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PORT MUHAMMAD-BIN-QASIM PROJECT

DETAILED DESIGN REPORT

FACILITIES RELATED TO IRON ORE & COAL BERTH

DECEMBER 1975

JAPAN INTERNATIONAL COOPERATION AGENCY

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Design Report

Volume II

Facilities Related to Iron Ore Coal Berth

C O N T E N T S

Preface

This report is a brief representation of the design for execution of the related facilities necessary to the iron-ore coal berth, such as reclamation works, water and oil supply systems, power supply and electric facilities and buildings including the small crafts berth.

As the iron-ore coal berth is apart from the land for about 4 km, it is required to create a land of reclamation close to the berth for accommodation of the facilities including office required for operation of the berth.

This reclamation land should include a space of about 10,000 m^2 as a site for PQA where the water supply facility, power supply transformation station and terminal office are provided.

A part of the cause way for belt conveyor which transports the raw material to the steel mill is also included in this reclamation land.

The bottom surface of the sea where the reclamation is to be carried out is of soft clay. The reclamation work is, therefore, performed upon dredging up to -5.00 m from the existing ground.

A small crafts pier is constructed at the location between the main berth pier and reclamation yard in pallarel to the access trestle.

Oil, water and power supplies are arranged for the iron-ore coal berth, small crafts pier and terminal office. The design of these facilities is limited to the arrangement including the connection work in the terminal area and installation of the reservoir and transformer.

For oil supply facilities, it is assumed that the oil company will plan and provide the required tank yard and tank capacity including pumping system.

The buildings include the terminal office for control of the ore coal

berth, pump house for water supply and fire fighting system, substation for power supply, and gate house for immigration and customs. The cost for construction of the related facilities is about 43 03 million Rs including the foreign currency fund in an amount of US$. The foregoing expense includes the expense of reclamation work.

CHAPTER I GENERAL

1. LOCAL CONDITION

1) General

All basic data given in the Drawings and the following description of the local condition are collected and supplied by the Authority.

2) Temperature

The air temperature in the region of Karachi are not extraordinary, the following Fig. 1-3, shows the mean monthly and the extreme recorded air temperature of Karachi (Manora) observed over a period of 30 years.

The greatest yearly temperature change is 108°F - 43°F = 65°F, 43°C - 6° = 37°C.

3) Relative Humidity

The mean monthly humidity at Manora in the morning and evening hours over a period of 59 years is shown in Fig. 1-4.

4) Precipitation

The mean annual rainfall is about 8 inches. The number of rainy days in a year is usually less than 10 days.

On the basis of 24 years rainfall record of Karachi Airport, rainfall durations - intensity - frequency curves have been developed for the return periods of 5, 10, 20, 50 and 100 years. Fig. 1-2 shows that curves.

5) Wind and Storm

The main wind direction in the months of April to October is southewest to west. In the other month, it fluctuates between

northwest and northeast. The Table 1-1 shows the mean monthly wind velocity in knots recorded at 5.00, 8.00, 17.00 hours at Manora and Karachi Airport observations.

The highest wind was recorded on 29th June, 1936, during a thunder-squall when a wind velocity of 81 mph was recorded. In general, wind speeds seldom exceed 20 knots. The wind velocity has been assumed for design as follows,

during normal condition	20 knots
during storms	70 knots

6) Tidal Range

Extreme Recorded High Water (ERHW)	+3.96 m	(+13.00 ft)
Highest Astronomic Tide (HAT)	+3.96	(+13.00 ")
M.H.H.W.	+3.40	(+11.16 ")
M.L.H.W.	+2.67	(+ 8.76 ")
M.S.L.	+2.05	(+ 6.73 ")
M.H.L.W.	+1.43	(+ 4.69 ")
M.L.L.W.	+0.70	(+ 2.30 ")
Lowest Astronomic Tide (LAT)	-0.61	(- 2.00 ")
Extreme Recorded Low Water (ERLW)	-0.83	(- 2.70 ")

7) Tide Current

Maximum and average velocities of tide current recorded at Gharo Creek are 3.6 knots per sec. and 1.6 knots per sec. at ebb tide, respectively.

8) Waves

Wave conditions at the entrance of Port Qasim are generally moderate, and wave heights are small in the water area inside Phitti Creek even during the S.W. monsoon.

9) Corrosion and Marine Growth

According to the observations of extracted sheet piling in the Karachi shipyard in 1969.

Corrosion manifestations below M.L.H.W. are tolerable. However, they increase and appear in extraordinarily severe form above this level.

Depth	Corroded steel thickness
Above M.H.H.W.	0.024" to 0.027"/year (0.061 mm to 0.068 mm)
Between M.H.H.W.	0.013" to 0.017" (0.033 mm to 0.043 mm)
Below M.S.L.	0.005", per year (0.014 mm per year)

10. Earthquakes

Horizontal - 0.10 x Dead load (including unloaders and all other permanent structures on the berth.)

Vertical - Vertical acceleration may be neglected.

11. Soil Condition

(1) General

Soil investigations in the proposed ore-coal berth area were already carried out in previous years. However, as these were limited, still further detailed soil exploratory works were demanded.

Meantime, the detail design of the berth for small crafts pier and terminal buildings, pump house in the terminal area will be carried out with the present available soil data in particular, B.H. 108, 109, and 519.

(2) Findings of the subsoil investigation the top layer of grey silty clay is generally soft and was recovered as sluch. The number of blows, SPT in this layer vary from 1 to 3.

However, stiff clay layers appear at elevation about -50 feet and below the number of blows increase considerably.

On the basis of B.H. 108, 109 and 519, it is concluded that the top grey clay layer is not suitable for sustaining heavy foundation loads. The pile foundation adopted for berth foundation shall be driven through this soft clay layer to the dense and hard strata.

The pil foundations should be carried through the top layer upto about elevation - 18.00 m below datum line. The top layer of the soft clay layer shall be replaced with sand to prevent the embankment slope from sliding.

On the basis of the soil exploratory findings and investigations at site, the characteristic soil cross sections, with soil parameters as shown on the Fig. 1-1, were used for the statical calculations of the berth for small crafts, facilities in the terminal area, and stability of embankment.

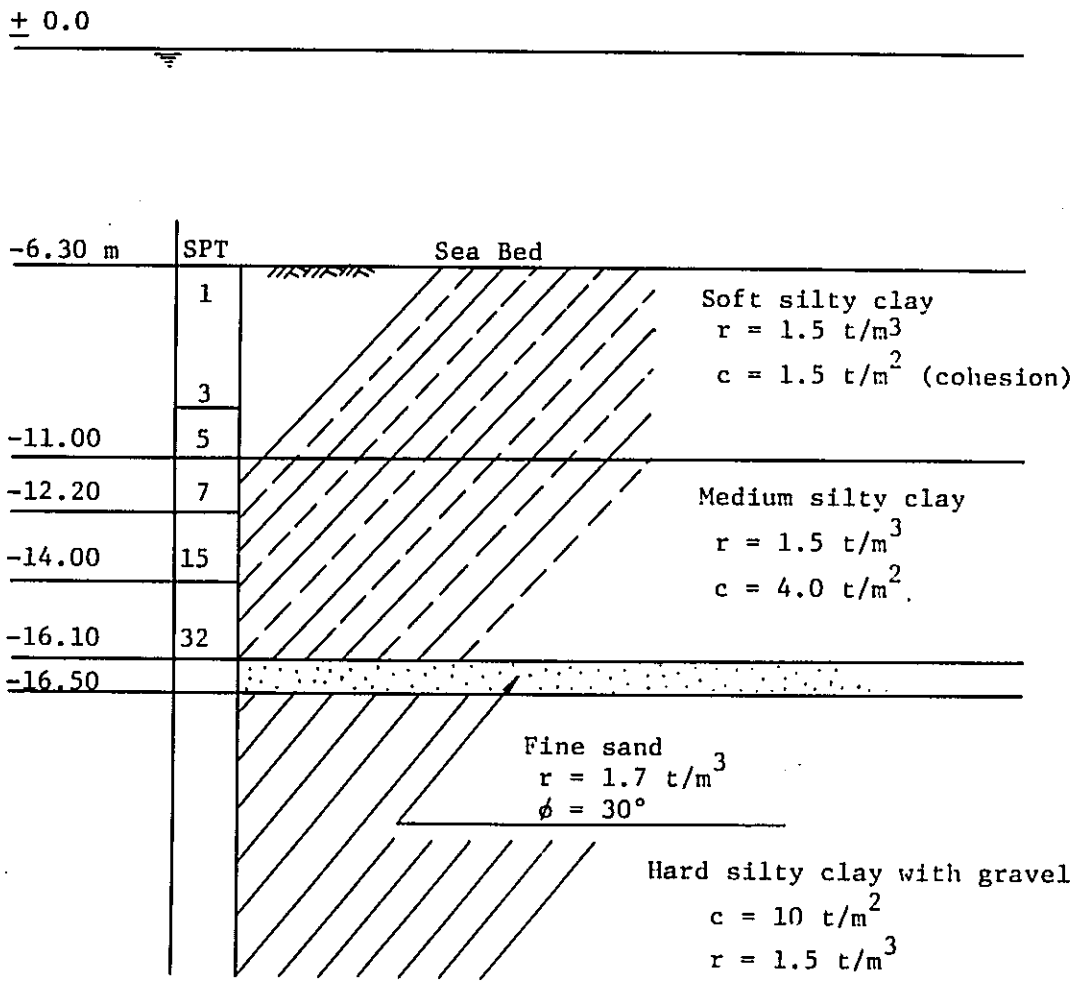
Table 1-1

Source: KDA=MP-RR/6 - 10 years data

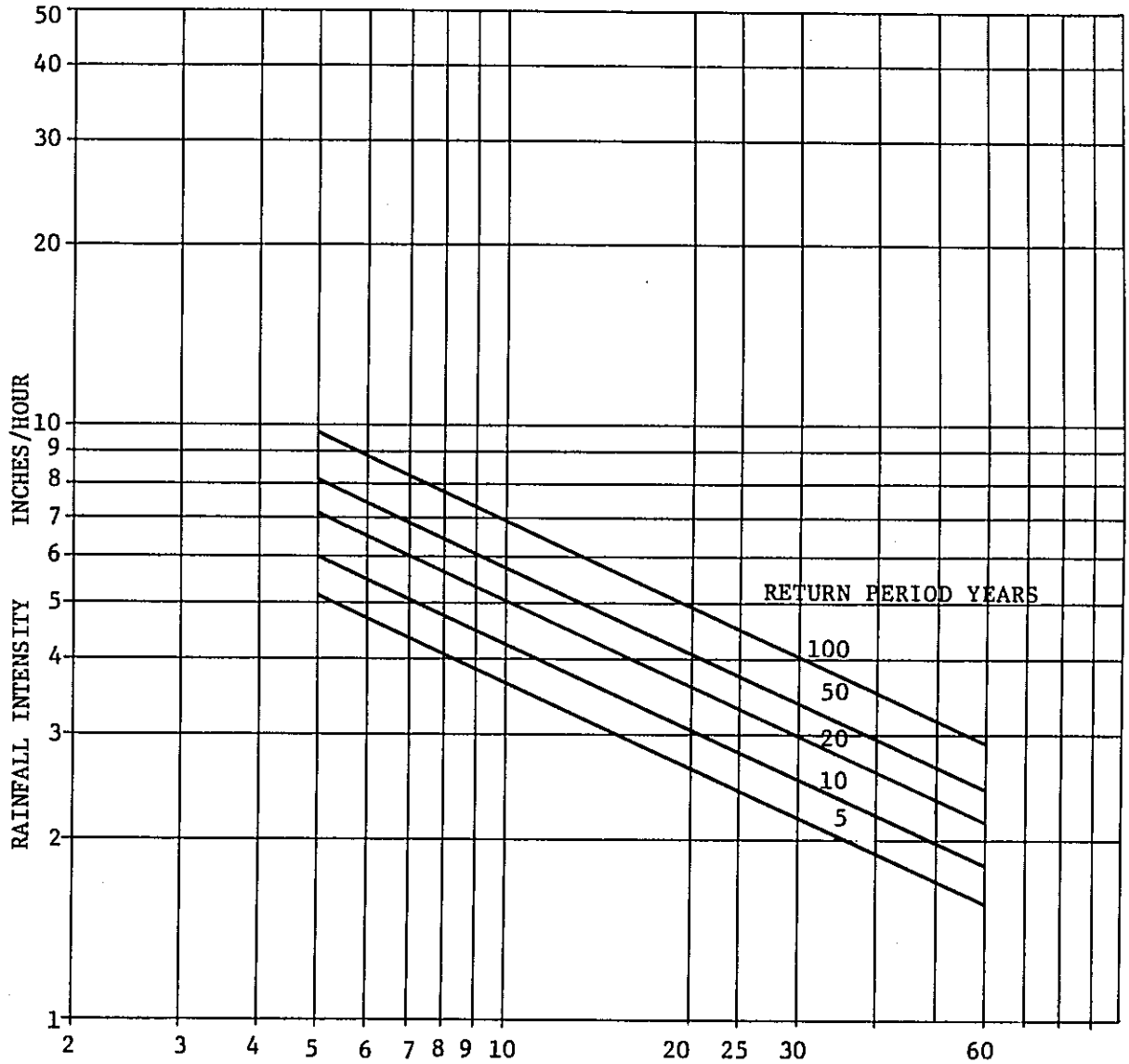
MEAN MONTHLY WIND SPEED (KNOTS) - KARACHI

Station & Time Hours	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
0500												
Manora	5.8	3.7	4.5	5.1	7.0	8.4	9.1	8.2	8.2	6.2	2.4	5.0
Airport	2.5	1.8	2.4	2.6	4.6	7.8	8.0	7.4	5.1	1.3	1.2	3.7
0800												
Manora	5.8	4.0	4.5	5.7	7.5	9.8	9.3	9.4	6.7	3.3	3.7	5.5
Airport	2.7	2.2	2.4	4.5	8.1	9.0	9.6	8.8	6.9	2.1	1.2	1.9
1700												
Manora	8.8	8.8	10.4	11.7	12.4	13.2	12.3	11.6	10.5	8.8	8.1	7.5
Airport	7.4	8.4	8.8	10.4	12.0	13.5	13.5	12.3	11.5	9.4	7.3	6.2

Fig. 1 - 1 Typical Soil Profile



RAINFALL DURATION-INTENSITY-FREQUENCY CURVES



DATA FROM KARACHI AIRPORT

Fig. 1-2

MEAN AND EXTREME TEMPERATURE

KARACHI (MANORA)

$C = \frac{5}{9}$ (F° - 32°)

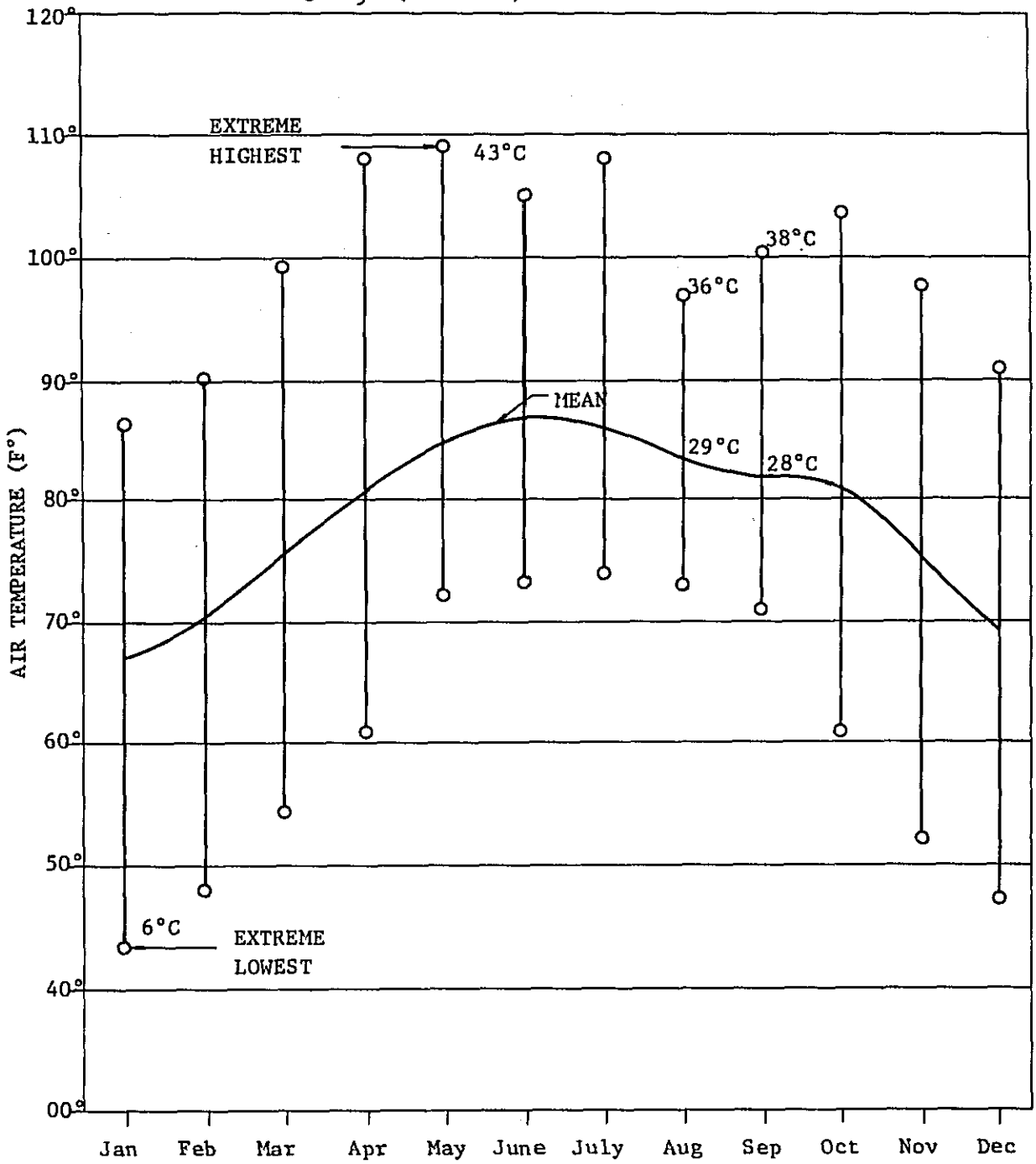
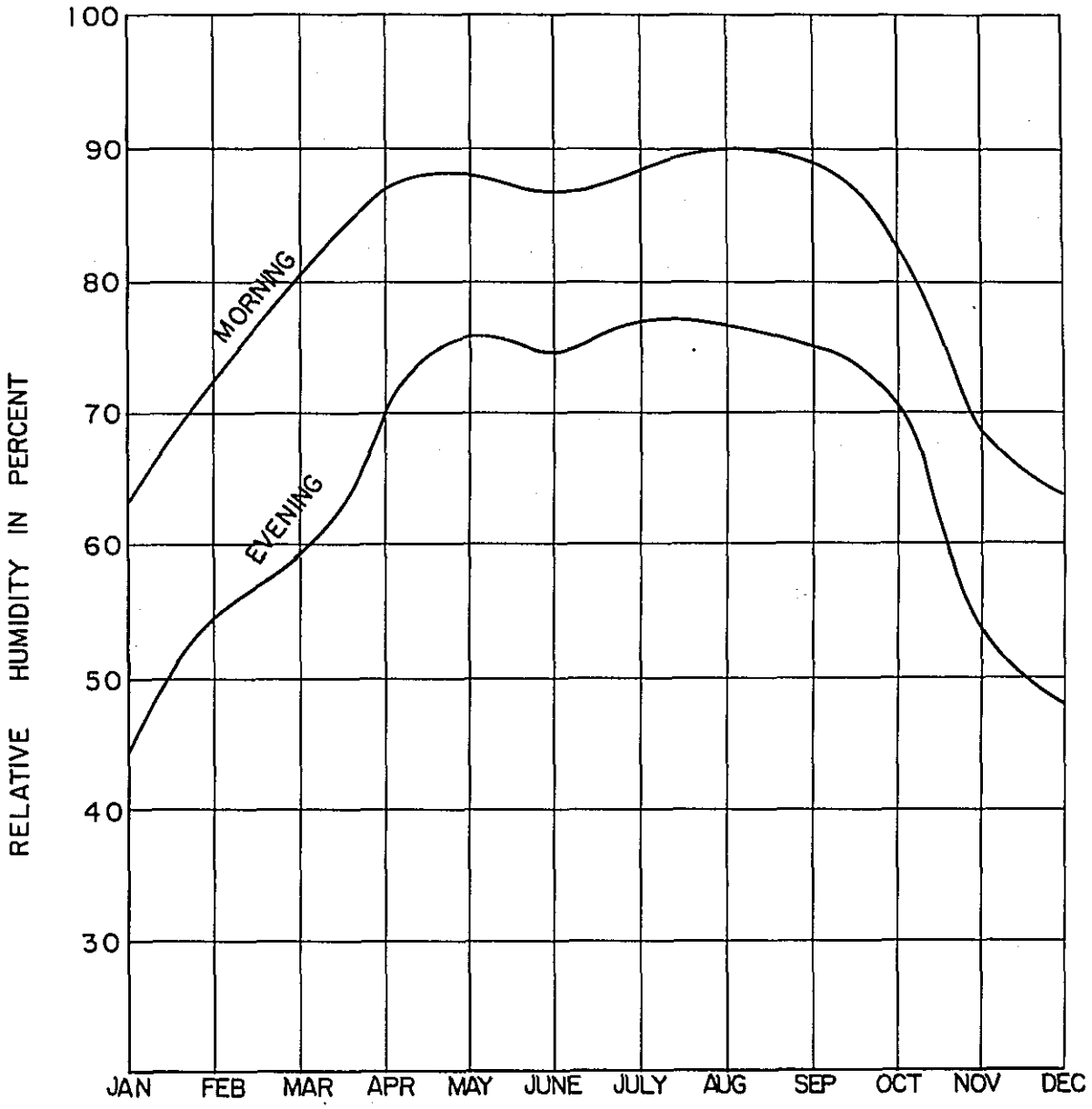


Fig. 1-3

Fig. 1-4

RELATIVE HUMIDITY

KARACHI (MANORA)



2. ITEM AND SCOPE OF THE WORKS

1) Pier for Tugs and Small Crafts

Pier is planned and designed parallel to the approach trestle 70 m length and 10 m width.

The front of pier must be dredged to secure required water depth -5.0 m.

The pier is designed with the consideration of being used during the construction period.

2) Water Supply

Water storage and distribution system are planned and designed within the terminal area as well as on the ore-coal berth for the tanker 75,000 DWT., tugs and other harbour crafts and building complex.

The provision of anti pollution measurement for unloaders and belt conveyors is made in the service duct on the berth structure.

In the design, the provision has been made for future requirements of second ore-coal berth.

3) Power Supply and Telephone System

The plan and design of power distribution system has been made for the following facilities.

(1) Yard illumination

(2) Berth illumination

(3) Power for capstan

(4) Power for fire fighting, fuel and water pumps

(5) Lighting and electrical equipment for office and building complex in the terminal area

However, the power for unloaders, belt conveyors and other equipments related to Steel Mill has not been designed.

Provision for future requirements of second ore-coal berth has been considered in the design of sub station and power cable. The sub station in the terminal area is planned and designed, however, the power cable installation from main to the terminal sub station is not included in the scope of work.

Plans for telephone and fire alarm system to the main berth and office and building complex has been made.

4) Bunkering and Oil Facilities

Oil distribution system has been planned and designed for the ore-coal berth, small crafts pier and stand-by generators.

The pumping system was beyond the scope of work. Taking into account of the beginning of the ore-coal berth operation, fuel to the ships may be unloaded at the small crafts pier by using utilities barges, the necessary space for oil pipe lines on the berth and the terminal area has been considered.

5) Fire Protection

The fire fighting system is planned and designed to ore-coal carriers, tugs and other harbour crafts and office and building complex area.

6) The Land Reclamation Works

The top soil layer on the proposed terminal area and in front of the small crafts pier are dredged upto -5.0 m. The terminal area are reclaimed with sand and slope protections are made with armour stone and riprap. Drainage of the land and pavement are made.

7) Office and Operation Buildings

The following buildings are planned and designed within the terminal area.

(1) Terminal office, provided with customs, immigration, health, engineering rooms. Caution and other necessary rooms for operation and maintenance.

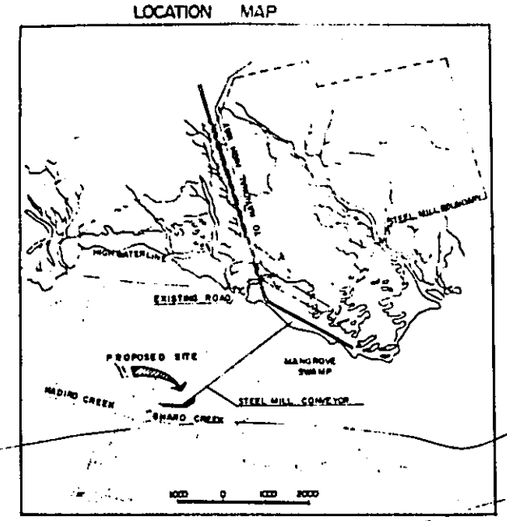
(2) Pump house for water supply and fire fighting.

(3) Gate house for customs, health, immigration and security rooms.

(4) Sub station building for power supply.

