Table 3-6 Number of Containers Landed

	1988	1989	1990	1991	1992
20ft Container	1,653	1,274	1,486	1,705	1,570
40ft Container	14	39	79	75	83
Total (20ft converted)	1,677	1,352	1,644	1,855	1,736

Source : TRANSCO

Table 3-7 Import of Petroleum Products and Fuel Oil

(unit: kilo liter)

1988	1989	1990	1991
17,922	19,859	21,526	22,104

Source: Department of Transportation, Chuuk State

Table 3-8 Number of Calls of International Vessels

1987	1988	1989	1990	1991	1992
67	50	46	46	52	51

Source: Department of Transportation, Chuuk State

(2) Domestic Port Function (intra-state service ships and National Government's patrol ships)

Around Truk Lagoon, there are six groups of outer islands that are inhabited by about 20 % of the State's population. The State Government is operating three ships for traffic purpose of island residents and for transport of daily commodities, and also for medical and educational services. The ships make about 90 trips per year transporting about 14,000 persons and about 4,800 tons of commodities. The National Government conducts 12 patrol services per year for the states, employing the same type of ship as the Chuuk State operates.

Table 3-9 shows the domestic vessels and Table 3-10 cargo volume and passengers transported by the domestic vessels. According to Table 3-10, the cargo volume increased by about 140 % and passengers by about 300 % during the past six years from 1985 to 1990. The intra-state service ships are the life line for islanders and play a cardinal role.

Table 3-9 Vessels of Domestic Shipping

Management Authority	Service	Name of Ship	Gross Tonnage (GT)	Length (m)	Width (m)	Draft (m)
FSM	State round trip	MICRO GLORY	789.74	56.4	10.0	3.6
Chuuk State	Intra-state field trip	MICRO DAWN	789.74	56.4	10.0	3.6
		MICRO TRADER	805.65	56.4	10.0	3.6
		CAROLINE ISLANDS (Landing Craft)	813.40	54.6	10.0	3.8

Table 3-10 Cargo and Passengers Transported by Domestic Vessels

	1984	1985	1988	1989	1990
Cargo (metric tons)	3,346.38	3,049.27	3,506.64	4,184.29	4,811.89
Passenger	4,781	8,619	10,276	16,546	14,311

Source : Department of Transportation, Chuuk State

About 90 regular voyages per year by the intra-state service ships are expected, and totally about 100 calls per year are expected including non-regular calls with an average of two ships per week to be moored at the port. One berthing requires three to four days for cargo and fuel loading.

Occupancy of berth by the domestic boats thus accounts for 300 to 400 days a year. Without a reserved berth for their use, some ships moors at Dock-A when it is free of international cargo vessels berthing or at Dock-B, and they are often forced evacuate from the berth to yield seat to international vessels being forced to move offshore waiting for berth vacancy. To improve this situation, provision of exclusive use berth for domestic service boats stationed at Weno Port is required.

(3) Commuter Boats

About 300 small crafts (commuter boats) come to Weno Port daily for transport of people commuting to work, school and shopping from other islands in Truck Lagoon. They are moored in the North and South Inner Basins of Weno Port.

These boats are about 5 meter long, wooden boats equipped with outboard engine and carry 4 to 5 passengers. About 6 meter long, glass-fiber boats are now increasing. Larger boats of about 10 meter long (capacity: 40 to 50 passengers) are also in service.

However number of commuter boats which are common means of transportation among the Lagoon island residents, is expected to increase in the future.

Due to lack of adequate mooring facilities for commuter boats, loading/unloading of passengers and cargo is not safe enough.

Since the present boats are small sized ones with high speed, but is low stable against waves, the State Government directs ban on boats operation when wind speed is beyond 4 m/sec. And some collision accidents are reported.

3.2.3 Port Facilities of Weno Port at Present

(1) Outline of Port Facilities

Table 3-11 shows the outline of port facilities at Weno Port.

Table 3-11 Outline of Port Facilities

Facilities	Contents
Approach Channel	Length of Channel: 22.5 km Width of Channel : 240 m (at narrowest part) Depth of Channel : -14.6 m
Dock-A	Length : 97 m Depth : -9.1 m Structure : Steele Sheet Pile Type built in 1962
Dock-B	Length : 91 m Depth : -9.1 m (Shallow by sand shoaling) Structure : Steel Sheet Pile Type built in 1983
Dock-C Fisheries Dock	Length : 37 m Length : 84 m Depth : -4.3 m Structure : Steel Sheet Pile Type under construction
Warehouse	1,443 m^2
Open Storage Yard	3,467 m^2
South Inner Basin	approx. 9,500 m^2
North Inner Basin	approx. 12,800 m^2
Navigation Aids	Lighthouse : 1 no. (Northeast Pass) Marker : 6 nos.(some are lighted)

Currently, there are no tug boats available for berthing and undocking of large sized vessels in Weno Port.

(2) Dock-A

The existing portion of Dock-A is a steel sheet pile structure built in 1962. Original berth length was 91 m, and 6 m of straight extension as approach was added at the time of Dock-B constructed in 1983. Therefore, its berth length is now about 97 m and the water depth in front of the dock is currently -7.5 m to -8.4 m. The wharf length is only one half of the standard berth length (about 160 to 170 m) for international container ships (8,800 DWT) that call this port presently, causing inconveniences in cargo handling and rope tieing. All the fenders are missing and old tires are used as provisional measures. Considerable portions of curbing are also damaged and steel bars are exposed. The typical cross section of existing Dock-A is shown in Fig. 3-6.

Damages of Dock-A caused by cyclone OWEN in November, 1990 include large cracks to the coping concrete and dent holes and cracks to the apron pavement. The Chuuk State Government performed emergency repairs in 1992 and 1993.

At the request of the State Government for a technical investigation of the docks, the Basic Design Study Team made diving survey of the steel sheet piles and measured their thickness. The survey revealed cracks and holes in sheetpile by corrosion and loss of backfill sands. It also revealed that a rather small section of steel sheetpiles (MZ-38 type) is in use and provision of lower tie rods at -4.6 m depth. As a number of head screw-nuts of the lower rods were corroded and missing, some rods were entirely useless, and at several points the backfill of the sheetpile wall were found lost as the soil had been washed out through the tie rod holes. These are considered to be the cause of cavity of the apron concrete and cracks in the coping concrete.

The survey divers used an ultrasonic thickness gauge to measure the steel sheet pile. The result are shown in Appendix Fig. A-3-9 and Table A-3-12. As the initial thickness of the sheetpile (MZ-38 type) was 12.7 m where the current thickness ranged from 8.4 m to 10.8 m, the corrosion has progressed during 30 years after construction.

As the sheetpiles used for the existing Dock-A are rather slender section, effect of rust corrosion developed in almost 30 years on the wall is very severe and, structural stability of the sheetpile wall has been already lowered to a point where failure of entire wall structure is feared.

(3) Dock-B

The existing Dock-B extends for 91 meters and its design depth is -9.1 m. The berth length is only one half of standard berth length. The area in front of the berth was dredged once to -9.1 m in 1983 when the berth was built, but the current depth is -8 m at the southern end and about -5 m at the northern end. Since the dredged area is quite limited, use of this berth for international cargo boat berthing is not possible.

All the fenders are missing and old tires are being used as provisional measures. Portions of the curbing are damaged. A number of hair cracks are seen at the coping concrete.

(4) Dock-C

The length of Dock-C is 37 m and the dock is situated along return wall portion of Dock-B. The dock is used by a sand dredger (199 GT) for landing of dredged coral sands as construction material.

(5) Container Yard

The area provided for cargo handling at Weno Port is extremely narrow with only 3,500 m^2 area as it was built 20 to 30 years ago when the cargo was limited to sundries and the cargo volume was very small. Currently cargoes on the international cargo vessels are all containerized except for small portions as break bulk and large sized cargoes. An average of 70 to 90 containers per ship are being landed today, causing extreme congestion in cargo handling with increasing rate of 40 ft containers. As the area for discharging of unloaded containers is also very small, delays are caused in getting out cargoes such as imported food.

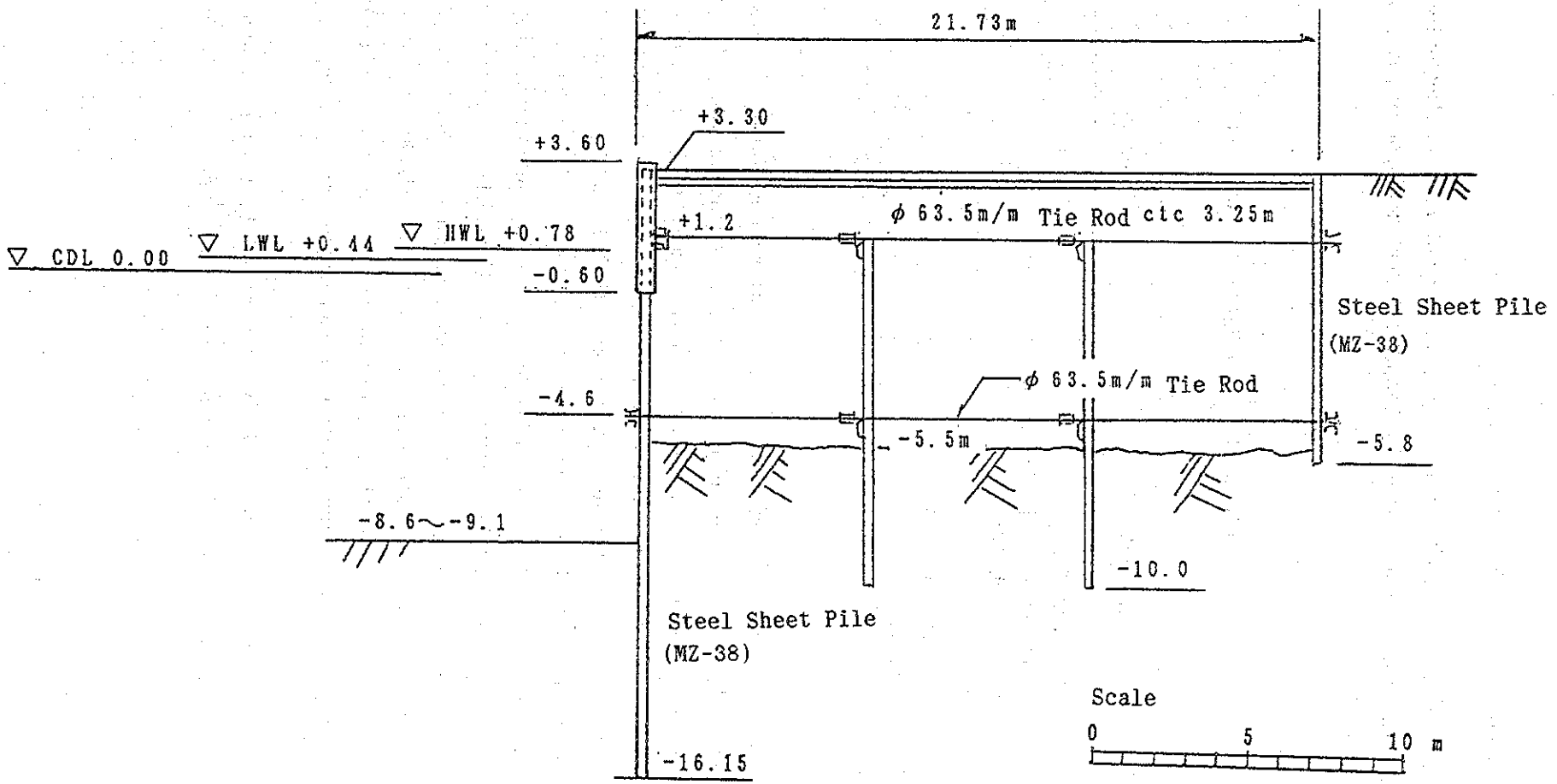


Fig. 3-6 Standard Cross Section of existing Dock-A

(6) Cargo Handling Equipments and Operation

The list of cargo handling equipments used for loading/unloading and moving the cargoes owned by TRANSCO (TRUK TRANSPORTATION COMPANY) is shown below.

Table 3-12 Cargo Handling Equipment

Equipment	Numbers
- 20 t forklift (for use of 20ft Container)	1
- 2.5 t forklift	5
- Trailer	2
- Chassis for moving container	

Fig. 3-7 shows flow of cargo handling operation. Containers and break bulk cargo are unloaded by using crane on ship to the apron, and shifted to the container yard in backyard area. While FCL containers are then transported to the cargo consignee by chassis trailers, LCL containers are removed seal and discharged and cargoes are classified and transported by truck to cargo consignee. Because no forklift is available for 40 ft containers, they are load on a chassis trailer directly from the ship by using the ship's crane for direct delivery to cargo consignee. The limited space in the container yard sometimes forces charge/discharge of cargoes on the apron, and also three tiers of empty containers stacking on the apron hindering cargo operation and causes damages to the apron.

Cargo handling is operated by one shift (12 workers), and necessary cargo handling time for a container or a cargo is 10 to 30 minutes.

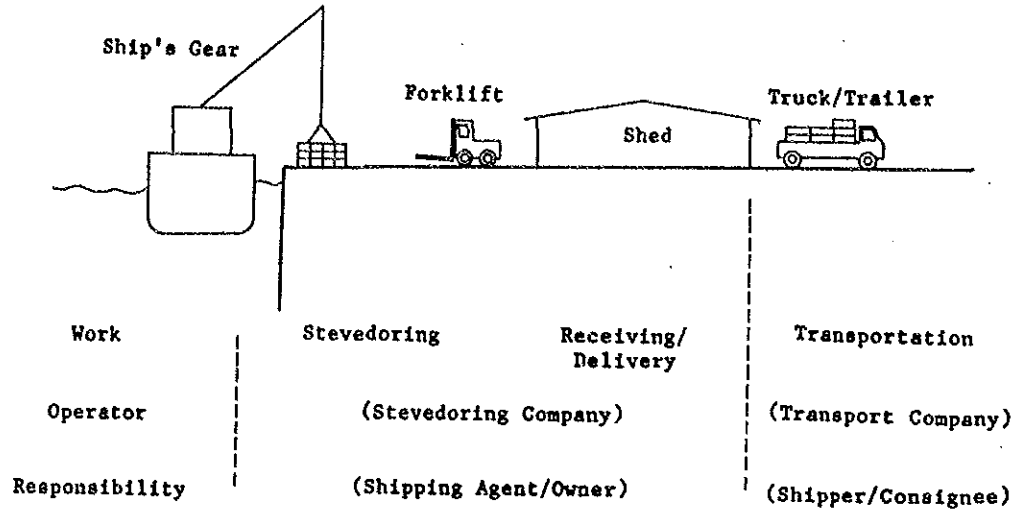


Fig. 3-7 Flow of Cargo Handling Operation

(7) Navigation Aids

As shown in Fig. 3-8, along Entrance Channel to Weno Port, the distance from Northeast Pass of Truck Lagoon to Weno Port is about 20 km, and there are one lighthouse on the outer reef of the lagoon, and six markers (some are lighted) on shoals along the navigation channel. The current conditions are shown below.

* Navigation aids

Lighthouse	: Working normally
Marker No. 2	: The lantern was lost by storm waves of cyclone
Marker No. 4	: No problem
Marker No. 6	: Leaned and moved from the original position by strom wave of cyclone
Marker No.8	: - ditto -
Marker No.10	: - ditto -
Marker No.11	: Positioned on sand bar Its height is too low for visual observation

Fig. 3-8 Entrance Channel to Weno Port

(8) Basins for Commuter Boats

There are currently two basins for commuter boats; in the South Inner basin area at the inner part of Deck- A and the North Inner Basin area. The depth is about -2 m, and the boats are moored to rubble mound, as there are no facilities for mooring.

When westerly wind blows, high wave and swells reach the innermost portion of the Southern Basin, making mooring difficult. On the other hand as the Southern Basin is located in inside of Deck-A, disorderly traffic of commuter boats causes extreme danger with international boats. As both basins are extremely small and there are no room for expansion, the congestion is increasing yearly.

In the Master Plan, a proposal was made to ban entry of all commuter boats to the Southern Basin and to moor them at new Primary Marina and the Northern Basin.

(9) Management and Administration of Weno Port

Weno Port is currently under the management of Department of Transportation of Chuuk State Government and there are 74 staffs working. Sixty out of 74 are the captains and crew members of the three state operated ships. Table 3-13 shows the port dues paid by international liners, Table 3-14 shows the annual budget of the Department of Transportation, and Fig. 3-9 shows the organization chart. The port dues are paid to the Office of Budget of the State Government.

Department of Transportation performs the following jobs.

1) Administration of port facilities

* Maintenance and administration of docks and navigation aids
* Permission for use of port facilities
* Supervising of cargo handling operation

2) Administration of ships entrance/departure

* Procedure for entrance/departure
* Designation of the mooring facility
* Designation of anchorage
* Security of navigation and order in the port
* Collection of port dues from users

3) Operation, maintenance and administration of the state operated ships

* Operation plan and management of the state operated ships
* Maintenance and administration of ships

TRANSCO, a private company, is in charge of loading and unloading, storage and transshipment of cargoes under the supervision of the Department of Transportation. A total of 46 persons are working in TRANSCO, 12 of them are engaged in cargo-handling operation.

Table 3-13 Port Dues (International Vessels)

(US$)

1987	1988	1989	1990	1991
21,317.60	18,922.11	19,750.61	12,191.87	22,833.00

Source : Department of Transportation, Chuuk State

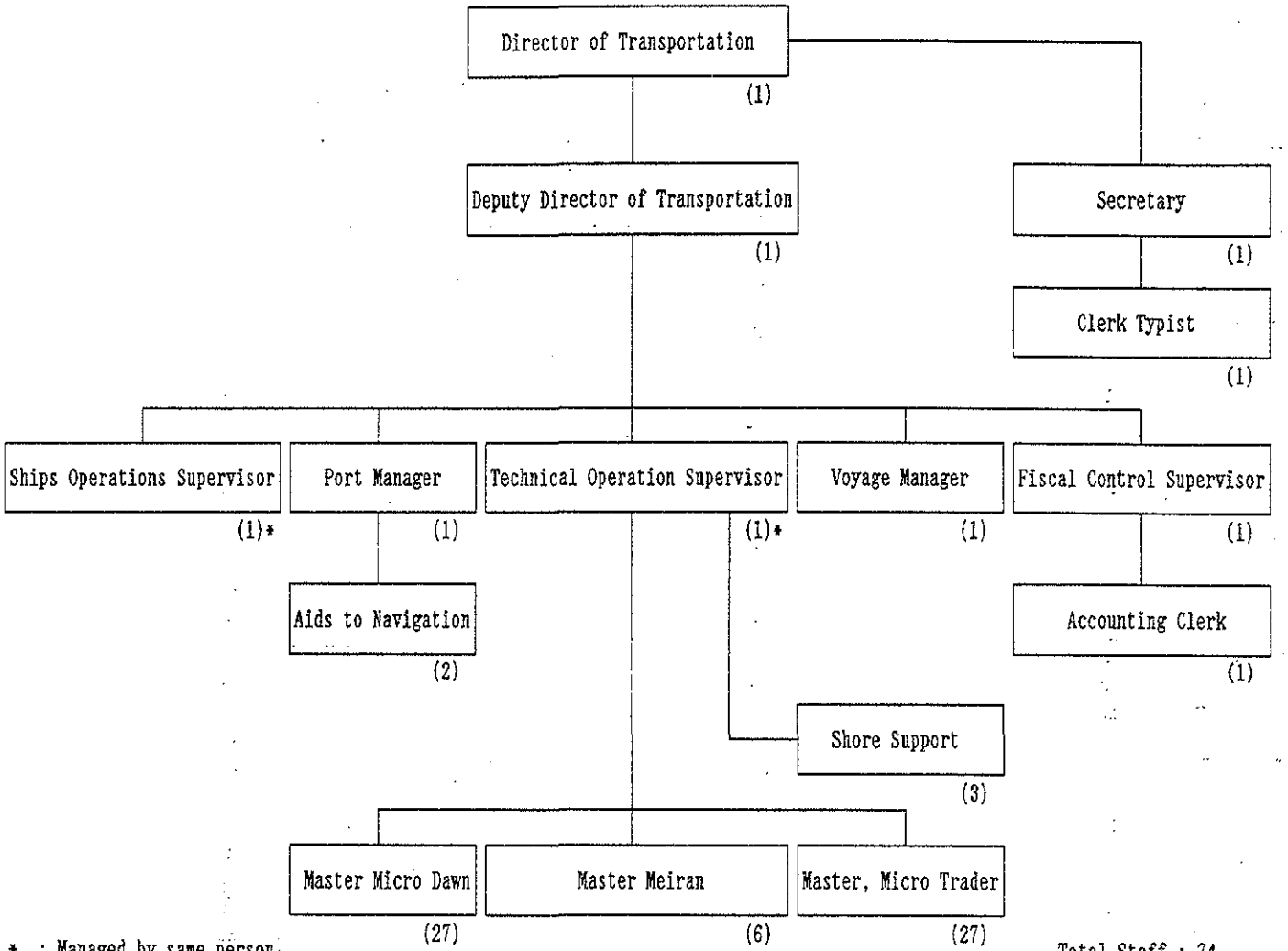
Table 3-14 Annual Budget of Department of Transportation

(US$)

	1991	1992	1993
Salary and Benefit	421,400	427,600	519,500
Travel	9,900	10,000	10,000
Contractual Services	0	200,000	223,341
Supplies & Materials	200,000	200,000	180,000
Petroleum Oil & Lub	200,000	200,000	200,000
Others	12,000	12,000	12,000
Total	843,300	1,049,600	1,144,841

Source : Department of Transportation, Chuuk State

Fig. 3-9 Organization Chart of Department of Transportation



* : Managed by same person
( ) : Number of staff

Total Staff : 74

(Source : Department of Transportation, Chuuk State)

3.3. Contents of the Request

Current conditions of Weno Port were discussed in Section 3.2 and the Government of the FSM sent the request to improve each of port facilities to solve problems as prescribed above.

The initial request by the Government of FSM included the following items.

* Extension of Dock-B (extension length 300 ft, depth 40 ft)
* Commuter Boats Terminal (length 100 ft x 3 rows, depth 12 ft)
* Revetment of north side of extension of Dock-B
  (length 380 ft, depth 40 ft)
* Revetment of Commuter Boats Terminal
  (length 345 ft, depth 12 ft)
* Expansion of container yard
* Apron of Commuter Boats Terminal (length 305 ft, width 40 ft)

At the time of site survey, the Basic Design Study Team were requested to include rehabilitation work of Dock-A, to which emergency measures has been applied by the Chuuk State for the cavity and cracks that are progressing in Dock-A since 1992. The Government also asked to include additional items basing on the newly formulated Master Plan.

These requests are described in the order of priority in the Minutes of Discussions between the Study Team and the Governments of Chuuk State and FSM. Fig. 3-10 shows plan of the requested items.

