures for safety of work or for other reasons, if so directed by the Engineer.

1.6 OBSTRUCTIONS

The Contractor shall remove obstructions which may cause trouble, if so directed by the Engineer.

1.7 SCAFFOLDINGS AND RUNWAYS

The Contractor shall furnish and maintain all required scaffolding, runways, guard rails, platforms, access stairs and other necessary pertinents. The plans for temporary facilities of each work shall be submitted to the Engineer for approval prior to commencement of the works.

2. EARTH WORK

2.1 SCOPE

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

2.2 EXCAVATION

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

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

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

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

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

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structures.

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

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

2.3 DEWATERING

1) If the Contractor carries out the excavation work, the Contractor shall set up the drain pit at the excavation area as soon as possible when the excavating depth attains to the required depth.

2) After the receiving of the permission by the administrator of sewage and port, the Contractor shall arrange the drainage at the excavating area with the passage of the sedimentation basin and the filtration facilities, in order to prohibit the discharge of the drainage into the roads or other existing facilities.

3) If much spring water and leakage is occured at the excavating area, the Contractor shall prevent the work area from the outflow of the soil and the relaxation of the ground by way of the chemical grouting work (Vid. 2.9 of this Clause) or other suitable works.

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4) Adequate pumping facilities shall be provided, maintained and ready for immediate use at any time during the progress of the construction work up until backfilling. The dewatering facilities which are necessary for the execution of the construction shall be provided according to the construction drawings approved by the Engineer.

2.4 SHORING

Shoring shall be of the type that is safe and suitable to the conditions of foundation and ground water. If sheet piles or retaining piles are to be driven, buried structures at piling locations and in the vicinity shall be investigated and confirmed as being made safe by manual trench excavation, etc., prior to piling so as to protect these structures from damage.
When piles are to be pulled out, care shall be taken not to cause any damage to buried structures.

2.5 BACKFILLING

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

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

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

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

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

(5) In backfilling, the layer of spreading shall be about 50 cm or less per lift under EL. + 3.8 m and about 30 cm or less per lift above EL. + 3.8 m to EL. 4.8 m. It shall be graded as horizontally as possible, and shall be sufficiently compacted by hydraulic filling or by use of an appropriate compactor, such as a rammer.

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

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

In particular, backfilling for buried pipes, culverts and the

like shall be uniform and the same level for all directions so as to preclude the possibility of nonuniform earth pressure. No stones or the like shall be used for backfilling.

(8) If it is necessary to bury the piles and the steel sheet piles, the Contractor shall drive or cut off the piles and the steel sheet piles under the directed level by the Engineer at the upper end of piles and the sheet piles.

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

2.6 DISPOSAL OF EXCAVATED MATERIAL

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

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

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

2.7 RUBBLE STONE

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

(2) The compaction shall be executed by a machine compact method (rammer or tamper), and shall be inspected by the Engineer.

Tamping with rammers shall be performed more than 3 times.

2.8 SLOPE PROTECTION OF EXCAVATED SURFACE

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

2.9 CHEMICAL GROUTING WORK

1) The fundamental items with the design and the construction

The contractor shall take a suitable measure in accordance with the condition of the ground water and the public water area. The Contractor shall submit the working plan and the data for the chemical grout to the Engineer for approval before the commencement of the work.

2) The chemical grouting test at the site

Before the commencement of the chemical grouting work, the Contractor shall carry out the chemical grouting test at the site in accordance with the working plan for the chemical grouting work.

3) The Measures to the chemical grouting

a) The Contractor shall take a suitable measure so as to mix the chemical grout adequately at the grouting work.

b) If the emergency condition will be happened during the work, the Contractor shall take a suitable measure to investigate of the cause of it as soon as the stop of working.

c) If the Contractor carries out the chemical grouting work at the visinity of the buried structures, the Contractor shall

take a suitable measure to prevent the outflow of chemical grout along the buried structures.

4) The Storage for the chemical grout

The Storage for the chemical grout shall be carried out by the Contractor so as not to be overflowed and stolen.

