Facility / Equipment	Ngaraard	Ngardmau
Shoreline protection sea wall and causeway restoration	Shoreline protection sea wall ①If the water depth of access channel is designed as CDL(basic water level) - 2.0m, west side of the channel and the shoreline protection sea wall (gabion structure) should be apart at least about 2.5m. Dredging is restricted to 100 feet (about 30m) from existing causeway. Access channel cannot be extended behind causeway. ②Shoreline protection sea wall (road behind existing causeway) There is a narrow (2.7m.wide) section. If shoreline protection sea wall is built on channel side, the road behind must be widened before general vehicles can go through. Large dump trucks carrying coral sand dredged at causeway's end could damage road unless there is enough shoulder space between sea wall and road. Total road width = Road width 6m + both side shoulders (1m x 2) = 8m.	Causeway restoration State road from village to project docking facility site (former wharf for bauxite loading which projects) far into sea from coast line) is connected by causeway(height CDL+3m, width 5m, length approx. 455m). Built more than 50 years ago; the causeway's stone masonry walls are extensively damaged on both sides, and part of the road surface (shoulders) is depressed. Therefore safe traffic of man and vehicles cannot be guaranteed under present conditions. Restoration scale : Restoration of stone filled structure to original condition. Restoration parts (13 parts) Total length : About 290m. A turnout should be built to allow vehicles to pass each other on the causeway. One turnout = 10m (l) x 3 m (w)
Waiting house	- Number of passengers and fishermen on an ordinary day is 40. - Number of people on an overlapping multi-purpose day is 75. In this project, passenger dock use is estimated at 2 cycles and waiting house use at 15-30 people per day. But since simultaneous use is infrequent, house is designed to accommodate 15 users at one time.	
Cargo handling equipment	Cargo handled onsite: Fuel drum can (200 kg.), fish refrigerator box (200 liter : 100-150 tons), outboard motor, small FRP boat (200-700 kg.), agricultural products, private construction materials and equipment (timber, pipe, tin roof material, concrete block, gravel, cement) Selected machine type : Diesel engine truck Capacity : 2 tons, Normal crane capacity 2 tons One for each state.	

2-3 Basic design

2-3-1 Basic concept

2-3-1-1 Basic design concept

The basic design has been realized in accord with present-day fishery by pursuing project concepts and examining the natural, social, construction- and supply-related conditions of the subject country. Specifically the finalized design takes into account the issues.

With the implementation of the Compact of Free Association, rapid economical and political expansion and overall national development is expected for Palau. Economic and social developments rely on public financial investments, which to date have largely focused on education and social welfare. Fishery, agriculture and tourism will become key industries in an environment of sound private investments which made possible by the development of national infrastructures and underdeveloped regions.

The basic design is of a project facility on a scale most in line with the Japanese government's grant aid and Palau's present conditions.

(1) Design of optimum project scale

1) Each docking facility has an optimum scale according to proper demand forecast.

2) Each facility item has realistic scale according to grant aid.

3) The goal is minimum facility maintenance cost.

4) The amount of civil labor is kept to a minimum.

(2) Design with regard for nature

1) Each project site's natural conditions such as weather, topography, geological structures, ocean currents and tides are reflected in the design..

2) Measures are considered to prevent the influence of construction work and post-construction on the environment.

3) Special features of each site are thoroughly examined.

(3) Appropriate project site construction materials and methods

1) Structures are simple for easy maintenance.

2) Preference is given to materials and methods available in Palau.

3) Regard is given to nature conservation.

2-3-1-2 Examination of design concept

(1) Design condition for natural conditions

1) Design condition for natural conditions

① Design condition with regard to weather conditions

1] **Temperature** : Diurnal range ≦10℃ and annual range ≦10℃ are sufficient for design condition. These ranges are small compared with those of Japan, and this allows for wider joint spaces in concrete pavement. Nevertheless standards for outdoor storage of concrete materials should be carefully set, since on sunny days the daytime temperature exceeds 30℃.

2] **Wind direction and force** : The annual frequency of strong winds affecting the efficient use of boats at each site is examined by wind direction. Maximum wind velocity recorded in the past or once every 50 years (25 m./sec.) is used to estimate reef wave action, which may affect docking facilities. In the application for grant aid assistance the standard for maximum wind velocity is given as 120 mph = 50 m/sec., but this is an overestimate.

3] **Rainfall** : Standards should be carefully set for concrete work and material storage in the event of rain, since showers occur even in the dry season.

② Design conditions for sea-related phenomena

1] **Tide level** : According to annual data, the tide range is 2.4 m. (from a high of 2.20 m. to a low of -0.2 m.),but for most structural considerations the average tide is used.

2] **Current** : Current need not be considered, since it has no influence and the reef tidal current is small.

3] **Silt sedimentation** : Silt deposits must be taken into account. Even with small tidal current, over a period of time silt from the estuary can be deposited in the access channel and berth.

4] **Marine environment** : Concrete and steel materials should be carefully selected as facilities built in sea areas are subject to corrosion.

③ Design conditions for topography, geological structure and soil characteristics

1] Topography, geological structure, and surface soil characteristics are based on field study results. But design conditions for deep soil types are based on the results of nearby site studies (1987) and simple pole survey.

2] The Proposal selects the Zone-3 standard of UBC (US Building Code) for earthquakes. This standard is overestimated and in need of review.

④ Design condition for environmental influence.

The EQPB and DCA permit conditions should be considered in the design.

2) Design condition regarding social conditions

Customarily, complications arise with private land ownership. This problem does not present itself here, however, since both sites are sea land-fill areas under state ownership. Existing facilities near each project site will be used in conjunction with the project facilities, which should be built without reducing the functions and structures of these existing facilities, and without diminishing the natural scenery.

The project facility design should take into account the utility of "satellite" facilities around the site. It has been proposed to conserve some of these existing facilities at the Ngardmau site. This proposal, along with DCA permit conditions/regulations, should be under consideration.

3) Design condition peculiar to construction industry.

① Permission and authorization are by notification only for EQPB/DCA described in 1)-④ and the Bureau of Public Works, a sub-organization of the Bureau of Natural Resources Development which oversees the project.

② While there are no explicit restrictions for the project, related laws do exist.

③ U.S.A. criteria and standards are followed for technical aspects of construction design and labor in Palau, but Japanese criteria are here adopted for the project (fishing port, JIS, etc.).

④ There are few technical consulting companies (e.g. SOCIO), but they can plan construction and management of simple facilities. Some of the project area's construction companies (numbering at least 5, including joint ventures) own large construction machinery (dredger, berge, crane, etc.). These companies should be used as subcontractors whenever they are advantageous in cost and performance.

4) Materials

① PNG made cement is distributed, but procuring from a third country should be considered for quality product selection with regard to reliable production factory, production date and warranty.

② Korean made reinforcing bars are circulated. As in the case of concrete, there should be a policy for selection of a reliable quality product.

③ Stone materials available in the project area should be used.

- Use coral sand stone and boulder from dredging for stone masonry.
- Use coral gravel from dredging for back fill of revetment.
- Use coral sand/gravel from dredging for back fill and road fill.
- Use bauxite (sand and gravel) for road material

④ Onsite material testing (cement, reinforced concrete, soil characteristics) is adequate.

5) Design condition for maintenance and management ability of implementing organization.

There are not enough workers, and they do not have enough skills. -There must be training and instruction on the state level.

6) Design condition for grade and scale assessment of facility and machinery.

Scale (see 2-2-3)

Grade

Civil work facility : Japan's fishing port criteria

Revetment : To some degree reinforcements may be done by local methods.

7) Design condition for construction time period

There are two separate construction sites, and preparing two sets of expensive heavy machinery (heavy machinery for dredging, crane, etc.) would add to construction costs. The structure must be designed to be built in a short period of time, so that one set of heavy machinery can be used to build as many similar facilities (dock, access channel) at each site as possible.

2-3-1-3 Design precision

(1) Survey of site location, shape, height and depth

Although the project location should be surveyed with topographic maps, this was done with surveying tape and compass according to a temporarily fixed TBM (Temporary BM) because there is no reliable benchmark at the sites.

Directional errors of ±5m/100m = ±5%, and ±3 degrees/ 90 degrees = 3.2% must therefore be taken into account. However, an accuracy of ±20cm/10m=± 2% may be expected for shape dimensions around the site.

Site height and depth are expressed on the basis of CDL. Specifically, at each site TBM height from sea level is periodically measured(every 30 minutes to 1 hour); high and low tides are adjusted to the tide table of Malakal port; then readings of height and depth from sea level are corrected to CDL.

In the survey, height is accurate within±2cm/1m =±2%. But depth from sea level is accurate within ±5cm/1m = ±5%. This is because the ultrasonic investigator malfunctioned during the survey, so the survey pole (bamboo pole scale) had to be used.

(2) Precision and reliability with regard to natural conditions.

Since weather (wind direction and velocity, rainfall, humidity and temperature) and tide level are measured by U.S. standards, there is an error of approx. ±2%. Moreover, wind direction measurements should include a 30 degree deflection (left and right).

In wind velocity, there must be a distinction between maximum momentary velocity (gusts) and maximum velocity (one min. average). One must bear in mind that these values are higher than the maximum wind velocity (three min. average) in Japan.

Statistics from past records indicate that the probability of the highest maximum wind velocity (25 m./sec.) recurring is once every 60 years. This is within safety standards for the project site facilities, and requested value of 50 m./sec. is therefore considered an overestimated value for their design concept.

As design condition is selected the estimated reef wave value (H1/3 = 1.0 m.) by the highest maximum wind velocity and fetch distance in front of the site. The wave value is roughly twice estimated value by 5 MB method in shallow water, even if extent of damage to satellite facilities surrounding the sites are also taken into consideration.

The estimated value is presumed higher than the actual highest in the range of +30%.

In the Proposal, the earthquake standard is given as Zone-3 of UBC Z= 0.3 (maximum). This is an overestimate for Palau, which has been earthquake-free for the last 100 years and is far from the Pacific ring volcanic zone. Zone-2A (Z=0.15) is considered sufficient.

As a result,

V= ZIC/Rw - 0.15 x 1.0 x (0.4) = 0.06

(UBC, Vol. 2 Sec 1632-Non Building Structure)

(Area factor) Z	:	Division of 0-4 , 0-0 / 1-0.075 / 2A-0.15 / 2B-0.20 / 3-0.3	
(Importance factor) I	:	1.0 (normal facility), 1.25 (hospital, etc.)	C/Rw≧0.4 (non-building structure)
(Shape factor) C	:	determined by shape height, 2.75 max.	
(By structure) Rw	:	RC structure, block structure Rw = 6	

With regard to soil conditions, surface soil data is a highly reliable because it is based on sampling of three locations at each site; analysis of grain size composition as well as underwater observation; measurement of surface mud by survey pole, and analysis of dredged soil. On the other hand, deep soil data is unreliable because it was obtained from data of similar nearby sites.

Sheet pile structure and back fill material are selected for the basic design, after careful examination based on previous results of boring for a similar project (see Attachment 5-1-7). The existing data is N≧5, an average value. It is nonetheless preferable to conduct boring and penetration tests at each site before starting detail design.

For material loads, stone material was determined from crushed basalt stone and sand of Malakal quarry, and on past test data of beach coral gravel and sand, which is in the safety (heavy) range, exceeding 20% (see Attachment 5-1-10).

(3) Selection of subject fishing boats

Table 2-1 shows that now 1-2 mid-size boats and 20-30 small boats at each site will use the project fishing port as their home port. These numbers are expected to increase after the facilities are completed, however.

Besides fishing boats, freight and passenger ferryboats will come regularly, and berge boats with heavy materials and machinery for construction are expected temporarily.

Table 2-8

		Ngaraard	Ngardmau	Remark
Natural condition	Maximum wind velocity (m/sec)	25/NE,N	25/S-SW	Once in 60 years. Highest maximum velocity
	Design wave height H1/3m	1.0	1.0	
	Tide level: HWL LWL	+1.8m +0.0m	+1.8m +0.0m	CDL = ±0
	Earthquake	0.05	0.05	Seismic force/ UBC / ZONE2A
Weather	Temperature	Highest 35℃	Highest 35℃	
	Humidity	84%	84%	(Yearly average)
	Rainfall	3,758mm	3,758mm	
Soil nature	Surface soil	Silt / Gravel mixed sand (0.5m)	Silt / Gravel mixed sand (<1.5m)	
	Deep soil	Gravel mixed sand N>10	Gravel mixed sand N>10	Estimated
	Density (t/m^3)	1.7	1.7	Estimated

Table 2-9 Material load

	Classification	Density (ton/m^3)		Internal friction	Remark
		In air	Under water	angle (ϕ)	
Dead Load	Riprap (crushed stone)	1.80	1.00	40	After compaction
	Riprap (coral)	1.60	0.90	30	
	Back fill stone (crushed stone)	1.80	1.00	40	No screening
	Back fill earth (coral)	1.60	0.90	35	
Live Load	Non-reinforced concrete	2.30	-	-	
	Reinforced concrete	2.45	-	-	
	Stone	2.60	-	-	Slipway, dock
	Live load	1.00	-	-	

2-3-1-4 Design criteria and standards

Facility design is based on the following criteria, avoiding an over-scale as the project is a base for small fisheries.

Design Standard for Fishing Port Structure	All Japan Fishing Ports Association (1990)
Design Guide For Fishing Port Structure	All Japan Fishing Ports Association (1996)
Road Pavement Requirements	Japan Road Association
Soil test method	The Japanese Geo-technical Society
Concrete test method	Japan Society of Civil Engineers
Other related standards	Japanese Industrial Standard (JIS), ASTM

2-3-1-5 Permit regulations and other EQPB (Environmental Quality Protection Bureau) restrictions.

[Ngaraard state] (For dredging / Dredging permitted area of private dredging contractor, IBC)

Since the project site in Ngaraard overlaps with the state's dredging area agreement which was signed with private firm IBC. A promise was made that the area would not be dredged to the extent of affecting the project construction area and facilities.

