2-3-4 Damages to Fisheries Harbour Facilities

(1) Damages

The Asau Fisheries Harbour on Vaitupu Island suffered considerable damages by the two large scale cyclones in early January, 1993. The fact finding study was conducted by System Science Consultants Inc. and Dai Nippon Construction immediately following the disaster. Fig. 2-21 shows damages revealed by the study.

The present study was conducted about one year and a half later and therefore the damages ascertained by the present study were quite different thanks to the emergency repair measures taken by the Government of Tuvalu and Dai Nippon Construction immediately following the disaster. The major changes are discussed below.

1)Sand and debris scattered on the north of north groin have been cleared to some extent.

2)Small stones and sand accumulated in the former soccer ground (currently basketball court) have completely been removed.

3)Stones that have been brought into the channel by the waves are now removed to make way for navigation of small vessels, thereby maintaining the minimum functions of a fisheries harbour.

(2) Damages to the Facilities

1)South and North Groins and Wharf

Fig. 2-20 is a plan view of the fisheries harbour before the disaster, Fig. 2-21 that immediately after the disaster, and Fig. 2-22 is its current status. Fig. 2-23 shows the typical cross section of the groin before the disaster. As shown in the figures, the groins were the armour stone type and built on the coral reef with filling sand, over which were placed sand bags and mats to prevent sand from flowing out and then with coral stones of about 500 kg.

Both groins were totally destroyed from the top to the toe. Both the filling sand and sand bags have flowed out and were scattered, and the

lightweight coral stones on the top were scattered whereas the bigger ones of 1 ton class remained at their original positions.

The concrete apron in the back of the wharf was destroyed but the wharf suffered no damages because it was made of mass concrete. This was a lesson in how to design future facilities.

The access road on the north groin was planned to connect the wharf and the hinterland, but destruction proceeded from the side as the groin could not resist the waves sufficiently, leading to destruction of the entire structure. Fragments from the concrete pavement of access road and the armour stones from the groin surface were scattered all over the area.

2) Channel and anchorage

As Fig. 2-22 shows, the armour stones and sand near the groin heads fell into and filled the channel and the anchorage.

The anchorage in front of the wharf at the approximate center of the north groin was also filled by filling sand from the groin. Some of the armour stones which fell into the channel have been removed, thereby allowing free entry into the port of small boats with outboard engines but not of extension vessel of "Manaui" class (30 tons).

3) Slipway

Although the concrete pavement portions of the main body had hardly been damaged, the stone pitching portions on both sides had been scraped off here and there.

4) Boat yard and beach

A part of the boat yard and beach had been destroyed by scouring and sand and small coral rocks are accumulated all over the area.

5) Light beacons

The pole-type support for the light beacons standing at the top of north groin were broken from the base and the top light portions are being washed with sea water. This is probably because the armour stones near the head were washed away by the waves, causing the concrete foundation almost to fall without support. The iron pole at the support was probably broken by the violent crash of drift stones.