5) The Disposal of the discharge for the chemical grouting work

a) In the case of the discharge of the wash water for the grouting instruments and the drainage for the spring water from the grouting area, the Contractor shall set up the disposal facilities to make good the water purity approved by the Engineer before the discharge to the public water area.

b) As to the mud with the drainage occurred at the disposal facilities, the Contractor shall dispose of the mud suitably in accordance with the laws related the disposal of industrial waste and the garbage or other ordinances concerned.

6) The disposal way for the existing soil and the residual materials

a) If the Contractor disposes of the excavating soil occurred in the chemical grouting work area, the Contractor shall take a suitable measure so as not to contaminate the ground water and the public water area.

b) If the Contractor disposes of the residual materials, the Contractor shall take a measure to prevent the neighborhood from the health injury.

3. PILING WORK

3.1 GENERAL

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

3.2 APPLICABLE STANDARDS

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

3.3 STEEL PIPE PILES

3.3.1 MATERIALS

All materials to be supplied by the Contractor shall be in accordance with the following Japanese Industrial Standards, or equivalent.

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

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

The Contractor shall submit the Mill Sheets to the Engineer for approval, prior to starting the fabrication.

3.3.2 SHOP DRAWINGS

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

3.3.3 WORKMANSHIP

(1) GENERAL

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

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

(2) TIP REINFORCEMENT

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

(3) CUTTING AND GROOVE FACE FINISH

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

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

(4) WELDING

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

(5) SHOP TEST AND INSPECTION

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

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

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

(6) OTHERS

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

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

. Pile mark

. Pile size; diameter and length

. Level indicating line

(every 50 cm)

3.3.4 DRIVING

(1) PILE DRIVING

(a) Piles shall be driven by a pile driver suitable for the type and size of the piles, geological conditions and construction environment. The capacity of piling hammer shall be as follows.

Capacity of Minimum Piling Hammer

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

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

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

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

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

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

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

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

(i) When eccentric error exceeds the allowable values shown in the table below or when a pile is damaged or cracked during piling operation, it shall be reported to the Engineer, and the pile shall be replaced or an additional shall be driven.

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

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

(2) SHEET PILING DRIVING

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

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

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

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

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

. Alignment of center line of wall: ± 10 mm

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

(d) If damage or mis-joining of the joint of sheet pile occurs, the sheet pile shall be pulled out and redriven. If it is

impossible to pull out the pile, the direction of the Engineer shall be required.

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

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

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

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

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

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

3.3.5 FIELD JOINING OF PILES

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

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

Prior to execution, the Contractor shall submit to the Engineer for approval the list of welders showing the name, age, length of experience, types of test passed, qualifications and employment particulars.

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

Welding rods shall be completely dry prior to use.

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

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

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

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

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

(9) The H-section steel pile shall be joined on a barge.

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

3.3.6 TREATMENT OF PILE HEAD

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

(2) After completion of driving, the heads of H-section steel piles shall be cut to the specified height specified in the Drawings. All adjacent steel piles shall be connected by

using steel materials so as to avoid inclination of driven piles and to maintain constant interval of the respective piles.

3.3.7 TRANSPORTATION AND HANDLING

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

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

3.3.8 REPORTS OF PILING

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

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

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

Ra : Allowable bearing capacity for long term (ton)

S : Penetration (cm)

K : Rebound (cm)

F : Blow Energy (t, cm)

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FORM 1

PILING DATA Dated _____

POWER PLANT

PILE MARK AND NO. .....
WEATHER .....

TYPE OF PILE .....
SHAPTE OF TIP .....

DRIVING MACHINE .....

LOCATION .....
PERSON IN CHARGE .....
WELDER .....
SHAPE OF JOINT .....
WEIGHT OF HAMMER .....