1. Repair of Dock A (-30 ft deep, 300 ft long)
   (Dredging of Mooring Basin)

2. Extension of Container Yard (with Revetment)

3. Extension of Dock B (-30 ft deep, 300 ft long)
   (Return Wall 150 ft long, Slope for landing craft)

4. Extension of Dock A (-30 ft deep, 200 ft long)
   (Freight Station, Tugboat)

5. Commuter Boat Terminal

A. Inner Northern Basin

- Eastern Apron
- Mooring Jetties
- Revetment in Western Side

B. Primary Marina

6. Miscellaneous

- Navigation Aids
- Forklift
- Revetment in Southern Basin

The project items requested by the Government of FSM are listed as followings in priority order;

1. Repair of Dock-A (-30ft deep, 300 ft long) (Dredging of Mooring Basin)
2. Extension of Container Yard (with Revetment)
3. Extension of Dock-B (-30ft deep, 300ft long) (Return Wall 150ft, Slope for landing craft)
4. Extension of Dock-A (-30ft deep, 200ft long) (Freight Station, Tugboat)
5. Commuter Boat Terminal
   A. Inner Northern Basin
      - Eastern Apron
      - Mooring Jetties
      - Revetment in Western Side
   B. Primary Marina
6. Miscellaneous
   - Navigation Aids
   - Forklift
   - Revetment in Southern Basin

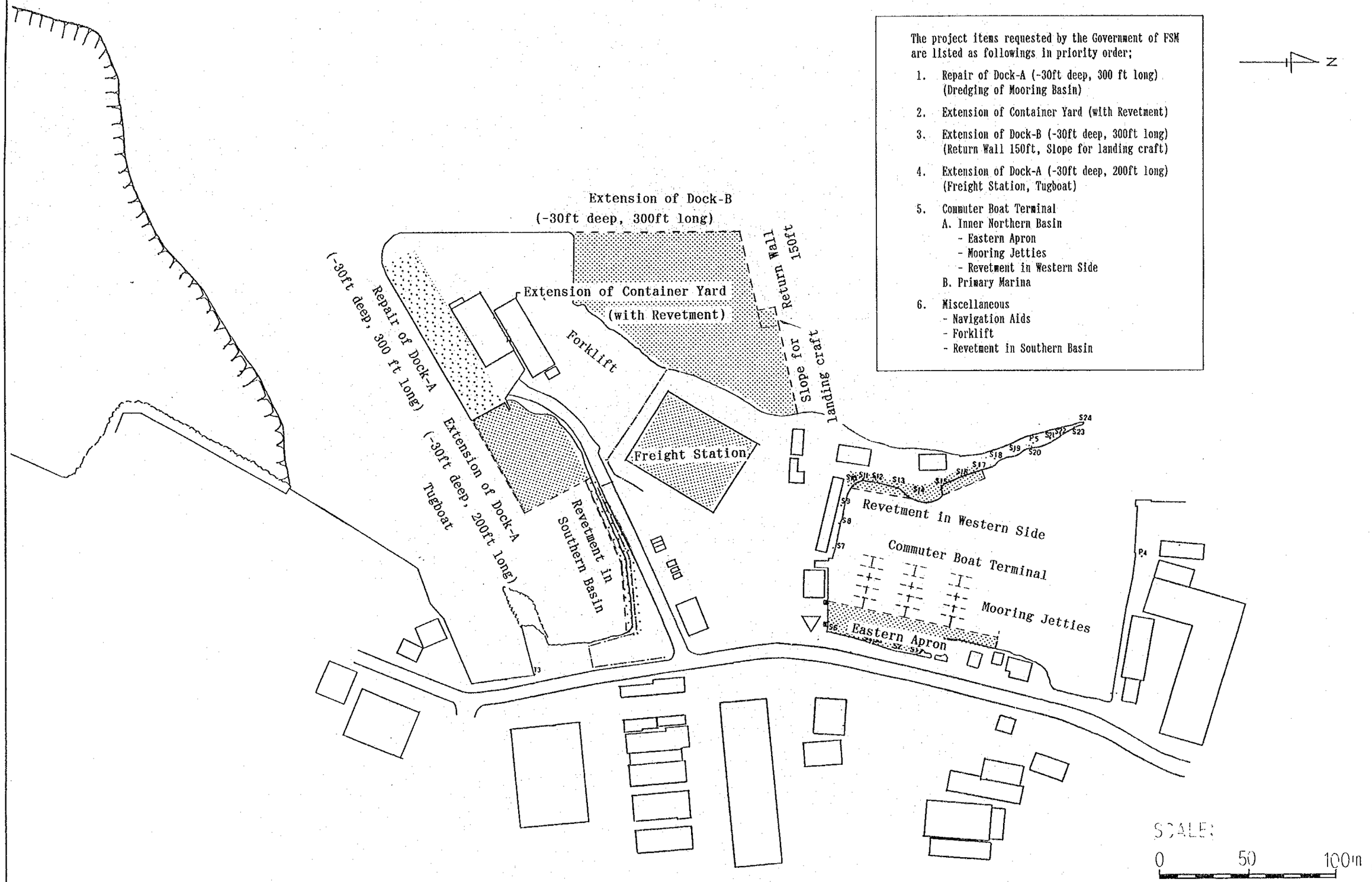


Fig. 3-10 (1) Contents of the Request (1)

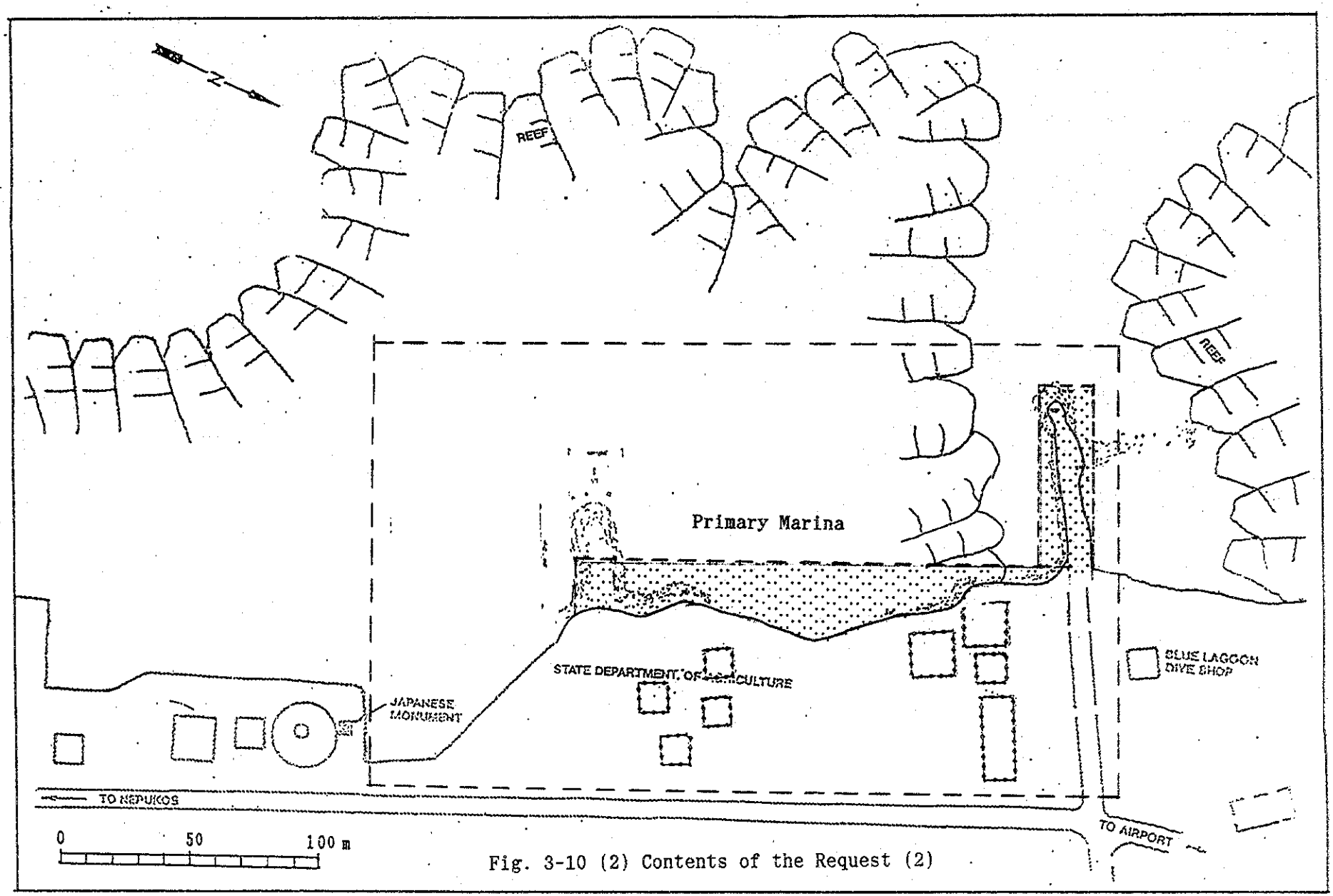


Fig. 3-10 (2) Contents of the Request (2)

CHAPTER 4

CONTENTS OF THE PROJECT

CHAPTER 4: CONTENTS OF THE PROJECT

4.1 Objectives of the Project

The role of Weno Port is of principal importance as the base for international trade connecting the State of Chuuk with Pan-Pacific countries, and for intra-state domestic shipping service, and for commuting boats terminal within Truk Lagoon.

These functions in Weno Port are now in a disorderly state because of insufficiency of berthing facilities as about 50 international vessels and about 100 domestic boats annually make calls at the port and some 300 commuter boats daily enter the port.

Thus in Weno Port, port operation are not carried out in a good efficiency and even some traffic hazards are arising in this port. To solve the problem, the Project aims to expand port facilities and to provide separate berths especially for commercial port functions.

4.2 Examination of the Request

4.2.1 Appropriateness of the Project

The project plan is intending to improve port facilities of Weno Port as the most important and urgent task to enhance economic development and to achieve economic self-reliance of Chuuk State.

Effects and benefits to be brought forth under this project are expected as below.

(1) Improved facilities for international trade will secure safe entry/berthing/departing of international trade vessels and efficient cargo handling operation, and thereby stabilize supply of imported commodities for daily life such as foods, sundries, construction materials, fuel oil, etc.

(2) Improved facilities for intra-state domestic shipping will eliminate offshore waiting and suspension of cargo handling for domestic service boats, resulting in drastic improvement of domestic shipping services.

The contents of the request will be discussed in detail in "4.2.5 Examination of Contents of the Request".

4.2.2 Operation and Administration Plan

Department of Transportation of Chuuk State Government has, as discussed in 3.2.3 (9), 74 staff members and the annual budget of US$ 1.1 million. About US$ 200,000 per year is currently set for maintenance and administration of the port facilities. After the completion of the Project, additional staff of four and budget of US$100,000 are planned, which are considered to be adequate for management and maintenance of the project provided facilities.

4.2.3 Associated Projects and Aid Programs

A fishery complex port for tuna longline fishing is currently under construction at the opposite side of Dock-A in the South Inner Basin (dock length: 84 m; refrigerator building: 1,700 m^2; etc.) by the National and the State Governments. After completion, fishery activity will be moved here to be separated from the commercial port area, and the proposed Project site will be reserved for commercial port activity.

There is no duplication for the present Project plan with other foreign government aid program.

4.2.4 Projection of Marine Transport in Weno Port

(1) Projection of Cargo Volume

The import cargo volume carried in by international vessels to Weno Port was 50,235 tons in 1992 (see Table 3-4). The Weno Port Master Plan projects the cargo volume for 2003 at about 85,000 tons basing on population growth estimation from the volume for 1991 as shown in Table 4-1. The cargo growth rate is estimated by assumption that consumption demands correspond to the projected population increase in 1989 - 2002, as the main factor to affect the future cargo volume (see Appendx Table A-4-1).

In addition to cargoes listed in Table 4-1, petroleum products and fuel oil imports are expected to increase to a level of about 33,000 kilo liters per year in 2003, basing on the similar growth rate assumption.

Table 4-1 Projection of Incoming Marine Cargo, 2003

(Revenue tons)

	Containerized			Break Bulk	Total
	FCL	LCL	Sub-total		
1992	35,333	3,551	38,884	11,351	50,235
2003	56,781	7,999	64,780	20,542	85,322

Source : Seaport Master Plan for Island of Weno, January 1993

(2) Projection of Ship Calls by Vessel Types

The breakdown of ship calls at Weno Port in 1992 was 51 in international vessels and 105 in domestic boats. When the annual growth rate of the number of ships calling at Weno Port is assumed to be proportional to that of cargo import volume, there will be 78 international vessels and 160 domestic boats in 2003. Furthermore calls of cruising ships are expected as well as increase of foreign fishing vessels due to improvement of the fishing base, finally leading to more berthing facility requirements.

Micronesian Pride (8,800 DWT) is one of the largest ships currently calling at Weno. A plan to build larger new ships is in progress in view of obsoleteness of the present vessels that are more than 10 years old, intending to meet increasing cargo volume, and to cut down transportation costs.

However, increase of vessel size subjects to the scope of facilities at other ports in FSM. As Cereza (11,388 DWT; 132.9 m length; 20.9 m width; 9.43 m draft) of Nippon Yusen Kaisha used to call FSM in the past, and as the Yap Harbor Extension Project which was implemented in 1990 - 1991 under the Grant Aid of Japanese Government was also intended for ships size of 10,000 DWT class, the Weno Harbor Extension Project plan also adopt the ship size of 10,000 DWT class as the maximum in near future. Thus, the Project plan is proceeded to accommodate container ship of 10,000 DWT size.

The projected size for domestic shipping is 880 DWT, the same size as Micro Dawn which is currently in service. There are three such ships in service today which stationed in Weno Port as the mother port.

Ships to be accommodated in this project are summarized as below:

International Cargo Vessels (container ships) 10,000 DWT

* length	137.0 m
width	19.9 m
full draft	8.5 m

* Domestic service ship (combination boat) 880 DWT

length	56.4 m
width	10.0 m
full draft	3.8 m

4.2.5 Examination of Contents of the Request

Items requested by the FSM Government are examined and discussed below.

(1) Rehabilitation of Dock-A

Out of the existing berth length of 97 m, 91 m was built in 1962 using steel sheetpiles. The FSM Government places the top priority on rehabilitation of the existing portion of Dock-A.

The technical investigation of the dock revealed that a rather small section of steel sheet piles is in use, and corrosion is heavy since the dock was built more than 30 years ago, and some of tie-rods are lost their function, and backfill sands were washed out (see 3.2.3 Port Facilities of Weno Port at Present), thereby lowering structural stability of the dock. Overall rehabilitation works including installation of new sheet piles wall is considered necessary.

(2) Expansion of the Container Yard

The water area in behind the extended Dock-B is intended to be used for disposal site of dredged soil from mooring basin dredging works, and consequently a new land area will be developed in this area. The

FSM Government requested for expansion of the container yard by connecting the newly developed land area with the existing cargo handling yard area.

The container handling yard is currently extremely narrow (about 3,500 m^2), forcing cargo handling on the apron area or forcing stacking of empty containers in three tiers, thus creating considerable problems in efficiency and safety of operations. Necessary area of container yard is estimated as below on the basis of number of containers to be handled.

1) Estimation of Number of Containers in 2003

Number of containers to be handled in 2003 is approximately 3200 pcs per year, as estimated on the basis of projected cargo volume in 2003 (see 4.2.4 Projection of Marine Transport in Weno Port), and the results are as given in Table 4-2 in 20 revenue tons cargo volume per a 20 ft container.

Table 4-2 Number of Containers in 2003

	Containerized Cargo (Revenue Ton)			Number of Containers	Remarks
	FCL	LCL	Sub-total		
1992	35,333	3,551	38,884	1,736	Actual Results
2003	56,781	7,999	64,780	3,239	Anticipation

2) Area Required for Container Handling

Area to be required for container yard are calculated for 2003 year on the basis of the estimated number of containers.

The area is calculated from the following formula.

$$A = \frac{N \times d \times \alpha \times a}{365}$$

wherein

A : Area required for container handling
Provided that area for container yard is the sum of storage area and passages area.

N : Number of containers (pieces) per year

d : Number of stay days of container in the yard
d is assumed at 21 days, as container ships call at the Weno Port at the interval of three weeks (PM&O Line).

α : Peak ratio
α is assumed at 1.5, considering cases when container ships enter the port in succession.

a : Area required for a container handling
a is assumed at 75 m^2/pc (see Appendix Table A-4-2) including passage area for forklift.

Table 4-3 shows necessary areas calculated for container handling in 1992 and in 2003. The table shows that present area is extremely small as it is only 31% of the necessary area in 1992, and it will be 17% in 2003. Therefore, expansion of the container yard is urgently necessary.

Table 4-3 Area Requirement for Container Yard

	Existing Container Yard Area A1(m^2)	Container Yard Area Requirement A2(m^2)	Rate of Provision A1/A2
1992	3,467	11,236	31%
2003	3,467	20,965	17%

(3) Extension of Dock-B

The current berth length of Dock-B is 91 m, which is extremely short and only about one half of standard berth length for the international cargo vessels. The depth in front of Dock-B is now -8 m at the southern end and -5 m at the northern end. Also mooring basin area is very narrow, being inadequate for maneuvering of international cargo vessels.

The FSM Government requested extension of Dock-B toward north by 300 feet (91 m) (depth at the dock; - 9 m) corresponding to the initial stage plan of the Port Master Plan. This will make Dock-B to a standard berth length of 170 m and provides a complete berth for 10,000 DWT class container ships as a main berth.

Because of sand deposit depth to -5 m to -8 m in front of the Dock-B, international cargo vessels cannot be moored at Dock-B currently. Since dock structure was designed and built originally as a -9 m dock, by re-dredging to -9 m and by extension of dock length, it can be used for berthing of the design international cargo vessel.

In this way, proposed improvement of Dock-B by extension will results in saving of project cost radically compared to building a new dock. Therefore the extension work of Dock-B to accommodate international cargo vessels can be assessed as an appropriate plan.

The Government further requested to replace Dock-C for small sized crafts along the return portion at north end of present Dock-B to a new location along new return wall at the extended Dock-B, and to provide ramp for landing crafts at eastern end of new Dock-C. As the depth of Dock-B is -9 m, for efficient use of investment, it is considered reasonable to utilize the transition part of return wall as a dock to accommodate small boats.

However, since the requested ramp location is very susceptible to waves from west and north, high cyclone waves are likely to uprush and overtop the ramp and cause damages to the container yard. Therefore, in this project plan, ramp is proposed at an alternate location in South Inner Basin at end of return wall of the extended Dock-A, where the sea is much calmer.

(4) Extension of Dock-A

Since the water area in front of Dock-A is narrow, it was requested to extend Dock-B, and to shift international cargo vessels berth from Dock-A to Dock-B as described above.

It was requested to extend Dock-A by 60 m toward east (land side) to accommodate two of the intra-state service boats of Chuuk State. Also, this Dock-A extension is requested intending to provide an alternate dock of Dock-B for international cargo vessels when mooring at Dock-B become difficult during season (August - November) of prevailing westerly winds.

Calmness of Sea at Dock-B was examined and the result is shown in Table 4-4. Calmness at Dock-B is found rather poor during the period from August to November, and the rate of operationable day is proved to go down to only 40 - 70% (1992) at Dock-B because of rough waves.

Since extension of Dock-A is expected to bring forth the following effects, this item is considered necessary and appropriate.

1) With the current berth length of 97 m at Dock-A, only one berth is available for the three domestic service boats which stationed in Weno Port. When all three boats enter the port simultaneously, two are forced to wait offshore. By provision of two berths for use of intra-state service boats by extension of Dock-A, most of offshore waiting and suspension of cargo handling for domestic service boats can be eliminated, resulting in drastic improvement of domestic shipping services.

2) Even westerly wind season of August through November when ship operation at Dock-B become difficult often, sea at Dock-A are mostly calm allowing berthing of international cargo vessels as an alternate berth for Dock-B, securing stable supply of commodities such as foodstuff, construction materials and fuel oil for Chuuk State.

However, since the water area in front of Dock-A is narrow, it is considered suitable to utilize Dock-B as a main berth.

(5) Improvement of Commuter Boats Terminal

For improvement of commuter boats terminal, following items were requested by the FSM Government.

A: Northern Inner Basin

* Eastern Apron
* Mooring Jetties
* Revetment in Western Coast

B: Primary Marina

C: Miscellaneous

* Revetment in Southern Basin

As this project focuses on improvement of the commercial port facilities for international trade and domestic service as of urgent need and importance, the commuter boats terminal works are not included in this project.

(6) Improvement of Navigation Aids

Since the entrance channel from the Northeast Pass into Truk Lagoon and Weno Port is about 20 km long and shoals are scattered along the channel, navigation aids are indispensable in assisting ships to enter the port safely. Many of these aids are now in defective condition by loss of lanterns or by low stability against waves. Also there are not sufficient navigation aids provided near Weno Harbor. Therefore their improvements are included in this project as requested.

(7) Forklift for 40 ft Container

There is only one forklift for 20 ft containers as shown in Table 3-12 cargo handling equipment available at present in Weno Port, and the request was made for a larger size forklift to be able to handle both 20ft and 40ft containers.

The number of 40 ft containers being landed in Weno Port at present is about 5% of total containers, though the rate is increasing, and this trend is expected to be continued for reduction of cargo transportation costs.

Though this project does not include 40 ft class forklift, provision of such forklift for 40 ft containers will become necessary in not long future.

(8) Container Freight Station

Current mechanic shop of Department of Public Works is located on the eastern side of the new container yard which is to be developed in behind the extension of Dock-B. The plan to move the mechanic shop is contemplated by Chuuk State Government. After the move, the building of about 2,000 m^2 will be available for use as a container freight station for international cargo.

(9) Tugboat

Water area in front of Dock-A is not wide enough for maneuvering of large sized vessels. However, since present size vessels are actually able to moor or depart without assistance of tugboat, tugboat is not included in this project plan. When new larger boat come into service with increase of cargo volume, provision of a tugboat will become absolutely necessary.

4.2.6 Strategy of Project Planing

The Project can be justified as an appropriate one for its urgency and effectiveness through the above examination. Department of Transportation has sufficient experience, work force and financial backup in administration and operation of the facilities planned in this project. Also high public utilization of Weno Port as basic infrastructure well conform the principles of the Japanese grant aid assistance.

Therefore, the project will be further examined and a plan will be proposed for basic design toward realization under the Japanese grant aid programme.

The contents of the Project have been changed following the results of examination in the preceding section.

4.3 Proposal of Project Plan

4.3.1 Proposal Plan

The followings are policies observed in the basic plan of the Weno Harbor Extension Project.

1) To satisfy commercial port functions corresponding to the initial stage of the Port Master Plan by expansion and improvement of port facilities.

2) To separate port facilities by function such as for international trade and for domestic shipping service, providing respective specialized berths.

3) To provide complete berth (main berth) for 10,000 DWT class container ship by extension of Dock-B, accommodating demand of the future cargo volume.

4) To provide a dock for small ships along the return wall at the extended Dock-B.

5) To provide mother port berths for the intra-state service boats and also to provide an alternate dock of Dock-B for international cargo vessels mooring at Dock-B become difficult during season (August - November) of prevailing westerly winds by extension of Dock-A.

6) To provide a dock for small ships and ramp for landing-craft along the return wall at the extended Dock-A.

7) To expand the container yard disposing dredged soil from mooring basin dredging works in the water area behind the extended Dock-B.

8) To secure safety of entrance channel by improvement of navigation aids.

The followings are project items covered by the proposal plan for the Weno Harbor Extension Project. One each item, scope and planning base consideration are given below:

(1) Rehabilitation of Dock-A

1) Scope

a) Rehabilitation length of Dock-A

The length of obsolete portion of Dock-A is 91 m, and which adding 2 m of the approach at western end of Dock-A, the entire rehabilitation length will be 93 m.

b) Water depth at Dock-A

The design water depth for the dock shall be -9 m the same as that of Dock-B for accommodation of international cargo vessels as an alternate international vessel berth (present water depth: -8.4 m).

(2) Extension of Dock-A

1) Scope

a) Extension Length

The required length for accommodation of two domestic service boats can be calculated as below:

L = 56.4 m + 8.7 m x 2 = 74 m

by adding to ship length of 56.4 m of Micro Dawn some allowances at both ends for line handling (8.7 m x 2).

The required length of the entire dock for two boats is:

L = 74 m x 2 + 9 m = 157 m

by adding 9 m of the approach at eastern end.

The dock length to be extended under the Project is 60 m, and the finished length of Dock-A will be 157 m in total. Although it is about 10 m shorter than standard berth length requirement of 170 m for accommodation of international cargo vessels, by provision of a mooring post at return wall portion sufficient line handling length can be provided.

b) Water depth at Dock-A

The designed water depth is -9 m similar to Dock-B as international liners will be accommodated on this dock. The current depth at the extension length of 60 m of Dock-A is about -6 m, and dredging is required.

c) Apron

The apron width for cargo handling is to be 20 m wide similar to the current Dock-A apron, provided with concrete pavement.