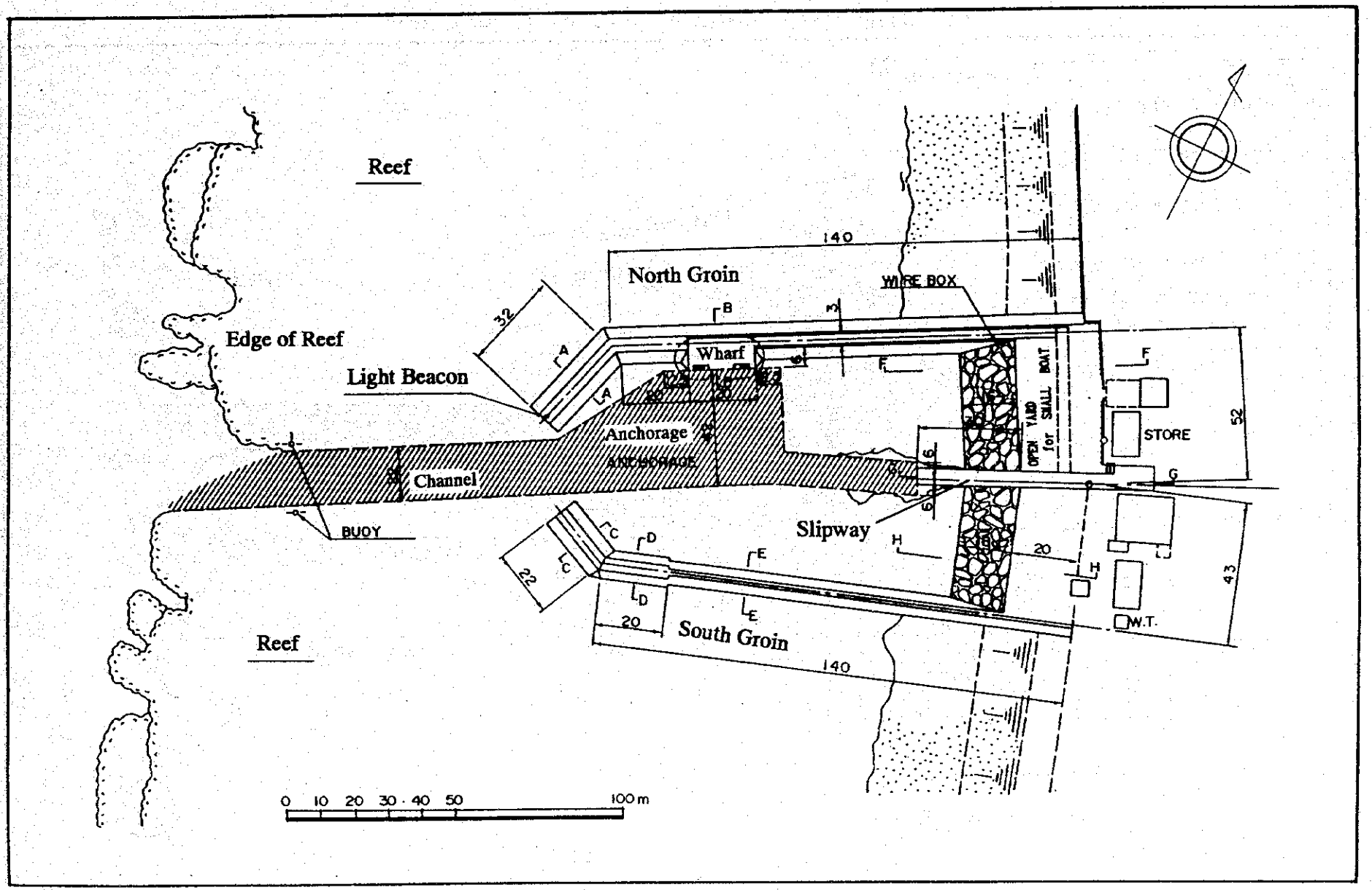


Fig. 2–20 Layout of the Asau Fisheries Harbour Before Cyclones

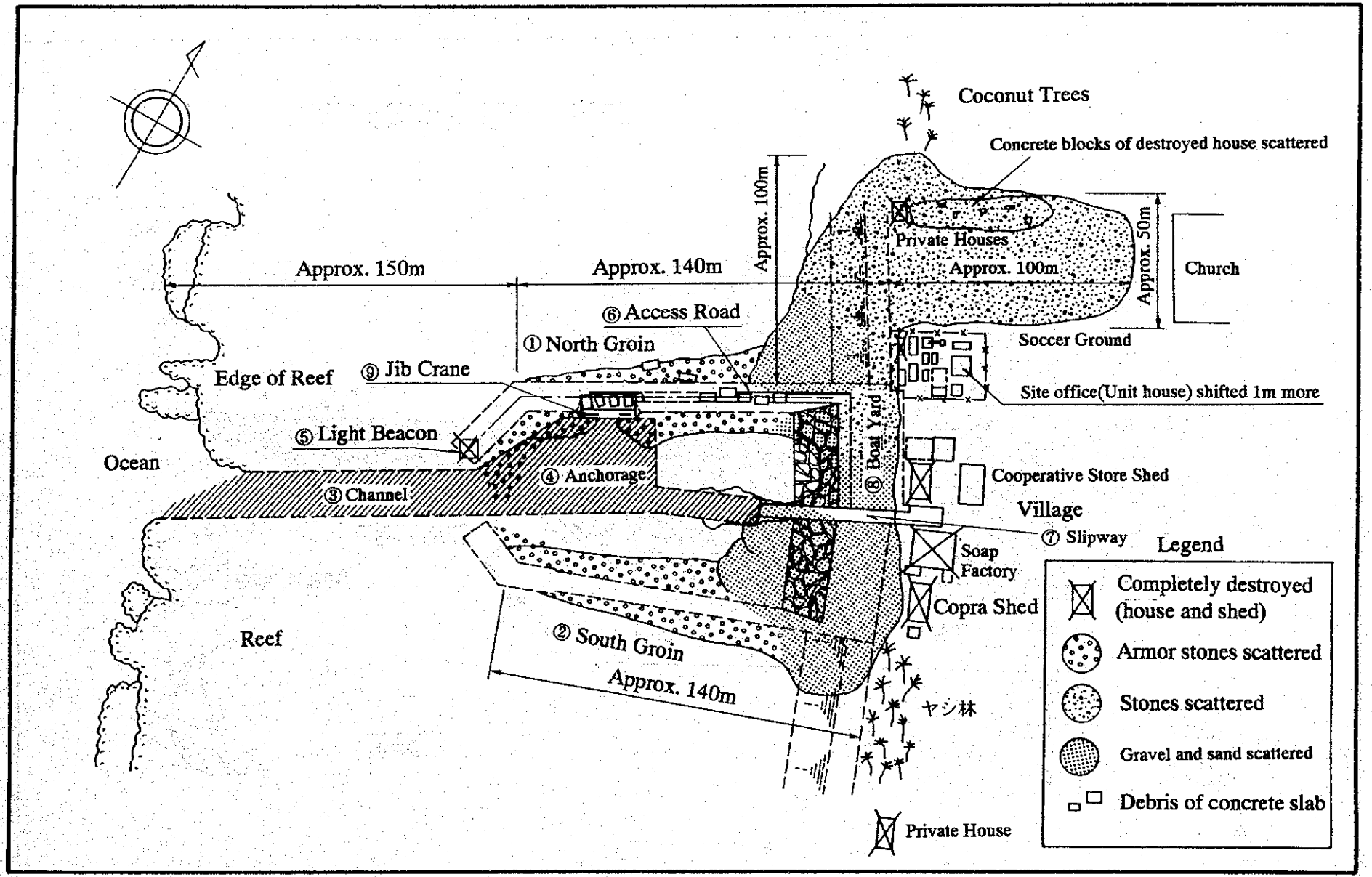


Fig. 2-21 Layout of the Asau Fisheries Harbour after Cyclones

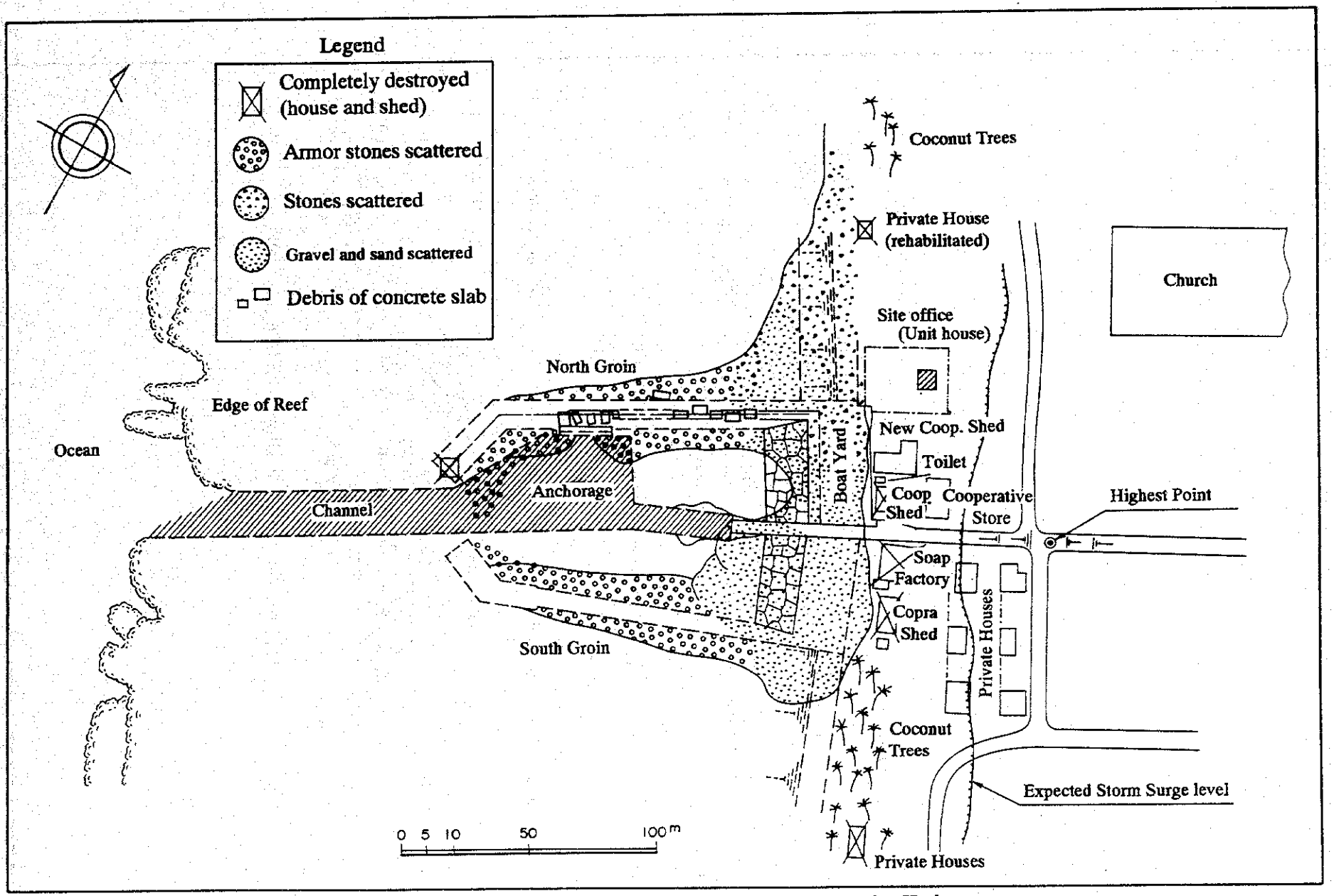
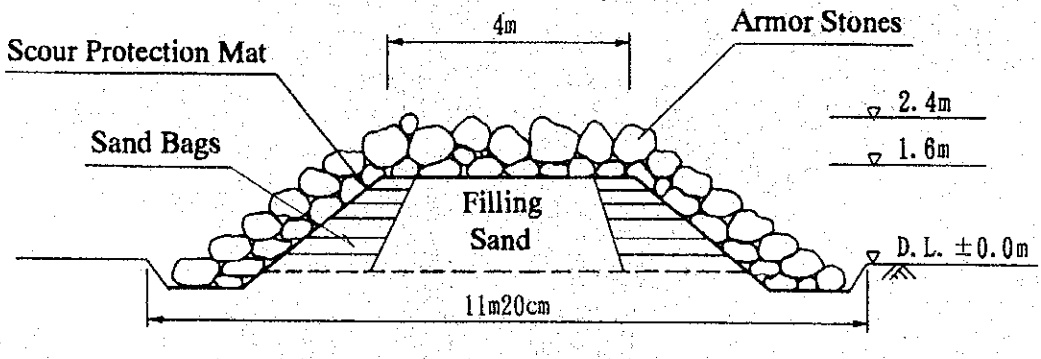
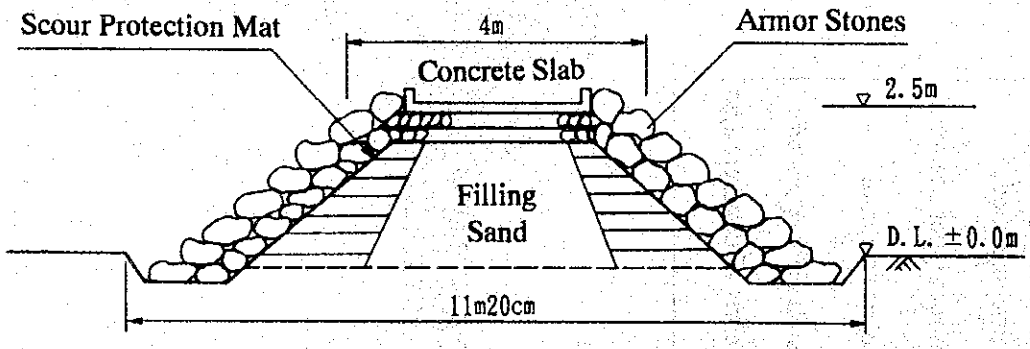


Fig. 2–22 Current Layout of the Asau Fisheries Harbour



Typical Cross Section of the Groin



Typical Cross Section of the Groin with Concrete Slab

Fig. 2-23 Typical Cross Section of the Groin before Cyclones

6) Jib crane

Because the wharf was not damaged, no large scale damage occurred to the jib crane. Corrosion to the steel material had advanced considerably.

7) Fisheries Centre

The Fisheries Centre stands on the lagoon side at about 300 m away from the harbour and had suffered no damages. The Government of Tuvalu is restoring the wooden gate and fences which had become corroded by the wind and the rain.

(3) Damages on the Land

The cyclones caused the elevation of the sea level by low atmospheric pressures and uprush of high waves, which raised the tidal level to an abnormal level. Moreover, as they remained stationary for an extended period of time, the waves carried off the armour stones and sand bags and filling sand from the south and the north groins to the harbour area. They became a sort of debris flow and inflicted a great deal of damages to the front line of the sheds and houses in the harbour area.

A photograph taken immediately after the disaster of the entire western coast of the island shows yellow coloration of the topmost leaves of palm trees covering the island with splashes indicating the magnitude of the high tide and waves. The fact that no notable damages occurred in the island except the Asau Fisheries Harbour Area demonstrates that the dense palm groves standing along the shoreline acted as the natural barriers and no damages except some fallen palm trees were inflicted since the area has no houses.

1) Degree of elevation of the high tides

As the low atmospheric pressure with big waves stayed for so many hours in the area, the tidal level was elevated and the entire area on the west coast of the island was flooded. In the harbour area, distinct traces of the high level of the high tide were observed on the inside doors of the unit house provisionally built by Dai Nippon Construction. Fig. 2–22 shows the contour line (expected storm surge level) depicted based on the traces. It shows how high the storm surge level rose and advanced onto the land. The difference in height between the contour line and the highest point in the area was only about 30 cm, suggesting that the local people

were not exaggerating when they said some of the waves went over the highest point into the lagoon.

2) Damages to the sheds and houses

Fig. 2-22 shows damages to the sheds and private houses. The harbour area sandwiched between the north groin and the south groin is congested with many buildings and the damages concentrated in this area.

The cooperative shed, the soap factory, the copra shed and two private houses were destroyed entirely. The houses on the northern side were built quite sturdily with solid concrete blocks and were repaired immediately after the cyclones. Those on the southern side stood in the palm groves and would have been protected by the palm trees except the fact that they were mainly obsolete and fragile. Fallen buildings such as the sheds and the factory have been removed, leaving only the foundation and many armour stones showing the signs of the major disaster. These buildings acted to protect private houses and the cooperative store standing behind them and flooding was about the only damage suffered. Hardly any damages were observed to private houses in the areas other than the harbour area.

2-3-5 Planning of the Facilities

1) Groins and wharf

The offshore waves were hindcasted with the return period of 50 years using the above mentioned method, and based on them the design wave height for the structures was obtained. The incident angle of the waves was used for calculating the wave force in the direction perpendicular to the top of groin and the wave force of the stem waves was considered for the middle and the base portions of the groin.

The crown height was designed to prevent occurrence of big overtopping waves in the harbour even when the offshore wave with the return period of 1 year came(about 2.0 m).