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

REMARKS:

PILING DATA

Type to soil	N-valve	Ground level EL+	Penet-ration m.	EVERY 50 CM			NUMBER OF STRIKE/50 CM	CALCULATED LOADING CAPACITY				
				Number of strike	Penetra-tion per strike	Total strike	Pentration/Strike	Hight of hammer drop	Penetra-tion strike	Rebound	Weight of hammer	Calcu-lated bearing capacity
				LEVEL OF TIP GL+ _____ m DEPTH OF PENETRAION GL- _____ m								

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FORM 3

WELDING DATA

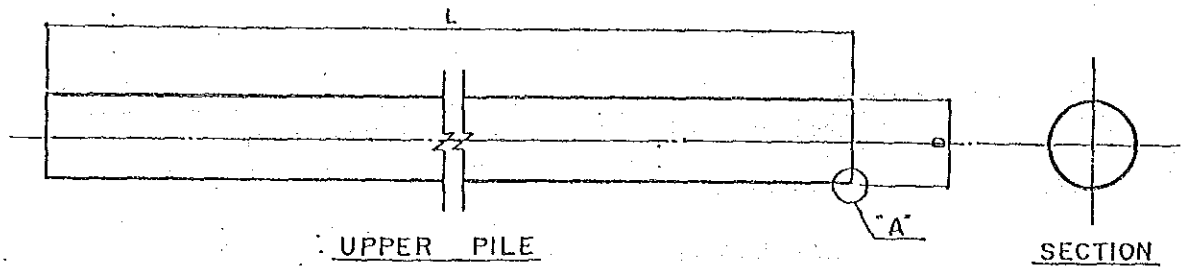
	Project: WEST WHARF THERMAL POWER PLANT		
Pile	Dimension		
	Pile Mark and Number		
Weather Conditions	Month, Date, Year		
	Weather		
	Wind Velocity and Direction	m/sec	
	Temperature	^{o}C	
Joint	Level (Above ground)	cm	
	Root	mm	
Welding Conditions	Temperature of Weld Portion (Preheated)		
	Welding Machine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

Results of Inspection:

Remarks:

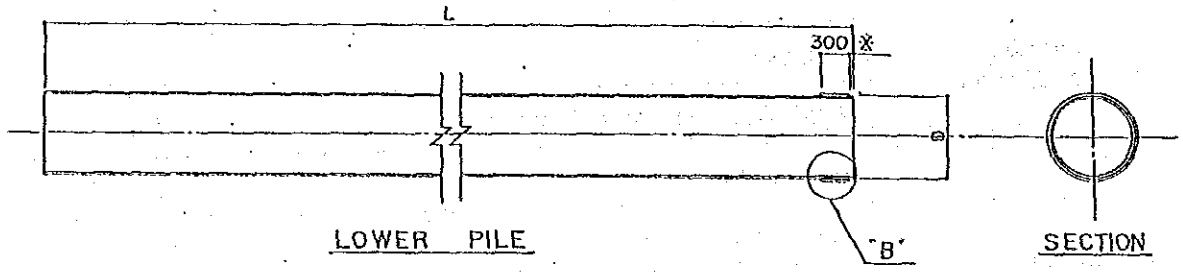
STANDARD DETAIL PLATE

PLATE NAME	PLATE NO.
STEEL PIPE PILE	SDP — —



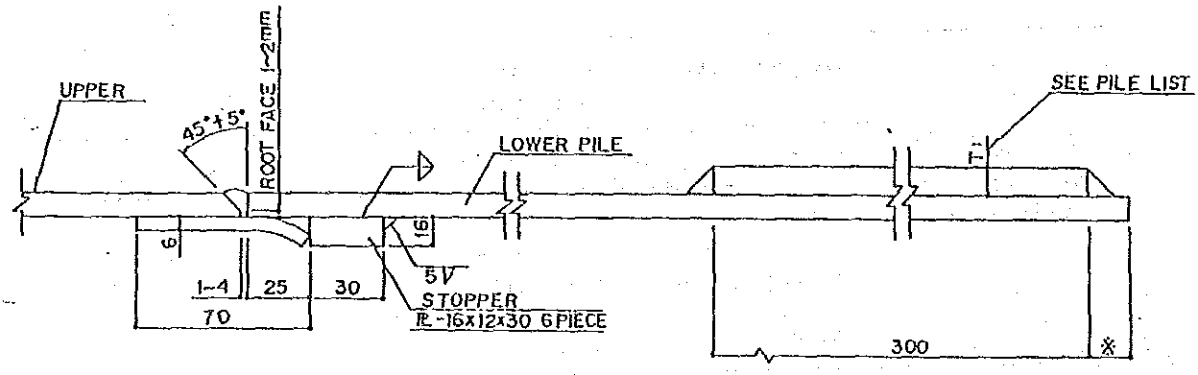
UPPER PILE

SECTION



LOWER PILE

SECTION



DETAIL "A"

