Ministry of Communications, Transport and Tourism Development
The Republic of Kiribati

IMPLEMENTATION REVIEW STUDY REPORT
ON
THE PROJECT FOR EXPANSION OF BETIO PORT
IN
THE REPUBLIC OF KIRIBATI

AUGUST 2010

JAPAN INTERNATIONAL COOPERATION AGENCY

ECOH CORPORATION

PREFACE

Japan International Cooperation Agency (JICA) conducted the implementation review study on the Project for Expansion of Betio Port in the Republic of Kiribati.

JICA sent to Kiribati a study team from June 18 to July 7, 2009.

The team held discussions with the officials concerned of the Government of Kiribati, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Kiribati in order to discuss a draft outline design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Kiribati for their close cooperation extended to the teams.

August, 2010

Kiyofumi Konishi

Director General,
Economic Infrastructure Department
Japan International Cooperation Agency

August, 2010

Letter of Transmittal

We are pleased to submit to you the implementation review study report on the Project for Expansion of Betio Port in the Republic of Kiribati.

This study was conducted by ECOH CORPORATION, under a contract to JICA, during the period from June, 2009 to August, 2010. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Kiribati and formulated the most appropriate outline design for the project under Japan's Grant Aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

Yutaka Ochi

Project Manager,
Implementation Review Study Team on
the Project for Expansion of Betio Port
ECOH CORPORATION

Summary

(1) Overview of Kiribati

Kiribati is located in the Pacific Ocean, comprising Gilbert Islands, Phoenix Islands and Line Islands, of which land area is 810.5 km^2. 33 atolls distribute widely in the vast water area of 4,500km from east to west and 1,800km from north to south with an exclusive economic zone ranked No.3 in the world. Kiribati is isolated geographically from the international market in the most prominent. Population derived from 2005 Census is 92,533, of which 83,683 people inhabit in Gilbert Islands. Population is concentrated in Tarawa of the Capital and 45,989 people corresponding to 50% of the gross population reside in southern Tarawa, where Betio Port is located. The industry of Kiribati is limited to copra production and fishery industry. Due to geographical isolation, the national narrow nature and the lack of natural resources, the financial condition is experiencing a lasting deficit. GDP and GDP per capita of 2007 are A$84,195,000 and A$876, respectively.

(2) Background of the Project

The land area is so flat and limited that agriculture is not suitable. Most of daily commodities including food must be imported from overseas countries. Maritime transportation, therefore, is performing as important lifeline to support the lives of the people and economic activities. In the national development plan, sustainable economic development is one of the targets and the improvement of infrastructure including maritime transportation under the purpose is one of the priority issues. And the port is an essential infrastructure of the international and domestic transportation base for cargo flow. Economic growth and poverty reduction is one of the priority issues and formulation identified in Kiribati Development Plan. Improvement of infrastructure, including maritime transportation is listed as an important item.

Betio Port is functioning not only as the merely international gateway but also as the domestic transportation base connecting isolated outer islands such as London Wharf of Christmas Island and other internal islands. In 2000, Japan's Grant Aid comprising the wharf, container yards, administration office, container freight station and related facilities were implemented. These port facilities are utilized very well as transportation base for international and domestic cargoes and fishery base. Meanwhile, due to further advancement of international containerization, container cargo volume handled at Betio Port has increased to account for more than 90 percents of the entire cargo volume. Ocean liner container ship is forced to unload and load cargoes by offshore transshipment with flat barges, not directly handled at the wharf, because the ocean liner can not berth alongside the existing wharf due to insufficient water depth and berth extension. Container handling through offshore transshipment causes the problem in terms of cargo handling safety and efficiency, which causes consequent rise in transportation costs. In addition, Betio Port is only the port of water depth less than 9.0 m and berth extension less than 100 m in neighboring countries, which can not cater the container ship to berth directly

alongside the wharf. It is an urgent need to improve the berthing facility to enable the ocean liner container ship to berth directly alongside a wharf.

Considering the above background, the Government of Kiribati requested a grant aids assistance in 2006 to develop the pier for medium-sized vessels of 9.0m water depth and 200m berth extension, and provide cargo handling equipment. In response, the request has been examined by the preliminary study carried out from July to October, 2007 due to the large scaled facilities, the location of the facilities and the needs and appropriateness of the project. And concerns on the marine environment affected by the large scaled construction such as a pier are considered and countermeasures according to JICA Guidelines for Environmental and Social Consideration must be examined by an appropriate course. Consecutively, the Basic Design Study was carried out aiming to re-confirm the necessity and appropriateness of the project based on the results of the preliminary study from June, 2008 to January, 2009. The basic design of the requested facilities and equipment according to the Japan's Grant Aid policy, formulation of the project implementation plan and project cost estimation are included in the study. However, conclusion of the Exchange of Note (E/N) between the Kiribati Government and the Japanese Government has been postponed, because the project cost was expected to exceed the initial plan due to rising material prices high and the rapid increase in transportation costs.

Under the circumstances mentioned above, the Implementation Review Study is carried out to re-estimate the project cost of the proposed facilities and equipment proposed by the Basic Design Study considering the commodity price changes after the basic design period, and alternate project plans are established for project cost reduction, such as shortening the extension of the pier and the width of the access bridge, reducing the number of cargo handling equipment and other countermeasures. A feasibility of the project is examined from the view point of the project costs of the alternate plans and the cargo handling efficiency.

In response to a request of the Government of Kiribati, the Government of Japan decided to conduct a Basic Design Study and a consequent Implementation Review Study, and send the Study Team as followings.

Basic Design Study:	June 16 to July 26, 2008.
Implementation Review Study:	June 16 to July 9, 2009.
Outline Design Explanation:	June 20 to August 1, 2010.

(3) Contents of the Project

This study aims to promote safety and efficiency of cargo handling operation by improving berthing facility and introduction of cargo handling equipment according to forthcoming cargo handling system so that the ocean liner container ships calling Betio Port can be berthed directly without offshore cargo transshipment.

Following 4 items are examined as project components. The relation of each component with Upper Plan and Project Objectives are shown as followings.

- Installation of Pier
- Installation of Access Trestle
- Introduction of Port Cargo Handling Equipment
- Installation of Navigation Aids

1) Contents of the Pier

Two layout plans have been proposed in the request letter by Kiribati, comprising the plan extending to offshore up to the area of sufficient water depth without dredging and the plan installing in nearer area with the required water depth obtained by dredging. The offshore installation plan is employed, as same as the result of the preliminary study, from the view of necessity of future maintenance dredging and environmental aspects. The ship wreck confirmed in the offshore area of the project area is decided not to remove because of interview survey results of container ship captains and other correspondents. For securing navigation safety, beacons will be installed to indicating the ship wreck.

Berth extension and the water depth of the pier can be planned in accordance with the specification of Kiribati Chief (13,668DWT) of Swire Shipping Service and South Islander (17,800DWT) of Greater Bali Hai Line, because other same size ship or bigger size ship have not been found so far. Based on the dimensions of the above two container ships, the water depth and extension of the quay are determined as -8.7 m and 200 m, respectively. The crown width of the pier is set as 18 m, considering the condition of cargo handling operation.

Layout plan of the pier is examined based on the bathymetric chart conducted during the field survey. Offshore distance from the tip of the existing wharf is set as 280 m in the area of isobath distribution without maintenance dredging. And the steel pipe pile type open pier is adopted considering the maritime environment, which will minimizes the effect to current, wave and bathymetry.

2) Contents of the Access Trestle

The access trestle is important facility to connect the pier and the container yard. And the access trestle is planned to ensure smooth container traffic through with fully utilization of container handling functions carried out on the pier.

Extension of the access trestle is determined as 261m connecting between the top of the existing wharf and the expected pier. Crown width of the trestle is set based on single lane road for 1 way traffic as mentioned on the request letter. To ensure smooth traffic, a waiting or evacuation zone of 60m extension is installed in the middle of the access trestle. Additionally a space for future installation of various pipelines shall be secured beneath the sidewalk of the trestle. Structure type is a steel pipe pile type open bridge as same as the pier structure from the view of environmental aspects. Pre-stressed concrete box girder is selected as upper structure of the trestle considering construction efficiency and cost.

3) Contents of Cargo Handling Equipment

The composition of cargo handling equipment will be changed according to the forthcoming cargo handling system of new berthing facilities. Cargo handling system will be shifted from offshore transshipment to direct loading and unloading on the pier. To meet the container cargo handling efficiency after the project completion, an appropriate number and capacity of the cargo handling equipment are introduced. The composition and type of cargo handling equipment is planned at minimum necessity, considering container loading and unloading efficiency of container ship. To cater for container handling operation after completion of the Project, the cargo handling equipment comprises 2 units of forklift and 5 units of tractor and trailer, excluding a top lifter substituted by a reach stacker introduced newly by KPA. In the implementation review study, 1 unit of forklift and 3 units of tractor and trailer are included in the Project, taking into account existing cargo handling equipment owned by KPA of 1 unit of forklift and 2 units of tractor and trailer.

4) Contents of Navigation Aids

According to the existing light buoys along the access channel which are aged or lost, the navigation aids are newly replaced. And minimum necessary navigation aids comprising beacons to indicate the location of ship wreck and the markers on the pier shall be installed.

Scope of the Project in comparison with the request is shown as followings.

【Project Facility and Equipment】

Project Item		Request	Study	Remarks
① Pier		200m (L)	200m (L)	18m (W), Steel Pipe Pile Type
② Access Trestle		200m (L)	261m (L)	6.5m (W), Steel Pipe Pile Type
③ Cargo Handling Equipment				
	Forklift	No Description	1 unit	30.5 ton Capacity or more
	Tractor and Trailer		2 units 1 unit	20’ Container Use 20’ & 40’ Container Multi Use
④ Navigation Aids				
	Light Buoy	No Description	11 units	Channel Entrance: 3units, Access Channel: 5units, Anchoring Area: 1unit, Ship Wreck: 2units
	Beacon		2 units	Pier: 2units

(4) Implementation Plan

The implementation period takes 44 months in total, comprising 8 months for detail design and tender procedure and 36 months for construction and procurement.

(5) Project Evaluation

Project implementation agencies are Ministry of Communications, Transportation and Tourism Development as responsible agency and Kiribati Ports Authority as implementation agency. Betio Port is operated and managed appropriately by Kiribati Ports Authority. Project facilities, comprising pier, access trestle, cargo handling equipment and navigation aids are not so different from the existing port facilities, so that no further and higher techniques are required for operation and maintenance. Beneficiaries due to project implementation are port authority personnel and port users of direct beneficiaries and 92.5 thousand people of Kiribati nationals.

Following direct and indirect effects are expected by project implementation.

1) Direct Effects

i) Safe and Efficient Container Operation without Offshore Transshipment

All of the container ships of regular services to Betio Port can berth alongside the pier. Container can be loaded and unloaded directly to the container ships through the pier without offshore transshipment. Cargo handling safety and efficiency will be improved distinctly due to no offshore cargo handling work.

Vulnerabilities of cargo handling operation including failure-prone mobile crane for container handling and work boats for container transshipment will be settled by installation of the pier and the access trestle. In consequence, container cargo handling operation will be stabilized.

ii) Less Transportation Distance of Containers

Container unloading and loading operation will be shifted from offshore to the pier, so that the transportation distance to the container yard will be shortened. Transportation distance of the offshore transshipment is 700 m on sea and 200 m on land is shortened to 600 m on land with direct loading and unloading.

iii) Speedy Transportation of Containers to Container Ship through Pier and Access Trestle

Offshore transshipment sequences comprising container unloading works from a container ship to barges, barge towing by tugboat and container landing works at the existing wharf by mobile crane will be replaced by onland transportation by tractor and trailers from the pier to the existing wharf through the access trestle, which significantly shorten transportation time of container from container ship to the existing wharf, in consequence.

Transportation time of the offshore transshipment by barge and tugboat takes 86 minutes for 10 loaded containers per barge (8.6 minutes/unit), 206 minutes for 30 empty containers per barge (6.9 minutes/unit). Vehicle unloading operation from a ship takes 126 minutes per barge (10.5 minutes/unit). After installation of the project, transportation time of each operation will be shortened as 2.4 minutes for loaded and empty container and 1.7 minutes for vehicle discharged through Ro-Ro ramp way equipped on a container ship.

iv) Efficient Container Handling Operation

Number of handled container for each hour will be increased from current 5.7 units of loaded container and 8.0 units of empty container to 18.5 units by 5 units of tractor and trailer comprising 2 existing units and 3 newly introduced units for loaded and empty container at maximum by model simulation of container handling operation. Number of unloading vehicles will be improved from current 5.1 units per hour to around 30 units by direct discharging through Ro-Ro ramp way of a ship to the pier.

v) Reduction of Port Time of Container Ship

Port time of the container ships will be reduced by improvement of container handling efficiency. Following reductions of port time on typical case will be expected on the assumption that unloading and loading works and transportation of containers are conducted smoothly and efficiently.

Required port time of Kiribati Chief, in case of 300 loaded container unloading and 300 empty container loading, will be reduced current 109.8 hours to 39.9 hours for 5 units of tractor and trailers after project implementation. Regarding another container ship of South Islander, her port time will be expected from current 44.4 hours to future 15.2 hours in case of 100 loaded containers unloading, 100 empty containers loading and 30 vehicle discharges. South Islander will finish her cargo handling operation within one day and will leave the port in the same day, expectedly. Accordingly, port time of container ships is expected to be reduced as approximately 1/3 of the current situation by installation of the project.

vi) Ripple Effects on Merchandise Price

Merchandise price distributing in Kiribati will be less by reducing the transportation cost, which contributes to decrease the price index. Large amount of cargo will have an advantage to reduce transportation cost by accepting more 40 footer containers due to smooth and efficient handling.

vii) Improvement of Ship Navigation Safety

Ship navigation safety through the existing access channel to the port set on complicated coral bathymetry will be improved by upgrade and replacement of lighted buoys. Consequently, ship accident, which affects seriously port activities, occurring in the access channel will be avoided.

viii) Night Navigation and Emergency Evacuation

Night navigation will be allowed by introducing new navigation aids of lighted buoys, so that adjustment of the ship schedule to enter or depart in daytime will not be necessary. In case of emergency, navigating ship in the vicinity area will be able to enter the port even in night time for evacuation.

2) Indirect Effects

i) Improvement of Maritime Transport Services

As to the advantage of shipping companies, trip time of ocean liner will be reduced by less port time in Betio, which contributes to improve maritime transportation services with more frequent ship allocation.

(6) Recommendations and Actions

After the completion of the project facilities, followings are requested to consider for effective utilization of the project facilities and settling forthcoming issues.

1) Enhancement of Operation / Management Body and Relocation of Personnel

After the introduction of port facilities and equipment, management and operation institution of Kiribati Ports Authority will be expected according to the new cargo handling system. In other words, staff engaged in tugboats and crane operator will be reallocate to another section due to elimination of offshore transship operation. It is recommended that the operation and management structure will be modified or re-established beforehand for smooth transition to the new system.

2) Safety Management of Port Facility and Equipment

Regarding operation and management of the port faculties including maritime area, safety management with complete site arrangement to prevent accidents in port activities must be considered.

3) Appropriate Use and Maintenance of Facilities

Appropriate use and proper maintenance of the project facilities is important to prolong the life year. It is important to respect the environment condition attached to the environmental licence and to monitor water pollution.

4) Financial Soundness of Institution

Financial condition of Kiribati Ports Authority is supposed to be less sound according to the financial statement available so far. Sound operation and management of the institution are established by appropriate balance of revenue and expenditure.

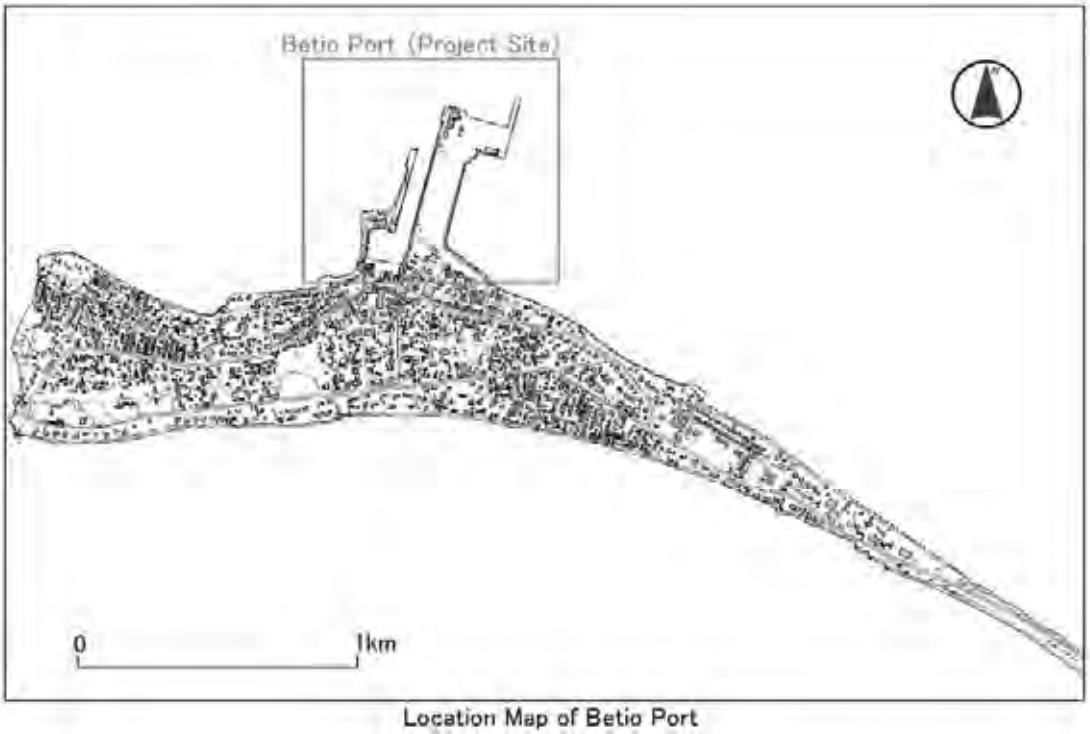
5) Environmental and Social Considerations

Environmental Act stipulates the necessity of environmental monitoring for development projects. With regard to the formulation of environmental monitoring plan for the project, it is important to determine monitoring parameters and set up a monitoring team in collaboration with competent authority of environmental conservation, namely MELAD.

Location Map of Kiribati

Location Map of Tarawa Atoll

Location Map of Betio



Location Map of Betio Port

The Implementation Review Study, JICA
The Project for Expansion of Betio Port in the Republic of Kiribati

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ABBREVIATIONS

A		
	ADB:	Asian Development Bank
	A$	Australian Dollar
	AIMS:	Australian Institute of Marine Science
	APHA:	American Public Health Association
B		
	BTC:	Betio Town Council
C		
	C.D.L.:	Chart Datum Level
	CPP:	Central Pacific Producer Limited
D		
	DWT:	Dead Weight Tonnage
E		
	EEZ:	Exclusive Economic Zone
	EIA:	Environment Impact Assessment
	E/N:	Exchange of Note
F		
	F. ton:	Freight Ton
G		
	GDP:	Gross Domestic Product
	GEF:	Global Environment Facility
	GNP:	Gross National Product
I		
	IEE:	Initial Environmental Examination
	IEER:	Initial Environmental Examination Report
	ISO:	International Organization for Standardization
K		
	KCM:	Kiribati Copra Mill Limited
	KCS	Kiribati Copra Society
	KOIL:	Kiribati Oil Limited
	KPA:	Kiribati Ports Authority
	KSSL:	Kiribati Shipping Services Limited
L		
	Loa:	Length Overall
M		
	MCTTD:	Ministry of Communication, Transport and Tourism Development
	MELAD:	Ministry of Environment, Lands and Agricultural Development
	MFMRD:	Ministry of Fisheries and Marine Resources Development
	M.S.L.:	Mean Sea Level
P		
	P/Q:	Prequalification
	PUB:	Public Utility Board
S		
	SPSLCMP:	South Pacific Sea Level and Climate Monitoring Project
T		
	TEU:	Twenty Foot Equivalent Unit
	TNTC:	Too Numerical to Count
	TSKL:	Telecom Services Kiribati Limited

Chapter 1 Background of the Project

1-1 Background of the Project

(1) Project Background and Sequences

Kiribati comprising 33 atolls scattering widely in the vast waters area in the Pacific, is isolated geographically from the international market in the most prominent. The maritime transportation is the important life line to support people's life and economic activities and the port & harbor is the essential infrastructure as the base for the transportation handling import, export and domestic cargoes.

Betio Port is functioning not only as the merely international gateway but also as domestic transportation base connecting isolated islands such as London Wharf of Christmas Island and other islands scattering. Any expansion and rehabilitation of the port facilities have not carried out, since the construction of the former port for a small sized vessel in 1950. In 2000, Japan's Grant Aid comprising a wharf of 6.0m water depth and 80m extension, container yards of 17000m^2 area, an administration office, the container freight station and related facilities was implemented.

Due to further advancement of international containerization, container cargo volume of Betio Port has increased significantly to account for more than 90 percent of the entire cargo handling volume. Ocean liner container ship is forced to unload and load the cargo by off-shore transshipment by flat barge not directly to the wharf, because the ocean liner, of which arrival draft is around 8.0m, can not berth alongside the existing wharf with insufficient water depth and berth extension. Container handling through off-shore transshipment causes the problem in terms of cargo handling safety and efficiency, which consequents to rises in the transportation cost. In addition, Betio Port is the only port, which can not cater the container ship to berth directly alongside the wharf, in neighboring countries. It is an urgent need to improve the port facility to enable the ocean liner to berth alongside.

Considering the above circumstances, the Kiribati Government requested a grant aids assistance in 2006 to develop the pier for medium-sized vessels of 9.0m water depth and provide cargo-handling equipment. However, the request has been examined by the preliminary study carried out from July to October, 2007 with respect to the large-scale facilities, the location of the facilities, and the needs and appropriateness of the project. And concerns on the marine environment affected by the large-scale construction of the pier are considered and countermeasures according to JICA Guidelines for Environmental and Social Consideration must be required by an appropriate response. Based on the preliminary study, the request has been justified as followings.

1) Volume of containerized cargoes significantly increased by approximately 1.4 times out of the imported cargo volume between 2001 and 2005. 90 percents of the imported cargoes are transported by the medium-sized container ships, of which draft is 8 to 9m. However,

the existing wharf can not cater for these medium-sized container ships due to the limited water depth of 6.0m and extension of 80m. Off-shore transshipment operation using tag boats and flat barges is easily affected by the wind and wave actions, which consequents to the low efficiency of container handling works and the safety issues. In addition, the loading and unloading operation frequently suspended by adjusting the operation cycle of the work boats and onshore cargo handling equipment. To improve the above situation, implementation of the project can be justified as significant.

2) Alternate plan of the current wharf extension with deepening water depth from current 6.0m to 9.0m by dredging the surrounding offshore area and the access channel route has some difficulty in maintaining the required water depth. Feasibility of the alternate plan is justified as low according to the following conditions.

i) Huge amount of dredging material and the disposal of the dredged material is deemed to be difficult to cater for, as well as significant impacts on the environment are concerned.

ii) the Kiribati government does not have capable dredgers for the maintenance dredging operation to remove deposited sediment in the offshore area.

3) Major cargo handling equipment owned the Kiribati Ports Authority is already aging. Minimum number and types of cargo handling equipment such as forklift and tractor & trailer deemed to be required to cater for new cargo handling system after the project completion.

4) Existing light buoys are suffered by corrosion and deterioration due to aging and significant damage. From view points of the navigation safety of calling ships, installation of the navigation aids is justified as reasonable.

In addition, this project is classified in category B according to the JICA's guideline of environmental and social considerations, so that under the support of the preliminary study team, Ministry of Communication, Transport and Tourism Development (MCTTD), the Kiribati government carried out the initial environmental examination (IEE) according to the environmental regulation. However, the agency responsible for environment (Ministry of Environment, Land and Agriculture Development: MELAD) requested to update the IEE to clear the affected intents based on the level of the basic design study including impact mitigation measures. In the course of the Basic Design Study, further support on the IEE study of the Kiribati government portion of MCTTD had been carried out and the environmental licence was issued in October, 2008.

The Basic Design Study was carried out aiming to re-confirm the necessity and appropriateness of the project based on the results of the preliminary study from June, 2008 to January, 2009. Basic design of the requested facility and equipment according to the Japan's Grant Aid policy, formulation of the project implementation plan and project cost estimation are included in the study. However, conclusion of the Exchange of Note (E/N) between the Kiribati Government and the Japanese Government has been postponed, because the project cost was expected to exceed the initial plan due to rising material prices high and the rapid increase in transportation costs.

Under the circumstances mentioned above, the Implementation Review Study is carried out to re-estimate the project cost of the proposed facilities and equipment of the Basic Design Study considering the commodity price changes after the basic design period and alternate project plans are established for project cost reduction, such as shortening the extension of the pier and the width of the access bridge, reducing the number of cargo handling equipment and other countermeasures. A feasibility of the project is examined from the view point of the project costs of the alternate plans and the cargo handling efficiency.

(2) Contents of Project

The outline of the plan and the contents of the requested facilities and equipment are shown as below.

1) Upper Goal

Maritime transportation routes of Kiribati will be secured.

2) Project Goal

Safe and efficient cargo handling operations will be realized.

3) Expected effects by Project Implementation

Betio Port will be extended.

4) Project Indicators

Numerical indicators: Increasing the number of midium sized container ships directly berthing alongside the pier
Shortening the port time of container ships, others

5) Action and Implementation Plan

i) Contents of the Requests to the Japanese Government

The outline of the plan and the contents of requested components of facilities and equipment are as shown below.

- Construction of New Pier with Access Bridge
- Improvement of Navigation Aids
- Introduction of Port Cargo Handling Equipment

The contents of the original requests for facilities and equipment and the altered components proposed by the preliminary study are summarized as shown in Table 1.1-1.

Table 1.1-1 Contents of Project Components

【Requested Facilities】

Component		Request	Preliminary Study	Basic Design Study	Remarks
Construction of New Pier					
	Pier	200 m	200 m	200 m	Crown Width 14m Steel Pipe Pile Structure
	Access Bridge	250 m	275 m	261 m	Crown Width 5m Steel Pipe Pile Structure

【Requested Equipment】

Component		Request	Preliminary Study	Basic Design	Remarks
Introduction of Port Cargo Handling Equipment					
	Forklift	No Details	2 sets	2 sets	25 to 30 ton Capacity
	Tractor & Trailer		3 sets	5 sets	20 feet
	Top Lifter		1 set	1 set	35～30 ton Capacity
Improvement of Navigation Aids					
	Light Buoy	No Details	8 sets	5 sets	
	Light Beaon			6 sets	
	Light Marker			2 sets	Both Ends of Pier

ii) Contents of Obligation of the Kiribati Government

- Removal of Existing Crawler Crane
- Removal and Processing of Unexploded Ordnance, if found

iii) Action Plan of the Kiribati Government

- Operation and Maintenance of Project Facility and Equipment

6) Project Area (Site)

The project site is indicated as following.