- Dredging area - Modified
- Dredging depth (50' = 15m) ⇒ Changed to 2.0m toward the project site side
  ⇒ Distance modified by IBC to a min. of 50 m. from site.
- Use of stock pile lot
- Dredging contractor ⇒ Exclusive IBC area eliminated.
- Silt spread prevention necessary in the event of dredging.
- Water quality monitoring ⇒ Not necessary
- Compact road location, structure, and crossing system with access road (section/plan) are undetermined (see Attachment 5-2-2).

[Ngardmau state] (conservation of relics)

- Design of the existing dock (docking facilities) must be taken into account.
- Blueprint, notification, and monitoring of DCA and EQPB are necessary.
- EIA (environment impact assessment) report is required.
- Foundations of old structure and tower on the dock should not be altered.

- Connection with the new dock (RC) should be carefully avoided.
- Countermeasures are needed for seawater inflow behind the site from the eroding and sinking back fill area at the rear of the collapsed dock end.
- Only on the dock end (40m x 25m) can temporarily stock construction material and equipment. ⇒ Temporary revetment / back filling is needed(see Attachment 5-2-2).

The following conditions must also considered for design.

- Future repair project for collapsed sea wall's north side in Ngardmau .
- Size of traffic in Ngardmau
- Size of traffic and types of vehicles for dredging and use of dredged soil in Ngaraard (~ 1 million m 3/5 years).
- Restrictions concerning temporary yard for construction (esp. Ngardmau).
- Restrictions for dredged soil stock yard (to protect mangroves in Ngaraard)

2-3-2 Basic design

2-3-2-1 Site layout design

(1) Ngarard project site

The project boundary is 40 m. wide; 30 m. (L30) northward and 10 m. southward of the collapsed existing dock (L0). It was agreed to change the state- and private contractor-approved dredging site to an area more than 50 m. from L0 southward.

As shown in Attachment 5-2-1, the access channel (total length 420 m, width 20 m.) falls within boundary lines (L10~L30); and the 40 m. dock was positioned 50 m. westward from the scheduled intersection of the compact road.

The access road is within lines L0~L10, and the sea wall protecting the access channel is positioned on line L0. At roughly the tip of the access road (approx. 20 m.+10 m.+10 m.) there is an unloading area for heavy construction machinery, directly exposed to waves in the NW direction. Although located in the reef, a stronger structure than a shoreline protection wall is needed.

The temporary yard used to stock pile channel dredge soil, as a site office, and for construction materials and equipment was positioned as illustrated in Attachment 5-2-1.

The waiting house was shifted to the east side of the dock to provide more space on the west side. This space, now used freely for parking space and storage, will have more uses in the future. Behind the dock is concrete pavement of about 3 m. wide from the sheet pile alignment. The remaining area is simply paved with crushed coral sand.

The access road must be widened to 6 m. from its present minimum to accommodate two lanes. The centerline will be shifted 1 m. southward since a road shoulder width of 1 m. is needed to ensure stability of the channel revetment.

(2) Ngardmau project site

In Ngardmau there must be space on the existing dock for a construction work office and a temporary yard for construction materials and equipment , since there the land has no such space from the beach to another village about 1 km away.

The areas in and outside the berth (see illustration) are sufficient for stock piling dredged soil because the amount of dredging is small (less than 2,000 m.3).

Even if the revetment of the existing access road is repaired, there will be only one lane of 3.5 m. effective width. Therefore one turnout will be placed in the access road's south side to accommodate the future increase in traffic.

Since future dredging is planned for large scale boats north of the existing dock, the project dock for mid-size boats will be constructed on the dock's south side, alongside the prior, state-built, concrete sea wall.

The access channel of 20 m. bottom width is shifted about 6 m. southward from the existing concrete sea wall, and the project dock alignment has similarly been shifted.

To conserve sufficient space in the existing dock area and old structures built during Japanese occupancy, the waiting house is positioned between the old structures and the tower foundation.

To ensure a temporary stockyard, the area between the dock tip (25 m. l.) and the collapsed part of the north sea wall (25 m. l.) shall be filled up with soil. Back-filling is necessary to prevent seawater inflow behind the new dock at high tide.

The project quay wall should have a 13 m. wide concrete pavement to the waiting house, which has parking space and apron functions.

2-3-2-2 Quay wall

A steel sheet pile suitable for soft ground was used in a similar facility built with 1987 grant aid. The soil condition (N≦6 max. 10 m. depth) was a silt/gravel mix (SM-GM) with an angle of internal friction estimated at 20 degrees by design standards; and the safety factor for slip resistance of concrete block was 1.02. The safety factor required by design standards is 1.3. There was thus no guarantee of safety, even if the quay wall bottom was replaced with quality stones 3 m. thick.

The steel sheet pile method is selected for this project. But deep soil conditions are only estimates, since no project site boring tests can be conducted at the basic design stage. The use of steel sheet pile makes it easier to meet the short construction time for completing both sites within one fiscal year (see 2-2-3, Examination of Contents and Scale of Facilities and Equipment). The steel sheet pile construction cost is also lower than that of concrete block structures.

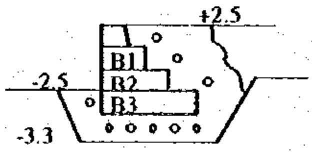
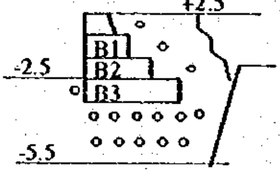
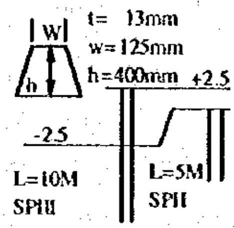
(see Table 2-10)

The steel sheet pile structure should have a safe corrosion protection to make it sufficiently durable. The design standard cites the following corrosion protection methods for steel materials: ① Corrosion margin method; ② Mixture of corrosion margin and anticorrosion coating; electric anticorrosion also acceptable.

In Palau, where the tide level range is as much as 2 m. at each site, the coping height must be 3 m. to prevent corrosion of steel sheet pile in the splash zone by coping concrete. This involves underwater labor for the lower part of coping concrete, and a higher construction cost. The coping bottom is therefore above LWL, and the repeated resin anticorrosion coating method, which has shown good results in the past, is selected for the part exposed to air and the part underwater.

Moreover, if part of the steel sheet pile has stress margin, it is effective as an anticorrosion margin. In steel sheet pile the maximum stress point by back fill pressure is about half of the water depth where the corrosion rate is low. But the water level area with a high corrosion rate has a sectional stress margin. With regard to material durability, the steel sheet pile is thus an extremely well balanced structure.

Table 2-10 Comparison of sea wall structures

Type		Block type		Steel sheet pile type
Illustrated outline			Replacement method (For soft ground) 	
Required materials	Concrete	B0=(0.4+1.2)/2x1.7m=1.36m³/m B1=1.6x1.2m=1.92 m³/m B2=2.4x1.2m=2.88 m³/m B3=3.2x1.2m=3.84 m³/m Total: 10 m³	Same as in the left column Total: 10 m³	Coping + anticorrosion 0.5x1+.135x4m=1.9 m³/m
	Steel	O	O	150kg/m² x (10+5)m=2.25ton/m +(tie-rod)
	Stone	Foundation: 30kg/stone -4m³ Back-filling: 30kg/stone -10.7m³ Total: 14.7 m³	-31.8 m³ -11.94 m³ Total: 14.7 m³	0
Work index		100	120	80
Work period/ Site		5 months Large working yard	6 months (50m+40m) Large work yard	4 months temporary placing area only
Characteristics	Excavation	Small	Large	None
	Stone cost	Small	Large	None
	Stability	(Unstable) Stable with light weight backing	(Stable)	(Stable)
	Durability	min. 50 years	min. 50 years	min.40 years with concrete anticorrosion coat.

Generally, the corrosion rate of steel sheet pile is at the maximum bending point (ocean side 0.1 mm./year, land side 0.02 mm./year as specified by Standard).

The results of structural calculation are given below.

Sheet pile structure sea wall (assuming soil nature of N=10)

	Ngaraard	Ngardmau
1) Structure	Counter support structure	Freestanding structure
2) Sheet pile section	FSPIII-8M (480kg) H-150x150x7x10 -5M (157kg)	FSP-IV - 12m (912kg)

2-3-2-3 Access channel/Berth

At both sites the sea bottom surface soil is a silt/sand mix with coral gravel. There is stability, with the exception of the sedimentary mud layer (clay/silt mix). The area is dredged with a slopegradient of (1 : 1). Dredging will be done by the land side (dredge mud is piled up to a mound for transport in heavy machinery which dredges both sides. When the assigned area's dredging is complete, the temporary embankment is demolished. This embankment method is with a few exceptions common in Palau (see

Table 2-11 Comparison of dredging methods (access channel-bottom excavation)

Work type	Combination of machinery	Coral gravel characteristics	Work condition	Work cost (small scale)	Result
On land	Backhoe (Combined use of ripper+bucket)	Soft	- Temporary embankment necessary. - Waiting time for favorable tide must be considered. - Ripper and bucket must be brought in.	◎	1
	Clam shell (Combined use of rock cutter + bucket)	Hard	Requires rock cutter. - No waiting period for favorable tide.	○	2
On the sea	backhoe on berge (Combined use of ripper and bucket)	Soft	Work boats must be brought in	△	3
	Drag line	Soft	Work boats must be brought in .	△	4
	Crane on berge (Combined use of rock cutter + bucket)	Hard	Work boats must be brought in .	×	5

Table 2-11). This method is well-suited to dredging in shallow reef water. However, as specified in the permit requirements of EQPB, measures to prevent widespread water pollution are necessary.

2-3-2-4 Revetment

Three types of revetment structures (see Fig. 2-2 and Table 2-12) were examined. Concrete revetment was rejected because it is economically disadvantageous by requiring thick rubble mound for soft ground with foundation ground of N=5. Of the remaining two types, the Gabion structure, which cope with the site width limit, is selected.

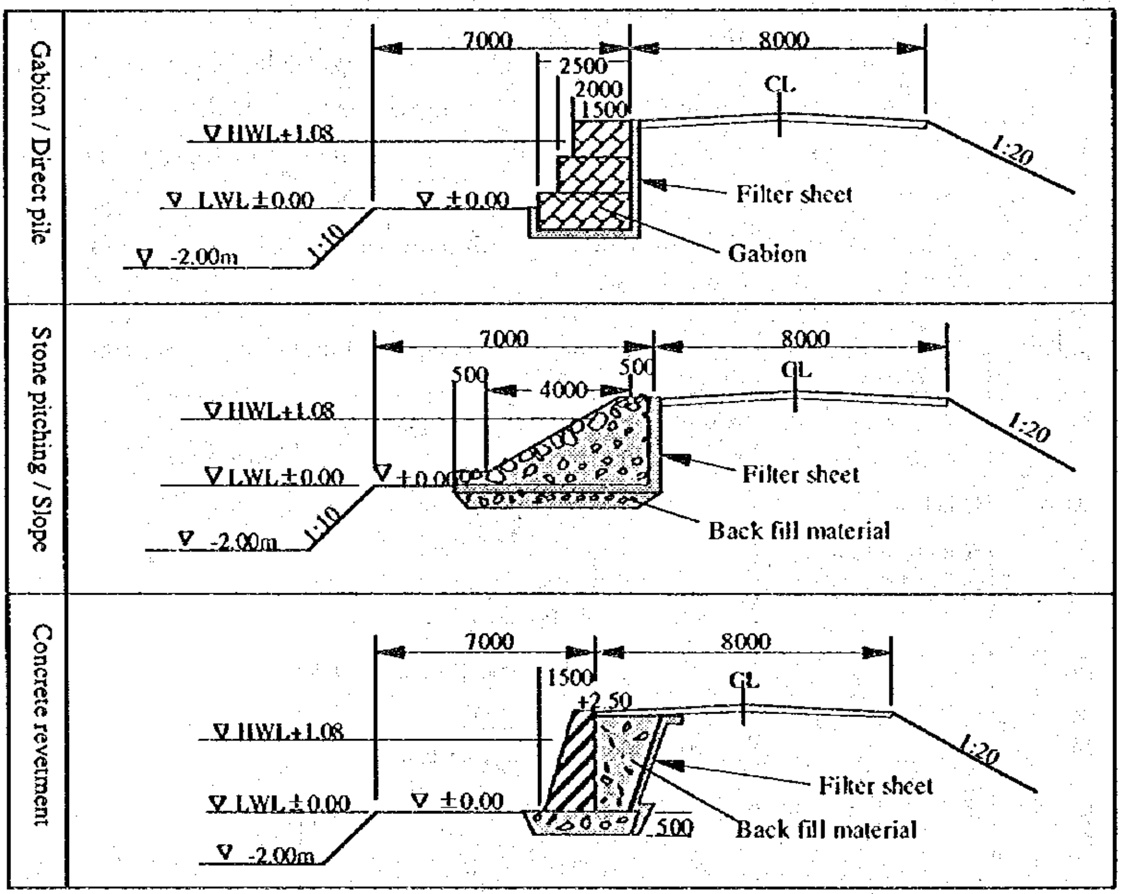


Fig. 2-2 Comparison of revetment structures

Table 2-12 Comparison of revetment structures

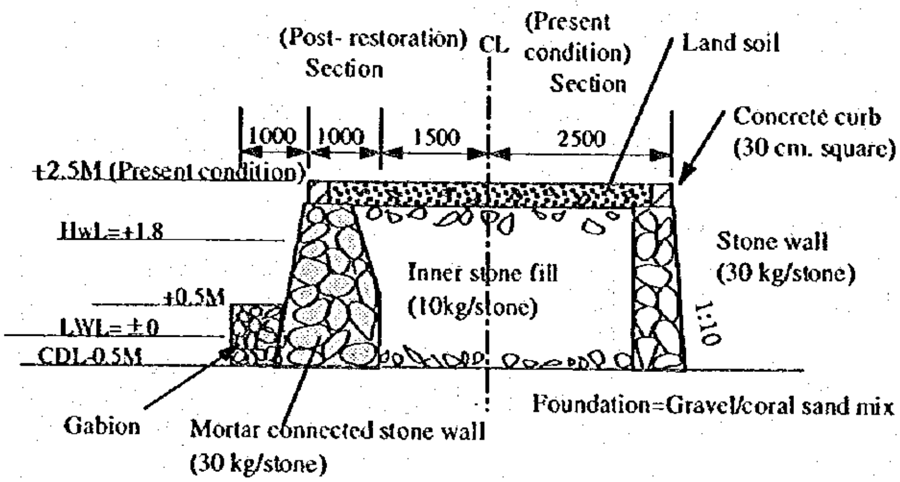
Method		Workability	Site width	Construction efficiency	Wave proof	Maintenance	Scenery	Econo-nic index	Result
Gabion / Direct pile	Dry stone	Can be constructed manually by divers and labors.	2-3m	Very high	Reflected wave is small. Collapse by large wave.	Filling stone falls out when wire net is cut. If this occurs, repair is necessary.	No special problem, since materials used are produced in the area.	100	1
	Mortar stone	Same as above	Same as above	Same as above	Medium size reflected wave	Not necessary basically	Cement color	120	
Stone covered / Slope (Wet)		Same as above	4-6m	Same as above	Small reflected wave	Same as above	Cement color	120	2
Con-crete	Cast in place	Frame work	2-3m	Block casting yard is needed.	High durability	Not necessary	Looks unnatural since concrete wall is exposed.	400-500	3
	Block pitching	Crane and trailer are needed for block installation		Care-full storage for cement and aggregate is needed.	Large reflected wave				

2-3-2-5 Restoration of stone masonry causeway

As shown in Table 2-13, the following methods were examined to restore the stone masonry of the existing causeway; ① Injecting mortar or concrete into niches of the existing dry stone wall; ② Pressing mortar into niches of stone wall; and ③ Reinforcing front base of mortar-stone by gabion for greater stability.