DETAIL "B"

NOTES

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

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3.4 CAST-IN-SITU CONCRETE PILES WORK

3.4.1 CONSTRUCTION METHOD

The Contractor shall set up the casing pipe that has the inside diameter D' = D (the designed diameter of a pile)

+ a (the clearance = 50 mm)

for the ensurance of the designed diameter of a pile.

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

3.4.2 MATERIALS

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

3.4.3 BORING

(1) Boring

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

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

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

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

(2) Drilling fluid

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

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

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

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(3) Concreting

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

4. CONCRETE WORK

4.1 GENERAL

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

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

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

4.2 APPLICABLE STANDARDS

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

4.3 CLASSES OF CONCRETE AND USAGE

4.3.1 STRENGTH REQUIREMENTS

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

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

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

4.3.2 USAGE

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

(1) Class A Concrete

For stop log

(2) Class B Concrete

For stack and T/G pedestal

(3) Class C Concrete

Not used

(4) Class D Concrete

For all concrete work in the buildings and structures of the power plant, unless otherwise specified.

(5) Class E Concrete

For slabs on grade, unless otherwise specified.

(6) Class F Concrete

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

4.4 MATERIALS

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

4.4.1 CEMENT

(1) Description

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

(2) Samples and testing

Cement shall be sampled either at the mill or at the site of the work in an approved manner and tested as prescribed in JIS R-5201 and R-5202. Tests shall be made by a cement manufacturer, a recognized laboratory, or a testing agency approved by the Engineer. No cement shall be used until notice has been given by the Engineer that the test results

are satisfactory. Cement that has been stored, other than in the bins at the mills, for more than four (4) months after being tested shall be retested before use. Cement delivered at the site of the work and later found under test to be unsuitable shall be removed from the work and its vicinity.

4.4.2 AGGREGATE

(1) Description

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

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(2) Quality

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

Quality of Gravel, Sand and Crushed Stone

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

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

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Quality of Blast Furnace Slag

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

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

(3) Grading

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

Standard Grading of Gravel and Sand

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

Note: Values in ( ) are for reference.

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(4) Maximum size of coarse aggregate

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

Maximum Size of Coarse Aggregate by Place of Use

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

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

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

(5) Testing

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

4.4.3 WATER

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

Water shall conform to the following requirements.

Quality Requirement of Water

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

(2) Testing

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

4.4.4 ADMIXTURES

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

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

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

4.4.5 REINFORCEMENT

(1) Reinforcing bar

Reinforcing bars shall confirm to ASTM A615 Gr.40, or equivalent. Certified copies of mill reports shall accompany deliveries of reinforcing bar.

(2) Mesh reinforcement

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

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

4.4.6 FORM

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

However, form of T/G pedestal shall be of plywood having 15 mm thickness or more.

4.4.7 STORAGE

(1) Cement

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

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

permission for its use from the Engineer.

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

(2) Aggregate

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

(3) Admixtures

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

(4) Reinforcement

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

4.5 PROPORTIONING OF CONCRETE MIXES

4.5.1 MIX DESIGN

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

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

The mix proportion shall be designed in due consideration of variance in the quality of concrete under anticipated working

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conditions so that the required workability, strength, durability and other properties will be obtained.

The design mix proportion shall be proven satisfactory through trial mix and testing for 7 or 28 days compressive strength and shall be approved by the Engineer well in advance of commencement of the work.