GENERAL PLAN SCALE 1:1000

LOCATION MAP



LEGEND	DWG NO
① IRON-ORE AND COAL BERTH	B - 1
② APPROACH TRESTLE	B - 1
③ SMALL CRAFTS PIER	S - 101
④ LAND RECLAMATION AREA	T - 101
⑤ CAUSE WAY	T - 101
⑥ TERMINAL OFFICE	A - 101
⑦ RESERVOIR FOR POTABLE WATER	W - 101
⑧ PUMP HOUSE FOR WATER SUPPLY	A - 401
⑨ SUB STATION FOR POWER SUPPLY AND ELECTRICAL FACILITIES	A - 301
⑩ GATE HOUSE FOR CUSTUM, IMMIGATION AND HEALTH	A - 201
⑪ SEPTIC TANK	A - 121
⑫ OPEN SPACE FOR PARKING AREA	A - 401
⑬ STOCK YARD AREA (FUTURE PLAN)	Y - 101
● BORING HOLES	
⊕ COORDINATE	

NO.	DATE	DESCRIPTION	APPROVED
		REVISION	

PORT MUHAMMAD-BIN-QASIM PROJECT
PAKISTAN

GENERAL PLAN OF PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY
CONSULTANTS

APPROVED	CHECKED	DESIGNED	DRAWING

SCALE 1:1,000 REV NO
DATE DWG NO. G - 101

CHAPTER II SMALL CRAFTS PIER

1. DESIGN CRITERIA

1) Elevation of the design sea bed; -5.0 m below datum line.

2) Uniform live load on the pier; 1.0 ton/m^2.

3) Traffic load on the pier; H-14 ton traffics and 25% impacts.

4) Hawser pull; 25 ton for single bollards.

5) Impact of ship; 30 ton.

6) Earthquakes; horizontal seismic factor 0.1 with one half of live load.

7) Allowable stresses and safety factor

(1) R.C. construction

Design strength $\sigma'ck = 240$ kg/cm^3

Compressive strength $\sigma'ca = 80$ kg/cm^2

(2) Structural steel member and steel round bar

Allowable tensile strength $\sigma'sa = 1,400$ kg/cm^2

(3) Steel pipe piles

Allowable tensile strength $\sigma'sa = 1,200$ kg/cm^2

Stress increase of 50% of all above materials is allowed for seismic condition.

8) Corrosion

On the basis of the experience of corrosion of steel material at Karachi ship yard. 0.1 mm/year has been taken into account of the corrosion of steel pipe piles.

9) The standards and regulations

The American standards are the basis for the design and calculation of structural materials. As supplement thereto, "The port and harbour design manual" authorized by the Ministry of Transport, Japanese Government is also applicable in particular cases.

2. PLANNING OF THE PIER

1) Location and Dimension

From the viewpoint of management and operation of the ore-coal berth and the work to be carried out at the time when iron-ore coal carriers are in the port, it is desirable that the pier shall be located near the ore-coal berth and the administration office.

The location of the pier has been decided as shown in the general plan upon due consideration of marine conditions to avoid as much as possible the influence of the monsoon winds, wave and current, and at the place where does not become an obstacle to ore-coal carriers coming to or leaving the wharf.

In this case, the present water depth at the proposed site for the pier is insufficient, and it is necessary to secure required water depth (-5.0 m) by dredging the surface layer.

An attempt to secure the required water depth without dredging will make the pier end extended beyond the face line of the ore-coal berth which means to be obstructed against ore-coal carriers coming to and leaving the wharf, and the original seabed in front of the pier may scraped by the dredging of the channel which will cause penetration length of foundation piles lose its sufficient length

and also the approach passage for this pier from the land will become longer and the construction cost of the pier will be expensive.

The length of the pier is 70 m to accomodate two tugs and the width is 10 m. The approach passage will be 40 m long and 6 m wide.

2) Foundation of the Pier and Approach Passage

Steel piles supplied by the Authority are to be used for the foundation of the pier and the approach passage. Although they were purchased four years ago, the inspection at the field revealed that they are sufficiently good for the foundation of this pier.

For the sake of safety, 2 mm corrosion margin was given and the allowable tensile strength was reduced to 1,200 kg/cm.

Piles are driven at 4 m pitch in both directions for the pier and at 5 m pitch for the approach passage.

The soil condition at the proposed site for the pier is such that the top layer about 3 to 5 meters from the existing seabed is soft clay (N value = 1 to 3, c = 1 t/m^2) and beneath this layer, rather medium clay at 5 to 15 m (N value = 4 to 7, c = t/m^2), and hard clay at below 15 m (N value = 32 to 35). Assuming that this layer of hard clay is the bearing layer, steel pipe piles will be driven into this layer for about 1.5 to 2.0 m. The pile will be estimated to be driven up to -18.00 m below datum line.

The length of piles for the pier are 22.10 m long, while the piles for the passage are 18.10 m long. Since piles of 12.65 m, 10.00 m and 6.00 m in the length are supplied, they are to be welded at the field. For the pier 12.65 m long piles and 10.00 m long piles

are to be combined. On the other hand, 12.65 m and 6.00 m long piles are to be used for the passage.

3) Deck Structure

Pile caps and beams which connect the piles are to be made by cast-in-site reinforced concrete. Precast reinforced concrete slabs are to be installed on the beams. They are made at the precast concrete yard in the temporary construction yard, and carried to the field for installation by a barge. The girder size is 80 cm width and 70 cm height. Anchor bars of 25 mm diameter are used for connecting slabs and girders. Holes made on slabs are filled with concrete for connection with anchor bars. The bars are fixed with bolts.
The maximum precast slab dimensions are 5.0 m x 5.0 m x 0.20 m and the maximum slab weight is 12.25 tons. Concrete pavement have been made on the slab.

4) Miscellaneous Items

(1) Bitt

7 bitts to allow 25 ton hawser pull force are installed on the pier. Bitts are to be made with reinforced concrete (Round of 45 cm in diameter and using steel bars ϕ19 - 12 pcs).

(2) Fender system

Wooden fenders are installed at 4 m interval for the pier.
A fender is to be made of two square timbers (30 cm x 30 cm x 5.50 m). They are fastened to the concrete girder facing to the sea side with anchor bolts.
The wooden planks are creosoted against marine organism attacks.

(3) Access steps

Two access steps are installed to allow tug boats and other

crafts to berth at low tide.

(4) Service lines

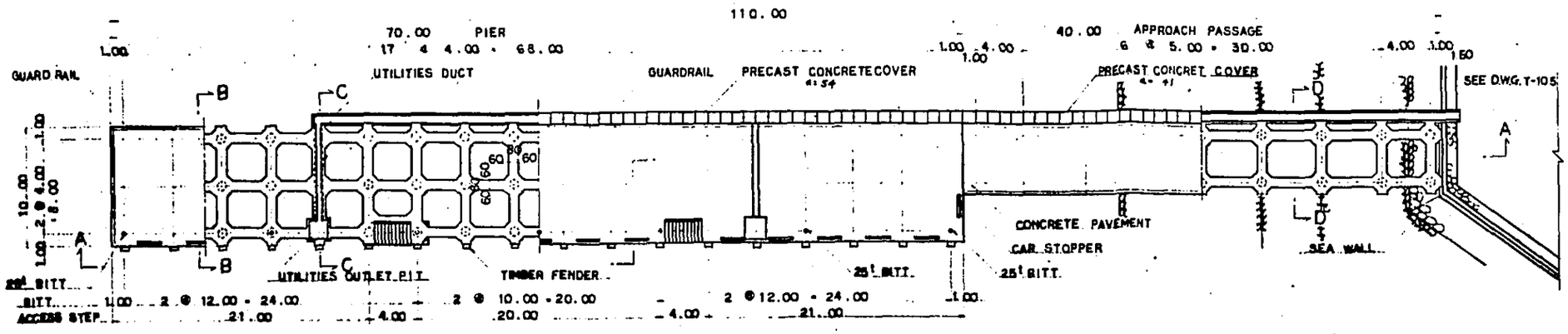
The service lines, water, fire extinguishing and oil supply pipes are installed in a utility duct to avoid corrosion of pipes and for easy maintenance, control and repair. The utility duct is to be installed on the land side of the pier and supported by extended girders. The duct is to be 90 cm high and 1.00 m wide.

Two outlets of service lines on the pier are provided.

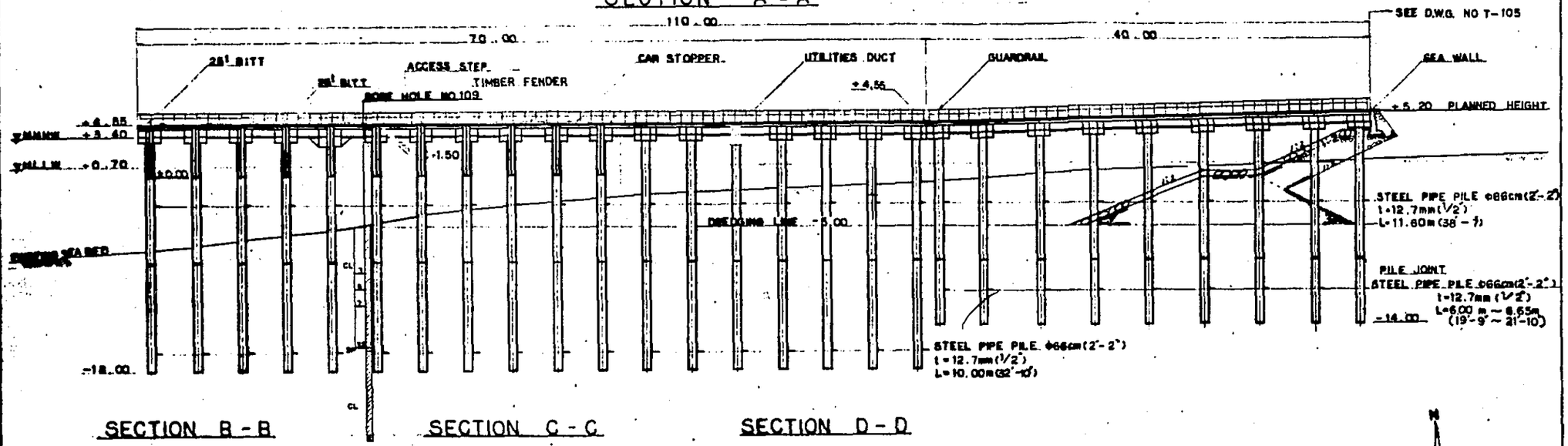
The telephone system and alarm system are also provided on deck and connected to the terminal office.

Fig. 2-1

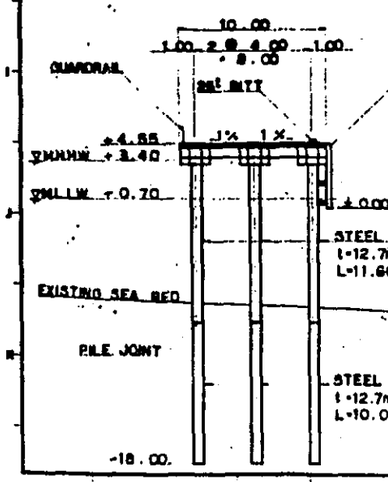
PLAN SCALE 1:200



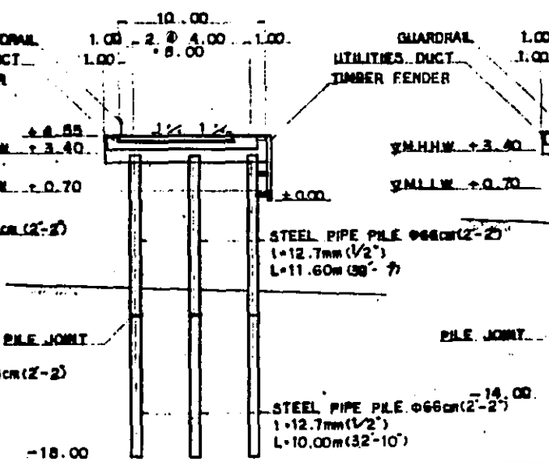
SECTION A-A



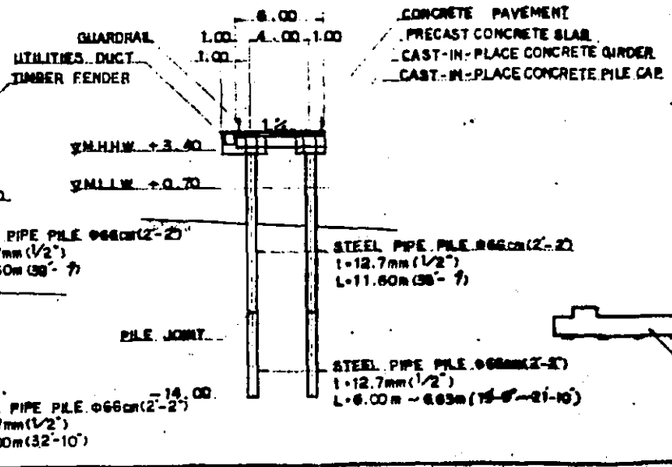
SECTION B-B



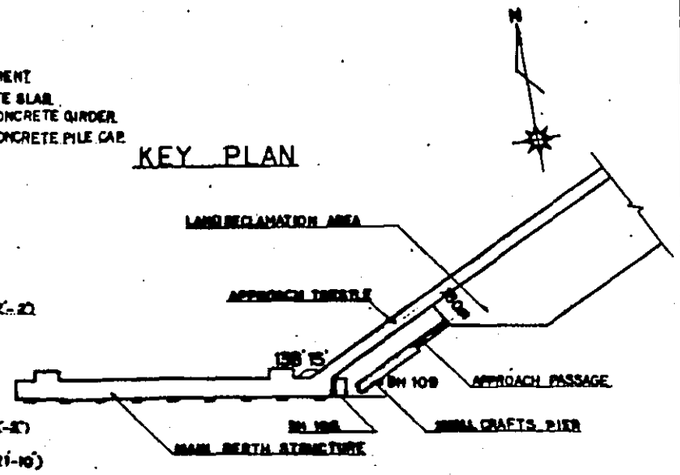
SECTION C-C



SECTION D-D



KEY PLAN



2 - 6

GENERAL NOTES

NO.	DATE	DESCRIPTION	APPROVED
		REVISION	

PORT MUHAMMAD BIN QASIM PROJECT
PAKISTAN

SMALL CRAFTS PIER
GENERAL PLAN

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS

APPROVED	CHECKED	DESIGNED	DRAWING

SCALE 1:200 REV. No.

DATE DWG. NO S-101

CHAPTER III WATER AND OIL SUPPLY AND FIREFIGHTING

1. RESERVOIR AND RELATED EQUIPMENTS

1) Bases of Design for the Reservoir

(1) Reservoir capacity

i. Initial stage

one reservoir Q = 650 m^3

ii. Second stage

two reservoir Q = 1300 m^3

(2) Diameter of inlet pipes

ϕ100mm in diameter of pipes, and assuming water to be flown into the reservoir continuously.

(3) Intervals of ships to come into the berth

Minimum intervals are assumed to 3 days at initial stage.

(4) Periods of water supply to ships

8 hours

2) Planning of the Reservoir

(1) Reservoir capacity

i. Quantity of water used

Quantity of water supply to ships:

Q_1 = 630 m^3/8 hr (initial-stage work)

Quantity of water for fire fighting:

Q_2 = 480 m^3/4 hr (for both initial- and second-stage works)

Quantity of water supply to control main building:

Q_3 = 15 m^3/8 hr

Quantity of water supply to ships:

Q_4 = 600 m^3/8 hr (second-stage work)

ii. Water supply condition

A. At the time of initial-stage water supply

	Water supply to ships	Fire fighting	Stopping of water supply to ships	Water supply to ships	Stopping of water supply
period:	8 hr	4 hr	16 hr	8 hr	
consumption volume:	$Q_1+Q_3=615m^3$	$Q_2=480m^3$ (continuous flow into reservoir)	$Q_3=30m^3$	$Q_1+Q_3=615m^3$	

B. At the time of completion of second-stage work

	Water supply to ships	Fire fighting	Stopping of water supply to ships	Water supply to ship
period:	8 hr	4 hr	24 hr	8 hr
consumption volume:	$Q_1+Q_2+Q_4$ = $1215m^3$	$Q_2=480m^3$	$Q_3=45m^3$	

C. Distributing reservoir capacities and inlet quantities

If denote distributing reservoir capacities at the initial and second stages by W_1 and W_2 respectively and inlet quantities at the initial and second stages by Q_a and Q_b, respectively, we obtain the following:

a. At the time of initial-stage water supply

$W_1 + 12\ hQ_a = 1{,}095\ m^3$

$16\ hO_a - 30\ m^3 = W_1$

a-1 Capacity

$16\ Q_a = W_1 + 30\ Q_a = (W_1 + 30)/16$

$W_1 + 12 \times (W_1 + 30)/16 = 1{,}095$

$W_1 + 0.75\ W_1 - 22.5 = 1{,}095$

$1.75\ W_1 = 1{,}072.5$

$W_1 = 1{,}072.5/1.75 = 613\ m^3$

a-2 Inlet quantity

$16\ Q_a - 30\ 12\ Q_a = 1{,}095$

$28\ Q_a = 1{,}125$

$Q_a = 1{,}125/28 = 40.18\ m^3/hr$

b. At the time of completion of second-stage work

$W_2 + 12\ Q_b = 1{,}695\ m^3$

$24\ Q_b - 45 = W_2$

b-1 Capacity

$24\ Q_b = W_2 + 45\ Q_b = (W_2 + 45)/24$

$W_2 + 12\ (W_2 + 45)/24 = 1{,}695$

$W_2 + 0.5\ W_2 + 22.5 = 1{,}695$

$1.5\ W_2 = 1{,}672.5$

$W_2 = 1{,}672.5/1.5 = 1{,}115\ m^3$

b-2 Inlet quantity

$24\ Q_b - 45 + 12\ Q_b = 1{,}695$

$$36\ Q_b = 1{,}740$$

$$* \ Q_b = 1{,}740/36 = 48.33\ m^3/hr$$

From the above-mentioned results of calculation, it is considered sufficient if the necessary water storage quantity and the inlet quantity at the initial stage of more than 613 m^3 and more than 40.18 m^3/hr respectively can be obtained.

In case of the second-stage, it is considered sufficient if the overall water storage quantity and overall inlet quantity of more than 1,115 m^3 and more than 48.33 m^3/hr respectively can be obtained.

Further, to facilitate the maintenance and control of the reservoir such as continuous water supply to office and small crafts in care of clearing inside of the reservoir at initial stage, a partition wall is provided in order to divide the reservoir into two sub-reservoirs.

D. Diameter of conveyance pipe (calculated with approximate values)

Distance (from existing pipe to reservoir): L = 8 km

Effective head

(difference between existing pipe and H.W.L. of reservoir): H_1 = 30 m

(dynamic water pressure of existing pipe) : H_2 = 25 m

Calculation by means of inlet quantity at the time of completion of the second-stage work:

$Q = 48.33\ m^3/hr = 13.43\ \ell/sec$

Assumed C = 110 (coefficient of friction loss)

$i = 6.2\ °/_{oo}$ (slope)

diameter of pipe: 150 mm

Velocity of flow can be obtained as follow.

$V = 0.72$ m/sec

$h = L \cdot i = 8000 \times 0.0062 = 49.6$ m

Assumed height difference is H = 55 m

Therefore, the diameter of the conveyance pipe shall be 150 mmϕ.

E. Diameter of inlet pipes

One inlet pipe shall be provided for each sub-reservoir and velocity of inlet flow will be 0.8 m/sec or less.

$Q = 40.18\ m^3/hr/2 = 20.09\ m^3/hr = 5.58\ \ell/sec$

Assuming the diameter of inlet pipes to be 100 mmϕ, the velocity of flows will be 0.71 m/sec. Therefore, the diameter of the inlet pipe shall be 100 mmϕ.

F. Intervals of water supply to ships

a. From Table 3-1

When one reservoir is constructed and one berth is used, water supply to a ship has to be stopped at least for 16 hours after supplying water to a ship and using water for fire fighting, in order

to fill up the reservoir with water, because volume of water to be flown into reservoir are assumed to 40.18 m^3 per hour.

When water for fire fighting is not used, stoppage of water supply to a ship should continue only for 8 hours, that is, if water is supplied and stopped at 8 hours' intervals, water for fire fighting will be always ensured.

b. From Table 3-2

When two berths are used at second stage, the following three cases are considered for water supply period after supplying water to two ships simultaneously and using water for fire fighting.

Case 1: Two ore-coal carriers can be supplied simultaneously after 24 hours of water supply stoppage to ships.

18 hours of stoppage will be sufficient to store the required water volumes for two ships in the reservoir.

Case 2: In case water supply to ships is stopped for 16 hours, one ship can be started to supply then second ship will be supplied 8 hours later. 10 hours will be quite sufficient to reserve the necessary capacity for one ship in the reservoir.

RELATION BETWEEN CONSUMPTION AND INFLOW VOLUME

TABLE 3 - 1 THE SHORTEST INTERVAL WATER SUPPLY TO SHIPS

(IN CASE OF USING FOR ONE BERTH)

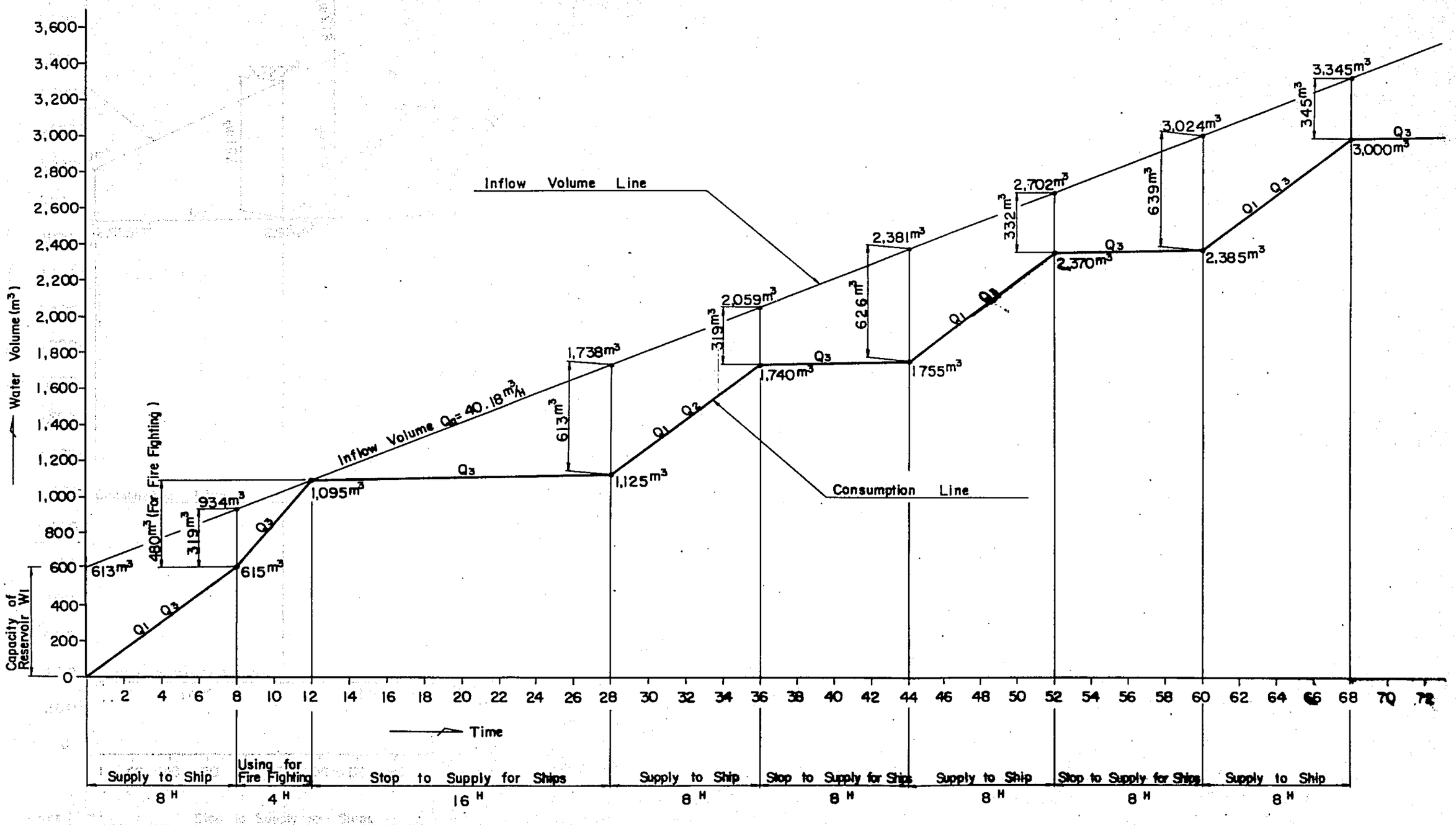
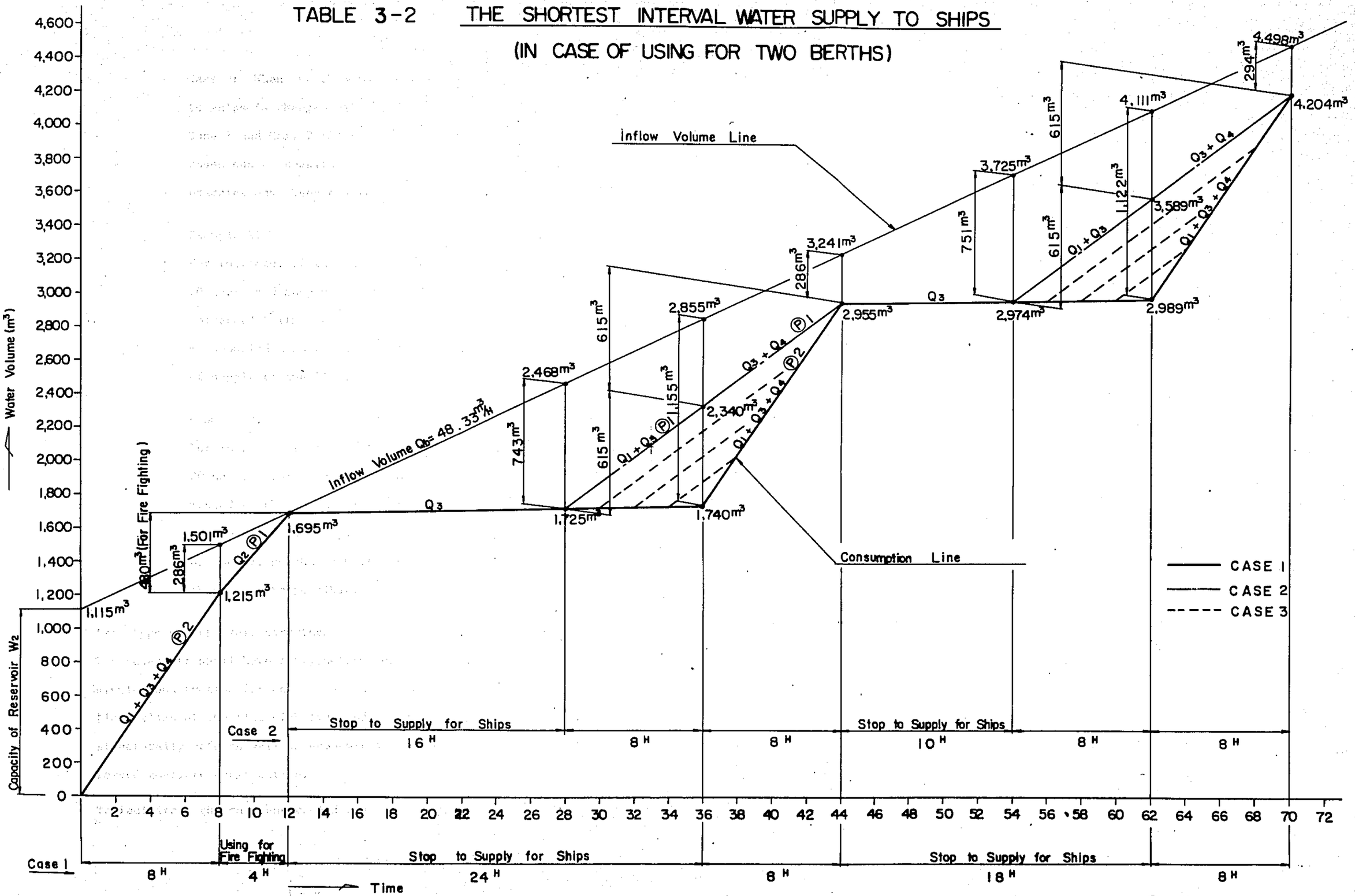


TABLE 3-2 THE SHORTEST INTERVAL WATER SUPPLY TO SHIPS

(IN CASE OF USING FOR TWO BERTHS)



Case 3: When the duration of stoppage of water to ships is changed within the range between Case 1 and Case 2 (24 hours to 16 hours), various cases can be considered. That is, the following examples have been considered.