③ was selected because only this combined method ensures stability of the causeway for soft ground of N≦5.

There are minor problems with this method regarding natural scenery, but a safe causeway was given priority over scenery.



Note: "Mortar connected stone wall" means "Wet mansory"

Fig. 2-3 Section of causeway in Ngardmau site

Table 2-13 Restoration method for stone masonry of causeway (Ngardmau)

	Wet masonry for whole area/50cm thick	Mortar injection for whole area/50cm thick	Combined masonry
Quantity/m long	Dismantle: $3m^2 \times 0.5$ m = 1.5 m^3 Wet mortar : 0.5 m^3 Stone masonry: 1.5 $m^3+\alpha$	Water proofing: 3 m^2 Washed: 1.5 $m^3+\alpha$ Mortar injection: about 1 m^3	Upper half : Wet masonry Lower half : Gabion pile work (2 piles) Gabion: 3 m^3
Construction method	Mostly manual power Scaffolding necessary. Prevention of core material collapse (unnecessary for stone material.	Injector needed Scaffolding necessary Injecting quantity increases if core material is stone.	Mostly manual Scaffold necessary Easy to prevent core material collapse.
Cost performance	100	150	120
Construction period	Waiting for favorable tide necessary (~10m^2/day)	Waiting for favorable tide necessary (~20m^2/day)	Less waiting time for favorable tide (~15m^2/day)
After restoration is completed			
Durability	High	High	High
Appearance	(Stone + Mortar)	(Cement color)	Irregular shape and color.
Maintenance management	Can be maintained by people in the area.	Not necessary	Can be maintained by people in the area.

2-3-2-6 Apron pavement

The dock will be used for small and mid-size fishing boats. Therefore cast-in place concrete which has proven effective for light loads is selected. To prevent chamber cracks and slab expansion or contraction from daily temperature fluctuations ($\Delta T \fallingdotseq$ 6℃), vertical and horizontal joints and surface wire mesh on the surface will be installed every 5 m.

The paving surface is sloped so that rain may naturally drain into the ocean, but it is not steep enough to disturb cargo handling. Due to the crown height of the sea-wall is (+2.5 .m), flooding could occur several times a year when high tides coincide with stormy weather. A wall 50 cm. deep should be installed on the side face of the apron pavement so that the lower pavement base does not erode.

K (Sub-grade) :	Road bed settled at 30 cm: K30=7~10kg/cm^3
K (Road bed) :	Aim for K30≧20kg/cm^3.
Thickness of pavement :	Defined at 20 cm. for light load (CPI)
Concrete quality :	Water curing at 20℃ - 28 day bending moment tensile strength = 45 kg./cm^2 (Standard compressive strength = 240 kg./cm. Class 2)

2-3-2-7 Simple pavement for access road

At both sites a simple pavement (gravel/ coral mixed sand; gravel/bauxite mix 30 cm. thick) like that of the present village road suffices for the access road that extends from the beach to the sea, foreseeing the extent of vehicle traffic in the near future.

The road width for the Ngaraard site will be 6 m. with two lanes (one lane=3 m.), which is Type 3 Class 3 (prefecture road with fewer than 500 vehicles per day, according to design standard). In Ngardmau the present access road width (one lane road with effective width of 3.5 m.) will be unaltered.

2-3-2-8 Turnout

The turnout, used as a stopping zone, is designed as 10 m. long and 3.0 m. wide (2.5 m. + 0.5 m. shoulder). The revetment will be a direct pile structure, and the present dry masonry will be replaced with a wet masonry.

2-3-2-9 Auxiliary facilities

① Mooring post

A 2 ton mooring post is sufficient for mid-size fishing boats. A 30 cm. square granite mooring post remains at the Ngardmau site. It is undamaged and should be reused if so proposed.

At the Ngaraard site a mooring post is made from a 20 cm. square stainless steel pipe filled with concrete.

At each site there will be a 15 cm. square stainless mooring ring for small boats.

See 2-2-3 for ② light beacon, marker ③ road shoulder indicating curb (Ngaraard).

2-3-2-10 Construction plan

(1) Basic plan of waiting house in Ngaraard state

1) Layout

The waiting house site will be approx. 6 m. of the 40 m. docking facility frontage made from reclaimed land in this project. The front area of the waiting house (wharf's channel side area) should as much as possible be kept to facilitate cargo handling and passenger boarding and alighting.

The waiting house will be at the dock end to allow for flexible and varied use of the 30 m. frontage (remaining dock area), such as unloading materials or fish catch. This will promote local industries, including offshore fishery.

2) Site plan

Pursuant to the layout, the area connected to the road has a porch, and the rectangular waiting house is parallel to the channel. The dock area in front of the waiting house, used mainly for passenger boarding and alighting, should be 2.5 m. wide.

3) Section

The waiting house floor should be reasonably elevated to allow for large waves. The waiting house roof will be large enough to provide shade from strong sunshine and water-proofed with pitch to protect from heavy rains common in this area.

4) Finishing plan

Finishing materials, chosen for structural strength and durability, easy maintenance and onsite availability (especially materials needed in large quantities), are listed below.

- Exterior finishing

- Roof : Colored aluminum or stainless steel roofing over asphalt water-proofing sheet.

- Eaves gutter:

Outer eaves : Marine paint over exposed concrete

Inner eaves : Urethane rubber water proof coating over cement mortar steel trowel finish

- Post and beam : Marine paint over exposed concrete

- Porch: Urethane coating on cement mortar steel trowel finish over slab on earth.

Outer plinth : Marine paint over exposed concrete

-Interior finishing

Ceiling : Preservative paint over ceiling board (2 x 4)

Post and beam : Marine paint over exposed concrete

Plinth : Marine paint over cement mortar steel trowel finish

Floor : Urethane coating on cement mortar steel trowel finish over slab on earth

5) Structure plan

The foundation floor, post, beam, and eaves will have a reinforced concrete, rigid-frame structure. The roof will have a heavy timber truss structure which reduces weight by minimizing the structural weight influence of the nearby sea-wall. The foundation will be built with flexibility in accord with the sea-wall construction method.

In deciding on a foundation method, individual footing and combined footing foundations should be considered without over-regard for the usual two-direction, continuous footing. As said before, it should be kept in mind that the foundation will be a little deeper than usual to minimize the load on the sea-wall.

Projecting from the shoreline, the site is exposed to strong wind and rain and is highly susceptible to salt-related damage. A reinforced concrete structure is selected for its strength, durability and widespread use in the Republic of Palau.

(2) Basic plan for waiting house in Ngardmau.

1) Site plan

The project site in Ngardmau is located on the present dock extending offshore. It was requested in the proposal that the new sea wall built by this project be used as the waiting house construction site. But the waiting house has been set in the center of the project site. Then the new sea-wall can be flexibly and effectively used to develop offshore fishery and other local industries, and to facilitate boarding and alighting of local residents and tourists,

This central area has concrete structures for loading bauxite left over from Japanese occupation: a three-story concrete rigid-frame structure and pulley block cable railway for ore transportation. Between the two structures are two rows of concrete foundation, the upper part of which has collapsed. The waiting house will be built in the inner area of these foundations, since removing them would be expensive.

2) Floor plan

To the south and north of the project site is an open view of the sea. To the west (offshore) is a pulley block of cable railway, and to the east (land) is a three story rigid-frame structure. The state government plans to retain the three story structure but remove the pulley block.

The three story concrete structure is partially cracked, exposing the reinforcing bars. The structure leans slightly, and while there is no present danger of if falling down, in the long run it should be restored. The scenic view from the third floor attracts many foreign tourists who also visit the waterfall and the mine remains inland.

The crown of the tallest existing foundation both north and south of the project facility is 50 cm. higher than the project dock apron height, about the same height as the causeway-linked dock section. A porch or balcony will thus be built around the waiting house over the existing foundations.

3) Section

The waiting house floor should be reasonably elevated to protect against storms. The plan should also take into account the existing foundation height.

The waiting house roof gives protection from strong sunshine. The roof should be made water-proof with pitch, since heavy rains are common to the area.

4) Finishing plan

The finishing materials, chosen for structural strength and durability, easy maintenance and onsite availability (especially materials needed in large quantities) are listed below.

- Exterior finishing

Roof : Colored aluminum or stainless steel roofing over asphalt water-proofing sheet.

Eaves gutter:

Outer : Marine paint over exposed concrete

Inner : Urethane rubber water proof coating over cement mortar steel trowel finish

Post and beam : Marine paint over exposed concrete

Porch : Urethane coating on cement mortar steel trowel finish over slab on earth.

Outer plinth : Marine paint over exposed concrete

- Interior finishing

Ceiling : Preservative paint over ceiling board (2 x 4)

Post and beam : Marine paint over exposed concrete

Plinth : Marine paint over cement mortar steel trowel finish

Floor : Urethane coating on cement mortar steel trowel finish over slab on earth.

5) Structure plan

The foundation, floor, post, beam, and eaves will have a reinforced concrete rigid-frame structure. The roof will be of heavy timber truss to reduce weight by minimizing the influence of the nearby sea-wall's structural weight. The construction method must be flexible to adapt to the sea-wall construction method.

The selection of a foundation should involve examining not just the commonly used two-direction continuous footing, but also the individual footing and combined footing foundations. As said before, it should also be kept in mind that the foundation should be a little deeper than usual to minimize the load on the seawall.

Projecting from the shoreline, the site is exposed to strong wind and rain is highly susceptible to salt-related damage. A reinforced concrete structure is selected for its strength, durability and widespread use in the Republic of Palau.

2-3-2-11 Machinery plan

Large cargo items, such as fuel drum cans (200 kg.), fish refrigerator boxes (200 liters : 100~150 kg.), outboard motors, small FRP boats, agricultural products, private construction materials (timber, pipe, tin roof material, concrete block, gravel, cement) must have onsite cargo handling machinery.

After considering details of crane truck type and crane and tonnage capacities, the all-purpose diesel crane truck was chosen for its ability to handle the above-mentioned cargoes, its diverse public utility functions and its easy, inexpensive maintenance.

1) Crane specifications (numbers are approximate)

Maximum lifting capacity	2,000 kg.
Maximum operating radius	4,000 mm.
Maximum land lift	5,600 mm/
Boom length	2,400~4,400 mm.
Turning ability	360 degrees
Boom type	Two-stage hydraulic telescope
Hoist rope	9 mm.(diameter) x 25 m.(length)
Hydraulic pressure pump	Gear drive (PTO)

Boom retraction	Front retraction
Outrigger	Hydraulic/Manual pull out
Safety devices	(Overloading prevention, Over-winding warning, Load indicator, etc.)