Betio Port, Tarawa Atoll

7) Beneficiaries

Beneficiaries due to the project implementation are indicated as followings.

- Direct Beneficiaries: Port Authority Personnel and Port User
- Indirect beneficiaries: 92.5 thousand people of all Resident in Kiribati

8) Project Implementation Organization

- Responsible Agency:

  Ministry of Communication, Transportation and Tourism Development (MCTTD)
- Implementation Agency:

  Kiribati Ports Authority (KPA)

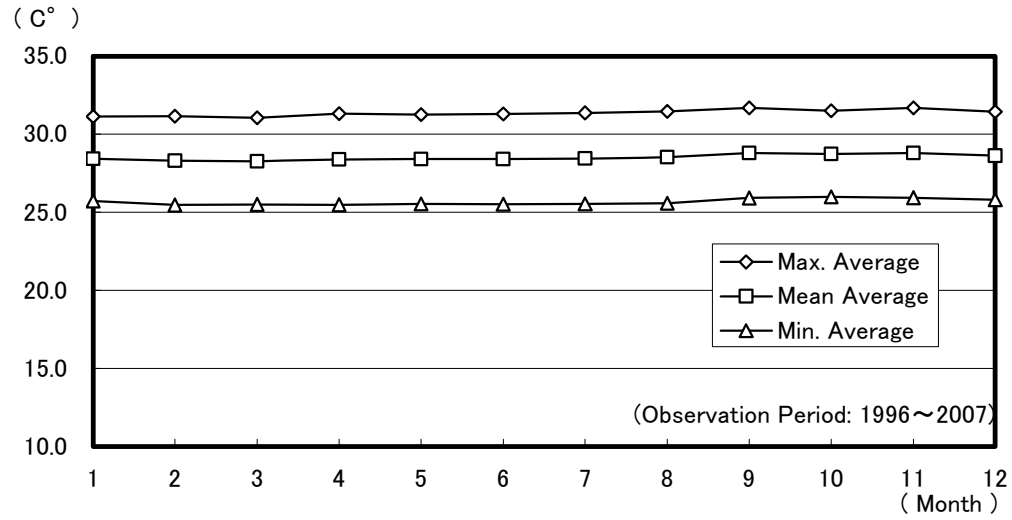
1-2 Natural Conditions

(1) Meteorological Conditions

The meteorological conditions observed at Meteorological Observatory located on the south side of Betio Port (latitude 1 ° 21 ', east longitude 172 ° 56') are mentioned as followings.

1) Air Temperature

Air temperature recorded from 1996 to 2007 is shown in Figure 1.2-1. Average temperature in Betio throughout the year is less variation. The annual average temperature is 28.5 ℃. Daily temperature difference is much smaller as 6.0 ℃, where the highest and lowest average temperatures are 31.7 ℃ and 25.5 ℃, respectively.



(Source: Meteorological Office, Kiribati)

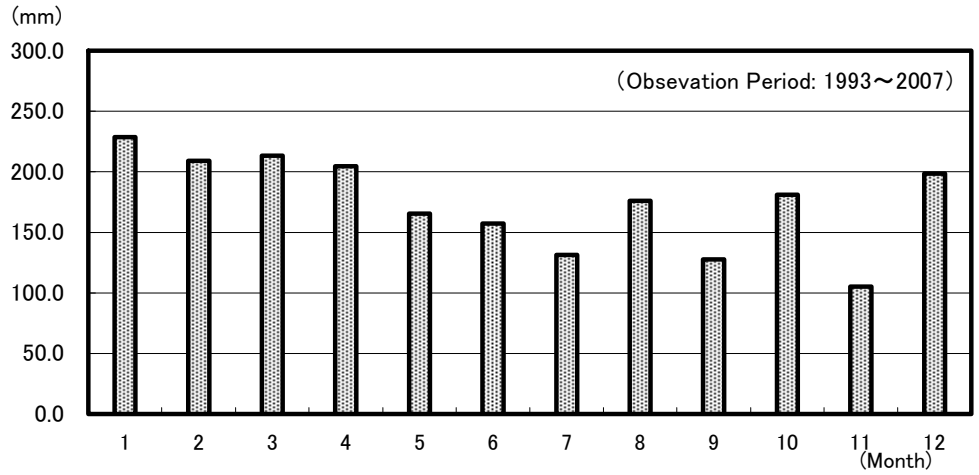
Figure 1.2-1 Monthly Air Temperature in Betio (1996 - 2007)

2) Humidity

Average humidity, the less change throughout the year, is around 70 percent.

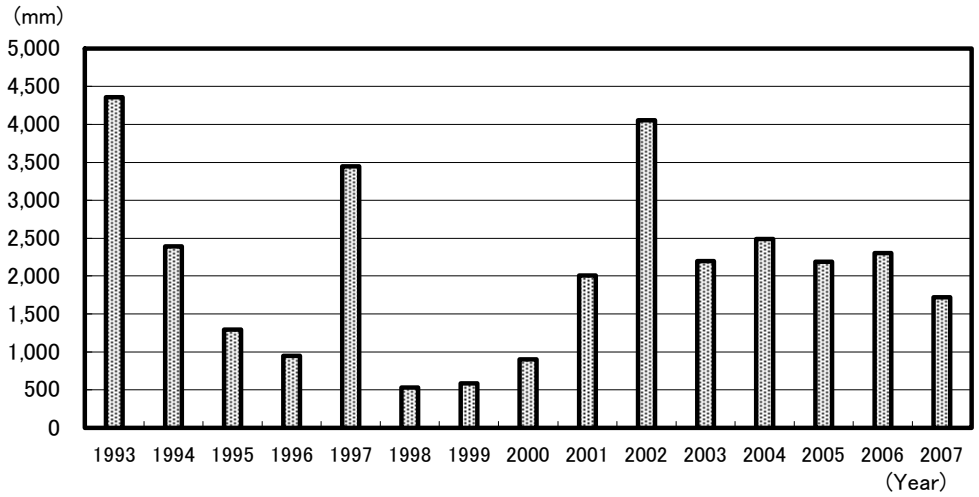
3) Precipitation

Monthly and annual changes in rainfall for 15 years from the years 1993 to 2007 are shown in Figure 1.2-2, 3. From variation of monthly rainfall amount, the period from December to May corresponds to rainy season and dry season is from January to April. Annual rainfall amount fluctuates very large, where the rainfall recorded about 500mm in 1998 and 1999 as draught year and more than 4,000mm in 1993 and 2002. Average annual rainfall is the extent of 2,100mm.



(Source: Meteorological Office, Kiribati)

Figure 1.2-2 Average Monthly Rainfall in Betio (1993 - 2007)



(Source: Meteorological Office, Kiribati)

Figure 1.2-3 Annual Rainfall Amount in Betio (1993 - 2007)

4) Wind Direction and Speed

Wind observation records (8 observations / day, 3 hours each) at Betio are shown in Table 1.2-1 in six years from 2002 to 2007. Wind roses of direction-wise frequency and wind speed are indicated for each season in Figure 1.2-4.

Wind condition in Betio is relatively calm and the easterly wind is predominant throughout the year. Total occurrence of 3 wind direction of ENE, E and ESE occupies 61 percents in frequency rate. The frequency rates of the wind speed more than 6.0 m/s and 10.0 m/s are calculated as 19.2 and 0.9 percent respectively and the rate of emergence of strong winds is very low.

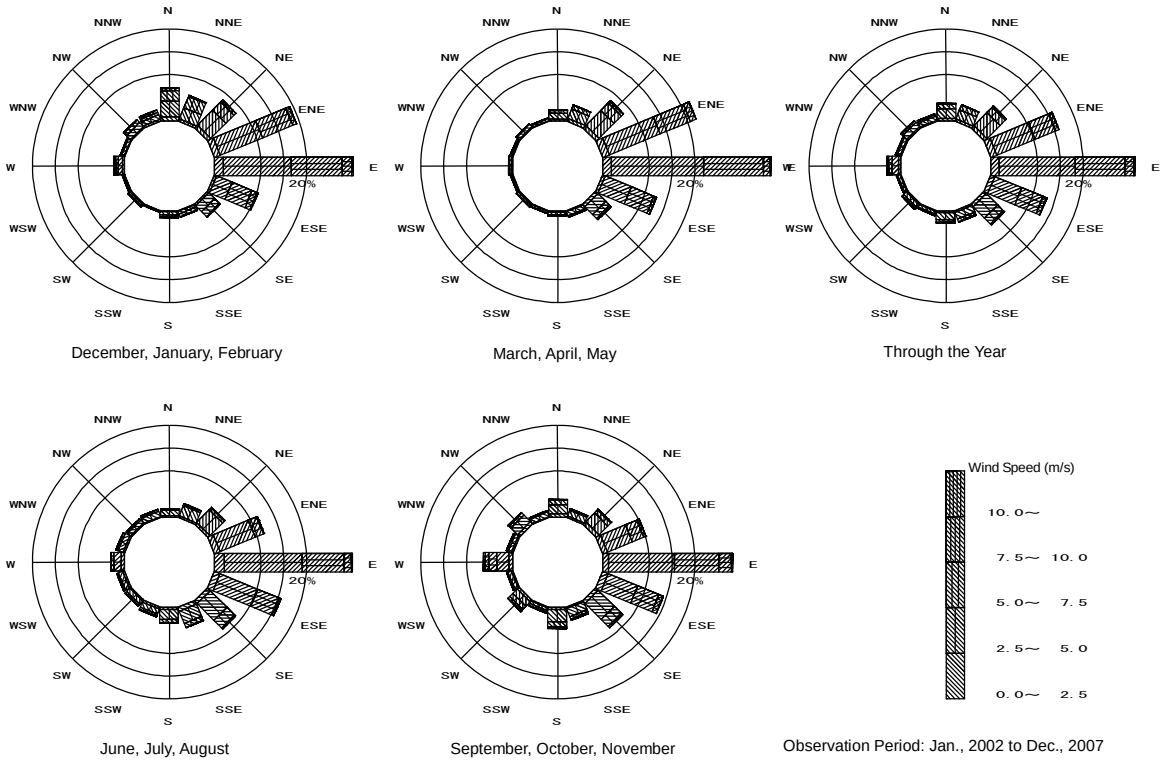
Table 1.2-1 Direction-wise Frequency Distribution of Wind Speed in Betio (2002 - 2007)

Observation: Jan., 2002 to Dec., 2007 — Wind Direction: 16 Direction
Location: Betio — Wind Speed: m/s

Direction / Speed	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	total
0– 2	23 0.2	29 0.2	49 0.3	61 0.4	29 0.2	37 0.2	14 0.1	23 0.2	11 0.1	22 0.1	9 0.1	26 0.2	14 0.1	17 0.1	10 0.1	44 0.3	418 2.8
2– 4	273 1.8	495 3.3	983 6.6	1713 11.4	630 4.2	375 2.5	211 1.4	192 1.3	98 0.7	111 0.7	82 0.5	198 1.3	115 0.8	165 1.1	122 0.8	249 1.7	6012 40.1
4– 6	216 1.4	335 2.2	986 6.6	1939 12.9	891 5.9	386 2.6	121 0.8	110 0.7	39 0.3	72 0.5	43 0.3	118 0.8	47 0.3	104 0.7	73 0.5	203 1.4	5683 37.9
6– 8	63 0.4	131 0.9	325 2.2	828 5.5	353 2.4	129 0.9	47 0.3	58 0.4	24 0.2	33 0.2	16 0.1	74 0.5	15 0.1	27 0.2	34 0.2	71 0.5	2228 14.8
8– 10	9 0.1	30 0.2	70 0.5	168 1.1	76 0.5	28 0.2	10 0.1	11 0.1	8 0.1	17 0.1	7 0.0	35 0.2	5 0.0	10 0.1	15 0.1	21 0.1	520 3.5
10– 12	2 0.0	5 0.0	6 0.0	30 0.2	14 0.1	3 0.0	3 0.0	5 0.0	1 0.0	9 0.1	1 0.0	14 0.1	1 0.0	2 0.0	2 0.0	3 0.0	101 0.7
12– 14		3 0.0	1 0.0	4 0.0	4 0.0	1 0.0		6 0.0		1 0.0		4 0.0			4 0.0	4 0.0	32 0.2
14– 16				1 0.0				2 0.0		2 0.0		1 0.0		1 0.0			7 0.0
16– 18								1 0.0				1 0.0					2 0.0
18– 20																1 0.0	1 0.0
20– 22														1 0.0			1 0.0
22– 24																	
24– 26																	
26– 28																	
28– 30																	
– 30																	
total	586 3.9	1028 6.9	2420 16.1	4744 31.6	1997 13.3	959 6.4	406 2.7	408 2.7	181 1.2	267 1.8	158 1.1	471 3.1	197 1.3	327 2.2	260 1.7	596 4.0	15005 100.0

Availability of Data: 85.6 % Missing Observation: 252 — Top: Observation Time Bottom: Frequency (%)

(Source: Meteorological Office, Kiribati)



(Source: Meteorological Office, Kiribati)

Figure 1.2-4 Wind Rose in Betio (2002 - 2007)

(2) Sea Conditions

1) Wave Climate

Wave condition off Betio Port is examined based on the wave hindcasting data, since no wave observation data is available at site.

Waves generated in the area of Pacific Ocean are hindcasted by "One-point Spectrum Method", adopting the wind data provided by the Meteorological Agency, Japan.

The significant wave height ($H_{1/3}$) and wave period (T) of the maximum stormy wave are estimated as 2.2 m and 5 s, respectively. The maximum wave height (H_{max}) in the wave train is evaluated as 3.5 m by applying the relationship (H_{max} = 1.60 $H_{1/3}$) between significant wave height and maximum wave height.

The wind wave direction-wise distribution hindcasted off Betio Port by the winds generated in the central Pacific Ocean are shown in Table 1.2-2. Easterly wave is prevailing in the area of Betio Port and occurrence frequency of waves less than 50 cm in height is 90 percent.

Table 1.2-2 Direction–wise Frequency of Wave Height Generated in Tarawa Atoll

W.DIRECTION	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	TOTAL
W.HEIGHT (M)																		
CALM	2086 14.4	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	2086 14.4
0.00 - 0.24	0 .0	217 1.5	351 2.4	681 4.7	1085 7.5	536 3.7	558 3.9	355 2.5	378 2.6	172 1.2	261 1.8	152 1.1	396 2.7	183 1.3	240 1.7	127 .9	223 1.5	5915 41.0
0.25 - 0.49	0 .0	201 1.4	341 2.4	946 6.5	1904 13.2	926 6.4	271 1.9	29 .2	8 .1	0 .0	3 .0	0 .0	69 .5	10 .1	79 .5	77 .5	239 1.7	5103 35.3
0.50 - 0.74	0 .0	100 .7	100 .7	309 2.1	404 2.8	147 1.0	7 .0	0 .0	0 .0	0 .0	0 .0	0 .0	1 .0	0 .0	5 .0	42 .3	67 .5	1182 8.2
0.75 - 0.99	0 .0	11 .1	18 .1	25 .2	36 .2	16 .1	1 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	1 .0	3 .0	19 .1	130 .9
1.00 - 1.24	0 .0	3 .0	1 .0	1 .0	4 .0	3 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	4 .0	5 .0	21 .1
1.25 - 1.49	0 .0	0 .0	1 .0	0 .0	1 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	1 .0	0 .0	2 .0	5 .0
1.50 - 1.74	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0
1.75 - 1.99	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0
2.00 - 2.24	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	1 .0	1 .0
2.25 - 2.49	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0
2.50 - 2.74	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0
2.75 - 3.00	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0
3.00 -	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0
TOTAL	2086 14.4	532 3.7	812 5.6	1962 13.6	3434 23.8	1628 11.3	837 5.8	384 2.7	386 2.7	172 1.2	264 1.8	152 1.1	466 3.2	193 1.3	326 2.3	253 1.8	556 3.8	14443 100.0

2) Tide Condition

Tide level at Betio Port has been observed at the Fishery Jetty by SPSLCMP (South Pacific Sea Level and Climate Monitoring Project) from December 1992. Mean sea level (MSL) is analyzed as +1.63 m above the datum level of SPSLCMP's Tide Gauge according to the results of harmonic analysis on tide level observation from 2003 to 2006.

Comparing the tide datum indicated on the Admiralty Marine Chart by Hydrographic Office, UK with the datum analyzed by the study, both datum levels and harmonic constants are very equivalent, so that the UK chart datum is employed as the datum for the bathymetric survey. Figure 1.2-5 shows the tidal relationship between the SPSLCMP and the Admiralty Chart datum, in which the datum difference between the two sides is 0.46m.

Table 1.2-3 Annual Average of Mean Sea Level (2003 - 2006)

Year	2003	2004	2005	2006	Average
Mean Sea Level (m) above tide gauge datum	1.65m	1.71 m	1.66 m	1.69 m	1.68 m

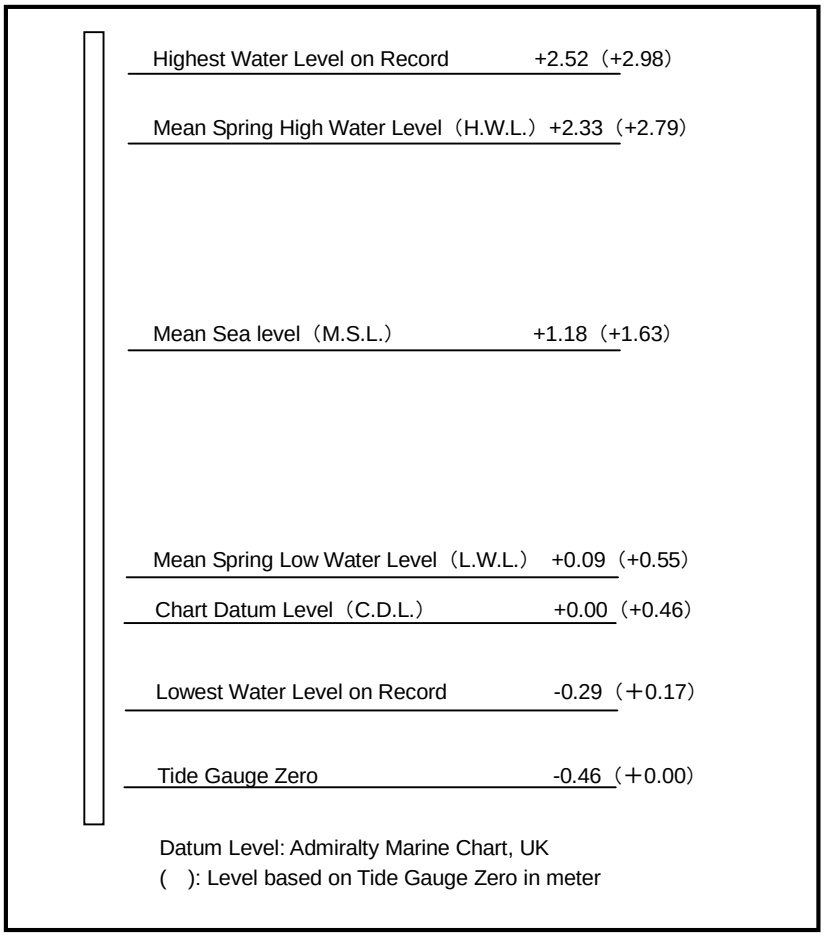


Figure 1.2-5 Tide Level Relationship

3) Tidal Current

During the field survey, tidal currents are observed by using the float tracking method at the point 300 m off the target area of the pier. Observation was carried out at the time of ebb tide and flood tide during spring and neap tide period. Tidal current pattern inside of the lagoon normally shows that the flows inward to the lagoon appear during flood tide and the flows outward open sea appear during ebb tide. However, only the currents outward to open sea from the lagoon are observed both during ebb tide and flood tide. It is presumed that the surface current generated by easterly wind prevails rather than the tidal currents. The maximum and average current speeds observed are 0.27 m/s and 0.14 m/s, respectively.

(3) Bathymetric Survey

Sounding survey was conducted in the period of June 26 to June 28, 2008. Figure 1.2-6 shows the bathymetry in the vicinity area of the pier site. And detailed topography of the seabed is indicated in Figure 1.2-7. Figure 1.2-8 shows a perspective view of the bathymetry. In addition, the location of ship wreck and the distribution of -9.0 m contour line are confirmed by the bathymetric chart.

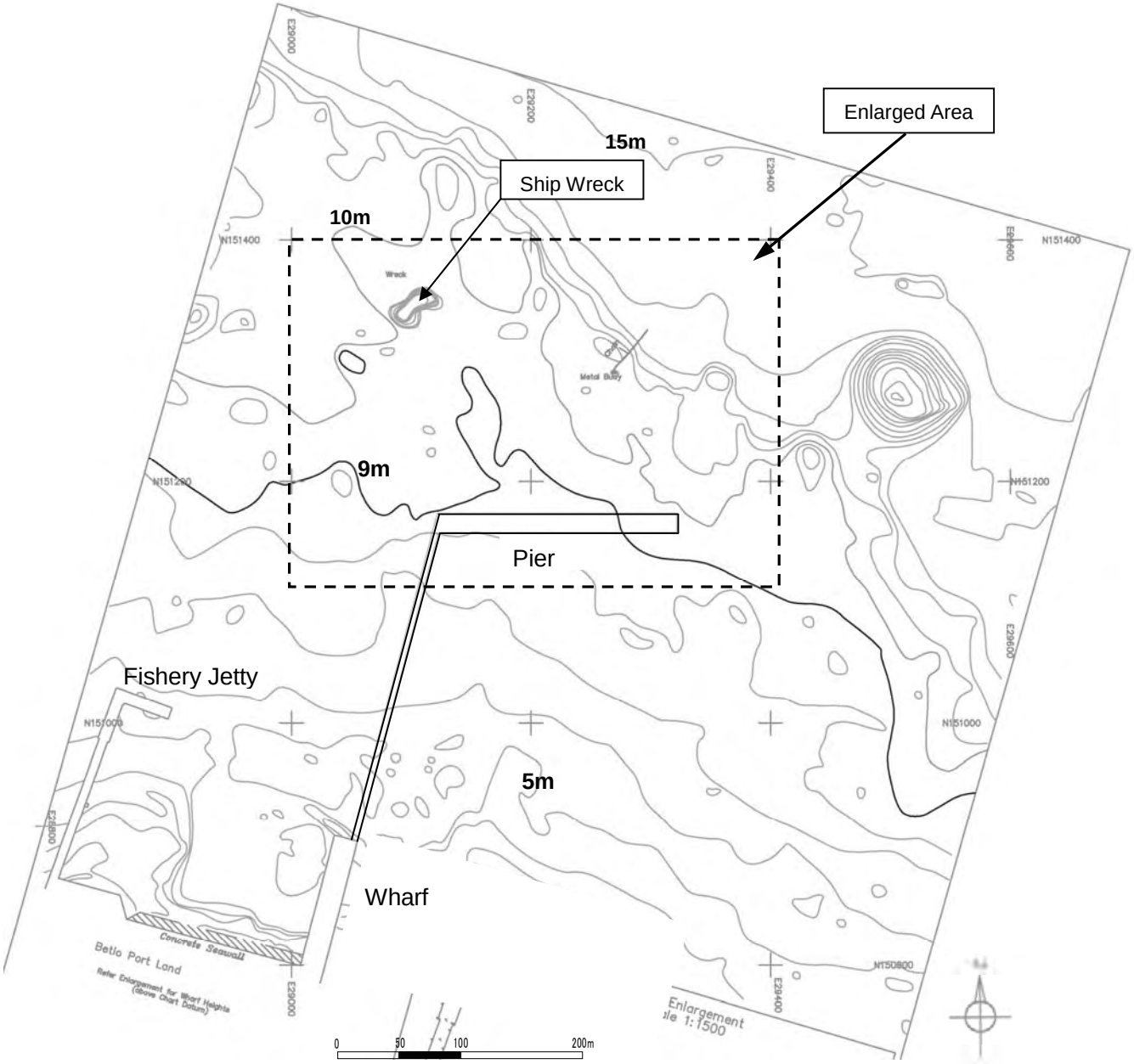


Figure 1.2-6 Bathymetry adjacent to the Pier Site

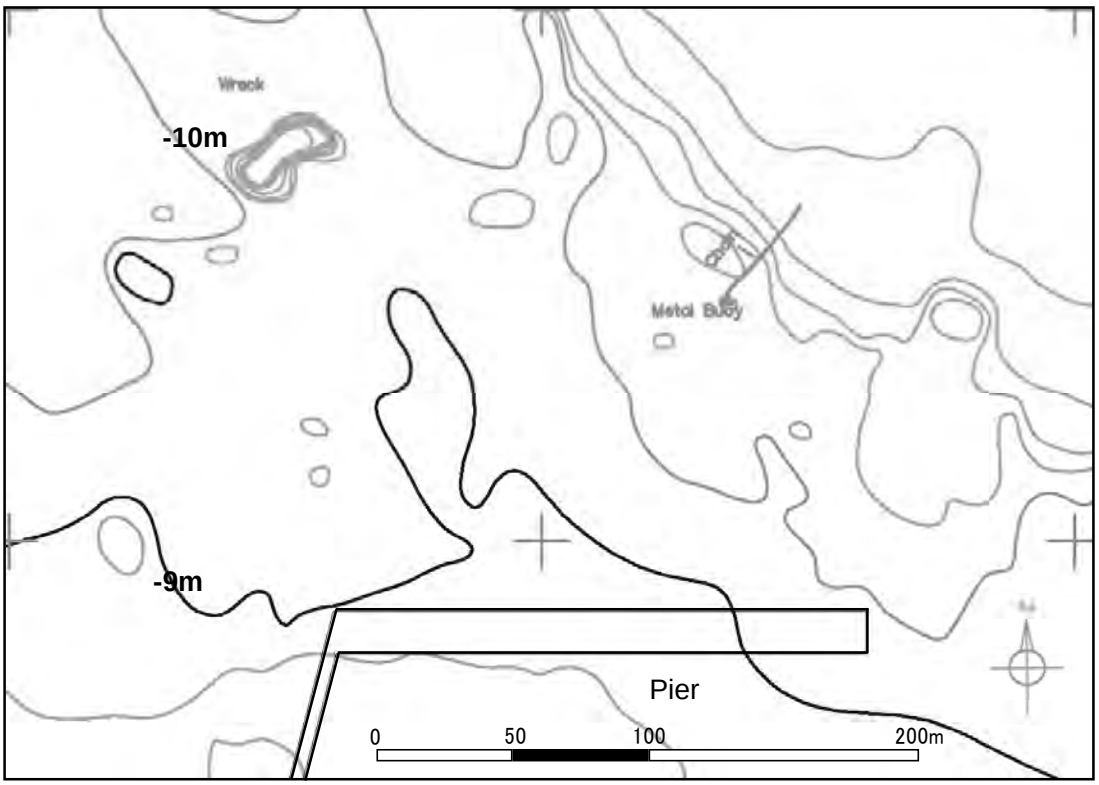


Figure 1.2-7 Detailed Bathymetry off the Pier Site

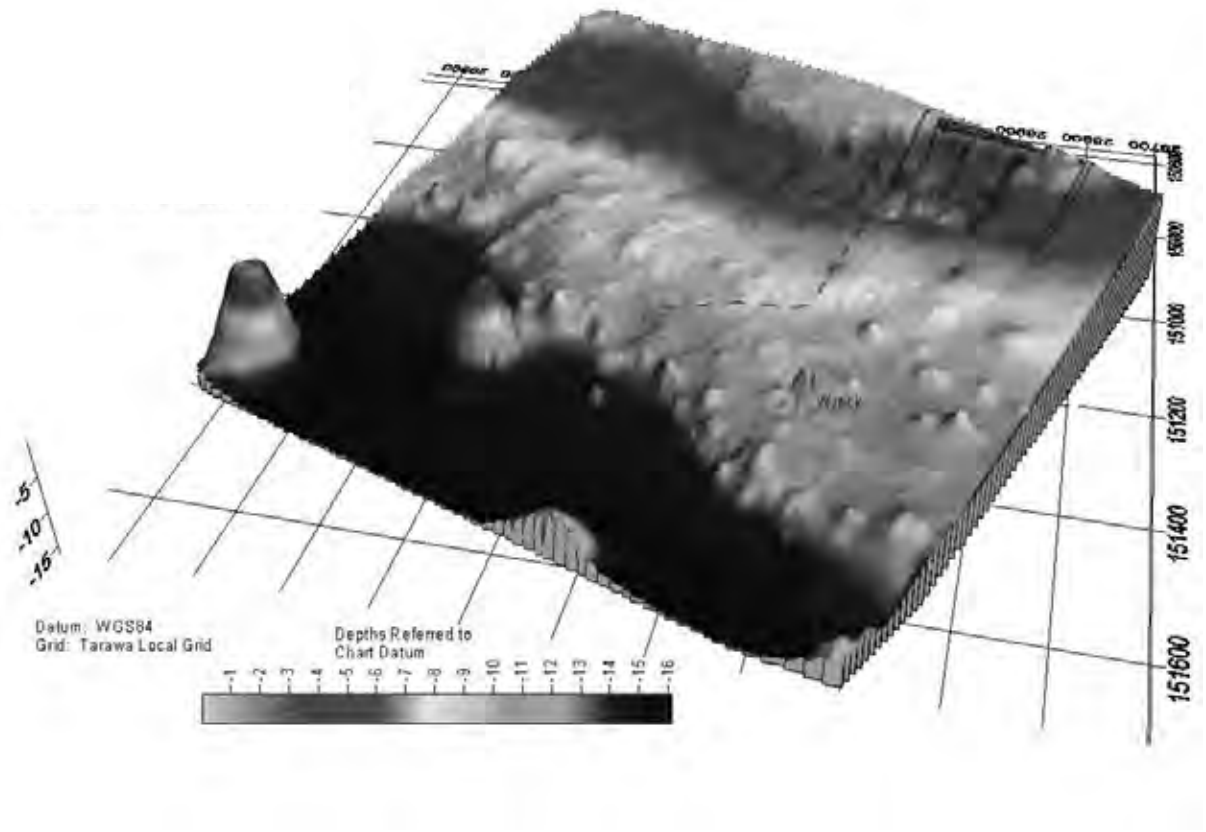


Figure 1.2-8 Perspective View of Bathymetry adjacent to the Pier Site

Ship wreck located off the pier site is observed as shown in Figure 1.2-9, in which the length of the ship wreck is 43 m and the water depth in the bow of the ship is 4.0m below the water surface.