2) Area of dredging in front of Dock-A

The water area in front of Dock-A is wedge-shaped as its width narrows toward inside of the South Inner Basin. Since there are revetments and docks in opposite shore across the basin, dredging of -9 m depth is limited not be beyond 40 m from the opposite shoreline. Fig. 4-4 shows the effective area for dredging to -9 m. The effective deep water area extends to about 80 m at west end and about 40 m at east end of the mooring basin.

3) Small Dock along east return wall with ramp

Along eastern return wall for the extended Dock-A, small dock of 50 m long with effective water depth of - 4.5 m is proposed utilizing effective existing water depth. At land side end of this dock, ramp is provided for landing crafts.

(3) Extension of Dock-B

1) Scope

a) Length

Dock-B work is intended for accommodation of international trade vessels, and requirements are as follows.

Ship to be served : 10,000 DWT
Required berth length : 170 m

By extension of 92 m, total berth length will be 183 m including the existing length of 91 m. This berth length just fits for berth length requirement of 170 m, excluding 13 m of corner portion at the northern end of the berth.

b) Water depth at Dock-B

The design water depth at the dock to be -9.0 m, by adding 0.5 m of allowance as bottom clearance to -8.5 m of full draft of the objective vessel. Since current water depth are -5 m to -8 m at the existing Dock-B portion, and -6 m at the proposed extension portion, dredging to -9 m is included.

c) Apron

The apron width is set at 20 m wide, provided with concrete pavement.

d) Rate of operationable days in Dock-B in westerly wind season

Dock-B for international vessel berth is facing west, and unsheltered fetch of sea in front of Dock-B (the distance from the dock to the reef on the outer periphery of Truk Lagoon) is about 20 km long, water depth being -20 to -50 m. Therefore this berth is likely to be influenced by waves in westerly wind season of August through November.

For this reason, calmness of sea at this dock was examined in view of rate of operationable days (ratio of days when cargo operation are possible in certain period).

Since no wave observation record is available in Weno Port, wave height estimation was carried out on the basis of wind data supplied by the Chuuk State. The methods of wave computation and method of calculation of operationable ratio, etc. are shown in Appendix 4(2).

The operationable ratios are obtained in a manner as given below.

Critical wave height for cargo handling is set at 0.5 m basing on the Port and Harbor Codes of Japanese Ministry of

Transport as a premises for evaluation, and port operation is assumed to be suspended if the wave height exceeds this value even once a day.

Table 4-4 shows the results of study by yearly ratio and by monthly ratio for a period of 1989 to 1992, and Fig. 4-1 shows the estimated wave height chronologically for the year of 1992. For reference, chronological graph of wave height for the period of 1989 to 1991 are shown in Appendix Fig. A-3-6.

According to Table 4-4, the annual operationable ratio is 96% - 99% for Dock-A, and 86% - 95% for Dock-B. Annual ratio is low for 1992, and monthly ratio become low for the period from August to November. Particularly in August 1992, the ratios were very low, being 87 % for Dock-A and 42 % only for Dock-B.

The difference of operationable ratios between Dock-A and Dock-B represents approximately the increase of operationable ratio of Dock-B when Dock-A is assumed to accommodate international vessels as the alternate berth of Dock-B in rough sea days. It can be seen from this table that, though the operationable ratio for Dock-B is as low as 42 % in August 1992, berth efficiency for international vessel can be raised as high as almost 87 % by utilization of Dock-A for international vessels in this season.

Fig. 4-1 shows that non-operationable days to last as long as a week at Dock-B sometimes in August through November season. Even in such season, by utilization of Dock-A, duration of non-operationable days may be reduced to 1 to 3 days length at the maximum.

Basing on the above study results, use of Dock-A and Dock-B is proposed in this project as the following ways:

* Dock-A shall be used basically as reserved berth for domestic service boats because of narrow water area in front of the dock.

* Dock-B shall be used as reserved berth for international cargo vessels because of wider water basin area and of closer distance to the expanded container yard. However, the dock may not be operationable in rough sea days in westerly wind season between August and November.

* Dock-A shall yield berthing priority to international trader vessels in occasion when sea condition is adverse at Dock-B during season of August through November.

Table 4-4 Rate of Operationable Days for Mooring

(Unit : %)

	Month	1	2	3	4	5	6	7	8	9	10	11	12	Total
1989	Dock A	100	100	100	100	100	100	100	96.77	100	93.55	100	100	99.18
	Dock B	100	100	100	90	100	100	100	83.87	90	83.87	93.33	96.77	94.79
	Relief rate	0	0	0	10	0	0	0	12.9	10	9.68	6.67	3.23	4.38
1990	Dock A	96.77	100	100	100	100	100	100	90.32	96.67	100	96.67	96.77	98.08
	Dock B	93.55	100	100	96.67	96.77	93.33	83.87	77.42	77.33	87.10	70	93.55	88.77
	Relief rate	3.23	0	0	3.33	3.23	6.67	16.13	12.90	23.33	12.90	26.67	3.23	9.32
1991	Dock A	100	100	100	100	100	100	100	93.55	93.33	100	96.67	100	98.63
	Dock B	100	100	93.55	100	96.77	96.67	93.55	54.84	66.67	80.65	80	100	88.49
	Relief rate	0	0	6.45	0	3.23	3.33	6.45	38.71	26.67	19.35	16.67	0	10.14
1992	Dock A	100	100	100	100	100	100	100	87.10	90	93.55	83.33	100	96.17
	Dock B	93.55	100	100	100	100	100	87.10	41.94	70	67.74	66.67	100	85.52
	Relief rate	6.45	0	0	0	0	0	12.90	45.16	20	25.81	16.67	0	10.66
Total	Dock A	99.19	100	100	100	100	100	100	91.94	95	96.77	94.17	99.19	98.02
	Dock B	96.77	100	98.39	96.67	98.39	97.50	91.13	64.52	75	79.84	77.50	97.58	89.39
	Relief rate	2.42	0	1.61	3.33	1.61	2.50	8.87	27.42	20	16.94	16.67	1.16	8.62

Note : Relief rate means difference of the rate that Dock A operationable while Dock B is not operationable

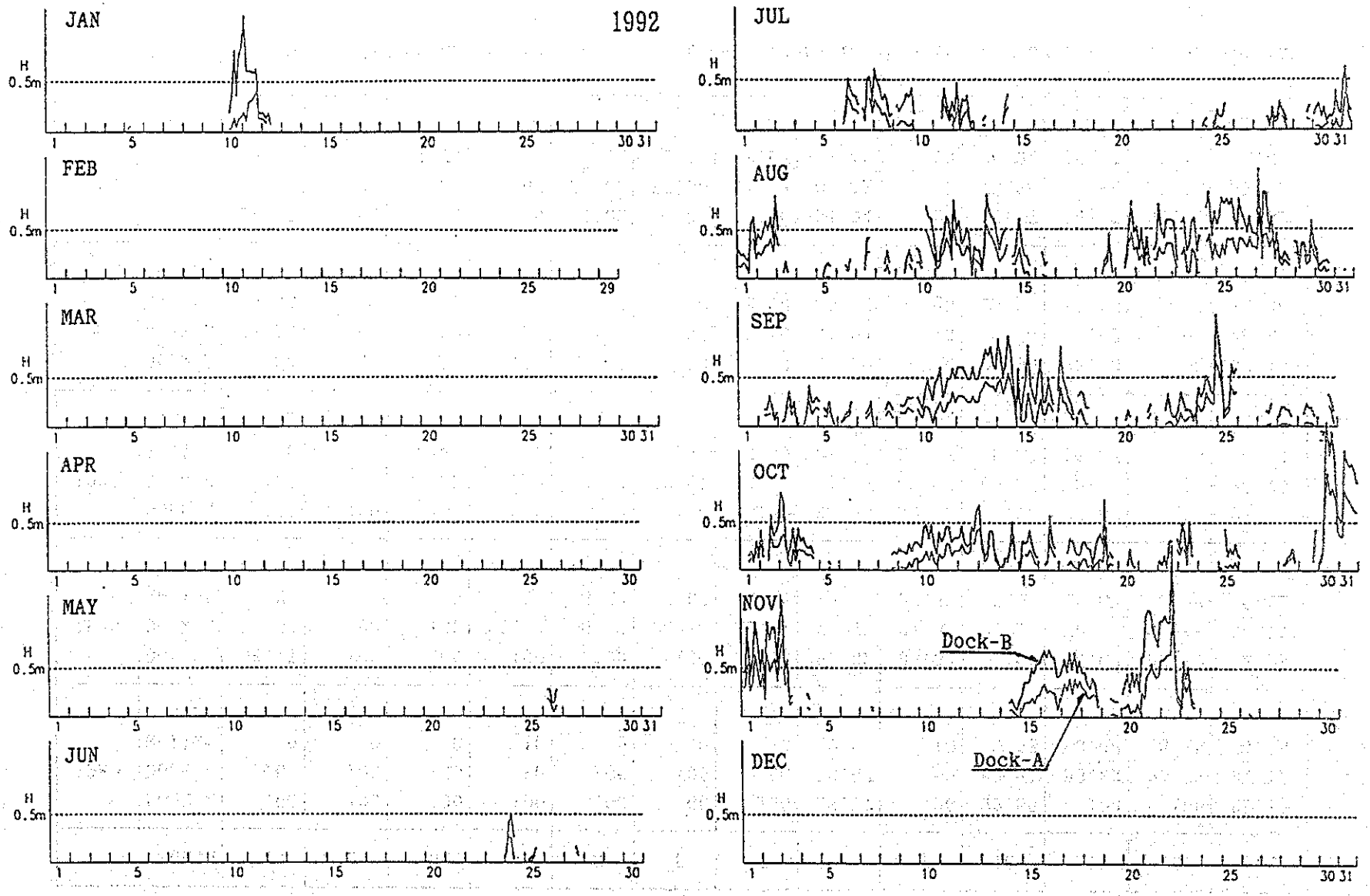


Fig. 4-1 Chrological Graphs of Wave Height at Dock-B in 1992

2) Turning basin and area of dredging for Dock-B

The turning basin should be provided in front of mooring facilities and shall have at least 3L diameter (three times the length of the object ship) when the ship make turn without tug assistance. Therefore a turning basin of diameter 3L = 420 m (137 m x 3 = about 420 m) is proposed, with line handling space of 1.5W (ship width) = 30 m (19.9 m x 2 = about 30 m) in front of the dock.

The design water depth for the basin is -9 m.

Further, the dredging area in front of the Dock-B shall include some allowance for safe maneuvering of the ships, in addition to the turning basin. Fig. 4-4 shows dredging area for - 9.0 m depth.

3) Repair of existing Dock-B

All fenders are missing from existing length Dock-B and temporally old tires are used in their place. New fenders will be provided on the existing length of Dock-B, to prevent damages to the moored vessels. Some of curbing along the pierhead crown are also damaged and require repair.

4) Small Dock along north return wall

The length and design water depth for this dock shall be as given below, in consideration ship size to be moored.

Dock length	: 50 m
Design depth	: - 5 m

(4) Expansion of the container yard

1) Scope of expansion

Water area to be surrounded by the extensions of Docks-B and new Dock-C and return wall is designated as disposal area of dredged soil from the mooring basin in front of Dock-A and Dock-B, to be developed into a new reclamation land of about 5,700 m^2 wide.

The new container yard is proposed to be developed in the area of about 9,200 m^2, to be obtained by jointing the new area of about 5,700 m^2 with the existing container yard of about 3,500 m^2. Fig. 4-2 shows the container yard areas before and after expansion.

Table 4-5 shows ratio of provision of the container yard after expansion. The ratio is 31% at present and 82% after expansion substantially meeting the requirements. However, for the cargo volume projected in 2003, the ratio will be only 44% even including expansion area, indicating severe shortage of yard area. Since there is room for further expansion in sea to north, future expansion is possible.

Table 4-5 Ratio of Provision of Container Yard after Expansion

	Actual Container Yard Area A1(m^2)	Container Yard Area Requirement A2(m^2)	Rate of Provision A1/A2
1992	3,467 (present)	11,236	31%
	9,206 (after expansion)	11,236	82%
2003	9,206	20,965	44%

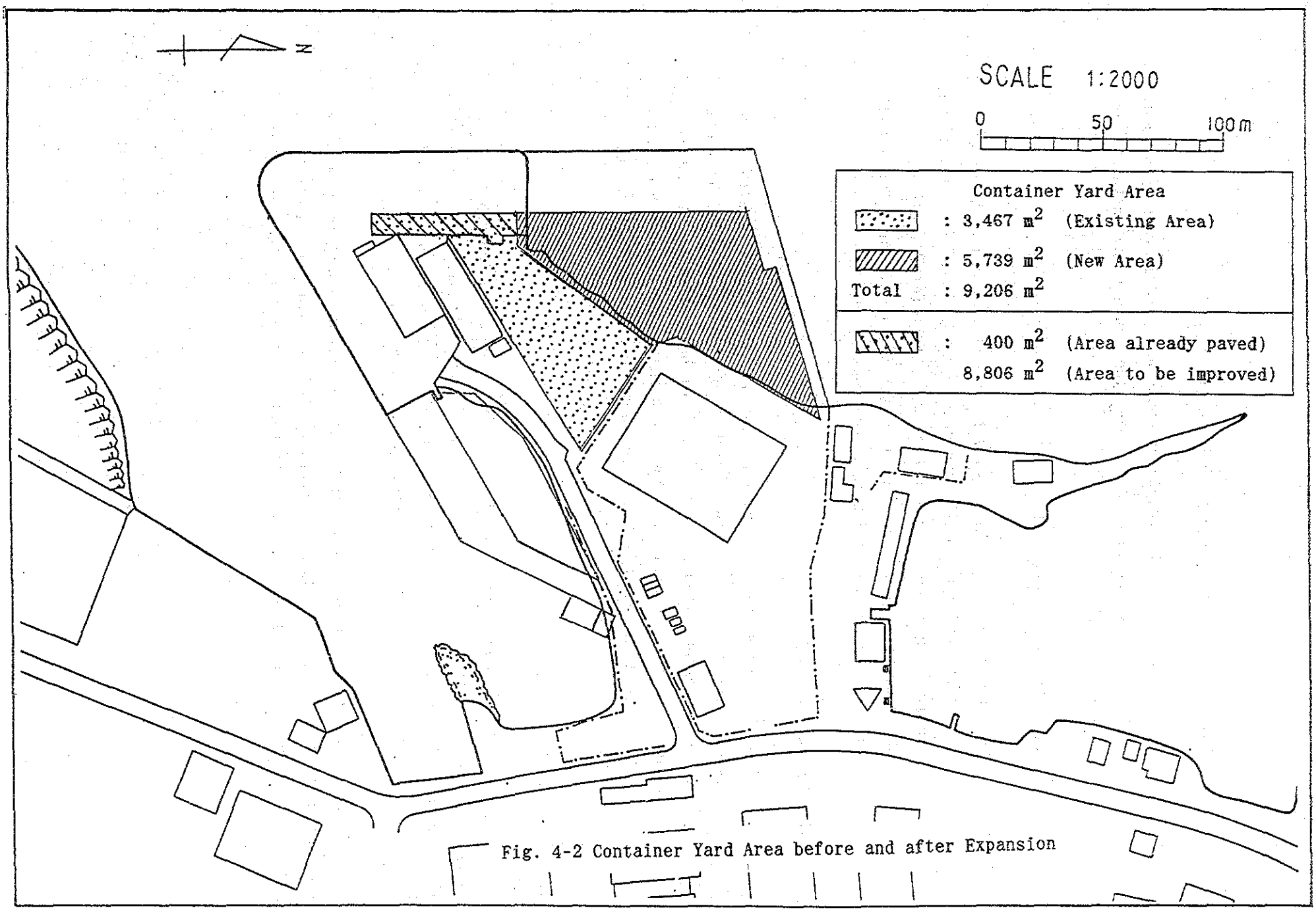


Fig. 4-2 Container Yard Area before and after Expansion

2) Revetment at north of expanded container yard

The north side of the expanded container yard is to be provided with 60 m long revetment for protection against wave attack from west and north.

3) Ancillary facilities

Surface of the container yard is to be provided with crushed gravel surface improvement and drainage. Lighting for yard area are to be provided for night work. Electricity power outlets are also to be provided for refrigerator containers. Fence and gate are to be provided with expansion of container yard.

(5) Navigation aids.

All of the existing six markers are to be provided with solar powered lights. Posts for shoal markers are to be improved by steel pilings. Two new lighted markers are to be installed to indicate boundary of turning basin in front of Dock-B. One light beacon also is to be provided on the dock to guide vessels in approaching to docks.

4.3.2 Layout of Proposal Plan

Dock-A shall be extended toward east into Southern Inner Basin. The extension length is 60 m, and the total length of Dock-A become 157 m together with the rehabilitated length. Along return wall portion at eastern end of the extended Dock-A small craft berth with ramp is layouted.

Dock-B shall be extended toward north. The extension length is 92 m, and the finished total length of Dock-B will be 183 m. Along return wall at north end of the extended Dock-B small craft berth of 50m long is arranged in the layout plan.

4.3.3 Outline of the Proposed Project Plan

As the results of examination and discussion presented in the preceding sections, the basic design of the planned port facilities which have been assessed to be appropriate for this project are described in Chapter 6, and the outline are shown in Table 4-6, Figs. 4-3 and 4-4.

Table 4-6 Outline of the Project Items

Facilities		Size/quantity
1. Dock-A Reformation		
* Rehabilitation of Dock-A	design depth -9 m	93 m
* Extension of Dock-A	design depth -9 m	60 m
* Small dock with ramp along return wall	design depth -4.5 m	50 m
* Dredging of mooring basin	design depth -9 m	approx. 32,000 m^3
2. Dock-B Extension		
* Extension of Dock-B	design depth -9 m	92 m
* Small dock along return wall	design depth -5 m	50 m
* Dredging of mooring and turning basin	design depth -9 m	approx. 73,000 m^3
3. Container Facilities		
* Yard Area Improvement		approx. 8,800 m^2
* Revetment		60 m
* Ancillary facility		
Drainage		210 m
Flood lighting		5 nos.
Reefer power		2 nos.
Fence and gate		Fence 20 m and gate 1 no.
4. Navigation Aids		
* Repair of markers		6 lighted markers
* Markers on border of turning basin for Dock-B		2 lighted markers
* Light beacon for approach to dock		1 lighted aid

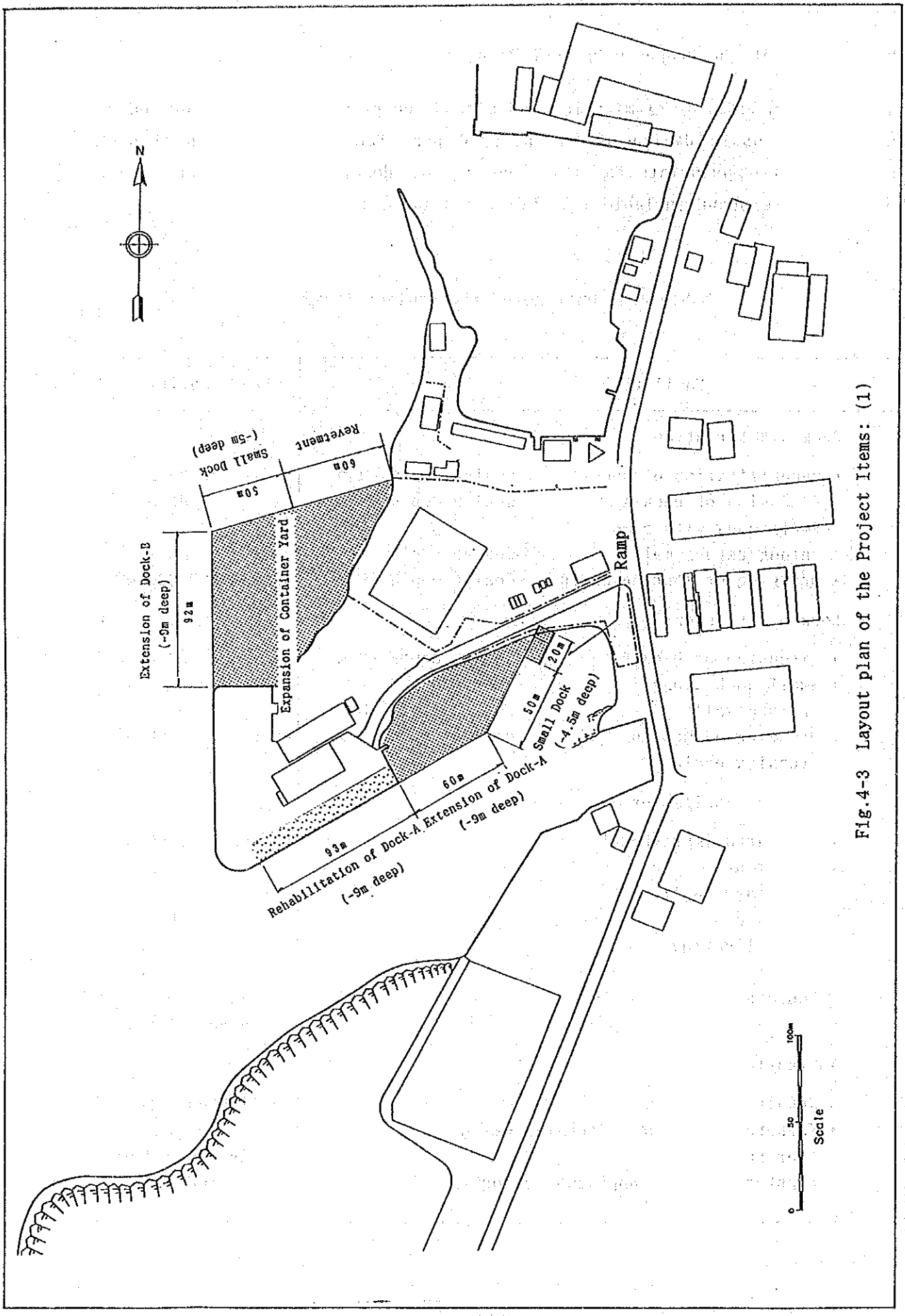


Fig.4-3 Layout plan of the Project Items: (1)

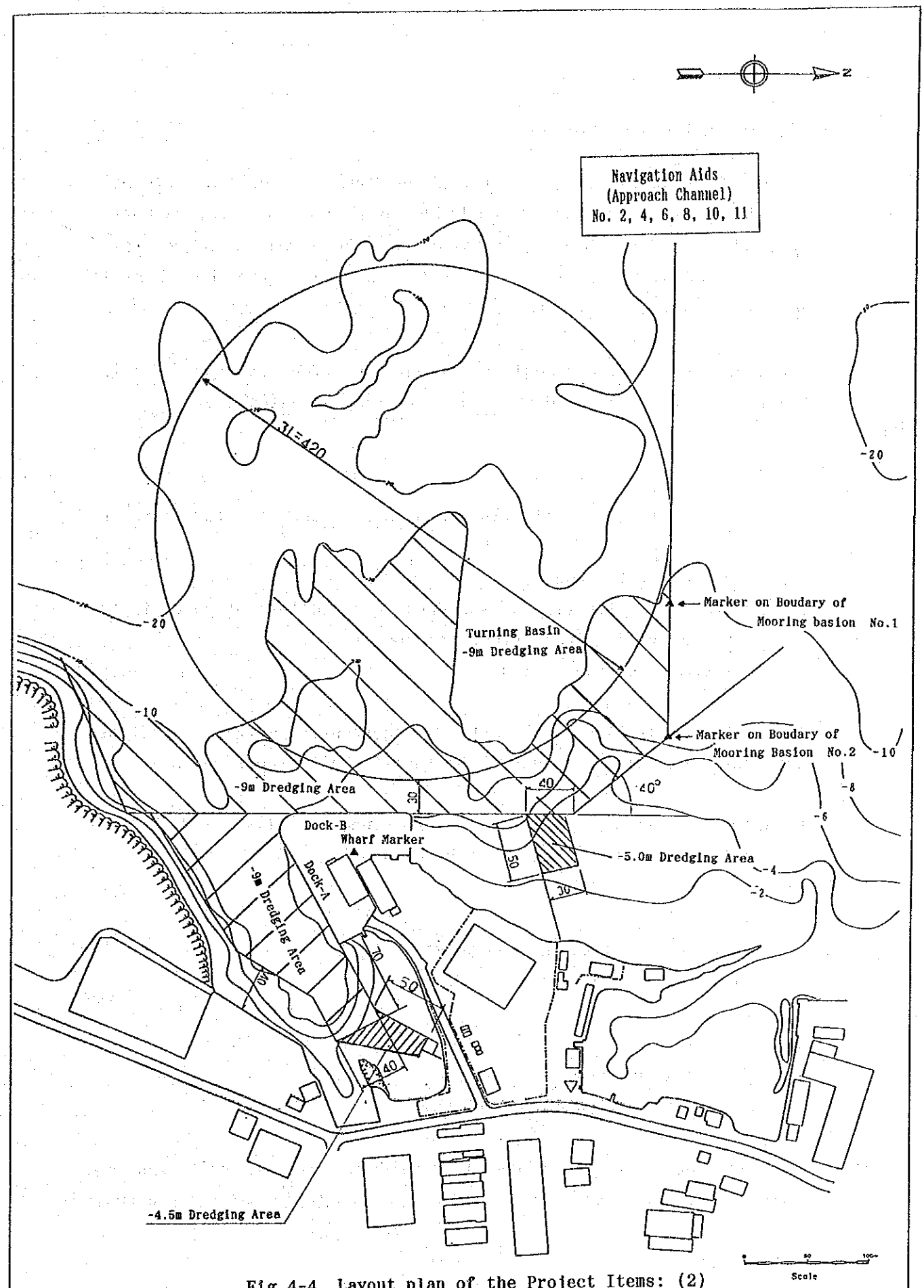


Fig.4-4 Layout plan of the Project Items: (2)

4.3.4 Operation and Maintenance Plan

(1) Administration/operation system

In "4.2.2 Operation and Administration Plan" discussion were presented on the organization and budget of Department of Transportation of the Chuuk State Government and the administration system after the completion. The administration system at the Department is considered quite satisfactory.