The groins are to be built entirely with in-situ concrete. The coral rock surface will be ground to make the in-situ concrete body and the coral base completely integral and to prevent scattering of the groins by abnormal waves.

The wharf is designed to accommodate fishing boats of 30 ton class, and a bollard and fenders will be provided to secure the safe berthing.

The access road from the wharf at the center of the north groin to the hinterland will be paved with concrete to allow passing of trucks and will be joined with the truck road of the island.

(NB)Three plans shown in Table 2-11 were studied for the groins and the gravity type by in-situ concrete was chosen finally.

2) Channel and anchorage

The channel width and the anchorage basin will be expanded in order to secure safe passing of the boats.

3) Seawalls

As some houses in the hinterland were destroyed by the large cyclones, a seawall will be built for protection in front of the hinterland.

4) Light beacons and lighting system

The light beacons for safe navigation and the lighting system for cargo handling at night will be provided. They will be a solar type to minimize maintenance and management work.

2-3-6 Operation and Maintenance Plan

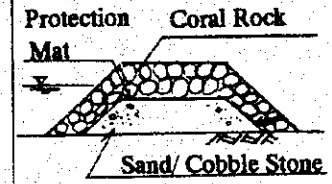
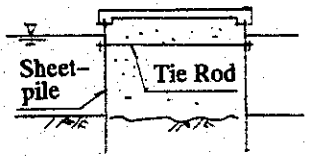
After completion of the reconstructed facilities, maintenance and management will become necessary after the consumables have been used beyond their durable years. Table 2-1 shows the estimates for material costs and personnel expense. One or two maintenance and repair personnel will be required per year for two days. The staff at the Vitupu Fisheries Centre is believed to be capable of the job.

2-4 Technical Cooperation

Although a JICA expert is rendering technical assistance for fisheries industry-related machinery in Funafuti, the capital, he is not involved with the

present project. No request has been made regarding the technical assistance by a fisheries expert.

Table 2-11 Comparison of Construction Type and Material

	Construction Types		Method to be chosen	Reasons for Use/ Non-use
Groins and Wharf	Site conditions indicate 3 types with sand and wave protection functions			•Coral rocks Local coral rocks are small and lightweight. The weight is not at all satisfactory for use as the material for the groin surface layer. •Concrete blocks Large size blocks are necessary if concrete blocks are to be used, necessitating large scale manufacture, transport and installation works. •Wave resistance is inferior.
	1. Rubble Mound Groin 	Materials- sand, cobble stone, coral stones(all locally available) concrete blocks(produced at site) Method- use construction machinery such as bulldozer and excavator	△	
	2. Gravity-type Groin 	Materials- cement, sand, gravel (local sand will be used, coral rocks crushed by a crusher will be used as gravels, cement will be imported) Method- in-situ concrete method. Concrete plant and agitator car will be used	○ chosen	•All the materials except cement are available locally. •The method is repetition of simple work of concrete work and will create job opportunities for many local people. •No maintenance/ management is necessary after construction. •Wave resistance is excellent.
	3. Sheet-pile Groin 	Materials- Steel sheet pile and tie rods(all imported) Method- Steel sheet pile will be placed by pile driving machine and pile heads joined with tie rods. Filling material will be local sand.	△	•Steel sheet piles and tie rods must be imported. The pile driving equipments be large type. •Steel sheet piles and tie rods are usually designed to last for 30 years because of steel corrosion. This method is not suitable because the proposed fishing harbour is designed for 50 years of use.
Dredging of channel and anchorage	1. by dredger	Method- dredge by dredger(bucket type) (Must be imported)	△	•To be procured from a third country. Dredger will be expensive. •Dredging amount is too small to justify the cost.
	2. by dynamite and excavator	Method- crush rocks with dynamite and scrap with excavator	○ chosen	•Method is simple. •Cost is low.

CHAPTER 3

BASIC DESIGN

CHAPTER 3 BASIC DESIGN

3-1 Design Policy

The basic design for the facilities such as the groins, wharf, channel and anchorage under this project will be according to the following policies based on the foregoing discussions.

(1) Policy regarding Natural Conditions

The most important factor to be considered in the basic design of facilities is hindcasting of the design waves. Its relevance is particularly noted because the disaster was caused by the attacks of unexpected waves.

The 10 largest cyclones which are assumed from their tracks and scopes to have brought big waves to the project site in the last 30 years were chosen, the relevant weather charts were obtained and the wave hindcasting was performed for each of the cyclones using the spectrum method.

Statistical analyses of the offshore waves were made in respect of 11 cases including the recent cyclones "Kina" and "Nina" to obtain the design offshore wave height for the harbour using the waves with the return period which concurs with the necessary period of use.

The study of the sounding survey and the foundation stability on which the structures would stand confirmed that they had the sufficient strength.

As for earthquakes, the study revealed that the country had no earthquakes of significance which should be taken into consideration in design.

(2) Policy regarding the Socio-economic Conditions

Although the country is an independent state, most of its commercial activities are supported through aids from developed countries. This suggests that the country would not be able to afford maintenance of structures, etc. which they had built with foreign aids, inevitably leaving them without proper maintenance or management. It is therefore proposed to design structures that are as maintenance-free as much as possible.

(3) Policy regarding the Construction and Labour Condition

The country has no construction company, and it is therefore necessary to procure all the construction machinery from third countries. They neither have any skilled labours. The study team therefore need to select a construction method which hardly requires any construction machinery or sophisticated skills. Un-skilled labour for simple work, however, is available in this country.

(4) Policy regarding Local Materials

In Vaitupu Island, only stones (coral rocks) and sea sand (coral sand) are available. All other construction materials must be imported. By using coral rocks and sand, the study team must try to decrease the construction costs.

3-2 Study and Examination on Design Criteria

(1) Design Criteria

Although Tuvalu has no design criteria for civil engineering structures, they have "National Building Code" for architecture.

We shall therefore rely on the following Japanese criteria.

Criteria	Publishers
Standard design method for structures in fishing ports (1990)	Japanese Association of Fishing Ports
Technical standards for facilities in fishing ports, and annotations (1990)	Japanese Association of Fishing Ports
Manual for planning fishing ports (1992)	Japanese Association of Fishing Ports
Technical standards for port and harbour facilities, and annotations (1989)	Japanese Association of Ports and Harbours

(2) Design Conditions

1) Tidal level

H.W.L. ; D.L. + 1.74 m

M.W.L. ; D.L. + 0.93 m

L.W.L. ; D.L. + 0.12 m

2) Design waves

Offshore wave height ; H1/3 = 5.8 m

wave period ; T1/3 = 14 s

Design wave height in front of groin ; H1/3 = 2.6 m

wave period; T1/3 = 14 s

3) Design seismicity

Horizontal seismicity; Kh = 0

Vertical seismicity ; Kv = 0

4) Foundation

Strong foundation which can support a gravity type structure.

5) Materials

Concrete	specific gravity;	γ = 1.8 t/m3
	Compression strength;	σ = 180 kg/cm2
Reinforcing bars		
	Allowable stress;	σ = 1,800 kg/cm2

3-3 Basic Plan

Basically, the project under the previous grant aid programme will be followed as much as possible and improvements will be made where feasible. Table 3-1 outlines the content and scope of the proposed facilities. Fig. 3-1 shows the layout plan and Figs. 3-2, 3-3 and 3-4 the cross sections of the structures.

3-3-1 Layout Plan

(1) South and North Groins

A groin is expected to prevent inflow of the littoral sand attributable to the littoral current and to prevent lowering of calmness in the fisheries harbour due to the incoming waves.

In order to meet these two functions, the south groin will be extended offshore by 175 m and the north groin by 165 m from the coast line.

To secure the wave preventing effects, the tips of the two groins will be bent inward to narrow the mouth of the harbour to thereby decrease the waves coming into the harbour. The south groin will be extended further offshore than the north groin to secure safety of the fishing boats anchoring against the incoming waves from the SW direction.

Table 3-1 Outline of the Planned Facilities

Facility(Structure)		Contents and scale
Removal of existing groins		Removal of broken south and north groins, about 5,000m3
	Gravity-type concrete	
South groin	Length x Crown width	Base 80 m x 4 m, Middle 70 m x 6 m, Top 25 m x 8 m
North groin	Length x Crown width	Base 80 m x 4 m, Middle 55 m x 6 m, Top 30 m x 8 m
Wharf	Water depth	-3.0 m
	Length x Apron width	Extension 5 m x 10 m
Jib crane		One
Bollard		One
Fender		One set
Channel	Bottom width x Depth	26 m x -3.5 m
Anchorage	Width x Depth	64 m x -3.0 m
Light beacons	Solar type	Two
Navigation aids	Concrete anchor type	Seven buoys (channel and anchorage), Two beacons (land)
Lighting facilities	Solar type	Two
South seawall	Gravity-type concrete	75 m
North seawall	Gravity-type concrete	40 m
Access road	Concrete pavement	Width 4 m x Length 20 m
Slope protection	Armour stones with concrete filling	20 m x 40 m, 2 Slope faces
Slipway	Concrete pavement	Length 10 m

(2) Wharf

In order to facilitate anchoring of fishing boats of "Manaui" class, the water depth of -3.0 m and the length of 25 m (20 m for the existing wharf) were planned. Although the length of the subject boat is 18.4 m, there should be some allowance.

For safety in berthing, fenders will be provided and a bollard will be built to expand the wharf. A corrosion-resistant jib crane (500 kg) with a manual winch will be re-built.