4.5.2 SLUMP TEST

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

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

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

4.5.3 PROPORTIONING STRENGTH

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

a - Specified design strength

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

c - Standard deviation of concrete strength

4.5.4 WATER-CEMENT RATIO

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

4.5.5 UNIT CEMENT CONTENT

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

4.6 READY-MIXED CONCRETE

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

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

4.7 FIELD-MIXED CONCRETE

4.7.1 TYPE OF BACKING AND MIXING PLANT

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

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

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4.7.2 ARRANGEMENT

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

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

4.7.3 WATER-BATCHER AND DISPENSER FOR ADMIXTURE

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

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4.7.4 MOISTURE CONTROL

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

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

4.7.5 SCALES

Adequate facilities shall be provided for the accurate measurement and control of each of the materials entering each batch of concrete. The accuracy of the weighing equipment shall

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

4.7.6 RECORDERS (FOR SEMIAUTOMATIC TYPE)

Not more than two accurate recorders shall be provided for a semiautomatic plant. Each recorder shall be housed in a cabinet that is capable of being locked, and shall be in a position convenient for observation by the plant operator and the Engineer. One recorder shall produce a printed or autographic record on a single visible chart or tape of the weights of all of the aggregates as batched, and after the batcher is discharged shall return to zero. One recorder shall produce a printed or autographic record on a single visible chart or tape of the weight of the cement as batched, and after the batcher has been

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discharged shall return to zero. The weight or volume of water shall likewise be recorded if batched at a central batching plant. The charts or tapes shall clearly indicate the different types of mixes used by stamped letters, numerals, colored ink or other suitable means, and shall be so marked that variations in batch weights of each type of mix can be readily observed. The charts and tapes shall show time of day (stamped or preprinted) at intervals of not more than 15 minutes.

4.7.7 PROTECTION

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

4.7.8 CONCRETE MIXERS

Concrete mixers may be stationary mixers or truck mixers of approved design. The mixers shall have sufficiently rated capacity of mixed concrete. Mixers shall be capable of combining the materials into a uniform mixture and of discharging this mixture without segregation. Stationary and paving mixers shall be provided with an acceptable device to lock the discharge mechanism until the required mixing time has elapsed. Truck mixers shall be equipped with accurate revolution counters. The mixers or mixing plant shall include a device for automatically counting the total number of batches of concrete mixed. The mixers shall be operated at the drum speed designated by the manufacturer on the name plate. The mixers shall be maintained in satisfactory operating condition, and mixer drums shall be kept free of hardened concrete. Mixer blades shall be replaced when worn down more than 10 percent of their depth. The use of

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any mixer that at any time produces unsatisfactory results shall be promptly discontinued until the mixer is repaired.

4.7.9 STATIONARY MIXERS

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

4.7.10 TRUCK MIXERS

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

4.7.11 MIXING TIME

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

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

4.8 PLACING

4.8.1 PREPARATION FOR PLACING

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

4.8.2 INSTALLATION OF ANCHORAGE ITEMS

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

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

4.8.3 CONCRETE PLACING

The Contractor shall submit to the Engineer a schedule of placing concrete. Any change in schedule shall be reported at least 24 hours in advance of placing concrete. The use of belt conveyors, chutes, or other similar equipment will not be permitted without

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written approval. Concrete shall be handled from mixer to transport vehicle to place of final deposit in a continuous manner, as rapidly as practicable, and without segregation or loss of ingredients until the approved unit of operation is completed. Concrete that has attained its initial set or has contained its mixing water for more than 45 minutes shall not be placed in the work. Placing will not be permitted when the sun, heat, wind or limitations of facilities furnished by the Contractor prevent proper finishing and curing of the concrete. Concrete shall be placed in the forms in uniform layers as nearly as practicable in final position. Forms or reinforcement splashed with concrete shall be cleaned in advance of pouring subsequent lifts. Immediately after placing, concrete shall be compacted by thoroughly agitating it in an approved manner. Tapping or other external vibration of forms not be permitted. Concrete shall not be placed on concrete sufficiently hard to cause formation of seams and planes of weakness within the section. Concrete shall not be allowed to drop freely more than 1.5 m in unexposed work nor more than 1.0 m in exposed work; where greater drops are required, a tremie or other approved means shall be employed. The discharge of the tremies shall be controlled so that the concrete may be effectively compacted into horizontal layers not more than 30 cm thick, and the spacing of the tremies shall be such that segregation does not occur. Concrete to receive other construction shall be screeded to the proper level to avoid excessive shimming or grouting.