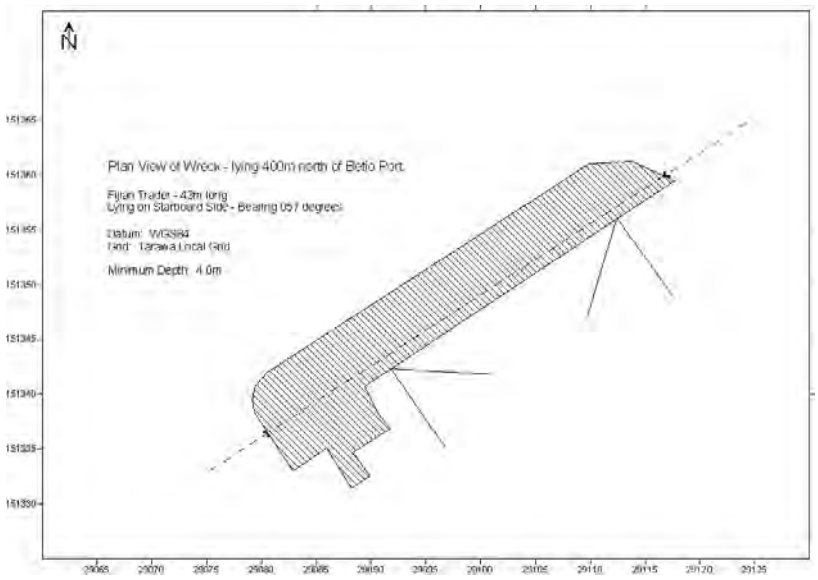


Figure 1.2-9 Sketch of Ship Wreck

In addition, bathymetric change and the condition of littoral drift are examined by comparing the isobaths configuration changes in seabed topography in July 2006 and June 2008 of the study. Figure 1.2-10 shows the bathymetric changes from July 2006 to June 2008, in which green line means the deposition area and red line means the erosion area.

Focusing on the area of the ship wreck, erosion area appears in the east and deposition area appears in the west, which means sedimentation off Betio Port is presumed to move from east to west with consideration of the predominant wind direction from east to west. In the area of the pier construction side in the water depth of -9.0m, no significant bathymetric change is recognized, which means the condition of the sea bed is confirmed as very stable. Critical water depth for sediment movement is calculated at the area of 9.0 m water depth by adopting the in-situ sand particle diameter to the formula. As a result, the sand on the surface of seabed and the substance of sand layer are evaluated as 5.07 m and 2.54 m, respectively.

It is concluded by the field survey, the project area for pier installation is presumed as very stable bathymetry without significant water depth change due to littoral drift generated by wave and current actions.

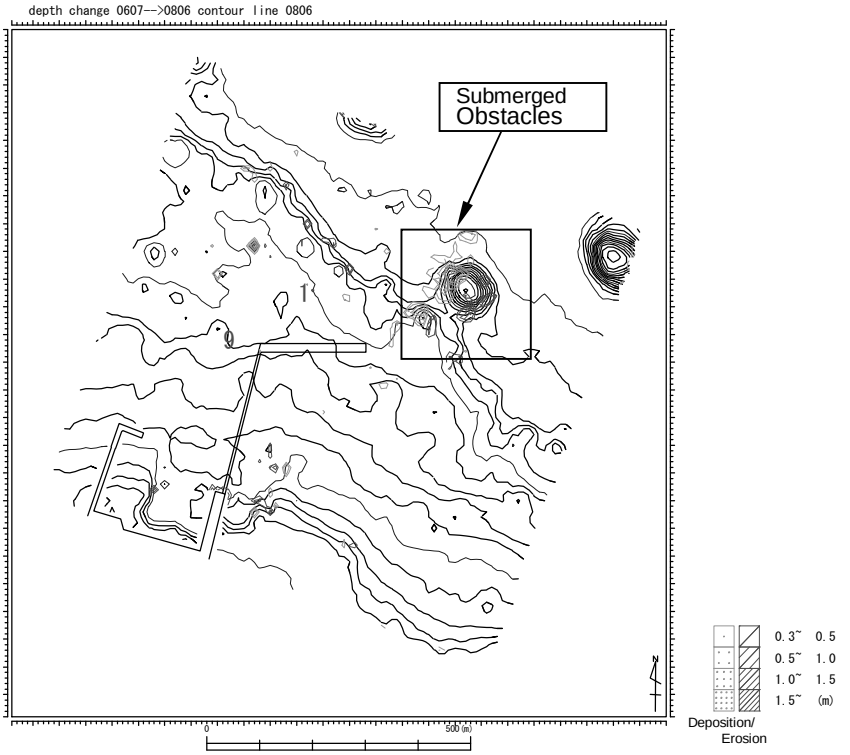


Figure 1.2-10 Bathymetric Change between July 2006 and June 2008

(4) Survey on Unexploded Ordnance by Magnetic Sounding

Magnetic sounding survey in the vicinity area of the pier site was carried out by divers as shown in Figure 1.2-11 in June, 2008. No unexploded ordnance was detected except a piece of metals, such as steel chip, cans, chains, metal buoy and ship wreck

Additionally, the visual observation carried out by divers have not found anything unusual like unexploded ordnance.

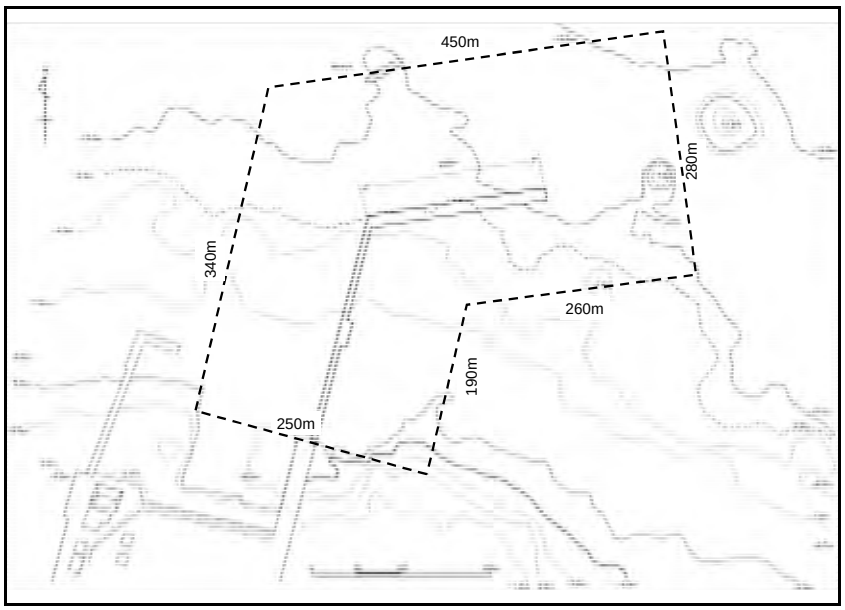


Figure 1.2-11 Magnetic Exploration Area

(5) Geological Survey

Geological condition of the project site was confirmed by marine bore drilling and laboratory test on 10 locations (BH1 to 10) indicated on Figure 1.2-12. Bore hole logs of each location are shown in Figure 1.2-13(a), (b). The soil condition along the pier and the access trestle are summarized as followings.

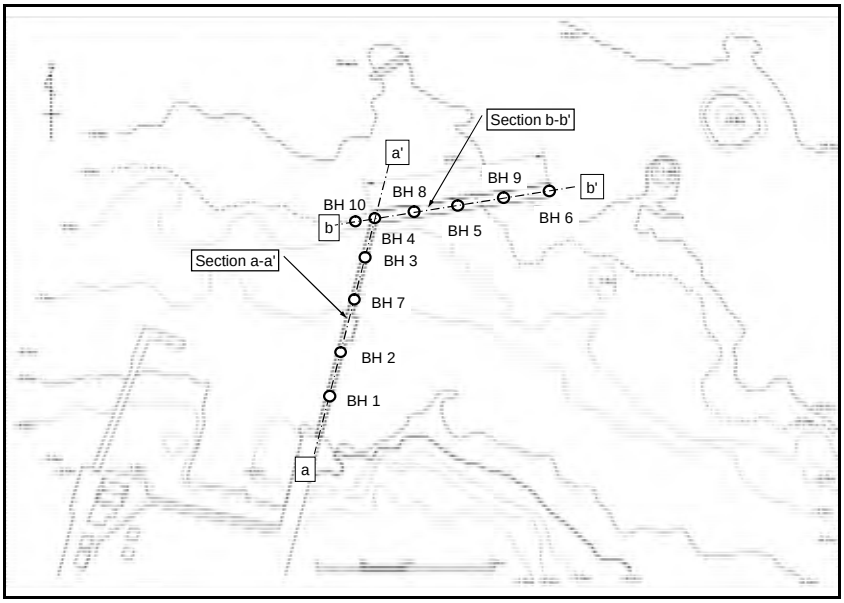


Figure 1.2-12 Bore Holing Points

1) Sub-soil Characteristics

Bore holing survey was conducted every 50m and 56m interval respectively along the longitudinal line of the pier and the access trestle.

Regarding the geological features, stratums drilled from surface to end at each point are composed mostly coral gravel and sandy gravel. N values of each point show N> 20, which means that the sub-soil condition of the project site is evaluated as good sandy soil. However, dispersion of N value for each bore hole log varies significantly and thin rocky stratums of N value more than 50 distribute in the project area.

In addition, uniformity coefficients ($Uc = D_{60}/D_{10}$) derived from a grain size distribution test of sub-soils show more than 10 at the whole project area, which means that sub-soil is composed of good grain size distribution.

2) Engineering Evaluation

Soil condition along the pier and the access trestle properties is concluded to be appropriate properties for their construction.

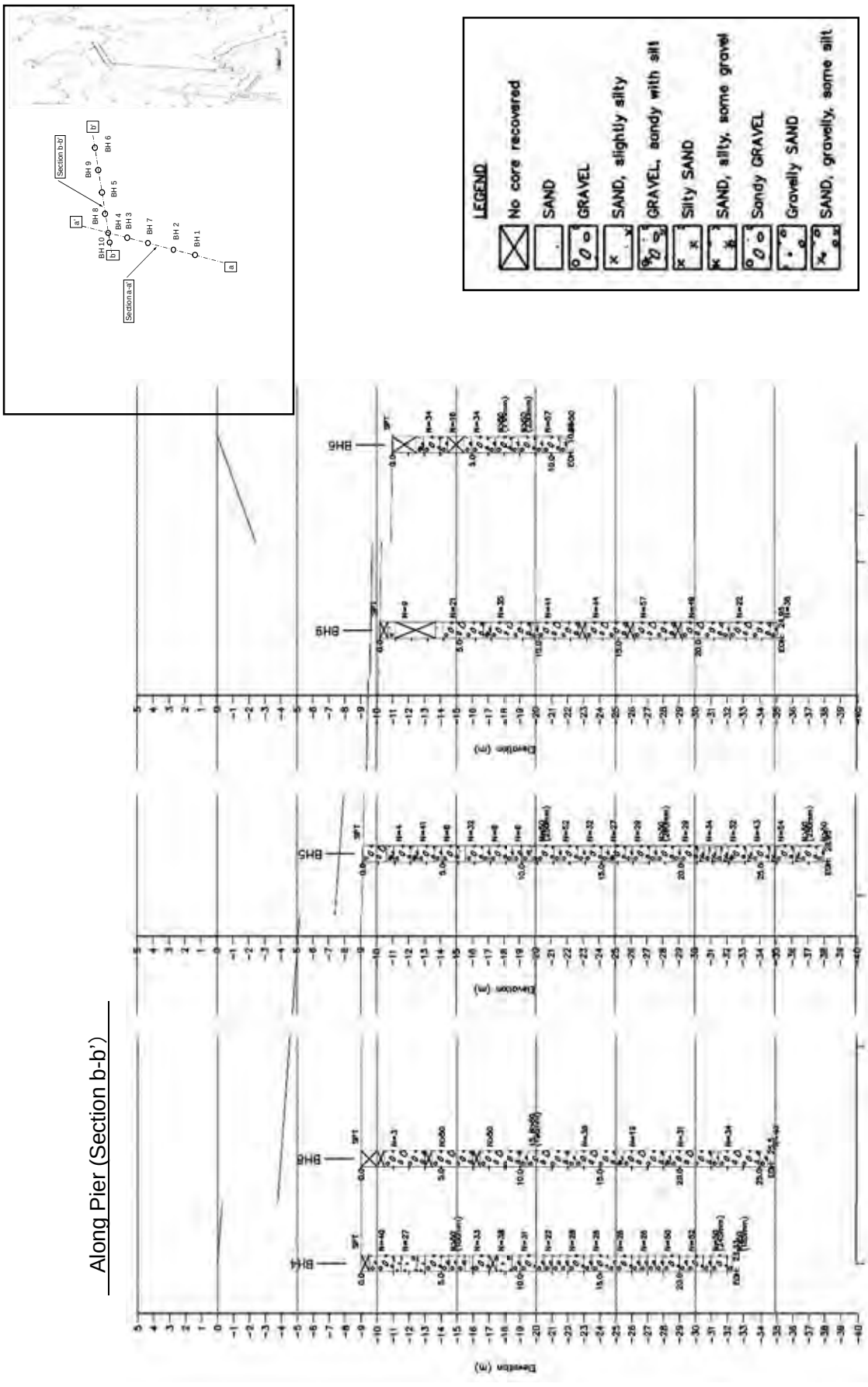


Figure 1.2-13 (a) Bore Hole Logs along Pier (Section b-b')

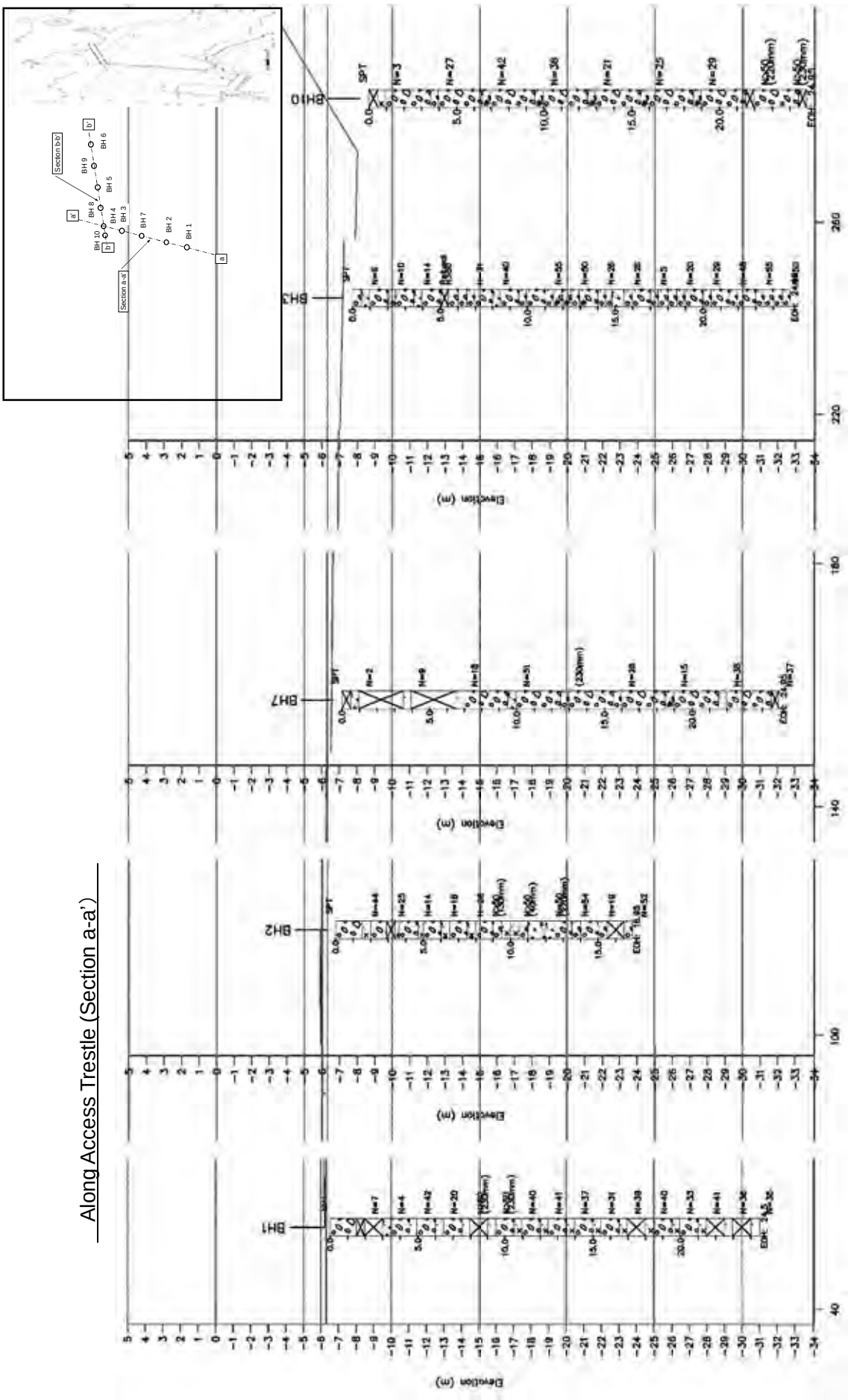


Figure 1.2-13 (b) Bore Hole Logs along Access Trestle (Section a-a')

(6) Salinity Survey on Tap Water

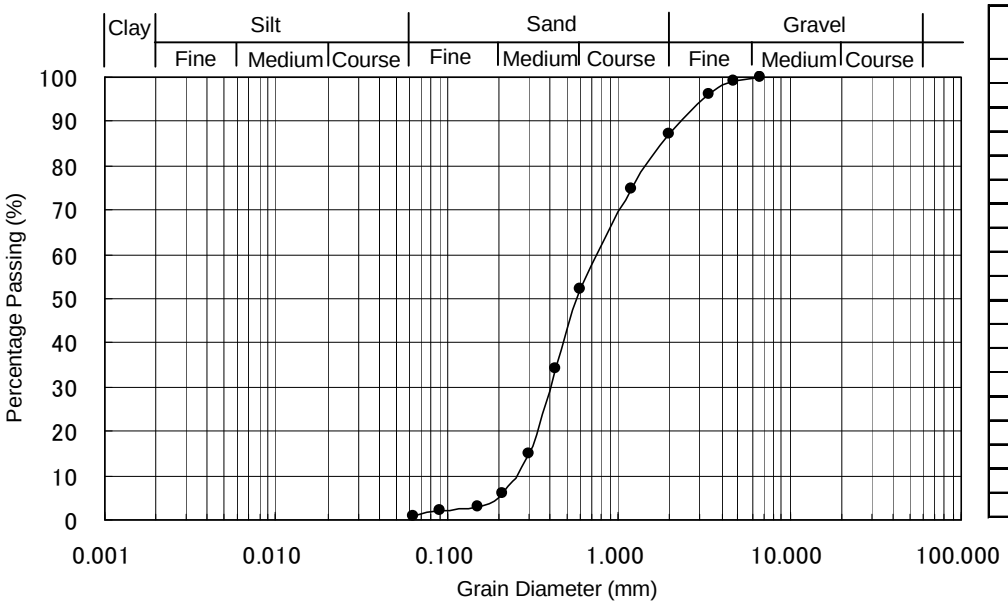
Salinity survey on tap water for concrete mixing was carried out two times at water supply in KPA. Quantab Tests indicate less than measuring limit on the conversion table, which is concluded to be no affection for concrete mixing.

(7) Construction Material Survey

Concrete aggregate utilized for the project construction is sampled at Standard Concrete Industries in Suva, Fiji. Table 1.2-4 shows the property of the extracted samples of sand and gravel. According to the test results, sand and gravel is confirmed to be appropriate for concrete aggregate. Grain size distribution curve is shown in Figure 1.2-14.

Table 1.2-4 Material Test Results

	Test Item	Results
Sand	Sieve Test	Ref. Figure 1.2-12
	Water Content	4.3%
	Specific Gravity	2.76 t / m^3
	Internal Friction Angle	φ´=47°
	Consolidation Test	Wet Density= 1.72 t / m^3 Dry Density= 1.65 t / m^3
Gravel （Max. Size 40mm）	Density	1670 kg/m^3
	Specific Gravity	2.77 t/m^3



Grain Diameter	Percentage Passing (%)
63.000	
53.000	
37.500	
26.500	
19.000	
13.200	
9.500	
6.700	100.0
4.750	99.0
3.350	96.0
2.000	87.0
1.180	75.0
0.600	52.0
0.425	34.0
0.300	15.0
0.212	6.0
0.150	3.0
0.090	2.0
0.063	1.0

Figure 1.2-14 Grain Size Distribution Curve

1-3 Environmental and Social Considerations

The survey and examination on environmental and social considerations covered the followings:

- Baseline survey on the existing environment related to the planning of Betio Port expansion,
- Clarification of concerns of MELAD on environmental impacts by the Project, and
- Examination and assistance for the issuance of Environment Licence (E/L) for the Project.

(1) Surveys on Existing Environment

1) Survey on Coral Reef

a) Objective

Survey on coral reef is aimed at clarifying the distribution of coral reef in and around the project site of Betio Port expansion. The survey included the following tasks:

- Evaluation on seabed materials in the proposed port expansion area
- Evaluation on coral species, colony size and percent cover of coral life form
- Evaluation on coral bleaching with other useful information on siltation, coral disease and predation.

b) Methodology

Coral survey was carried out on SCUBA, i.e. submergible survey, and direct measurement during the period from June 27 to July 1, 2008. Six linear transects with a total length of 850 m were surveyed as shown on Figure 1.3-1. Seabed materials and coral species were recorded based on the Life form Category defined by the Australian Institute of Marine Science (AIMS). In addition, water quality was surveyed and marine organisms encountered were recorded to make clear the marine habitat environment.