The proposed staff and administration/ operation expenses for the facilities after the completion are examined as below.

(2) Staff plan

The proposed Project will expand and improve the port facilities by

1) extension of the docks,
2) provision of lighting of the docks and outlets of power in the container yard for refrigerator containers,
3) improvement of navigation aids

As for "3) navigation aids", the two currently working staff are considered capable to maintain the facility after completion.

Department of Transportation aims to increase its staff by four person for items 1), 2) as given below.

* Electrician 1
  (in charge of lighting and power for refrigerator container)

* Workers 3
  (in charge of dock maintenance and administration)

The increase of four persons is considered to be sufficient for maintenance and administration after the completion of the project.

(3) Administration/operation expenses

Expenses that will be incurred anew after the completion are given below.

1) Personnel expenses

* Electrician	1	US$ 8,000/year
* Superintendent	1	US$ 8,000/year
* Workers	2	US$ 8,000/year ($4,000 x 2)
Sub-total		US$ 24,000/year

2) Maintenance/repair of navigation aids

Maintenance/repair, painting poles, etc.

once/year	US$ 2,000/year
Sub-total	US$ 2,000/year

3) Lighting of container yard and refrigerator containers power outlets

Painting work for light poles and spare parts such as lamps are included.

Sub-total US$ 2,000/year

Electricity charge for lighting of container yard for night work and power for refrigerator containers shall be paid by the beneficiary and therefore not included.

4) Maintenance/repair of extended docks

Maintenance costs for painting of mooring posts and replacements of damaged for fenders:

0.5% of dock construction cost
Sub-total US$ 50,000/year

Approximately US$ 78,000/year is estimated as additionally needed. Since Department of Transportation is planning an addition of budget of US$ 100,000/year for maintenance and administration after the completion, administration/operation after the completion will be performed satisfactorily.

4.4 Technical Cooperation

Department of Transportation of the Chuuk State Government is responsible for administration of Weno Port, and TRANSCO, a private company, is in charge of cargo handling operation.

In an effort to integrate and improve efficiency of the port administration and management and to promote Weno Port, the Chuuk State Government has a plan to establish Port Authority which will take over the port management.

With implementation of the Project, the port facilities will be expanded and improved, the cargo volume and the number of ship callings at the port will increase, and more efficient port management will be required.

Therefore technical assistance for training and education of port management and maintenance to bring up specialists is considered effective, regardless the port management is to be transferred to Port Authority or to be continued under the current system.

CHAPTER 5

ENVIRONMENTAL CONSIDERATION

CHAPTER 5: ENVIRONMENTAL CONSIDERATION

5.1 Background of Environmental Control

In FSM environmental protection is governed by the Environmental Impact Assessment Regulations (EIA). For approval of a project which may affect the environment, evaluation based on the EIA is required before implementation of the project.

According to the EIA, there are two types of environmental assessments. As the preliminary step of evaluation, an Initial Assessment is required to be conducted by official concerned, and when significant impacts are not found in any check item, the project will be approved. When some significant impacts are expected, then the Comprehensive Assessment must be carried out.

In FSM the environmental problem is within the jurisdiction of the Department of Health Services, and a construction works is required to be examined and to be approved by DHS. Also in each state, an administrator is appointed for environmental protection services.

Prior to the implementation of the project, Chuuk State Government will make application for EIA authorization of the project to Government of FSM.

Also before implementation stage of the project, project proponent is required to make application to the Government of FSM for permission of dredging and disposal of soil in compliance with the Earth Moving Regulations of FSM.

The article concerning the air pollution had been added to EIA in 1984. Attention are required not to make air pollution or noise in the course of the implementation of the project.

5.2 Environmental Survey by the Study Team

As a baseline study, environmental survey was carried out by the Study Team during site survey. The items of survey conducted to obtain basic data for environmental impact assessment are as follows;

(1) Sea Current Survey
(2) Water Quality Survey
(3) Marine Sediment Survey
(4) Marine Biological Survey

Also survey for bombs and shells at sea bottom were conducted by visual inspection. Results of the surveys are described in the following sections.

5.2.1 Sea Current Survey

Sea Current survey are intended to evaluate effect of dispersion of turbidity due to dredging works, and the survey were carried out by using Recording Current Meter (RCM-7) and floats in following manners.

(1) Current Observation

1) Twenty Four Hour Current Observation

Three Twenty Four Hour Current observations were conducted in ten minute intervals from 22 to 24 April, at the stations shown in Fig.5-1. Recorded data had been analyzed by tidal current harmonic analysis. The observed depth was one half of water depth at each stations. According to results of the analysis, the tidal type at each station was the mixed tide which is closed to the diurnal tide (see Appendices Tables A-5-1 to A-5-3). The maximum current speeds (Table 5-1) were approx. 5 cm/sec near docks, from 6 to 10 cm/sec at offshore, and average current speed were mostly less than 4 cm/sec.

Flood current at offshore Station C-2 indicated the tidal direction of East South East (ESE) for lower high water to higher high water and South West (SW) for lower low water to lower high water. Ebb current at Station C-2 indicated the tidal direction of North East (NE) for higher high water to lower low water. The maximum tidal speed of ebb current was 3.7 cm/sec recorded three hours after the time of high water shown in Fig. 5-2.

In general, current speed in project site are rather low.

Table 5-1 Results of Current Meter Survey

Stations	Surveyed layer (m)	Principal Current Direction (°)	Maximum Velocity in the Principal Current Direction			Maximum Velocity in the Anti-Principal Current Direction		
			Occurred Time	Velocity (cm/sec)	Current Direction	Occurred Time	Velocity (cm/sec)	Current Direction
C-1	- 2.5	35	22/4,18:50	5.2	75	23/4,11:00	3.1	129
C-2	-12.0	70	24/4, 8:40	5.7	71	23/4,12:30	10.4	250
C-3	- 4.0	275	23/4, 8:10	2.8	186	25/4,14:50	4.3	117

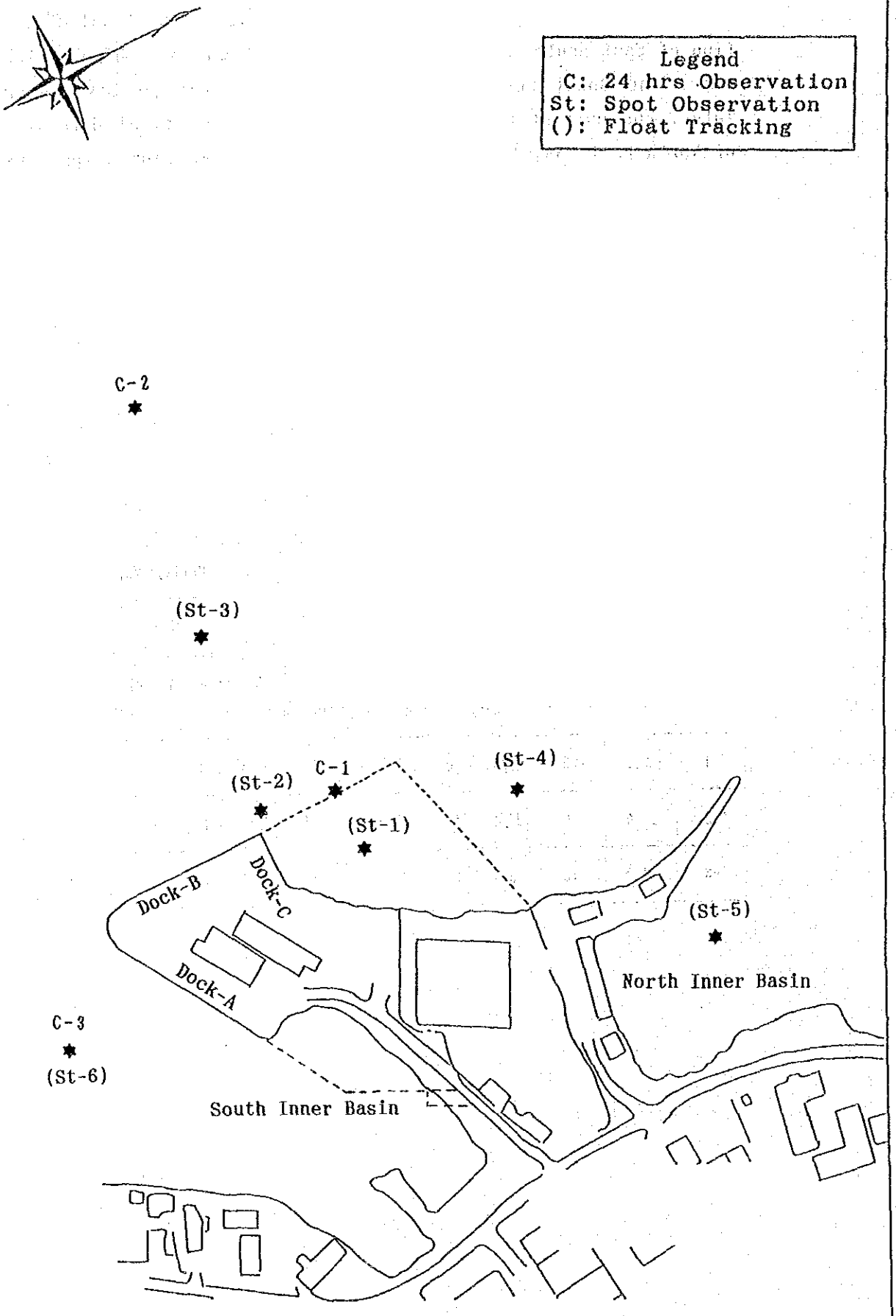
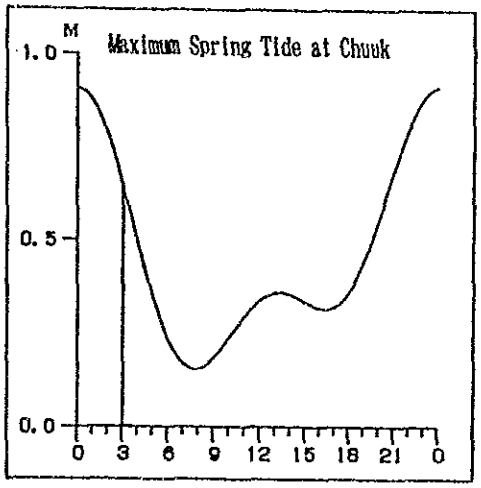


Fig. 5-1 Location of Current Observation

Reference Port	: Chuuk
Observed Time	: 3 hours after HHW
Observed Layer	: 1/2H
Unit	: cm/sec



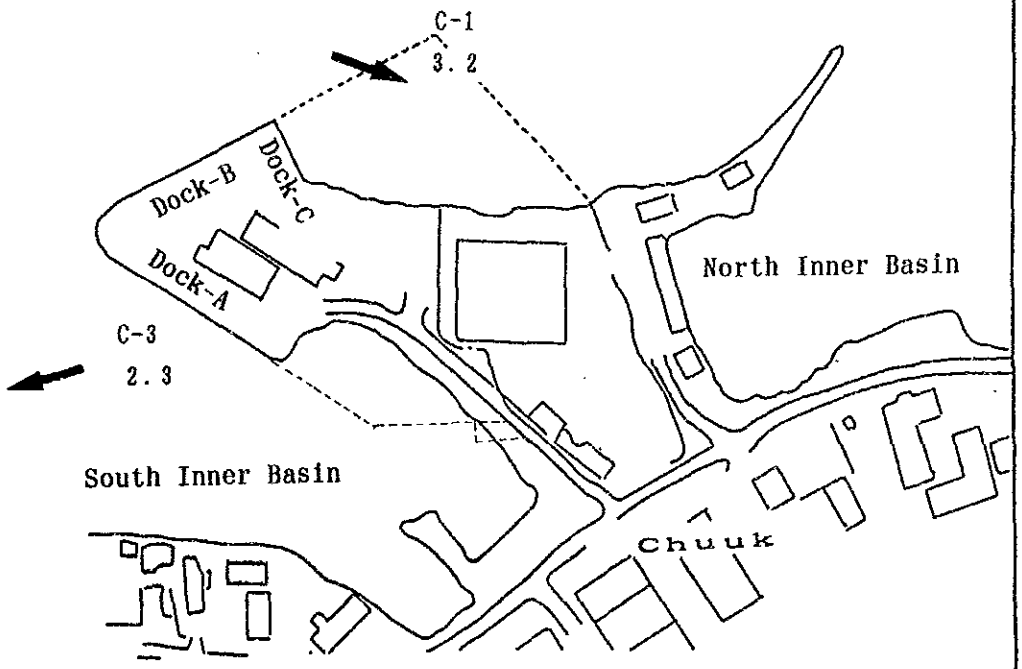


Fig. 5-2 Maximum Current Speed and Direction

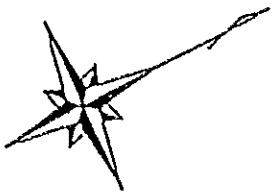
2) Spot Observation

Observations of spring tidal current at both ebb and flood tides were conducted on 26 April at six stations, to grasp the current direction and speed at upper and lower layers of water column. The maximum current speeds recorded at six stations were shown in Fig.5-3.

The maximum current speeds and directions of the flood current were 7.2 cm/sec South (S) at the depth of -1.0m (upper layer) and 6.6 cm/sec South East (SE) at the depth of 1.0 m from the sea bottom (lower layer) of offshore St.3. The maximum current speeds and directions of ebb currents at St.3 were 18.8 cm/sec West North West (WNW) at the upper layer and 12.7 cm/sec East South East (ESE) at the lower layer.

(2) Float Tracking

Float trackings were conducted on 15 April with neap tide and on 24 April with spring tide at four stations shown in Fig. 5-1. The results of floating tracking are shown in Table 5-2. The maximum tidal speed of approx. 18cm/sec and current direction of South West (SW) were recorded on both days under effect of North East Trade Wind.



Area	:	Chuuk
Tidal Time	:	Ebb Tide
Observed Layer:		-----→ -1.0m
		— ——→ B+1.0m
Time	:	26th April 1993
Beginning	:	9h 55min
Ending	:	11h 56min
Unit	:	cm/sec

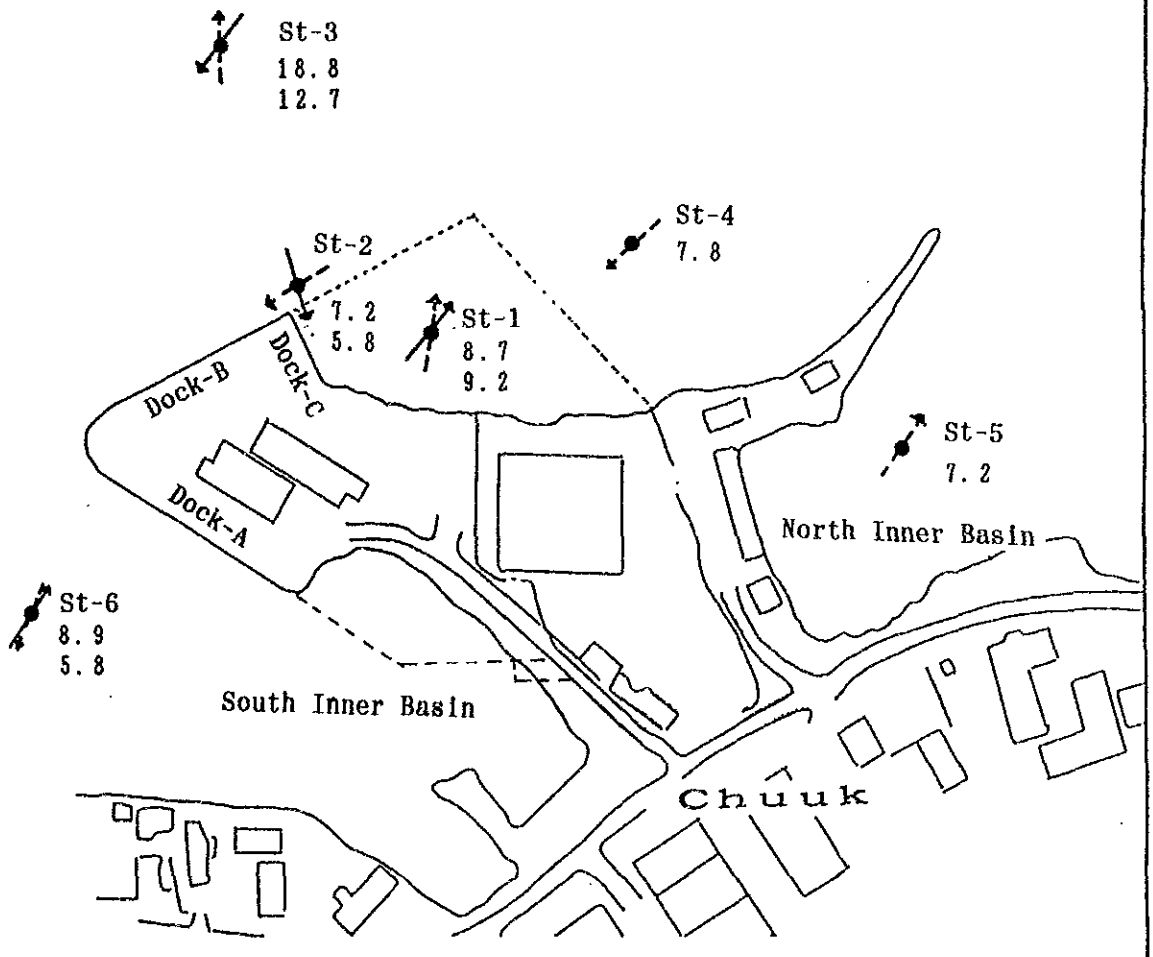


Fig. 5-3 Spot Observation

Table 5-2 Results of Float Trackings

Station	15th April 1993 (Neap Tide)			24 April 1993 (Spring Tide)		
	Observed Time	Current Direction( )	Velocity(cm/sec)	Observed Time	Current Direction(°)	Velocity(cm/sec)
St.1	09:52-10:28	240	17.5	08:30-08:50	*	*
St.2	09:42-10:11	245	17.9	09:02-10:18	225	18.5
St.3	09:27-09:48	225	15.3	08:42-10:13	236	13.5
St.6	09:40-10:08	240	14.6	08:24-08:54	*	*

* : Unable to observe due to the loss of float

5.2.2 Water Quality Survey

The water quality survey was conducted to examine the influence of implementation of the project on the water quality through grasp of the present condition of the water quality surround the construction site.

The locations of the water quality survey are shown in Fig. 5-4. The survey were conducted for the following twelves items; water temperature, transparency, salinity, dissolved oxygen (DO), pH, chemical oxygen demand (COD), sustained solid (SS), ammonium nitrogen (NH_4-N), nitrite nitrogen (NO_2-N), nitrate nitrogen (NO_3-N), total phosphorus (T-P) and turbidity. The results of the water quality survey are shown in Appendix Table A-5-4. All analyzed values were indicating good water quality conditions including Stations in Southern Inner Basin and Northern Inner Basin. Concentrations of SS in all stations were less than 0.5 mg/l (under the limit of detection).

In general, the water quality in this area was evaluated being in good condition for both inorganic and organic components.

In a rainy survey, fresh water flowing into the sea from a stream south of Mobil Tanks would affect on water quality in the surrounding area. Compared with ordinary water temperature, drop of 3.1 (St.1) to 3.8 (St.5 and St.6) degrees centigrade were observed. Values of salinity in St.5 and St.6 decreased by 3 points, respectively. There were no changes of salinity in the front area of Dock-B and Dock-C, but remarkable changes of salinity in the front area of the stream were observed. For example, there were more than 10 points of decrease of salinity near the wreck on the south shore of the stream. The change of turbidity was incorrelative with the change of salinity, decrease of salinity meaning increase of turbidity.

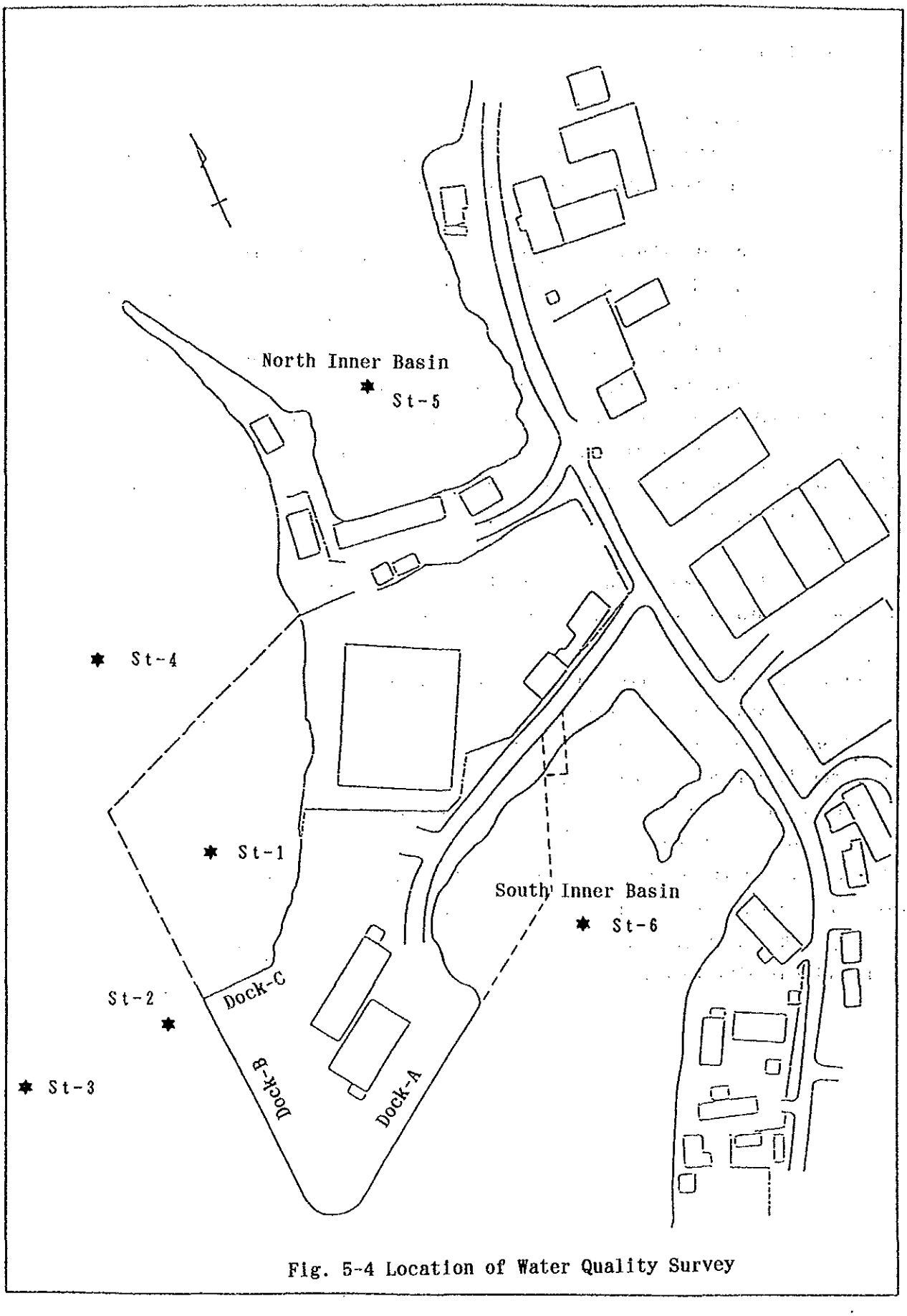


Fig. 5-4 Location of Water Quality Survey

5.2.3 Marine Sediment Quality Survey

Marine sediment survey were performed at eight stations (Fig. 5-5) and the results are as shown in Appendix Table A-5-5.