4.8.4 EARTH-FOUNDATION PLACEMENT

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

4.8.5 CHUTE OR CONVEYOR PLACEMENT

Concrete may be conveyed by chute or conveyor if written approval is obtained from the Engineer. The chute shall be of metal or metal-lined wood with sections set at approximately the same slope to assure a continuous uniform flow throughout the length of the chute. The slope of the chute shall be not less than one vertical to three horizontal nor more than one vertical to two horizontal. The conveyor shall be designed and operated to prevent segregation of the aggregate and loss of mortar. The discharge of the chute or conveyor shall be provided with a baffle plate or other device to prevent segregation. The chute and conveyor shall be thoroughly clean before and after each run. Waste material and flushing water shall be discharged outside the forms.

4.8.6 PUMP PLACEMENT

Concrete pump shall be either piston or squeeze type. Use of any other type of concrete pump shall be at the instruction of the Engineer.

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

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

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

4.8.7 BUCKET PLACEMENT

For large powerhouse substructure which involve the continuous placement of considerable quantities of concrete, bottom dump buckets may be used subject to the following conditions:

That the bucket shall be of an approved type and adequate in capacity; and that the bucket capacity shall conform to the size of the batch or a multiple thereof so that no splitting of batches in loading buckets occurs.

The bucket shall designed so as to allow the discharge of a portion of a bucket as needed, and shall be controllable to avoid damage to or misalignment of forms. The discharge shall be sufficiently large and the operation of the discharge gates such that there will be no delay in dumping concrete of the lowest

slump that can be successfully worked and vibrated into place. Buckets shall be filled and discharged without noticeable separation of the coarse aggregate. Buckets shall not be used whenever they have to be hauled for long a distances during which time a noticeable separation or bleeding occurs.

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

4.9 CURING

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

These surfaces as well as steep or vertical formed surfaces shall be kept completely and continuously moist prior to and during form removal by applying water to the top surfaces and allowing it to run down between the forms and the concrete.

4.10 FORM

4.10.1 GENERAL

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

Exposed concrete edges or corners shall be provided with 2cm x

2cm chamfer, unless otherwise indicated.

4.10.2 SHOP DRAWINGS

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

4.10.3 INSPECTION OF FORM ERECTION

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

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

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

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

4.10.4 REMOVAL OF FORMS AND SUPPORTS

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

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

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

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

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

4.10.5 FORM OIL

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

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

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

4.10.6 FORM TIES

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

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

4.10.7 CONCRETE SURFACES TO BE EXPOSED

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

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

Cut surfaces shall be smooth and treated with form coating.

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

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

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

4.10.8 FORM WORK FOR TURBINE-GENERATOR PEDESTAL

Prior to manufacturing the form for the turbine-generator pedestal, the Contractor shall draw the full size drawing and obtain the Engineer's approval. Then, the Contractor shall manufacture the form for the said pedestal using 15 mm thick plywood or more. The interval of reinforcing materials of the form and the arrangement of support shall be sufficiently provided and shall take into account the speed and quantity of concrete placing, load of concrete and other factors. In principle, steel pipe shall be used for support and form ties shall be used for keeping forms in the correct position.

4.10.9 MECHANICAL STEEL FORM FOR STACK WINDSHIELD

The design and construction of formwork shall be carried out by competent persons. The formwork shall be sufficiently rigid and tight to prevent loss of grout or mortar from the concrete at all stages and for the appropriate method of placing and compaction.

Slipforms shall be designed and constructed and the operations shall be carried out by a person or persons experienced in this type of work.

Formwork, including supports, shall be sufficiently rigid to maintain the forms in their correct position and to correct shape and profile. The supports shall be designed to withstand the worst combination of self weight, formwork weight, formwork forces, reinforcement weight, wet concrete weight, construction and wind loads together with all incidental dynamic effects

caused by placing, vibration and compacting the concrete.

Tolerance of form work:

Overall structure tolerances shall be as follows.

(a) Maximum horizontal deviation (translation plus rotational) of any point on the structure with respect to a corresponding point at the base of the structure shall not exceed 25 mm per 15 m of height above the base, nor 75 mm whichever is the smaller.