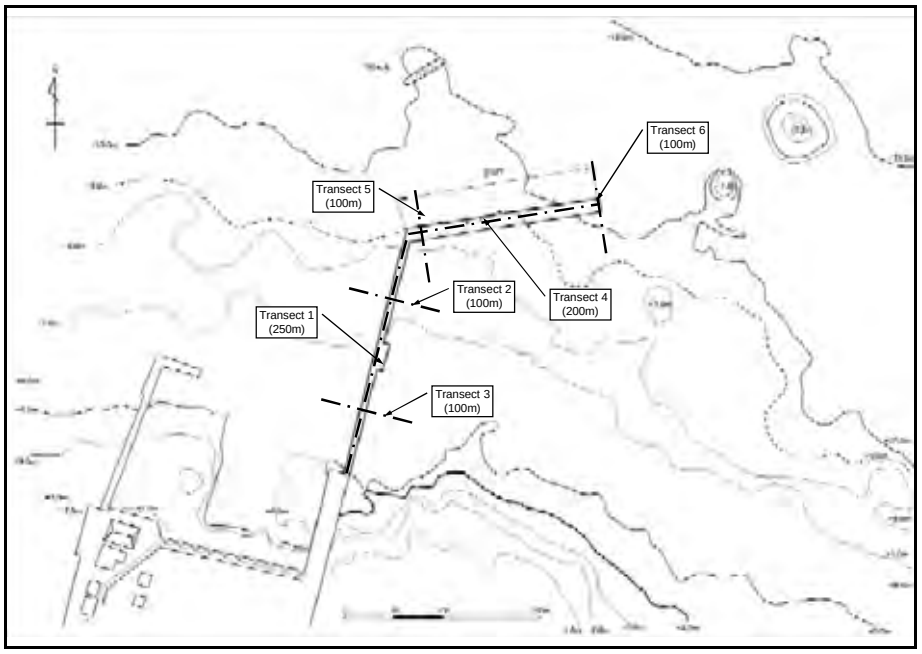


Figure 1.3-1 Survey Location of Coral Reef

c) Survey Results

Survey clarified that no live hard coral was identified in and around the proposed area of Betio Port expansion. Therefore, coral bleaching, coral disease or predation was not observed. The recorded substrate was silt (categorized grain particle size : 0.002～0.05mm). The reason for no live hard coral is supposed to be that the survey area is heavily sedimented with silty / sandy materials, which is not suitable condition for coral habitat.

The recorded substrates were silty bare seabed and *Halimeda* Algae, and covered with a thin film of red *Filamentaous* Algae in patches. Occasional clumps of sponges were observed on the seabed. Silty bare seabed is the dominant substrate type with a covering percentage of more than 95% and that of *Halimeda* Algae is less than 5%. *Halimeda* algae are calcareous and contribute to sand production in most sandy beaches. Red *Filamentaous* Algae can indicate some form of nutrient enrichment.

Regarding other marine organisms, the identified fish along the transects includes Vagebond Butterflyfish (*Chaetodon Bagabundus)*, Neon Damselfish（*Pomacentrus coelectis*), and Pufferfish, most likely Shortfin Puffer (*Torquigener brevipinnis*). Regarding invertebrates, only sand/tube anemones were common along the transects. All these species are common in the lagoon environment and no endangered or threatened marine species in the area were identified. Environmental water quality parameters such as temperature (29.0 – 29.5C), salinity(38 – 38.5‰), pH (8.4 – 8.8) and transparency (1.5 – 2.5m) are considered normal.

d) Evaluation of Survey Results

No live hard coral was recorded in and around the proposed area of Betio Port expansion. Very few fish and invertebrates were recorded, indicating the survey area is not rich marine ecosystem. More than 95% of substrates are covered by Silt. *Halimeda* Algae, red *Filamentaous* Algae and

occasionally clumps of sponges were noticed on the seabed. The survey area is heavily sedimented with silty / sandy materials with low transparency of the sea water. The reason for this is that the proposed project site is located in the vicinity of the acting port with heavy boat/ship traffic which may cause poor degradation of water quality and turbidity by dispersion of seabed materials.

2) Water Quality Survey

a) Objective

Water quality survey is aimed at clarifying the sea water quality in and around the project site of Betio Port expansion so as to obtain baseline data for environmental monitoring.

b) Methodology

Sea water sampling for water quality survey was carried out on July 1, 2008 at the 5 locations shown on Figure 1.3-2, and laboratory analysis was finished on July 11. The sampling was done at the depth of 40 cm below the water surface. It was done two times, i.e., at both flood and ebb tides at each sampling location.

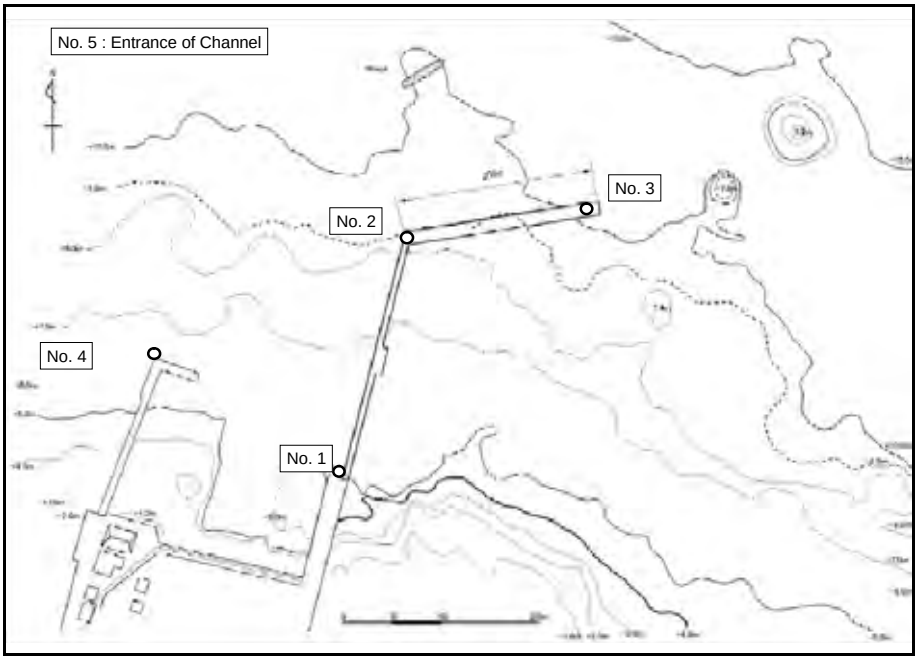


Figure 1.3-2 Sampling Locations for Water Quality Survey and Bed Material Survey

All water samples were air freighted to Fiji in a chilled container. Coliform samples were delivered to the University of the South Pacific, Institute of Applied Science in Suva, Fiji, while all other samples were air freighted to deliver to Hill Laboratories in Hamilton, New Zealand, for analysis. Laboratory analysis was conducted based on the analysis standards of American Public Health Association (APHA).

c) Survey Results

Table 1.3-1(a) and (b) show the analysis results, indicating that the water quality is a usual one in a lagoon on the whole except for n-Hexane Extraction Substances. Comparing the analysis results with the Water Quality Standard stipulated by Environment Regulations (2001) of Kiribati, water temperature and pH are consistent with the standard value. Regarding the other parameters, n-Hexane Extraction Substances exceeded the environmental standard of Japan (less than a detection limit: 0.5mg/l). Normal-Hexane Extraction Substances is an indicator to show the existence of oil in the environment. High value of it suggests a threat of oil contamination in the water in question. The possible cause of the high contents of oil includes drainage of waste water containing oil to the sea from the land and oil spill from ships and boats.

Transparency is varying in a range from 2.5 to 8.0 m. Survey points other than No.5 which is located the farthest from the land showed low values less than 5.0 m. This result is consistent with that of Coral Survey, which suggested the water quality degradation due to the dispersion of seabed materials.

As for coliform, the highest value was recorded at the tip of the existing Betio Port (Point No.1). The farther from the land, the less became the transparency, which suggests the sea water quality is affected from the land.

Table 1.3-1(a) Results of Water Quality Survey (No. 1 – 3)

Parameter	Unit	No. 1		No. 2		No. 3	
		Ebb tide	Flood tide	Ebb tide	Flood tide	Flood tide	Ebb tide
Sampling time	hr : min	8:00	10:20	8:10	10:10	8:20	10:05
Temperature	Celsius	28.1	29.7	28.4	29.3	28.2	29.0
pH	-	8.1	8.07	8.14	8.2	8.08	8.18
Dissolved Oxygen (DO)	mg/l	6.73	7.03	7.63	6.48	7.59	7.03
% Saturation of DO	%	87.0	93.7	98.8	88.5	98.8	94.6
n-Hexane Extraction Substances	mg/l	4.3	5.2	5	6	5.2	5.2
Suspended Solids (SS)	mg/l	< 3.0	< 3.1	< 3.0	< 3.0	< 3.0	< 3.0
Chemical Oxygen Demand (COD)	mg/l	2.1	1.9	1.8	1.8	2,1	1.9
Transparency	m	3	2.5	3	5	3	4
Total Coliform	MPN/100ml	79	170	8	49	27	2

Table 1.3-1(b) Results of Water Quality Survey (No. 4 – 5)

Parameter	Unit	No. 4		No. 5		Water Quality Standard*	Environmental Standard of Japan (Sea, Type A)
		Ebb tide	Flood tide	Ebb tide	Flood tide		
Sampling time	hr : min	8:30	9:55	8:45	9:30	-	-
Temperature	Celsius	28.6	28.7	28.7	28.6	≦30	-
pH	-	8.17	8.16	8.18	8.13	6.5 - 8.5	7.8 - 8.3
Dissolved Oxygen (DO)	mg/l	8.17	7.04	7.76	7.68	-	> 7.5
% Saturation of DO	%	91.2	93.7	99.2	99.5	-	-
n-Hexane Extraction Substances	mg/l	< 4.0	< 4.0	6.6	< 4.0	-	Detection Limit (< 0.5 mg/l)
Suspended Solids (SS)	mg/l	3.3	< 3.0	< 3.0	< 3.0	-	-
Chemical Oxygen Demand (COD)	mg/l	1.6	2.1	1.9	1.5	-	< 2.0
Transparency	m	4	3.5	6	8	-	-
Total Coliform	MPN/100ml	8	5	2	2	-	< 1,000MPN /100ml

*: Guidelines on Maximum Acceptable Limits of Certain Water Pollutants in the Coastal and Lagoon Waters of Kiribati, Environment Regulations (2001)

3) Sediment Quality Survey

a) Objective

Sediment quality survey was aimed at clarifying the heavy metal contents in the sea bed material and physical conditions of the seabed in and around the project site of Betio Port expansion so as to obtain baseline data for environmental monitoring.

b) Methodology

Sampling for the sediment quality survey was carried out on July 1, 2008 at the 5 locations (same as those for water quality survey) shown on Figure 1.3-2, and laboratory analysis was finished on July 24. The sampling was done in the sea bed with a tube with a diameter of 5 cm and a length of 50cm by inserting it into the seabed and taking bottom sediments.

All sediment samples were air freighted to deliver to Hill Laboratories in Hamilton, New Zealand, for analysis. Laboratory analysis was conducted based on the analysis standards of New Zealand Standard (NZS).

c) Survey Results

Table 1.3-2 shows the analysis results, indicating that the concentration of the heavy metals in the seabed materials is no problem at all in terms of contamination. Comparing the analysis results with the Standards for Soil Contamination stipulated by Environment Regulations (2001) of Kiribati, analysis results were far below the guidelines except for Chromium (Chromium VI and Total) of which standards are not given in the Environment Regulations.

Table 1.3-2 Sediment Quality Analysis Result

Parameter	Unit	No. 1	No. 2	No. 3	No. 4	No. 5	Range (Max. – Min.)	Limits for Contamination*
Arsenic（As）	mg/kg	0.52	< 0.40	< 0.40	< 0.40	< 0.40	< 0.40 – 0.52	100
Cadmium (Cd)	mg/kg	0.084	0.045	0.056	0.049	0.057	0.045 – 0.084	20
Chromium (Total Cr)	mg/kg	4.2	3.6	3.9	3.7	3.1	3.1 – 4.2	-
Chromium （Cr+6）	mg/kg	< 2.0	< 2.0	< 2.0	< 2.0	-	< 2.0	-
Copper（Cu）	mg/kg	1.9	0.77	0.61	2.3	< 0.40	< 0.40 – 2.3	1,000
Lead（Pb）	mg/kg	1.8	1.2	0.46	3.3	< 0.080	< 0.080 – 3.3	300
Nickel（Ni）	mg/kg	4.6	5.1	5.6	6.2	6.4	4.6 – 6.4	600
Zinc（Zn）	mg/kg	6.2	5.7	1.2	2.8	< 0.80	< 0.80 – 6.2	7,000
Specific Gravity	t /m^3	2.77	2.77	2.78	2.82	2.82	2.77 – 2.82	-
Moisture Content	%	93.9	56.6	46.3	46.6	39.0	39.0 – 93.9	-
Grain Size Distribution	Gravel(%)	2	2	5	2	12	2 – 12	-
	Sand(%)	70	64	57	73	87	57 – 87	-
	Silt(%)	28	34	38	25	1	1 - 38	-

*:Guidelines on Maximum Acceptable Limits of Certain Soil Pollutants, Environment Regulations (2001)

(2) Environmental and Social Consideration System for Development Project

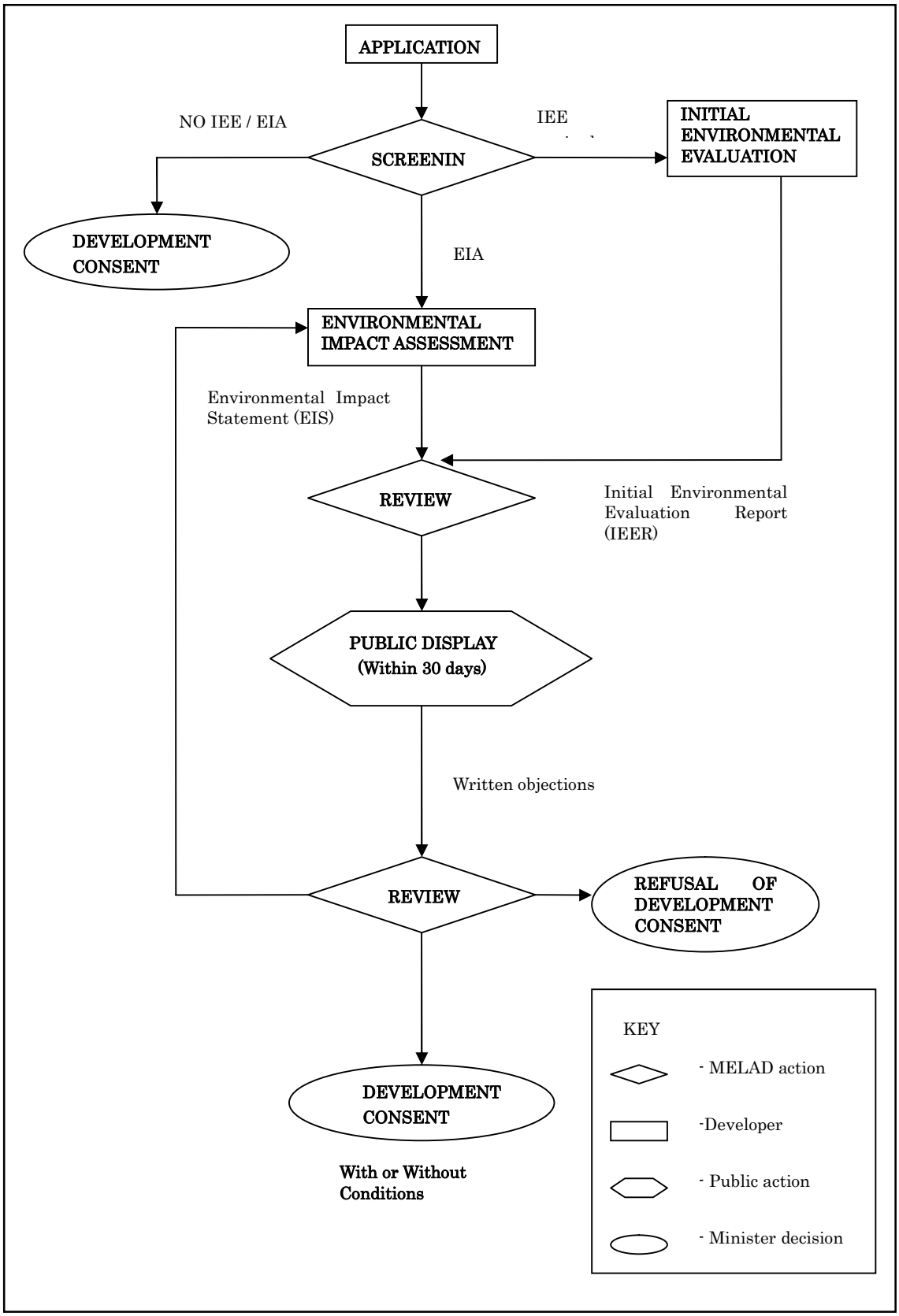
The most important legislation on environmental and social considerations system for development projects in Kiribati is Environmental Act (Law No.9, 1999), in which relevant procedures on environmental assessment for the projects is stipulated. Section 14 of the Act stipulates that any developer shall make application to the Minister and follow the procedures required for obtain a development consent. The following briefs the necessary procedures (refer to Figure 1.3-3):

- Any developer shall prepare an application form for carrying out a prescribed development and submit it to the Environmental Conservation Division, MELAD.
- MELAD shall notify the developer within 15 working days either necessity of initial environmental evaluation (IEE), necessity of environmental impact assessment(EIA), or approval of development without IEE/EIA.
- In case that IEE is required, the developer shall describe the scoping result, alternatives, and TOR of environmental survey, etc. in the IEE report, and submit it to the Environmental Conservation Division, MELAD.
- Environmental Commission established in MELAD will examine the report and return it to the developer with comments.
- The finalized IEE report shall be published by the Minister to the attention of all public authorities and persons.
- Based on the opinions from the public, the Environmental Commission shall examine the report

again and the Minister shall notify the developer either consent or refuse to the prescribed development, or the necessity of environmental impact assessment.

The Environmental Act was amended and the amended Act (Law No. 1 , 2007) was provided in 2007, in which the procedures for the development consent were revised. The following are the main differences before and after the amendment:

- The term "development consent" for carrying out the prescribed development is no more used but changed to "environmental license."
- Provisions on "Initial Environmental Evaluation" are no more stipulated, and therefore, the option of "necessity of IEE" in Figure 1.3-3 has been deleted.
- In screening process after development application, other than "environmental license" and "necessity of EIA," "refuse to the prescribed development" option has been added.
- In screening process after development application, a stipulation on the time period for decision making(15 working days) has been deleted.
- Time limit for comments from the public on the IEE/EIA report was stipulated as 30 working days in the original Act (1999). In the amended Act (2007), however, no time limit is stipulated but Principal Environmental Officer may set a particular date.
- It was stipulated in the original Environmental Act that publication of prescribed development and IEE/EIA report should be done in an adequate and effective method while Principal Environmental Officer may require the publication be done in newspaper and radio, and the holding of public hearings, etc. be carried out in the amended Act.



Source: Preliminary Study Report (Oct. 2007)

Figure 1.3-3 Procedures for Development Consent in Kiribati
(based on Environmental Act (Law No. 9 , 1999))

(3) Procedures for Issuance of Environment License

With this regard to the Betio Port Expansion Project, the original Environmental Act (1999) is applied because the amended Act was not provided yet at the time of development application of the Project. Accordingly, the Project shall follow the procedures shown in Figure 1.3-3 based on the stipulation in section 14 of the original Act.

In the screening process after development application, it was concluded that the Project would not cause significant impact but a certain degree of impact, and therefore IEE was required. Based on this judgment, MCTTD, including KPA, a competent authorities of the Project, carried out the survey, prepared IEE report and the publication of it.

The actual process carried out was as follows:

MCTTD made application of development in Sept. 2007. MELAD examined the application form and concluded the necessity of IEE based on the screening process. IEE report was prepared under the assistance of JICA Preliminary Study Team, and submitted it to MELAD on October 16, 2007.

Examination results of IEE report, MELAD issued comments on it twice. The first comment was issued dated December 28, 2007, and the second one was on March 4, 2008. Upon receipt of the comments, MCTTD prepared and submitted answer reports to MELAD; firstly as "Supplementary Paper" in February, 2008, and secondly "Answer for the Comments" dated July 18, 2008, of which the second one was assisted by JICA Basic Design Study Team.

1) Confirmation of Initial Environmental Evaluation (IEE) and Comments from MELAD

MCTTD conducted the IEE survey under the assistance of JICA Preliminary Study Team, dispatched in July 2007, who prepared and submitted the survey report on environmental potential impacts of the Project to MCTTD. The survey report consisted of the outlines of the project components, existing environment conditions, environmental impact assessment system in Kiribati and mitigation measures for potential impacts of the project. Based on the contents of the report, MCTTD made out and submitted the IEE report to MELAD on October 16, 2007.

MELAD examined the contents of the IEE report and issued the first comments, dated December 28, 2007, on environmental concerns in the implementation of the project as follows:

- Erosion anticipated from this project to adjacent areas,
- Disturbance to flora and fauna including fisheries resources within the vicinity,
- Increase of sedimentation that may affect coral conditions and other marine organisms further downstream,
- Marine pollution from unexpected oil spill from construction vehicles and other sources,
- Solid wastes that will be produced from construction debris, and
- Disturbance to marine habitats and fishing ground of local fishermen anticipated from the Project.

In response to the first comments of MELAD, MCTTD prepared the Preliminary Paper of the IEE report in February, 2008 to explain and clarify the environmental potential impacts and mitigation measures to be taken during the implementation of the project. In spite of the efforts of MCTTD to have prepared the Preliminary Paper, MELAD further issued the second comments on March 4 in the same year to MCTTD to show the environmental concerns as follows.

- Oil spill from construction equipment and the methods to remove and dispose of the waste oil,
- Clarification of the possibility of re-export of malfunctioned construction equipment and waste, and the responsible agency of it,
- Implementation of baseline survey on coral conditions in and around the Project site,
- Clarification of the scope of work including the quantity of materials, list of equipment required and responsible entity for the work,
- Confirmation and clarification of the major offshore dredging operation by MFMRD in the Betio Lagoon, and
- Water and power supply plan for the implementation of the Project.

2) Assistance of MCTTD in Preparation of Answer Report and Completion of IEE Process

JICA Study Team prepared a draft answer report in cooperation with officials of MCTTD based on the results of the surveys on existing environment. MCTTD submitted the draft answer report to an Environment Officer of MELAD, and the officer gave following inquiries/requests for finalizing the draft answer report.

- Although oil spill can be prevented by adopting a vibration hammer type or hydraulic hammer type pipe driver for steel pipe pile driving work, it is necessary to equip an oil boom to prepare for any contingency (unexpected oil spill).
- It is necessary to keep good maintenance of construction machinery and equipment to minimize noise from them.
- Although the contractor is primarily responsible for the management of construction waste management including reuse, recycle and disposal, MCTTD and the consultant to be hired should be in charge of waste management in terms of supervision of the construction work. It is necessary to clearly describe this point in the answer report.
- The description of waste management in the answer report is understandable. But how to guarantee for ensuring it is also needed to be described in the report.

Considering these comments, MCTTD finalized the answer report and submitted it to MELAD with the name of Secretary of MCTTD on July 18, 2008. The Answer Report was attached in the Appendix-5.

3) Necessity of Procedural Change due to Amendment of Environment Act

Environment Act of Kiribati was provided in May, 1999 and came into effect in March, 2000. After that, the act was drastically amended in 2007. The original Environment Act was composed of five parts, in which provisions on environmental impact assessment were given in part III, but after the amendment, they are given is part IV.

Table 1.3-3 Composition of Environment Act of Kiribati

	Original（Law No. 9, 1999）	After Amendment（Law No. 1, 2007）
Composition	Part I: Preliminary Part II: Administration Part III:Development Control, EIA, Review and Monitoring Part IV:Control of Pollution Part V: Miscellaneous	Part I: Preliminary Part II: Administration Part III:Obligations Part IV:Environment Licence Part V: Conservation Part VI: Enforcement Part VII: Miscellaneous
Relevant Law / Regulation	Environment Regulations（2001）	Environment Regulations（2001） （Original Regulation has not been amended yet as of July, 2008）

The biggest difference between the original and amendment acts is that all the parts from III to V in the original act were amended and new parts from VI and VII were newly added in the amendment act. As for the EIA, two different levels of process, i.e., IEE and EIA were stipulated in the original act but EIA only was defined after the amendment. According to the Environment Officer of MELAD, however, although EIA only was stipulated after amendment, the concept and process of former IEE is still remained by means of using the expression “Basic EIA.” The Basic EIA will be stipulated in the Environment Regulations after its amendment. But it has not been amended yet as of July, 2008.

Regarding the project for expansion of Betio Port, the procedures for Environment Licence for the Project commenced based on the original Environment Act, and the IEE report of the project was prepared and submitted. As mentioned above, articles on IEE were deleted in the amendment Environment Act. Therefore, JICA Study Team inquired at MELAD about how the procedures for Environment Licence would be carried forward based on the amendment act. The Environment Officer of MELAD answered that the processes for Environment Licence will be completed by issuance of it from MELAD to MCTTD in response to submission of the Answer Report dated July 18, 2008. The Officer added that any of additional procedures on EIA based on the amendment Environment Act is not required.

4) Public Hearing or Public Consultation Meeting

JICA Study Team inquired at MELAD about whether Public Hearing or Public Consultation Meeting for the project would be needed or not. MELAD answered that it is not necessary to hold such meetings because Public Display for the project has finished as a procedure of IEE. The Public Display was carried out in the form of appearance in a newspaper and broadcasting on radio.

Although section No. 19 of Environmental Act (Law No. 9 of 1999) stipulates that publication of prescribed development and IEE/EIA report should be done in an adequate and effective method, there is no clear description about the method of publication. In the amended Environmental Act (Law No. 1 of 2007), however, it was stipulated in Section No. 36 that Principal Environmental Officer may require the publication be done in newspaper and radio and, the holding of public hearings, etc. be carried out.

Regarding the Betio Port Expansion Project, application for the approval of the Project and procedures of IEE were conducted pursuant to the original Environmental Act. Publication of the Project plan was done through newspaper and radio, and no comments and objections were given for the Project.

However, all the procedures for development consent of the Project have not been completed by the enforcement of the amended Environmental Act. It was, therefore, inquired to Principal Environmental Officer of MELAD by JICA Basic Design Study Team that whether or not the Project should follow the amended Environmental Act, specifically the conduct of public hearing or public consultation meeting. Eventually, MELAD denied the necessity of it.

Thus, the JICA Study Team concluded that the publication of the Project has been adequately conducted pursuant to Environmental Act (1999) and that it is not necessary to conduct public hearing or public consultation meeting because Principal Environmental Officer of MELAD does not require it.

5) Environmental Monitoring

Amended Environment Act stipulated that an environment licence may be subject to requiring the environmental monitoring (Part IV, Article 38, item(e)). However, the methodology of the environmental monitoring is not provided in the act. JICA Study Team, therefore, inquired at MELAD about the details of the monitoring. MELAD answered the following:

- Environmental monitoring in general requires the measurement of environmental quality such as waster quality, air quality, noise, etc. during the period of implementation stage. In Kiribati, however, there is a constraint for accurate method of monitoring in terms of equipments and human resources, which gives difficulty for carrying out such monitoring of environmental quality as mentioned above.
- The monitoring stipulated in the Environment Act is rather to monitor whether the conditions attached in the Environment Licence (collaterals) is implemented or not.
- The monitoring on the implementation of conditional collaterals is basically to be carried out by MELAD but the implementing body of the Project is requested to arrange, coordinate and support MELAD in conducting the monitoring activities. The environmental monitoring for this Project will be required in this manner.