Example 1.

For instance, if the stoppage is continued for 20 hours and supplying water to one ship is commenced (with one pump), the second ship will be supplied 8 hours later after the commencement of supply to the first ship.

Example 2.

For instance, if the stoppage is continued for 20 hours, supply to the second ship can be commenced (with two pumps) 4 hours after the commencement of the supply to the first ship (with one pump), so that simultaneously supply to two ships will be possible.

(2) Type of reservoir structure

The reservoir shall have a rigid-frame construction, i.e., a single construction formed by side walls and upper and lower floor slabs of the flat slab type and columns, which is structurally safe as well as economical because of the reinforced concrete construction.

To facilitate the maintenance and control of the reservoir, a

partition wall is provided to divide the reservoir from the pump well, and another partition wall is provided to divide the reservoir into two equal parts so that the reservoir can have the function of two reservoirs.

Taking into account of the following engineering aspects, the reservoir has been designed to construct semi-underground type structure, which means that the bottom slab of the reservoir has been designed to burry up to such a depth that the uplift load will not act on the bottom slab by the underground water and its construction will not be disturbed by the water.

1 In case of constructing whole of the reservoir under the ground

The bottom slab have to increase its thickness to resist the uplift load caused by the underground water and also foundation piles have to be wider section against pulling force caused by the uplift load.

2 The side wall have to increase its thickness to resist against the earth pressure load therefore, the member of structures and foundation piles have to be strong enough against earth pressure load and seismic horizontal load.

3 Large amount of earth works will be required.

However, the reservoir will not be possible to construct on the ground, because the inlet flow pipes and main pipe should be connected smoothly under the ground. In case the inlet flow pipes are above the ground, the excessive water pressure

in the main pipe is required for continuous flow of water into the reservoir.

(3) Comparative studies on reservoir

i. Comparative plans

Comparative studies have been made among the following three plans for the construction method of a reservoir having a capacity of 613 m^3 which has been obtained by the calculation for determining the capacity:

Plan A:

The reservoir and the pump well are constructed separately and are so constructed that at the time of completion of the second-stage work, the reservoir which has been constructed at the initial-stage will be made empty. The pump house is built above the pump well and suction-type pumps will be installed.

Plan B:

No pump well is provided and the reservoir and the pump house are made into a unified construction. Pump suctions are installed at the reservoir and thrust-type pumps will be installed. The pump house has the same height as that of the reservoir and is made into a semi-underground construction.

Plan C:

No pump well is provided and a partition wall is constructed inside the reservoir so that the reservoir

will be made into a construction which combines a reservoir and a pump well.

The pump house is constructed above the pump well portion of the reservoir and suction-type pumps will be installed.

* In all the three plans, a partition wall will be provided at the center of the reservoir so that either sub-reservoir can be emptied for cleaning and continuous water supply can be made for terminal office. Refer to the attached Fig. 2-1, 2-2 and 2-3.

According to the comparative studies of the above-mentioned plans, which show on the following table, it has been decided to design the reservoir after Plan C, because which is the easiest for construction work, maintenance and control and the most economical among the three kinds of plans.

(4) Effective capacity of designed reservoir (from Drawing)

Assuming that the effective water depth is 2.10 m, we obtain the capacity as follow.

7.85 x 15.85 x 2.1 x 2	= 522.57
3.85 x 16.00 x 2.1	= 129.36
- 0.30 x 0.30 x 2.1 x 6	= -1.34
Total	650.59 = 650 m^3

Therefore, the effective capacity of the reservoir is 650 m^3.

Table 3 - 3

Comparison Table of Reservoir Construction Plans

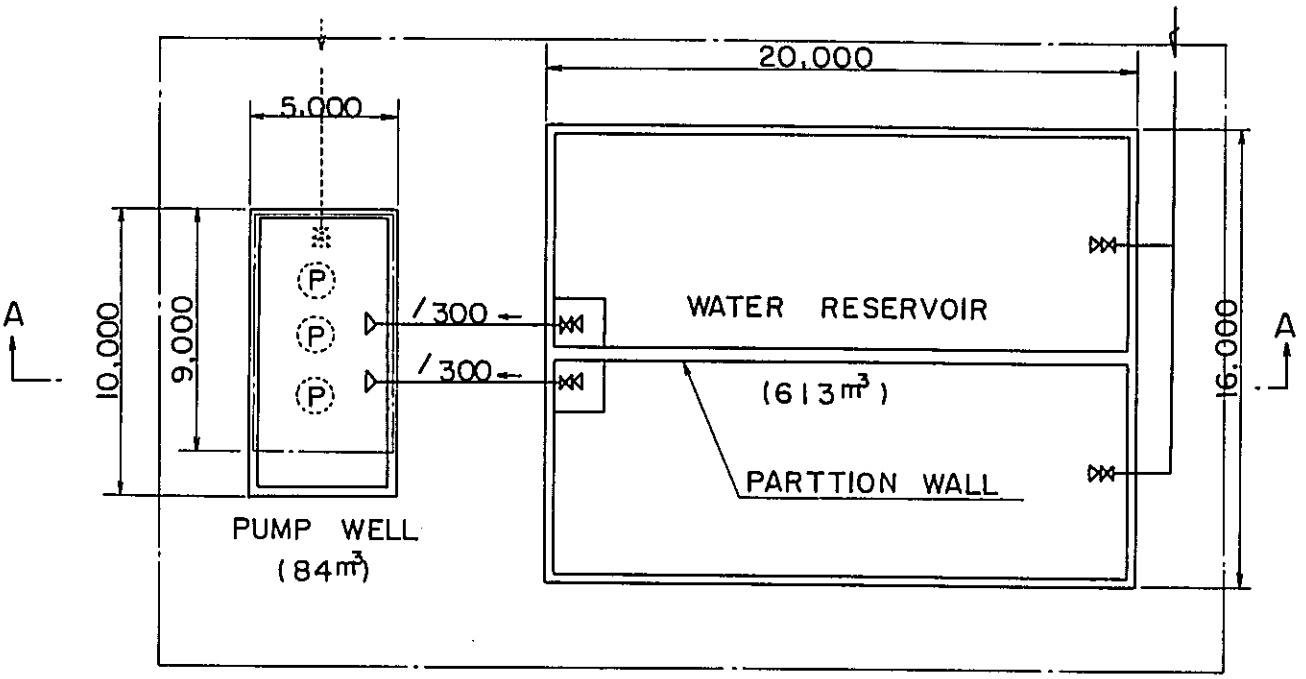
Item \ Plan	Plan A	Plan B	Plan C	Remarks
1. Workability and structure	As a structure, this plan is the simplet one, and construction is easy. But the pump well is a superfluous installation.	This plan requires no pump well. But since the pump house is half buried underground and has a wall that faces the reservoir, sufficient waterproof and drainage facilities will be required.	Since the pump house is constructed above the reservoir, a partition wall for a pump well becomes necessary and the construction requires that the pump well constitutes a part of the reservoir.	
2. Maintenance and control	Since the reservoir and the pump well become independent from each other, more auxiliary installations will become necessary, resulting in more time and labor for control. Also, since the pump house is constructed above the pump well, the space for control will become smaller.	Since the pump house is half buried underground and faces the reservoir wall, frequent checking of machinery and equipment becomes necessary against water such as dew and moisture. This type of construction is particularly disadvantageous to electrical equipment.	Although the pump house is constructed above the reservoir, sufficient space for control is available. Also since the control of the reservoir and pump well is considered in combination with that of the pump house, this plan is the most beneficial among the three plans for maintenance and control.	
3. Area for exclusive use for site	$36.0\,m \times 22.0\,m = 792m^2$	$31.0\,m \times 22.0\,m = 682m^2$	$26.0\,m \times 22.0\,m = 572m^2$	
4. Effective capacity	$697m^3$	$613m^3$	$613m^3$	Including pump well capacity (required capacity: $613\ m^3$)
5. Approx. construction cost (percentage)	$1,970,000^{RS}$ (100)	$1,870,000^{RS}$ (95)	$1,700,000^{RS}$ (86)	Including direct cost for reservoir, pump house and foundation work only (excluding equipment cost)
6. Evaluation	3	2	1	

Fig 3 - 1

GROUND PLAN

TYPE A

PLAN



SECTION A – A

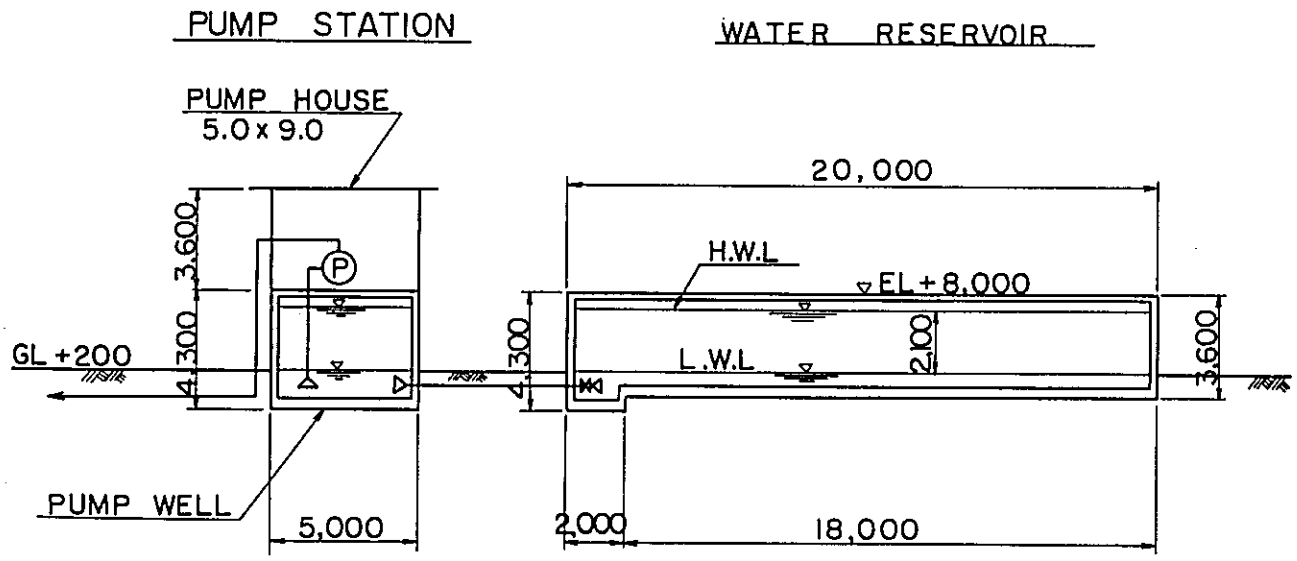
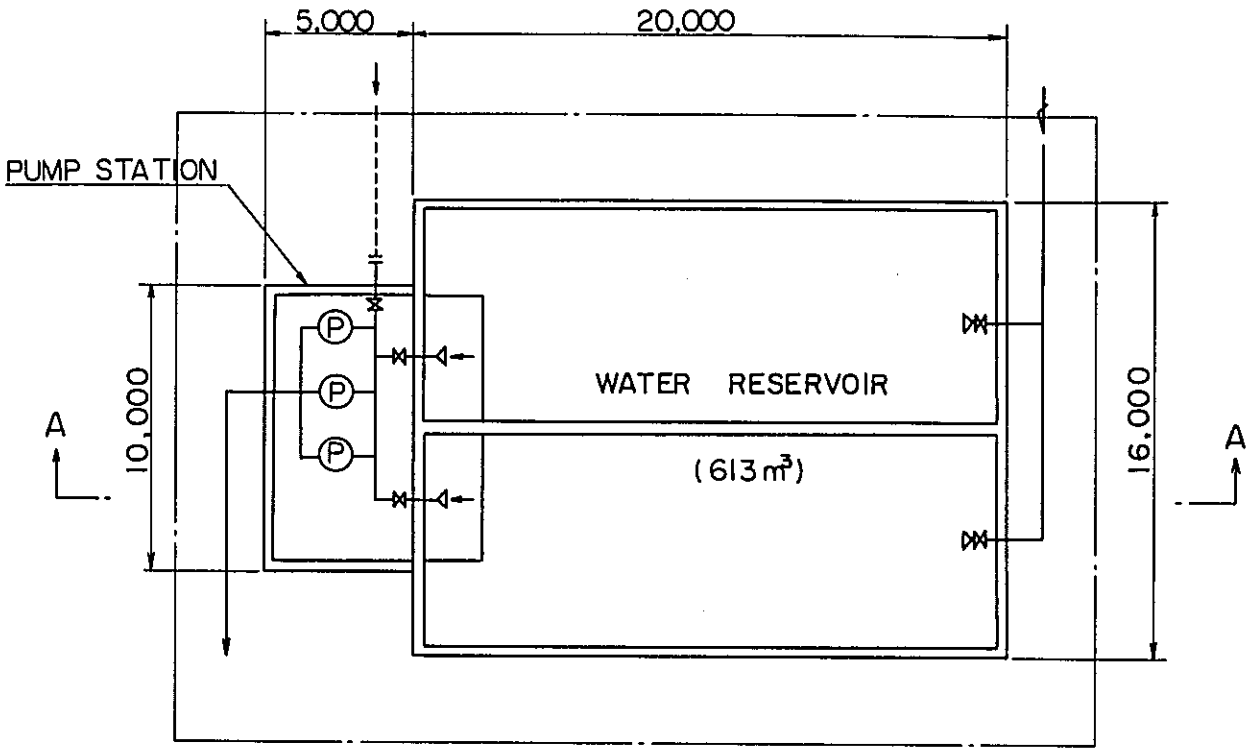


Fig 3 -2

TYPE B

PLAN



SECTION A - A

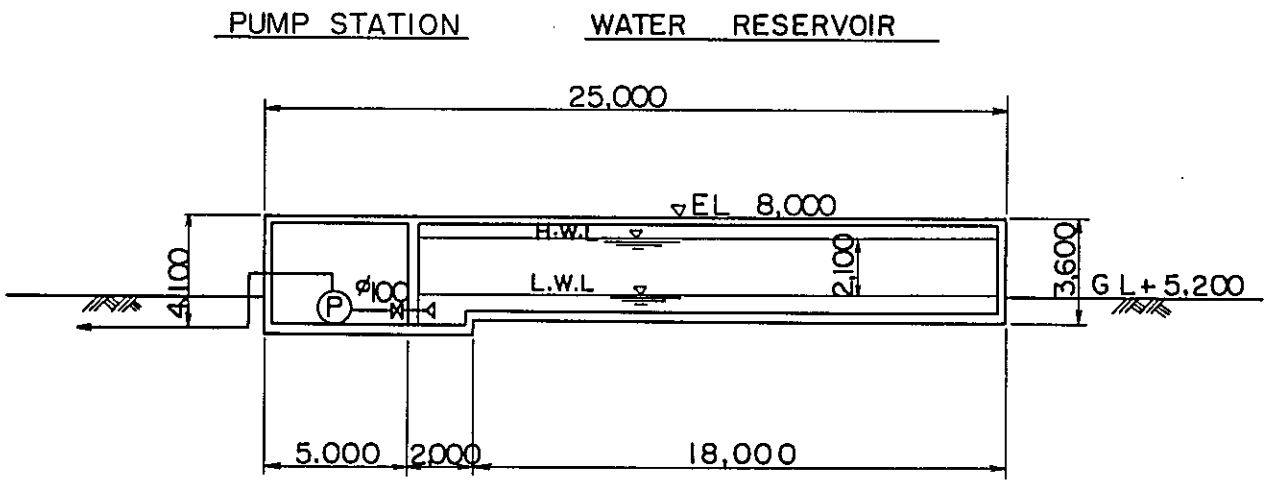
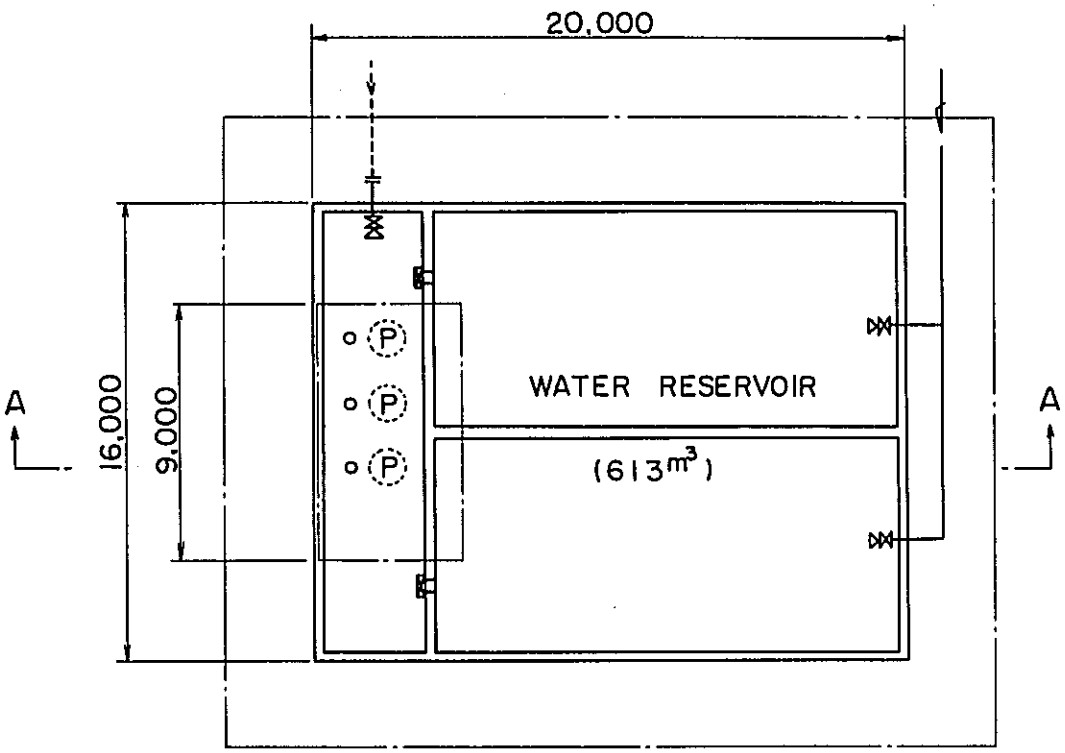


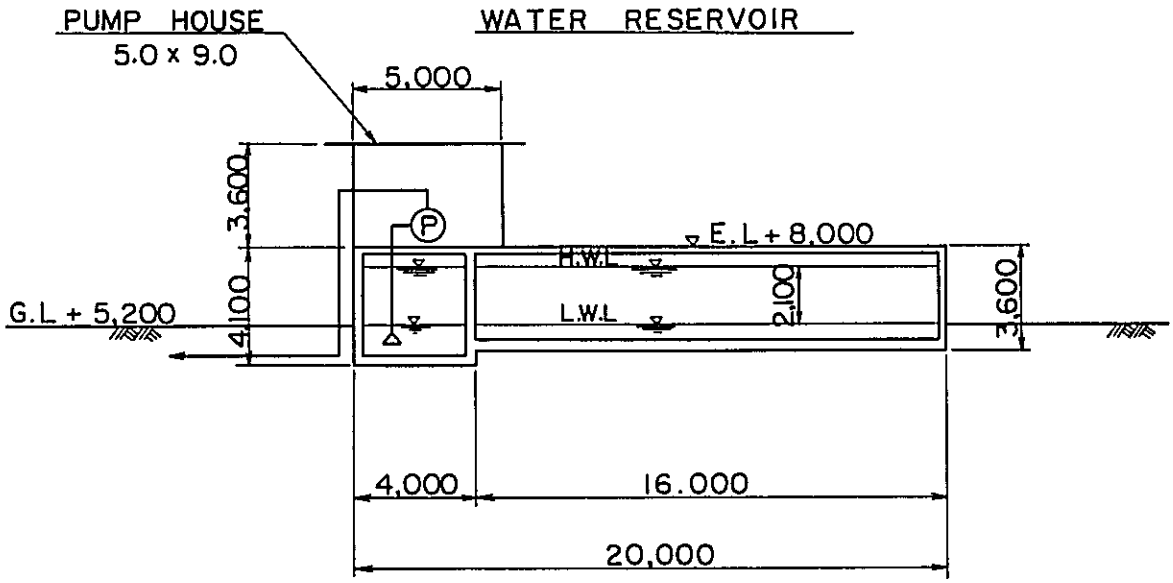
Fig 3 - 3

TYEP C

PLAN



SECTION A - A



(5) The foundation of the reservoir

Since the weight of the reservoir per unit area is about 5.8 t/m^2 at normal condition, foundation piles are necessary even if the soft layer is replaced with fine sand down to a depth of -5.0 m. The length of the pile shall be ℓ = 22 m, assuming that the pile is to be driven down to the bearing layer having an N-value of more than 30, that is, the height of the pile head is +4.50 m and the depth of the bearing layer is -16.00 m deep.

As for the kind of piles to be used, square-shaped RC piles to be made at site have been adopted due to consideration for the construction cost and the availability of material to be purchased.

A pile size of 400 x 400 mm has been adopted in view of the bearing power per pile and the pile interval, and a pile length of ℓ = 11.0 m has been adopted in view of the ease of pile driving at the time of forming the pile body and the magnitude of stress that is applied to the pile at the time of handling; and two piles are to be joined into a pile of 22.0 m in length by the welding joint which is simple and reliable.

(6) Related equipments

i. Water-conveyance pipe: Painted and covered steel pipe for water service (S.T.P.W.)
Diameter of pipe: 150 mmφ

ii. Inlet pipe : Painted and covered steel pipe for water service (S.T.P.W.)
Diameter of pipe: 100 mmφ, 2 pipes

iii. Inlet valve : Type: Sluice valve for water service (vertical type), 100 mmφ, 2 ea.
Operating apparatus: Internal-screw type manual operating apparatus (with bearing), 2 ea.

vi.	Inlet adjust valve	:	Float valve, 100 mmϕ, 2 ea.
v.	Outflow gate	:	Type: Regulating door (internal-screw-type, square-shaped), 500 x 500 mm, 2 ea. Operating apparatus: Internal-screw-type manual operating apparatus, 2 ea.
vi.	Sludge pipe	:	Painted and covered steel pipe for water service (S.T.P.W.) Diameter of pipe: 75 mmϕ
vii.	Sludge valve	:	Type: Sluice valve for water-service (vertical type), 75 mmϕ, 3 ea. Operating apparatus: Internal-screw-type manual operating apparatus, 3 ea.
viii.	Overflow pipe	:	Diameter of pipe: 75 mmϕ, at 3 places
ix.	Ventilator	:	Stationary ventilator, 300 mmϕ (natural ventilation)
x.	Water gauge	:	Float type (w/water level transducer)
xi.	House for pumping station	:	5.00 x 9.00 = 45.0 m^2

3) Summary of Design

(1) General

The calculation has been made in five cases, i.e., four cases in which structural calculations have been made in longitudinal and lateral directions at the normal time and at the time of earthquakes in respect of the reservoir which is filled up with water and the other is empty. The arrangement of reinforcement has been calculated by using the maximum moment of each case.