2) Vehicle type / Specifications (numbers are approximate)

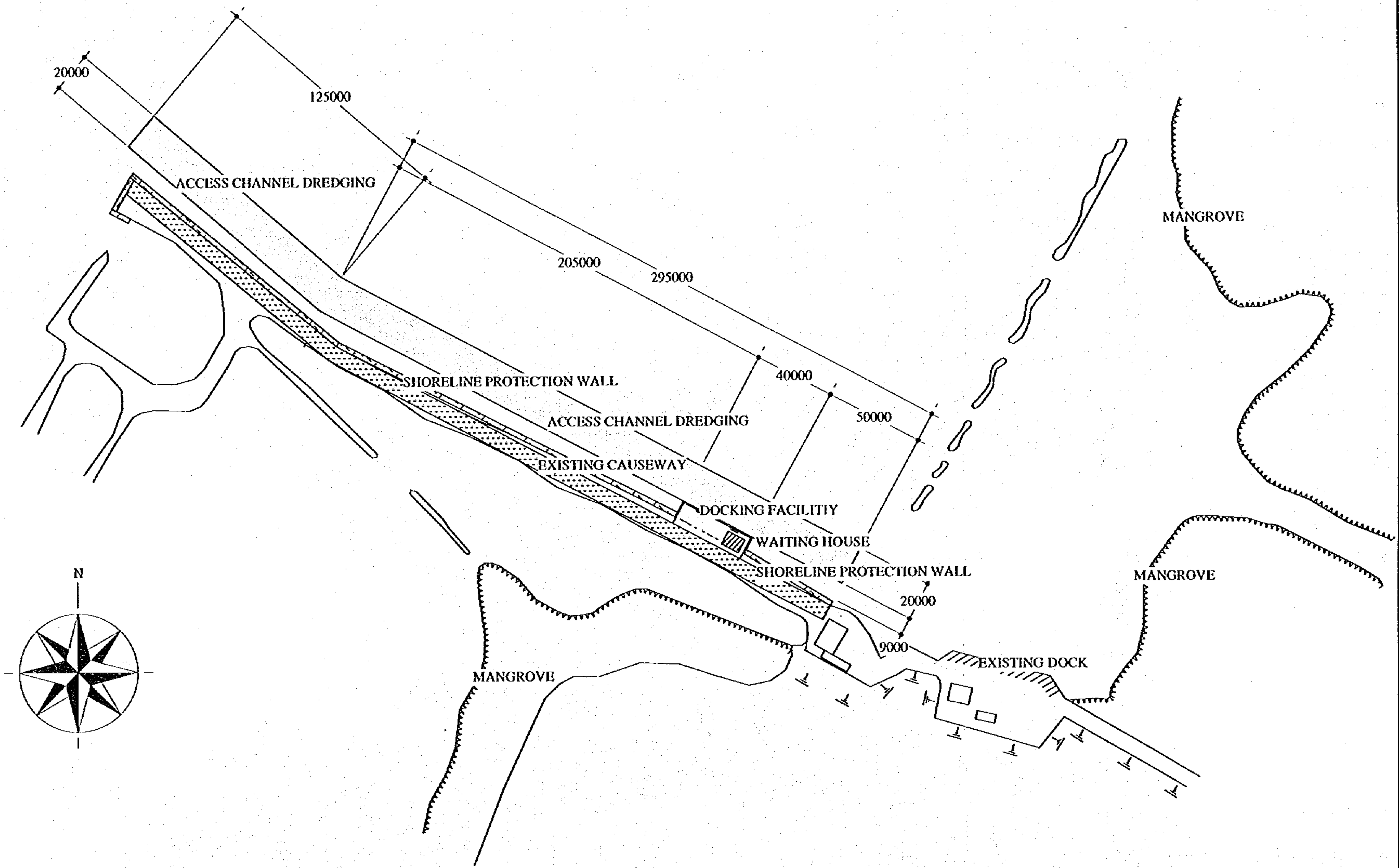
Length x width x height	6,400 mm. x 1,900 mm. x 2,400 mm.
Maximum payload	2,000 kg.
Vehicle weight	5,000 kg.
Rear body dimensions	Length x width x height (3,300 mm. x 1,800 mm. x 380 mm.)
Engine	Diesel engine
Displacement	3,000 cc (power in excess of 85 Hp)

Crane features

Operating radius	1.8	1.9	2.0	2.2	2.5	3.0	3.5	4.0	4.2
Rated crane lifting capacity	2.02	1.82	1.62	1.37	1.12	0.82	0.67	0.57	0.57

2-3-2-12 Basic design drawing

1. NGRD-D 01 Ngaraard docking facility plan
2. NGRD-D 02 Ngaraard docking facility general plan and section
3. NGRD-D 03 Ngaraard shoreline protection sea-wall section and close-up section.
4. NGRD-D 04 Ngaraard waiting house general plan, elevation, section
5. NGRDM-D 01 Ngardmau site plan
6. NGRDM-D 02 Ngardmau docking facility plan
7. NGRDM-D 03 Ngardmau docking facility general plan, section
8. NGRDM-D 04 Ngardmau waiting house general plan, elevation, section, facade.



OAFIC OVERSEAS AGRO-FISHERIES CONSULTANTS CO., LTD.
TOKYO, JAPAN

SHUWA DAINI TORANOMON BLDG. 2F, 21-19, TORANOMON 1-CHOME, MINATO-KU, TOKYO 105, JAPAN
TEL 81-3-3504-0769 TELEX J 27178 OAFIC E-mail:oafic@gol.com NIFTY:KYJ00252
FAX 81-3-3504-0779

PROJECT TITLE:	PROJECT FOR IMPROVEMENT OF FACILITIES FOR FISHINGVILLAGES IN NORTHERN STATES IN THE REPUBLIC OF PALAU
DRAWING TITLE:	NGARAARD / SITE PLAN
DESIGNED BY:	N. ITOI
DRAWN BY:	T. ISHII
CHECKED BY:	
APPROVED BY:	
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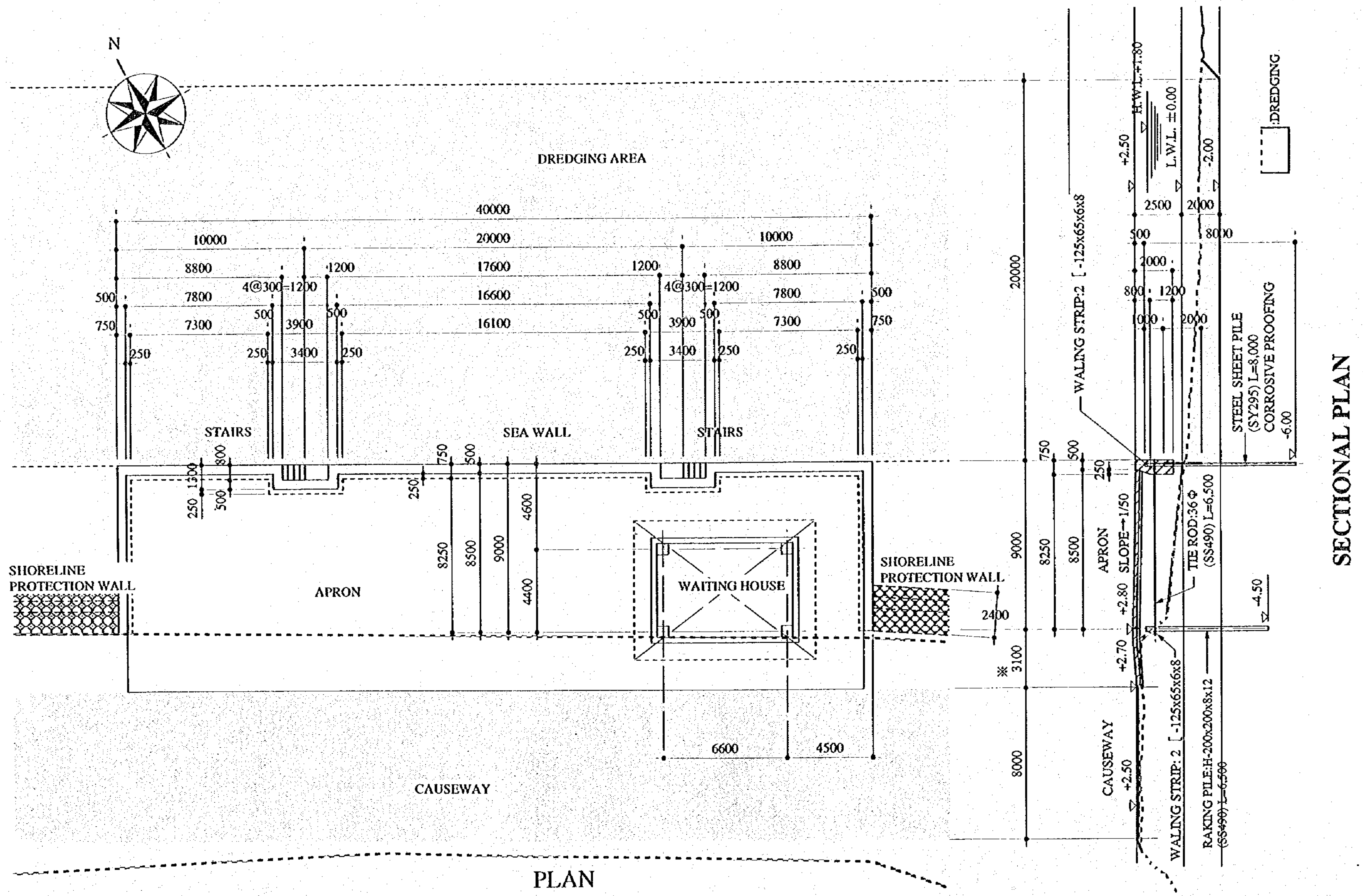
DATE:	JAN.24.96.
DRAWING NO.	NGRD-D-01



PLAN

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TOKYO, JAPAN

SHUWA DAINI TORANOMON BLDG. 2F, 21-19, TORANOMON 1-CHOME, MINATO KU, TOKYO 105, JAPAN
TEL:81-3-3504-0769 TELEX:J 27178 OAFIC E-mail:oafic@gol.com NIFTY KYJ00252
FAX:81-3-3504-0779

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DRAWN BY:	T. ISHII
CHECKED BY:	
APPROVED BY:	
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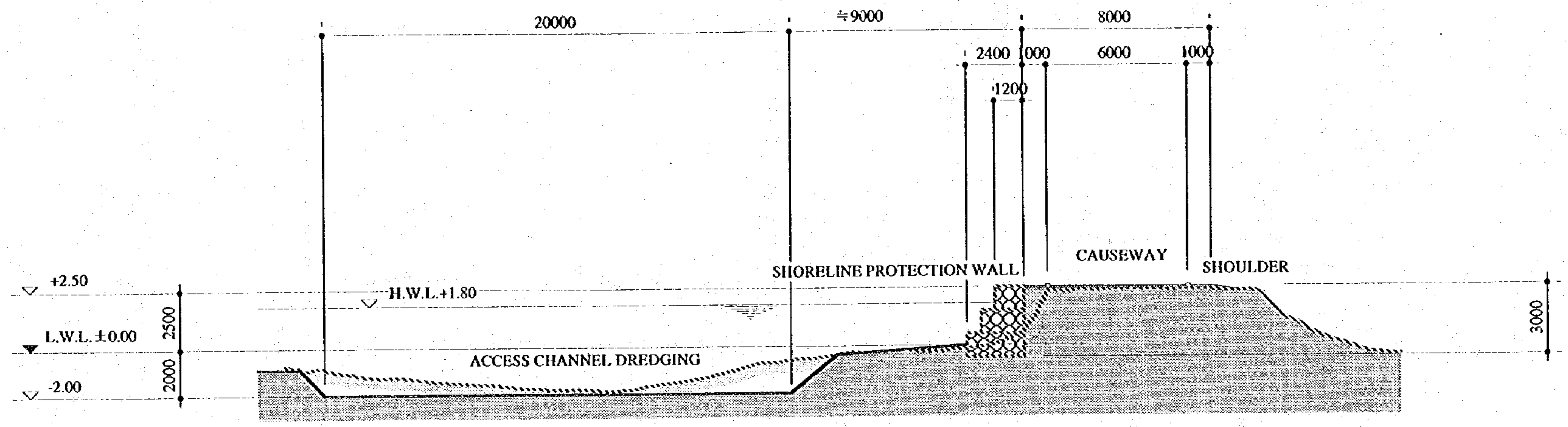

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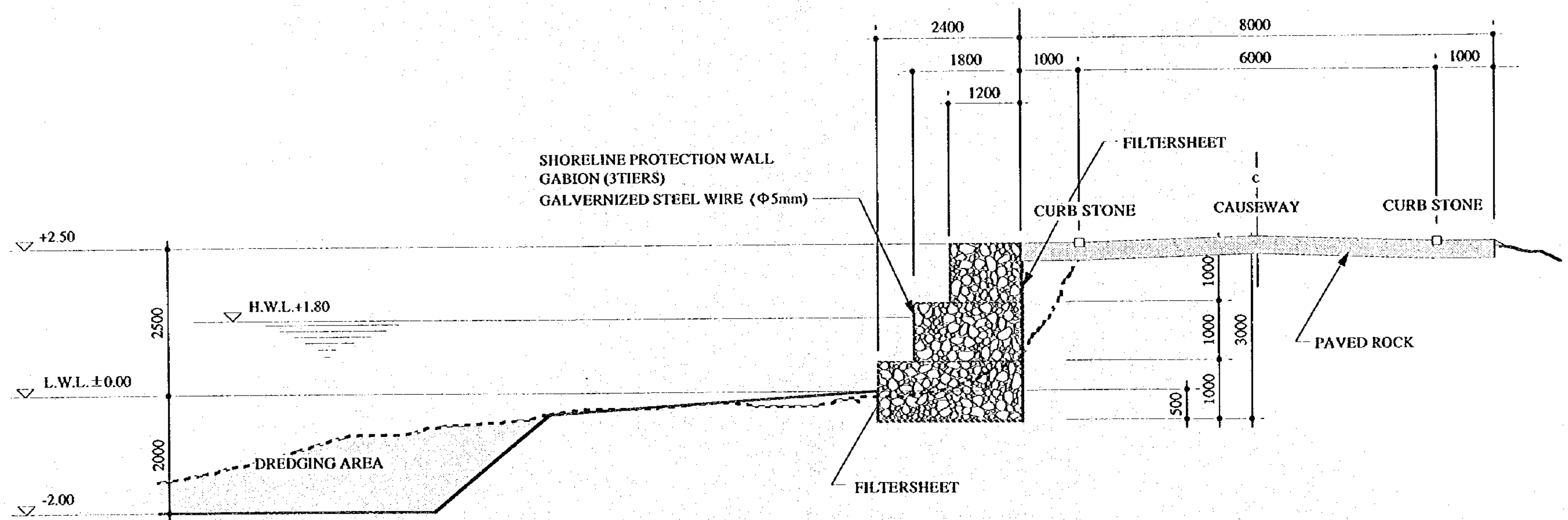