(4) Environmental Impact and Mitigation Measures

1) Potential Environmental Impacts

Environmental impacts to be caused by the implementation of the Project and evaluation of the impacts were discussed in IEE report (October, 2007) and Supplemental Paper (February, 2008). However, the impacts and its evaluation were re-examined here based on the facility plan in this Basic Design Study, and the results were summarized in the table below. The environmental elements other than those listed in the table below were evaluated as "no impacts." It should be noticed that terms to indicate the environmental elements below are not always identical with those listed in the JICA Environmental and Social Considerations Guidelines since more adequate terms were used here based on the specified facilities and activities included in the Project.

Table 1.3-4 Environmental Impacts to be Caused by the Implementation of the Project

No.	Environmental Elements	Environmental Impacts and Impact Factors	Magnitude of Impacts*
1	Degradation of environmental sanitation	Degradation of environmental sanitation duo to generation of liquid and solid wastes from temporary construction yard and office	B
2	Hazards (risk) of HIV/AIDS	Increase of hazards (risk) of HIV/AIDS due to intrusion of foreign workers during construction works	B
3	Tide, seabed erosion and sedimentation	Change of tidal flow due to the construction of port facilities (trestle and pier) and increase of seabed erosion and sedimentation	B
4	Coral reef and marine organisms	There is no live coral around the Project site. However, stirring up of seabed materials to be caused by construction works might happen and generate turbid water flow and sedimentation, which may cause temporary degradation of photosynthesis of aquatic flora and eventually impacts on marine ecosystem.	B
5	Terrestrial flora and fauna	The Project side is located inside the sea, and therefore there will be no impact on terrestrial fauna. Although temporary construction yard (approx. 1 ha) is located on land, there is no flora in it but bare land and no habit of flora and fauna.	C
6	Aesthetics	The Project site is near the harbor area, and therefore the port facilities such as pier and trestle to be constructed would be harmonized with surrounding landscape.	C
7	Air pollution, noise and vibration due to construction works	Emission of noise and vibration due to operation of construction machinery and vehicles.	B
8	Marine pollution from oil spill and impacts on marine resources	Possibility of marine pollution and impact on marine resources due to unexpected oil spill from floating pile driving barge depending on the type of pipe driving machine to be adopted.	B
9	Waste and soil contamination	Possibility of scattering of waste and soil contamination due to spoiled construction machinery and vehicles, and construction wastes.	B

10	Accidents during construction works	Possibility of emission of harmful substances during construction works and marine pollution, accidental fire, explosion, traffic accidents, and threatening of human life and environment due to natural disaster.	B

Note) Magnitude of impact (Rating) indicates those in case of no mitigation measure, as follows:
A: There is significant impact, B: Not significant but a certain degree of impact, C: Impact is minimal or negligible.

2) Mitigation Measures

As for the potential environmental impacts (Rating B) in the previous section, the following mitigation measures will be applied in the table below. Thus, the potential impacts will be minimized and the Project will contribute to the development of Kiribati and environmental conservation.

Table 1.3-5 Mitigation Measures and Responsible Bodies

No.	Environmental Elements	Environmental Impacts and Mitigation Measures	Responsible Body for Mitigation Measures
1	Degradation of environmental sanitation	Waste water to be generated from temporary construction yard will be once stored in a septic tank and then entrusted to PUB for adequate treatment and disposal under the waste water treatment system in South Tarawa. Construction wastes to be generated during construction works will be adequately treated or disposed of, including recycling, based on the waste management plan (refer to "Answer to the Comments, 18/07/2008). Paper rubbish and organic rubbish will be entrusted to BTC for its waste collection and disposal under the waste disposal system in BTC.	Construction contractor is responsible for waste treatment. Consultant is responsible for supervision.
2	Hazards (risk) of HIV/AIDS	An appropriate training and education to prevent infectious diseases including AIDS will be given to all the construction workers including foreign workers of the Project.	Construction contractor is responsible for training and education. Consultant is responsible for supervision.
3	Tide, seabed erosion and sedimentation	The analysis on critical traction based on the data on sand particles of the seabed at the location of the Betio Port Expansion indicated that basically there is very limited possibility for the sand particles to move with the wave agent under the existing depth of the sea, which means this area is featured with a relatively stable topography. In case the substructure of the new pier would be steel pipe pile type, almost no obstacle against tidal current flow and wave motion will be provided in the Project and the change in current is expected to be very limited.	Consultant is responsible for detailed design of the port facilities.
4	Coral reef and marine organisms	The results of coral survey at the Project site and its surrounding areas showed that there is no living coral, and therefore no impact would occur on coral reefs. In the Project, it is not proposed to conduct excavation/dredging, and accordingly there will be no disturbance or removal of marine organisms living on the seabed.	Construction contractor is responsible for selection of pile driver and implementation method of pile driving. Construction contractor is

		As for the risk of waste oil leakage and marine pollution during the pile driving, such method that will not cause any oil spill or leakage, specifically, vibro-hammer type or hydraulic hammer type of pile driving at the floating barge will be adopted in the Project. Accordingly, no impact of waste oil contamination on marine biota will occur.	responsible for pile driving activities and Consultant is responsible for the supervision.
5	Air pollution, noise and vibration due to construction works	Emission gas, noise and vibration to be generated from operation of construction machinery and vehicles are inevitable as long as implementing the Project. However, the impacts of it would be minimized as follows: - Selection of emission gas control vehicles for the construction works, - Keeping good maintenance for the construction machinery and vehicles to prevent from increasing emission gas attributed to un-adequate maintenance, - Providing through instruction to operators and drivers of construction machinery and vehicles for avoiding unnecessary idling away, goosing the accelerator, and sudden starting. etc.	Construction contractor is responsible for avoiding public pollution. Consultant is responsible for the supervision.
6	Marine pollution from oil spill and impacts on marine resources	As for the risk of waste oil leakage and marine pollution during the pile driving, such method that will not cause any oil spill or leakage, specifically, vibration hammer type or hydraulic hammer type of pile driving at the floating barge will be adopted in the Project. Accordingly, no impact of waste oil contamination on marine biota will occur. Accordingly, the likely impact on marine habitat would be mitigated and thus the Project would avoid the impact on marine resources. An oil boom (fence) will be prepared for the unexpected oil spill accident for in case. In case of oil spillage accident, the spilled oil will be prevented from diffusing over the sea and will be removed using an absorption mat for collection. The collected waste oil will be entrusted to KOIL for an appropriate treatment and disposal.	Construction contractor is responsible for selection of pile driver and implementation method of pile driving. Construction contractor is responsible for avoiding marine pollution by oil leakage and Consultant is responsible for the supervision.
7	Waste and soil contamination	Construction equipments and vehicles to be used for the construction works in the Project will be basically re-exported to Japan or procurement country. No scrap cars or malfunctioned equipment will be remained or disposed of in Kiribati. Wastes (liquid and solid) to be generated during construction works will be adequately treated or disposed of, including recycling, based on the waste management plan (refer to "Answer to the Comments, 18/07/2008).	Construction contractor is responsible for maintenance of construction machinery and waste management. Consultant is responsible for the supervision.
8	Accidents during construction works	An oil boom (fence) will be prepared, as mentioned above, for the unexpected oil spill accident for in case. The spilled oil and other harmful substances will be prevented from diffusing over the sea and will be removed using an absorption mat for collection.	Construction contractor is responsible for avoiding accidents during construction

		Regarding accidental fire and explosion during the construction works, worker will be provided with through training and education to prevent these accidents and other human disasters. Regarding the traffic accidents during the construction works, the possibility will increase if the vehicles pass through the inside of existing container yard. Accordingly, the traffic line will be set up to avoid the inside but to use outer circumference route. Regarding the threatening lives and environment by natural disaster, "safety firstly" policy will be strictly applied to prevent accidents such as destruction on a barge and scattering and flowing out of hazardous materials during the works even under strong wind and high wave situations to keep planned implementation schedule.	works. Consultant is responsible for the supervision.

(5) Issuance of Environmental Licence

In response to the Answer for the Comments of MELAD dispatched by MCTTD, the environmental licence was issued on October 22, 2008, including the conditions attached to the licence. The attached conditions are to be modified from time to time when changes occur related to the project plan. And eventually the three parties comprising MELAD, Kiribati Port Authority and the Contactor of the Project have a written agreement regarding compliance with the conditions of the Environmental Licence.

The original documents of the Environmental Licence and other relevant documents are attached on Appendix-5.

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

2-1-1 Basic Concept of the Project

(1) Scope of the Study

Betio Port has been functioned as the transportation base for domestic cargoes to connect outer islands as well as only the port to accept foreign cargoes in Republic of Kiribati. Over 90 % of the handling cargoes in the port have been occupied by containerized cargoes by further progress of international containerization, so that the improvement of port facilities becomes inevitable to cater for container ships. However, since water depth is 6.0m and length of the berth is 80m in present wharf facility, container ships can not berth alongside the wharf due to insufficient water depth and berth extension, in which the cargo handling operation through offshore transshipment has been obliged. The offshore container transshipment causes many issues on operation safety and efficiency, as well as increase of marine transportation cost.

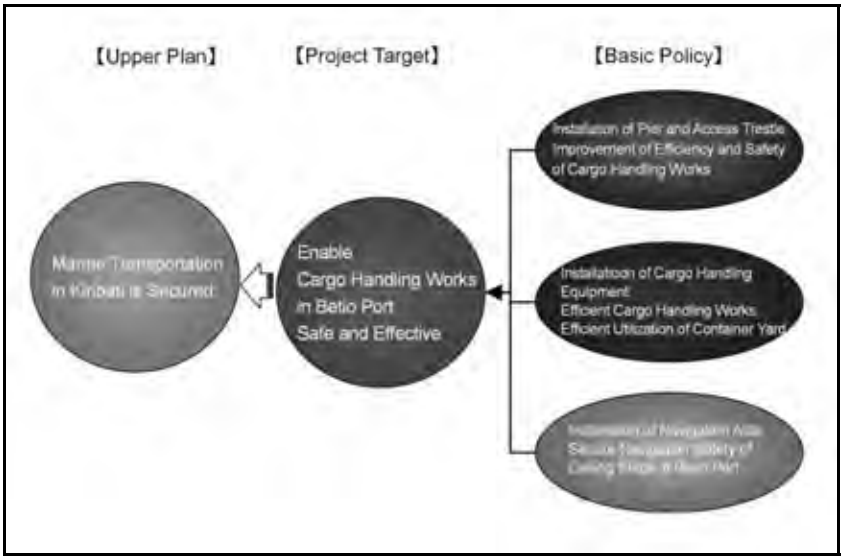
This study aims to promote safety and efficiency of cargo handling operation by improving berthing facility and introduction of cargo handling equipment so that the ocean liner container ships calling Betio Port can berth directly without offshore cargo transshipment. And, as the installation of new pier leads to changes of the cargo handling system with longer onland transportation distance of containers, the effective port cargo handling equipment to meet the new cargo handling system will be provided for the purpose of appropriate utilization of berthing facility. In respect of the navigation aids, aging and deteriorated light buoys will be replaced by new one and light beacons necessary and inevitable on the pier and around the ship wreck off the expected pier will be provided for berthing and deberthing ships, which will contribute to the promotion of navigation safety of calling ships.

To establish the implementation plan, the feasibility of the project and the degree of cargo handling efficiency are taken into consideration in the course of examining the extension of the pier, the width of the access trestle and the composition of the cargo handling equipment.

(2) Basic Concepts of the Study

The following 4 items are examined as project components. The relation of each component with Upper Plan and Project Objectives are shown as below.

- Installation of Pier
- Installation of Access Trestle
- Introduction of Port Cargo Handling Equipment
- Installation of Navigation Aids



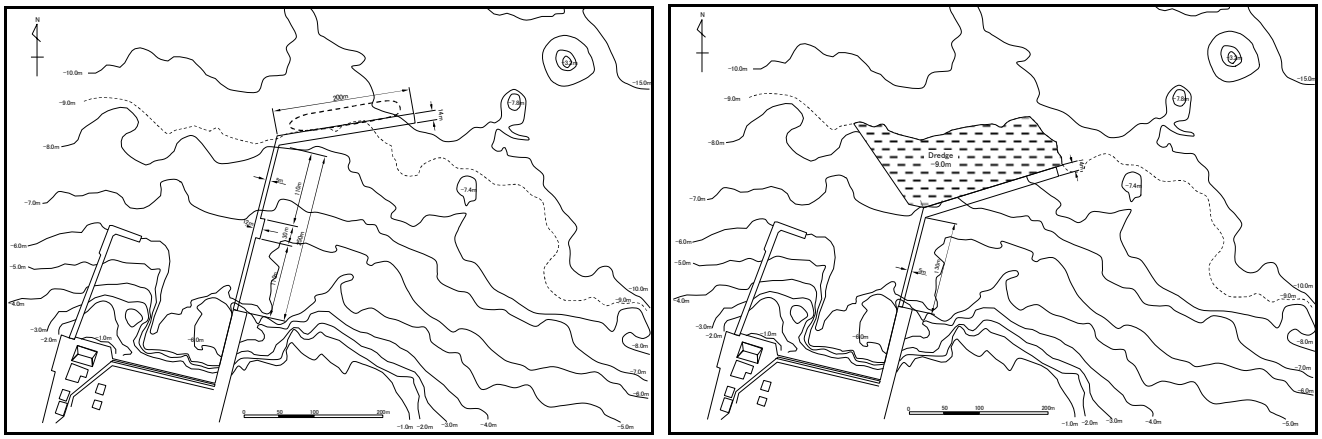
Planning and designing these components will be carried out incorporated with following 3 basic concepts.

- Safe Port
- Efficient Port
- Well Arranged Port

1) Basic Concept on Layout Plan of Pier

Two layout plans have been proposed in the request letter by the Government of Kiribati. One is that the location of the pier is extended to offshore up to the area of sufficient water depth without dredging. Another is that the location of the pier is set with the required water depth obtained by dredging at front area of the pier.

As the result of the Preliminary Study, which compared both ideas, water depth shoaling by sand sedimentation is predicted in the dredged water area from long term view, which means that the maintenance dredging might be inevitable. There is no dredging machinery and dredger in Kiribati, and no past experience of dredging in extensive area. From the view of maritime environment, water turbidity during dredging will create negative effects to the environment. Therefore, the plan of the pier extending offshore up to the sufficient water depth without dredging has been selected as the basic layout plan.



Alternate (1): Offshore Extension w/o Dredging　　Alternate (2): Nearshore Extension w/ Dredging

Figure 2.1.1-1　Alternate Layout Plan of Pier

2) Basic Concept for Ship Wreck Located off the Port

A ship wreck is confirmed in the offshore of the project area, which is very important factor to establish the layout plan of the pier.

Ship maneuvering methods to approach to the proposed pier without demolishing ship wreck has been examined based on the interview survey results to captains of the container ship of the regular shipping service to Betio Port, comprising Swire Shipping Service and Greater Bali Hai Line. And at the same time, the hearings to the former port master of KPA who used to work as a pilot and the deputy port master who is working as a pilot are conducted. As a result of these hearings, it was found that ships can come into the port and access to the pier from west side centering around the ship wreck, considering predominant wind from east side and can go out passing through east side as shown on Figure 2.1.1-2. Therefore, subject to securing necessary distance from the pier, the ship wreck shall not be removed but the light buoys to indicate the location of the ship wreck shall be installed.

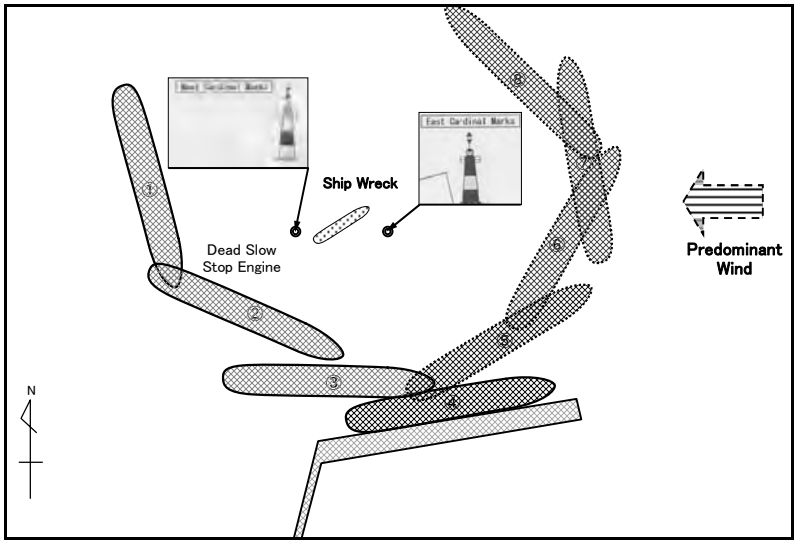


Figure 2.1.1-2　Ship Maneuvering Operation to Pier

3) Basic Planning Concepts of the Pier

Liner Container ship calling Betio Port is limited by two typical ships, one is Kiribati Chief (13,668DWT) of Swire Shipping Service and another is South Islander (17,800DWT) of Greater Bali Hai Line. Their alternate ships of these two ships are also their sister ships of the same class. According to the port registration records collected during the basic design study, other same size ship or bigger size ship have not been recognized. However, Pacific Fantasy (29,538 DWT) and Pacific Discoverer (25,561 DWT) calling in January and March, 2009 are recorded, which are rated larger than other ships found so far. These ships are supposed to be tramper of temporary schedule changes due to the allocation of ships. Recently, Pacific Harmony (13,669 DWT) of the sister ship of Kiribati Chief is introduced to the shipping line.

Therefore, the berth extension and the water depth of the pier can be planned in accordance with the specification of these container ships, since the target ships can be specified in Betio Port. Additional space of future installation of pipeline for oil manifold in taking from a tanker and loading copra oil which is main export product shall be secured on the pier. As there are many small cargo ships of offshore berth waiting, the south side of the pier shall be allocated as the berthing facility for these small ships.

The steel pipe pile structure of the pier is indicated on the request letter. Two types as the jetty structure are examined as shown in Figure 2.1.1-3. One is the open type jetty with steel pipe piles which minimizes the effects against wave, current and littoral drift. And the other one is impermeable structure against the above, representing by existing wharf, with double steel sheet pile type.

In this study, the open type pier supported by steel pipe piles will be adopted considering the maritime environment, which will minimizes the effect to current, wave and bathymetry.

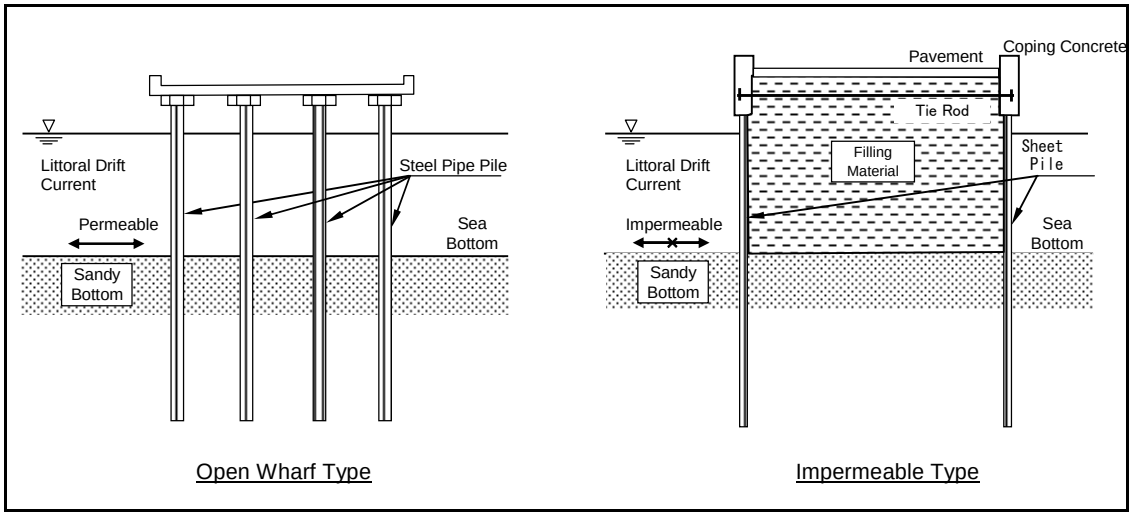


Figure 2.1.1-3 Alternate Structural Type of Pier

4) Basic Concepts of Access Trestle

The access trestle is important facility to connect the pier located offshore and the container yard. And the access trestle should be planned to make container traffic such as tractor & trailer smoothly pass through with fully utilization of container handling functions carried out on the pier. And the space for future installation of pipelines to connect to the pier shall be secured beneath the sidewalk of the trestle.

As the access trestle shall be extended approx. 260m offshore and be located perpendicular to the coast, the structure type shall be steel pipe pile type open bridge as same as the pier from the view of environmental aspects.

5) Basic Concepts of Port Cargo Handling Equipment

The composition of cargo handling equipment will be changed according to the new berthing facilities. Cargo handling system will be shifted from offshore transshipment to direct loading and unloading on the pier. The composition and type of cargo handling equipment will be planned at minimum necessity, considering container loading / unloading system of container ship and the introduction plan of Kiribati Port Authority.

Although most of the existing cargo handling equipment owned by KPA is aged more than 7 years of their durable year and deteriorated, the existing equipment which is usable with sufficient capability shall be effectively utilized as backup of newly introducing equipment.

6) Basic Concepts of Navigation Aids

According to the existing light buoys along the access channel and the channel entrance which are aged or lost, the navigation aids shall be newly replaced. And minimum necessary navigation aids comprising beacons to indicate the location of ship wreck and the markers on the pier shall be installed.

2-1-2 Examination of Project Components

(1) Civil Engineering Facilities

1) Pier

The unloading / loading works from and onto container ship in Betio Port is conducted offshore using tugboats and barges, which results in very low efficiency of cargo handling operation. As the operating cycle does not meet each other at on-land and on-ship cargo operation, there is much waiting time for loading and unloading, which affects the port time of container ship much longer. During loading / unloading operation from / onto container ship, the movement of barge is severe under rough wave condition, in addition to movement of container ship. And as the cargo handling work is continued day and night for 24 hours, the safety issues especially in night time are quite severe.

The efficiency and the safety of cargo handling works are expected to be dramatically

improved by cargo handling system change from offshore cargo transshipment to direct handling on the pier by the installation of the pier. Existing cargo handling equipment such as mobile crane and forklift which is essential for container handling is getting old and deteriorated. The port function is interrupted when main cargo handling equipment is in trouble. Therefore, the construction of the pier which enables direct cargo handling to and from container ship is extremely significant.

2) Access Trestle

As the pier is constructed offshore of the existing wharf, the access trestle to connect the pier and the container yard is justified as essential.

(2) Equipment

1) Cargo Handling Equipment

The construction of the pier makes cargo handling method change from offshore handling to direct handling on the pier. In case of direct cargo handling, land cargo handling equipment to meet with the efficiency of container ship is required and the transportation distance between the pier and the container yard shall be longer, thus the existing cargo handling equipment shall be inadequate. And, existing cargo handling equipment is already getting old and the time for renewal is getting closer.

The provision of port cargo handling equipment is understood necessary in view of new cargo handling system and its improved efficiency of cargo handling work.

2) Navigation Aids

Betio Port is located at the end of narrow and complicated access channel passing through coral reef gap where the comparatively large size ships like liner container ships, refrigerated fish carriers and purse seiners enter and leave the port by using pilot service. The navigation aids to show the location of the access channel are essential from the aspect for securing safety of navigating ships.

As the existing navigation aids are badly aging by deterioration and etc. and some of them were lost, the improvement of navigation aids is appropriate from the view point of securing safety of navigating ships. The installation of buoys indicating the ship wreck located at the turning basin off the pier and markers on the both end of the pier are considered to be necessary in addition to the navigation aids along the access channel.

2-2 Outline Design of the Requested Japanese Assistance

2-2-1 Design Policy

(1) Design Policy of Pier and Access Trestle

The pier is designed in accordance with the total evaluation of the calling ships, such as ship size and arrival draft, as well as ship maneuvering method of berthing and deberthing. Water depth distribution defined by the bathymetric survey and location of the ship wreck, direction of predominant wind, wave conditions and so forth are also considered as the premise of the safe and secure port improvement. The study flow and factors considered in planning and designing of the pier are as per Figure 2.2.1-1, in which planning conditions comprising utilization and basic conditions are included.

The access trestle is designed with the consideration of utilization conditions such as the container traffic of tractor & trailer and the passage of labors including its additional functions. The design condition will be referred to the conditions of the pier such as the natural condition and others.

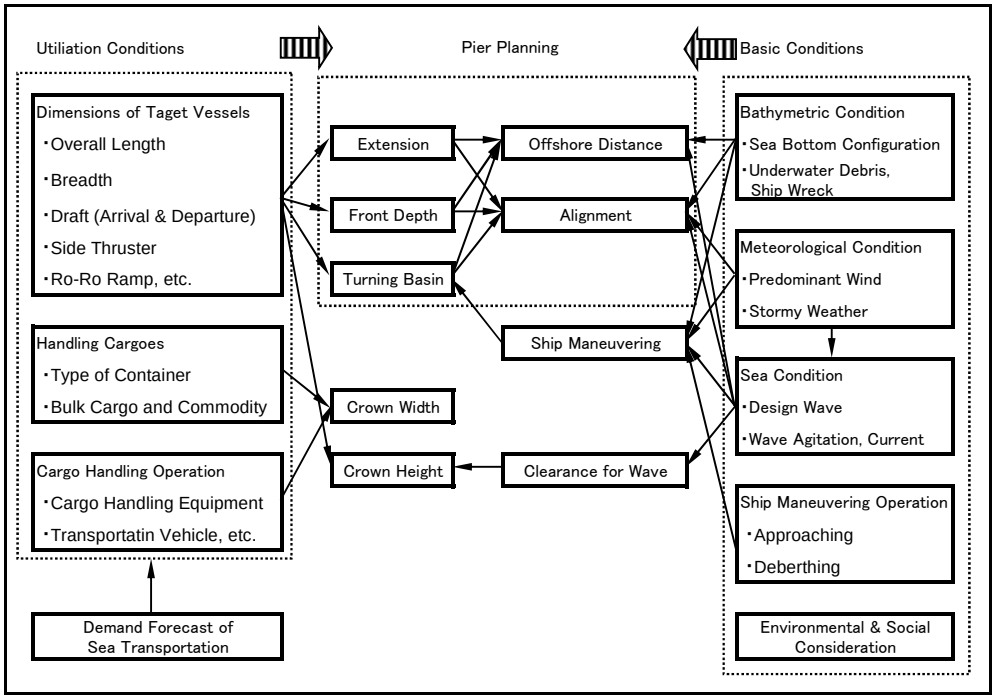


Figure 2.2.1-1 Flow Chart for Planning of Pier and Access Trestle

(2) Design Criteria

Since there is no relevant design criterion in Kiribati, "Technical Standards for Port and Harbour Facilities in Japan" and other related Japanese standard are adapted for planning and designing these facilities.