As a result of the calculation, the following values of thickness of members have been obtained: 25 cm for the floor slab, 30 cm for the side wall and 40 cm for the bottom slab.

The bearing power of the pile at this time is 26.3 tons per pile and the bearing load per pile is 40.5 tons as per 7.0 m^2. Therefore, it has been decided that piles are to be arranged at a rate of one pile per 7.0 m^2, that is at a pitch of 2.8 m.

(2) Freeboard and gradient of reservoir bottom

The freeboard from H.W.L. shall be 40 cm and the reservoir bottom has been determined on being 50 cm lower than L.W.L., taking into consideration of sand and sediments that will accumulate on the reservoir bottom during the long-term use and also the drainage ditch.

The bottom of the reservoir is given a gradient of 1/100 in the shorter direction. In the longer direction, a drainage ditch of 20 cm in width is provided at a gradient of 1/150 towards the drainage pit.

(3) Inlet pipe and outlet gate

An inlet pipe of 100 mm in diameter shall be installed, assuming that the inlet velocity is 0.8 m/sec or less. An outlet gate having a dimension of 500 x 500 mm is provided to slow down the inlet velocity to the pump well as much as possible.

(4) Connecting pipe

To cope with future additional installation of another reservoir, a connecting pipe of 300 mm in diameter is provided,

assuming that the inlet velocity is 0.8 m/sec or less. The connecting pipe shall be provided with a sluice valve and a blind flange.

(5) Drainage facilities

At the bottom of the reservoir, a drainage pit (1.5 x 1.5 m) and a drainage pipe are installed. The drainage pipe shall be able to discharge by natural drainage all the water that overflows H.W.L. of the reservoir and the water below L.W.L. of the reservoir. The water shall be drained to the sea at a level higher than H.W.L. of the sea.

The pipe diameter shall be 75 mm, assuming that the quantity of overflow accounts for one-fifth of the quantity of inflow ($Q = 2.69\ m^3/s$).

The quantity of drained water is estimated at $Q = 2.8\ m^3/s$, by assuming that ϕ = 75 mm pipe diameter ℓ = 100 m length of pipe and h = 1.0 m and by calculating with c = 100 and i = 10%. The time required for draining the water below L.W.L. of the reservoir is about 4 hours.

(6) Ventilator and manhole

The ventilator shall have a ventilation area which allows free inlet and outlet of the quantity of air ($2.0\ m^3/min$) which corresponds to the flow rate of the maximum quantity of water supply per day. An air hole measuring 500 x 250 mm shall be provided on the partition wall above H.W.L. to ventilate the two reservoirs, and a stationary ventilator of 300 mm in diameter shall be installed above H.W.L. to ventilate

the two reservoirs, and a stationary ventilator of 300 mm in diameter shall be installed above the pump well for the purpose of natural ventilation. This ventilator has a capacity of 5.9 m^3/sec, when the wind velocity is 1.0 m/sec and the difference in temperature between the interior of the reservoir and the outside air is 3°C, and a capacity of 7.6 m^3/sec when the temperature difference is 6°C. Thus it can be said that the ventilator has a sufficient capacity.

For a manhole, a waterproof manhole iron cover of 600 mm in diameter shall be installed at each reservoir to prevent the entry of rain water. The iron cover is fitted with a chain lock to prevent the iron cover from cracking.

(7) Water gauge

The inlet float valve automatically opens and closes depending upon changes in the water level. If inlet float valves develop malfunction and the water level rises 30 cm above H.W.L. or falls 30 cm below L.W.L., an alarm will be sounded at the control main building.

The water gauge shall be of a float type and directly visible both at site and at the Terminal Office. It shall be provided with a transducer and a waterproof stand cover.

(8) Operating apparatus

Since the operating apparatuses for the valve and the regulating door are not used frequently and can be operated manually, internal-screw type manual operating apparatuses are used.

(9) Waterproof mortar

To preserve water-tightness of the reservoir, the upper surface of the bottom slab, inner surface of side walls and upper surface of the floor slab shall be finished with waterproof mortar.

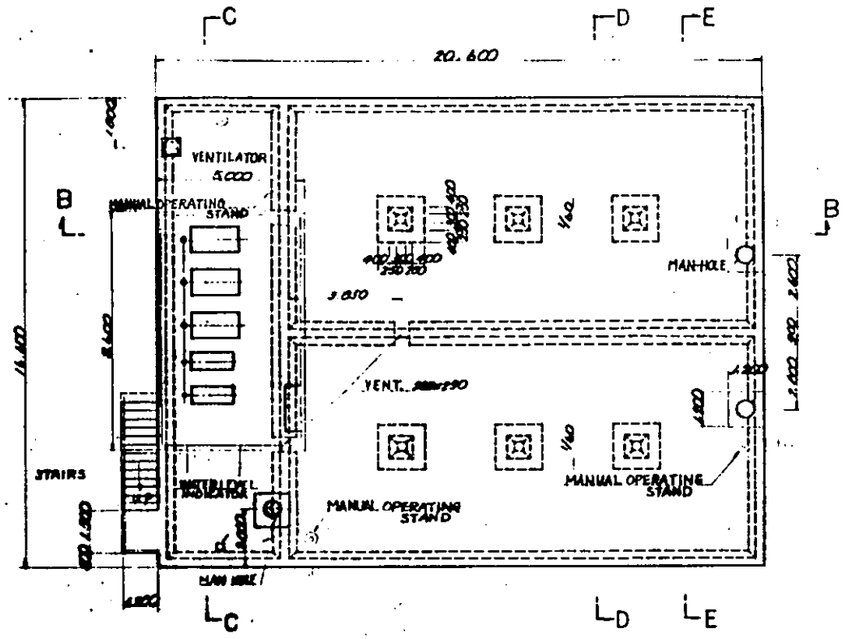
The blending of waterproof mortar shall be 1:1.5 and the waterproof mortar shall contain a waterproof agent in an amount that corresponds to 7% of the cement content.

The thickness of mortar shall be 3 cm for the bottom slab and side walls and 3 to 8 cm for the floor slab. The mortared surface of the floor slab shall be given a gradient to facilitate drainage.

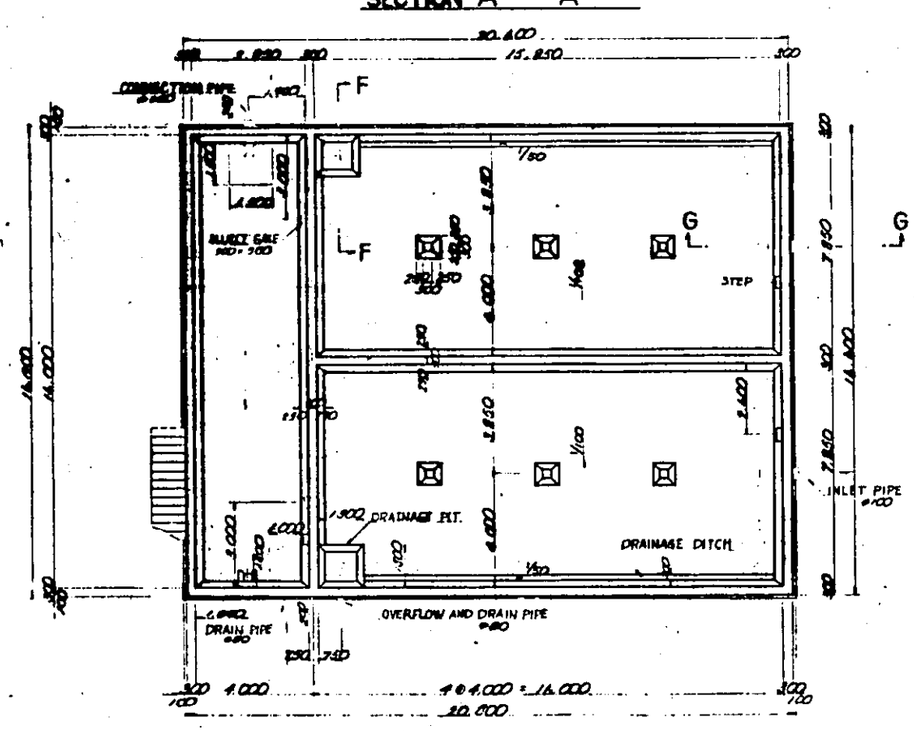
Fig. 3-4

GENERAL PLAN SCALE : 1/100

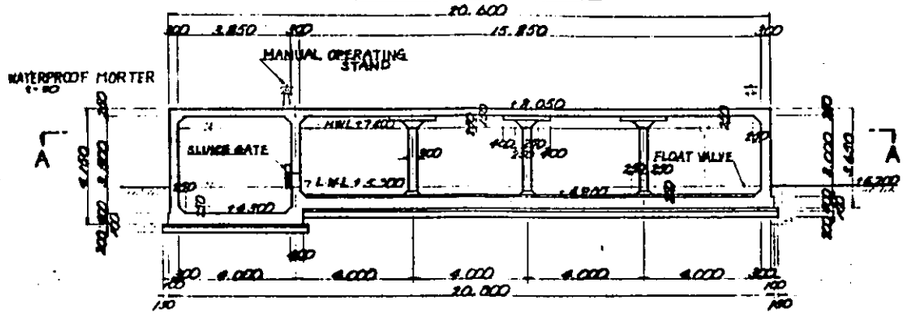
PLAN



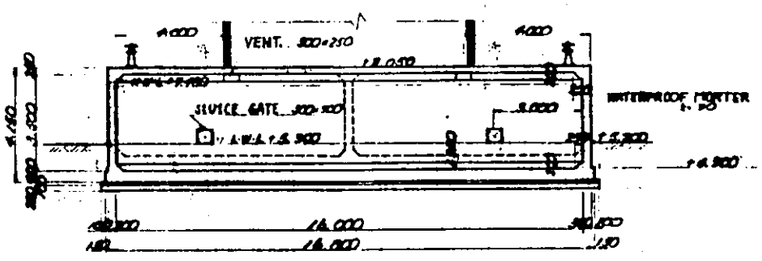
SECTION A — A



SECTION B — B



SECTION C — C

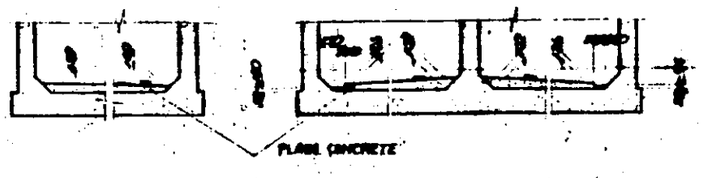


DRAIN

SCALE : 1/50

SECTION C-C

SECTION D-D



GENERAL NOTES

NO.	DATE	DESCRIPTION	APPROVED

REVISION

PORT MUHAMMAD BIN QASIM PROJECT
PAKISTAN

JAPAN INTERNATIONAL COOPERATION AGENCY

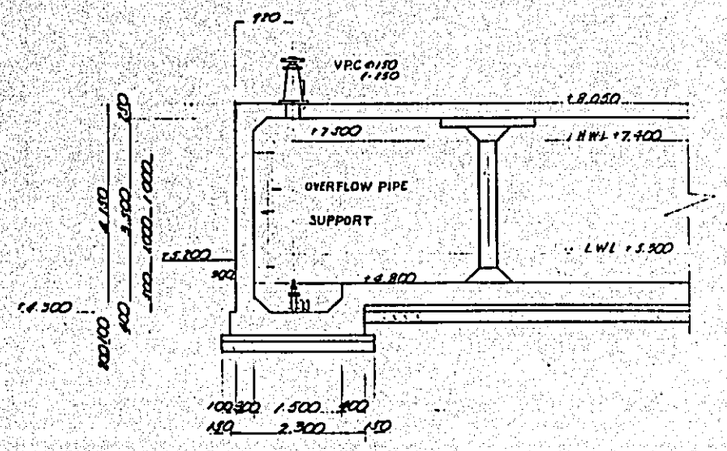
CONSULTANTS

APPROVED	CHECKED	DESIGNED	DRAWING

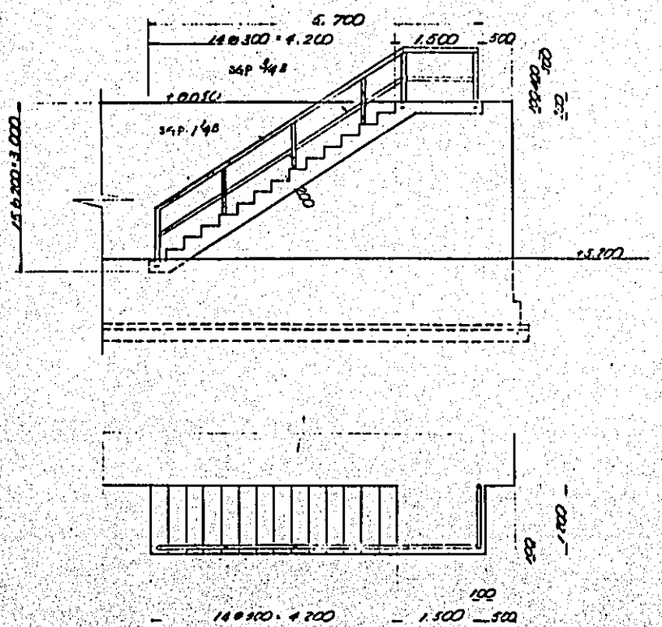
DATE

Fig. 3-5

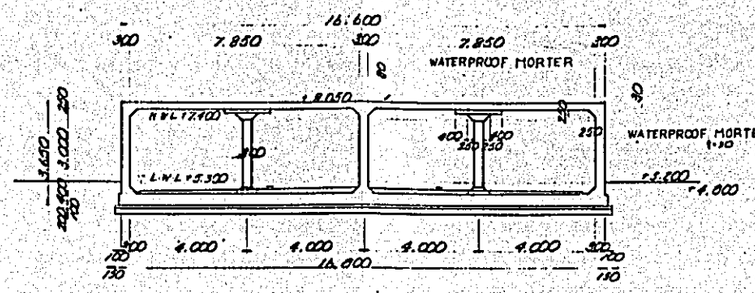
SECTION F-F SCALE-1/50



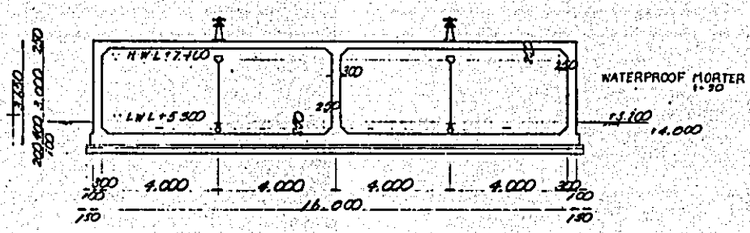
STAIRS SCALE-1/50



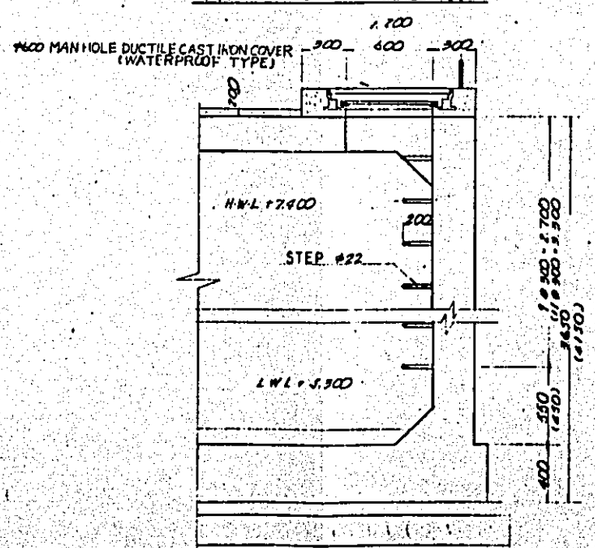
SECTION D-D SCALE-1/100



SECTION E-E SCALE-1/100



MAN HOLE SCALE-1/20



GENERAL NOTES

NO	DATE	DESCRIPTION	APPROVED

REVISION

PORT MUHAMMAD-BIN-QASIM PROJECT
PAKISTAN

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS

APPROVED	CHECKED	DESIGNED	DRAWING
SCALE		REV. No.	
DATE		DWG No.	

2. PIPING SYSTEM AND THEIR EQUIPMENTS FOR WATER AND OIL SUPPLY AND FIRE FIGHTING

1) Bases of Design for the Piping Systems

(1) General

This section summarizes the results of the designing work for the water supply, fire extinguishing and oil supply systems for the main berth, the tug boat pier and the facilities belonging to POA's terminal as well as for the gasoline service system (metering machine and underground gasoline tank) for cars. With regard to the facilities (oil supply pumps and oil tanks) for the oil tank base and the facilities excluded from the scope of designing, however a brief study and materials are attached.

(2) Designed vessel

Designed vessel at initial stage will be 25,000 DWT class of Iron-ore coal carrier and 2,400 HP tug boat equavalent to 200 DWT ships.

(3) Atmospheric temperature

On the basis of the DWG, Fig. 1-3, the max temperature is 110°F (43°C) and the min. is 44°F (7°C). Average temperature is 70°F (21°C).

(4) Water level

i. Tidal level

MHHWL	+3,400 m
MLLWL	+0,700

ii. Water level of reservoir

HWL	+7,300 m
LWL	+5,100 m

(5) Rate of supply

i.	Water supply	600 m^3/8h = 1.25 m^3.min
ii.	For fire hydrants	2 m^3/min
iii.	Oil supply	(provisional)
	C type heavy oil	= 1.8 m^3/min
	A type heavy oil	= 5.08 m^3/min

(6) Period of supply

i.	Water supply	8 hours
ii.	Fire hydrants	4 hours
iii.	Oil supply	(provisional)
	C type	20 hours
	A type	4 hours

(7) Number of outlets

	On the iron-ore coal berth	Small craft pier
i. Water supply	4 pcs.	2 pcs.
ii. Fire hydrants	4 pcs.	2 pcs.
iii. Oil supply	4 pcs.	2 pcs.

(8) Outlet discharge head

i.	Water supply	15 m
ii.	Fire hydrants	45 m
iii.	Oil supply	15 m

(9) Temperature of fluid

The temperature of water and A type heavy oil can be supplied under the normal temperature. However, C type heavy oil is required to be heated between 40°C to 50°C for supply.

(10) Piping system

The pipes for water supply and fire fighting purpose will be combined and water sources for fire extinguishing is the same source of water supply - dringking water. Oil supply will be made with two pipe line systems.

2) Planning of the Piping System

(1) Water supply system

i. Quantity of water .....Q

A. Water for vessels .....Q_1

a. Water for ore-coal carrier ...q_1

a-1 Number of days for two-way trip between Port Qasim and Australia: 30 days

a-2 Drinking water consumption : 2 m^3/day

a-3 Water for miscellaneous use : 12 m^3/day

a-4 Allowance rate : 25%

q_1 = (2 m^3/day + 13 m^3/day) x 30 days x (1 + 0.25) = 562.5 m^3

b. Water for tug boat ..... q_2

q_2 = 4 boats x 2.5 m^3/boat = 10 m^3

$Q_1 = q_1$ = 562.5 + 10 = 572.5 m^3

B. Quantity of water for terminal office and other miscellaneous uses ..... Q_2

a. Terminal office ..... q_3

Employees: 100 persons (assumed from the spaces required for terminal office)

Water consumption: 150 l/person.day (assumed from the spaces required for terminal office)

q_3 = 150 l/person.day x 100 persons = 15 m^3/day

b. Unloader and belt conveyor .. q_4 (for antipollusion measurement purpose.)

Rate of water sprinkling for dust control number of nozzles: 4 pcs.

Rate of water sprinkling : 5 l/min.nozzle

q_4 = 4 x 5 l/min. x 60 min. x 24 hours/day

= 28.8 m^3/day

$q_3 + q_4$ = 15 + 28.8 = 43.8 m^3/day

The number of working and operating hours is assumed to be 8 hours.

$Q_2 = 43.8 \times \frac{8}{24} = 14.6\ m^3$

C. Quantity of water

$Q = Q_1 + Q_2 = 572.5 + 14.6 = 587.1\ m^3$

Additionally, water supply to a sub station, an independent power plant and a cooling water tank must also be considered. Therefore, the total quantity of water supply is assumed to be 600 m^3.

ii. Water supply period

Each vessel stays at this berth for three days even in the busiest case. Therefore, three days are allowed for water supply. Water supply should be completed as quickly as possible for vessels, however, a system with an exessively large capacity means long idling period.

For this project, 8 hours (conventionally adopted water supply period) are adopted on the basis of the study on facilities of this type.

iii. Rate of water supply per unit time

The rate of water supply is obtained from above mentioned conditions.

$Q = 600\ m^3/8\ hours = 75\ m^3/hour = 1.25\ m^3/min.$

iv. Rate of water supply at second stage

When an additional main berth is constructed in the future, it is assumed that the rate of water supply must be doubled.

$Q = (600\ m^3/8\ hours) \times 2 = 150\ m^3/hours = 2.5\ m^3/min.$

v. Number and arrangement of water hydrants

Each vessel has a water inlet on the both sides of the ship. Even if a vessel will berth in the form of either the starboard or the port, effective water supply must be ensured for 25,000 DWT - 75,000 DWT ore-coal carriers. Therefore, a main berth is to have four water hydrants at about 50 m intervals. A small craft pier is to have two water hydrants.

(2) Fire extinguishing system

i. Applicable objects and district

Vessels at mooring and PQA terminal area to be covered by the fire extinguishing system.

ii. Source of fire extinguishing water

Since the rate of potable water supply is limited, it is

ideal to use sea water, however, sea water will cause presents various problems, including the selection of materials for equipments, maintenance and control cost and deterioration of pump suction due to sea weed and shells. As a result of the study on reservoir in the previous section show, sufficient fire extenguishing water can be secured even after the construction of an additional berth at the second stage. Therefore, potable water of a water supply reservoir is to be used for fire extinguishing.

iii. Simultaneous occurrence of fires and fire extinguishing capacity

It is assumed that two or more fires do not occur simultaneously. Therefore, the capacity of water to be consumpted for one fire is considered. That is 480 m^3 for four hours.

iv. Fire extinguishing system

The maximum duration of fire extinguishing operation is assumed to be four hours.

A. Scale of fire extinguishing system

a. Main berth

Fire hydrants and rate of water discharge

The radius of a fire hydrant is to be 30 m.

The rate of water discharge per fire hydrant is to be 350 l/min.

$$\text{Number of fire hydrants} = \frac{320 \text{ m (overall length of main berth)}}{30 \text{ m} \times 2}$$

$$= 5.4$$

Rate of water discharge = 350 l/min. hydrant x 5.4 = 1890 l/min.

= 2 m^3/min.

Number of hydrants: 4 pcs.

Interval : 50 m to60 m

Number of hydrants to be opened simultaneously : 2 at a time

Rate of water discharge : 2 m^3/min. with two hydrants opened simultaneously

Rate of water discharge per one hydrant : 1 m^3/min.

Hydrant type : Double outlet (500 l/min. per outlet)

b. Small crafts pier

Rate of water discharge

$$\text{Number of hydrants} = \frac{70 \text{ m (overall length of small berth)}}{30 \text{ m} \times 2}$$

= 1.2

Rate of water discharge = 350 l/min. hydrant x 1.2 hydrant

= 420 l/min.

500 l/min. with some allowance

Number of fire hydrants: 2

Interval : About 35 m

Number of hydrants to be opened simultaneously : 1

Rate of water discharge per hydrant : 500 l/min.

Type of hydrant : Single outlet hydrant

c. Outdoor hydrants

The fire hydrants for the PQA terminal area are determined as given below along the road way on the building side of terminal area.

Rate of water discharge per hydrant	:	350 l/hydrant
Number of hydrants	:	1 pc.
Location	:	Front of the Terminal Building
Type of hydrant	:	Single outlet hydrant

B. Required head at hydrant outlet

The relation between the pressure at nozzle tip and the rate of water discharge is depended upon hose length and nozzle diameter. An example of the relations is shown in the following table.

Case	Pressure at nozzle tip (kg/cm^2)	Nozzle diameter (mm)	Hose length (mm)	Rate of water discharge (ℓ /min.)
1	2	19	20	333
2	4	19	20	470
3	10	19	20	750
4	12.5	19	20	850
5	4	20	20	520
6	10	20	20	800
7	12	20	20	900

The nozzle tip pressure for a main berth must be about 4 kg/cm^2. The required discharge head at hydrant outlet is to be 45 m in consideration of the loss of head in a hose and a nozzle.

(3) Oil supply system

i. Properties of fuel oils

Major properties as design conditions are given below.

Fuel oil	Heavy oil C	Heavy oil A
Specific gravity	0.93	0.82
Redwood I 100°F second	1,000 at 100°F (38°C)	
Dynamic viscosity coefficient	270 CS at 100°F (38°C)	7.5 CS at 100°F (38°C)
Pour point	75°F (24°C)	30°F (-1*C)

Note: 1) The above figures were obtained from the data of NESPAK.

2) Maximum and minimum value

In using figures in the data, the minimum figures were taken for specific gravity and the maximum figures were taken for dynamic viscosity coefficient and pour point to ensure sufficient safety for the oil supply system.

3) Dynamic viscosity coefficient

The dynamic viscosity coefficient of C heavy oil was obtained by conversion from Redwood practical viscosity.

ii. Temperature of heavy oil C

As the data show, the pour point of heavy oil A is 30°F (-1°F), while that of heavy oil C is 75°F (24°C). Since the atmospheric temperature falls to 7°C (minimum), heavy oil C must be constantly maintained at 40°C - 50°C by heating and insulation. However, 100°F (38°C) is adopted to ensure the safety of the oil supply system.

iii. Quantity of oil supply

The quantity of oil to be supplied to the main berth and the small crafts pier is assumed as below.