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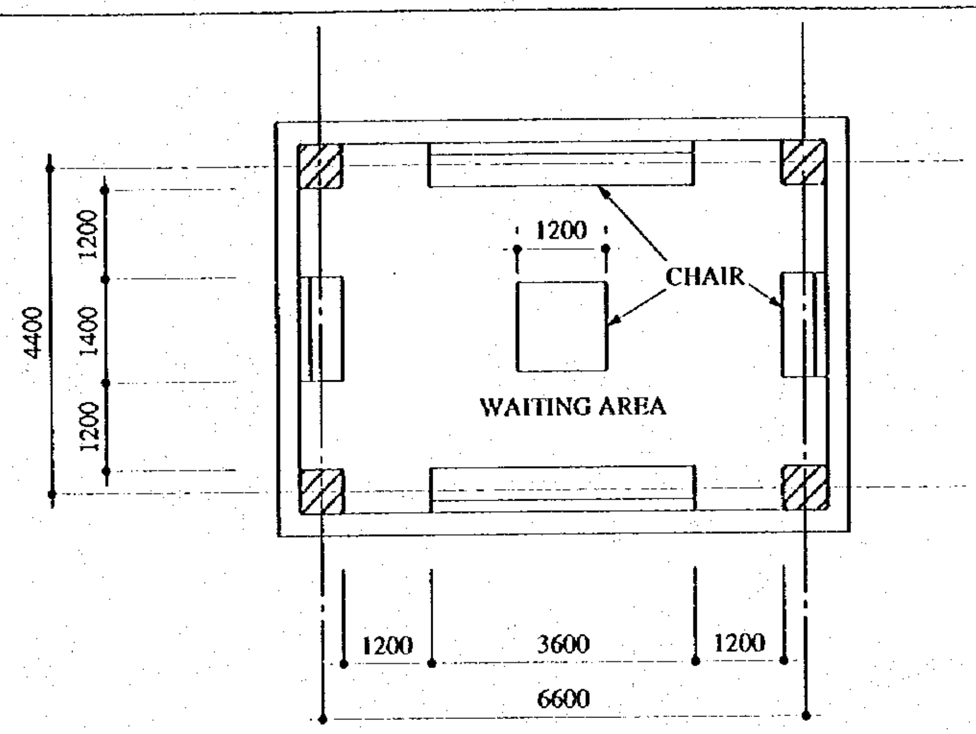
TOKYO, JAPAN

SHUWA DAINI TORANOMON BLDG. 2F, 21-19, TORANOMON 1-CHOME, MINATO-KU, TOKYO 105, JAPAN
TEL 81-3-3504 0769 TELEX J 27178 OAFIC E-mail oafic@gol.com NIFTY KYJ00252
FAX 81-3-3504-0779

PROJECT TITLE:
PROJECT FOR IMPROVEMENT OF FACILITIES
FOR FISHINGVILLAGES IN NORTHERN STATES
IN THE REPUBLIC OF PALAU

DRAWING TITLE:
NGARAARD SHORELINE PROTECTION WALL
/ SECTIONAL PLAN & SECTIONAL DETAIL

DESIGNED BY:	N. ITOI
DRAWN BY:	T. ISHII
CHECKED BY:	
APPROVED BY:	
SCALE:	1:200 , 1:75
DATE:	JAN 24 96
DRAWING NO.	NGRD-D-03



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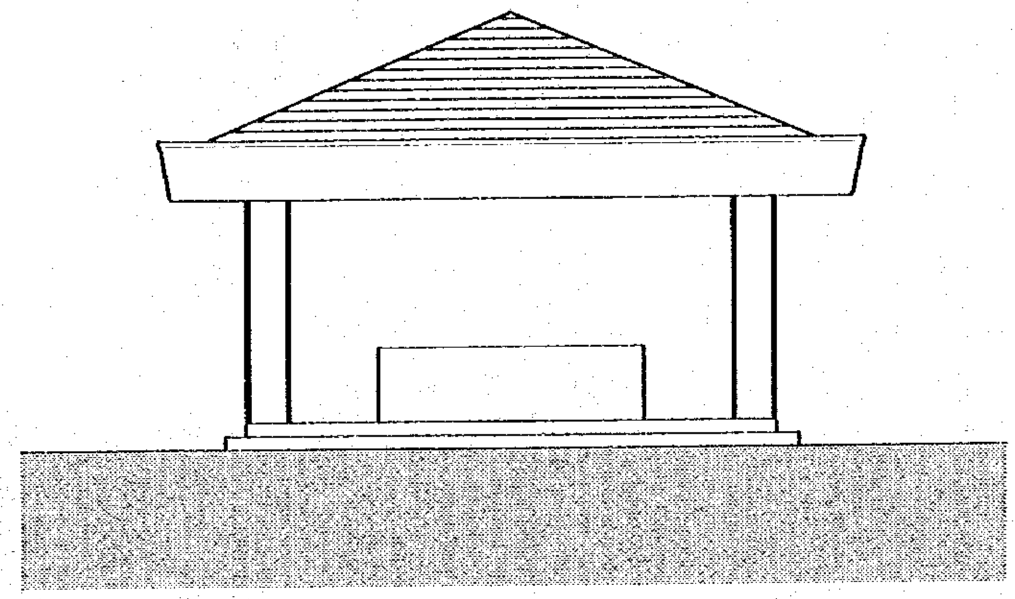

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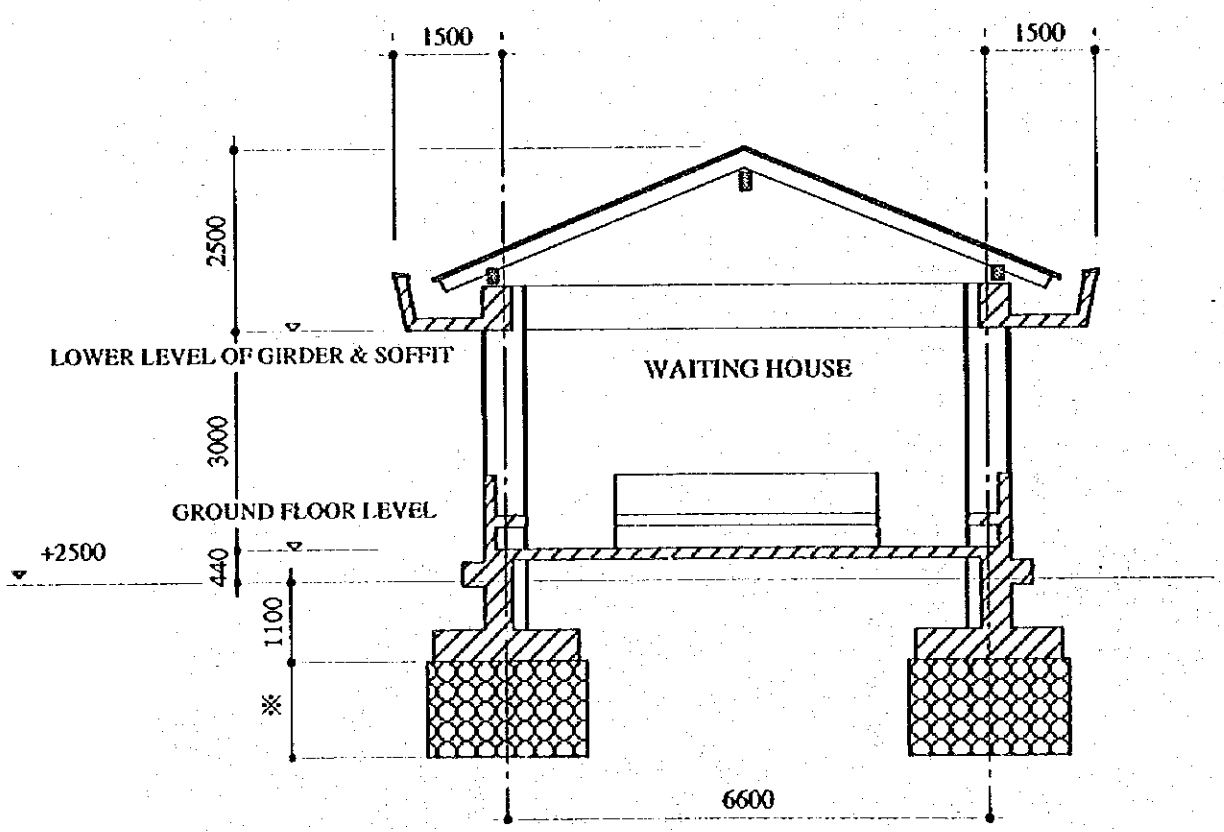

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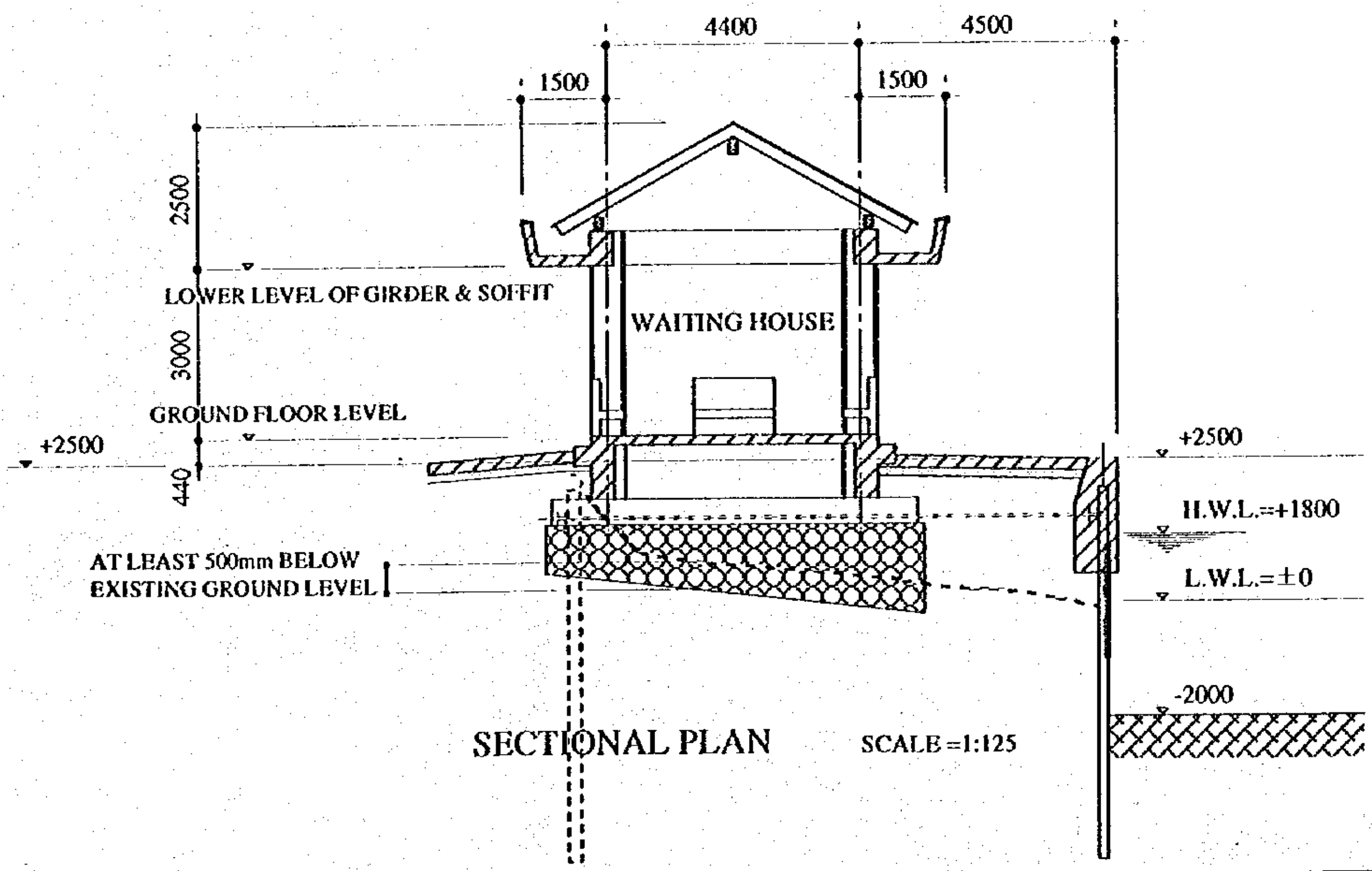

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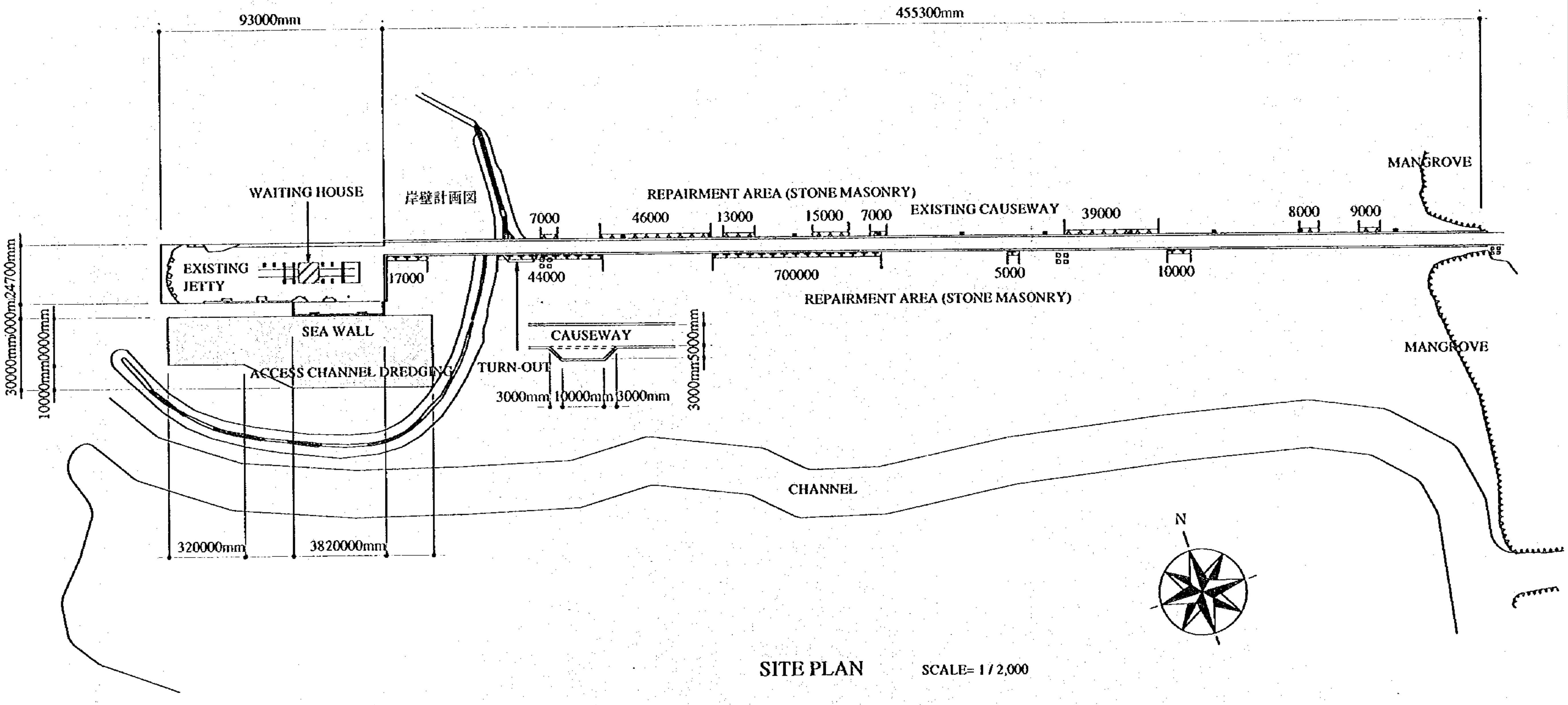