2-2-2 Basic Plan

2-2-2-1 Basic Plan of Pier

(1) Basic Conditions

1) Dimensions of Design Ship

At the basic design stage in June, 2008, design ships for the pier are set as Kiribati Chief and South Islander which are two largest container ships out of calling ships to Betio Port.

Recently, Kiribati Chief of Swire Shipping Service is replaced by Pacific Harmony and will be replaced by Pacific Horizon, soon. Greater Bali Hai Line introduces Coral Islander II, substituted by Pacific Islander II. Tropical Islander of newly built ship is scheduled for the next input. Each container ship, as shown in Table 2.2.2-1, is a sister ship of the equivalent ship particulars of Kiribati Chief or South Islander. Therefore, the dimensions of the design ships are set as the same dimensions of South Islander and Kiribati Chief established in the Basic Design Study.

Table 2.2.2-1 Dimensions of Design Ships

Shipping Company	Ship Name	Dead Weight (DWT)	Length Overall (Loa)	Full Draft (Draft)
Swire Shipping Service	Kiribati Chief	13,668 mt	158.1 m	7.98 m
	Pacific Harmony	13,387 mt	158.1 m	7.96 m
	Pacific Horizon	13,387 mt	158.1 m	7.96 m
Greater Bali Hai Line	South Islander	17,800 mt	160.7 m	9.38 m
	Pacific Islander II	17,916 mt	160.7 m	9.23 m
	Coral Islander II	17,913 mt	160.7 m	9.23 m
	Tropical Islander	18,144 mt	160.7 m	9.38 m

Pacific Harmony and Pacific Horizon operated by Swire Shipping Service are full-container ships with the capacity of 876TEUs. South Islander and other ships operated by Greater Bali Hai Line are semi-container ships with container loading capacity of 912TEUs, equipping Ro-Ro Ramp for vehicle loading / unloading at her stern.

2) Design Draft of Calling Ships

The design water depth for the pier is determined by the arrival or departure draft of each container ships when they call at Betio Port. Table 2.2.2-2 shows the arrival and departure draft in bow and stern of Kiribati Chief, Pacific Islander II and South Islander. Arrival drafts of Pacific Harmony and South Islander collected during the Implementation Review Study are added on the table.

Arrival drafts of Kiribati Chief and Pacific Harmony operated by Swire Shipping Service are approximately 7.0m, which is 1.0m less than their full draft. While, as South Islander and Pacific Islander II enter Betio Port as the first or second calling port since departing Japan, the arrival drafts reported are somewhat deeper than 8.0m in many times. Pacific Islander II and

Coral Islander II entering Betio Port via Fiji in June and July respectively show the same arrival draft as the above ship drafts departing Japan.

Table 2.2.2-2(a) Arrival Draft of Design Ship (Swire Shipping Service)

Kiribati Chief

	Arrival Draft (m)			Departure Draft (m)		
Voy #	Date	Fore	Aft	Date	Fore	Aft
88	2006/11/19	4.70	6.83	2006/11/22	3.70	6.05
89	2006/12/21	4.90	7.10	2006/12/22	4.90	6.00
90				2007/01/27	4.28	6.28
91	2007/03/01	5.88	7.96	2007/03/04	4.88	7.24
92	2007/04/04	5.52	7.20	2007/04/07	4.40	5.86
93	2007/05/08	4.40	7.26	2007/04/08	4.40	5.86
94	2007/06/12	5.80	6.80	2007/06/16	4.18	5.48
97				2007/09/30	4.70	5.90
99				2007/12/17	4.10	5.70
102	2008/03/21	6.58	7.21	2008/03/23	4.91	5.75
103	2008/04/25	4.72	6.44	2008/04/27	3.46	6.00
104	2008/05/27	5.67	7.19	2008/05/29	4.64	6.90
105	2008/07/06	7.60	7.80			
100	2008/01/15	4.68	7.01			

Pacific Harmony

	Arrival Draft (m)		
Voy #	Date	Fore	Aft
104	2009/04/08	4.68	7.00
105	2009/05/10	4.70	6.40

Table 2.2.2-2(b) Arrival Draft of Design Ship (Greater Bali Hai Line)

Pacific Islander II

	Arrival Draft (m)			Departure Draft (m)		
Voy #	Date	Fore	Aft	Date	Fore	Aft
25	2007/03/02	5.75	8.25	2007/03/04	4.40	5.86
26	2007/05/03	6.15	8.35	2007/05/05	5.75	8.15
31	2008/03/05	6.45	7.85	2008/03/07	6.40	8.20

South Islander

	Arrival Draft (m)			Departure Draft (m)		
Voy #	Date	Fore	Aft	Date	Fore	Aft
3	2008/04/16	6.86	8.10	2008/04/15	5.45	8.15
4	2008/06/21	7.13	8.00	2008/06/23	6.75	7.99

South Islander

	Arrival Draft (m)		
Voy #	Date	Fore	Aft
9	2009/04/24	6.35	8.24
10	2009/06/22	7.07	7.90

Pacific Islander II

	Arrival Draft (m)		
Voy #	Date	Fore	Aft
38	2009/06/09	6.75	8.10

Coral Islander

	Arrival Draft (m)		
Voy #	Date	Fore	Aft
40	2009/07/05	6.51	7.76

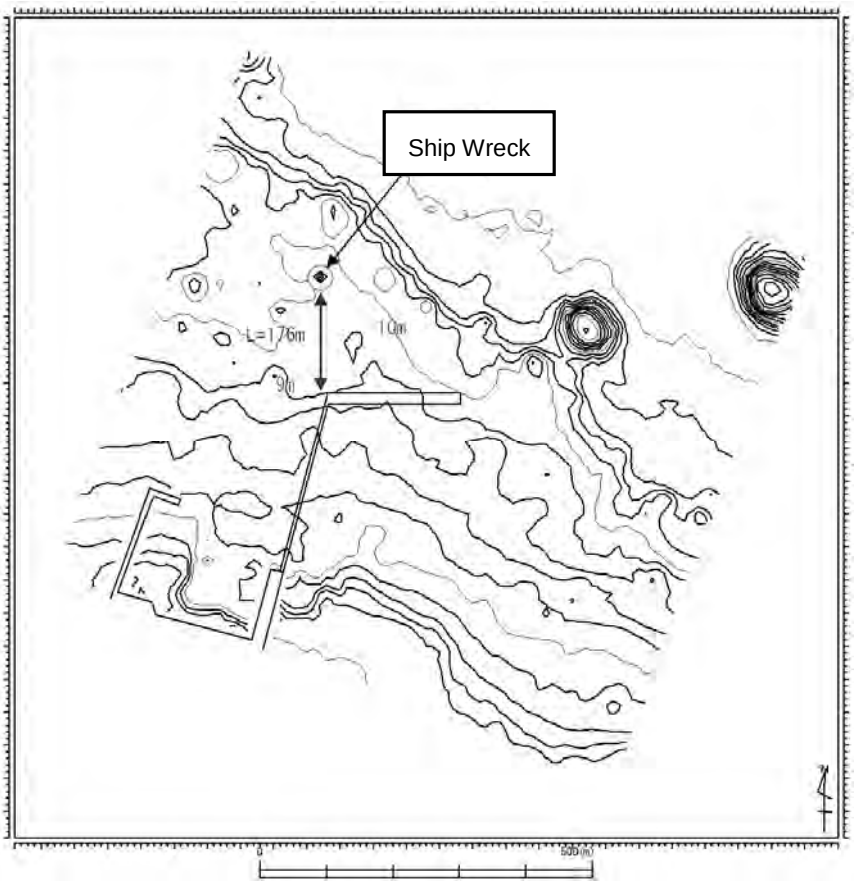
According to interview surveys for each captain about the arrival draft, the draft of ships can be adjustable by ballast water to lower the draft less than 8.0m. Therefore, the draft of the design ship is set as 8.0m on the premise that the arrival draft of calling ships is secured less than 8.0m from the perspective of the safety operation.

(2) Alignment Plan and Design Water Depth of Pier

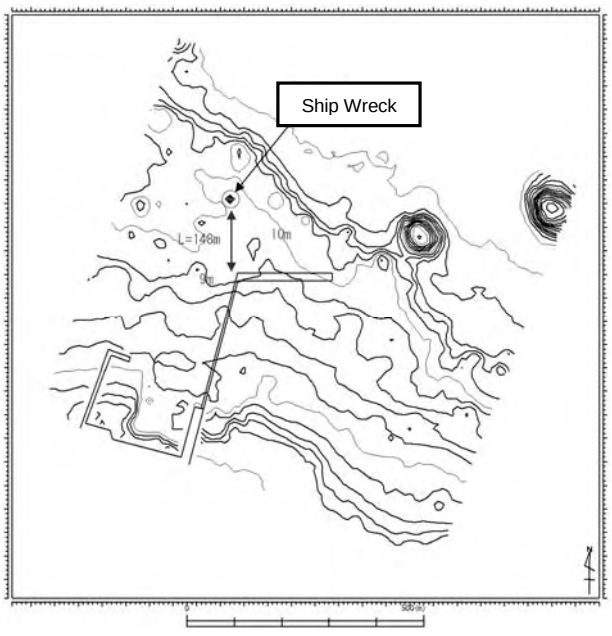
1) Alignment and Location Plan of Pier

The offshore location of the pier is examined by taking into account the vicinity area to secure design water depth of the pier and the positional relation with the ship wreck based on the result of sounding survey in this study. The alignment of the pier is set so as to lie in east to west to make it closer to the direction of the easterly predominant wind by the suggestions of the person well acquainted the ship maneuvering and bathymetry, such as captains of container ships who are the frequent users of the port, deputy port master who is now working as pilot and former port master working as former pilot.

Figures 2.2.2-1 show the alternatives of the offshore distance form the existing wharf of 280m, 300m and 330m, as laying the normal line of the pier from east to west. Iso bath of the depth of -9.0m is forming like tongue shape in the adjacent bottom to the pier. And water area shallower than -9.0m depth extends in further offshore. In order to secure the necessary water depth without dredging, it is necessary to make the distance in offshore longer than 330m. In that case, as the distance between the pier and the ship wreck is too close, which affect seriously the safety of ship operation. The alternative of 280m offshore from existing wharf has been selected to secure the necessary water depth of the design ships, because the distance between the ship wreck and the pier is secured as 176m, equivalent to the overall length of the design ships.



(a) Pier Alignment of 280m offshore from Wharf



(b) Pier Alignment of 300m offshore from Wharf (c) Pier Alignment of 330m offshore from Wharf

Figure 2.2.2-1 Offshore Location of Pier

2) Design Water Depth of Pier

In the request document of the project, the design water depth of the pier is indicated as D.L. -9.0m. The design water depth of the pier is set by the draft of the design ships adding the marginal depth equivalent to about 10% of draft for ship movement at the pier. In the Basic Design Study, the design water depth of the pier is determined as D.L. -9.0m, including 1.0m of marginal depth. To secure the design water depth, the water area of 4,000m^2 will be leveled with average thickness of 0.2m, in which about 800m^3 of the bottom material will be removed.

Water Depth＝Draft of Design Ship＋Margin (10% of Draft or more)
＝ 8.0m ＋ 1.0m ＝ 9.0m

As the result of establishing the datum level of water depth based on the tide observation by Australia, the datum level of UK Admiralty Marine Chart is considered to be appropriate. Significant bathymetric change on sea bottom is not found with the record of the requested letter or the previous survey, comparing with our bathymetric survey map carried out during the field survey and the other past sounding maps converting at the same datum.

3) Alternative Plan of Design Water Depth of Pier

Regarding the layout plan of 280m offshore distance, so as to secure the necessary water depth, initial dredging of 0.3m thickness at maximum is required in somewhat shallower area of water depth less than D.L. -9.0m.

From the view of project cost reduction, the design water depth of the pier is employed as D.L. -8.7m without initial dredging of the shallower area. As shown in the below equation, the marginal depth is 0.7m, which is equivalent to 8.9% of the design draft of the target vessels.

Water Depth＝Draft of Design Ship＋Margin (8.9% of Design Draft)
＝ 8.0m ＋ 0.7m ＝ 8.7m

During the Implementation Review Study, a questionnaire on the pier water depth is carried out for captains of calling ships at Betio Port. As per attached on Appendix-6, it is confirmed that safety issues of ship's entering and berthing are not expected. Therefore, the pier water depth of D.L. -8.7m is an alternate plan to reduce the project cost by eliminating the initial dredging to secure the design water depth.

4) Additional Water Depth Margin Expected by Tide Level

The design water depth is secured under the datum level of marine chart, which is classified as very low tide level. Difference between the datum level and daily low tide level gives a marginal water depth of the pier. Table 2.2.2-3 and Figure 2.2.2-2 show the number of semidiurnal low tide occurrence processed based on tide prediction table in 2009 issued by

Bureau of Meteorology, Commonwealth of Australia. According to the number of low tide occurrence, low tide level at Betio Port is not lowered less than the datum level of D.L. ±0.0m.

Frequency of low tide level occurrence less than 0.3m throughout the year shows 20.4%, which means that daily low tide level of 287 days a year is expected to be more than 0.3m and the allowable water depth of the pier is considered as 9.0m or more. Therefore, ships of her draft slightly more than 8.0m can berth alongside the pier without tide waiting, depending on tide level.

Table 2.2.2-3 Number of Semidiurnal Low Tide in 2009

Low Tide	0.00～0.09m	0.10～0.19m	0.20～0.29m	0.30～0.39m	0.40～0.49m	0.50～0.59m	0.60～0.69m	0.70～0.79m	0.80～0.89m	0.90～0.99m	1.00～1.09m	1.10～1.19m	Total
No. of Occurrence	3	33	76	100	94	95	80	82	79	43	19	2	706
%	0.4%	4.7%	10.8%	14.2%	13.3%	13.5%	11.3%	11.6%	11.2%	6.1%	2.7%	0.3%	100.0%
Accumulative %	0.4%	5.1%	15.9%	30.0%	43.3%	56.8%	68.1%	79.7%	90.9%	97.0%	99.7%	100.0%	

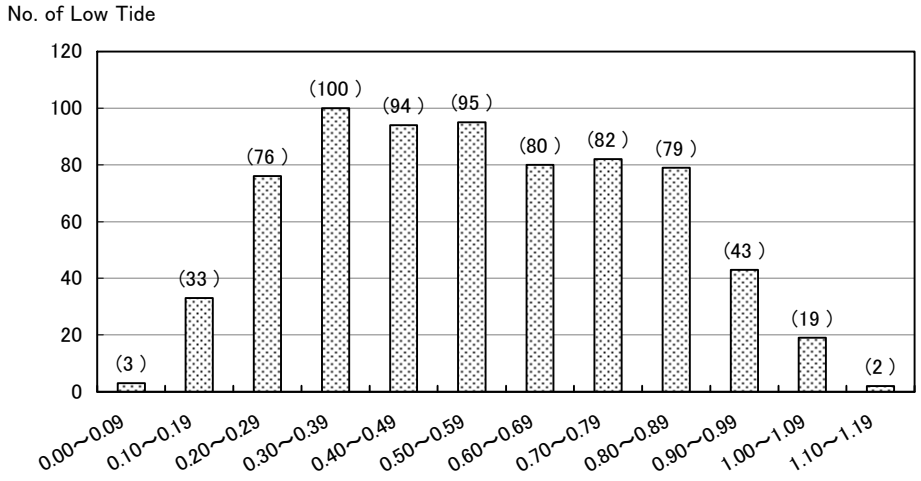


Figure 2.2.2-2 Distribution of Semidiurnal Low Tide in 2009

(3) Extension of Pier

The length of the pier is set by the overall length of Kiribati Chief and South Islander of the design ships. Figure 2.2.2-3 shows berthing condition of each container ship. In case of the pier extension set as 200m as per the request, the mooring space for berthing lines with about 20m in both bow and stern can be secured since the overall length of Kiribati Chief is 158.055m. While, South Islander equips Ro-Ro Ramp at her stern for loading and unloading vehicles, which require the space for Ro-Ro Ramp and shift the position of the ship to bow.. In case of South Islander, the vehicle unloading space can be secured by shifting about 10m of the berthing position to bow side and also the space for mooring lines in bow side with about 10m can be secured. Therefore, even South Islander can be berthed with the pier of 200m extension.

As the vehicle unloading and container handling works are executed simultaneously on the pier, the ramp of 10m width will be the obstacle to the tractor and trailer traffic for container

handling. From the view of container traffic and vehicle unloading operation, a vehicle handling zone is allocated at the end of the pier and is separated from trailer traffic by making the pier configuration as L shape. This space also can be utilized as swirling of cargo handling machinery or waiting zone.

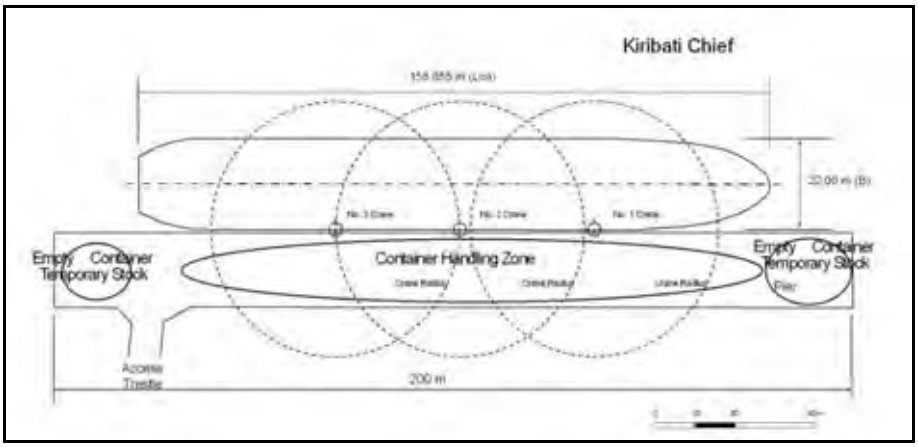


Figure 2.2.2-3(a) Berthing Condition of Design Ship (Kiribati Chief)

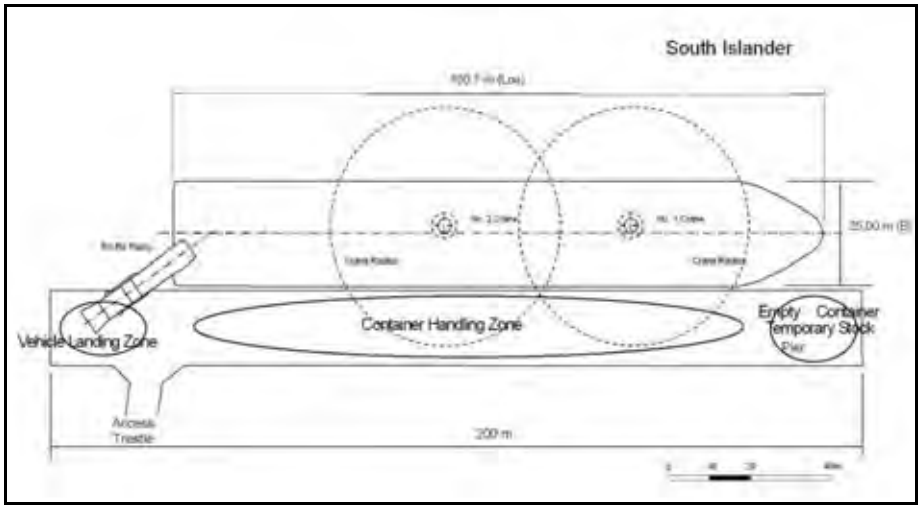


Figure 2.2.2-3(b) Berthing Condition of Design Ship (South Islander)

(4) Crown Width of Pier

The crown width of the pier is set considering evolution of tractor and trailer and the necessary working width for cargo handling by large sized forklift on the pier.

Figure 2.2.2-4 shows examples of traffic line of tractor and trailer in container handling. Tractor and trailer approaching to the unloading poison after turning around on the pier is loaded containers by forklift and move to the container yard through the access trestle. Since Kiribati has adopted left-hand-traffic, the traffic line of tractor and trailer at fixed part area of access trestle is happen to be tangled. So it is necessary to induce some counter measure against safety like installing stop signs when entering the pier.

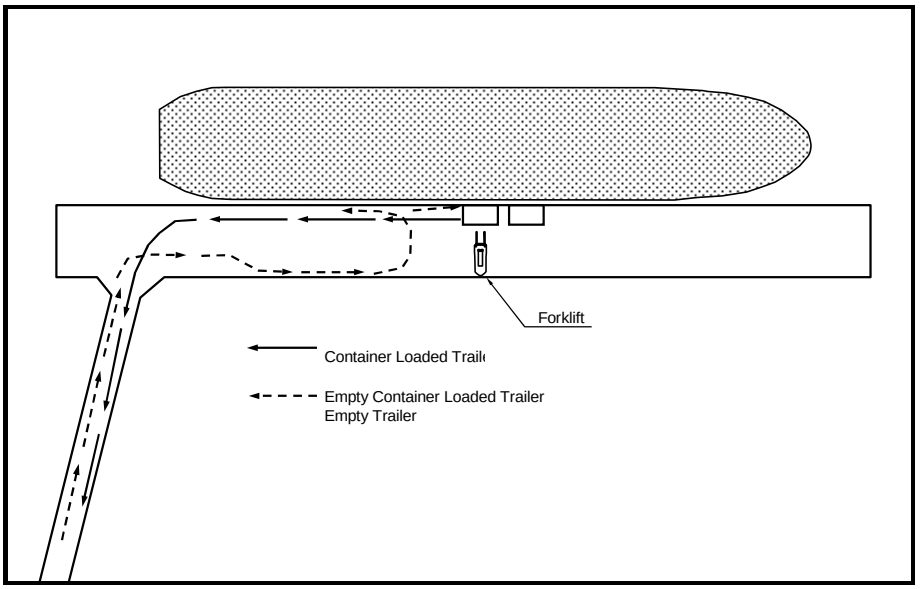


Figure 2.2.2-4(a) Traffic Line Alternative of Cargo Handling Equipment

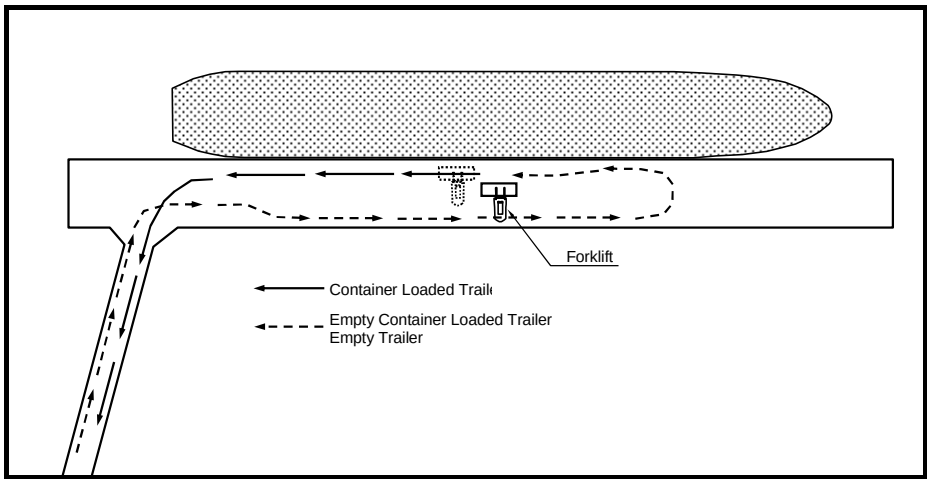


Figure 2.2.2-4(b) Traffic Line Alternative of Cargo Handling Equipment

Containers mainly handling in Betio Port are 20ft container, since there is the restriction of container weight due to capacity of the existing cargo handling equipment. However, after the project completion, 40ft containers are expected to be introduced and be handled although the quantity is not much. Figure 2.2.2-5 shows the minimum revolution area when tractor tows 40ft container trailer. The minimum revolution area needs the area of 13.7m x 30m since it starts turning after the complete stop. Therefore 16.0m length as the working width on the pier is considered to be necessary with adding about 1.0m marginal space at both ends.

$$\text{Working Area} = \text{Revolution Width of Tractor and Trailer} + \text{Margin} \times 2 \text{ Ends}$$
$$= 13.7\text{m} + 1.0\text{m} \times 2 = 15.7\text{m} = 16.0\text{m}$$

And, about 16m as actual revolution width without complete stopping was confirmed according to the field observation of swirling activity of tractor and trailer handling 20ft container. Therefore, the crown width of 18m is considered to be appropriate including 1.0m as installation space of pier accessories such as bollards and curbing at both ends.

$$\text{Crown Width} = \text{Working Area} + \text{Space of Curbing and Bollards} \times 2 \text{ Ends}$$
$$= 16.0\text{m} + 1.0\text{m} \times 2 = 18.0\text{m}$$

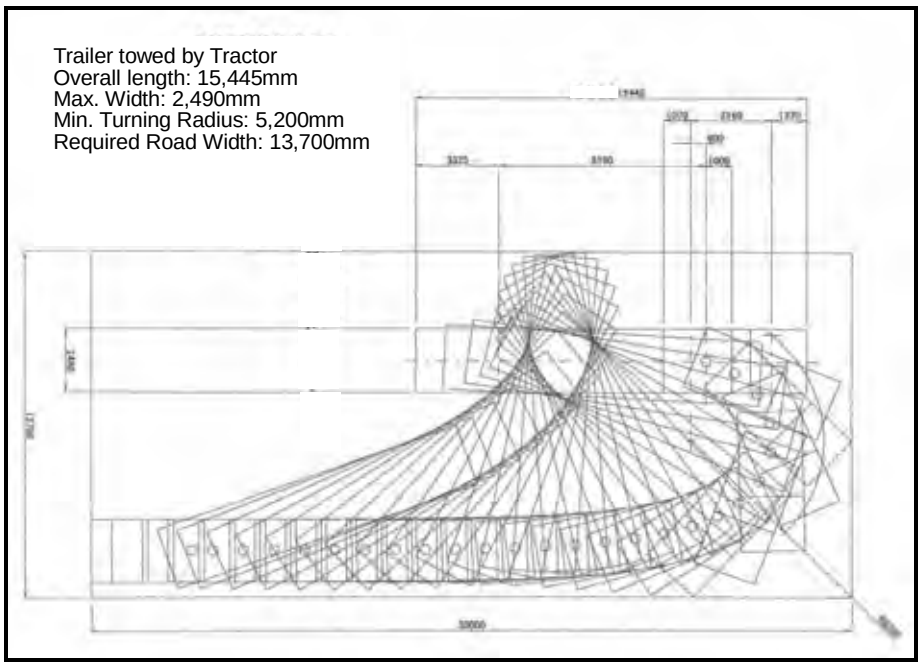


Figure 2.2.2-5 Revolution Capacity of 40ft Tractor and Trailer

Furthermore, the crown height is examined according to the container handling situation on the pier. Figure 2.2.2-6 shows the forklift operation of container handling on the pier. The container unloaded from container ship is temporary stored on the pier and after that containers are loaded onto trailer by forklift.