A. Main berth

Since oil can not be supplied at any ports in Australia if Iron-ore coal are imported from Australia sufficient fuel oil for a two-way voyage between Port Qasim and Australia must be supplied at this port. Design oil supply quantity is to be determined on the basis of the data on fuel consumption of a 75,000 DWT ore-coal carrier.

a. Heavy oil C: The actual required quantity for a two way voyage: 1500 tons

The ratio of additional fuel consumption due to port weather or port calling is assumed to be 25% of net consumption.

Required quantity of oil supply = 1,500 x (1 + 0.25)

= 1875 tons

With some allowance, the quantity of oil supply is assumed to be 2,000 tons.

Conversion into volume: 2,000/0.93 = 2,150 m^3

b. Heavy oil A:

Heavy oil C is the main fuel during navigation, and voyage, but it is inadequate for delicate speed control at the time of docking and berthing time. Heavy oil A featuring high thermal efficiency is used for such purposes.

The consumption of heavy oil A is estimated to be about 1/4 of that of heavy oil C.

Required quantity of heavy oil A = 2,000 x 1/4
= 500 tons

Conversion into volume = 500/0.82 = 610 m^3

B. Small crafts pier

It is assumed that two tug boats with bollard pull capacity of 30 tons/boat receive heavy oil A (diesel oil) simultaneously. The engine capacity is 2,400 HP (equivalent to 180 - 200 DWT) and the fuel oil tank capacity is about 74 kl. Therefore, they require far less oil than a 75,000 DWT oil tanker. Therefore, the oil feeding period for the former is hardly influenced by simultaneous oil feeding to an oil tanker.
Therefore, the design quantity of oil supply for this system is to be determine on the basis of the quantity for an ore-coal carrier.

C. Quantity of oil supply with additional main berth at second stage

An oil supply system must be able to feed oil to two 75,000 DWT ore-coal carriers moored at the main berth simultaneously. The quantity of heavy oil A and C. With additional main berth will require as follows.

Heavy oil C: 2150 m^3 x 2 = 4,300 m^3

Heavy oil A: 610 m^3 x 2 = 1,210 m^3

iv. Oil feeding period

A 75,000 DWT ore-coal carrier stays at least three days. For vessels, oil feeding period should be as short as possible. Contrally for the oil supply system, the period should be prolonged to make capital cost less. The total oil feeding period of heavy oil C and heavy oil A is assumed to be 24 hours.

The required supply of heavy oil C is 2,000 tons, while that of heavy oil A is 500 tons. The ratio is 4 : 1.

Oil feeding period for heavy oil C : 20 hours

Oil feeding period for heavy oil A: 4 hours

Oil feeding is to be completed within 24 hours.

v. Piping system

Two separate piping systems are to be installed for supplying heavy oil A and C to avoid the mixture of C into A.

vi. Outlet of oil supply

A. Number of outlet of oil supply

Four oil hydrants are to be installed on the berth in consideration of two possible directions to be berthed and 20,000 - 75,000 DWT vessels can be fed.

B. Outlet head

a. Height from water level to vessel's oil inlet level at lightest draft: 13 m (75,000 DWT)

b. Actual lift from berth to oil inlet

$$13\text{ m} - \underset{\text{level}}{(6.1\text{ m berth}} - \underset{}{3.4\text{ m HWL})} = 10.3\text{ m}$$

c. The outlet pressure of a berth side is determined by assuming the loss of pressure in an oil hose as 4 m.

Head of outlet is obtained as below.

10.3 - 4 = 14.3 = 15 m.

(4) Gasoline service system for vehicles

A gasoline service system for cars in the terminal office is considered. A gasoline metering equipment and an underground oil storage tank are planned on the basis of the following assumption.

Number of employees under service	:	100 employees/day (assumed from the spaces required for terminal office)
Number of vehicles	:	1 vehicle/2 employees
Distance	:	Two-way trip between Port Qasim and Karachi
		40 miles x 2 = 80 miles/two-ways
		= 130 km/two ways
Gasoline consumption:		1 l/10 km

3) Brief Description of Equipment for Supply System

Brief Description of Equipments Table 3 - 4

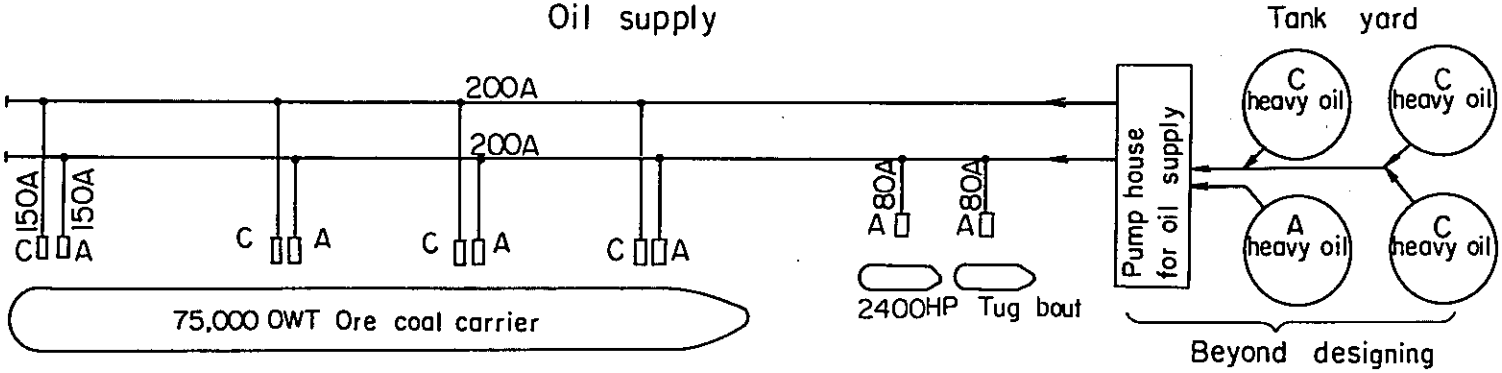
Item	Water supply	Fire-extinguishing	Oil supply	
1. Pump				
1-1 For berths			C heavy oil	A heavy oil
1st stage	Q=1.25m^3/min. H=40m P=22 kw	Q=1.0m^3/min. H=65m P=22kw	Q=1.8m^3/min. H=85m P=45kw	2.54m^3/min. 70m 37kw
	Three pumps to be shared by water supply and fire extinguishing systems (One for spare)		Two pumps (one for spare)	
2nd stage	No addition		One pump for C and one pump for A	
1-2 For building etc.	Q=0.4m^3/min. H-25m P=3.7kw Two pump(including one spare)			
2. Flow meter	200ϕ flow meter ..... 1 (for measuring total water flow of berths)			
	150ϕ flow meter ..... 4 (Main berth)		Main berth 150ϕ flow meters .... 4 150ϕ flow meters 4	
	75ϕ flow meter ..... 2 (Small berth)		Small berth 80ϕ flow meters.... 2	
3. Water hydrant, outlet of oil supply			C heavy oil,	A heavy oil
Main berth	150ϕ hydrant 4	100ϕ hydrant ..... 4 (Double outlet)	150ϕ hydrant ..... 4 each	
Small berth	75ϕ hydrant 2			75ϕ hydrant 2

Table 3-4 (Contfd)

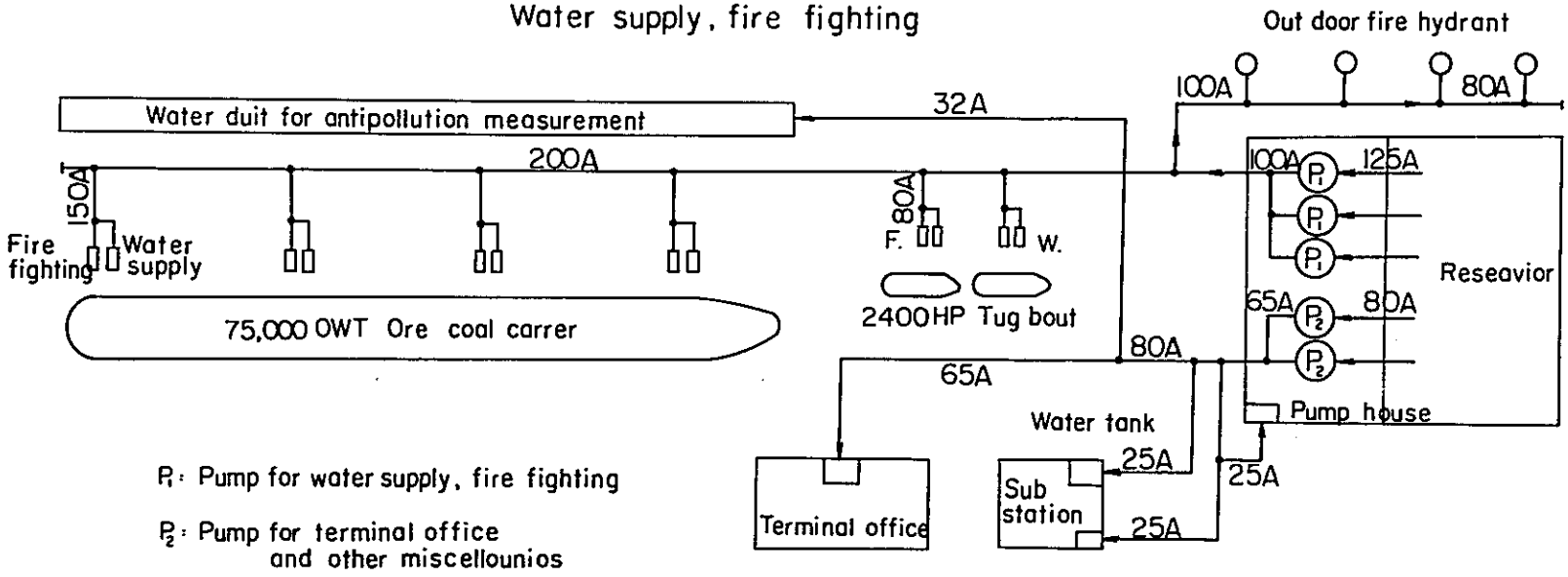
Item	Water supply	Fire-extinguishing	Oil supply
3. (cont'd) Outdoor		75ϕ hydrant ... 1 (Single outlet)	
4. Piping			C heavy oil A heavy oil
Main pipes for berth	200ϕ pipe (with painting and coating for service water)		200ϕ 200ϕ (Carbon steel pipe)
Branch pipes	150ϕ pipe (Material: Specified above)	150ϕ pipe (Material: SG D)	150ϕ pipe 150ϕ pipe (Material Specified above)
Water for miscellaneous use		For outdoor fire hydrants ..... 80ϕ pipe	
Main	80ϕ pipe		
Management building	65ϕ pipe		
Unloader	32ϕ pipe		
Substation	25ϕ pipe		
Capacity to be supplied			
5. Others			Gas station underground tank capacity $10m^3$

4 Flow diagram piping system

Oil supply



Water supply, fire fighting



CHAPTER IV POWER SUPPLY AND ELECTRICAL FACILITIES

1. BASES OF DESIGN

1) Standard and codes

The electrical facilities are designed according to the following standards and codes:

(1) Pakistan Standard

(2) Regulations for the Electrical Equipment of Buildings (I.E.E.)

(3) National Electrical Code (National Fire Protection Association, USA)

(4) Japanese Industrial Standard

(5) National Fire Code (National Fire Protection Association, USA)

2) Illumination standard

The intensity of illumination of lighting equipment at various locations is designed on the basis of the following standard:

Office rooms	:	250 to 300 lx.
Rooms other than office rooms	:	100 lx.
Corridors	:	100 "
Roads	:	Average 7 lx.
Berth	:	" 7 "

3) Voltage drop on trunk lines

Voltage drops on various trunk distribution lines are designed as to be 6% or less at the end terminal of trunk.

2. PLANNING OF FACILITIES

1) Power Supply Facilities

(1) Ordinary power supply

A power of 11 KV, 3-phase and 50 Hz is received via the overhead power line at the receiving pole and transmitted via underground cable to the sub-station, where the power is transformed into a power of 380/220 V, 3-phase, 4-line and 50 Hz and distributed to various facilities in the premises. Power trunk-line cables which connect the sub-station to various facilities are laid in conduits buried underground and in trenches.

Asbestos cement pipes will be used for protecting exteior power distribution cables under the ground. However, street lighting cable will be buried in the thick vinyl pipes.

(2) Emergency power supply

A diesel generator shall be installed at the sub-station to prevent complete power failure at various facilities due to the power failure or voltage fluctuations of supply distribution lines. This generator is automatically actuated by the power failure or voltage fluctuations of supply distribution lines and is connected to the power system, thereby supplying power to the following predetermined important facilities in the premises:

a. Water supply pumps

b. Water-purifier tanks

c. Water-supply and fire-fighting pumps

d. Capstans

e. A part of berth lighting

f. A part of approach lights

g. VHF transmitter and receiver

h. A part of street lights

i. A part of building lights

j. Power source for oil pumps

k. Berth flood light

(3) Outline of equipment

The outline of major equipment is shown below:

a.	Main circuit breaker:	Oil circuit breaker, 11 KV, 400 A, 350 KVA
b.	Transformer:	Oil-immersed self-cooled type, 11 KV/380 V/220 V, 500 KVA x 1
c.	Distribution panel:	Enclosed type, w/MCCB as branching circuit breaker
d.	Generator:	Diesel engine, 600 HP Generator, 3-phase, 380/220 V, 50 Hz, 500 KVA

(4) Extension schedule

Not only the capacity of transformer and generator are decided as to be able supplying power for extended loads, but the space for a transformer and switch gear is prepared in the sub-station.

2) Telephone Facilities

(1) Main line

Five circuits are led in from the local exchange office and are connected to the switchboard via MDF installed at the terminal office.

(2) Exchange

The exchange shall be installed at the mechanical work shop of the terminal office and shall be a crossbar-type automatic exchange having a capacity of 40 extension lines.

(3) Telephone sets

Telephone outlets shall be installed at the following locations:

a.	Berth deck	: 3 sets
b.	Gate house	: 2 sets
c.	Pump house	: 1 set
d.	Sub-station	: 1 set
e.	Terminal office	: 22 sets
f.	Berth for small crafts	: 1 set

(4) Excluded work

The present work does not include the wiring between the MDF to various telephone sets, and the installation of telephone sets.

3) Electrical Facilities for Buildings

(1) Lighting facilities

The intensities of illumination of various rooms shall conform to the design standard.

All the lighting equipment shall be sprayed with anti-corrosion paints to prevent the injury from salt.

(2) Plug-socket facilities

Two-pole 12-A plug-sockets shall be installed at the corridors, and each rooms to facilitate the use of general office equipment, cleaners, etc.

(3) Telephone facilities

Refer to Clause 2-2.

(4) Automatic fire detectors

Heat-type spot-shaped automatic fire detectors shall be installed

in all the rooms of the terminal office and other buildings and smoke-type fire detectors shall be installed at corridors. When the fire breaks out, an alarm is sounded on the receiver panel installed at the information office of the terminal office and, at the same time, the fire area is indicated on the panel. The number of windows for indication on the receiver panel is 30 K.

(5) Power supply for air-conditioners

All the office rooms shall be provided with exclusive-use plug-sockets for air-conditioners.

4) Berth Electrical Facilities

(1) Approach lights

To facilitate approaching by ships, fluorescent lamps (20 W-2-lamp type) shall be buried into the side walls of the berth. The lighting equipment shall be of a waterproof type and given a treatment to prevent injury from salt.

(2) Deck lighting

A pole light shall be installed on the berth deck. The height of the pole is 6 m and the lighting equipment consists of a 300-W mercury arc lamp with a glass cover. The lighting equipment shall be of a waterproof type and be given a treatment to prevent injury from salt.

(3) Flood lights

At an end of the berth, a pole of 20 m in height shall be erected and 3 1-KW flood lights shall be installed on the top of the pole so that the sea surface in the vicinity of the berth can be lighted.

5) Power Supply for Pumps and Control Equipment

(1) Kinds of pumps

Power shall be supplied to the following pumps:

a. Oil supply pumps (for fuel oil A): 37 KW (provisional), 2 ea

b. Oil supply pumps (for fuel oil C): 34 KW (provisional), 2 ea

c. Water-supply and fire-fighting pumps: 22 KW, 3 ea

d. Pumps for supplying water to buildings: 5.5 KW, 2 ea.

e. Power supply for water-purifier tank: 6.25 KW

(2) Control panel

Since the pumps mentioned in Items 5-i c and d are operated automatically respectively, a necessary control panel shall be installed.

(3) Control of water-supply and fire-fighting pumps

The water-supply and fire-fighting pumps are controlled under the following conditions:

a. Remote manual control from the terminal office is possible.

b. Manual control in the pump house is possible.

c. Automatic starting is possible by means of the operation of fire detectors and manual alarm push-buttons at the each alarm panels.

(4) Control of pumps for supplying water to buildings

These pumps are controlled under the following conditions:

a. Automatic operation is possible by means of the water level of the high water tank installed on the roof of the terminal office.

b. Manual control in the pump house is possible.

6) Central Surveillance Equipment

A surveillance panel shall be installed at the information office in the terminal office to indicate alarms regarding the following matters:

a. Trouble at the sub-station

b. Trouble at the generator

c. Trouble with equipment at the pump house

d. High and low water levels of the reservoir

e. High and low water levels of the overhead water tank on the terminal office building.

3. Summary of Works

1) Summary of the electrical works Table 4-1

Facilities	Provisions	Quantities and Volume
(1) Substation	Transformer	500 KVA 1 set
	Diesel generator	500 KVA 1 set
	Lighting Ceiling light	FL-40-1 19 sets
	Telephone outlet	1
	Fire detector smoke type	4
	heat type	1
	Fire alarm panel	1
(2) Terminal Office Lighting	Ceiling light Wall mounted type (water proof type)	FL-40-2 149 sets
	Power feeder for septic tank	17 sets
	Alarm signal panel for pumps and electrical equipments	
	Telephone exchange	40 extension lines
	Telephone outlet	22
	Fire alarm board	1
	Fire alarm panel	2
	Fire detector smoke type	7
	heat type	30
(3) Gate house	Lighting Ceiling light	FL-40-1 9 sets
	Telephone outlet	2
	Fire detector heat type	2
	Fire alarm panel	1
(4) Pump house	Lighting Ceiling light	FL-40-1 4 sets
	Control panel for pumps	
	Water fire pump	30Kw x 3
	Water pump	3.7Kw x 2
	Telephone outlet	1
	Fire alarm panel	1
	Fire detector heat type	1
(5) Berth	Lighting Pole light	HF300 W-2 6m heights 8 sets
	Flood light	HF 1KW-3 20m heights 1 set
	Signal light	1 set
	Approach light	FL 20-2 8 sets
	Power feeder and distribution board for capstan	11KW 6 sets
	Telephone stand (water proof type)	3
	Fire alarm panel (water proof type)	4
(6) Street and Parking area	Lighting Pole light	HF400 W-2 10m heights 12 sets
	"	HF300 W-1 6m heights 14 sets
	Power feeder for oil pump	
	Fire alarm panel (water proof type)	5
	Telephone stand (water proof type)	1

2) Electrical Power Supply Works

(1) Service Cabling

Supply and installation of concrete pole, insulator and fittings, main cables and cable ducts installed between incoming point and primary terminal of the main circuit breaker.

(2) Sub-station

Supply and installation of the transformer, switch gears, all cables installed in the substation and grounding conductors. The electric power room will be separated to the high tension distribution load room and low tension according to the Pakistan code.

(3) Power Station

Supply and installation of the diesel engine generator, switch gears, fuel tank and piping cooling water tank, cooling tower and piping, exhaust duct, silencer, all cables for generator and other necessary equipment.

(4) Power distribution Line

Supply and installation of all cables and cable ducts from sub-station to each facilities such as distribution board and control panel.

(5) Capacity of Transformer

a. The load and capacity of No. 1 transformer

The capacity of No. 1 transformer has been designed on the basis of the following power requirement load required for the facilities.

i) Capstan on the dolphin 66 kw

ii)	Berth light, terminal office lights, V.H.F.	30 kw
iii)	Pumps for water supply to the terminal office and pump house	10 kw
iv)	Pumps for water supply and fire hydrant to the berth	60 kw
v)	Power in the sub-station	10 kw
vi)	Reserved power for oil supply (provisional)	50 kw
	Total required load	226 kw

The power requirements

226 kw x 1.25 kva/kw = 282.5 kva

Rate of demand assumed to 0.8

282.5 x 0.8 = 226 kva

250 KVA capacity of No. 1 transformer which will will be sufficient to meet the max. power requirement has been provided.

3) Power Supply and Control System Works for Pumps

Supply and installation of control panels, alarm signal panel, remove control board and all power and control cables.

4) Lighting and Plug Socket Works

Supply and installation of distribution boards, lighting fixtures, plug sockets, conduit pipes and wirings, and other necessary equipment installed in the following buildings.
The equipment of lightings and plug sockets will be used those available locally as much as possible.

(1) Terminal office

(2) Sub-station

(3) Gate house

(4) Pump house

(5) Street and parking area

(6) Berth

5) Telephone Works

(1) Exteior Cabling

Supply and installation of all external cable and cable ducts for telephone system.

(2) Terminal office

Supply and installation of the MDF, exchange, battery unit, terminal boards, telephone outlets and conduit pipe in the terminal building.

(3) Sub-station

Supply and installation of telephone outlets and conduit pipes in the sub-station.

(4) Gate house

As same as Item 3.

(5) Pump house

As same as Item 3.

(6) Berth

Supply and installation of the telephone stands and cable ducts at the berth.

6) Automatic Fire Alarm System Works

(1) Exterior Cabling

Supply and installation of all external cables and cable ducts for fire alarm system.

(2) Terminal office

Supply and installation of the alarm signal receiving panel, battery unit, manual alarm panel, detectors, wirings and conduits pipes in the terminal office.

(3) Sub-station

Supply and installation of the manual alarm panel, detectors,wiring and conduits pipes in the sub-station.

(4) Gate house

As same as Item 3.

(5) Pump house

As same as item 3.

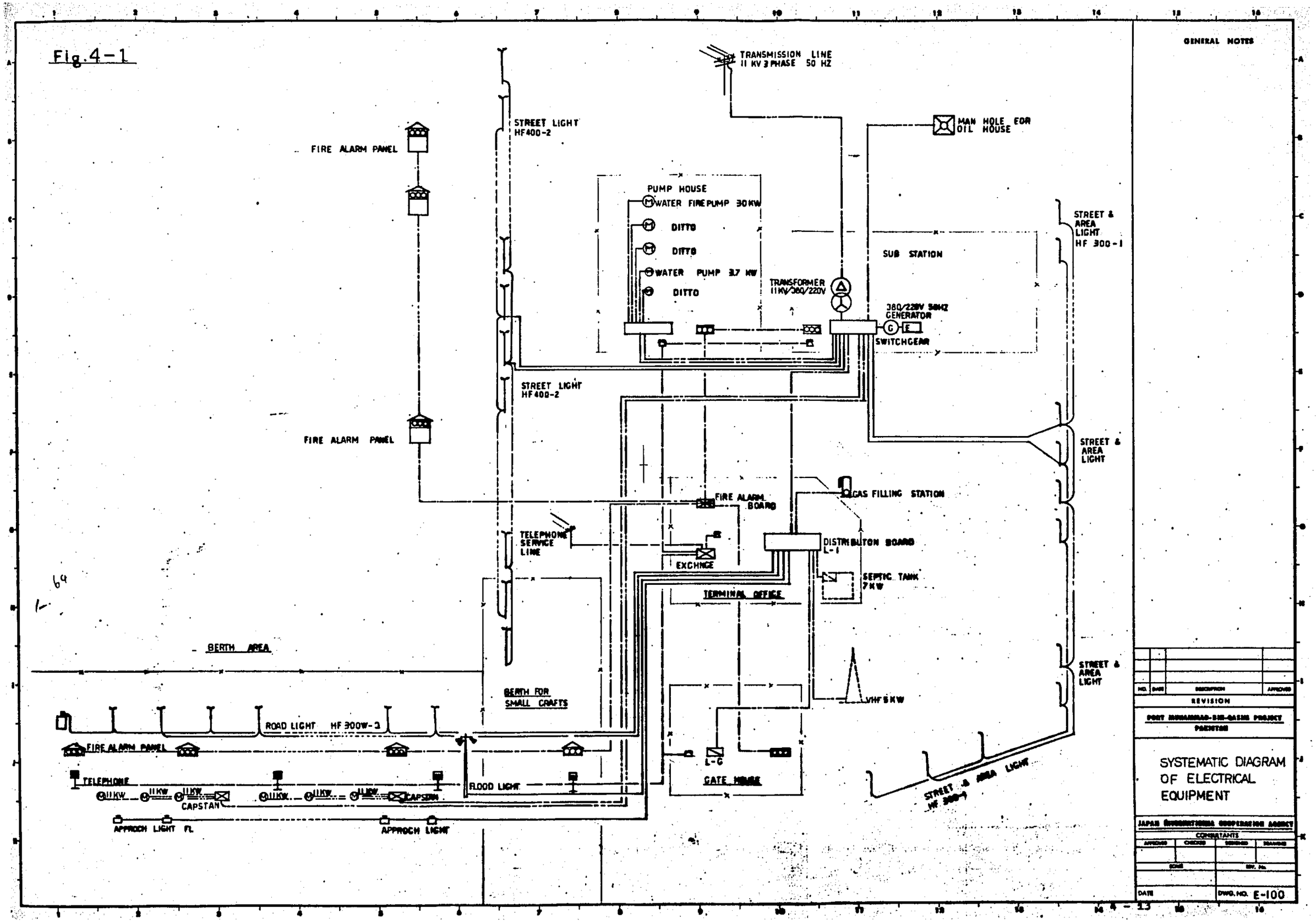
(6) Berth

Supply and installation of the water proof type manual alarm panels, cables and cable ducts for berth.