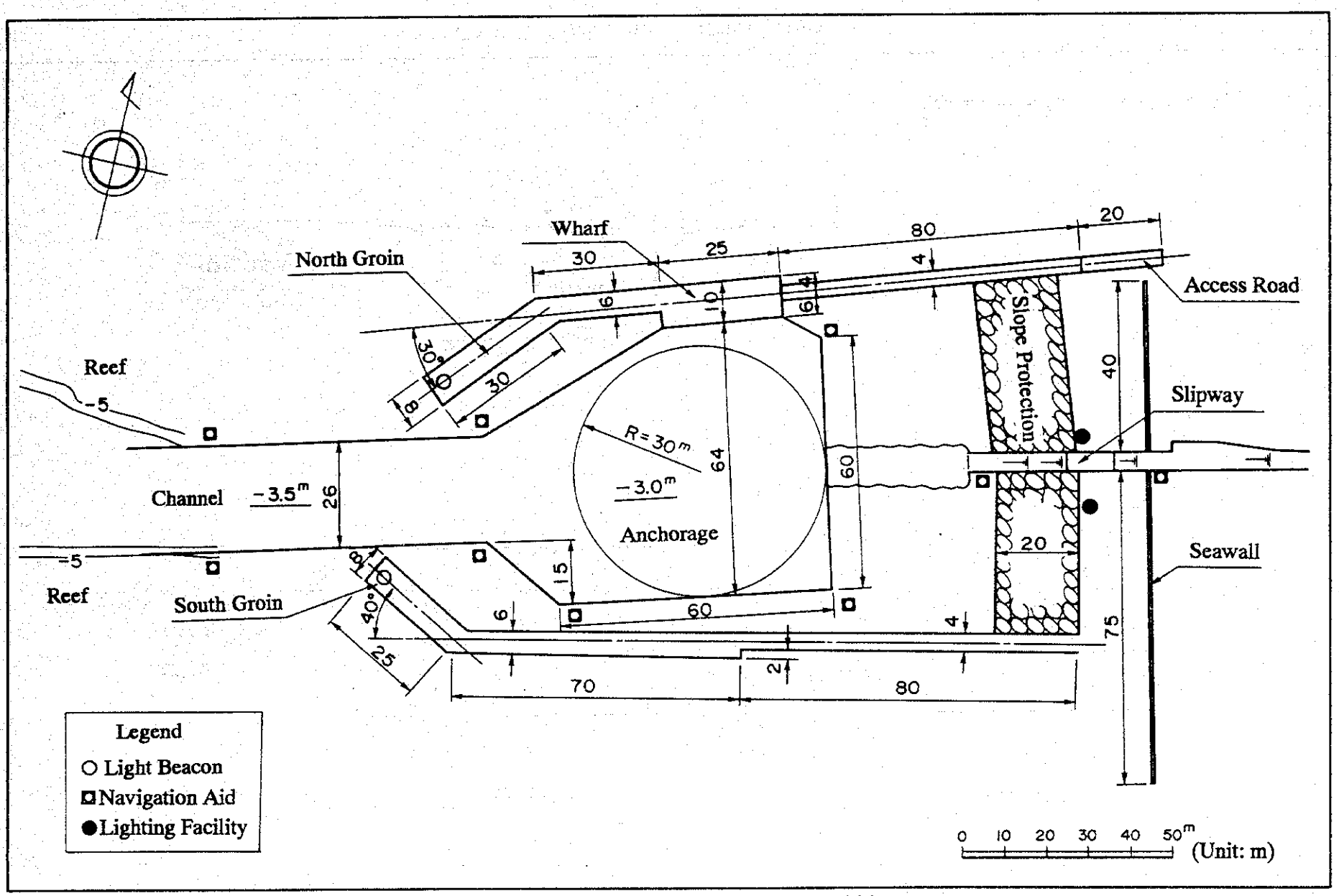


Fig. 3-1 General Layout Plan of Project Facilities

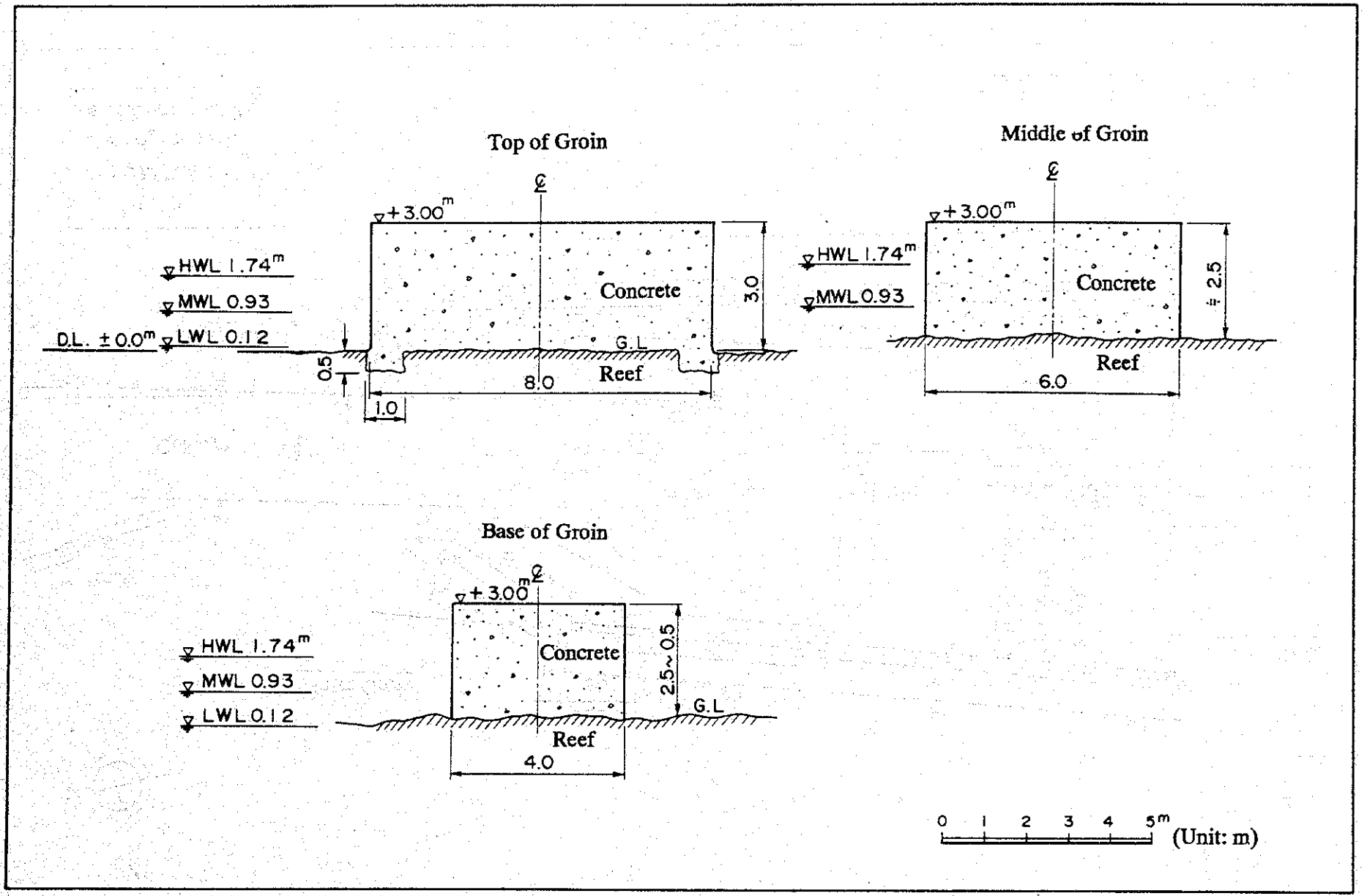


Fig. 3–2 Typical Cross Section of Groin

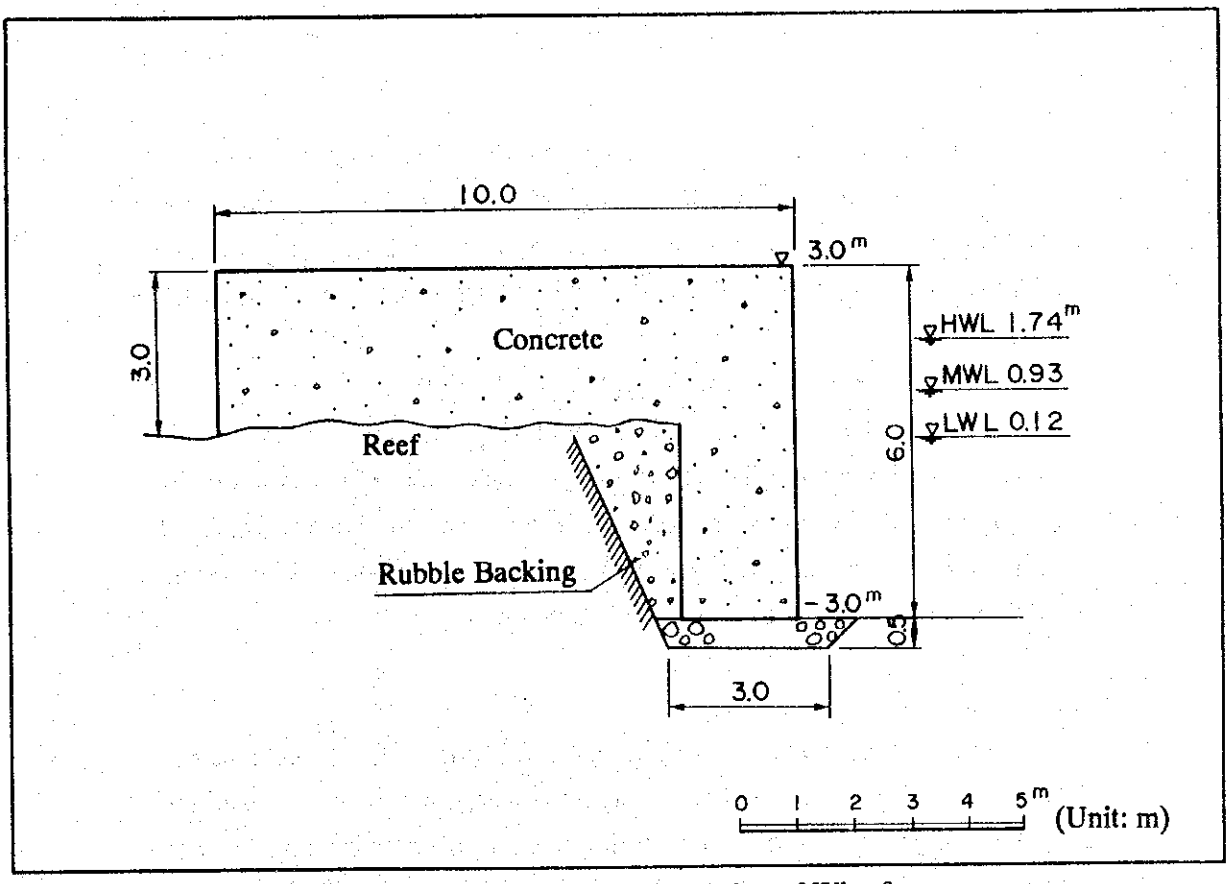


Fig. 3–3 Typical Cross Section of Wharf

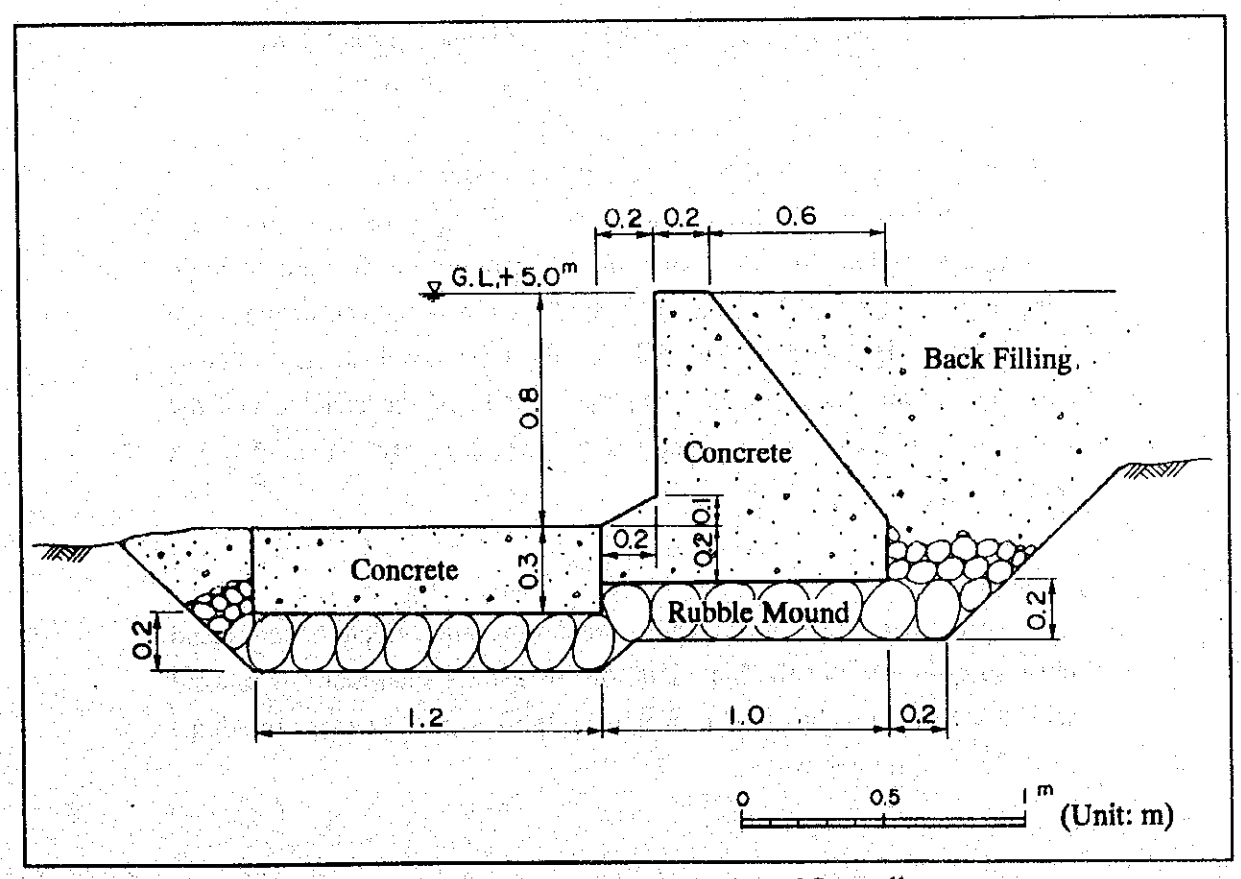


Fig. 3–4 Typical Cross Section of Seawall

(3) Channel

The channel should have depth and width sufficient for navigation of vessels. By adding 1 m to the draft (2.15 m) of the subject vessel and considering the ease in construction, the sea depth is set at -3.5 m. The width is 5 to 6 times the width of the subject vessel and is obtained by the following formula.

$$5 \sim 6 \text{ x vessel width}(4.8 \text{ m}) = 24 \sim 29 \text{ m}$$

The harbour will become a shoal during the low tide except the channel. Navigation at this state will easily cause a boat to be stranded by a slight error in the direction. Local fishermen want to have the channel width extended as much as possible to secure safety of boats. The bottom width of 26 m is therefore chosen for the channel.

(4) Anchorage

The anchorage should be calm and have sufficient surface area and depth to facilitate safe anchoring, smooth operation and cargo handling. The harbour requires a space for turning boats in front of the wharf and its area should be a circle with the diameter of 3L (L: vessel length) to allow a fishing boat to turn on its own. By considering cases where a vessel may be anchored in the turning area,

$$3 \text{ x vessel length}(18.4 \text{ m}) + 1.5 \text{ x vessel width}(4.8 \text{ m})$$
$$= 62.7 \text{ m} \fallingdotseq 64 \text{ m}$$

(5) Light Beacons, Lighting Facilities and Navigation Aids

Light beacons will be installed at the top of the south and the north groins to safeguard the boats entering and leaving the harbour at night. Lighting facilities will be installed near the slipway to secure safe cargo operations at night. All of them will be solar type to reduce the burden of maintenance and management. On the borders of the channel and the anchorage will be placed navigation aids for safe navigation and to mark both places.

(6) Seawall

In the harbour area, the cooperative store and private houses stand close to each other in the hinterland of the fisheries harbour. A seawall with the crown height of +5.0 m will be built to protect these buildings from the overtopping waves.

(7) Others

Unpaved portions of the existing slipway will be covered with concrete. The slope protection work of boat yard will be constructed.

3-3-2 Sectional Plan

(1) South and North Groins

The groins are required to prevent waves. While higher crowns will prevent overtopping waves and improve the calmness in the harbour, the groin will become instable against the wave force. Therefore, the groins will be made as low as possible.

If the offshore waves of H1/3 = 2.0 m with the return period of one year come, the wave height will be about 1.5 m in front of the top of the groin. To prevent this wave from generating notable overtopping in the harbour, the crown height should be made +3 m.

(2) Wharf

The water depth should be – 3.0 m to accommodate berthing of the subject vessels. The crown height shall be + 3.0 m.

(3) Channel

The water depth should be – 3.5 m to accommodate navigation of the subject vessels. The channel width at bottom shall be 26.0 m.

(4) Anchorage

The water depth should be – 3.0 m to accommodate anchoring of the subject vessels.

3-4 Implementation Plan

3-4-1 Construction Conditions

(1) Construction Conditions

1) Work habit

Normal work hours: Monday～Thursday; 8:00～17:00
(12:00～13:00 recess)
Friday; 8:00～12:00
Saturday & Sunday ; Holidays

Annual holidays: 12 days