Sulfide concentration was relatively high with 0.06 mg/g (dry weight) at St.6 located in South Inner Basin. The concentrations of sulfide and other analytical items in all other stations were relatively low. Therefore, bottom sediments of this survey area were evaluated mostly as non-pollutional sediments.

Grain size of sediment at St.6 was finer than in all other stations, and the components were mainly fine sand, silt and mud. This indicates that current speed in the South Inner Basin is slower than in surrounding areas.

The results of test for poisonous constituents at St.7 and St.8 indicated that there were no sign for poisonous materials in marine sediment.

In addition to the results, all stations excluding St.6 have sediments characterized by relatively coarse surface sand composed of the calcareous dead thallophyte of Halimeda spp.

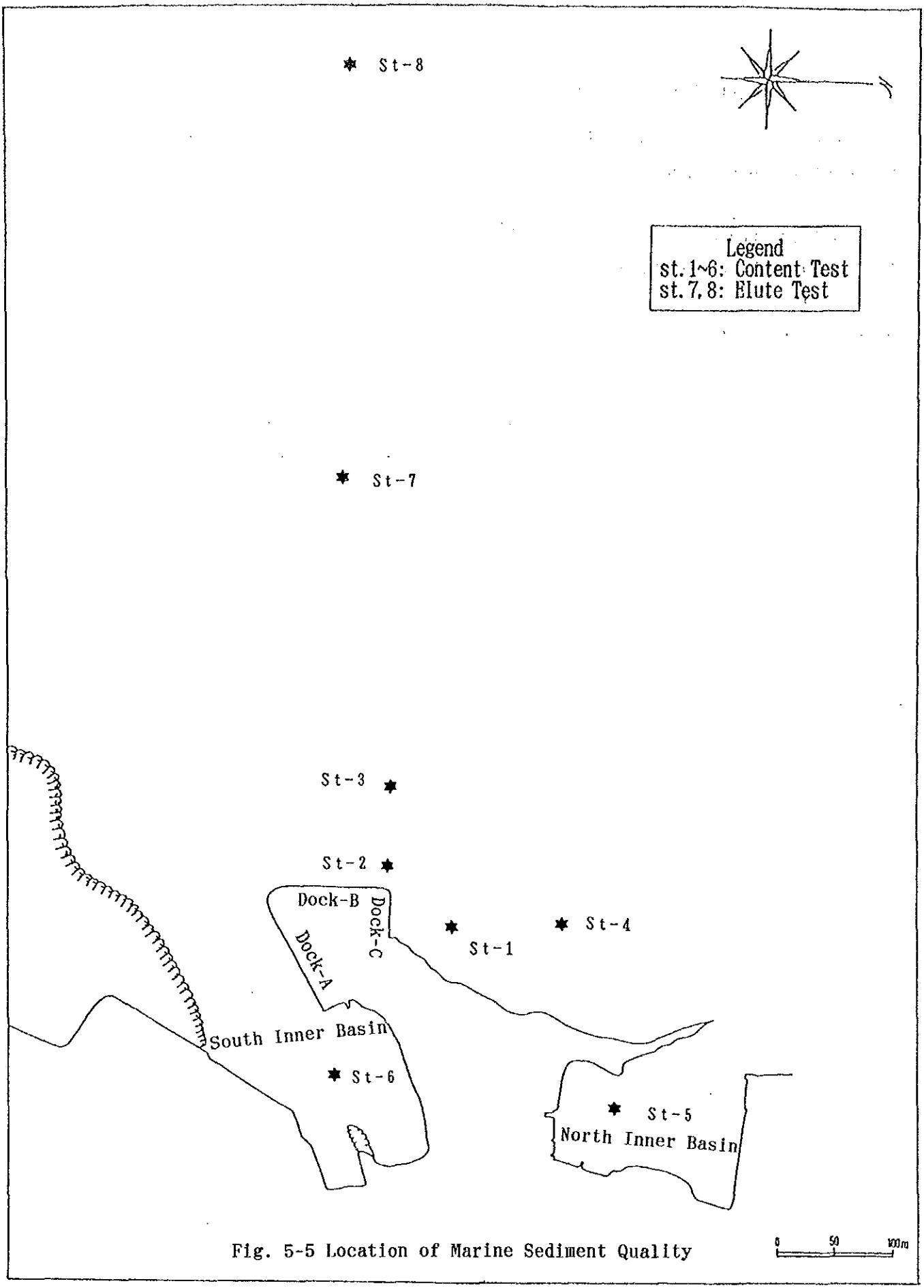


Fig. 5-5 Location of Marine Sediment Quality

5.2.4 Marine Biological Survey

Marine biological survey were performed to obtain information on marine lives, especially corals and rare species. The survey consists of general survey by visual inspection method and by detail survey in the survey area as shown in Fig. 5-6.

(1) General Survey for Marine Organisms

The general survey using the manta method (see Appendix Fig. A-5-1(1) was taken to grasp the high coverage areas of corals and algae and the high population density area of megarobenthos along the shoreline from the airport to Dock-B of Weno port. These results are shown in Appendix A-5-6.

High coverage area of corals (more than 50 % of the coverage/10 m x 10 m) has not been observed, but the branch Acropora and the massive Porites corals have been observed as a high coverage species at several points. Less than 5% coverage of the corals has been observed at most of the survey area.

High coverage areas of algae and sea grass (more than 50% coverage/ 10 m x 10 m) have not appeared in the study area. Halimeda incrassata f. incrassata on the sandy bottom and the other species belonging to the genus Halimeda on the gravels and the rocks were the dominant algae species in the study area.

The dominant species of the megarobenthos was Holothuria (Halodeima) atra on the survey line from the west mouth of the North Inner Basin to Dock-B.

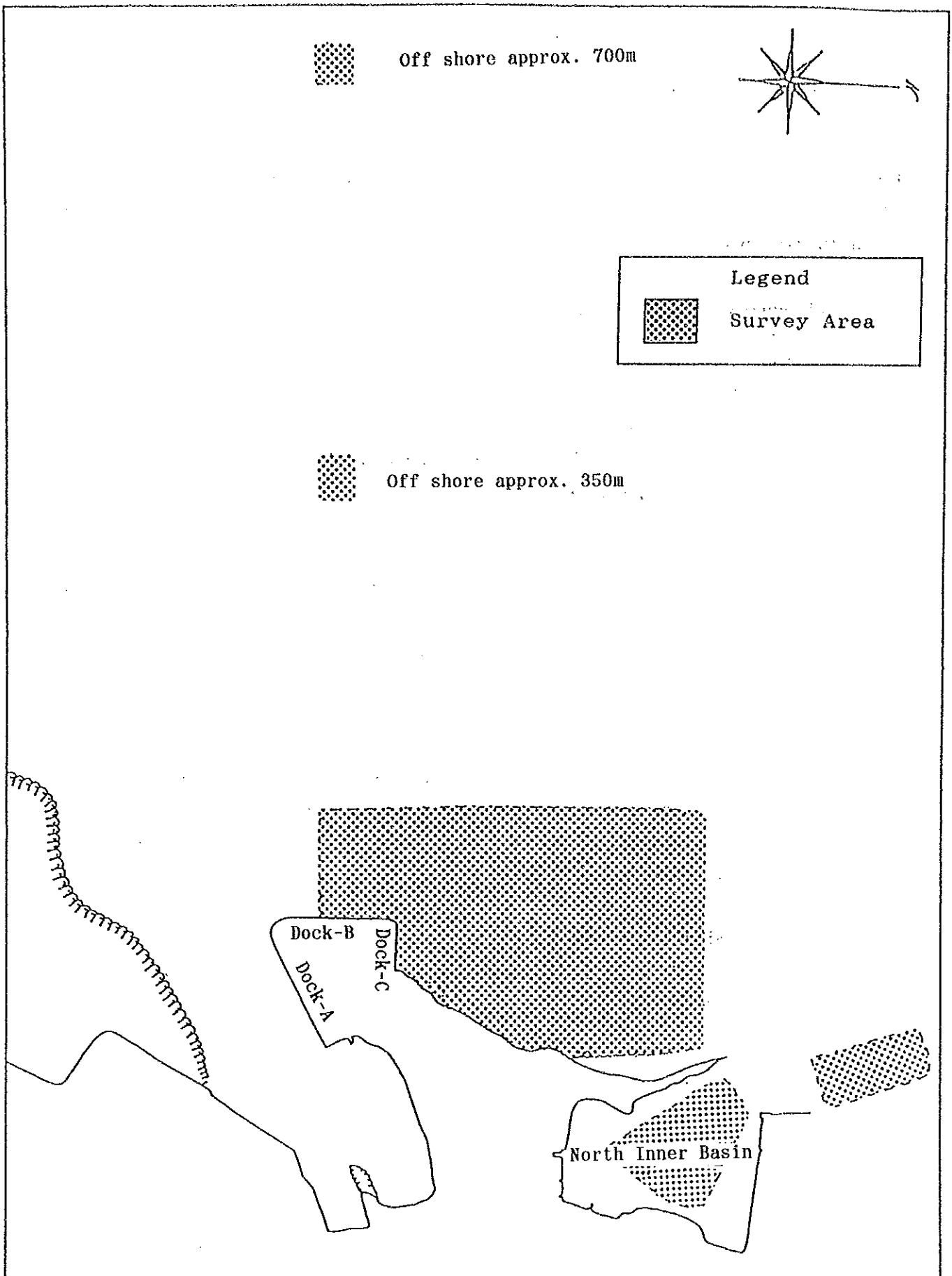


Fig. 5-6 Location of Marine Organization Survey

(2) The Detail Survey for Marine Growth

The visual observations in the quadrat (50 cm x 50 cm) for corals, algae, sea grass and megarobenthos were performed at five study areas (see Appendix Fig. A-5-1(2). The macrobenthos survey was also taken at six stations of the marine sediment quality survey with regards to the grain size distribution, ignition loss and sulfide concentration. The results of the corals and macrobenthos survey are shown in Appendix Table A-5-7.

The underwater-photographs of the main inhabitant species are shown in Appendix Fig. A-5-2.

1) The North Inner Basin

In the North Inner Basin, algae, sea grass and megarobenthos were scarcely appearing at the muddy sand bottom along passage of boats in the basin.

Coral coverage outside of the quadrats was mostly less than 1 %, and coral coverage inside the quadrat was 5%. The coral species inside the quadrat was Porites solida.

Algal coverage were more than 60 % and appearing algal species were Halimeda spp., Caulerpa racemosa var. laetevirens, Neomeris annulata, Padina minor and Dictyota sp. at both outside and inside of the quadrats. The megarobenthos species appearing in both the inside and outside quadrats were Holothuria (Halodeima) atra and Stichops chloronotus.

2) The Front Area of Dock-C

There were shadowy area that look like rocks or corals and white area that look like sand. In fact, white area were the sandy bottom, but shadowy area were mostly the aggregation of gravels made from the branch of Acropora formosa.

Coral coverage outside of the quadrats was mostly less than 5 %. Acropora formosa, the table Acropora and the massive Porites were appearing at the coverage of 50 % or more in the quadrats. Pocillopora damicornis, Seriatopora hystrix, Acanthastrea sp., Pseudosiderastrea tayamai and so on were observed with low coverage in the quadrat.

Algal coverage in the quadrats set on the aggregation of gravels made of dead branch Acropora and on the coral rocks were mostly more than 50 %. The dominant algal species were Halimeda spp. in these quadrats. The other species observed in this area were Padina minor, Dictyota sp., Halimeda incrassata f. incrassata and so on. There were few aggregations of gravels made of dead branch Acropora, mostly covered by Halimeda spp. Algal coverage on sandy bottom were mostly less than 10%.

The dominant species of megarobenthos were Discosoma sp. observed as a large colony at the limited area. The other species observed commonly in this area were Holothuria (Halodeima) atra, Stichopodidae sp., Polycarpa aurata, Lopha cristagalli, Streptopinna saccata and Lambis lambis.

3) The Front Area of Dock-B (Inshore)

Sea bottom was sandy near Dock-B, and it seemed that the bottom had been dredged.

Coral coverage outside of the quadrats were mostly less than 1%. Coral coverage in the quadrats were 10 % consisting of the massive Porites, Favia laxa and Goniastrea pectinata.

Dominant species of algae was unknown microscopic and filaments species. Algal coverage of the relatively larger species were mostly less than 1 %. The observed species were Halimeda macroloba, Halimeda incrassata f. incrassata, Padina minor, Neomeris annulata, Udotea sp. and so on. There was a tendency of decreasing algal coverage with depth.

The megarobenthos species were Synapta maculata, Didemnum (Didemnum) molle and Terpios sp. in the quadrats.

4) The Turning Basin Area in front of Dock-B (Offshore)

Survey were taken place at 350 m and 700 m offshore points from Dock-B. Both places were sand bars with a depth of approximately - 10 m and had similar sceneries. These two positions were also the two stations of marine sediment quality survey for the elute test of poisonous constituents.

Coral coverage on rapid area were more than 80 %, and the observed coral species compositions of the two positions were mostly identical. The dominant coral species were Acropora formosa, Porites cylindrica and the massive Porites.

The observed species of megarobenthos were Holothuria (Halodeima) edulis, Holothuria (Halodeima) atra, Linckia laevigata, Polycarpa aurata and so on.

5) Macrobenthos Survey

The macrobenthos (remainder after sieving of 1 mm) were abundant at St.5 set on the bottom in the North Inner Basin. The observed species were Amphistegina radiata and Marginopora vertebralis belonging to Foraminifera and Pisione sp., Sphaerosillis sp., Spioniidae sp. belonging to Polychaeta and a unknown species belonging to Archaiannelida.

Living macrobenthos Foraminifera were seen at St.5 and St.3 set on the bottom in the front area of Dock-B but were very small in numbers. On the other hand, the shells of Foraminifera were seen at all 6 stations. Polychaeta and other macrobenthos group were also rarely seen at the stations. For Polychaeta, the observed species were characterized by the surface-living group, tiny species and clean environmental living group.

5.2.5 Survey for Explosive Objects

Survey for bombs and shells at sea bottom were conducted by visual inspection, and no such objectives were discovered in underwater observation near the boring test points. However, due to the large numbers of Japanese wreck sunk in the Truck Lagoon during World War II, there remains a possibility of hazards to exist under sandy sea bottom being covered by marine growth which make them even more difficult to be discovered.

Therefore, in execution stage of this project, a more detailed survey using magnetic detector will be needed.

5.3 Environmental Consideration

5.3.1 Environmental Impact Factors

It can be expected that there will be little change of social activities surrounding the project site resulting from the implementation of the project, since it is just a expansion of the existing port.

Three factors on environmental impact are considered to require more detailed consideration as follows;

(1) Currents: Current may subject to change after completion of this project because of change of shape of the shoreline.

(2) Water quality: Water quality may be effected during construction, land reclamation and dredging for expansion of the docks because of occurrence of turbid water and eluted poisonous materials.

(3) Marine organisms: Marine life may be influenced by construction, land reclamation and dredging for expansion of the docks.

5.3.2 Preliminary Environmental Assessment by the Study Team

(1) During Construction

1) Water Quality

Dispersion of poisonous materials contained in sea bed due to dredging works and dispersion of turbid water originating from construction works were investigated by the Study Team.

In regard to poisonous substances, all investigation records were below standard permissible values for the marine sediments, and no problem is expected.

For dispersion of turbid water, there will be possibility of some turbidity occur in the surrounding water of work area during construction though sea bed sediment consist of non silty coarse sand. Even in case when turbidity occurs under construction, dispersion of turbid water will be restricted in a small area, because of the relatively slow current speed (approx. 5cm/sec) in the surrounding area.

For the above reasons, effects of turbidity during construction can be considered not serious, yet provision of silt protector curtain will be required in specification to prevent dispersion of turbid water.

2) Marine Organisms

As factors influence on marine lives in the project site and surrounding areas, removal of benthos by dredging, burying of habitat of benthos by reclamation and influence of turbidity on corals living in the surrounding area were studied.

For removal and burying of habitat of benthos due to construction, only little effect considered on benthos population because of relatively small area of construction, relatively low coverage of coral and algae, relatively low diversity of benthos species and the existence of plenty of similar species in surrounding area.

The turbidity to be caused by this construction will hardly have affect on benthos living in the area because of the low coral coverage, low species diversity in the planned area and taking counter measures such as a silt protector curtain to protect marine resources and marine environments.

(2) After Completion of the Project

1) Current

As for influence on sea current after completion of works, changes of land shape due to the dock works and reclamation and dredging were examined.

Influence to be caused by the reclamation work will not be significant since reclamation area is small, since the reclamation land area is closely adjoining to existing docks and located in bay between the existing dock and the tip of west mouth of the North Inner Basin, and also sea current velocity is very low (approximately 5cm/sec).

As the dredging area is limited, the current near the dredging area will not subject to change significantly, and such change will not affect the present current patterns in this area.

As conclusion, influence on current to be caused after completion of this project will not be significant.

2) Water Quality

As there is no water polluting material included in the project, no any influence on the water quality around the reclamation area is expected.

3) Marine lives

As mentioned above, influences on current and water quality to be caused by the dredging and reclamation work are negligible. Therefore, significant influence on marine lives in this area are not expected.

5.4 Measures for Environmental Protection

Influence on the ecosystem of the project site is evaluated to be not significant for reasons mentioned above. However, such environmental protection measures can be best advisable for this project as provision silt protector curtain around the dredging site, monitoring of water turbidity during the work, safety management for workers under construction and environmental education for workers before construction.

Periodic inspections and appropriate guidance by the concerned proponent officials also will be the most effective measure for working people of the project to keep orderly system for environmental protection.

CHAPTER 6

BASIC DESIGN

CHAPTER 6: BASIC DESIGN

6.1 Policy for Basic Design

Basic design for this project facilities are worked out and presented in this chapter, basing on engineering study utilizing the results of analysis of data and information collected by the site survey.

The followings are policies observed in the basic design of the Weno Harbor Extension Project, to improve operational efficiency and maneuvering safety of Weno Port, which is the real lifeline port of Chuuk State.

1) To facilitate international marine transport and inter-state and intra-state navigation activities in Weno Port.

2) To consider integration of the facility layout plan of the project with the Port Master Plan.

3) To coordinate expansion of port facilities with increase of the number of ship calling and the cargo.

4) To minimize the construction cost and period through the consideration of local condition and local technical skill.

5) To minimize disturbances due to construction works on daily port operation

6) To organize project plan so as to provide opportunity of participation for local society and local economy of Chuuk State and FSM in implementation stage of the project, by as much as possible utilization of local construction capability and local materials.

7) To design the project facilities to be easier in maintenance in consideration of natural and social condition of the project site.

8) To design the project facilities basically with Japanese system in respect to engineering and technical codes and standards.

9) To implement the project in conformity with laws and regulations of FSM on environments.

6.2 Basic Design of Project Facilities

6.2.1 Work Items of the Project

The project items taken up in this report are as prescribed in Chapter 4. The scope and scale of each detailed item are as already presented in Chapter 4 also, and they are reorganized and categorized by site location in this chapter, so as to constitute sets of works in group as given below:

Work Items of the Project

Facilities		Size/quantity
1. Dock-A Reformation Works		
* Rehabilitation of Dock-A	design depth -9 m	93 m
* Extension of Dock-A	design depth -9 m	60 m
* Small dock with ramp along return wall	design depth -4.5 m	50 m
* Dredging of mooring basin	design depth -9 m	approx. 32,000 m^3
2. Dock-B Extension Works		
* Extension of Dock-B	design depth -9 m	92 m
* Small dock along return wall	design depth -5 m	50 m
* Dredging of mooring and turning basin	design depth -9 m	approx. 73,000 m^3
3. Container Facilities Works		
* Yard Area Improvement		approx. 8,800 m^2
* Revetment		60 m
* Ancillary facility		
Drainage		210 m
Flood lighting		5 nos.
Reefer power		2 nos.
Fence and gate		Fence 20 m and gate 1 no.
4. Navigation Aids Works		
* Repair of markers		6 lighted markers
* Markers on border of turning basin for Dock-B		2 lighted markers
* Light beacon for approach to dock		1 lighted aid

6.2.2 Selection of the Type of Quaywall Construction

(1) Conditions of the project location

In the Weno Harbor Extension Project, the type of quaywall structures of Dock-A reformation works and Dock-B extension works are selected on the basis of the following conditions.

1) Natural Conditions

a) Foundational Sea bed layers

The foundation sea bed layers of Dock-A and Dock-B relatively are loose, mainly consisting of large depth of strata of medium to weak silty sand.

b) Waves

Though sea at Dock-A are mostly calm facing the South Inner Basin, water area in front the dock is narrow. Since Dock-B faces west and north, attack of strong waves are feared inevitable in westerly wind season (August through November).

2) Execution conditions

a) Dock-A

Since the existing portion of Dock-A has been already badly deteriorated, construction methods not to lose structural stability of the dock shall be adopted for the rehabilitation works. And also land space behind the Dock-A for construction works is restricted by the existing transit shed.

b) Dock-B

Since backfilling works in behind the extending Dock-B takes long time, very high attention is required for safety of quaywall under construction against sea wave force in front.

c) Type of quaywall of the existing Docks

The existing Dock-A and Dock-B structures were constructed in anchored sheet pile wall type.

(2) Selection of quaywall construction

For quaywall construction, gravity type structure such as concrete caisson or concrete blocks, sheetpile wall type and pile mounted platform type are compared as shown in Table 6-1. Considering the site conditions, sheet pile wall is selected to be best suitable in this site.

(3) Selection of type of sheetpile structure

For most of sheetpile wall structure for this project, instead of conventional anchored steel sheetpile wall with tie-rods and anchor piles, sheetpile wall with battered anchor piles are adopted in consideration of the site conditions. Table 6-2 shows the reason of selection of type of sheetpile structure for each location respectively.

In this type of construction, row of batter piles are required to be installed first, and then sheetpile are allowed to be installed on condition that heads of driven sheetpile to be fixed to head of batter pile row as soon as possible.