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TOKYO, JAPAN
SHUWA DAINI TORANOMON BLDG. 2F, 21-19, TORANOMON 1-CHOME, MINATO KU, TOKYO 105, JAPAN
TEL:81-3-3504 0769 TELEX J 27178 OAFIC E-mail:oafic@gol.com NIFTY KYJ00252
FAX 81-3-3504 0779

PROJECT TITLE:	PROJECT FOR IMPROVEMENT OF FACILITIES FOR FISHING VILLAGES IN NORTHERN STATES IN THE REPUBLIC OF PALAU
DRAWING TITLE:	NGARDMAU / SITE PLAN
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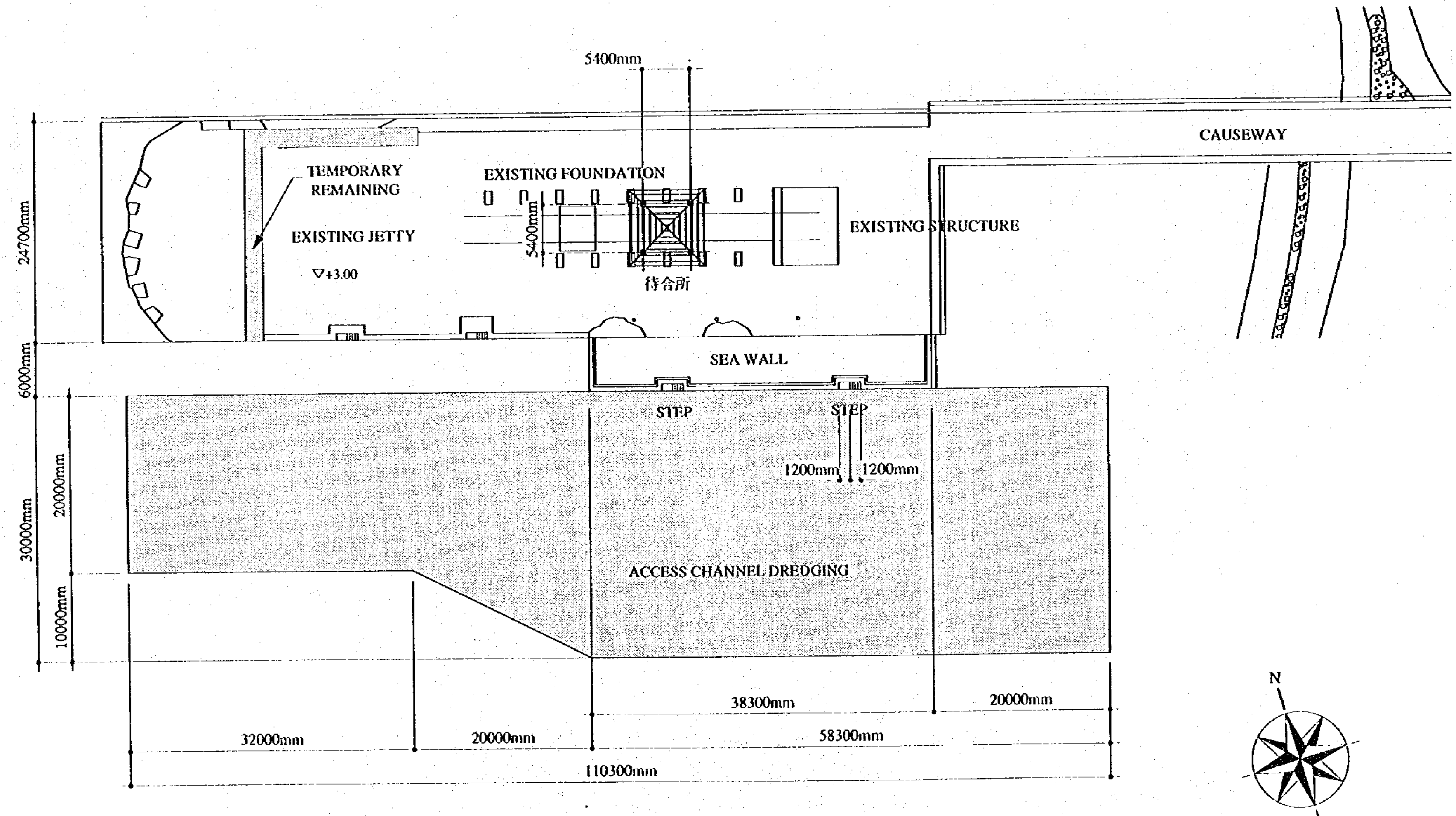

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TOKYO, JAPAN
SHUWA DAINI TORANOMON BLDG. 2F, 21-19, TORANOMON 1-CHOME, MINATO-KU, TOKYO 105, JAPAN
TEL 81-3-3504-0769 TELEX J 27178 OAFIC E-mail oafic@gol.com NIFTY KYJ00252
FAX 81-3-3504-0779

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DRAWING TITLE:	NGARDMAU DOCKING FACILITY / SITE PLAN
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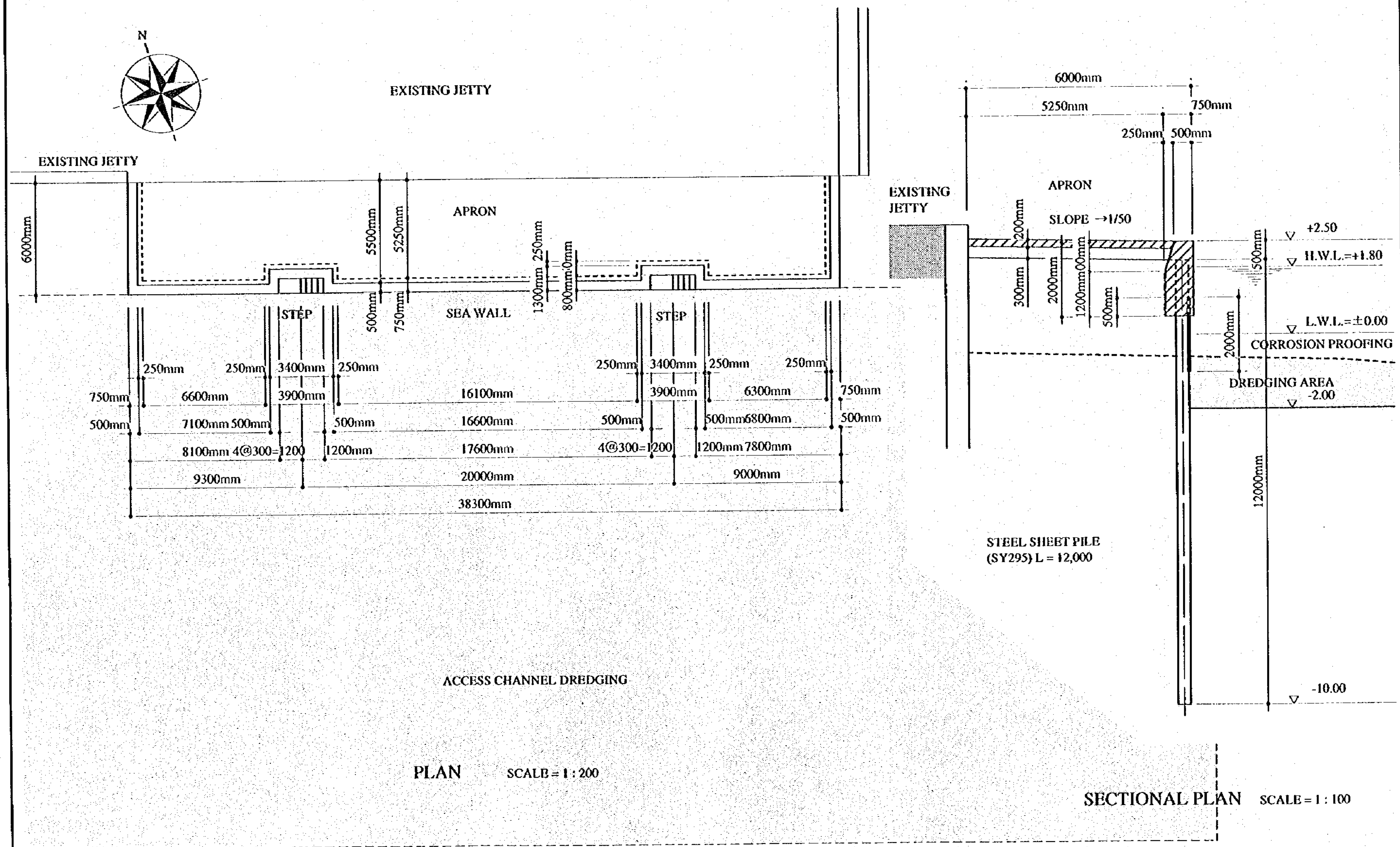

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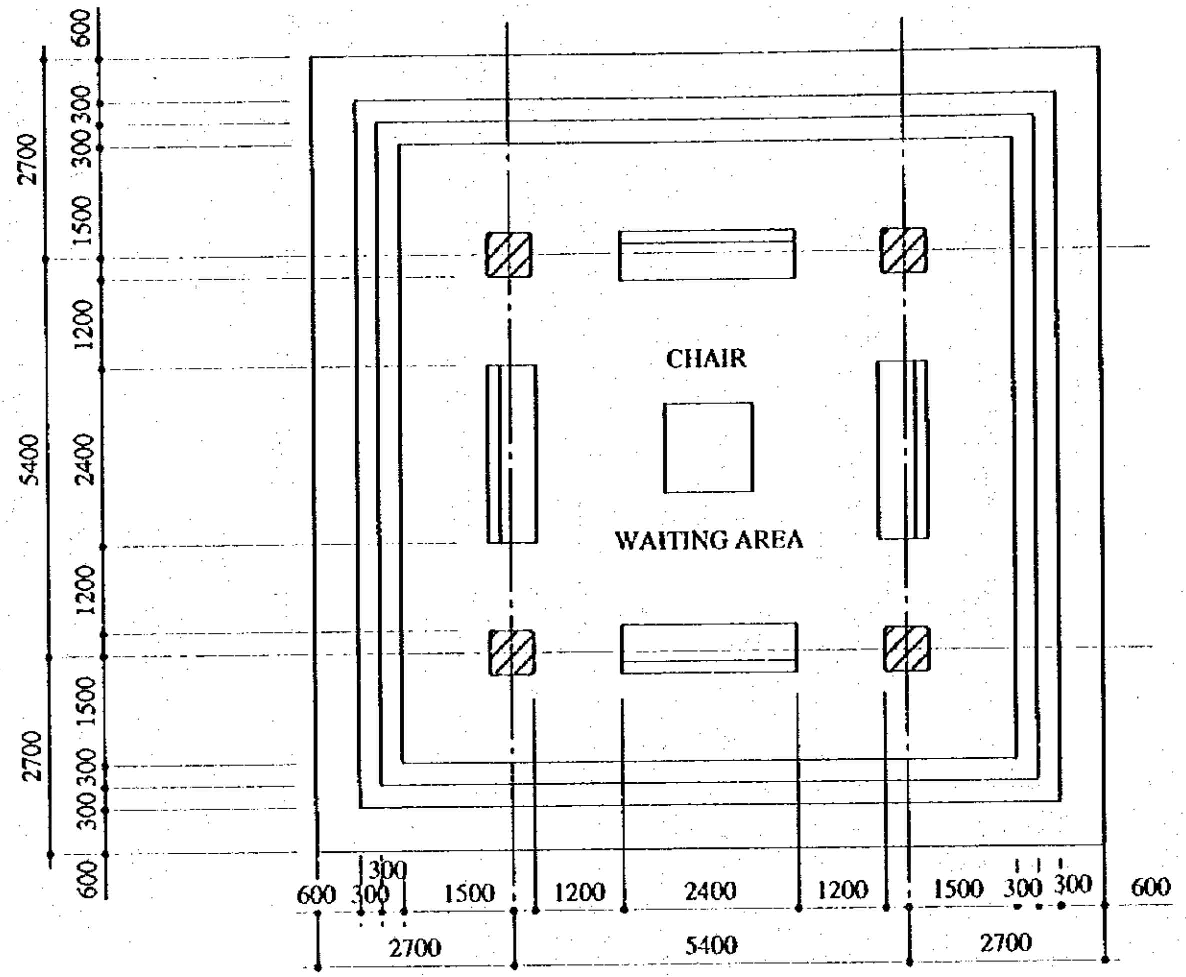