(7) Street and parking area

As same as Item 6.

Fig.4-1



GENERAL NOTES

NO.	DATE	DESCRIPTION	APPROVED

REVISION

PORT MUHAMMAD BIN QASIM PROJECT
PAKISTAN

SYSTEMATIC DIAGRAM OF ELECTRICAL EQUIPMENT

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS			
APPROVED	CHECKED	DESIGNED	DRAWN
SCALE		DWG. No.	
DATE		DWG. NO.	E-100

CHAPTER V LAND RECLAMATION

1. DESIGN CRITERIA

1) Planned ground height +5.20 above D.L.

2) Uniform live load acting on the surface of the terminal area;

Normal condition $q = 1.0\ t/m^2$

3) Presumption of Soil Condition

Due to the lack of suitable boring data at the terminal area for the study of slope stability, the soil condition and parameters have been presumed from the nearest boring logs, B.H 108, 109 and B,H 519.

(1) Sand for reclamation $r = 1.7\ t/m^3$

$\phi = 30°$

$c = 0\ t/m^2$

(2) Stone for armour and gravel $r = 1.8$

$\phi = 40°$

$c = 0$

(3) Clay (below the existing sea bed)

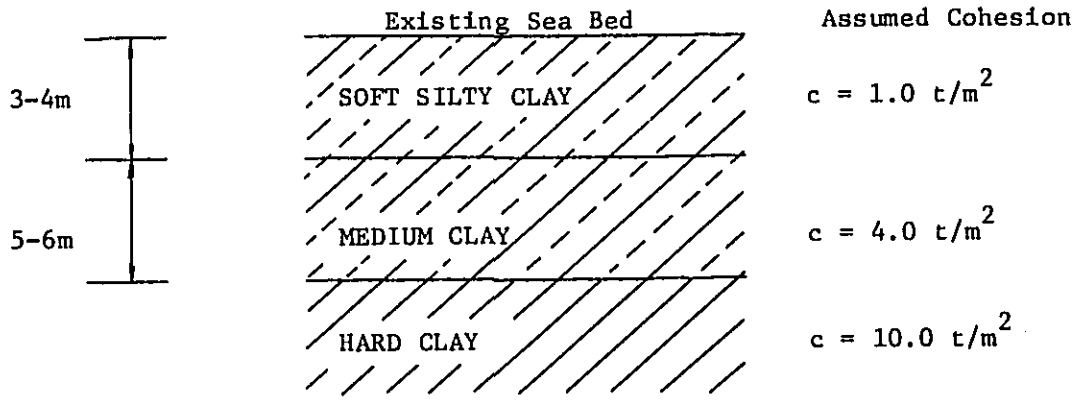


Fig. 5-1 Presummed soil strata for reclamation area.

4) Allowable safety factor against sliding failure

(1) Normal condition Fsa = 1.3

(2) Seisurric condition Fsa = 1.0

5) The precipitation of rainfall

The precipitation of rainfall have been assumed from Fig. 1-2. This is 60 mm/hr, adopted for desiging of drainage pipe line system.

6) The Pavement

Normal passenger vehicles and 1.0 t/m^2 of uniform line load has been taken into account for designing of asphalt emulsion pavement.

2. CONSTRUCTION METHOD

For the work of reclamation, the following three methods are conceivable.

Case 1 To carry out the reclamation work with an access road extended from the land and the rubble mound and sand carried by land or large dump trucks along the road.

Case 2 To reclaim the area with the river sand dredged out of the nearby creeks by pump dredgers.

Case 3 To carry out the reclamation work with barges to carry the rubble and sand for about 6 km from the base to the reclamation site.

Advantages and disadvantages of these three methods have been studied as follows.

	Advantage	Disadvantage
Case 1	1. Land transportation of the materials permits easy operation.	1. Bridge work required to cross a creek of about 120 m width. 2. Construction machines required to complete the access road before the scheduled time are not available in Pakistan. Start of the work is delayed to make it difficult to complete the work before the scheduled time.
Case 2	1. Work efficiency is improved, provided a lot of sand is available. 2. The work period is reduced.	1. From the data presently available on the soil, it is not known whether or not the required soil is secured quantitatively as well as qualitatively. 2. If the sand is to be collected from 2 or 3 places, troubles are involved of moving the dredger, installing the pipeline, etc. 3. River sand is collected. Thus, the work to remove the upper soft clay layer is involved. 4. Where an exclusive dredger is provided, the overall cost becomes high.
Case 3	1. Reclamation materials are secured.	1. Work process is rather complex. 2. Indirect construction costs are required for bringing the barges back and related temporary works.

Case 3 is the highest with respect to the construction cost, but acquisition of the reclamation sand is insured, while the work is

complete within the specified period after the required working machines are mobilized. Thus,Case 3 is employed.

In case of executing the work of Case 1, in the absence of fundamental data, topographical maps and data on the soil for the work to carry out the reclamation with the creek buried and an access road extended from the land, it is not known whether or not the work is completed within the specified period only through mobilization of the working machines.

3. SUMMARY OF DESIGN CALCULATION

1. Reclamation

The bottom of the sea area designed for reclamation is very soft. While there are no test data of soil available, the bottom is of clay of about c = 1.0 t/m^2 in the soil parameter according to the boring tests. As the result of stability calculation of the revetment, if the sand is laid directly over such soil, a very gentle slope is required for stability of the revetment. This requires a large amount of reclamation sand. Further, if the depth required for the small crafts pier is to be satisfied, the revetment and reclamation lines have to be retreated. Thus, this soft layer is removed by dredging up to -5.00 m, and the reclamation work is carried out thereover with sand and gravel. A stable profile was provided for the revetment erected with rubble mount at a slope of 1:2.

The reclamation this time is limited to the PQA area, and that for PASMIC or Oil Company area will be performed later.

The slope of the revetment will have covering stones, 50 cm in diameter and 80 kg in weight, embedded on the surface to prevent erosion of the rubble mound and sand.

At the crown of the revetment facing to the creek, a reinforced concrete sea wall is provided to cope with the wash of waves.

The design height of the reclamation land is 5.20 m, provided the road is sloped to drain rain water.

In case reclamation have been carried out on the existing sea bed without its any improvement, the result of studies on the slope stability of embankment have been shown on Fig. 5-4, 5-5, and Fig. 5-6.

Due to the results of the above studies, the reclamation shall be carried out after dredging top soft layer about 4 - 5 m thickness.

The safety factor against circular failure of the section has improved to be 1.7 as shown on Fig. 5-7.

To reduce volume of dredging and reclamation, the top soft silty clay layer on the embankment area only shall be dredged and reclamation to be carried out thereupon.

The typical cross section is shown on Fig. 5-8.

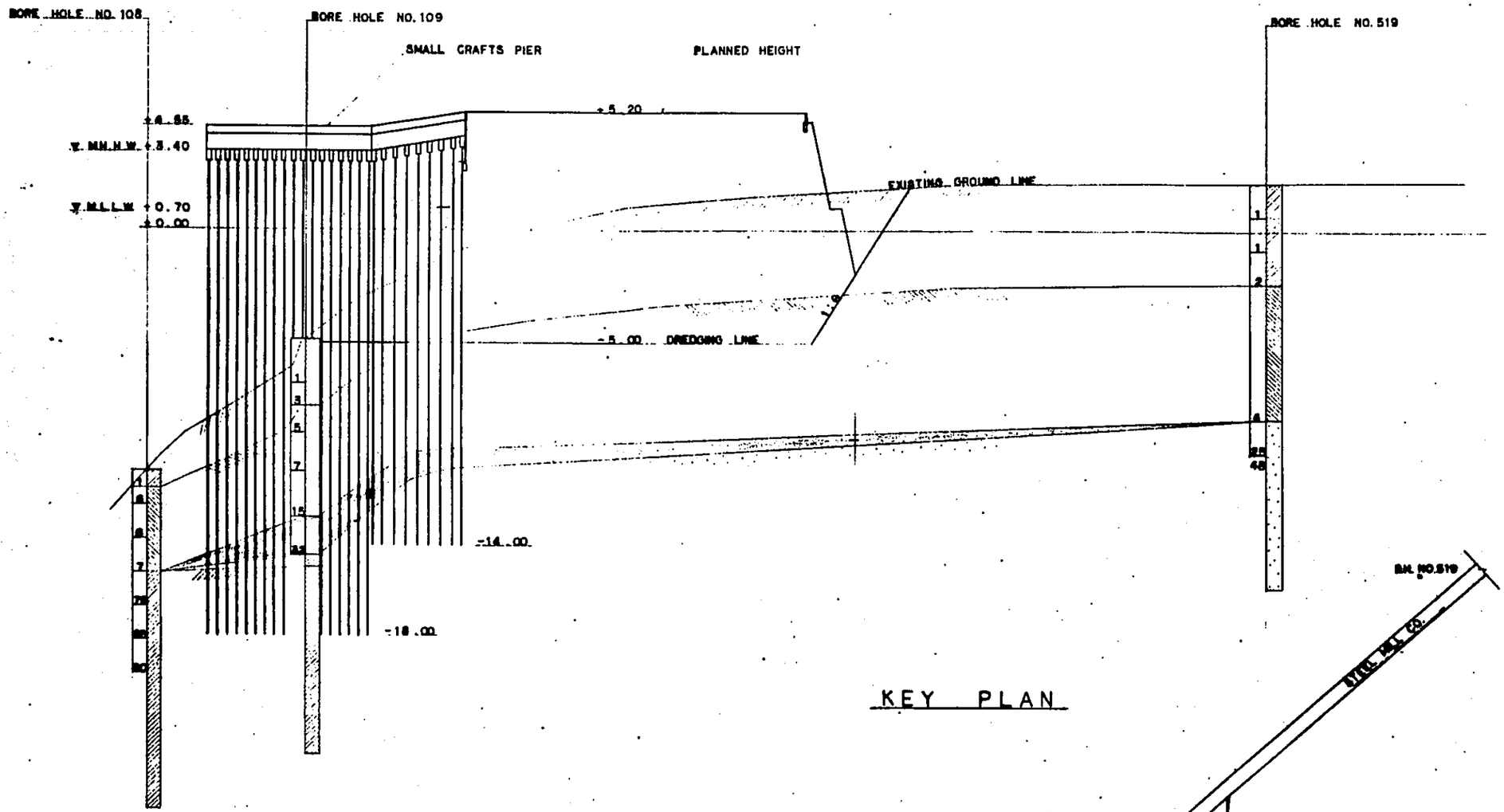
TABLE 5-1 Comparative Study of Slope Stability

	SAFETY FACTOR OF MINIMUM SLOPE STABILITY (Fs min)	RADIUS (M)	IMPROVEMENT METHOD
CASE 1 Reclamation on the existing sea bed.	Fs min = 0.748 $< F_{sa} = 1.3$ Fsa; ALLOWABLE SAFETY FACTOR OF MINIMUM SLOPE STABILITY	26.2057	None
CASE 2 Reclamation after dredging top soft layer.	Fs min = 1.710 $>$ Fs = 1.3	28.5126	In case of the soft silty clay layer ($C=1.0\ t/m^2$) with 3.0 - 4.5 m thickness was dredged and replaced with sand ($\phi=30°$) as shown in Fig. 5-8.

Fig. 5-2

PROFILE OF ASSUMED SOIL PROPERTIES

SCALE H. 1 : 1,000
V. 1 : 100



KEY PLAN

LEGEND

	SILTY CLAY	STP Blows/ft	1 ~ 3
	SILTY CLAY	STP Blows/ft	4 ~ 15
	SILTY CLAY	STP Blows/ft	15 ~ 32
	GREY FINE SAND		
	HARD SILTY CLAY		

GENERAL NOTES

NO.	DATE	DESCRIPTION	APPROVED
		REVISION	

PORT MUHAMMAD BIN QASIM PROJECT
PAKISTAN

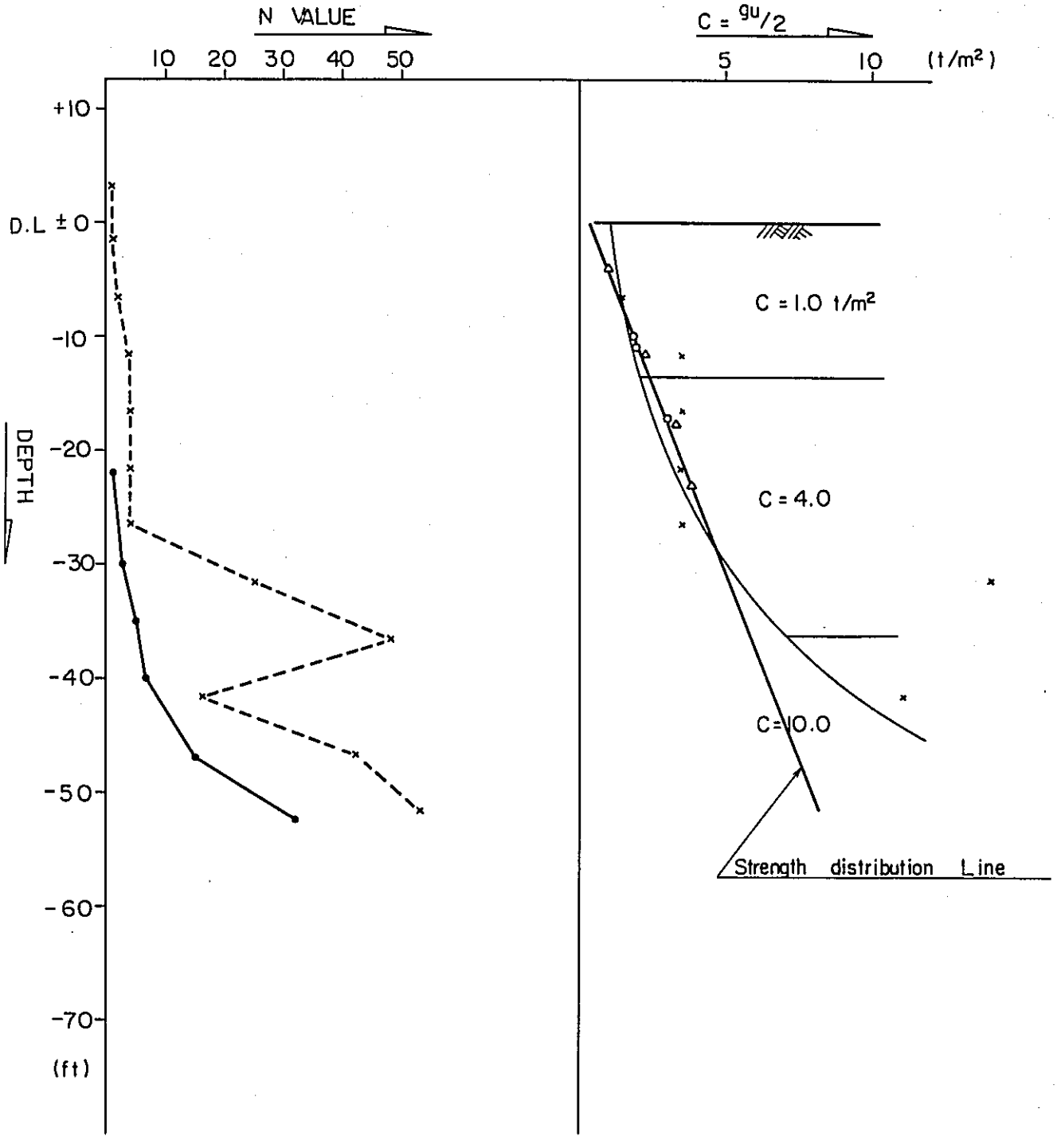
LAND RECLAMATION

SOIL PROFILE

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS			
APPROVED	CHECKED	DESIGNED	DRAWING
SCALE		REV. No.	
DATE		DWG. NO. T-107	

Fig 5-3 RELATIONSHIP BETWEEN N-VALUE AND COHESION



—— B.H 109

---- B.H 519

o, Δ Strength Confirmed in the additional Boring Bore Hole "R"

Fig. 5 – 4 RELATIONSHIP BETWEEN Fs AND SLOPE

IN THE CASE OF SEISMIC CONDITION

SAFETY FACTOR INDICATES SUCH AS { UPPER STAIR AT SLOPE 1 : 2 / CENTER STAIR AT SLOPE 1 : 5 / LOWER STAIR AT SLOPE 1 : 10

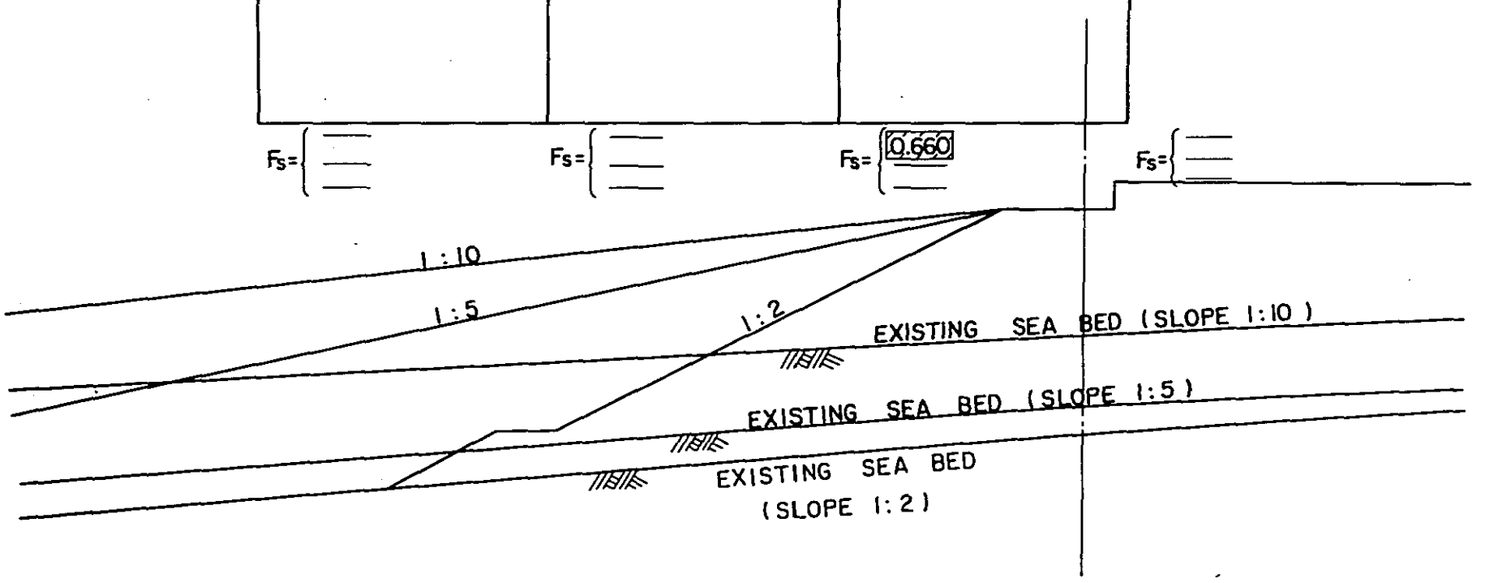
(-28.5 .65)

Fs = 1.129 / 1.631	Fs = 1.279 / 2.156	Fs = 1.368 / 1.197	Fs = ——
Fs = 1.216 / 1.221	Fs = 0.978 / 1.263 / 2.180	Fs = 0.779 / 1.182	Fs = 1.102
Fs = ——	Fs = 0.921 / 1.113 / 1.852	Fs = 0.774 / 0.997	Fs = 0.906
Fs = ——	Fs = 0.896 / 1.096	Fs = 0.751 / 0.842	Fs = 0.727
Fs = ——	Fs = ——	Fs = 0.660	Fs = ——

TYPICAL SOIL CONDITION

EXISTING SEA BED

$\gamma = 1.5\ t/m^3$
$\phi = 0°$
$c = 1.0\ t/m^2$
-3.00 -4.00m
$\gamma = 1.5\ t/m^3$
$\phi = 0°$
$c = 4.0\ t/m^2$



Note : In case the embankment has been designed on the existing sea bed without any improvement of soil condition, the above figure show the relation between stalitized slope and its safety factor against the circular failure of embankments. the number with back shade indicate the minimum safety factor against the circular fairue at corresponded slope angle.

Fig 5-5 RELATIONSHIP BETWEEN Fs AND SLOPE

In case the embankment is to be constructed on the existing sea bed without any improvements the minimum safety factor against circular failure can be obtained at the slope 1:8 or more from the below graph which indicates the relation between the safety factor and slope angle at seismic condition

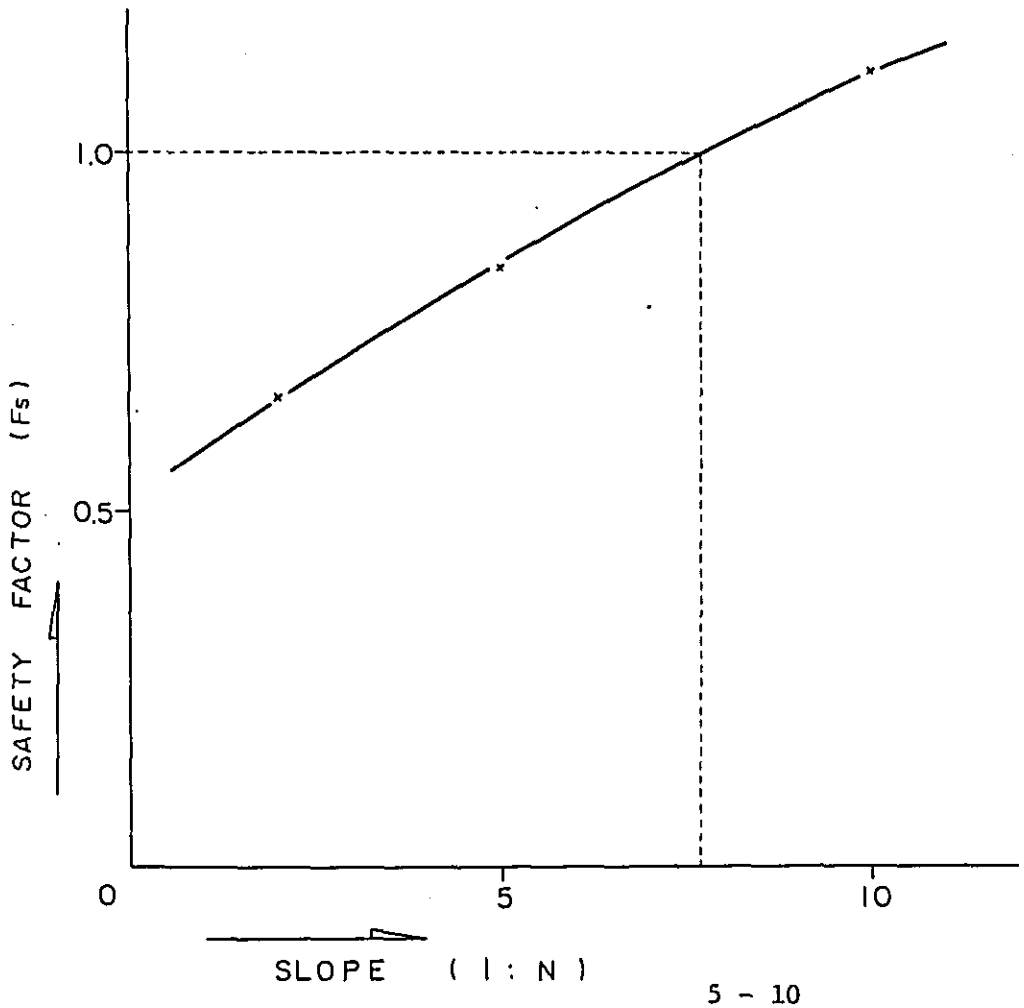
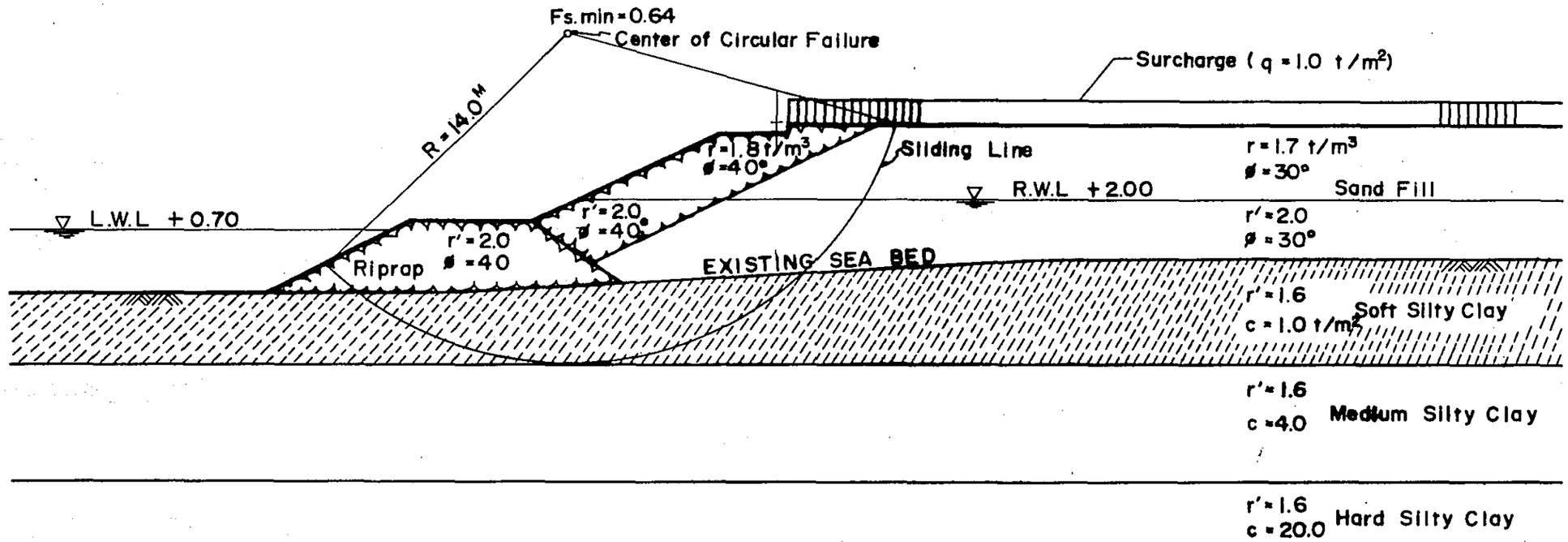


Fig.5-6 RESULT OF SLOPE STABILITY PRIOR TO IMPROVEMENT OF POOR SUBBASE

S = 1 / 200

Fs.min = 0.64 $\underset{out}{<}$ 1.3 (Required Fs) in Normal Condition.