Labour costs: Payment will be according to the standard unit price prescribed by the Island Council where the construction will take place. Increase in unit prices for overtime work and work on holiday shall be as follows.

Overtime work on Monday～Friday; 50% increase

Work on Saturday, Sunday and Holiday; 100% increase

Social insurance: Employment insurance by payment of 10% of income (5% by the worker and 5% by the employer)

2) Marine climate

Although the site has comparatively abundant rainfall, the rains do not concentrate nor last long. Therefore, the rains will not affect the construction work so much. The wind of over 11 m/s generates with the probability of 0.7%, indicating that the climate is mild throughout the year. The E–N winds predominates, while SW–NW wind which affect the site generates comparatively often in summer between December and March. The swells predominate in E–NE direction.

3) Standards for design and construction

The standards for architecture are similar to those of Australia and New Zealand with some modifications. There are no standards regarding civil engineering. The project shall follow the Japanese standards with some modifications.

4) Construction machinery

There are no construction machinery for lease in Funafuti or Vaitupu.

5) Construction materials

Stones (coral stones) and sand (coral sand) alone can be procured in Funafuti and Vaitupu. The place for collecting the materials should be selected with care by considering the coastal erosions, etc. As the rainwater accumulated from the building roofs is used for daily life, there is no fresh water for use in construction. Therefore, the water from the two wells in the island will be used.

(2) Factors to Take Note in Construction

1) Transport of construction materials and equipments

Construction materials and machinery except stones and sand will be imported. Although commercial cargo ships will be used from Japan or a third country to Funafuti Port, cargoes will have to be transferred to another ship at Fiji or Kiribati, and from Funafuti to Vaitupu, the only one cargo ship in Tuvalu will be used. Thus, weighty cargoes or large cargoes cannot be transported. As the number of services is extremely limited and the storage space in Funafuti is also limited, a most careful plan for transportation is needed.

2) Landing of construction materials and equipments

As Vaitupu Island is surrounded by shallow coral reef, the materials and machinery must be landed by using the channel for the fisheries harbour built previously or landed on the adjacent coast at the time of high tide. Use of small boats with outboard engine should be carefully planned particularly between December and March when the west wind blows frequently and affects the landing point.

3) Transportation means

As the means of transportation to Vaitupu from Funafuti, there are just three ocean-going ships in the country every one of which is used for support of fishery operations, emergency contacts with other islands and cargo transport to other islands. For transport of personnels to be engaged in the present project, it is

necessary to use a high speed ocean going boat and make detailed plans carefully.

4) Communication means

There are no telephone lines in Vaitupu; there is just one wireless radio station. The time zones for use of the wireless telephone are one hour in the morning and 30 minutes in the afternoon from Monday to Thursday and one hour on Friday mornings, thus causing congestions, and international telephone can be very poor. In order to facilitate smooth progress of the work, it will be necessary to provide alternative communication means.

5) Dispatch of technical personnel

As there are no skilled technical experts in Tuvalu, we should plan dispatch of appropriate numbers of technical experts from Japan at appropriate times and periods as the construction proceeds.