Table 6-1 Selection of Type of Quaywall Structure

	Gravity Type (Concrete Caisson, Concrete Blocks, etc.)	Sheetpile Wall Type	Pile Mounted Platform Type
Natural Conditions	* In case of soft bed layer, foundation improvement is required. * This structure increase in weight and construction cost at deep water depth. * The structure is stable against waves.	* This type is suitable even for relatively soft bed layer. * In case this structure is feared subject to wave attack during construction, anchoring system of batter piling is more stable than than tie-rod.	* This type applicable for relatively soft bed layer. * Platform may be easily damaged by wave force, and not applicable for Dock-B
Execution Conditions	* In case of concrete caisson large scale construction facility is required for manufacturing. * In case of concrete blocks, large manufacturing yard is required. * Construction requires long time, and not suitable for this particular project.	* Advantage of this type is faster speed in construction and less requirements of mobilization of construction facilities.	* In case of the narrow area such as Dock-A, Construction space is limited and not applicable.
		adopted	

Table 6-2 Selection of Type of Steel Sheetpile Wall

Work Item		Type	Reason
Dock-A	Rehabilitation	Batter Pile Anchor Type	* Special considerations are paid for safety of the existing quay wall structure and the transit shed structure during construction works. In this connection, to avoid excavation of ground soil in front of the transit shed for the purpose of installation of new tie-rods and new anchors piles, batter pile anchors in row just in behind the existing sheetpile wall is adopted in design. * Even in case the construction space in behind the sheetpile wall is narrow, this type of construction is possible.
	Extension and Return Wall	Conventional Tie-rods Type	* Wave condition is comparatively calm at this site, and there are no space restriction for installation of tie-rods and anchors piles. Therefore, conventional steel sheetpile walls with tie-rods and anchors piles are designed.
Dock-B	Extension and Return Wall	Batter Pile Anchor Type	* Since all quay wall structures in this area are feared subject to wave attack during construction period, stability of quay wall structures under construction is very important. Tie-rod type sheetpile wall generally take long time for getting stability with completion of backfilling. During construction tie-rod type sheetpile wall might be suffered serious damage from wave forces. To solve that problem batter pile anchored system is adopted. * This type of construction is comparatively easy for control of construction in regard to safety of works during construction.

6.2.3 Dock-A Reformation Works

Dock-A Reformation Works consist of four sub-items of

1) Rehabilitation of the existing quay-wall
2) Extension of quaywall toward east
3) Small vessel dock with ramp along return wall
4) Dredging of mooring basin

and they are layouted as shown in Fig. 6-1.

They are designed on the basis of following conditions:

(1) Vessel Size for Design

Though the main service of Dock-A is intended to accommodate two Intra-State boats simultaneously, occasional service to accommodate international container cargo vessels of up to the maximum 10,000 DWT class are also taken into consideration for this berth, especially in westerly windy season of August through November each year, as an alternate berth for Dock-B.

Vessel size for design are assumed as below:

	International cargo vessel	Intra-state boat
Dead Weight Tonnage	10,000 DWT	880 DWT
Overall length	137 m	56.4 m
Width	19.9 m	10 m
Draft	8.5 m	3.8 m

(2) Design Requirements

1) Design Water Depth : - 9.0 m (C.D.L.) for Dock-A wall front
- 4.5 m (C.D.L.) for Return wall front

Note: Full loaded draft of 10,000 DWT vessel is -8.5 m, and 0.5 m allowance of bottom clearance is added for Dock-A Design

2) Apron elevation : + 3.3 m (C.D.L.) along pier-head line

Note: The same as the present apron elevation of Dock-A

3) Design Surcharge Load: 3.0 t/m^2 at normal condition
1.5 t/m^2 at seismic condition

Note: 3.0t/m^2 is equivalent to stacking of three tiers of full charged containers

4) Seismic force : 0.1G static
Intensity of earthquake are pressured on the basis of data in surrounding area as given in Appendix 4(3).

5) Tide : H.W.L. +0.78 m
L.W.L. +0.44 m
C.D.L. $\pm$ 0.00 m
Residual water pressure : +0.5 m(C.D.L.) at low tide

6) Apron Width : 20.0 m (Extension of Dock-A)
10.0 m (Return wall)

Note: The same as the present width of Dock-A

7) Soil condition :

a) Rehabilitation of Dock-A

Angle of internal friction (Ø) of sea bottom soil layer is set at 30° as this is the existing portion of Dock-A.

b) Extension of Dock-A and return wall

Angle of internal friction (Ø) of sea bed soil layer is set at 25°. As back filling material behind the quaywall is planned to use rubble stone, angle of internal friction (Ø) is set at 35°. Land side beyond back filling is to be reclaimed by dredged soil disposition.

8) Ancillary facilities

a) Fender system

Rubber fenders are to be installed in front of the quaywall.

b) Curbing

Concrete curbings are to be installed at the top of coping concrete.

c) Mooring posts

35 ton bollards are to be installed at 25 m interval. 100 ton bitt are to be installed at west and east end of Dock-A respectively.

(3) Basic Design

1) Dock-A Rehabilitation Work

a) Dimensions: -9.0 m deep, 93 m long

Note:

The length of obsolete portion of Dock-A is 91 m, and adding 2 m of the approach at western end of Dock-A, the entire rehabilitation length is 93 m.

Water depth in front of the existing Dock-A is already -8.4 m, and to accept design size container cargo boats only 0.6 m deepening excavation is required.

b) Type of construction:

Steel sheetpile wall anchored at top directly to a row of batter piling is designed for this quaywall work.

In basic design, new steel sheetpile wall is designed to be installed enclosing the existing old sheetpile wall, just in front of the existing damaged sheetpile wall, since they are already very badly deteriorated beyond repair after almost 30 years' long services.

To support new sheetpile wall, special type of construction is adopted with provision of a row of anchoring batter piles to be driven just in behind the existing old sheetpile wall, so as that rehabilitation work not to make any harmful effect on the existing transit shed.

Typical cross-section of the wall is shown in Fig. 6-2.

2) Dock-A Extension Work

a) Dimensions: -9.0 m deep, 60 m long

b) Type of construction:

Conventional type of anchored steel sheetpile wall with tie-rods and anchor piles is designed for this extension length, since this work is an ordinary sheetpile work for a new wall installation.

Typical cross-section is shown in Fig. 6-3.

3) Small vessel dock and ramp (along East return wall)

a) Dimensions. -9.0 m to -4.5 m deep, 50 m long for return wall;
-4.5 m deep and +1.0 m high at ramp tip; and
10 m width at ramp slope.

b) Type of construction

All walls are designed in conventional anchored steel sheet-pile wall, as typical cross-sections is shown in Figs. 6-4 and 6-5.

4) Water Basin

Water area in front of Dock-A is designated as the mooring basin for Dock-A, and designed to be dredged to - 9.0 m depth. However, the bottom dredging work shall be limited not to be within 40 m distance from the opposite shore line.

Layout of Dredging Area is shown in Fig.6-10.

Dredged soil is planned to be disposed in designated damp area for Dock-A extension works and for reclamation of container yard expansion works.

6.2.4 Dock-B Extension Works

Dock-B extension works consist of four sub-items of

a) Extension of quaywall toward north
b) Small vessel dock along Return Wall
c) Repair of existing quaywall
d) Dredging of mooring and turning basin

and their layout plan is as shown in Fig. 6-1.

They are designed on the basis of following conditions:

(1) Vessels Size for Design

Main service of Dock-B is intended for accommodation of international large size container cargo vessels of up to the maximum 10,000 DWT class.

Small vessel dock is intended to serve for Intra-state and Inter-state service boat operation, making use of deep portion of revetment wall along the north return wall at north end of the extended Dock-B.

(2) Design Requirements

1) Design Water Depth: - 9.0 m (C.D.L.) for Dock-B front
- 5.0 m (C.D.L) for small dock front

Note: Full loaded draft of 10,000 DWT container vessel is -8.5 m, and 0.5 m allowance of bottom clearance are added for Dock-B design.

2) Apron Elevation: +3.3 m (C.D.L.) along pierhead line

Note: The same as the present Dock-B elevation

3) Design Surcharge Load: 3.0 t/m^2 at normal design
1.5 t/m^2 at seismic design

Note: 3.0 t/m^2 loading is equivalent to three stack of fully charged containers.

4) Seismic Condition: 0.1G static

5) Tide : H.W.L. +0.78 m
L.W.L. +0.44 m
C.D.L. $\pm$ 0.00 m
Residual water pressure : +0.5 m (C.D.L.) at low tide

6) Apron width : 20 m (Extension of Dock-B)
10 m (Return wall)

7) Soil condition :

Angle of internal friction (Ø) of sea bed soil layer is set at 30^{0}. As back filling material behind the quaywall is planned to use rubble stone, angle of internal friction (Ø) of sea bottom soil layer is set at 35^{0}. Land side beyond backfilling is to be reclaimed by dredged soil disposition.

8) Ancillary facilities

a) Fender system
Rubber fenders are to be installed in front of the quaywall

b) Curbing
Concrete curbings are to be installed at the top of coping concrete

c) Mooring posts
35 ton bollards are to be installed at 25 m interval. 100 ton bitt is to be installed at north of Dock-B.

(3) Basic Design

1) Dock-B Extension Work

a) Dimensions: - 9.0 m deep, 92 m long

b) Type of construction:

Steel sheetpile wall anchored at top directly to a row of heavy section batter pilings is designed for this quaywall work.

In this particular location, during construction, sheetpile wall might subject to strong wave force on front face before and during backfilling work, and it also subject to earth pressure from behind when back filling work progresses.

This selected type of quaywall structure is stable against two way lateral forces of back and forth, and such precaution for safety of structure during construction are strongly required in this quaywall work.

Typical outline cross-section of the wall is shown in Fig. 6-6.

2) Small vessel dock

a) Dimension: -9.0 to -5.0 m deep, 50 m long

b) Type of construction:

Also similar to Dock-B, steel sheetpile wall anchored at top directly to a row of batter pilings of heavy section is designed for this quaywall work.

Similarly as in case of Dock-B extension work, Dock-C construction work requires precaution for safety of structure during construction work.

Typical outline cross-section is shown in Fig. 6-7.

3) Repair of existing Dock-B

As all the fenders are missing, new rubber fenders are to be installed in front of the existing quaywall. Also a part of existing concrete curbing is to be repaired.

4) Water Basin

Water area within 420 m diameter in front of Dock-B is designated as the mooring and turning basin for Dock-B, and sea bottom inside the mooring and turning basin is designed to be dredged to -9.0 m depth.

Dredged soil is designed to be disposed in designated damp area for reclamation of container yard expansion.

Dredge area layout plan is as shown in Fig.6-10.

6.2.5 Container Yard Works

Containerization works consist of three sub-items of

1) Northern revetment works
2) Area development works
3) Ancillary facilities

and their layout plan is as shown in Fig.6-1.

They are designed on the basis of following conditions:

(1) Containers in this Port:

Containers to be unloaded here are 20 feet and 40 feet class containers filled with foods, construction materials, various kinds of equipments and machineries transported from U.S. west coast and Pacific countries. Some of containers are refrigerator type requiring power supply. Discharged empty containers are shipped out on board container boats.

(2) Design Requirements:

1) Size and weight of Containers: 20 feet, maximum loaded weight 20 ton
40 feet, maximum loaded weight 30 ton

2) Number of containers to be stored: maximum 200 pcs

3) Stack height of containers: maximum 3 tiers

(3) Basic Design

In the water area in behind the Dock-B extension, adjacent to north side of present container yard, dredged soil disposal area is designated to damp in dredged materials from Dock-A and Dock-B water basin deepening works.

After filling up the disposal area, new land area of approximately 5,700 m^2 will be acquired here. By utilization of this newly developed land area, combining to the existing container yard of approximately 3,500 m^2, total area of newly developed container yards will be 9,200 m^2 wide.

Some ancillary works are required in design to complete this project item .

1) Northern Revetment Works

Along the extension line of the new northern small dock, reclamation land requires 60 m long revetment to protect the land area from wave action during westerly windy season.

The 30 m long deeper section at west of the revetment is designed in steel sheetpiling wall with a row of anchoring batter piles as in the small dock, to avoid damage due to wave during construction.

Remaining eastern 30 m long shallower section is designed in rubble mound revetment.

The crown elevation along face line of the revetment is +3.3 m (C.D.L.). As the Design wave height for rubble mound is 1.9 m, the required weight of armor stones of the revetment is calculated at 1.0 t.

Typical cross-section of structures are as shown in Fig.6-8, 6-9.

2) Container Yard Works

In the new container yard area of 9,200 m^2, surface of 8,880 m^2 of yard area is to be improved with gravel compaction, except for area behind the existing Dock-B where concrete pavement is already executed as the apron.

Since some settling down of ground is feared to occur in the newly reclaimed area, surface of the container yard is designated to be provided with crushed gravel compaction improvement. Average land elevation is designed at +3.4 m.

Also provision of drainage (210 m long) to cope with heavy rainfall, and five flood lightings for night cargo operation are included in design.

3) Ancillary facilities

Two refrigerating container stands with electric power outlets and KWH meter for refrigerating containers are included in design.

6.2.6 Navigation Aids Works

Navigation aids works consist of three sub-items of

(1) Lighted shoal markers along entrance passage from the Northeast Pass

(2) Lighted markers on boundary of dredged turning basin

(3) Light beacon for approaching Dock-A and Dock-B.

and their layout plan is as shown in Figs. 6-10 and 6-11.

(1) Basic Design

1) Navigation aids on the entrance passage

Along passage, six shoal markers with solar powered light are included in basic design.

2) Turning basin markers

Two lighted markers are provided in basic design to indicate northern end of the dredged turning basin area in front of Dock-B.

3) Light beacon on Dock-A and Dock B

A light beacon to indicate direction for Dock-A and Dock-B is included in basic design for a ship approaching and installed in the vicinity of TRANSCO warehouse.

(2) Type of Construction

* Marker No.2 : H-shaped steel pile with 3 m long is to be added to the existing steel pile and platform with lantern is to be installed on the top of the added pile.

* Marker No.4 : A lantern is to be installed on the existing platform.

* Marker No.6 : H-shaped steel pile is to be driven into the sea bottom and a lantern is to be installed at the top of the pile.

* Marker No.8 : -ditto-

* Marker No.10: -ditto-

* Marker No.11: -ditto-

* Two markers on border of turning basin : -ditto-

* Light beacon for approach to dock : H-shaped steel pile is to be erected on concrete base and a lantern is to be installed at the top of the pile.

Typical design are shown in Fig. 6-12.

6.3 Design Drawings

Design layout plans and typical cross-section or design for main facilities in this project are given in following figures.

Fig. 6-1 Layout Plan of Extension of Docks
Fig. 6-2 Typical Cross-section of Rehabilitation of Dock-A
Fig. 6-3 Typical Cross-section of Extension of Dock-A
Fig. 6-4 Typical Cross-section of Small Dock along East Return Wall
Fig. 6-5 Typical Cross-section of Ramp
Fig. 6-6 Typical Cross-section of Extension of Dock-B
Fig. 6-7 Typical Cross-section of Small Dock along North Return Wall
Fig. 6-8 Typical Cross-section of Revetment of Container Yard (Steel Sheetpile Type)
Fig. 6-9 Typical Cross-section of Revetment of Container Yard (Rubble Mound Type)
Fig.6-10 Plan of Dredging Area and Navigation Aids
Fig.6-11 Plan of Navigation Aids (Entrance Channel)
Fig.6-12 Typical design of Navigation Aids