This figure shows that this subbase shall be improved.



Where
- r : Unit Weight of Soil.
- r' : Unit Weight of Saturated Soil.
- ø : Internal Frictional Angle of Sand.
- c : Cohesion of Clay.

Fig 5-7 RESULT OF SLOPE STABILTY AFTER IMPROVEMENT OF POOR SUBBASE

S = 1 / 200

Fs. min = $1.43 \underset{ok}{>} 1.3$ (Required Fs) in Normal Condition

Fs'. min = $1.11 \underset{ok}{>} 1.0$ (Required Fs) in Seismic Condition. ----- kh = 0.07 (Seismic Coefficient)

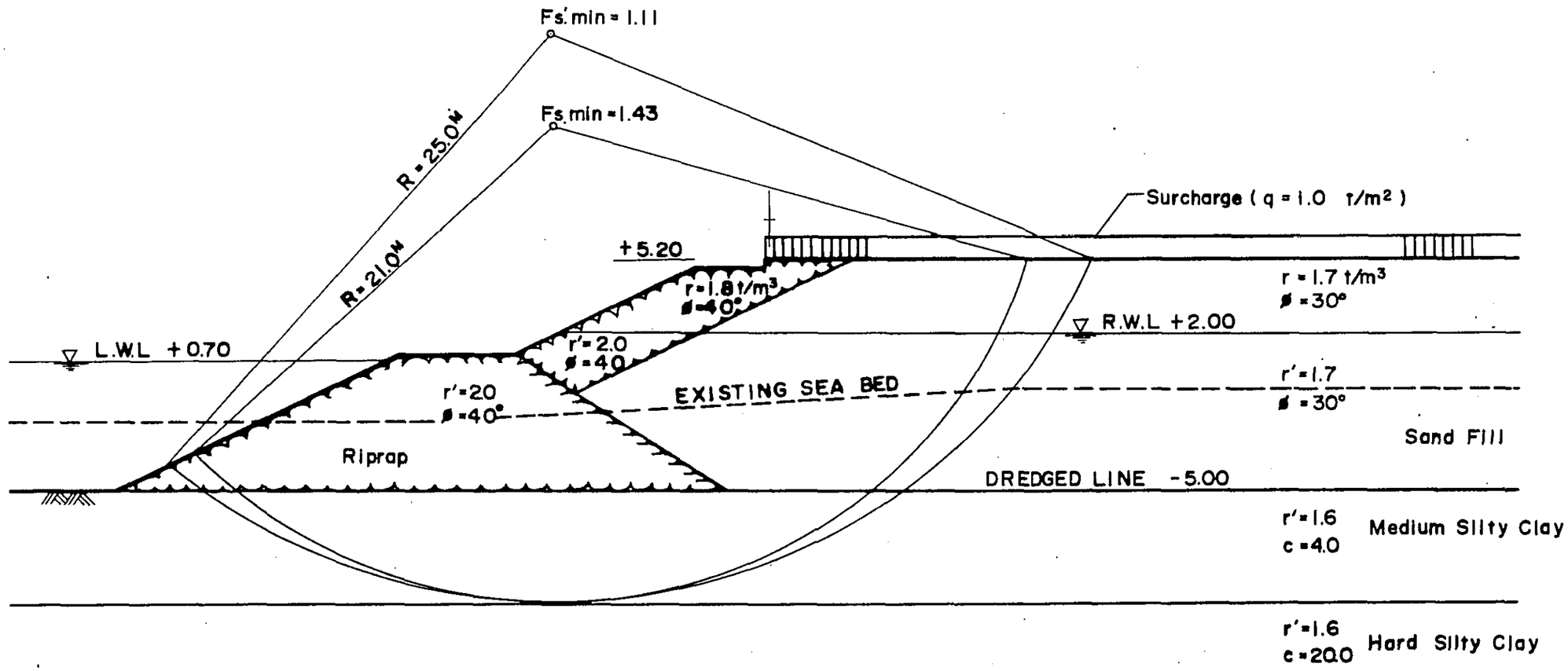


FIG.5-8 DIAMETER OF STABLE ARMOUR STONE AGAINST VELOCITY OF FIOW

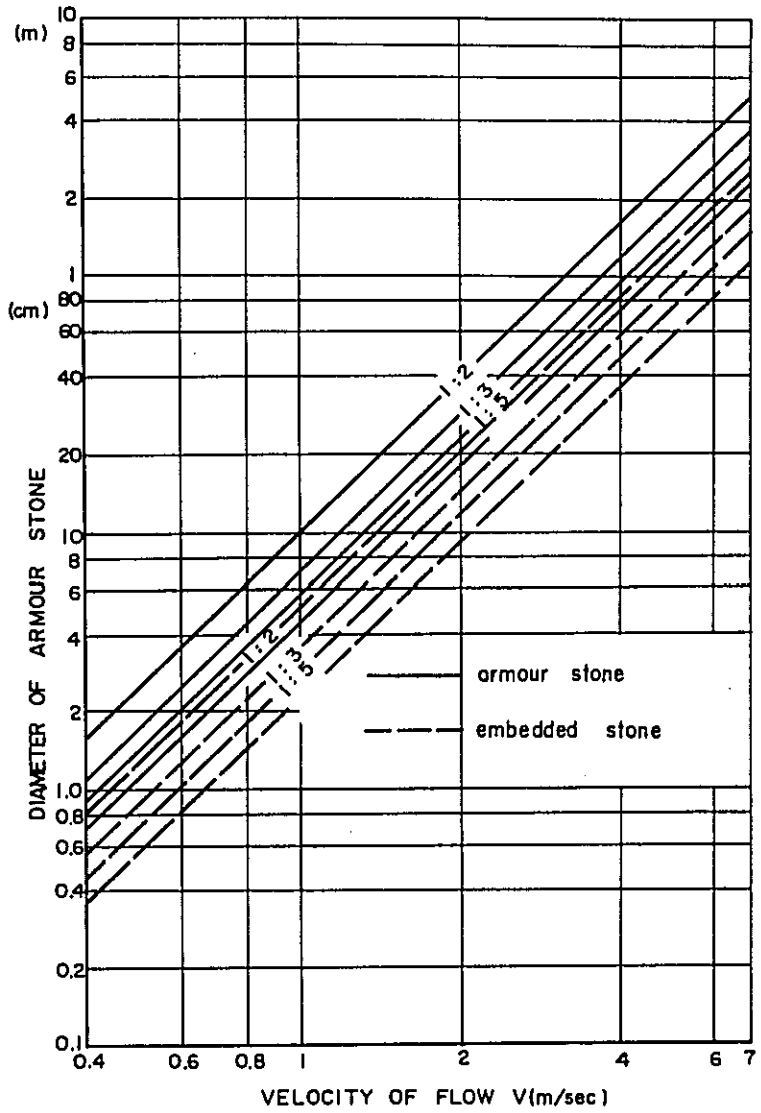


FIG.5-9 STABLE WEIGHT OF ARMOUR STONE AGAINST VELOCITY OF FIOW

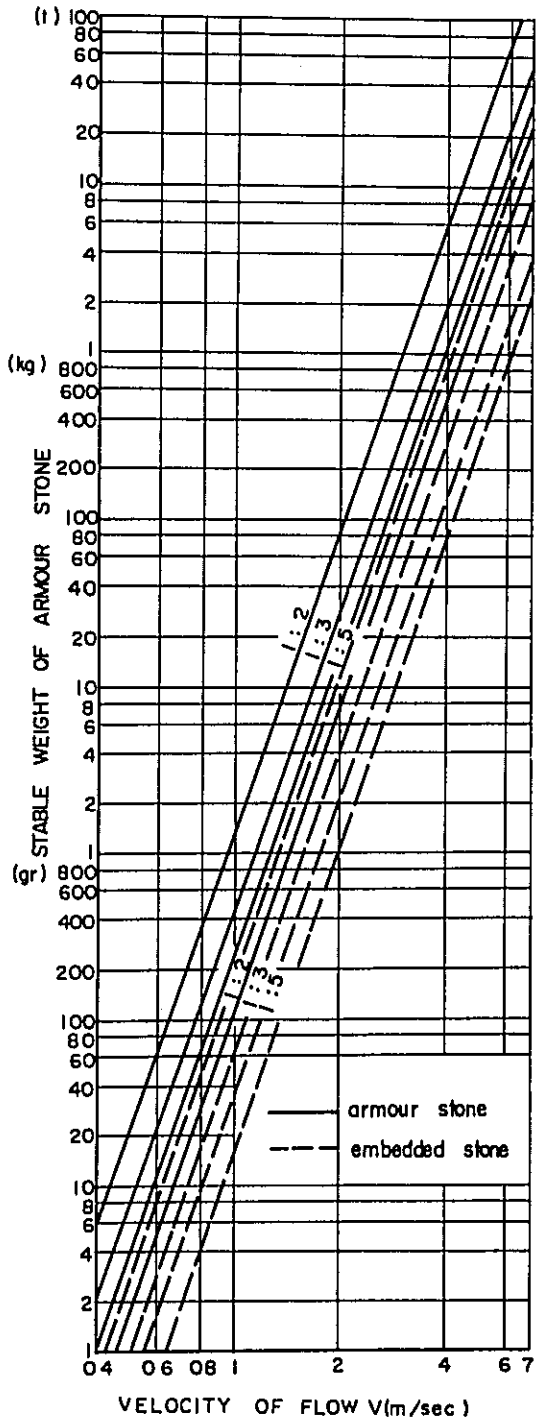
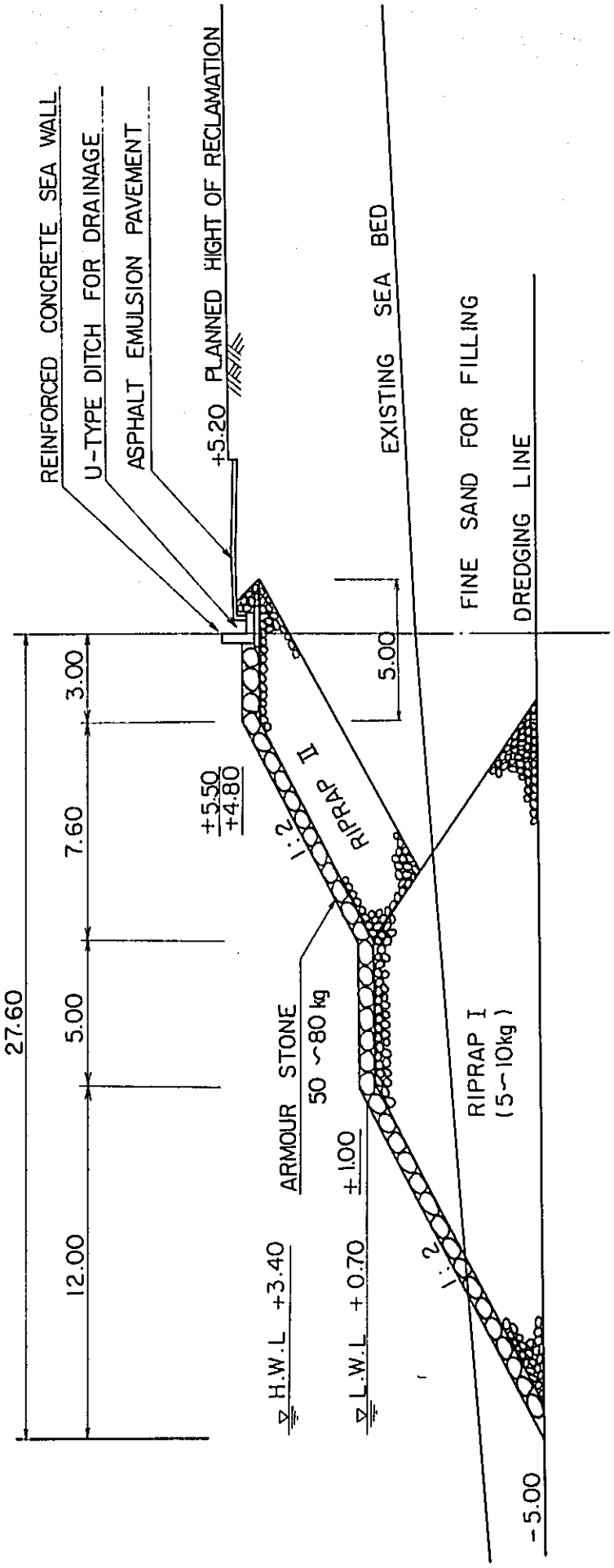


Fig 5-10 TYPICAL CROSS SECTION OF EMBANKMENT

Scale 1:200



2) Drainage

(1) Drainage have been designed for the whole terminal area, including causeway.

The precipitation of rainfall have been assumed from Fig. 1-2. That is 60mm/hr., adopted for designing of drainage pipe line system.

The slope of pipes and elevation of mahole were designed to gain the adequate velocity of flow to prevent the siltation in the pipes.

The velocity in the pipes will vary from 0.6 m/sec to 0.8 m/sec.

The maximum discharge of flow in drainage pipe is calculated and shown on the following table.

Table 5-2

Dia. (mm)	R=0.3030 (m)	V=3.440 R 2/3 (m /sec)	A_2 (m^2)	Q=A.V ($x10^{-2}$ m^3/sec)
ϕ250	0.076	0.616	0.045	2.77
ϕ300	0.091	0.695	0.064	4.45
ϕ400	0.121	0.843	0.114	9.61

However, the side ditch, U-type and L-type cast-in-concrete, have been installed along the road and the sea wall to carry off the rain water and collect to the sumps.

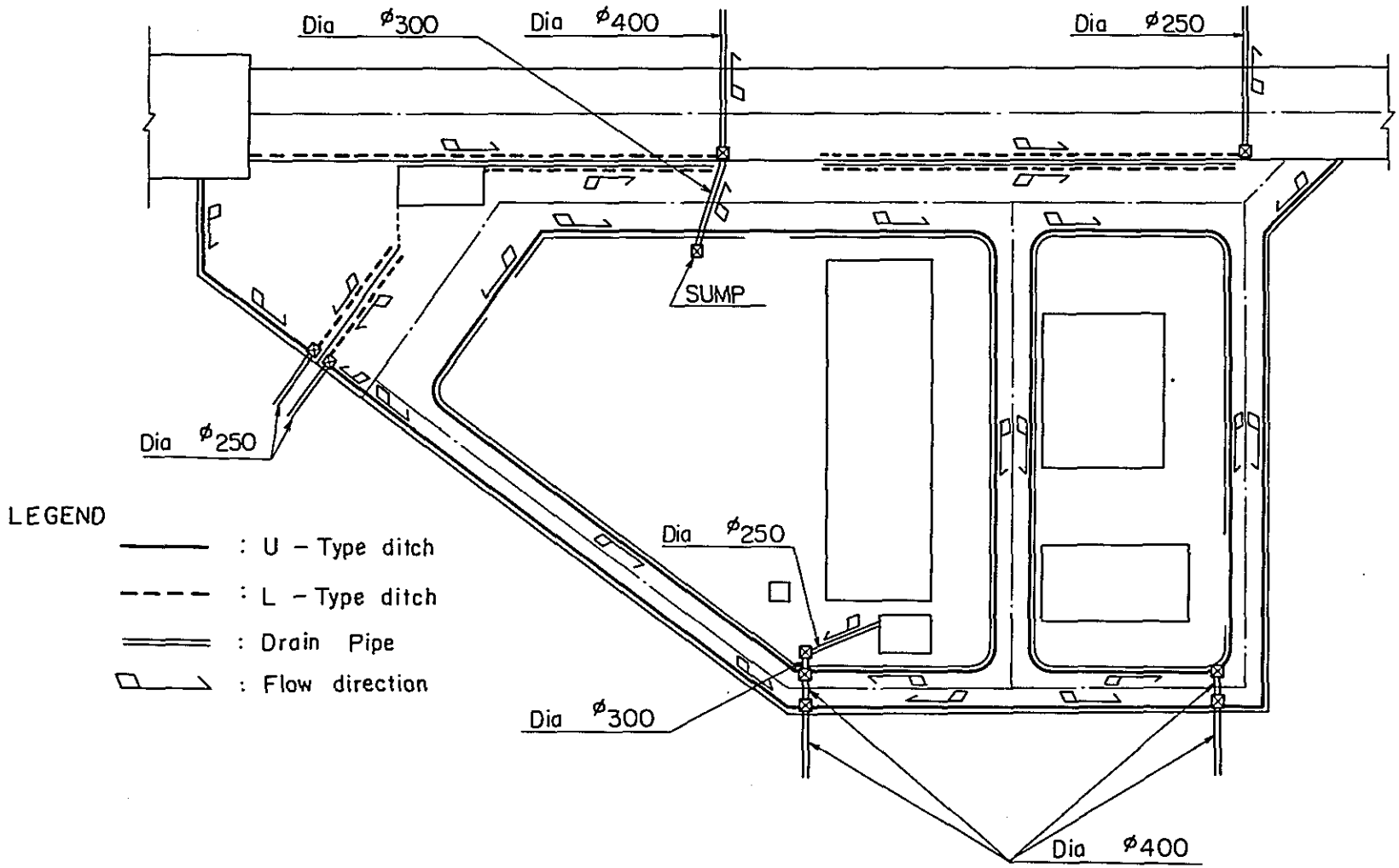


Fig 5-11 Drainage System

The slope and the section of U-type and L-type side ditch which will be 0.15% and 30 cm x 30 cm respectively have been designed to run off the water smoothly from the pipe at the end sump at high water tide.

A combined sump and manhole 60 cm width x 60 cm length, which is the minimum clearance for maintenance and smooth flow through the sump and manhole, will be installed along the road and sea wall in the terminal area.

The asbestos cement pipes available locally will be used for this drainage pipes.

3) The Pavement within the Terminal Area

It has been taken into account of normal passenger vehicles and 1.0 t/m^2 uniform live load for designing of asphalt emulsion pavement within the terminal area after the construction of ore-coal berth. The thickness of pavement is 35 cm including gravel stone foundation. However, during the construction periods, the road areas for construction purpose are paved with gravel stones.

4) Fencing and Gate

The fence, 2 m height and approx. 120 m long have been planned to install along the causeway side of the road and made with concrete blocks against dusty pollution, on the other hand, the creek side of road.

Wire mesh fence, 2 m heigh have been planned to install along the sea wall.

The gates will be installed at the entrance of terminal area and the main berth area.

5) Building Complex within the Terminal Area

The following buildings have been planned and designed in the land reclamation.

(1) Terminal office has been designed to provide the necessary office rooms and facilities to operate the ore-coal berth and whole terminal complex.

(2) Gate house has been designed to provide the rooms for immigration, customs, health and security and located with gate at the connection point of causeway and approach bridge.

(3) The room for pumps of potable water supply and fire fighting purpose has been provided on the water storage round, which is constructed with flat slab reinforced concrete structure.

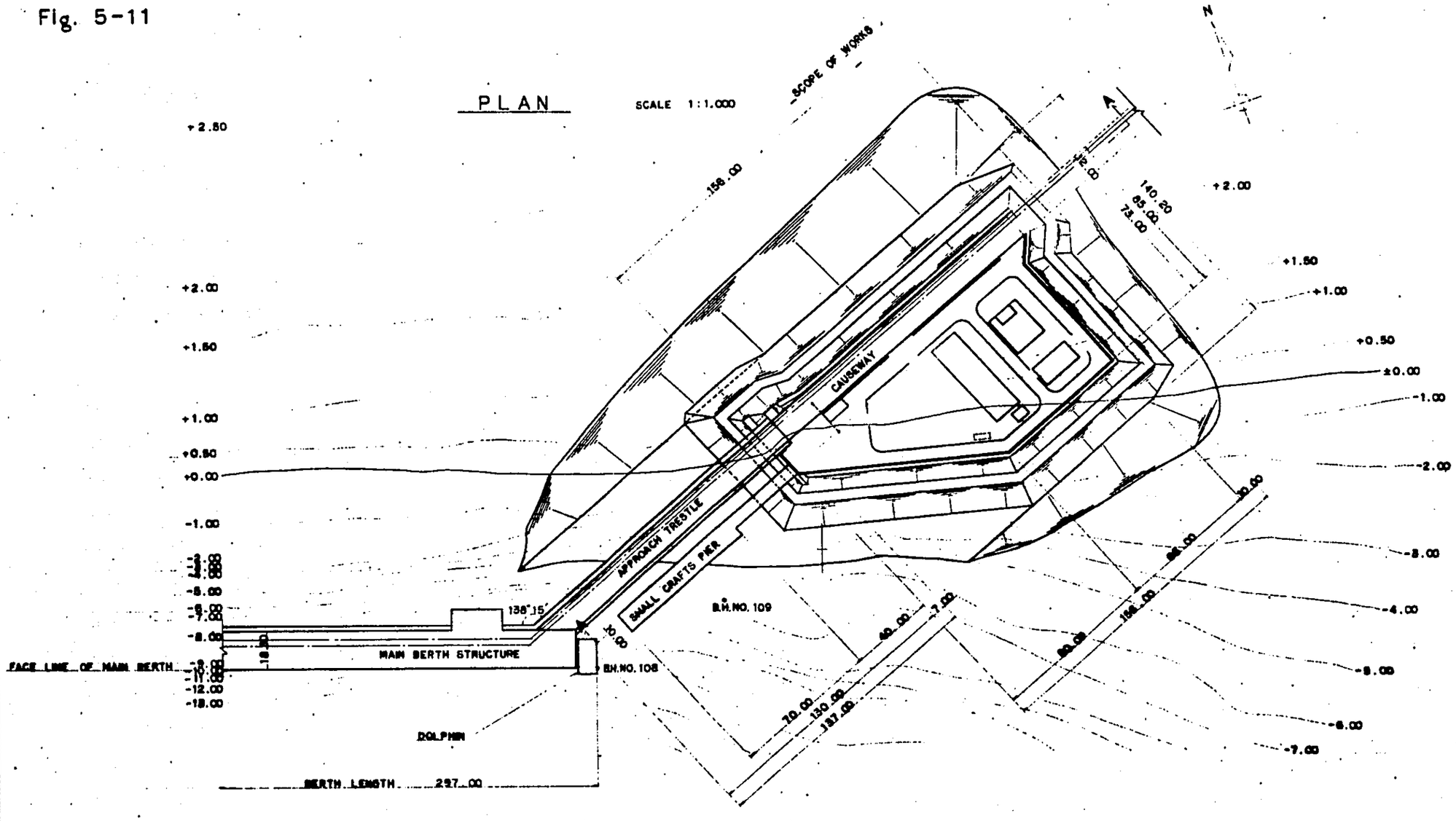
Because of the convenient operation to supply potable water to ships, offices and tugs smoothly.

(4) Substation building has been provided for power supply to office, motor pumps of water, oil and fire fighting and stand-by generator.

Fig. 5-11

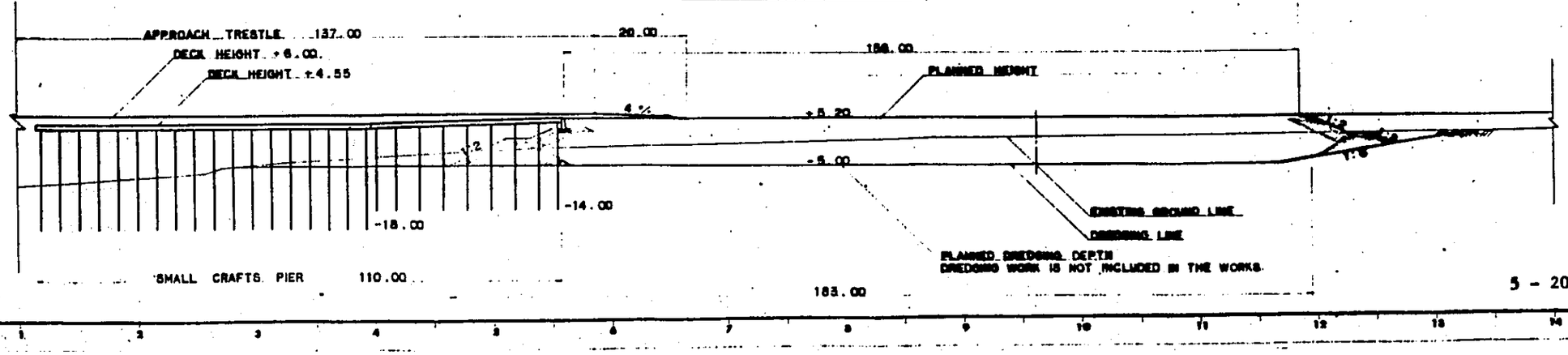
PLAN

SCALE 1:1,000



SECTION A-A

SCALE 1:500



GENERAL NOTES

NO.	DATE	DESCRIPTION	APPROVED
		REVISION	

PORT MUHAMMAD BIN QASIM PROJECT
PHASE-III

LAND RECLAMATION

PLAN AND SECTION OF TERMINAL AREA

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS			
APPROVED	CHECKED	DESIGNED	DRAWING
SCALE		REV. No.	
DATE		DWG. NO.	T - 102

CHAPTER VI OFFICE AND OPERATION BUILDING COMPLEX

1. BASES OF DESIGN

1) Space Requirement

Terminal Office are designed in accordance with the following table (space requirements) which was given by the authority.