6) Medical facilities

As there is no adequate medical facility or a doctor in Vaitupu, special consideration should be paid to sickness or injuries during the construction work.

7) Accommodation

As there is no public accommodation facility with adequate amenities, a private house will be rented during the construction work to secure accommodation for the staff.

8) Accident prevention

As there are works which entail the use of dynamites, safety precautions for the islanders and their houses should be taken.

3-4-2 Implementation Method

The project is implemented within the framework of the Japanese Government's grant aid. After the project is approved by the governments of the two countries and E/N is exchanged, the project will be implemented formally.

The Government of Tuvalu will then appoint a Japanese consultant company and detailed design of the facilities will be started. After completion of the detailed design and tender documents, a Japanese construction company appointed by tender will start the construction work.

At the start of work, the materials and equipments will be transported with fewest lots possible in the initial phase of the work in view of the inconvenient transportation to Tuvalu from Japan or from any other third countries. Based on the investigation of the forwarders, etc., the period from procurement to delivery to the site of materials and equipments is estimated to be about three months. As the site is situated on an island located on coral reef which becomes exposed during the low tide and as there are no port facilities for landing these materials and equipments directly, large machinery will be limited to minimum. Small machinery and manpower will be relied on in construction as they can be used on land or while waiting for tide.

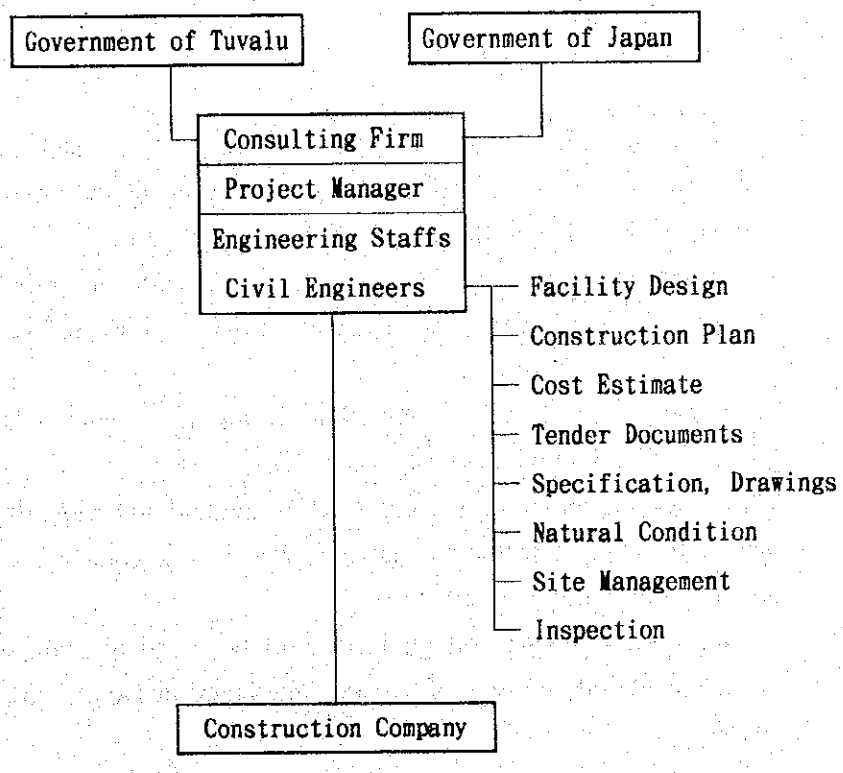


Fig. 3-5 Organization Chart of Project Implementation

It will be necessary to remove all the facilities which had been damaged except the wharf embankment in order to secure stability for the new structures.

Only after that, construction of the new facilities will be started. The work will consist of removing the existing structures, excavation and dredging of the anchorage and channel, and constructing gravity type groins with in-situ concrete placing. By following these steps, the period of construction will be about 11 months. Fig. 3-5 shows the organization chart for project implementation.

3-4-3 Construction Supervisory Plan

Based on the Japanese Government's grant aid policy, the consultant shall organize a project team for detailed design and supervision of construction work in the light of the intent of the basic design in order to facilitate smooth progress of the project. In the phase of construction and supervision, the consultant will dispatch a full-time supervisor to be stationed at site for guidance and liaison work as well as technical experts at appropriate times for inspection and guidance of the work.

(1) Policy for Supervision

1) By maintaining close contacts with the organs and the persons concerned of both countries, the construction of facilities shall be completed according to the construction schedule.
2) For construction of the facilities concurring with the design drawings, speedy and appropriate guidance and advice will be offered to those involved in the construction.
3) Local methods of construction using local materials will be preferentially employed whenever possible.
4) The attitude regarding the construction method and technology will be that of technical transfer so that the effects of a grant aid cooperation project will be fully exerted.
5) Appropriate advice and guidance will be given to maintenance and management after delivery of the completed facilities to encourage smooth operation.

(2) Construction Work Supervision

1) Cooperation regarding the construction contract

The cooperation includes selection of the contractor, deciding on the policy for contracting the construction contract, preparing the draft contract documents, investigating the content of the detailed specification of the construction, and attesting the execution of the work

2) Checking and confirmation of the work drawings, etc.

The work drawings, materials and equipments which are submitted by the contractor will be inspected.

3) Guidance for the construction work

The construction plan and schedule will be examined and guidance given to the contractor. The progress will be reported to the owner.

4) Assistance in payment to the contractor

The debit notes, etc. for the construction work which are to be settled during and after the work will be examined, and assistance given for going through the necessary formalities.

5) Witnessing inspections

During the construction, inspections of the completed portions will be performed as necessary and guidance given to the contractor. The consultant shall confirm that the work has been completed and the contract conditions have been met, be present at the delivery of the contracted facilities and obtain confirmation of the receipt from the owner. The consultant shall also report on the progress of the work, procedure of the payments and the items required for delivery after completion to those concerned of the Japanese Government.

3-4-4 Procurement Plan

The following issues will particularly be noted in procurement of the materials and machinery required for this project.

(1) Procurement Policy

Since construction machinery and materials except stones and sand are not available in Tuvalu, these are to be procured from Japan or a third

country. In selecting the country from which they are to be procured, economy, quality and supply capacity should be fully studied.

1) Procurement from Japan

For the materials to be procured from Japan which need to be made to order or be processed in Japan, a detailed transportation plan should be made as considerable time is required for issuing an order, manufacturing, packing, and shipping and in view of the extremely scarce number of cargo services to Tuvalu.

The construction machinery shall be procured from Japan in view of economy, maintenance, and continued use for an extended period of time.

Construction materials and machinery shall be landed at Funafuti Port for custom clearance, and the materials will be transferred to a cargo ship of Tuvalu and the machinery to a transport barge for transportation to Vaitupu. As there is only a very small storage area in Funafuti Port, it is recommended to maintain close contact with a Tuvalu implementation organ to secure the place of storage and speedy custom clearance.

2) Procurement from third countries

Similar care should be taken in regard to procurement from third countries.

3) Local procurement

Stones and sand are to be procured locally. In selecting the site of collection, consultation with the concerned local organization is essential to prevent disasters and adverse effects on people's life.

4) Costs

Cost comparison was made in regard to procurements from Japan and from third countries to choose a country with cheaper costs. For procurement from Japan, the additional costs will be needed for packing, transportation and insurance, but there will be tax exemptions. Having reviewed the procurement plan in the light of the foregoing, procurement of the materials and machinery for the present project was decided as follows.

(2) Items Procured

1) Materials procured

locally: stones, crushed stones, sand, fuel

from Japan: steels, steel moulds, light beacons, lighting facilities, fenders, jib crane, bollard, buoys, anchors, ropes, etc.

from Fiji: reinforcing bars

from New Zealand: cement, timbers, plywood moulds, gunpowder

2) Construction machinery procured

locally: none

from Japan: high speed ferryboat between Funafuti and Vaitupu, boat with outboard engine, other construction machinery, materials for temporary works