At the time of loading by forklift, position adjustment with folk pockets of container will be easier when the distance between forklift and container is longer as shown in Figure 2.2.2-6(a). In case that working area on the pier is 16.0m, as about 4.6m adjusting distance can be secured, the distance between the folk head and container will be about 2.0m and therefore the folk position adjustment is considered to be possible. Figure 2.2.2-6(b) and (c) shows container loading operation to trailer by forklift and trailer passing situation at backside of forklift. Each case shows that the work is possible securing minimum marginal width and therefore the crown width of the Pier is set as 18.0m.

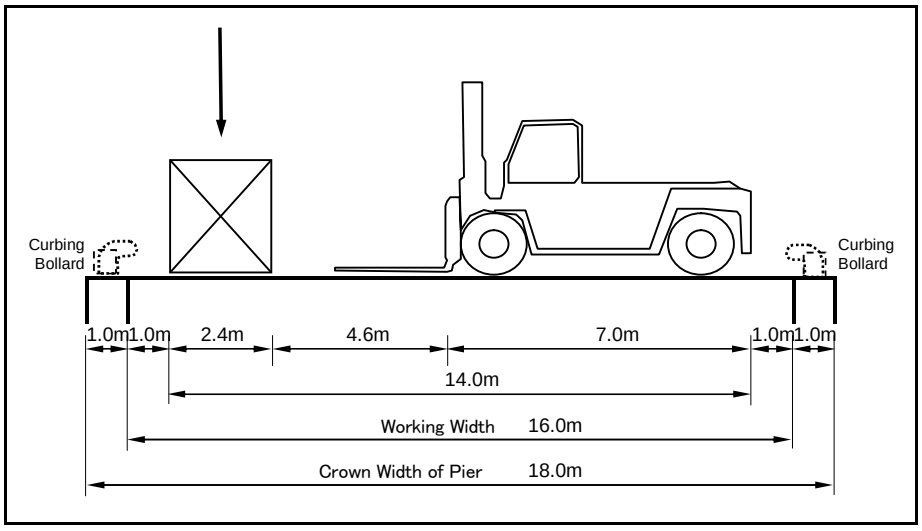


Figure 2.2.2-6(a) Container Handling Work on Pier

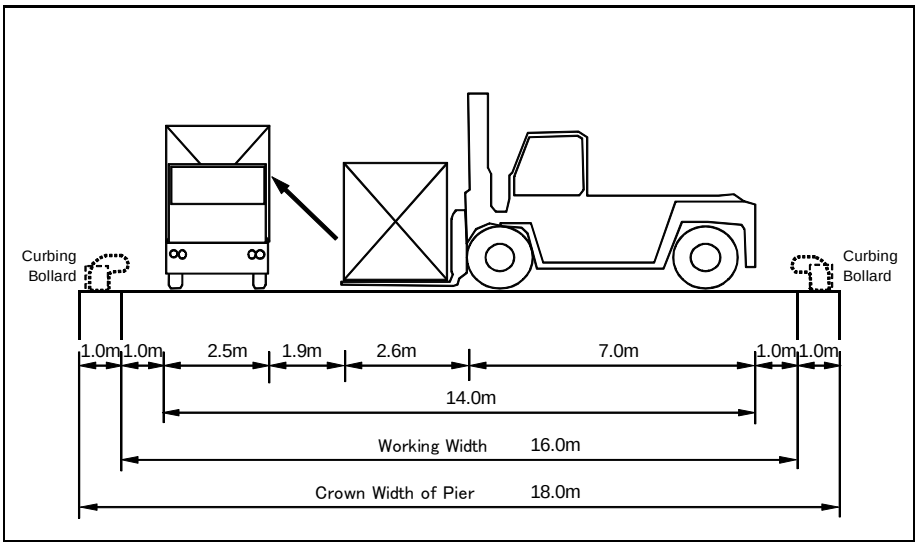


Figure 2.2.2-6(b) Container Handling Work on Pier

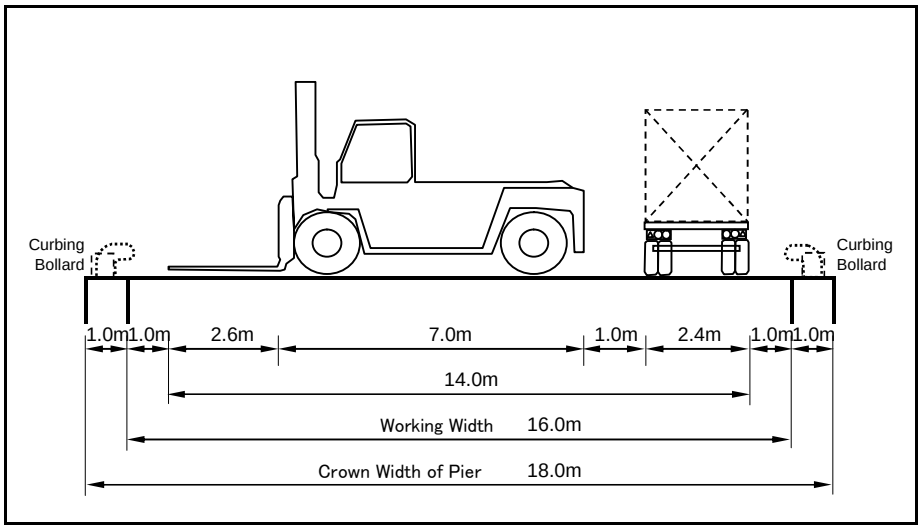


Figure 2.2.2-6(c) Container Handling Work on Pier

(5) Alternative Plan of Pier Extension

From the view of project cost reduction, the extension of the pier is shortened by introducing mooring dolphins.

1) Alternate Plan (I): 150m of Pier Extension

In case of the pier extension shortening to 150m, two mooring dolphins on bow side and one dolphin on stern side are required. Mooring conditions of target ships are shown on Figure 2.2.2-7(a) and (b). For Kiribati Chief, swing range of 3 ship geared cranes are covered by the area of the pier. However, there is no space for temporary stock area of container and ship fittings at both end of the pier. For South Islander, while swing range of two ship geared crane is out of the pier in the bow, the container handling operation can be seen not much in trouble.

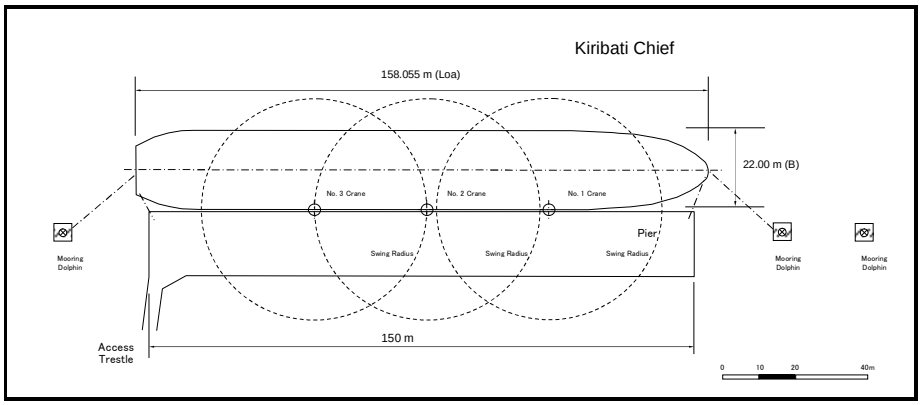


Figure 2.2.2-7(a) Mooring Condition along Pier of 150m Extension

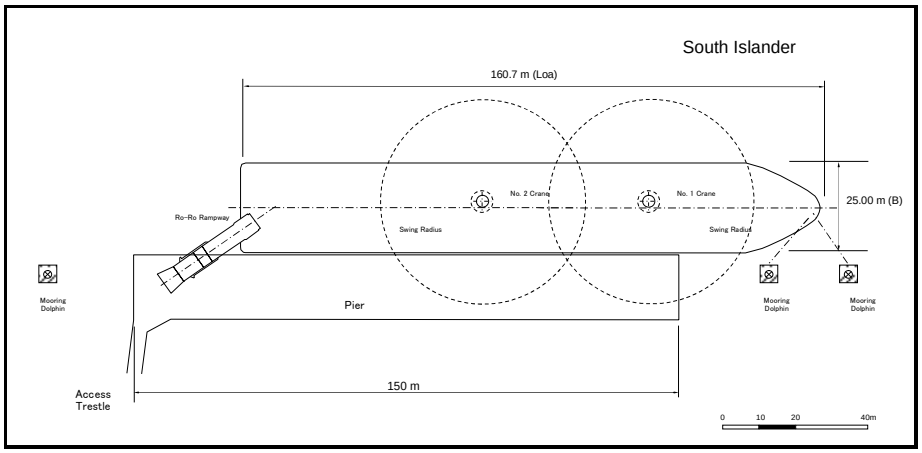


Figure 2.2.2-7(b) Mooring Condition along Pier of 150m Extension

2) Alternate Plan (II): 100m of Pier Extension

In case of the pier extension shortening to 100m, one mooring dolphin and two breasting dolphins on bow side and two mooing dolphins on stern side are required to stabilize ships. Mooring conditions of target ships are shown on Figure 2.2.2-8(a) and (b). For Kiribati Chief,

container handling operation concentrates in the middle portion of the pier because the pier area can not cover the swing range of the ship geared crane. For South Islander, most of the swing range of the ship geared crane is out of the pier area, so that during container handling operation the ship must be moved to stern side.

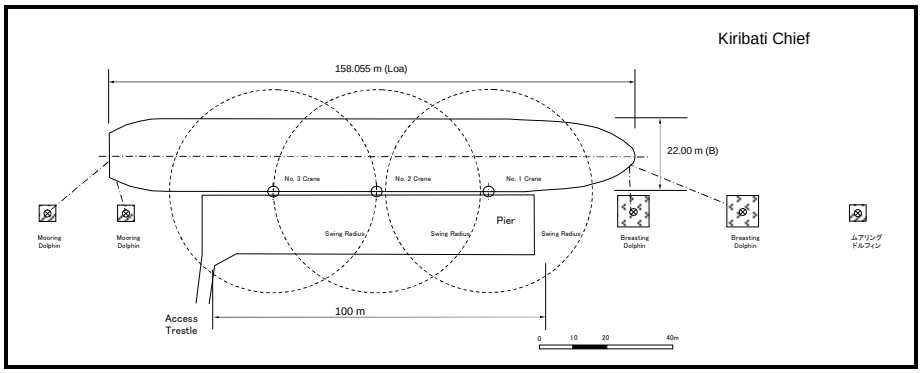


Figure 2.2.2-8(a) Mooring Condition along Pier of 100m Extension

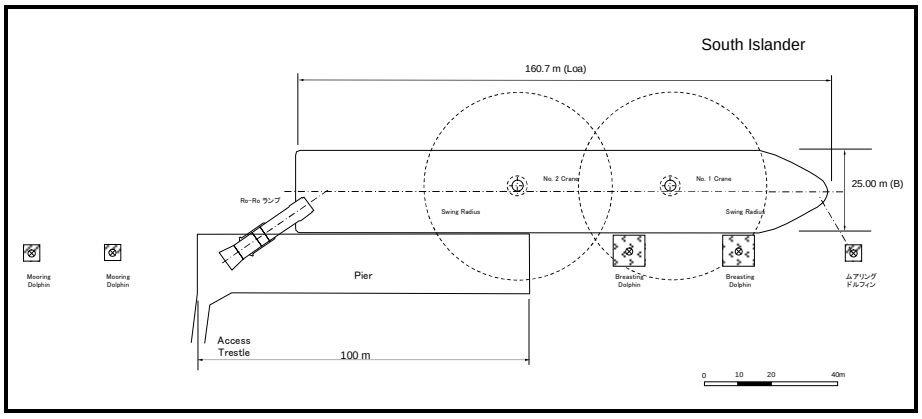


Figure 2.2.2-8(b) Mooring Condition along Pier of 100m Extension

(6) Ancillary of Pier

The following items as ancillary of the pier are examined.

- Fender
- Bollard
- Curbing
- Lighting Facility and etc.

And the spaces for the apparatuses such as oil unloading manifold from tanker, loading manifold of copra oil pipe line and fuel and water supply units shall be secured on the pier.

2-2-2-2 Basic Plan of Access Trestle

(1) Basic Conditions

1) Design Vehicle

The access trestle is designed considering following vehicles and space

- Tractor and trailer (container loaded condition)
- Forklift traffic (empty)
- Passage of workers and related staff
- Spaces for pipe line (pipeline of oil from tanker, copra oil, water and fuel supply and electricity line)

2) Number of Traffic Lane

According to the observation results of cycle time of ship's crane of Kiribati Chief, container handling cycle time is about 4 minutes/crane/container. The unloading / loading of container on the pier are conducted at the speed of two minutes for one unit by simultaneous operation of two ship geared cranes. In order not to stagnate containers on the pier, 30 units per hour are necessary to transport to the container yard through the access trestle from the pier. Therefore, during container handling operation, the 60 traffics of tractor and trailers back and forth are born on the access trestle.

According to the request, there existed a standby area on the way for traffic exchange with one lane in the access trestle however in that case, traffic jam and stagnation by tractors are expected to be happened and it will be the obstacle for smooth container transportation. As well as, the safety issues like traffic accident or downfall to water are also anticipated. Therefore, the access trestle is planned as two lanes.

In addition, for smooth turning of cargo handling vehicles, trapezoid area is installed in the connection area with the pier

(2) Extension of Access Trestle

The extension of the access trestle is set as 262m, subsiding the distance from the existing wharf front to the front face of the pier (280m) from the diagonal crown width of the pier (19m) as follows.

Extension＝Offshore Distance of Pier Front from Wharf Front－Crown Width of Pier
＝ 280.0m － 19.0m ＝ 261m

(3) Crown Width of Access Trestle

Crown width of the access trestle is planned as 9.5m with securing 2 lane road for cross traffic of tractor and trailers as shown on Figure 2.2.2-9 including necessary width of side walk for labors and related staff with trench below for pipe line installation.

Traffic Width ＝ Traffic Lane × 2 ＋Center Strip ＋ Side Buffer (w/ Curbing) × 2
＝ 2.5m × 2 ＋ 1.0m ＋ 1.0m × 2 ＝ 8.0m

Crown Width＝Traffic Width ＋ Side Walk（w/ Trench below）
＝ 8.0m＋ 1.5m ＝ 9.5m

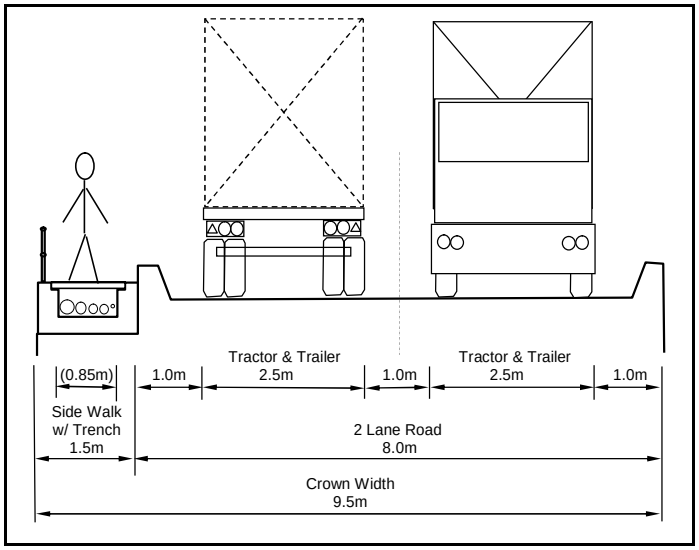


Figure 2.2.2-9 Traffic Condition of Access Trestle (2 Lanes)

(4) Alternative Plan of Crown Width of Access Trestle

Alternative plan is proposed that crown with of two lane road is reduced to one lane road as shown in Figure 2.2.2-10, in the premise of one-way traffic control with container tractor travelling in convoy to avoid traffic congestion on the access trestle. In case of one lane road, the crown width is set considering slightly more buffer zone as follows.

Traffic Width ＝ Traffic Lane × 1 ＋ Side Buffer (w/ Curbing) × 2
＝ 2.5m × 1 ＋ 1.25m × 2 ＝ 5.0m

Crown Width＝Traffic Width ＋ Side Walk（w/ Trench below）
＝ 5.0m＋ 1.5m ＝ 6.5m

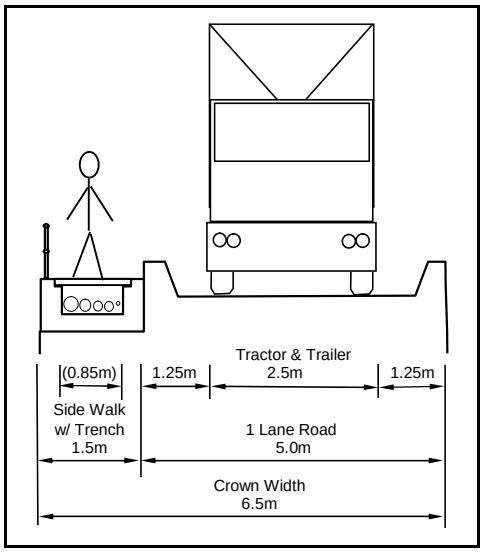


Figure 2.2.2-10 Traffic Condition of Access Trestle (1 Lane)

For safety and efficiency of container traffic, degrading by the long extension of the access bridge as 261m, evacuation or waiting zone is installed in the middle of the access bridge as indicated on Figure 2.2.2-11. The extension of the waiting zone is set as 60m including required extension to cater for two units of standby tractor and trailers and buffer zone for approaching and leaving. Width of the waiting zone is secured as 4.6m, taking into account the both-side expected margins of about 1.0m for approaching and leaving buffers of tractor and trailer. Therefore, the total width of the waiting zone portion is required to be 11.1m, comprising 5.0m of the traffic portion, 4.6m of the waiting zone and 1.5m of the side walk with trench.

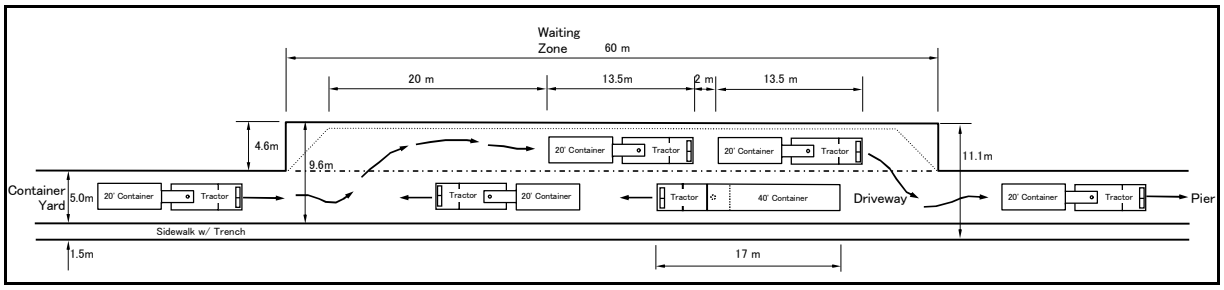


Figure 2.2.2-11 Waiting Zone Installed in the Middle of Access Trestle

(5) Ancillary of Access Trestle

The following item as ancillary of the access trestle is examined.

- Lighting Facility and etc.

The installations of pipe lines except electricity supply line to ancillary facility like lighting facility are responsibility of each operator with their own account.

2-2-2-3 Basic Plan of Port Cargo Handling Equipment

(1) Basic Conditions

1) Cargo Handling System

Container ship becomes possible to berth directly to the pier after the construction and containers are loaded and unloaded by ship's crane directly on and from the pier and loaded onto tractor and trailer by forklift and transported. The containers transported to container yard are unloaded from tractor and trailer by forklift and stored at designated slot in the yard. Cargo handling system of imported container and exporting container are shown at Figure 2.2.2-12.

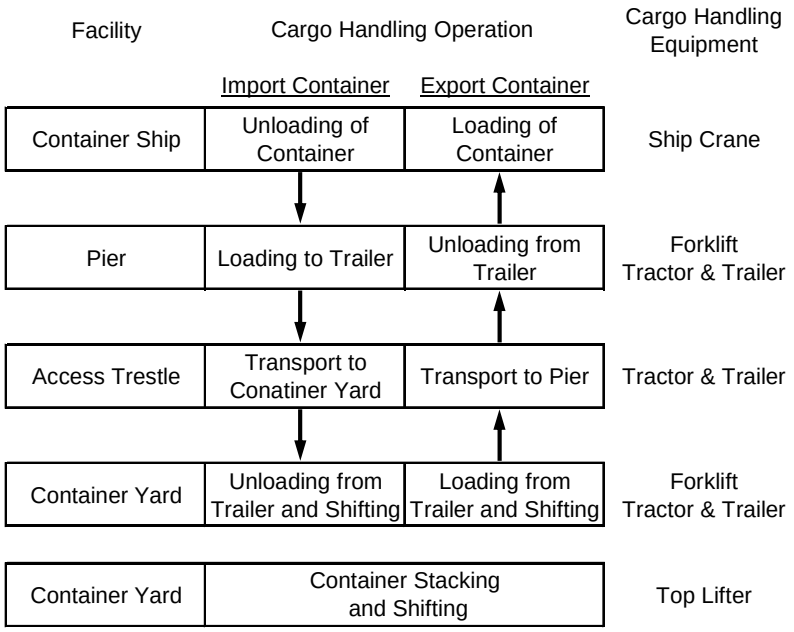


Figure 2.2.2-12 Cargo Handling System after Construction of Pier

2) Container Handled in Betio Port

Container size and maximum gross weight which are distributing mostly in the world now are shown at Table 2.2.2-4.

Betio Port has accepted containers with the weight less than 25 tons at a maximum due to the limited capability of cargo handling equipment. Most of handling containers are 20ft, but occasionally 40ft containers are handled. According to the hearing survey to the captain of Kiribati Chief, 20ft containers are still main type of container, judging from the current situation of neighboring countries. But, 40ft containers are recognized significantly now, which means that it will be expected to handle more 40ft containers expected after the completion of the project. Therefore, for establishing the basic plan of the cargo handling equipment, handling operation of 40ft containers take into consideration.

Table 2.2.2-4 ISO Container Size and Max. Gross Weight

Type	Length			Width		Height			Max. Gross Weight	
	mm	ft	in	mm	ft	mm	ft	in	kg	lb
1AAA	12,192	40		2,438	8	2,896	9	6	30,480	67,200
1AA	12,192	40		2,438	8	2,591	8	6	30,480	67,200
1CC	6,058	19	10 1/2	2,438	8	2,591	8	6	30,480	67,200

(2) Equipment Plan for Forklift and Top Lifter

Forklift and top lifter are container handling equipment for unloading and loading containers onto trailer and shift them at close range. The same class forklifts are used in KPA and the maintenance is considered to be easy. Top lifter is basically the same mechanics as forklift equipped spreader to hang upper part of container. The forklift is possible to cope with only 20ft container and the stacking height is up to two tires loading. While, top lifter can cope both with 20ft and 40ft containers by adjusting the spreader and it is possible to tier multi loadings.

During the Implementation Review Study, it is confirmed that Kiribati Port Authority is to purchase a reach stacker by their own finance and introduce in October, 2009, which has an equivalent capability of a top lifter. And the reach stacker was procured at site in December, 2009. Therefore, the top lifter is excluded from the equipment plan.

Since most of handling containers are 20ft containers in Betio Port and the 20ft containers will be main one after completion of the project. Number of 40ft containers will not be increased to significant quantity for the time being. Therefore, the selection of the port cargo handling equipment aims mainly to 20ft container. Loading and unloading method of 40ft container is considered separately.

1) Selection of Container Handling Equipment on Pier and in Container Yard

The main work in cargo handling operation on the pier and in the container yard is to transport containers at close range and loading and unloading onto/from trailer and no container stacking work in multi tiers is required. Therefore, forklifts that can handle 20ft containers and get used to operate and maintain due to the same class with existing equipment shall be allocated.

2) Selection of Equipment for Container Storage Operation

Container yard in Betio Port is planned at the target year of 2000. Container handling capacity has already exceeded because the quantity of the container is supposed to be increased at the rate of 6.6% per year by the projection. Therefore, in the aspect of effective utilization of container yard, loading container with more tiers are required. Present container stacking conditions from the capacity of existing forklifts are loading container with two tiers for loaded containers and three tiers for empty containers. Container pool capacity is considered to be promoted by stacking containers with more multi tiers with inducing a top lifter.

KPA expects to increase more than three or more stacking tiers for loaded container and four

loading tiers for empty containers, which expectation is considered to be appropriate, judging from cargo handling situation and the confirmed case that the empty containers overflow from the container yard and are stored temporarily on all over port-front roads. Therefore, one top lifter or equivalent capable equipment that enables to load containers with multi tiers is necessary to be introduced and select equipment to be able to load containers with four tiers. KPA is going to introduce a reach stacker in October, 2009, of which capability is 45 ton hoisting capacity and 40 ft container handling. Top lifter is capable to be substituted efficiently by reach stacker. The container pool capacity is considered to be increased by about 50% for loaded container and 33% for empty container.

3) Selection of Container Transportation Equipment

As a result of cycle time measurement of one ship geared crane of Kiribati Chief, the container handling capacity is about 4 minutes per one container. As three ship's cranes are equipped and two cranes are simultaneously operated, container is unloaded with the ratio of one unit in every two minutes onto the pier. Therefore, in order to keep no stagnation of container on the pier, it is necessary to transport 30 units of containers per hour to the container yard from the pier.

Cycle time was calculated with the assumption of about two minutes of loading efficiency to trailer by forklift, about one minute of unloading time at the container yard from trailer and 10 km/hr of traffic speed of tractor. Total cycle time of one trailer from loading to unloading will be 10.2 minutes adding one way transportation time of tractor of 3.6 minutes for 600m distance from the pier to the container yard.

Figure 2.2.2-13(a) shows a container traffic diagram of introducing 5 sets of tractor and trailer in case of double lane access trestle. In case of single lane access trestle, figures (b) and (c) show container traffic diagrams of introducing 4 sets and 5 sets of tractor and trailer. Table 2.2.2-5 summarizes the simulation results on number of container units transported by tractor and trailers. ( ) indicated in the table is a efficiency ratio comprising number of containers transported by container and number of containers discharged from a container ship estimated as 30 units per hour.