Space Requirement

Name of room	Space (each room)	Number of room
Health Office	6 m x 5 m = 30 m^2	1
Custom Office	" "	1
Immigration Office	" "	2
Security Office	" "	2
Pilot Room	" "	1
Crew Room	" "	2
Engineer's Room	" "	1
Communication Room	" "	1
General Office	" "	1
Store	" "	1
Meeting Room	6 m x 9 m = 54 m^2	1
Mechanical Work Shop	6 m x 7 m = 42 m^2	1
Information Office	25 m x 3 m = 7.5 m^2	1
Locker Room	5 m x 5 m = 25 m^2	1
Canteen	6 m x 9 m = 54 m^2	1
Kitchen	4.5 m x 3 m = 13.5 m^2	1
Toilet		2
Shower		2

Furthermore stairways for egress are planned with 60 m of each other in accordance with Japanese building code. Smoke exhause windows (transom windows) will be installed at all sub entrance. Portable fire extinguishers will be planned within the building according to Japanese fire code.

2) Structural Design Standards and Code

Buildings are designed in accordance with ACI Code and Uniform Building Code of USA. Detailed structure plan are shown on the detailed structual drawings.

3) Load Assumption

i. Load assumption

a. Live loads

Live loads at each part of building are determined according to uniform Building Code of USA.

(1) Roof : 100 kg/m

(2) 1st Floor : 400 kg/m

b. Wind loads

Wind loads are determined the followings.

Condition	Max. wind speed	Wind pressure
(1) Normal condition	20 knots/sec.	60 kg/m
(2) Cyclone	70 "	800 "

c. Seismic load

(1) Seismic coefficient of horizontal force K = 0.1

(2) Seismic load V = 0.1 x D.L

ii. Design working stresses

a. Reinforced concrete

(1) Reinforcing bars (deformed bars)

f_s = 1400 kg/cm^2

(2) Concrete

f'_c = 210 kg/cm^2 fc = 95 kg/cm^2 (0.45 f$'c$)

(3) Allowable bond stresses (kg/cm^2)

Bar size	D10	D13	D16	D19	D22	D25	D28
Top Bars	24.5	24.5	20.8	17.3	14.9	13.0	11.5
Other Bars	35.0	35.0	29.4	24.5	21.0	18.4	16.3

b. Pile

In accordance with soil investigation data, foundation pile will be employed.

(1) Precast concrete pile 450ϕ (12 m + 12 m) length

(2) Pile bearing capacity = $\frac{40}{3}$ N. AP = 50 t/pile

where N=30, AP = 0.125 m^2

4) Soil Condition at Site

Due to the lack of suitable boring data at the terminal area, the soil condition and parameters have been presumed from the nearest boring logs, B.H 108, 109 and B.H 519. The parameters are referred to the Chapter I. soil condition at site.

The reclamation are to be made with fine sand and its soil parameter is assumed to a unit weight 1.7 t/m^3, angle of internal friction 30°.

2. ARCHITECTURAL DESIGN POLICY

1) Buildings

Buildings are designed reinforced concrete as well as concrete

block bearing wall construction. These types of construction will be allowed for a fire resistive construction better than could be obtained with structural steel faming. In addition to these, they will be allowed for easier construction, lower cost and give better weatherbility in salt laden atmosphers. The elastomeric water-proofing finish will be given for easier execution and better weatherbility in salt laden atmosphers.

Exterior doors and windows will be of aluminium construction in order to resist the effects of salt laden airs. The interior finishes will be of fire resistive materials.

Toilet fixtures for Terminal Office will be separated for the office staff and employees (workers) and will be provided with western style and asian style respectively.

2) Water Tank and Sewerage Treatment

An elevated water tank (a water reservoior) will be provided on the roof of Terminal Office for the water supply system. Sewer and waste drains will be collected into a septic tank, and the treated effluent (30 P.P.M.) will be discharged in a sewer collection system shown on Dwg. No. AM-104.

3) Air Condition System

Air-conditioning units (Window type cooler) will be through the wall units which will be given a low cost than central air-conditoning systems and will be permitted cooling in spaces where necessary rather than cooling the entire building. Mechanical ventilation will be provided in toilets, shower rooms, locker rooms, etc. as shown on respective drawings.

3. SUMMARY OF OFFICE AND OPERATION BUILDING COMPLEX

1) Terminal Office

Terminal office will consist of customs office, health room, immigration rooms, security rooms, general offices, mechanical workshop, crew rooms, locker rooms, shower rooms, toilets, canteen, kitchen, staircase, hall and other sundry spaces as shown on Fig. 6-1 and the gross floor area will be 1,317 m^2.

Terminal office will be of two (2) storyed building, and of reinforced concrete with concrete block construction, with sprayed color cement motor exterior finish. All exterior windows and doors are made of aluminium with a fly screen for windows, while interior window and doors are made of wood. The roof have the heat insulation and clastometric waterproofing finish.

Terminal office will be provided with the following incidental facilities.

1. Plumbing
2. Air conditioning (window cooler)
3. Ventilation
4. Septic tank
5. Fire extinguisher
6. Electrical facilities

2) Gate House

Gate house will consist of guard room, office and toilet and the gross floor area will be 60 m^2. Gate house will be of one story building, and of concrete block bearing wall construction, with sprayed color cement mortar exterior finish. The interior finishes are

shown on Dwg. No. A-201. Exterior windows and doors are also made of of aluminium with a fly screen, while interior doors are made of wood. The roof has the same manner as terminal office.

Gate house will be provided with the following incidental facilities.

1. Plumbing
2. Air conditioning (window cooler)
3. Ventilation
4. Electrical facilities

3) Sub-Station

Sub-station will consist of generator room, oil tank room, tool storage, switchboard room, and transformer rooms and the gross floor area will be 211 m^2.

Sub-station will be of one story building, and of combinations of reinforced concrete and concrete block bearing wall construction, with sprayed color cement mortar exterior finish. All exterior windows are made of aluminimum with a fly screen but sliding hanger doors and wire meshed doors for transformer rooms are made of steel. Air intake lourers and other doors are made of aluminium. The roof have elastomeric waterproofing finish.

Sub-station will be provided with ventilation and electrical facilities.

4) Pump House

Pump house will be built on the reservoir and the gross floor area will be 43 m^2.

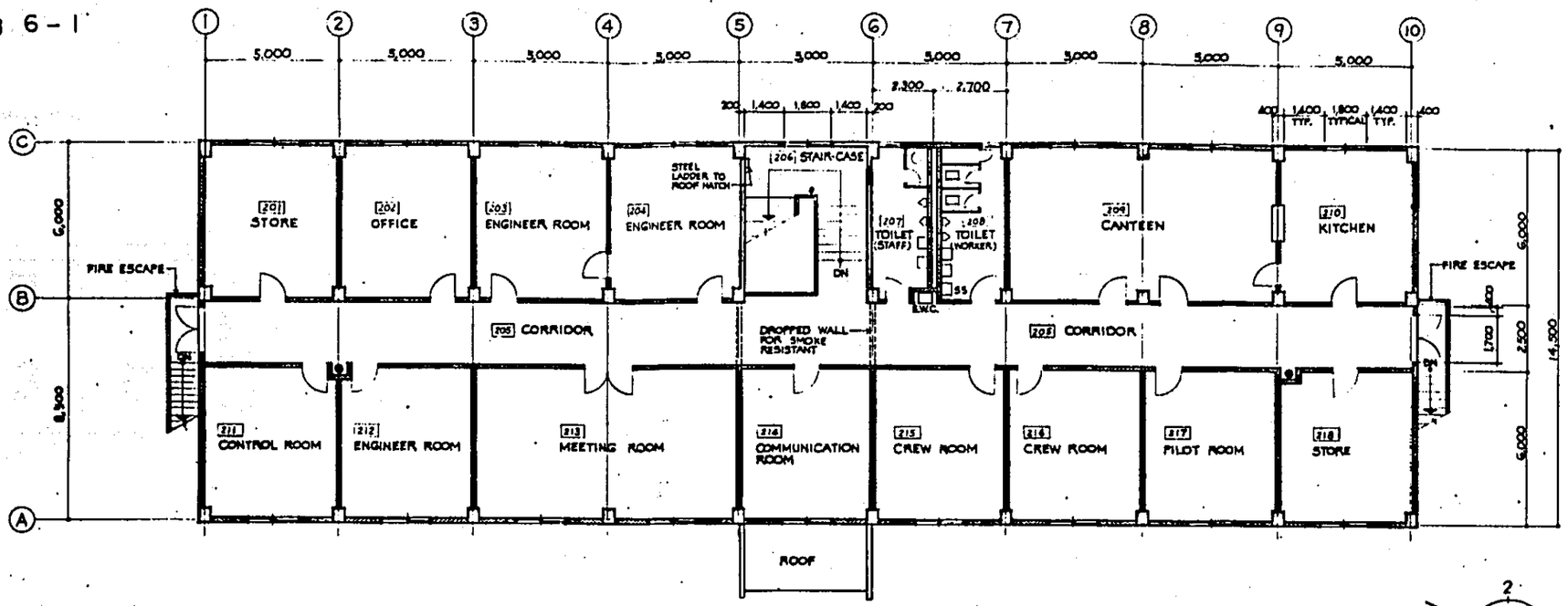
Pump house will be of one story building and of concrete block

bearing wall construction, with sprayed color cement mortar exterior finish.

All exterior windows and doors are made of aluminium. The roof has the same manner as Sub-station.

Pump house will be provided with plumbing, ventilation and electrical facilities.

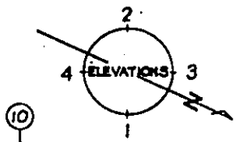
Fig 6 – 1



FIRST FLOOR PLAN SCALE 1/100

GROUND FLOOR PLAN SCALE 1/100

GENERAL NOTES



NO.	DATE	DESCRIPTION	APPROVED
		REVISION	

PORT MUHAMMAD-BIN-QASIM PROJECT
PAKISTAN

— RELATED FACILITIES —

TERMINAL OFFICE

LOCATION OF GROUND & FIRST FLOOR PLANS

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSULTANTS

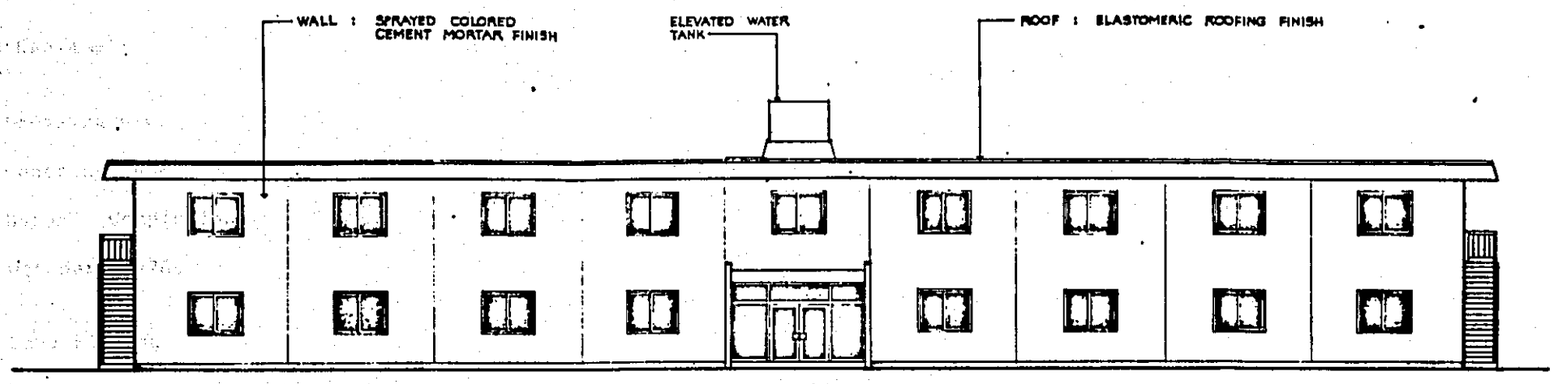
APPROVED	CHECKED	DRAWN

SCALE 1 : 100

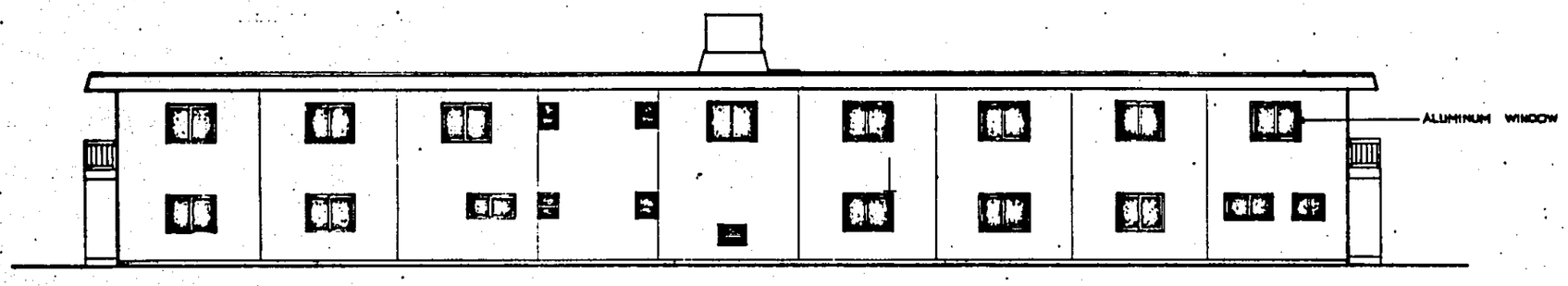
DATE

DWG NO 105

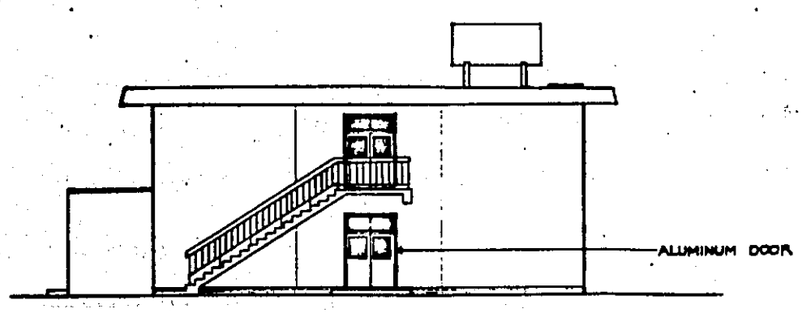
Fig. 6 - 2



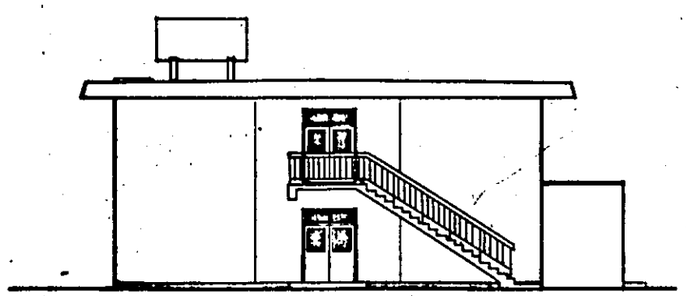
1. SIDE ELEVATION SCALE 1/100



2 SIDE ELEVATION SCALE 1/100



3 SIDE ELEVATION SCALE 1/100



4 SIDE ELEVATION SCALE 1/100

GENERAL NOTES

NO.	DATE	DESCRIPTION	APPROVED
		REVISION	

[illegible] PROJECT
PAKISTAN

— RELATED FACILITIES —

TERMINAL OFFICE

LOCATION OF ELEVATIONS

[illegible] COOPERATION AGENCY

CONSULTANTS

APPROVED	CHECKED	DESIGNED	DRAWING

SCALE	REV. No.
1 : 100	
DATE	DWG. NO. 106

Chapter VII Summary of Construction Schedule

1) Land Reclamation

1. Dredging work for this area will be carried out by the other Contract, Dredging of Navigation Channel, up to -5 m below Chart Datum. Completion date for this dredging will be the end of October 1976.

2. Sand Filling

Material for sand filling will be collected from the borrow area at the daily rate of 920 m^3 and will be transported to the working yard through the temporary construction road way, 6 m effective wide with crushed stone pavement of 2 Km long approx.

At the working yard material will be dumped directly to barge of 500 ton utilizing the elevated ramp way on the T-shaped temporary pier.

After towing the barges by tugboats of 500 Hp to the Site, the material will be picked and threw in the area by tractor shovel of 1.4 m^3 clamshell of 1.2 m^3.

Reclamation above +0.5 m on the Chart Datum will be graded and leveled by Special Bulldozer of 16 ton class which will be available of maneuvering on soft and wetted filling material.

3. Riprapping

Material for riprapping will be brought from approved quarry and will be handled and transported to the Site by same procedure with sand filling works and picked and threw in the area by clamshell of 1.2 m^3 which will be mounted on the pontoon of 300 ton.

Execution for mounting and diking of riprap will be carried out within two stages, part I and II. Part-I up to +0.5 m will be constructed parallelly to the works for sand filling. However, on Part-II above +0.5 m the work will be done after sand filling. Smoothing the surface of riprap will be constructed by divers and labourers for submarged portion and exposed portion respectively.

4. Armour stone

Transportation, handling and pitching of Armour stone will be carried out by same procedure with riprapping.

Order of placing and pitching of armour stone will follow to the area where riprapping and sand filling are finished.

Smoothing the surface of stone above +0.5 m on Chart Datum will be pitched by assistance of pontoon of 300 ton with clamshell of 1.2 m^3.

2) Small Crafts Pier

1 Piles

Piles supplied by P.Q.A. will be transported to the working yard and fabricated including cutting off the deformed parts into the designated length of piles.

Through the temporary pier close to working yard, all piles will be loaded on barges by crane and handling, pitching positioning and driving will be carried out as same procedure as piles for the Main Berth Structure and Approach Trestle.

All driving will executed parallelly to the works for Approach Trestle. All piles will be supported and fixed temporarily by structural steel.

2. Pile jacket

Pile jacket will be casted in-situ using metal form.

3. Pile caps and Beams

Staging and Scaffolding work by steel members will be installed for supporting form preparing pile caps and beams which consist of cast-in situ concrete works.

Metal form will be used for concrete work at the stairs. General procedure of concrete works will same as for Main Berth Structure and Approach Trestle.

4. Precast concrete slab

Precast concrete slab will be prefabricated at the working yard where necessary concrete plant and yard for precasting will be prepared.

Slabs will be handled and transported to the temporary pier assisted with 40 ton truck crane and heavy truck of 15 ton. By such truck crane prefabricated slab of maximum weight of 15 ton will be loaded on the berges of 100 ton towing by tugboat of 250 pH.

For placing and pitching of slabs, 40 ton crawler crane mounted on 300 ton barge will be prepared at the Site.

3) Combination Schedule of Constructional Plants and Machines

Item of Works		Constructional Plants and Machines	Size & Capacity	Numbers
Reclamation	Sand filling	Barge	500^{t}	2
		Tugboat	500^{ps}	1
		Bulldozer	21^{t}	1
		Tractor shovel	2.1^{m3}	1
		Dump truck	11^{t}	8
		Tractor shovel	1.4^{m3}	1
		Pontoon with clamshell	$300^{t}+1.2^{m3}$	1+1
		Tugboat	250^{ps}	1
		Diving boat	30^{ps}	2
		Bulldozer for swamp	15^{t}	1
	Riprapping	Barge	500^{t}	1
		Tugboat	500^{ps}	1
		Tractor shovel	2.1^{m3}	1
		Dump truck	11^{t}	2
		Pontoon with clamshell	$300^{t}+1.2^{m3}$	1+1
		Tugboat	250^{ps}	1
		Diving boat	30^{ps}	2
	Armour stone	Barge	500^{t}	2
		Tugboat	500^{ps}	1
		Tractor shovel	2.1^{m3}	1
		Dump truck	11^{t}	2
		Pontoon with clamshell	$300^{t}+1.2^{m3}$	1+1
		Tugboat	250^{ps}	1
		Diving boat	30^{ps}	2
Transportation of Material on Sea	Remforcing bar and steel	Barge	100^{t}	1
		Tugboat	250^{ps}	1
		Truck crane	15^{t}	1
		Heavy truck	11^{t}	1
	Cement	Barge	100^{t}	1
		Tugboat	250^{ps}	1

Item of Works		Constructional Plants and Machines	Size & Capacity	Number
	Aggregate	Barge	100^{t}	1
		Tugboat	250^{ps}	1
		Tractor shovel	2.1^{m3}	1
		Dump truck	11^{t}	1
		Clamshell	0.6^{m3}	1
		Dump truck	8^{t}	1
Small Crafts Pier	Pile driving	Pontoon with driver	Steel D70	1
		Tugboat	250^{ps}	1
		Diving boat	30^{ps}	1
		Barge	100^{t}	2
		Truck crane	40^{t}	1
		Heavy truck	11^{t}	2
	Concrete placing on sea	Batcher plant	0.5^{m3}	1
		Belt conveyor	7^{m}	2
		Barge	300^{t}	1
		ditto	100^{t}	1
		Tugboat	250^{ps}	1
		Concrete pump-car	40^{m3}	1
	Transportation installation of precast concrete slab	Truck crane	40^{t}	1
		Heavy truck	15^{t}	1
		Pontoon with crawler crane	300^{t}+40^{t}	1+1
		Barge	100^{t}	2
		Tugboat	250^{ps}	1
	Miscellaneous	Pontoon with derrick crane	100^{t}	1
Pavement	Sub-grading	Bulldozer for swamp	16^{t}	1
	Surface	Tired roller	8.5 - 15^{t}	1
		Vibrating roller	2.8^{t}	1
		Soil tamper		1
		Dump truck	8^{t}	1
		Clamshell	0.6^{m3}	1
		Sprinkling car	5,500^{l}	1
		Engine sprayer	600^{l}	1

Item of Works		Constructional Plants and Machines	Size & Capacity	Number
Temporary Pier at Working Yard	Concrete Mixing at reclamation Area	Portable mixer	0.3^{m3}	1
	Working yard and reclamation area	Semi-automatic batching plant	0.5^{m3}	2
		Tractor shovel	1.4^{m3}	2
	Dredging	Pontoon with clamshell	$1.2^{m3}+300^{t}$	2+2
		Pontoon	500^{t}	2
		Tugboat	250^{ps}	2
		Tractor shovel	1.4^{m3}	2
	Access road			
	Riprapping	Bulldozer	11^{t}	1
		Diving boat	30^{ps}	1
	Pier			
	Pile driving	Truck crane	40^{t}	1
		Heavy truck	11^{t}	1
		Pontoon with crawler crane	$40^{t}+300^{t}$	1
		tugboat	250^{ps}	1
	Framing and decking	Truck crane	40^{t}	1
		Heavy truck	15^{t}	1
		Barge	100^{t}	1
		Tugboat	250^{ps}	1

PORT MUHAMAD-BIN-QASIM PROJECT

CONSTRUCTION SCHEDULE FOR RELATED FACILITIES

No.	Facilities	Works		1976						1977												1978	
				7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1.	Land Reclamation	Reclamation	Dredging																				
			Riprap																				
			Sand fill																				
			Armour stone																				
			Smoothing																				
		Sea wall	Type - A																				
			Type - B																				
		Drainage	U - type ditch																				
			L - type ditch																				
			Manholes																				
			Pipes																				
			Curb																				
		Pavement	Asphalt pavement																				
			Concrete pavement																				
2.	Small crafts Pier	Pile driving																					
		Concrete jacket																					
		Scaffolding and staging																					
		Cap concrete																					
		Concrete insitu																					
		Precast concrete																					
		Paving concrete																					
		Miscellaneous																					
3.	Water and oil supply and Fire fighting	Pile driving																					
		Reservoir																					
		Equipments																					
		Piping																					
4.	Electric facilities and Power supply	Sub-station																					
		Equipments																					
		Wiring																					
5.	Buildings	Terminal office																					
		Gate house																					

CHAPTER VIII SUMMARY OF CONSTRUCTION COST OF RELATED FACILITIES

The direct construction cost of related facilities has been estimated to 43.0 million Pak. Rs.

Due to the lack of adequate topographic data and sufficient soil condition, the contingency at 10% of construction cost of each facilities have been considered in the above mentioned estimated figures, however, the mobilization cost and temporary construction cost, i.e. temporary berth, access road and yards, concrete plant, etc. are excluded, from the above estimated cost which should be coordinated with the Main berth construction, therefore, these temporary construction cost are listed in Vol-V, Summary of Construction Cost.

Summary Construction Cost

of

Related Facilities

Item	Works	Cost million Pak Rs.
1	Small crafts pier	3.47
2	Land Reclamation	24.37
	(Earth Work	22.73)
	(Sea Wall, Pavement, Drainage	1.64)
3	Water, Oil Supply, Fire Fighting	4.90
	(Civil Works	1.72)
	(Piping Works	3.18)
4	Electrical Facilities and Power Supply	5.87
5	Buildings	4.62
	TOTAL	43.03
		(4.30 million US$)