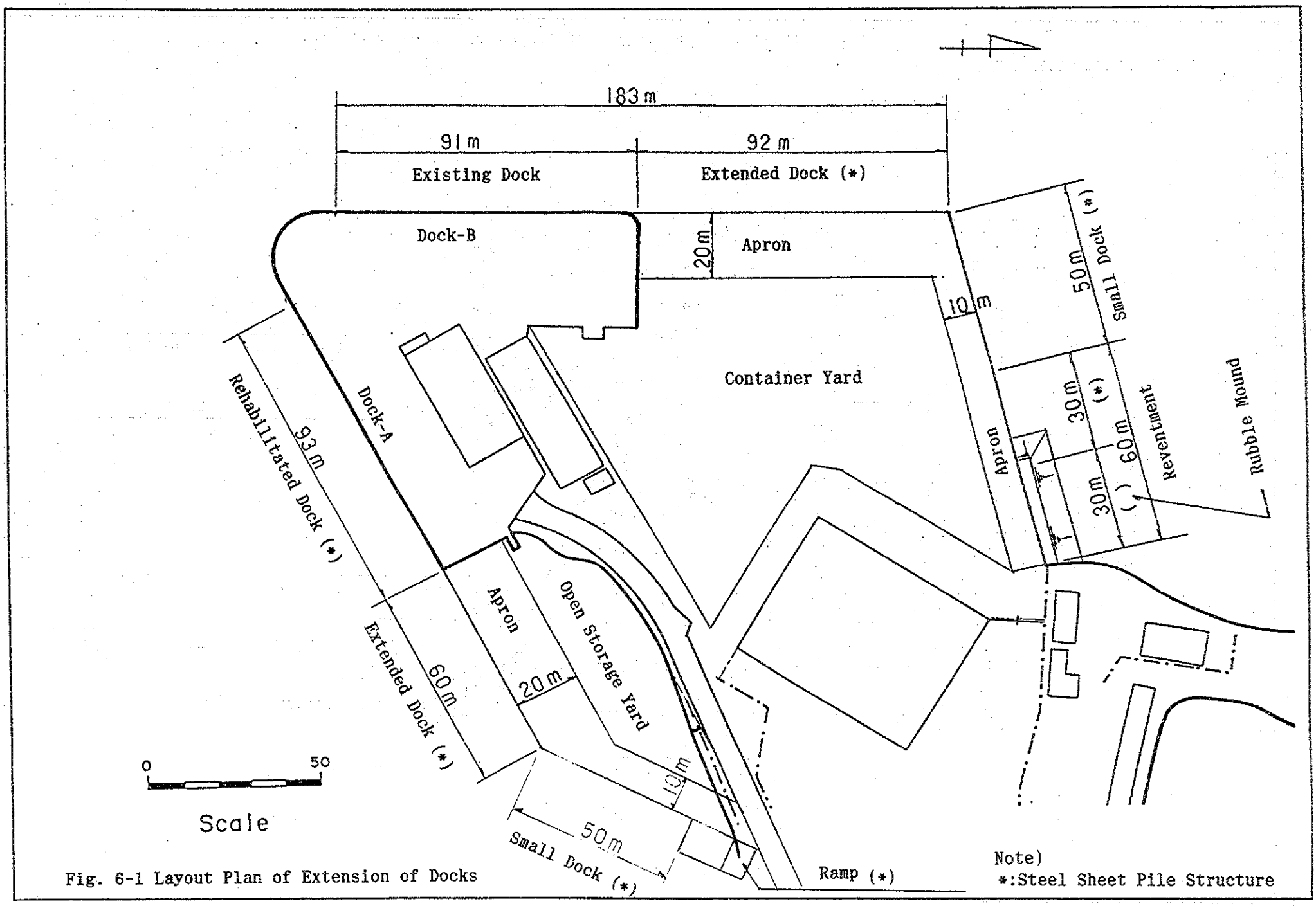


Fig. 6-1 Layout Plan of Extension of Docks

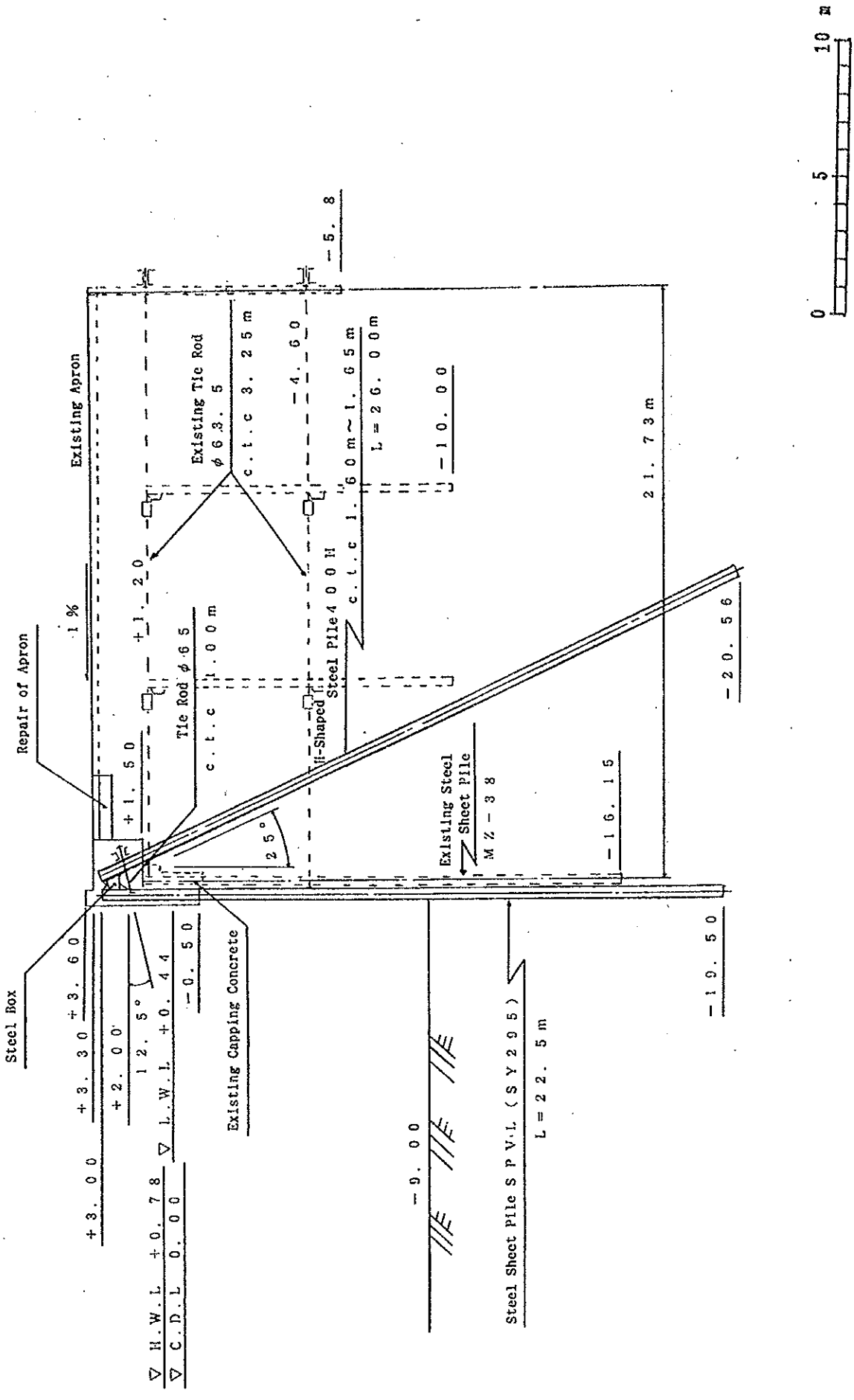


Fig. 6-2 Typical Cross-section of Rehabilitation of Dock-A

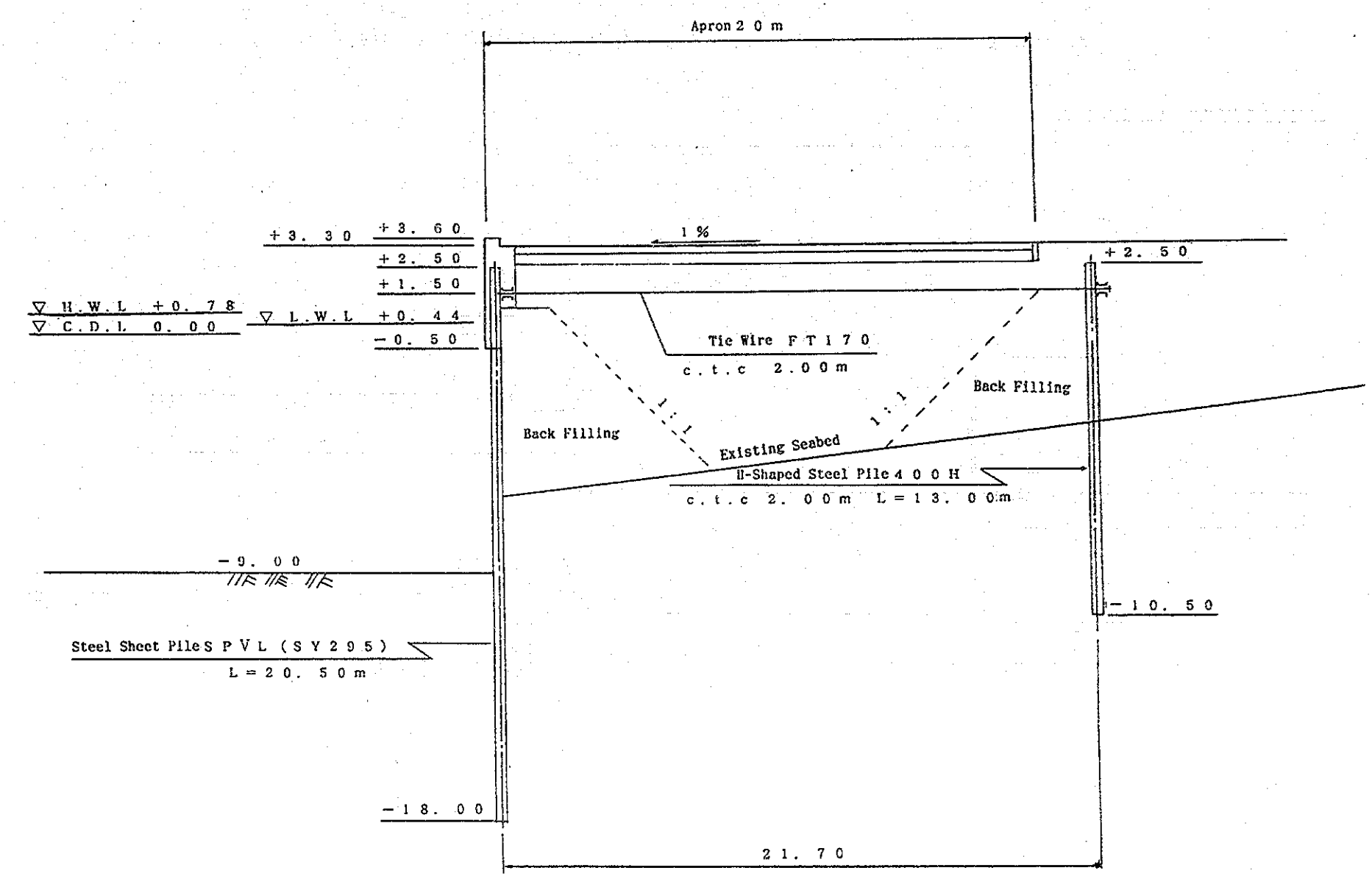


Fig. 6-3 Typical Cross-section of Extension of Dock-A

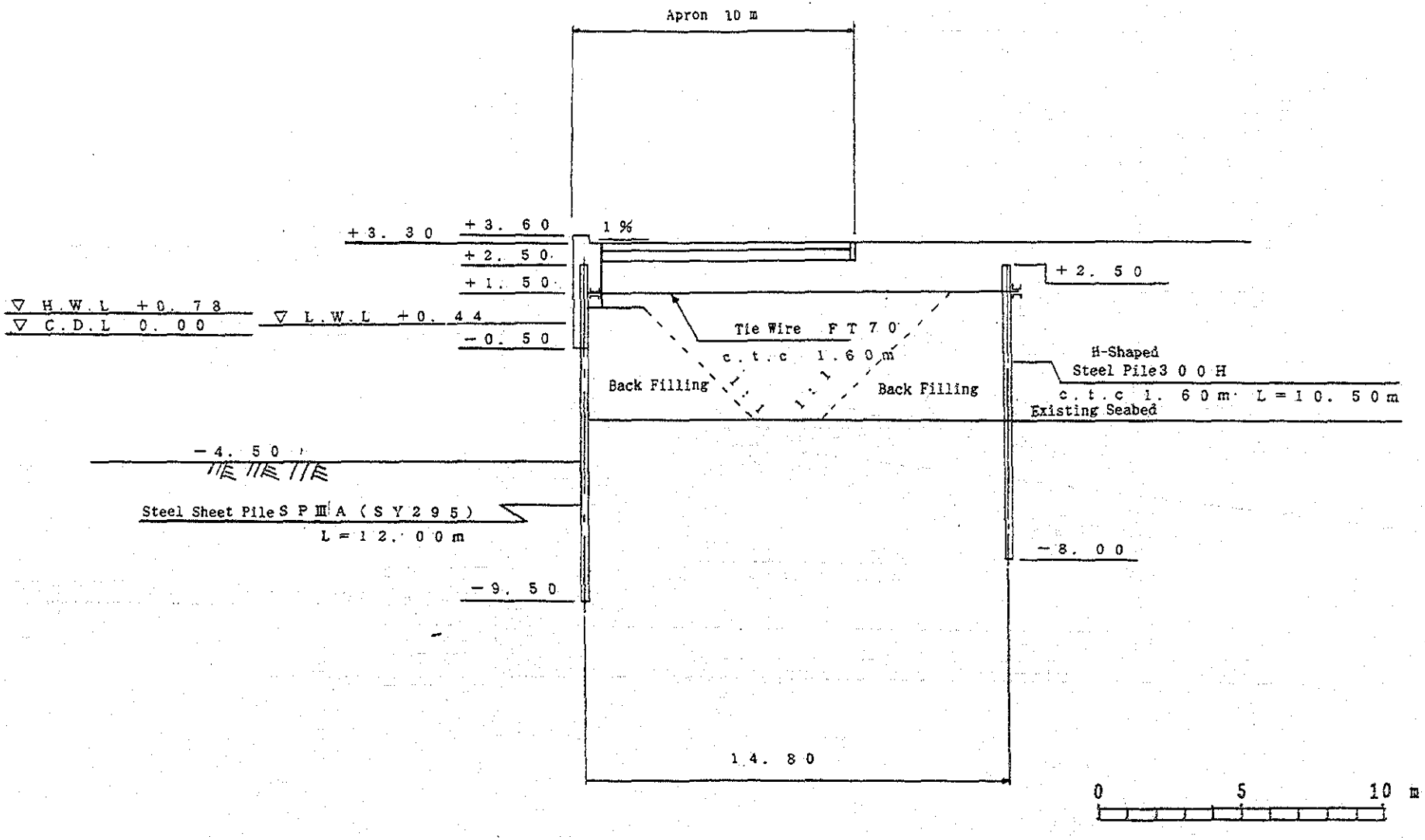


Fig. 6-4 Typical Cross-section of Small Dock along East Return Wall

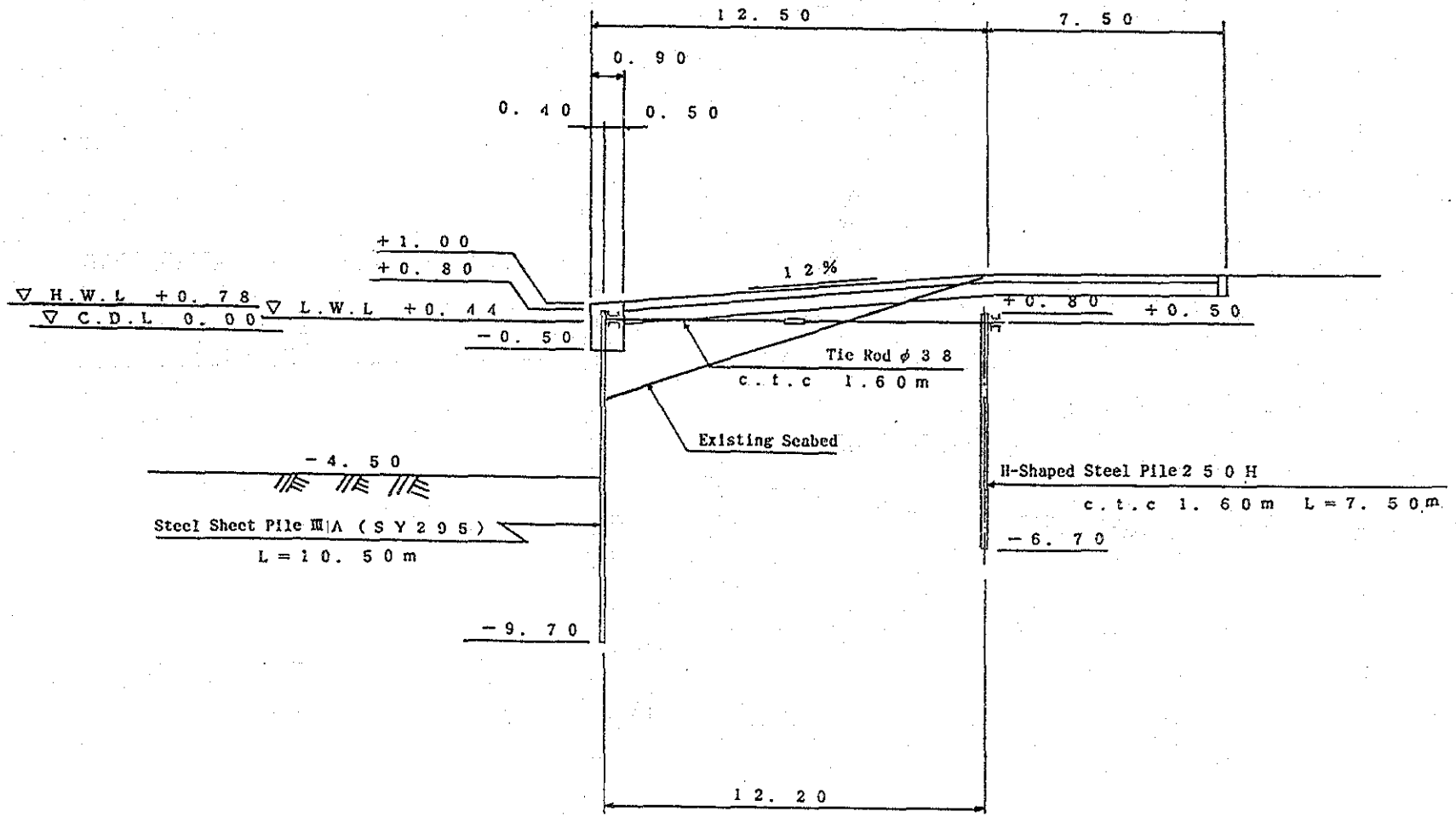


Fig. 6-5 Typical Cross-section of Ramp

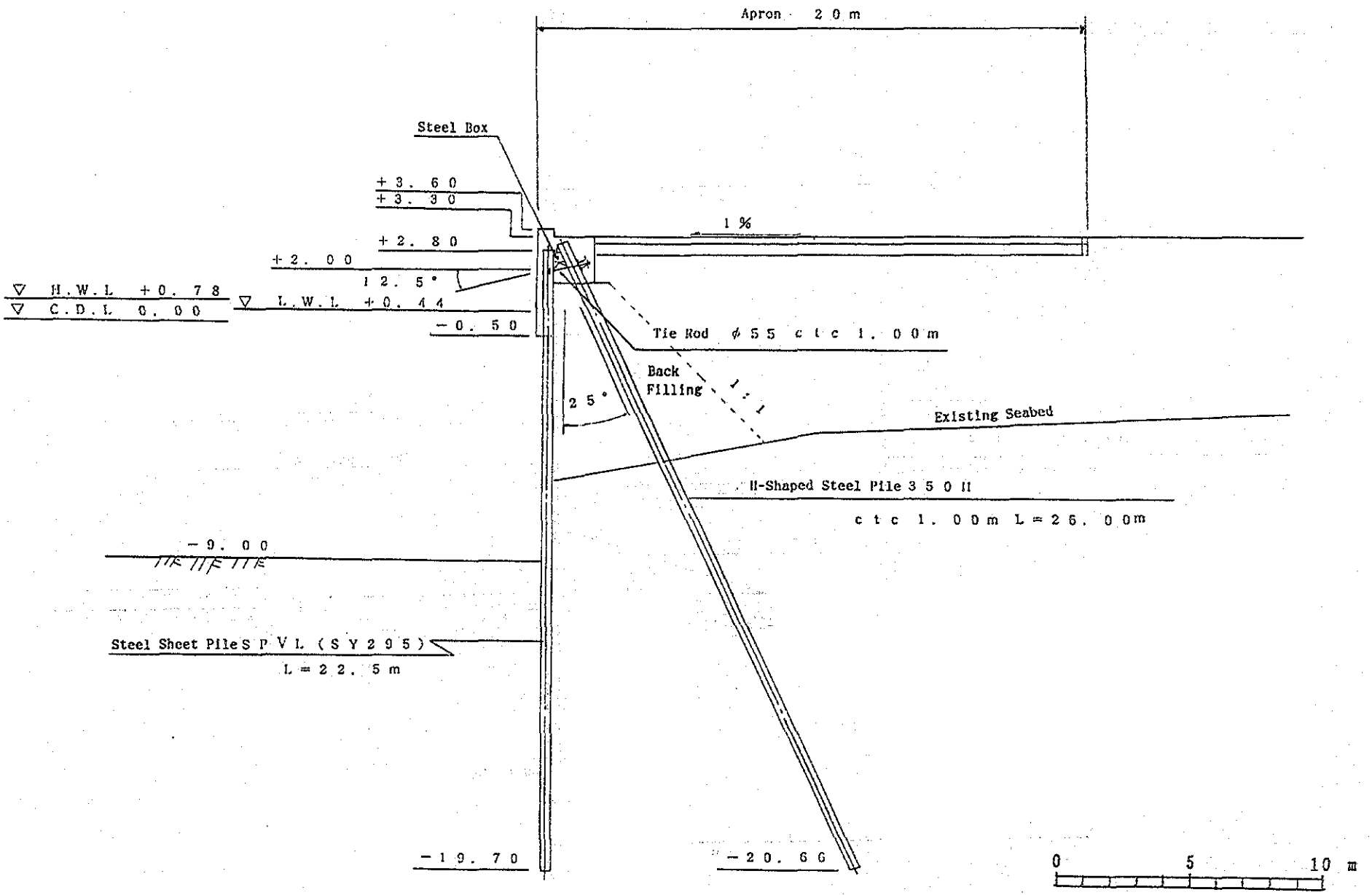


Fig. 6-6 Typical Cross-section of Extension of Dock-B

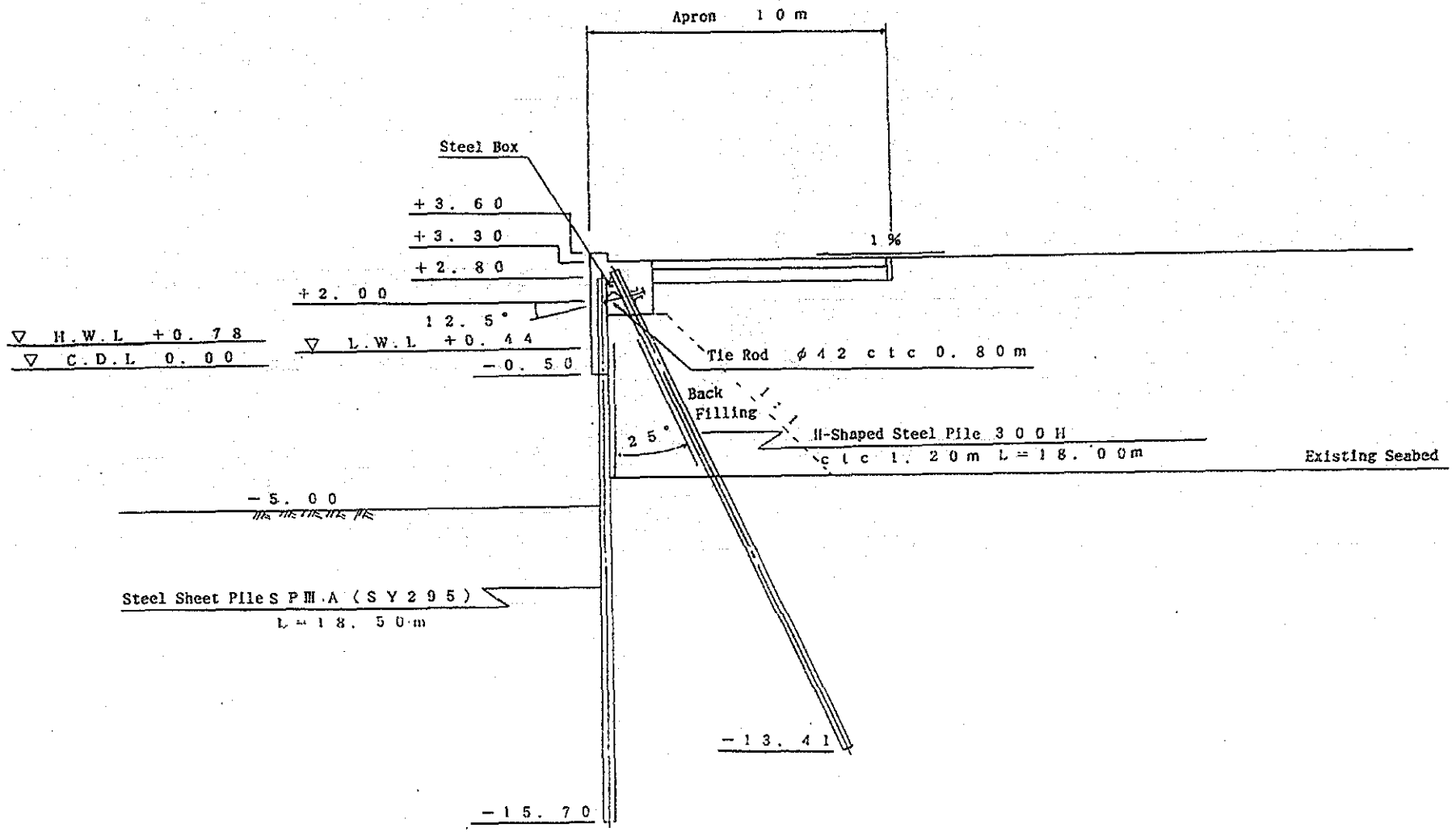


Fig. 6-7 Typical Cross-section of Small Dock along North Return Wall

0 5 10 m

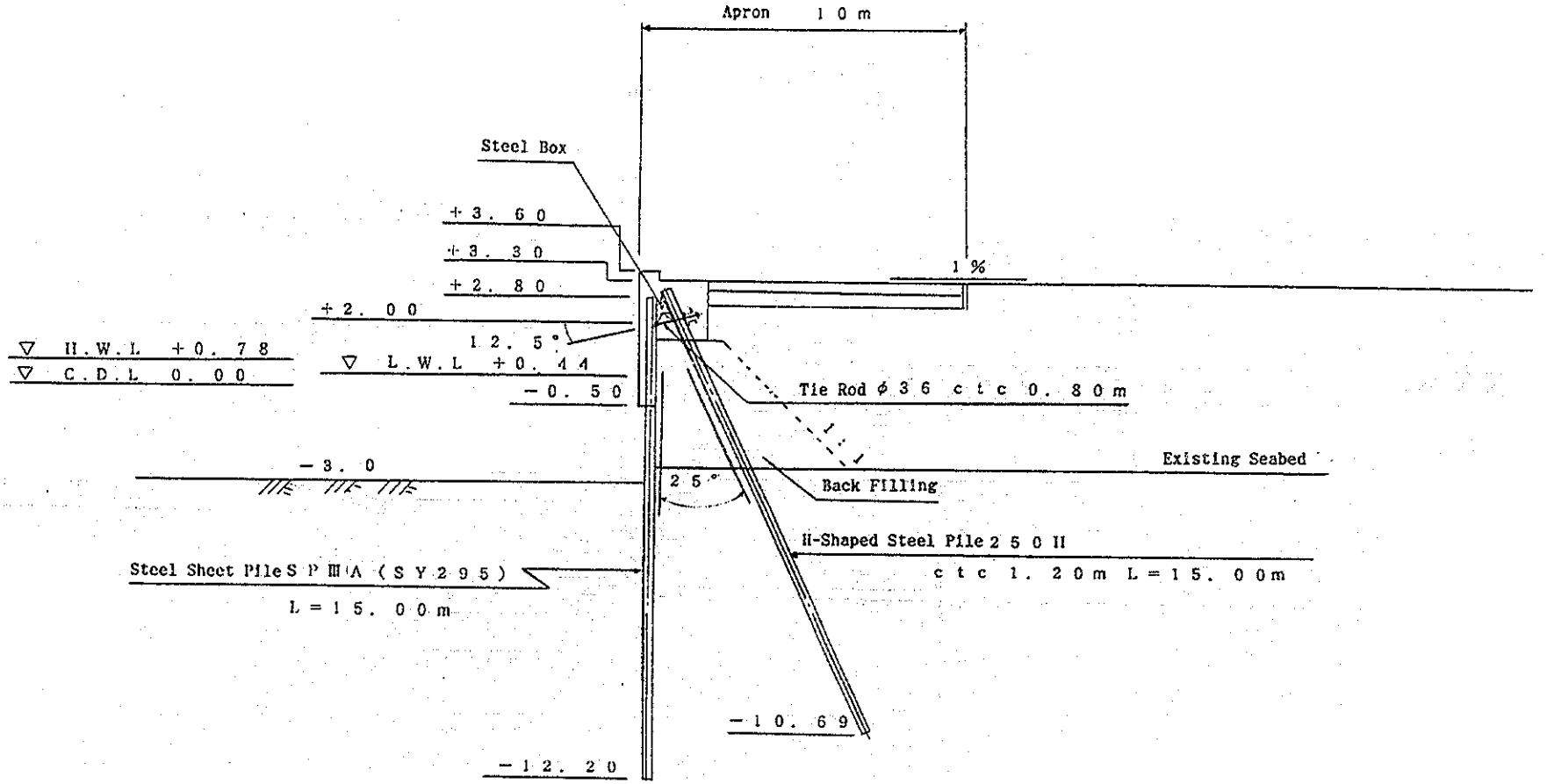


Fig. 6-8 Typical Cross-section of Revetment of Container Yard
(Steel Sheetpile Type)

0 5 10 m

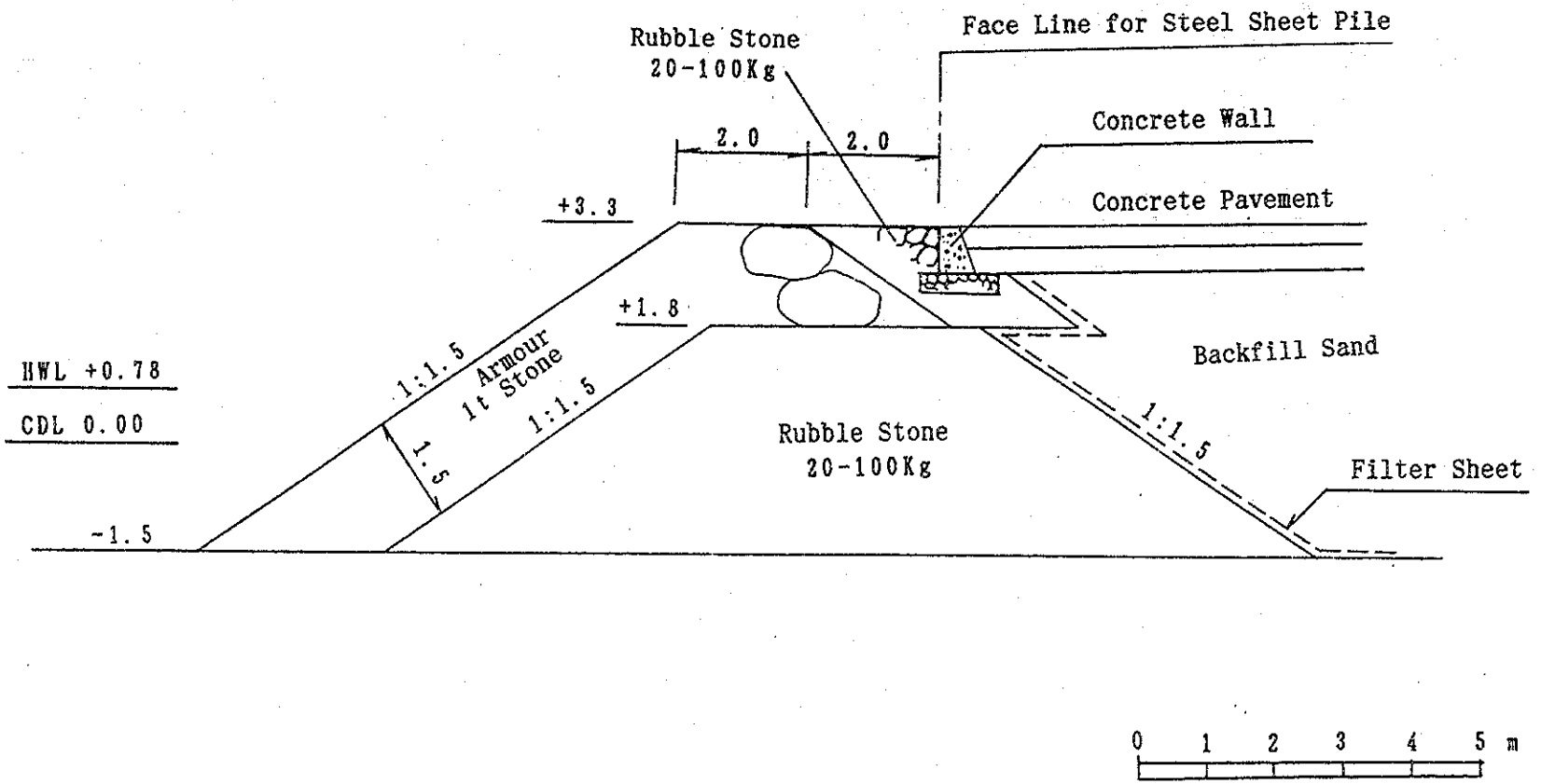


Fig. 6-9 Typical Cross-section of Revetment of Container Yard
(Rubble Mound Type)