(b) Variation from prescribed diameter or variation from true circular cross-section shall be not more than ±25 mm or 4 mm per meter of diameter, whichever is larger, but in no case more than ±75 mm.

(c) Variation from prescribed wall thickness -10 mm + 25 mm.

(d) Top elevation of blockouts plus 50 mm, minus 0. Bottom elevation of blockouts, plus 0, minus 50 mm. Sides may be 12 mm but opening width must be not less than that as specified on the Contractor's "Approved" drawings.

All exposed vertical or horizontal sharp arises in concrete work shall be chamfered to a width of 25 mm.

The formwork shall be so arranged as to be readily dismantled and removable from the cast concrete without shock, disturbance or damage.

No concrete shall be placed in any portion of the work until the forms for that portion have been completed and approved by the Engineer. All rubbish shall be removed from the interior of forms before the concrete is placed.

The faces of the forms in contact with the concrete shall be clean and treated with a suitable release agent. Forms that are

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to be used for forming concrete surfaces on which tile adhesives, paint, epoxies, masonry coatings, or overlays are to be applied, shall not be treated with form coating or release agents that leave residuals on the surface of the concrete. The release agent shall be chosen by the Contractor and approved by the Engineer. Only one agent shall be used for all surfaces that are permanently exposed. The release agent shall be applied evenly to the forms and contact with the reinforcement shall be strictly avoided.

4.10.10 THE WORKING LOAD TO THE TEMPORARY STRUCTURES FOR THE CIVIL WORK

1) As to the design of the temporary structures (the forms, the supports, the scaffolds, etc.) for the main work, the Contractor shall carry out the detailed study of the stress occurred by the working load to the temporary structures during the work, and shall design those structures enable to endure against the various load occurred by each stage.
2) In theory, even though the design load is the vertical load only, the temporary structures shall have the design mechanics enable to endure against the horizontal force that the value shall be 5 percent of the vertical force.
3) If the curing sheets shall fit up to the scaffold, in particular, after the detailed study of the wind pressure, the fitting portion to the scaffold shall be stable to the curing sheets.

4.10.11 THE DRAWING FOR THE TEMPORARY STRUCTURE FOR THE CIVIL WORK

Before the commencement of the erection work for the temporary structures, the Contractor shall make the erection drawings for

the temporary structures and make clear the dimension and the joint structure of each member, and after that, the Contractor shall submit those drawings to the Engineer for approval.

4.10.12 THE JOINT OF THE TEMPORARY STRUCTURE FOR THE CIVIL WORK

The joint of the temporary structure shall be executed by the Contractor so as not to be a weak point in comparison with a normal section, in particular, as to the compression members, the Contractor shall take care of setting up those members so as not to cause an eccentric load.

4.11 STEEL REINFORCEMENT

4.11.1 GENERAL

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

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

4.11.2 CLEANING REINFORCING BARS

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

4.11.3 PLACING REINFORCING BARS AND INSPECTION

(1) Reinforcing bars shall be arranged at the proper locations

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

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

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

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

4.11.4 LAPPED SPLICES IN REINFORCEMENT

(1) Location of splices

Splices at points of great stress shall be avoided whenever possible, and care shall be exercised to avoid concentration of splices at one place.

(2) Length of lap

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

Length of anchorage of lapped splices

40 d without hook

35 d with hook

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

4.11.5 ANCHORAGE OF REINFORCEMENT

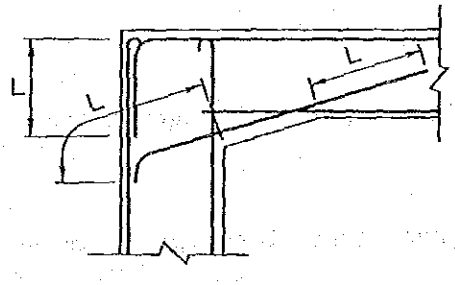
The length of anchorage of reinforcement shall be determined in accordance with the type of reinforcing bar, the grade of concrete and type of stress acting on the reinforcement, and shall be as indicated in the table below, unless otherwise indicated.