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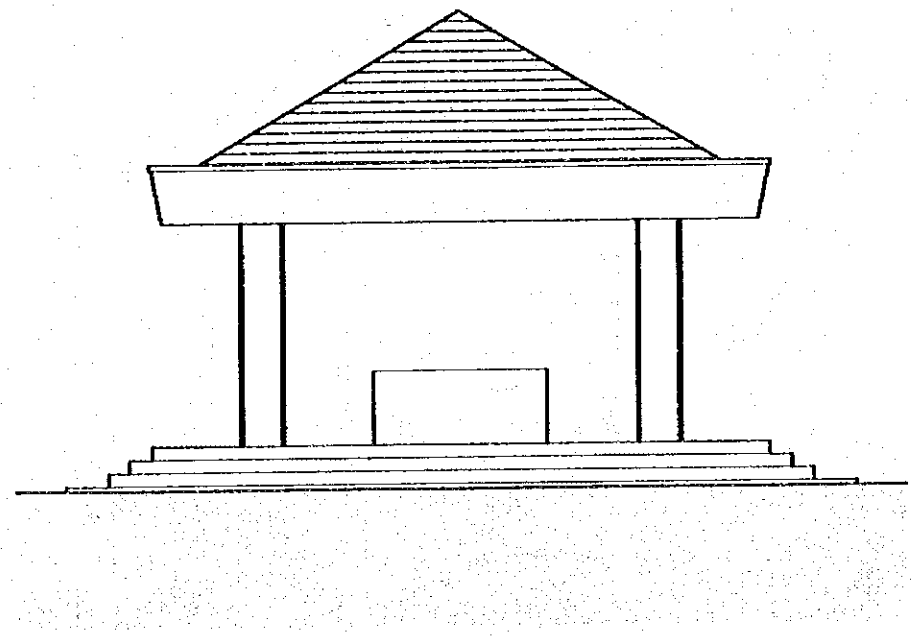

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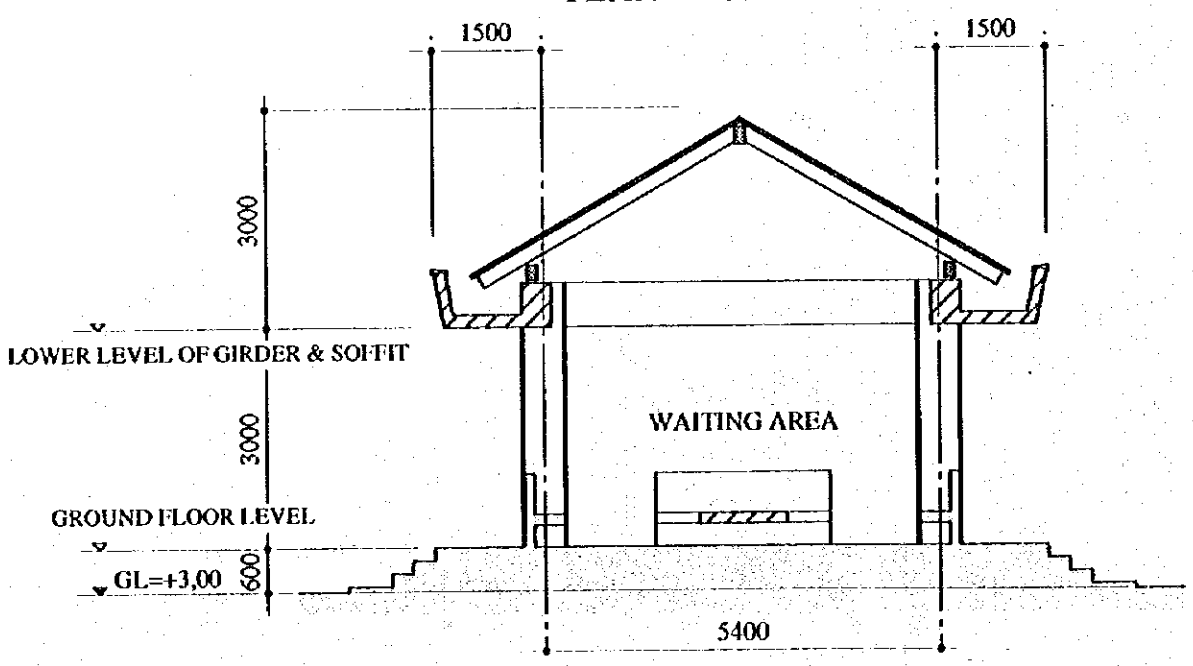

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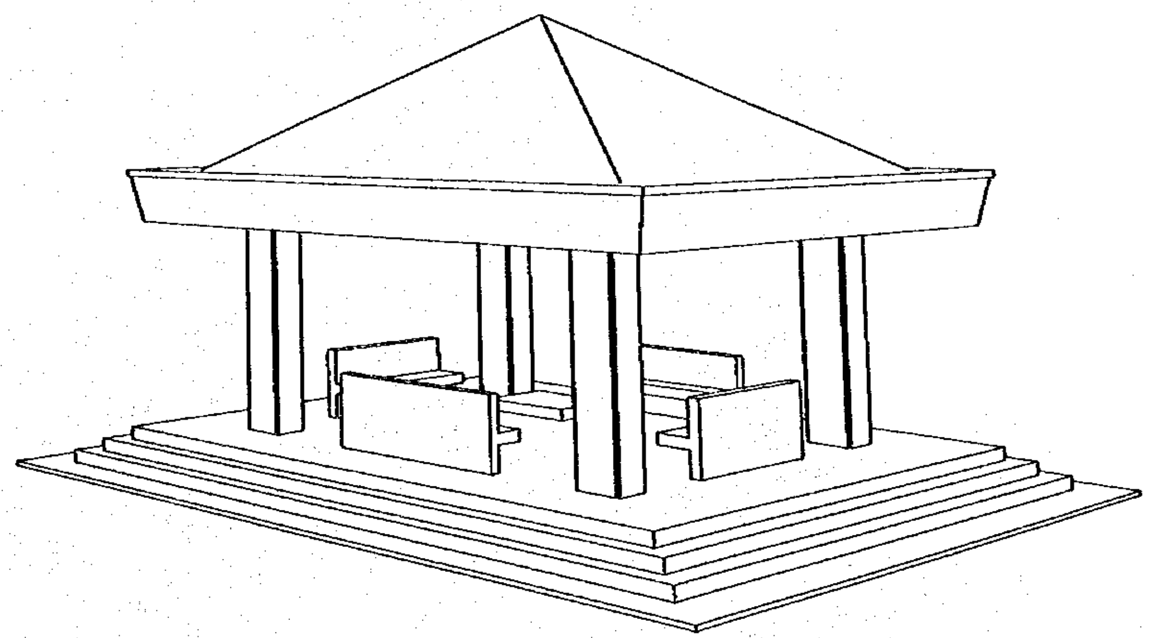

PERSPECTIVE

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CHAPTER 3 IMPLEMENTATION PLAN

3-1 Implementation plan

3-1-1 Implementation concept

This project is implemented as follows: First, a Exchange of Notes is concluded between the Government of Japan and the Government of Palau. A design implementation contract is signed between the Government of Palau and a consultant recommended by JICA. The consultant conducts the necessary field study, detail design, project cost estimate and comparison of basic design and detail design; and then prepares the required contract documents of tender. With the authorization of the Government of Palau, the consultant selects a contractor. This is a Japanese corporation by public announcement of tender; qualification examination for tender; tender; and examination of tender documents.

The construction contract is signed between the Government of Palau and the contractor. Then facility construction, and procurement and delivery of equipment and materials are implemented.

General issues, and issues for project implementation specifically, are described below.

(1) Ministry overseeing project

In Palau, the Ministry of Resources and Development will as overseer of the project be responsible for contracts of the consultant, construction contractor, etc. The Division of Marine Resources of the Ministry will as overseer of the project implementation be responsible for procedures pertaining to other ministries, examination of implementation contents, authorization, and adjustment and advice for a smooth operation.

(2) Consultant

After the consultant contract is signed, the consultant, as an implementation agent of the government of Palau, explains in detail the project contents with the recipient country, prepares tender documents, tender-related works and construction supervision, as set forth in the Exchange of Notes and the JICA Consultant Guidelines.

To supervise construction, civil engineers are sent for the entire duration of construction, and architects are sent for short periods as needed.

The local consultant in Palau will supervise the survey of land sections and the investigation of soil and materials.

(3) Contractor

The contractor will be responsible for facility construction, and procurement and delivery of equipment and materials, etc.

Contractors in Palau will oversee the rental of heavy construction machinery (with operator/ driver); the transport of material and equipment from Malakal to each site; and the procurement of construction labor.

(4) Implementation plan

As a rule, construction methods common to Palau should be used for the project facility construction. An exception is the steel sheet pile method for the docking facilities since it shortens the construction period. To counteract salt-related damage, a corrosion preventive will be pre-applied in Japan to the exposed splash belt.

Priority should be given to construction methods that are widespread in Palau.

① The labor, equipment and materials of Palau should be used whenever possible. A method of construction appropriate to the site should be selected.

② The operating rate of heavy machinery should be increased so that both sites may be completed within one fiscal year.

③ Attention should be paid to natural conditions and environmental conservation.

④ To avoid conflict, there should be close contact with the state government and area residents.

⑤ Respect should be given to the culture and traditions of the recipient country.

The mode of transport for materials and equipment should be carefully selected. The project site is more than 20 miles from the capital and its land routes are poorly developed, so that in a sense it is like an isolated island.

- In plans related to construction schedule, storage and transport of material and equipment, weather must be taken into account.

- Facilities should be built with consideration for the effects of salt damage salt removal of fine aggregate, etc.), since the project sites are on the coast.

1) Implementation plan for docking facility construction in Ngaraard and Ngardmau.

   The vibrohammer is selected (on land) for piling machinery, to minimize the side effects of construction, since there are historical structures next to the Ngardmau site.

   For the same reason Ngardmau will use the free stand steel sheet pile. The area near Ngaraard has no restrictions, and therefore a counterfort type tie rod. will be used. Each site is entirely constructed with time-saving machinery to reduce costs. Materials and equipment are shipped from Japan and unloaded in the Malakal port of Palau. They are then shipped to the Ngaraard site, which requires a considerable amount of sheet pile piling work for domestic marine transport. After finish the piling work at Nagaraard, materials and machines are systematically transported to Ngardmau for the construction.

2) Shoreline protection sea-wall in Ngaraard

   Direct piling gabion (three stage) is selected to reduce cost. The sea-wall will be built in the finished dredging area, from the land to the sea in an orderly fashion. A filter sheet placed behind the gabion will prevent back-filling erosion.

3) Restoration of causeway in Ngardmau

   In consideration of cost performance, natural conditions and environmental conservation of the surrounding area, the causeway will be repaired with the same masonry method used for the existing causeway. Reusable stones around the site will be selected to reduce costs. Wet masonry with concrete and cement mortar will reinforce the causeway being repaired. It will not be used for the existing causeway, however. Gabion (one stage) will be fixed at the masonry base on the ocean side.

4) Dredging in Ngaraard and Ngardmau

Since the water of the project dredging area is a relatively shallow CDL-2 m., building from this land is considered possible. Dredging will be done by back hoe. Priority will be given to cost reduction and ease of operation; although construction duration is also a concern. A temporary embankment should be made just enough so that the back hoe bucket can directly reach the area to be dredged. As dredging proceeds the temporary embankment is moved.

5) Waiting house construction work in Ngaraard and Ngardmau

The construction method commonly used in Palau is selected for its cost reduction, durability, and easy maintenance on completion. The posts and beams are made of concrete. The roof slab is not made of concrete but of wood to decrease weight. Since the waiting house site in Ngaraard is reclaimed docking facility land, it should be excavated at least until the rock mass, and cobble stone concrete will be used on the ground for the structure. Care must be taken that the steel sheet pile back at the foundation base is free from needless superimposed loads.

3-1-2 Implementation conditions

(1) Construction

As a general rule the state government is in charge of ordering state roads, service water, electricity, ports, etc. for the state. The central government orders interstate highways, power lines and international airport. Presently public works of both central and state government are carried out with compact funds from the U.S.A. and Japanese assistance. The construction contractor procures some construction machinery, materials (sand, ballast), and labor from construction companies in Palau.

SCIO, IBC and some other construction companies in Palau make practical use of onsite construction machinery. Many sites of these companies are in Babeldaob, but since roads are insufficiently developed (K-B bridge has also collapsed), heavy machinery is shipped from Koror to the project site by a berge leased from a private company or by tugboat and berge leased from the Philippines and Guam.

(2) Construction material

In many cases, coral sand (gravel mix) from the sea bottom is used for the roadbed of road works and embankment. More gravel facilitates compacting.

Since coral sand is lime, it becomes concrete with time and forms a quality sub-grade layer. Coral sand is obtained by a quay method especially used in Palau (Sea bottom sand is dredged by drag-line excavator from the land side. The quay is extended by the dredged coral fill from the sea bottom of both sides of the quay.). In Koror, the coral is bought through local companies. But in Ngaraard, the coral is directly gathered by IBC, a state-authorized private company.

Materials and devices needed for the project facility construction include silt, concrete, mortar, steel (reinforcement, steel frame, sheet pile), filter sheet, auxiliary devices (mooring post, markers, beacon), and construction materials (roofing material, block, paint, etc.) Materials produced in Palau are silt, sand, ballast (crushed stone) and block. Other materials, while procurable, are nevertheless imported from various countries (South Korea, Philippines, PNG, etc.). Quality Japanese construction materials should therefore be used, except for materials produced in Palau.

(3) Local characteristics

1) Quality control for concrete

Since temperature and rainfall greatly affects the quality of concrete, measures listed below are needed to keep the temperature of freshly placed concrete at less than 35 degrees C. When concrete is placed outside, rain-proofing is necessary.

① Temperature control for raw materials (cement, sand, gravel, and water)

② Concrete temperature control when concrete is placed (shade from direct sunshine if possible)

③ Temperature control and protection from drying during curing (water spray curing)

④ Prevention of spreading mud (use mud pollution prevention sheet for underwater work)

3-1-3 Work Scope

All the facilities and structures in the project sites are constructed by the Japanese counterparts. Scope of works for the recipient country and Japan are as follows.

(1) Authority and duties of the Government of Palau

① Ensure construction site and removal of obstacles from site, including water area.

② Provide coral gravel for construction works and land filling. Provide temporary yard and storage area materials and equipment.

③ Planting and outer fence-related work.

④ Customs procedures for materials and equipment used in the project, and import duty exemption.

⑤ Procedures for exemption of all tax and surcharges imposed in the event of provision of construction materials and equipment, and services.

⑥ Exemption of permission and authorization of project implementation required for all the Japanese personnel concerned, and acquisition and provision of other privileges.

⑦ Effective maintenance and management of facilities constructed by the grant aid assistance.