from Fiji: tugboat, pontoon

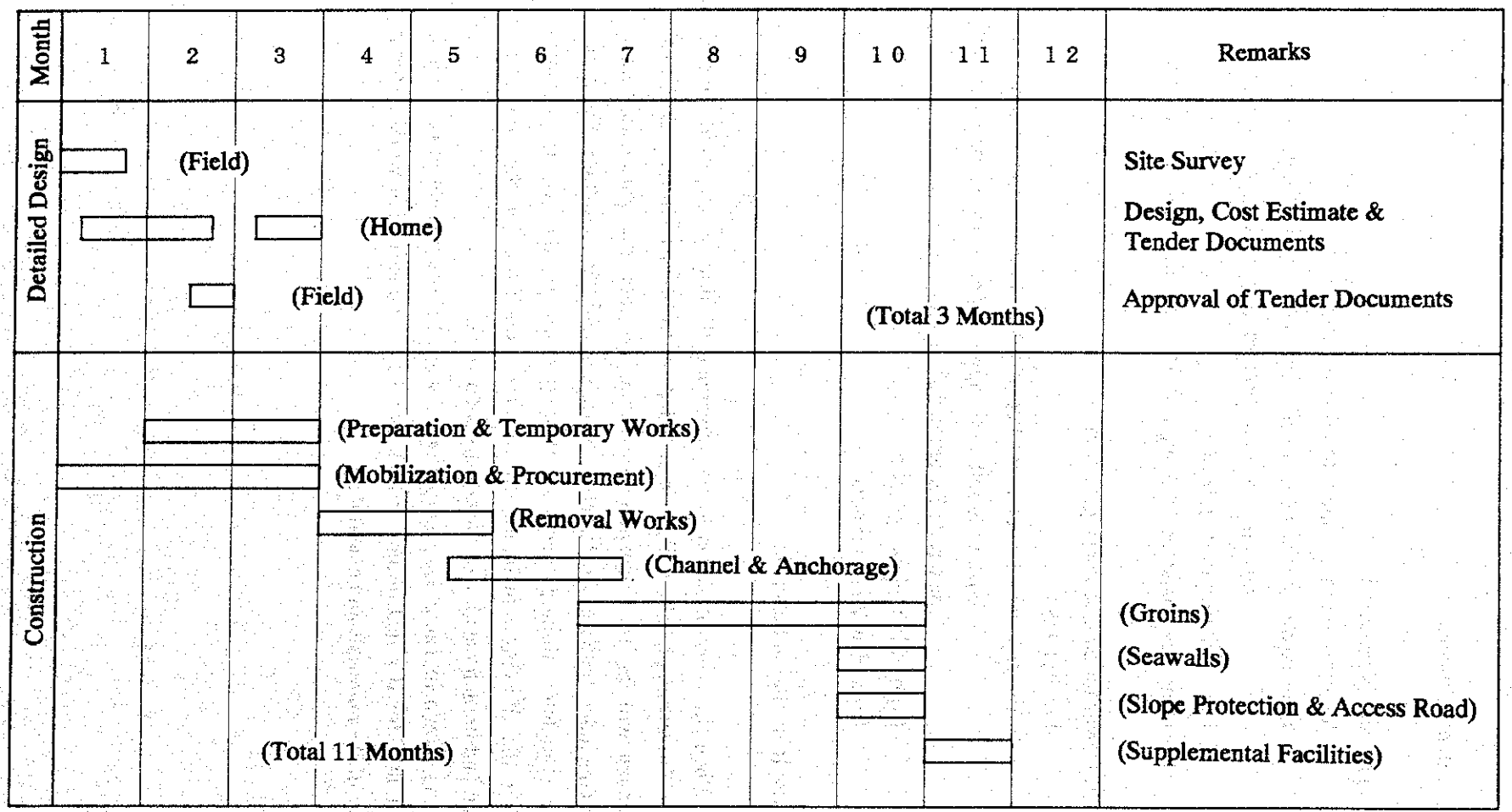
from New Zealand: none

3-4-5 Implementation Schedule

When the construction is to be implemented with the grant aid from the Japanese Government, E/N will be concluded by the two countries, the Tuvalu Government will choose a Japanese consultant firm, and the consultant contract will be concluded between the Tuvalu Government and the consultant. The project will be completed through these steps; preparation of the tender documents including the drawings, invitation for tenders, conclusion of the construction contract, and implementation of the construction work.

As shown in Table 3-2, the period of work for the present project will be three months for detailed design and 11 months for construction work including delivery of the materials and machinery.

Table 3-2 Project Implementation Schedule



3-4-6 Scope of Work

(1) Works to be performed by Japan

South groin	Length 175 m
North groin	Length 165 m
Wharf (-3.0 m)	Length 5 m (extension)
Installation of a jib crane	One unit
Installation of a bollard	One unit
Installation of fenders	One set
Excavation and dredging of channel	One
Excavation and dredging of anchorage	One
Installation of light beacons	Two units
Installation of navigation aids	Seven units
Installation of buoys	Two
Installation of lighting facilities	Two
South seawall	Length 75 m
North seawall	Length 40 m
Access road	Length 20 m x width 4 m
Slope protection	20 m x 40 m x 2 slopes
Pavement for slipway	Length 10 m

(2) Works to be performed by Tuvalu

Securing the yard for construction work

Securing the space for disposing residual earth

CHAPTER 4

PROJECT EVALUATION AND CONCLUSION

CHAPTER 4 PROJECT EVALUATION AND CONCLUSION

4-1 Evaluation

Table 4-1 shows direct effects expected from reconstruction of the fisheries harbour facilities. These effects will restore primary functions to the Asau Fisheries Harbour.

Table 4-1 Effect from the Implementation of this Project

Current Situation	Countermeasures	Effect/ Improvement expected
Damaged groins lost functions	Design a groin which will not damage other facilities at the time of big waves	Effective prevention of disaster recurrences
Boats unable to berth at the wharf	Dredge the front area and expand the wharf Use fenders and bollard	Securing safe berthing
Shoaling and narrowing of the channel	Redredge and expand channel width for safe navigation	Securing safe navigation even at night
Shoaling and narrowing of the anchorage	Redredge anchorage and expand width for safe turning	Securing safe anchoring
Poor access road conditions	Connect with the access road	Improving transportation
Construction of seawalls	Protect houses in hinterland and prevent cyclone damages	Improving people's life
Lack of lighting facilities and light beacons	Aim at safe loading/ unloading at night in harbour	Improving safety in the harbour
Slope protection	Armour stones cover the slope with concrete to prevent scouring	Preventing disaster recurrence
Debris disposal	Transport to appropriate places	Preventing disaster recurrence Preventing re-shoaling of the channel and anchorage

In addition to the above mentioned effects, the following advantages are expected as the country's National Development Programme progresses smoothly.

1) Added values of fish catches will be increased as the distribution system and machinery are improved. With extended storage life and enhanced freshness of fish landed on the island, a stable fish supply becomes possible.
2) Construction of fisheries harbour facilities and the Fisheries Centre on the island is being planned ahead of similar projects in other islands. The nation is watching the effectiveness of the project with great interests.

Early reconstruction of the fisheries harbour facilities on the island will invigorate the fisheries of Vaitupu as well as of the entire country and ensure a stable supply of fish proteins, and is expected to contribute to the promotion of marine products export in the future.

4-2 Conclusion

The fisheries harbour facilities to be reconstructed under the present project had been completely destroyed by the large cyclones which attacked the country in January, 1993. These facilities were positioned as an important link in the country's fisheries development programmes.

Although small boats with outboard engines can enter the harbour thanks to the emergency repairs undertaken after the disaster, scattered debris may cause another shoaling of the channel and anchorage.

Restoration and rehabilitation of the fisheries harbour by the full scale reconstruction based on the design which fully takes into consideration the lessons learned from the disaster is essential and urgent.

The rationale for the grant aid in the framework of this project is discussed as follows in further detail.

1) The fisheries harbour damaged by the cyclones of the unprecedented magnitude was originally built by the grant aid from the government of Japan.
2) The project will benefit poor people and will basically stabilize their livelihood.
3) With the implementation of this project, the maintenance and management operations undertaken for the harbour will be made easier.

4) The project concurs with another one for Vaitupu Island under Fourth National Development Programme (1988–1990).

5) Undesirable effects are not foreseen on the environment.

The study team would like to make the following requests to the Government of Tuvalu in order to facilitate the implementation and the management of the project in a more smooth and effective manner.

1) Full-scale cooperation in construction

The large cyclones "Kina" and "Nina" not only destroyed the fisheries harbour facilities on the island but also ravaged its residential areas. As the implementation of this project requires a full understanding and cooperation from the Vaitupu Island Council and the islanders, the study team requests the Government of Tuvalu to take an active initiative for a smoother operation.

2) Thorough maintenance and management

The study team has designed structures that require little maintenance, with the full knowledge that jib crane, light beacons and lighting facilities, however, essentially need maintenance. Regular and adequate maintenance and management alone will be able to extend their capacity. The study team recommends to allocate sufficient budgets for their maintenance.

As for the littoral sand near the fisheries harbour, the study team recommends a long term observation (about once a year) and taking necessary precautionary measures.

3) Development of human resources

The lack of civil engineers in the country has delayed reconstruction process following the disaster caused by both cyclones. The study team recommends to take this opportunity by training engineers who will be good counterparts in this project as well as qualified experts for the fisheries harbour of Tuvalu.

APPENDICES

APPENDICES

Contents

		Page
Appendix-1	Member List of Survey Team	A-1
Appendix-2	Survey Schedule	A-2
Appendix-3	Member List of Party Concerned in the Recipient Country	A-3
Appendix-4	Minutes of Discussion	A-4

Appendix-1 Member List of Survey Team

The Following personnel are assigned to participate in the field survey for the project.

Name	Assignment	Position
Mr. Takeru Kato	Team Leader Fishing Port Planner	Duputy Director, Fishing Port Construction Division, Fishing Port Department, Fishing Agency, Ministry of Agriculture, Forestry and Fisheries
Mr. Kazuhiro Kurosawa	Coordinator	Second Basic Design Study Division, Grant Aid Study & Design Department, Japan International Cooperation Agency
Mr. Tatuo Fuke	Chief Consultant Port Civil Engineer	Nippon Tetrapod Co., Ltd.
Mr. Gen-ichiro Shimoji	Natural Condition Surveyor	Nippon Tetrapod Co., Ltd.
Mr. Makoto Namatame	Construction Planner Cost Estimator	Central Consultant Inc.

Appendix-2 Survey Schedule

Field Survey Schedule

Day	Date		Itinerary				
			Team Leader, Fishing Port Planner	Coordinator	Chief Consultant, Port Civil Engineer	Construction Planner, Cost Estimator	Natural Condition Surveyor
1	Aug. 13	Sat					Narita(NZ034) →
2	14	Sun					→ Auckland
3	15	Mon	Narita(FJ303) →				Agreement of Field Survey
4	16	Tue	Nadi(PC124) → Suva, Courtesy call to the Embassy of Japan and JICA				Auckland(FJ441)→Nadi Nadi→Suva
5	17	Wed	Suva(CW008)→Funafuti, Courtesy call to Ministry of Natural Resources				
6	18	Thu	Explanation on Field Survey Schedule				
7	19	Fri	Investigation of Funafuti, General Meeting and Disoussion with Fisheries Department				
8	20	Sat	Funafuti→Vaitupe (by Te Tautai)				
9	21	Sun	Site Investigation, Team Meeting				
10	22	Mon	Discussion with Vaitupe Island Council				
11	23	Tue	Vaitupe→Funafuti (by Te Tautai)				Natural Condition Survey
12	24	Wed	Disoussion on Minutes			Data Collection	〃
13	25	Thu	Signing of Minutes with Ministry of Natural Resources			〃	〃
14	26	Fri	Funafuti(CW011)→Nadi(PC128)→Suva Courtesy call to the Embassy and JICA		Investigation of Damages		〃
15	27	Sat	Suva(FJ950)→Brisbane		Team Meeting		〃
16	28	Sun	Brisbane(JL776)→Narita		Funafuti→Vaitupe(by Te Tautai)		〃
17	29	Mon			Investigation of Damages		〃
18	30	Tue			〃	Data Collection	〃
19	31	Wed			Disoussion with Vaitupe Island Council		〃
20	Sep. 1	Thu			Vaitupe→Funafuti (by Te Tautai)		〃
21	2	Fri			Inves. of Damages	Data Collection	〃
22	3	Sat			〃	〃	〃
23	4	Sun			Team Meeting		
24	5	Mon			Visit Ministry of Natural Resources		Natural Condition Survey
25	6	Tue			Data Collection, Funafuti(CW013)→Suva		〃
26	7	Wed			Courtesy call to the Embassy and JICA		〃
27	8	Thu			Data Collection, Suva(PI014)→Nadi		Vaitupe→Funafuti
28	9	Fri			Nadi(FJ440)→Auckland, Data Collection		Data Collection
29	10	Sat			Auckland(NZ033)→Narita		〃
30	11	Sun					Data Analysis
31	12	Mon					Data Collection
32	13	Tue					Funafuti(CW013)→Suva→
33	14	Wed					Nadi
34	15	Thu					Nadi(FJ302)→Narita