Length of Anchorage of Reinforcement

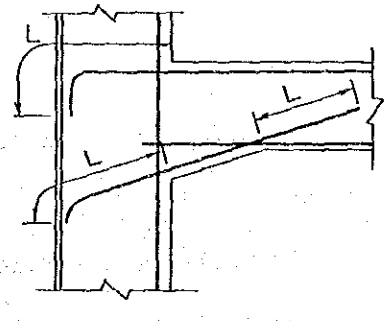
Re-Bar	Strength of concrete	Length of anchorage		
		Orindary	Lower bar	
			Beam	Floor, roof
ASTM A615 Gr.40	210 kg/cm^2	35 d or	25 d or	10 d and
	270 kg/cm^2	25 d with hook	15 d with hook	15 cm or more

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

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



End of Beam at Top of Structure



End of Beam at Intermediate Floor

4.11.6 CONCRETE PROTECTION FOR REINFORCEMENT

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

Table Minimum thickness of Concrete Cover for Reinforcement

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

4.11.7 DOWELS

Dowels shall be installed at right angles to construction joints.

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

4.12 JOINTS

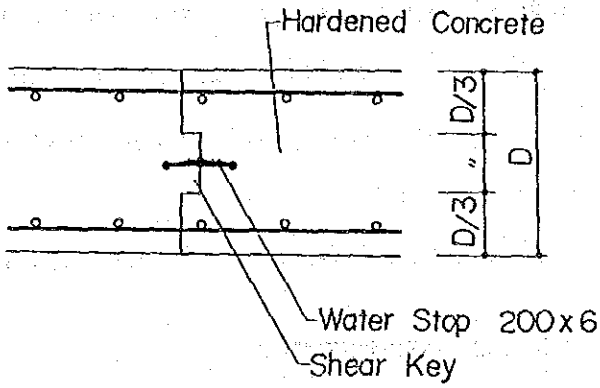
4.12.1 CONSTRUCTION JOINTS

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

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

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

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



CONSTRUCTION JOINT

4.12.2 CRACK-CONTROL JOINT

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

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

Horizontal joints shall be provided at every floor level.

4.12.3 PERIMETER FELT JOINT

Joint between interior ground floor slabs and vertical surfaces of equipment foundations shall be filled by 12 mm thick asphalt-saturated felt, extending full slab depth.

The perimeters of slabs at the joints shall be free of fins, rough edges, spalling or other unsightly appearances.

4.12.4 WATER STOP

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

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

4.12.5 EXPANSION JOINT

1) The thickness of expansion joint shall be a normal 10 mm, and asphalt joint compound shall be filled into the joint.
2) The material for waterstop shall be polyvinyl chloride of JIS K-6773, or equivalent.
3) The slip bars shallo be setted up at the expansion joints.

4.13 TOLERANCES FOR CONCRETE CONSTRUCTION

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

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

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

Tolerance Limits

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

4.14 REPAIR OF CONCRETE SURFACES

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

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

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

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

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

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

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4.15 PRECAST CONCRETE PANEL FOR EXTERIOR WALL

4.15.1 GENERAL

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

4.15.2 MATERIAL

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

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

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

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

4.15.3 DESIGN

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

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

Reinforcing steel frame

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

Fitting

Insert: 22φ bolt

Piece: L-120 x 120 x 8

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

4.15.4 MANUFACTURING (CONCRETING WORK)

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

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

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

4.15.5 CHECKING

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

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

4.15.6 INSTALLATION

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

4.16 LIGHTWEIGHT CONCRETE

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

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

4.17 FILL CONCRETE (AIR MORTAR)

The mix proportion of air mortar shall consist of Portland cement, sand, air entraining admixture and water.

The mix proportion of the air mortar shall be as follows.

Cement: Sand = 1 : 5

Cement: More than 224 kg/m^3

Sand : More than 1.116 kg/m^3

Air entraining admixture: 12.3 l/m^3

Air volume: 30 $\%/m^3$

Design strength of the air mortar shall be more than 20 kg/cm^3 at four (4) weeks strength.

Air mortar in the proportion indicated above shall be thoroughly mixed and shall be placed around previously installed pipes and empty spaces under the ground floor of the Main Powerhouse by a concrete pump.

4.18 STEEL TROWEL FINISH

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

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

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

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

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