(2) Responsibilities of the Government of Japan

① Procurement of all construction materials and equipment.

② Transport of sea and land transport of imported construction materials and equipment; obligation of export insurance.

③ Consultant services such as implementation plan, assistance in tendering, and supervision of construction.

3-1-4 Consultant supervision

Consultant supervision must follow Japanese grant aid assistance procedures. The consultant signs the implementation design and consultant project supervision contract with the Ministry of Resources and Development, the main authority of the recipient country, and then gets certified by the Government of Japan.

After this consultant supervision contract, the consultant conducts a field study and has a conference with the Government of Palau. Then the consultant prepares the details of design, structural calculation, bill of quantities, construction specifications, and drawings needed for tendering. When the tender documents are completed, a construction contractor is appropriately selected by project approval procedures, tender qualification examination, tender, and tender evaluation.

When agreement is reached for the construction contract, the consultant checks the working drawings submitted by a domestic contractor, supervises improved quality of processed materials, witnesses quality inspection of export products, materials and equipment, and conducts the shipping inspection. When the construction work is implemented, a project supervisor is sent to the site and arranges for the contractor, supervision, quality control examination, witnesses progress survey; and prepares a duty completion report.

As stated under Implementation Plan, the project site is far from Koror, the capital. Materials and equipment are transported by sea in berge boats and are highly susceptible to weather and sea conditions. Schedule control is therefore difficult. Also, the existing sea-wall work and dredging in the basic design plan is based on available data. Given the possibility that unexpected problems may arise, flexible and appropriate measures must be prepared.

Accordingly, during the consultant supervision, drawings should be studied in detail in Japan; the construction schedule should be fully discussed with the contractor; rework at the site should be avoided; civil engineers should be sent early to the sites; and governmental authorities and contractors should be in close communication, so that work may progress quickly and efficiently.

(1) Basic concept

After the Exchange of Notes, a design supervision contract is made between the Republic of Palau and the designated consulting company (consultant), and the project gets underway. Construction is allotted very little time, since access channel dredging at both sites will start from the land to reduce costs. A time-saving construction method is used for the project docking facilities. To facilitate the work progress, preparation of implementation design documents will begin before the design supervision contract.

The consultant follows the basic design report policy: confirmation of implementation agreements; contractor selection process; tender method; facility design contents; specifications, production and transport of material and equipment; construction work schedule; turnover; etc. Various other matters are discussed and arranged with the recipient country's Division of Marine Resources, which is part of the Bureau of Natural Resources and Development.

When the project is approved for operation, the consultant details the implementation schedule to the recipient organizations. In addition, the consultant confirms procedures, custom duty exemptions, preparations, accommodations, and turnover acceptance with the Division of Marine Resources and each subject state government; and advises on duties, equipment, maintenance and management.

(2) Plans for implementation, materials and equipment production, and procurement.

Except for locally supplied materials, all facility construction materials and equipment are procured from, and produced in, Japan. During production, the consultant appoints an engineer who is familiar with materials and equipment and technically experienced, to supervise the entire work schedule. In addition, the consultant prepares tender documents: discusses and confirms specifications; approves drawings; inspects factories; and accepts delivery goods. The consultant will also see that construction is on schedule.

The chief elements of construction supervision and procurement of materials and equipment are listed below.

- Implementation, supervision and management of construction contract, and procurement of materials and equipment.
- Advise construction contractors
- Manage work schedule
- Examine and approve working drawings
- Explain and confirm material use, process and assembly method, and implementation plan.
- Give progress reports to implementing organizations of recipient country.
- Counsel on preparing and operating facilities, materials, and equipment.
- Observe acceptance and trial operation (in Japan and project sites)
- Assist and advise concerning approval procedures and contract remuneration.

(3) Construction work supervision

With two project sites, construction must progress simultaneously at both sites so that most of the work may be completed on schedule. Moreover, there are detailed clerical duties such as arrangement procedures for domestic sea transport of materials and equipment, locally supplied materials and equipment, local contract work, construction machinery lease, etc. The Japanese supervisors must therefore have two personnel for one office manager (class 3), and one civil engineer to oversee construction for the entire duration (7 months). In addition, a financial staff (class 4) will work onsite for at least 4 months from the onset of construction. Since it is difficult to acquire and install telephones and other devices at each site, construction supervision should be based in the capital Koror, with a small office (approx. 12 m. 3) built only in Ngaraard, which will handle both sites. A small boat can go from one site to another in less than an hour. The Koror lodging house rented for Japanese staff will also be used as the base office to reduce indirect costs. The site office in Ngaraard will need access to such temporary structures as a rest room, construction shed and cement warehouse.

3-1-5 Procurement plan

(1) Major materials

1) Civil engineering materials

In the procurement of civil engineering supplies, priority is given to local materials. Steel sheet pile, appurtenant steel materials, and construction machinery are difficult to get locally and will be supplied from Japan. The following table lists materials and the country from which are procured.

Table 3-1 Civil engineering materials by countries

Materials	Countries		
	Palau	Japan	Third country
Cement	○		
Aggregate	○		
Reinforcement	○		
Form steel		○	
Steel sheet pile		○	
Galvanized iron wire gabion		○	
Filter sheet, Pollution prevention curtain		○	
Form material, Timber	○		
Fuel	○		

2) Construction materials (same for both sites)

Major construction materials	Countries of procurement
Reinforcement (epoxy resin coated) :	Japan
Cement :	Palau (made in South Korea, New Guinea)
Coarse aggregate :	Palau
Crushed stone :	Palau
Timber (heavy timber) :	Japan or USA
Timber (2 x 4 inches) :	Palau (USA)
Roofing material (colored aluminum or stainless steel) :	Japan
Waterproofing for roof :	Palau or Japan
Paint :	Palau or Japan

(2) Major construction machinery

As a rule, project construction machinery will be obtained locally, and only machinery not readily available locally will be supplied from Japan. The plan of machinery procurement by country is shown in the following table. Third country procurements are not under consideration.

Table 3-2 Construction machinery by countries of procurement

Machinery	Specification	Palau	Japan	Third country	Remarks
Crawler crane	40t.		O		Unavailable locally
Vibrohammer	40Kw Motor operation		O		Unavailable locally
Engine generator	200KVA		O		Unavailable locally
Engine generator	50KVA	O			
Bulldozer		O			
Back hoe	$0.6m^3$	O			
Truck crane	15-20t	O			
Concrete mixer	$0.3m^3$	O			
Other		O			

(3) Mechanical equipment

Crane trucks (machinery for cargo handling) are procured in Japan for the following reasons.

- Most crane trucks used in Palau are made in Japan, so after-service is established and spare parts are locally available.
- Drivers and operators in Palau are most familiar with the Japanese crane. Therefore, procuring Japanese cranes will minimize operational problems after the turnover
- Since this project emphasizes the facilities, machinery is a minor part. Obtaining machinery should be based on package procurement, delivery, and turnover with construction materials by contractors. Attention should also be given to reducing the tender procedures, cost, and construction duration.

(4) Transport plan

Currently there is no direct ship service between Japan and Palau. Regular liners (for containers and general cargo : approx. G/T 6,000) operate via Saipan and Guam at the rate of three every two months.

Transport via Guam, Yap usually takes about 14 days, but there must be margin for delay for route change or detour during the typhoon season.

Sea transport from Japan to Koror, and land transport from Koror to the project sites, should be planned separately for both construction materials and heavy machinery, for a meticulous procurement material transport plan.

Since customhouse agencies in Palau do not provide domestic transport services, material transport is usually arranged by local contractors. It should be kept in mind that custom, storage, and transport arrangements can take time.

3-1-6 Implementation schedule

Project implementation schedule is shown in Table 3-3.

3-1-7 Duties and authorities of the recipient country

Authority and responsibilities of recipient country, which is involved in the project, are as follows.

(1) Ensuring of sites needed for the project, and removal of obstacles, leveling of ground, and preparation of approach road, prior to project implementation.

(2) Procurement and installation of auxiliary facilities for the nearby outdoor area of the project sites, as necessary; for example, yard, fence, outdoor lamp.

(3) Prompt unloading of materials and equipment procured for the project in Palau, and custom, domestic transport and other arrangements.

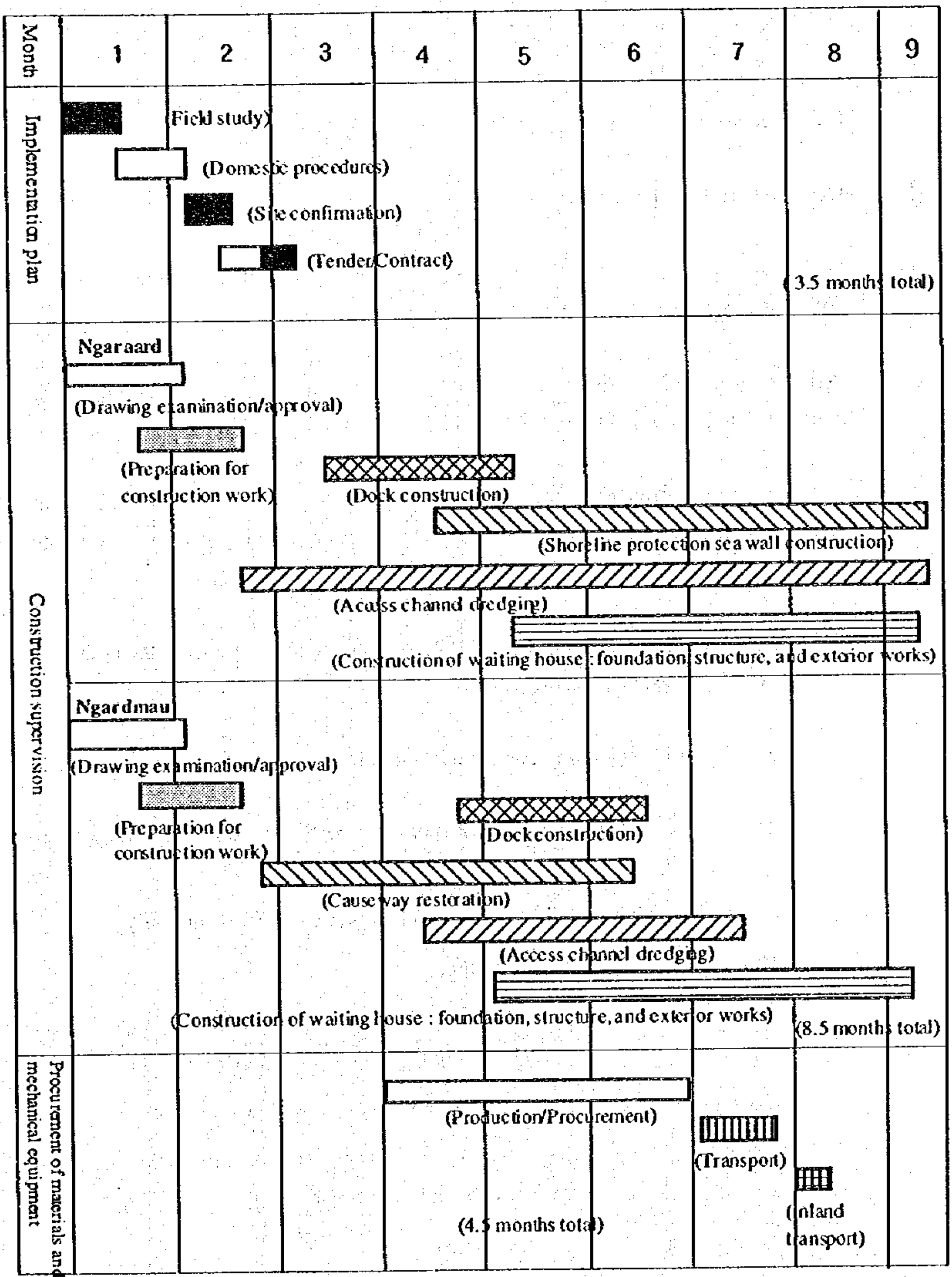
(4) Exemption of custom duties and other taxes in Palau, imposed on materials and equipment procured for the project.

(5) Exemption of taxes imposed on Japanese corporations and staff who work for the implementation of the project.

(6) Permission of entry and stay in Palau for Japanese staff involved in project implementation.

(7) Bearing of notification fee and commission for Authorization to pay certificate, and necessary payment for bank operations according to the Banking Agreements for Japanese foreign exchange banks.

Table 3-3 Project implementation schedule



(8) Securing of permission, license, and approval relevant to project implementation.

(9) Effective maintenance, management and operation of materials and equipment provided through grant aid assistance.

(10) Responsible for expenses not borne by grant aid assistance.

3-2 Operation and maintenance plan

Project facilities such as dock, shoreline protection sea wall, causeway, and waiting house have no operating cost.

Periodic cleaning and simple repair of the waiting house and surrounding area are done by state government employees with state financing.

In the event of serious facility damage and collapse by natural disaster, technical assistance is provided by the Bureau of Public Works and financed by the central government.

The operating expenses relating to fuel, labor and expendable parts of the crane trucks are financed by the state government.

Estimated crane truck operating costs are listed below.

① Labor: U.S. $100/month x 12 months = U.S. $1,200 annually (concurrent service of present officials)

② Fuel cost : c70 liters x 2 liters/day x 260 days = U.S. $364 annually.

- Unit fuel cost : c70 liters
- Daily fuel consumption : 2 liters/day (for av. operating kilometrage and cargo handling time : calculated at 10 km./liter)
- Operating days : approx. 260 days annually (5 days /week)

③ Maintenance cost : 5% of crane truck price annually = approx. U.S. $ 35,000 x 0.05 = U.S. $ 1,750

Operating cost = ①+②+③ = U.S. $3,314
(approx. 0.7% of Ngaraard state budget; approx. 0.9% of Ngardmau state budget in FY 1996)

The estimated crane truck maintenance cost (with labor) is U.S. $3,314 annually. This low figure represents less than 1% of the state budget. For state fuel and maintenance expenses in FY1996, Ngaraard allocated U.S. $20,000 and Ngardmau U.S. $15,000. Therefore crane truck operations and maintenance will not be a financial burden to either state government.