Appendix–3 Member List of Party Concerned in the Recipient Country

1. The Government of Tuvalu

1.1 Ministry of Natural Resources

Mr. OTINIELU TAUSI	Minister
Mr. SIMETI LOPATI	Secretary
Mr. SAUTIA MALUOFENUA	Director, Fisheries Division
Mr. KELESOMA SALOA	Extension Officer

1.2 Ministry of Labour, Works and Communications

Mr. POKIA TIHALA	Assistant Secretary
Mr. SIO PATIALE	Director, Marine & Port Services

1.3 Ministry of Finance & Economic Planning

Mr. TINE LEUELU	Secretary

1.4 The National Fishing Corporation of Tuvalu(NAFICOT)

Mr. SEMN SOPOANGA TAAFAKI	General Manager

1.5 Development Bank of Tuvalu

Mr. PAANI K. LAUPEPA	Manager, Business Advisory Services

1.6 Vitupu Island Council

Mr. IUTA TANIELU	President
Mr. MONO MANALEA	Former President
Mr. TELAVA IELEMIA	Vice President
Mr. MOUPA FAGALELE	Ex Vice President
Mr. IAPESA VAVE	Executive Officer
Mr. MAGAONO PAPUU	Member of the Council

Appendix-4 Minutes of Discussion

MINUTES OF DISCUSSIONS

BASIC DESIGN STUDY
ON
THE RECONSTRUCTION PROJECT
OF
THE FISHERIES HARBOUR AT VAITUPU
IN
TUVALU

In response to a request from the Government of Tuvalu, the Government of Japan decided to conduct a Basic Design Study on the Reconstruction Project of the Fisheries Harbour at Vaitupu (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Tuvalu a study team, which is headed by Mr. Takeru Kato, Deputy Director of Fishing Port Construction Division, Fishing Port Department, Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries and is scheduled to stay in the country from August 17 to September 13, 1994.

The team held discussions with the officials concerned of the Government of Tuvalu and conducted a field survey at the study area.

In the course of discussions and field survey, both parties have confirmed the main items described on the attached sheets. The team will proceed to further works and prepare the Basic Design Study report.

Funafuti, August 25, 1994

加藤 武留

Mr. Takeru Kato
Leader
Basic Design Study Team
JICA

Otinielu T. Tausi

Mr. Otinielu Tausi
Minister
Ministry of Natural
Resources

1. OBJECTIVE

The objective of the Project is to restore the fisheries harbour at Vaitupu damaged by the cyclones.

2. PROJECT SITE

The Project site is located at Vaitupu Island as shown in Annex I.

3. RESPONSIBLE AND EXECUTING AGENCY

Responsible Agency : Ministry of Natural Resources.
Executing Agency : Fisheries Department, Ministry of Natural Resources.

4. ITEMS REQUESTED BY THE GOVERNMENT OF TUVALU

After discussions with the Basic Design Study Team, the project items which were finally requested by the Tuvalu side are shown in Annex II. However, the final components of the Project will be decided after further studies.

5. JAPAN'S GRANT AID SYSTEM

(1) The Government of Tuvalu has understood the system of Japanese Grant Aid explained by the team.

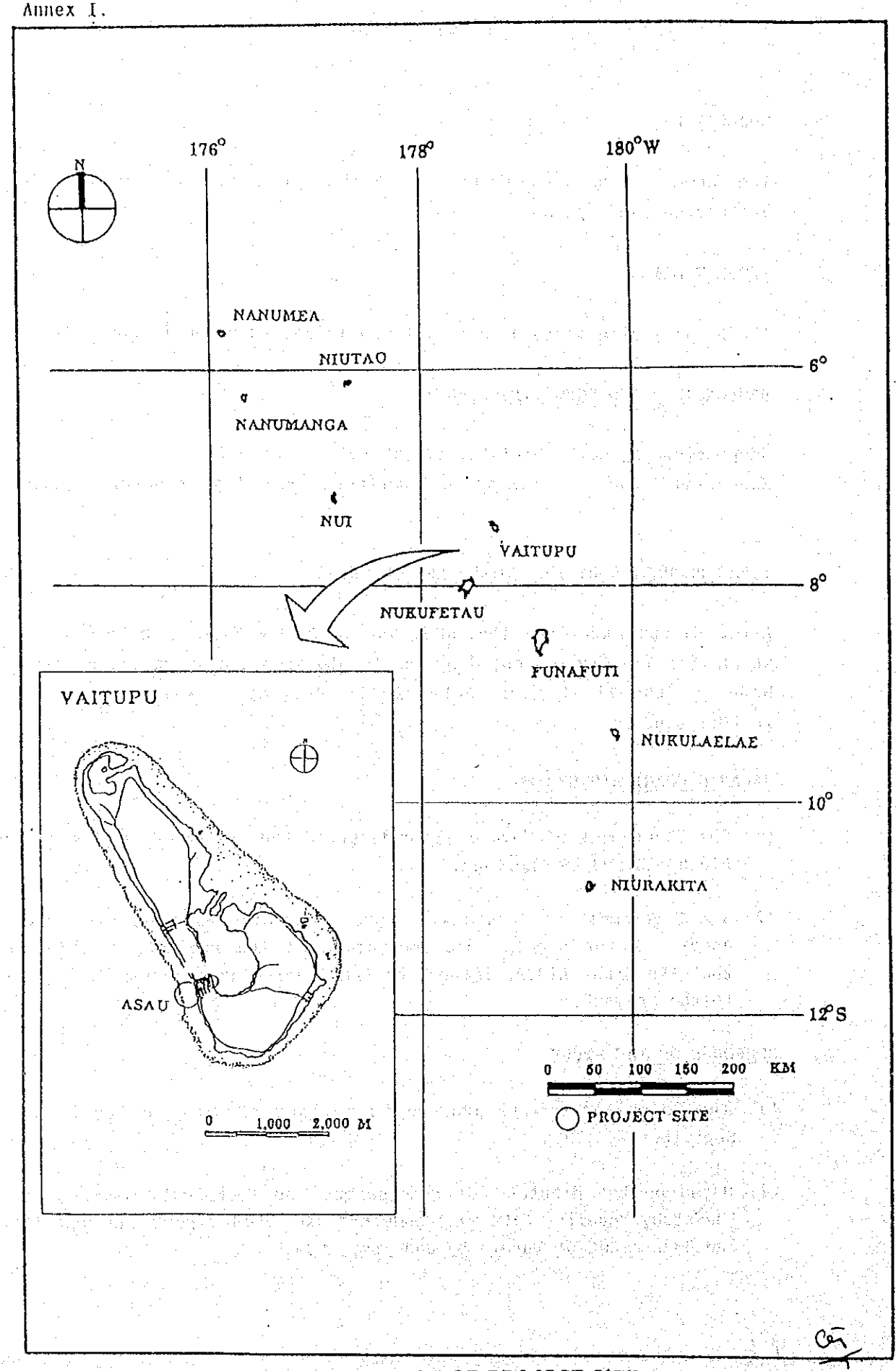
(2) The Government of Tuvalu will take necessary measures, described in Annex III for smooth implementation of the Project, on condition that the Grant Aid Assistance by the Government of Japan is extended to the Project.

6. SCHEDULE OF THE STUDY

(1) The Consultants will proceed to further studies in Tuvalu until September 13, 1994.

(2) Based on the Minutes of Discussions and technical examination of the study results, JICA will complete the final report and send it to the Government of Tuvalu by January, 1995.

J.K



LOCATION OF PROJECT SITE

ANNEX II. ITEMS REQUESTED BY THE GOVERNMENT OF TUVALU

The project items requested by the Government of Tuvalu are listed as followings;

1. Rehabilitation of Groin

2. Rehabilitation of Landing Pier

3. Removal of debris and dredging of Reef Access Channel and Anchorage

4. Repair of Slipway

5. Repair of Beach Protection

6. Equipment:
   *Light Beacon
   *Jib Crane

Annex III. NECESSARY MEASURES TO BE TAKEN BY TUVALU

1. To secure the site for the Project.

2. To clear the site prior to commencement of construction.

3. To undertake incidental outdoor works such as fencing and gates in and around the site.

4. To construct the access road to the site prior to commencement of construction.

5. To ensure prompt unloading and customs clearance at the port of disembarkation in Tuvalu and internal transportation of imported materials and equipment to the construction site.

6. To exempt any equipments, materials and supplies brought into and/or purchased in Tuvalu in connection with the performance of the works from any tax, duties and levies which are imposed in Tuvalu.

7. To exempt Japanese nationals engaged in the Project from custom duties, internal taxes and other fiscal levies which may be imposed in Tuvalu with respect to the supply of the products and services under the verified contract.

8. To accord Japanese nationals whose services may be required in connection with the supply of products and the services under the verified contract such facilities as may be necessary for their entry and stay therein for the performance of their work.

9. To bear commissions to the Japanese foreign exchange bank for the banking services based upon the Banking Arrangement.

10. To bear all expenses, other than those to be borne by the Grant, necessary for construction of the facilities.

11. To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid.

12. To coordinate and solve any related matters which may arise with third party in the Project area during implementation of the Project.

J.k.