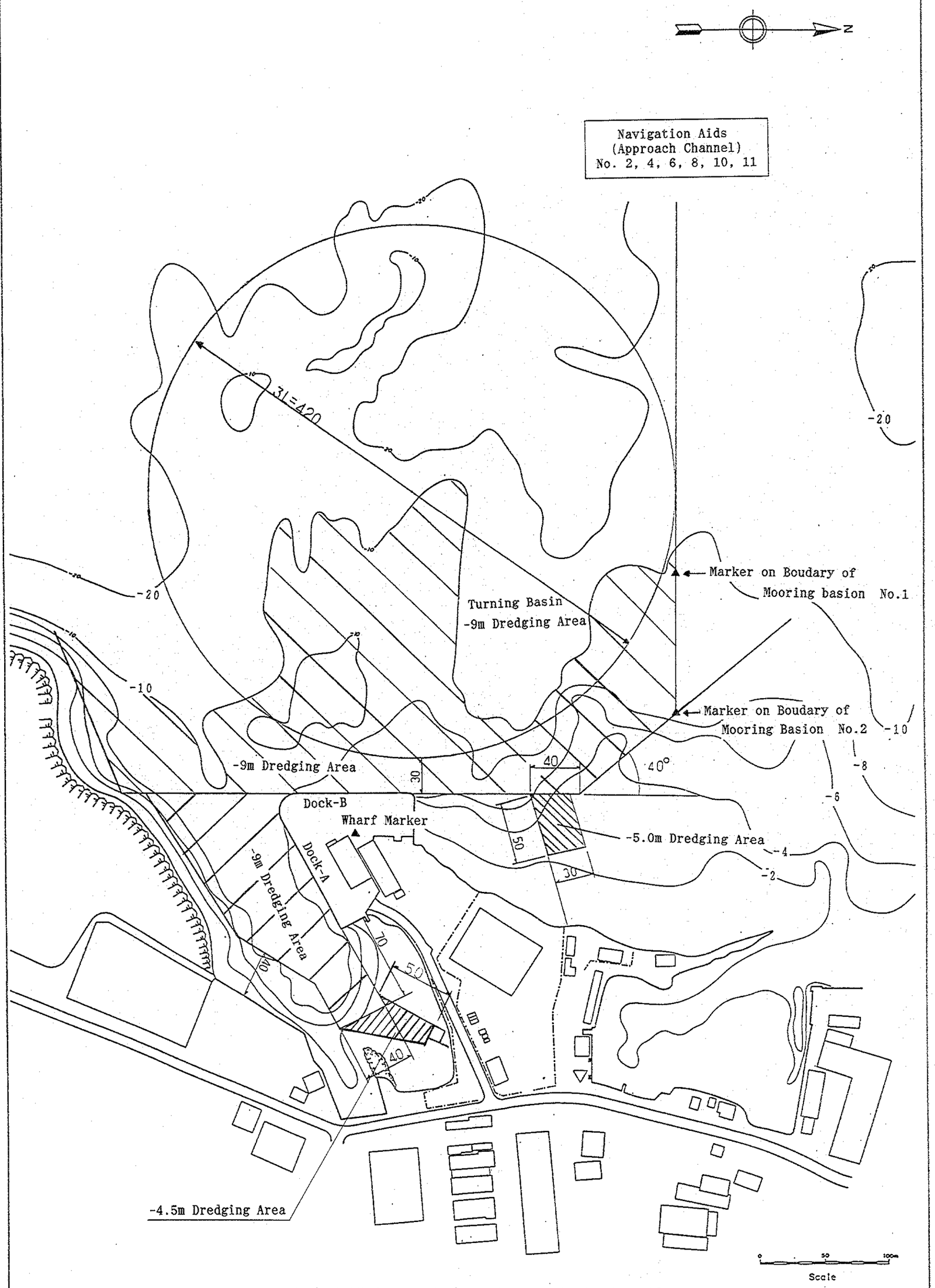


Fig.6-10 Plan of Dredging Area and Navigation Aids

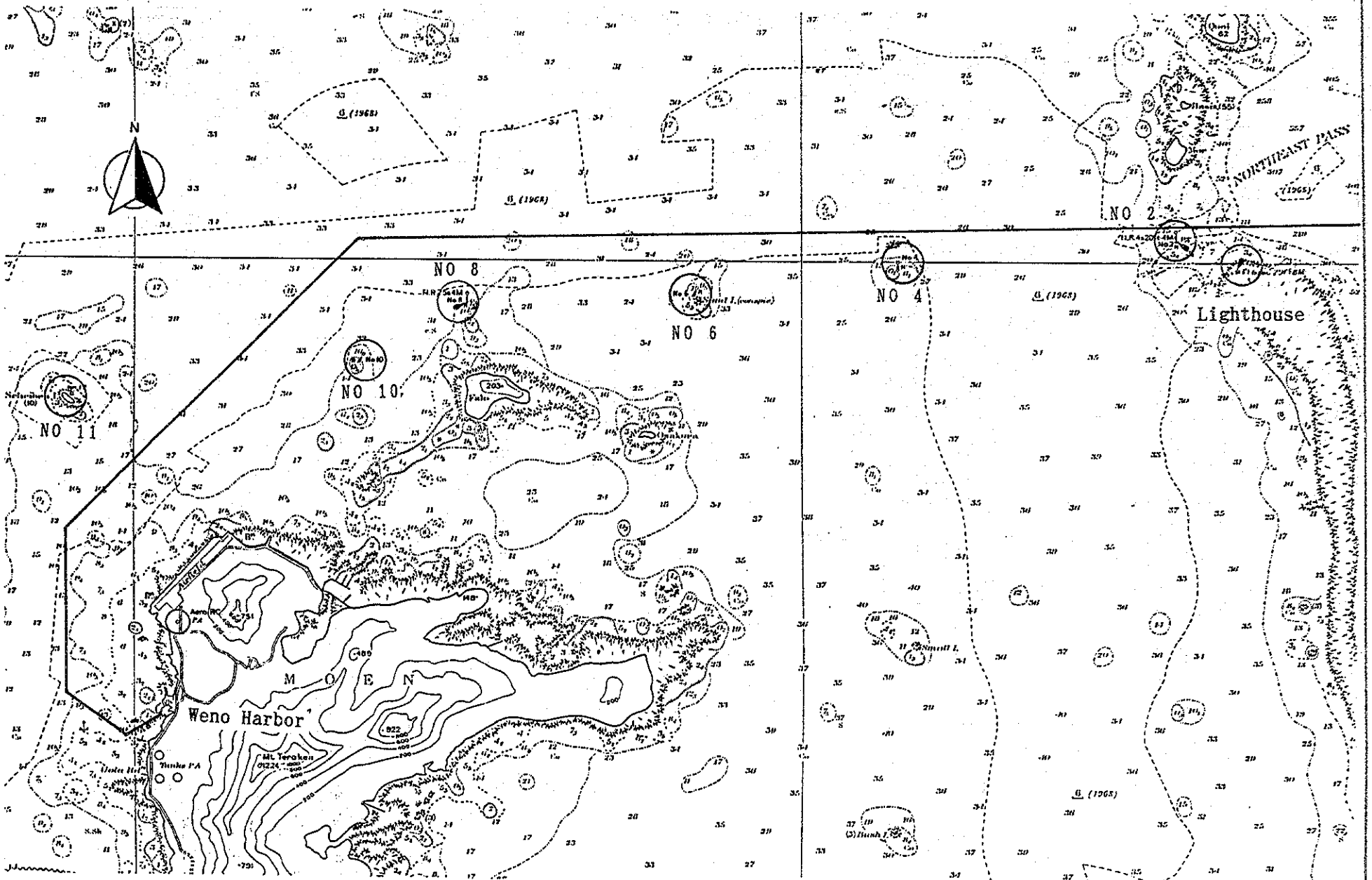
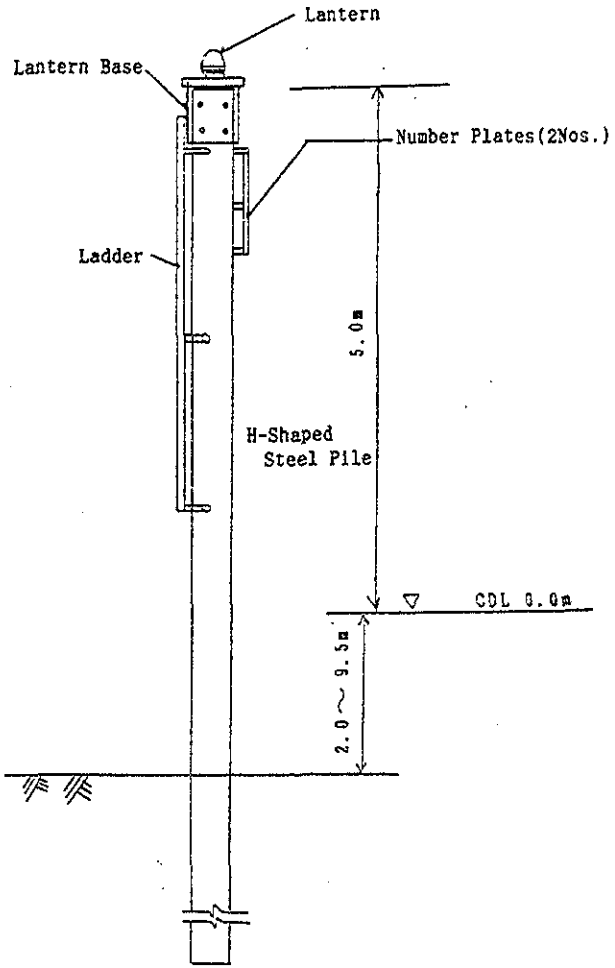
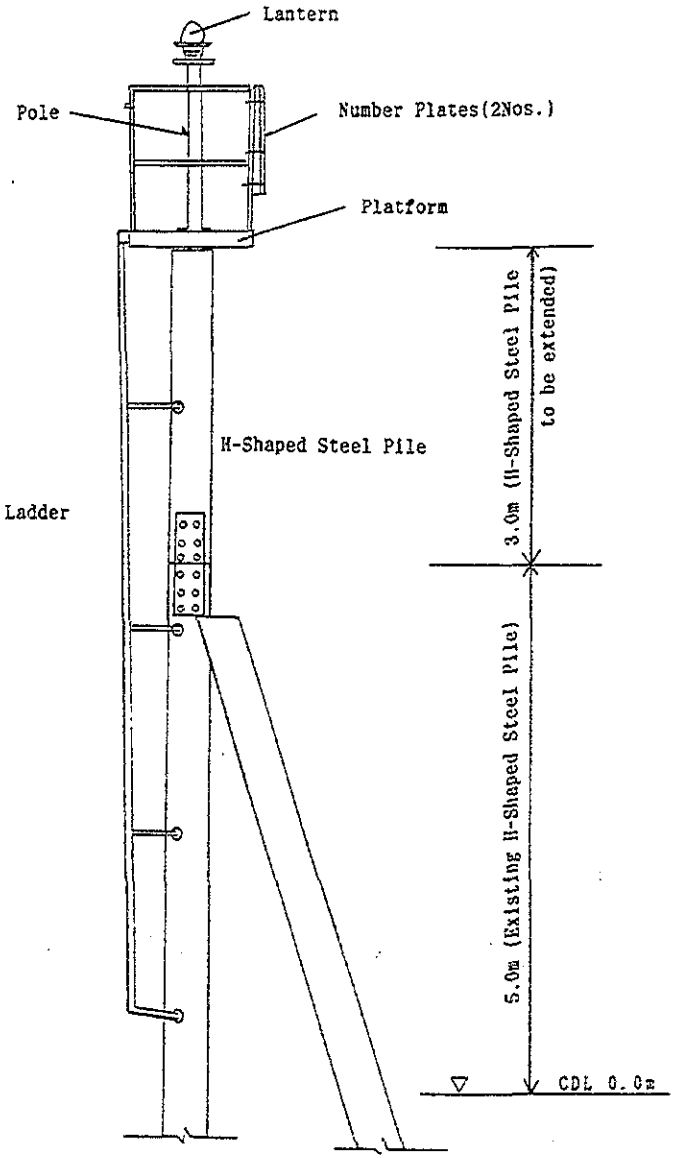


Fig.6-11 Plan of Navigation Aids (Entrance Channel)



(Shoal Marker No. 6 to 11)



(Shoal Marker No. 2)

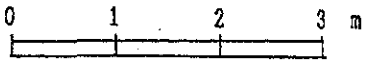


Fig.6-12 Typical Design of Navigation Aids

6.4 Implementation Plan

6.4.1 Implementation Policies

(1) Implementation Policies

After Exchange of Notes (E/N) between the Government of Japan and the Government of Federated States of Micronesia (FSM), a contract will be concluded between the Government of FSM and a Japanese consultant for consulting services on this project.

The construction period is expected to be 24 months in two phases, taking into consideration the scope of the Project and site conditions. The Department of Transportation and the Department of Planning and Statistics of the Chuuk State Government are the executing organizations of the Project. For execution of the Project, close cooperation and coordination between the executing organizations and the consultant are essential. Fig. 6-13 shows the organization of construction management.

The consultant will prepare all the tender documents such as drawings, technical specifications, cost estimation, conditions of contract etc. necessary for construction contract. Contractor for this project will be a Japanese construction company selected by pre-qualification and tender. The construction works will be performed by the selected contractor in accordance with the contract.

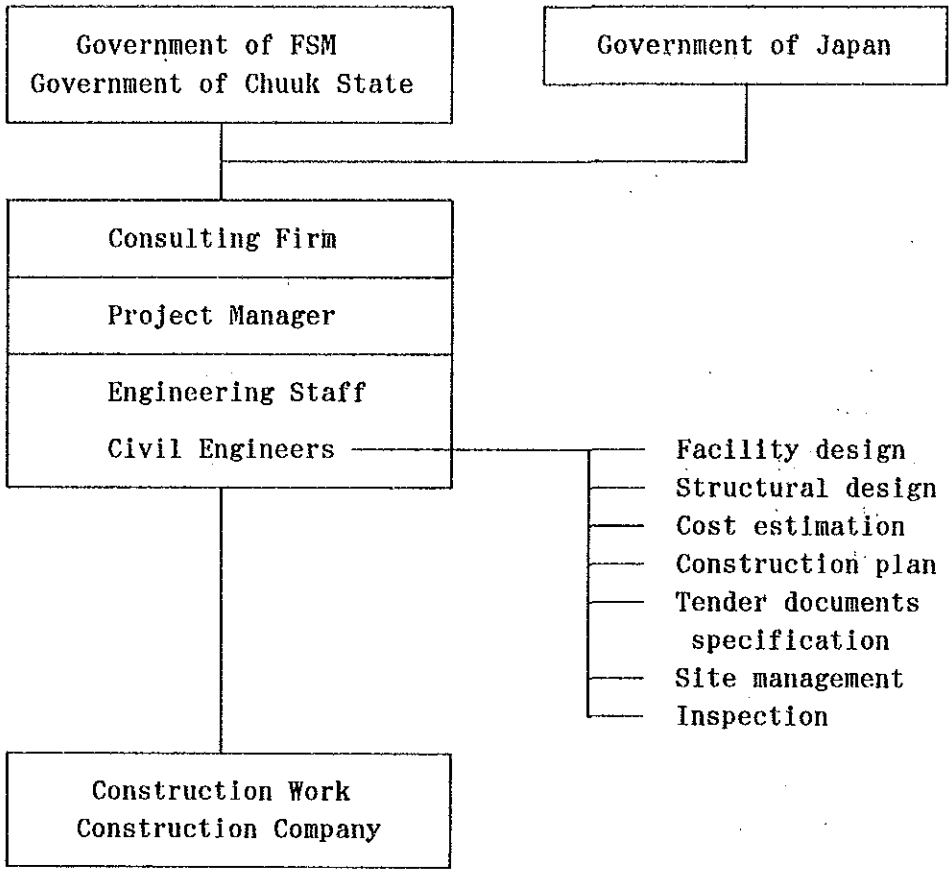


Fig. 6-13 Organization Chart of Project Implementation

(2) Scope of the Work

The scope of works of the Project to be performed respectively by the two governments are described below.

1) Scope of Work to be undertaken by Japan

a) First Phase

* Extension of Dock-B
* Small Dock on North Return Wall
* Dredging of Mooring and Turning Basin-B
* Revetment of the container yard
* Improvement of navigation aids

b) Second Phase

* Rehabilitation of Dock-A
* Extension of Dock-A
* Small Dock on East Return wall with Ramp
* Dredging of Mooring Basin-A
* Improvement of container yard
* Ancillary facilities of Container Yard

2) Scope of Work to be undertaken by FSM

* Securing and Clearance of Work Site
* Removal of Sunken boats in project site
* Provisions of electricity and telephone
* Provisions of sewage
* Partial removal of existing fence
* Disposal of explosive shells (if discovered)

6.4.2 Construction Conditions and Implementation Plan

(1) Construction Conditions

1) Construction Equipment

In Chuuk State, three overseas construction companies are currently operating construction business under approval of the State Government. They can mobilize their own equipments from main depot outside, but they have usually no excess machinery at site. The State Government owns some construction equipments which are leased to private companies, but is scarce of large units available. Since the construction for this project will be executed mainly in sea, most of marine work equipment will have to be mobilized from abroad. The machinery likely to be available at site are such as those for road construction.

2) Labor for Marine Construction

There are few experienced laborers locally available for marine construction work such as sheetpile driving or dredging with grab dredgers. Skilled Japanese engineers and workers have to be dispatched for the Project.

3) Imported Goods and Materials

Goods and materials for the Project such as steel sheet piles and H-shaped steel piles will be imported from Japan. The stock at import agents and merchants in the State will not be sufficient and may be sold out. For a stable supply of these materials, an advance procurement schedule and close coordination with import agents are indispensable for inventory control.

4) Annual Working Days

Although five days a week from Monday to Friday are the customary working days, six working days/week shall be needed in view of the limited schedule given for this construction work. Since the construction works of this project is in the vicinity of the existing docks, precaution for safety of works is highly required when vessels enter the port.

As there are national holidays, the average working days/month will be 23 days.

(2) Work Execution

1) Work schedule should be prepared elaborately considering the natural conditions of the site.

2) The works to be undertaken by FSM and by Japan should be coordinated and scheduled to avoid confusion.

3) The Contractor should dispatch experienced work supervisors by selecting appropriate number of persons, timing and duration of their dispatch.

4) Use of local materials and workers should be maximized, and procurement from Japan should be minimized.

5) Utmost attention should be paid to traffic of vessels and small boats during the marine construction work.

6.4.3 Supervision by the Consultant

The policy of the Japanese Government for a grant aid projects requires that the Project proceeds consistently throughout the period from the Detailed Design stage to the construction stage with assistance of the consultant who fully understands the objective of the basic design. The Consultant is required to supervise the construction work by stationing capable resident engineers at the site for management and communication as well as by dispatching specialist engineers for short terms for each phase of the work for inspection and guidance.

(1) Policy of Supervisory Control

1) Control of the work progress in accordance with the construction schedule, maintaining close contact and reporting between the responsible personnel in both countries;

2) Provision of adequate guidances and advice to the work execution staff so that they can complete construction of the facilities in conformity with the design plans;

3) Provision of guidances for maximal adoption of local materials and subcontractors

4) Promotion of technology transfer in construction and engineering to make the most of the grant aid project

5) Provision of adequate advices and guidances on maintenance of the delivered facilities to help smooth operations thereof

(2) Main Supervisory Work on Construction

1) Assistance on Contracting

Providing assistance on selection of contractors, determining type of contract, drafting contract agreements, reviewing details in work plans and witnessing contract awarding

2) Checking and Approval of Working Drawings, etc.

Checking and approving work drawings as well as materials and equipments proposed or submitted by the contractors

3) Guidance in Construction Work

Reviewing work plans, processes, etc., providing guidance for contractors and reporting progress of the work to the owner

4) Assistance in Payment

Collaborating with checking and processing bills on payment to the contractor for the work in progress or for the completed work

5) Inspection

Inspecting where necessary the work in progress and giving instructions to the contractor

The consultant shall, upon confirmation of completion of the works and fulfillment of requirements of the contract, witness delivery of the objects of the contract and confirm the Owners' acceptance thereof to complete his obligations.

The consultant shall also provide reports to the Government of Japan in relation to work progress, payment procedures and delivery of completed facilities.

6.4.4 Procurement and Logistic Policy

In procuring necessary materials/equipments for this Project, special attention are required to the items below;

(1) Policy of Procuring Materials/Equipment

For procurement of materials and equipment, by examination of local availability, supply from Japan should be minimized.

1) Supply from Japan

For certain materials/equipment to be procured from Japan, a procurement schedule must be studied carefully since such materials require an extended period from production to packing and shipping. Procurement from Japan should be determined considering cost-effectiveness, local service conditions and possibility of long term lease.

2) Local Supply

Stones and filling materials are to be supplied locally. In procuring the imported materials such as cement, etc. quality should be thoroughly checked and controlled.

3) Cost

Lower prices have priority in selecting a supply either locally or from Japan. It should be noted that price of supply from Japan must include fees for packing, transport and insurance, but exempted from tax.

The procurement of materials/equipment for the Project shall be planned considering the above.

(2) Material Procurement and Equipment Mobilization Sources

1) Materials

Local: stones, crushed stones, sand, cement
Japan: steel sheetpiles, H-shaped steel piles, reinforcement bars, fenders, curb-stones, navigation aids apparatus

2) Equipment

Local: tire rollers, vibrating rollers, trailers, motor-loader
Japan: grab dredger (4 m^3), pile driving barge (D32), dredging barge, tugboats (1000 PS, 250 PS), floating crane

6.4.5 Environmental Monitoring Plan and Safety Control

In order to assess impacts from construction to marine environment, turbidity shall be monitored regularly in outer peripheral area of dredging and near the docks. Since turbidity may diffuse during dredging and dumping, provision of silt protector is required for dredging work. If monitoring reveals the values notably exceeding permissible limit, countermeasures should be taken. Monitoring at reference points shall be made at least once a week.

The construction site is where military operations were active during the World War II, and a number of war wreck vessels remain submerged, suggesting presence of explosive shells. Prior to earthwork and pile driving, the contractors should probe for any submerged shells to prevent accidents.

6.4.6 Implementation Schedule

Implementation of the Project by the Japanese Government's Grant Aid Program will be proceeded in the following manner.

The project will be proceeded in two phases. In each phase, after Exchange of Notes between the Government of Japan and the Government of FSM, the latter is requested to conclude consulting contract with a Japanese consultant firm.