Regarding the double lane access trestle, 30 units of container, which equivalent to container unloading efficiency of ship geared cranes, can be transported by introducing five sets of tractor and trailer, according to operation diagram as shown in Figure 2.2.2-13(a),

Meanwhile, in case of the access trestle with single lane road, container transportation efficiency declines due to waiting time for passing traffics. Number of containers transported by tractor and trailers is increased by number of introducing tractor and trailers, however, growth rate has declined gradually. As for the access trestle with single lane, container transportation efficiencies for 4 and 5 sets of tractor and trailer are estimated as 16.9 units/hr and 18.5 units/hr, respectively. Introduction of 5 sets of tractor and trailers is proposed in the plan, considering that the container transportation efficiency is expected more than 60 % and is improved

significantly by container operation training after implementation of the Project.

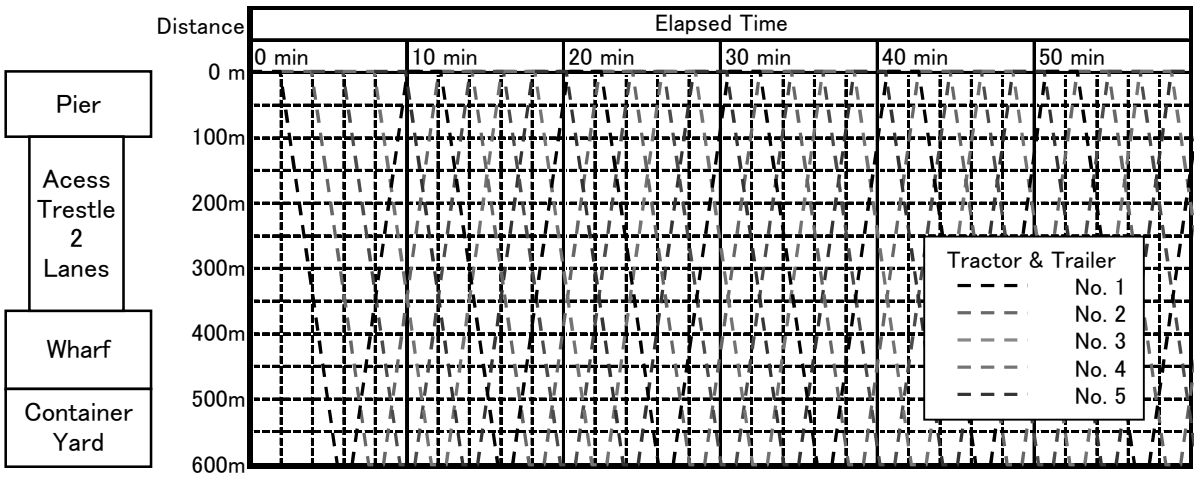


Figure 2.2.2-13(a) Operation Diagram of Tractor and Trailer (2 Lane Access Trestle with 5 trailers)

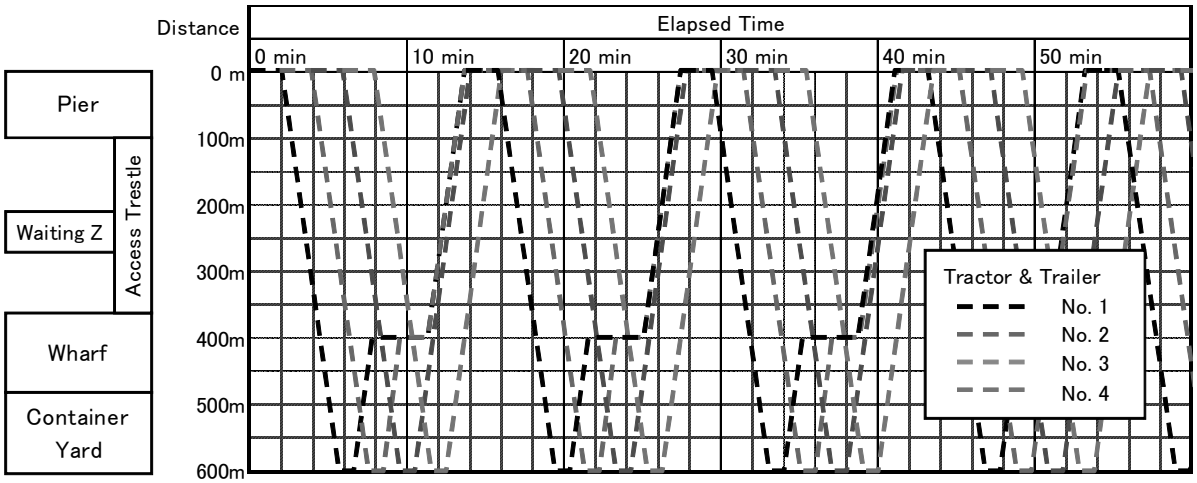


Figure 2.2.2-13(b) Operation Diagram of Tractor and Trailer (1 Lane Access Trestle with 4 trailers)

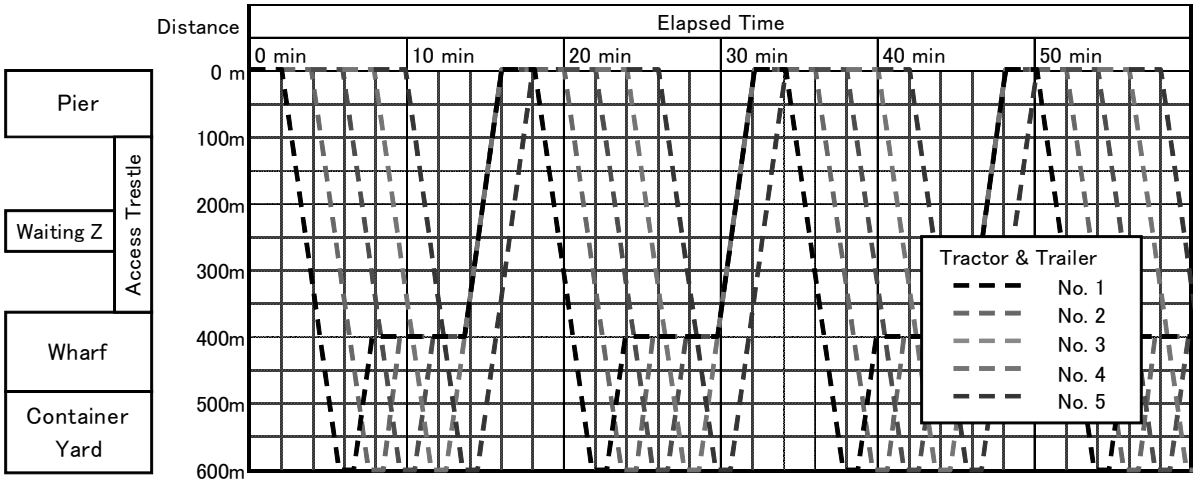


Figure 2.2.2-13(c) Operation Diagram of Tractor and Trailer (1 Lane Access Trestle with 5 trailers)

Table 2.2.2-5 Hourly Rate of Containers Transported by Trailer and Tractors

(Containers/Hour)

Aceess Trestle	Number of Tracto and Trailers					
	1 set	2 sets	3sets	4 sets	5 sets	6 sets
Double Lane	5.9 unit (19.6%)	11.8 units (39.3%)	17.6 units (58.7%)	23.5 units (78.3%)	29.4 units (98.0%)	30.0 units (100%)
Single lane	5.9 units (19.6%)	11.8 units (39.3%)	14.7 units (49.0%)	16.9 units (56.3%)	18.5 units (61.7%)	19.8 units (66.0%)

（ ）: Transportation Efficiency=Transported Containers/Unloaded Containers from Ship

4) Cargo Handling Method of 40 ft Container

As forklifts and sets of tractor and trailer for 20 ft container can not handle 40 ft container, trailer that is capable to load 40 ft container will be provided. In addition, as a number of 40 ft containers is limited currently and the handling work for 40 ft containers shall be carried out when excess time is born like a time after completion of cargo handling for 20 ft containers. Handling methodology is as follows.

- Direct unloading onto a trailer for 40 ft container from ship's crane.
- Transporting in container yard by a tractor and trailer for 40 ft container
- Shifting in short distance to designated spot, unloading and stacking by a reach stacker.

Direct unloading onto trailer by ship's crane requires a very careful work due to the up and down movement of container ship, however it will be possible taking present cargo handling situation in offshore into consideration. Therefore, one set of tractor and trailer of multi type of 20 ft and 40 ft containers shall be introduced out of 5 sets of tractor and trailers for 20 ft container.

5) Specification and Quantity of Port Cargo Handling Equipment

For the above study results in case of single lane and double lane of the access trestle, the specification and quantity of necessary port cargo handling equipment catering for new container handling system after construction of the pier are the same as mentioned in Table 2.2.2-6.

These provisions of port cargo handling equipment lead to be able to handle up to 30.48 tons that is the maximum load of container defined by ISO Standard removing the container full load limit of 25 tons and can reduce the burden of transportation cost for cargo owners and consumers.

Table 2.2.2-6 Specification and Quantity of Port Cargo Handling Equipment

Cargo Handling Equipment	No.	Specification	Utilization
Forklift	1	30.5t or more	Pier (Loading / Unloading to/from Trailer, Shifting)
Forklift	1	30.5t or more	Container Yard (Loading / Unloading to/from Trailer, Shifting)
Top Lifter	1	30.5t or more	Container Yard (Container Stacking, Shifting) Replaced by New Reach Stacker of KPA
Tractor & Trailer	4	20' Container	Pier to Container Yard (Container Transportation)
Tractor & Trailer	1	20'・40' Container	Pier to Container Yard (Container Transportation)

6) Spare Parts

New port cargo handling equipment are the same as equipment that KPA now have and the maintenance is considered to be possible by their own mechanics. However, as the cargo handling work is stopped during the equipment is out of order as well as taking time to purchase the parts, critical trouble on cargo distribution will be occurred. Therefore, the spare parts to cover one year for each cargo handling equipment shall be provided.

2-2-2-3 Basic Plan of Navigation Aids

(1) Basic Plan of Navigation Aids for Access channel

Eight navigation beacons are installed in the access channel to Betio Port, all of which shall be replaced.

1) Location of Navigation Aids

Navigation aids shall be basically installed at the same location indicated on the marine chart shown as Figure 2.2.2-14. Wiskey Point is showing shallow water area located east end of the anchoring area in Betio Port, where simple pile is installed serving as guidepost for the transect line of the access channel. A simple light buoy is to be installed at Wiskey Point for the security of ship's navigation safety and indicating the transit line of the access channel.

According to the comments from the captain of Kiribati Chief, the points of installation are necessary to establish with having a discussion with a pilot and related organizations, since the locations of some light buoys are deviated from the exact location along the access channel indicated on the marine chart.

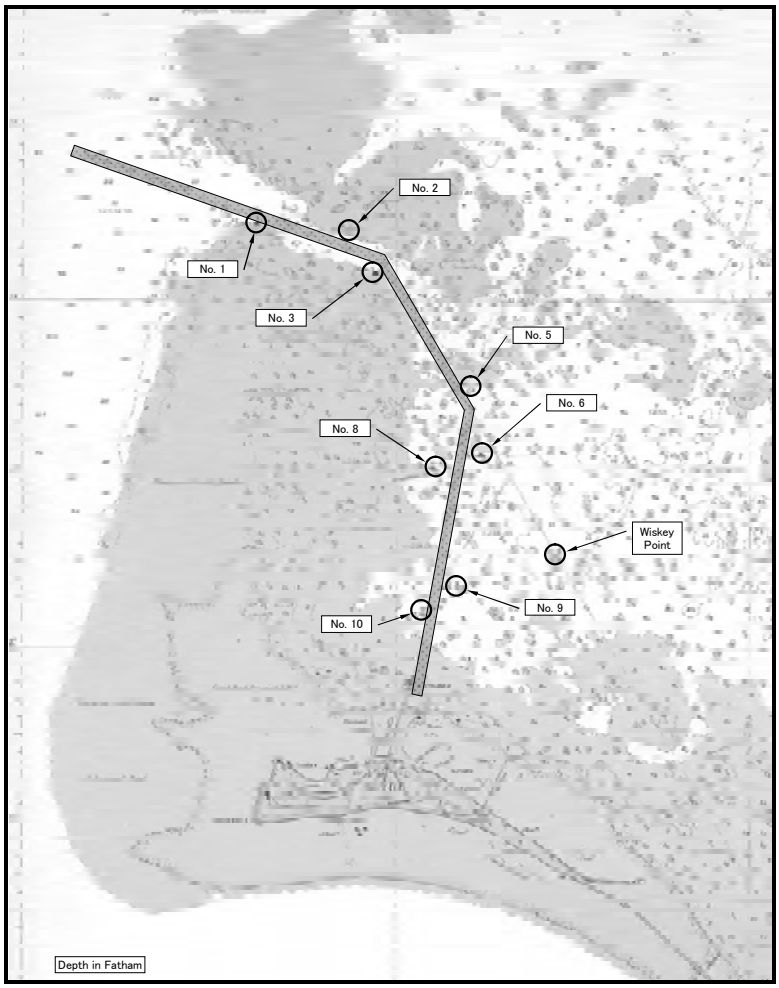


Figure 2.2.2-14 Installation Location of Navigation Aids for Access channel

2) Contents of Navigation Aids

There are two types of navigation aids, one is floating type to install navigation aids on buoy and the other is fixed type to install beacon on foundation like steel pile. Installation of the beacon type needs a pile driving barge for foundation pile driving, so that all of the navigation aids are buoy type anchored by sinker.

In addition, each navigation aids with luminescent lantern for the ships coming in and going out during night and emergency cases shall be equipped. The lantern light range shall be 5 n. miles for No.1, 2 and 3 at the access channel entrance and the range of others shall be 2 n. miles, of which light ranges are equivalent to the existing buoys.

(2) Beacons on Pier and for Ship Wreck

As the ship wreck located off the pier is the underwater obstacle, the location shall be indicated by cardinal marks. In addition, as there are many small boats and fishing boats are sailing in surrounding water area, markers shall be installed at both ends of the pier in order to clearly distinguish the location of the pier during night.

Each beacon shall equip luminescent lantern device of the lighting range of 5 n-miles in markers on the pier and 2 n-miles in cardinal marks.

As for the access trestle, no beacons are not installed and are substituted by security lightings installed along the trestle to show its location during night time.

(3) Specifications of Navigation Aids

Each specification of navigation aids are as per Table 2.2.2-7.

Table 2.2.2-7 Specifications of Navigation Aids

Location	Name	No.	Type	Light Color	Lantern	Lighting Range
Entrance of Access Channel	No. 1 to 3	3 Units	Light Buoy	Green Red	LED Solar Battery	5 n. mile
Along Access Channel	No. 5 to 8	5 Units	Light Buoy	Green Red	LED Solar Battery	2 n. mile
Anchoring Area	Wiskey Point	1 Unit	Light Buoy	Yellow	LED Solar Battery	2 n. mile
Around Ship Wreck	East & West Side	2 Units	Light Buoy	Yellow	LED Solar Battery	2 n. mile
Pier	East & West Ends	2 Units	Light Marker	Yellow	LED Lantern Outer Supply	5 n. mile

2-2-2-4 Implementation Review Plan

Implementation review plan will be established, considering the alternative plans of each facility and cargo handling equipment.

(1) Implementation Review Plan of Pier and Access Trestle

Regarding the project cost reduction of the pier and the access trestle, following two measures are considered.

- Scale down of the scope of the facility
- Change of construction method such as combined construction from maritime and landside to construction method from landside.

The construction from maritime and landside has an advantage of shortening the construction period, however the construction cost increases due to mobilization and demobilization costs of work vessels, such as crane boat, tug boats, barges, anchor boats and others. The landside construction method is to construct the access trestle and the pier gradually from landside through completed portion, which requires not many construction machinery and work boats, which enable to reduce construction costs, comparing to the maritime and landside construction method. However, the construction period becomes longer.

Table 2.2.7-8 shows the alternative plans for cost reduction regarding the construction methods of the maritime and landside simultaneously and the landside. Alternative (1) and (2) are cost reduction plans, of which extension is shortened by installation of dolphins. These two alternatives must be constructed restrictively by the maritime and landside construction method, because the dolphins are isolated from the main body of the pier. For the landside construction method, alternatives to narrow the width of the access trestle are feasible. Regarding alternatives (1) and (2), extensions of the pier are shortened from 200 m to 150 m or 100m. Alternatives (3) is the same dimensions as proposed in the basic design study, but the construction method is changed from the maritime and landside to the landside. Alternative (4) is the same as alternative (3), in which the width of the access trestle is narrowed to the one lane of 6.5m. The alternative (5) is the alternative (3) excluding the local dredging of the maritime area off the pier. Each alternate plan is shown in Figure 2.2.2-15 (a) ~ (e).

Alternative (4) is selected by examining minimum required functions to carter for the current container ships calling Betio Port and container cargo handling volume as well as project costs of those alternatives.

Table 2.2.2-8 Layout of Basic Plan and Alternatives

Pier and Access Trestle		Basic Plan	Alt. (1)	Alt. (2)	Alt. (3)	Alt. (4)	Alt. (5)
Construction Method		Offshore and Landside			Landside		
Pier	Extension	200m	150m	100m	200m	200m	200m
	Width	18m	18m	18m	18m	18m	18m
	Depth	DL-9.0m	DL-9.0m	DL-9.0m	DL-9.0m	DL-8.7m	DL-8.7m
Dolphin	Mooring	----	3 sets	3 sets	----	----	----
	Breasting	----	----	2 sets	----	----	----
Dredging	Off Pier	Required	Required	Required	Required	None	None
Access	Lane	Two	Two	Two	Two	One	Two
Trestle	Width	9.5m	9.5m	9.5m	9.5m	6.5m	9.5m
	Waiting Zone	----	----	----	----	60m	----
	Extension	261m	261m	261m	261m	261m	261m
Layout Plan		Fig.2.2.2-15(a)	Fig.2.2.2-15(b)	Fig.2.2.2-15(c)	Fig.2.2.2-15(a)	Fig.2.2.2-15(d)	Fig.2.2.2-15(e)

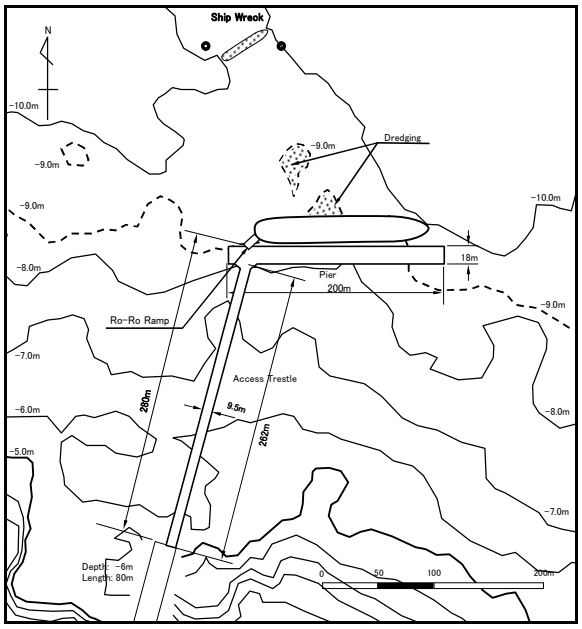


Figure 2.2.2-15(a) Layout of Basic Plan and Alternative(3)

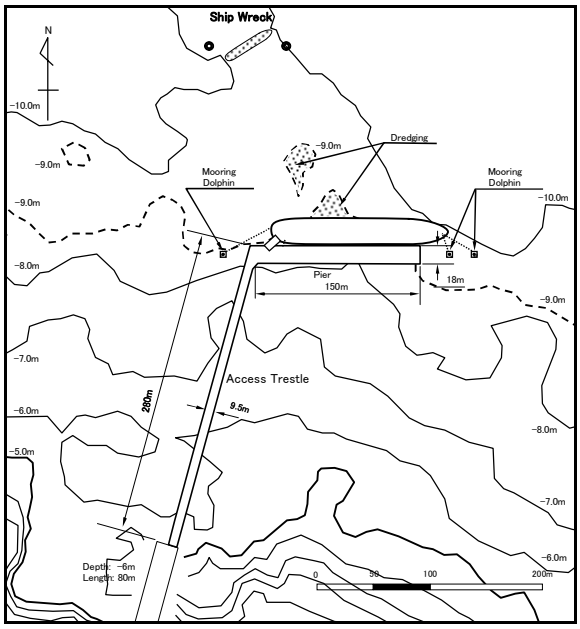


Figure 2.2.2-15(b) Layout of Alternative(1)

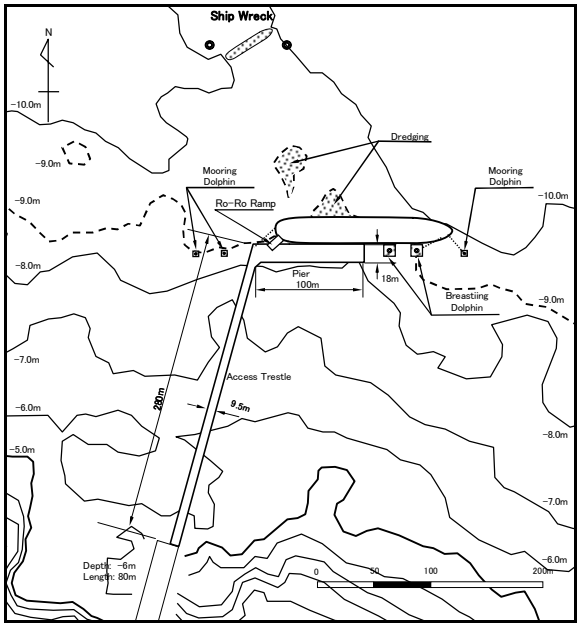


Figure 2.2.2-15(c) Layout of Alternative(2)

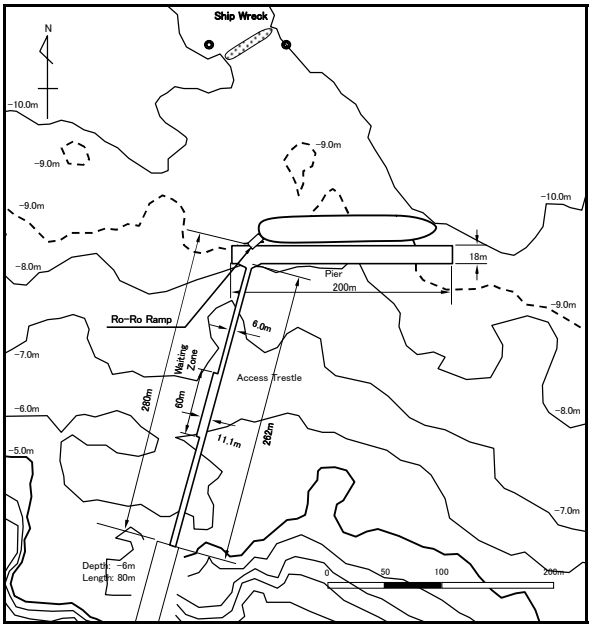


Figure 2.2.2-15(d) Layout of Alternative(4)

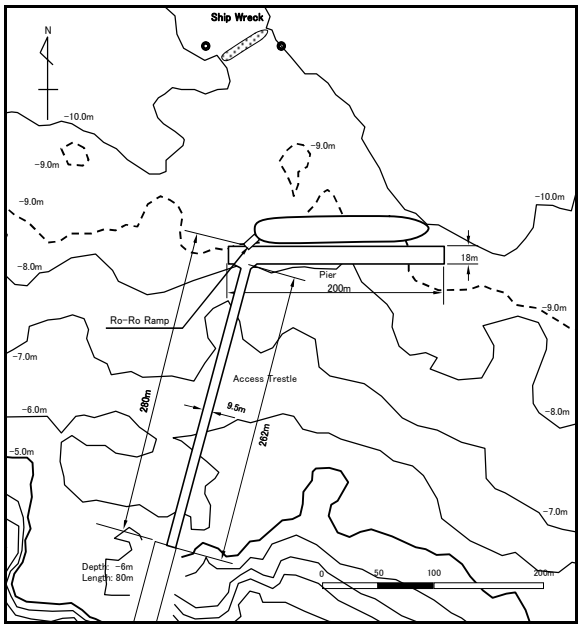


Figure 2.2.2-15(e) Layout of Alternative(5)

(2) Implementation Review Plan of Cargo Handling Equipment

To cater for the new cargo handling operation, 2 sets of forklift and 5 sets of tractor and trailer are required through the examination of new container handling operation. However, one set of forklift and two sets of tractor and trailer owned by Kiribati Ports Authority are currently operated for container handling. The formation of the cargo handling equipment introduced by the Project will be determined taking into account the existing cargo handling equipment. One sets of forklift and two sets of trailer and tractor are planned to be introduced as mentioned on Table 2.2.2-9.

Table 2.2.2-9 Introduction Plan of Cargo handling Equipment

Cargo Handling Equipment	Capacity	Units (Set)		
		Required	Existing	Project
Forklift	30.5ton or more	2	1	1
Tractor & Trailer	20' Container	4	2	2
	40'&20' Container	1	0	1

(3) Implementation Review Plan of Navigation Aids

Replacement of the navigation buoys installed at the entrance and along the access channel is included, considering their deterioration and aging. And marker buoys indicating the location of the ship wreck and marker beacons on the both end of the pier are installed in the Project.

2-2-2-6 Project Outline

The outline of facilities and equipment to be constructed and purchased in this project are shown below. And the outline of layout plan of the pier and the access trestle are as per Figure 2.2.2-16.

(1) Pier and Access Trestle

Facility	Dimension	Remarks
Pier	Alignment	East to West
	Extension	200m
	Crown Width	18.0m
	Water depth	8.7m
	Crown Height	D.L..+4.5m
Access Trestle	Extension	261m
	Crown Width	6.5m (60m 2-lane zone)

(2) Port Cargo Handling Equipment

Cargo Handling Equipment	No.	Remarks
Forklift	1 sets	30.5t or more
Tractor & Trailer	2 sets	30.5t or more for 20' Container
Tractor & Trailer	1 sets	30.5t or more for 20' & 40' Container

(3) Navigation Aids

Location	Type	No.	Lighting Distance of Lantern
Entrance of Access Channel	Light Buoy	3 Units	5 n. mile
Along Access Channel	Light Buoy	5 Units	2 n. mile
Anchoring Area (Wiskey Point)	Light Buoy	1 Units	2 n. mile
Around Ship Wreck	Light Buoy	2 Units	2 n. mile
Pier	Light Marker	2 Units	5 n. mile

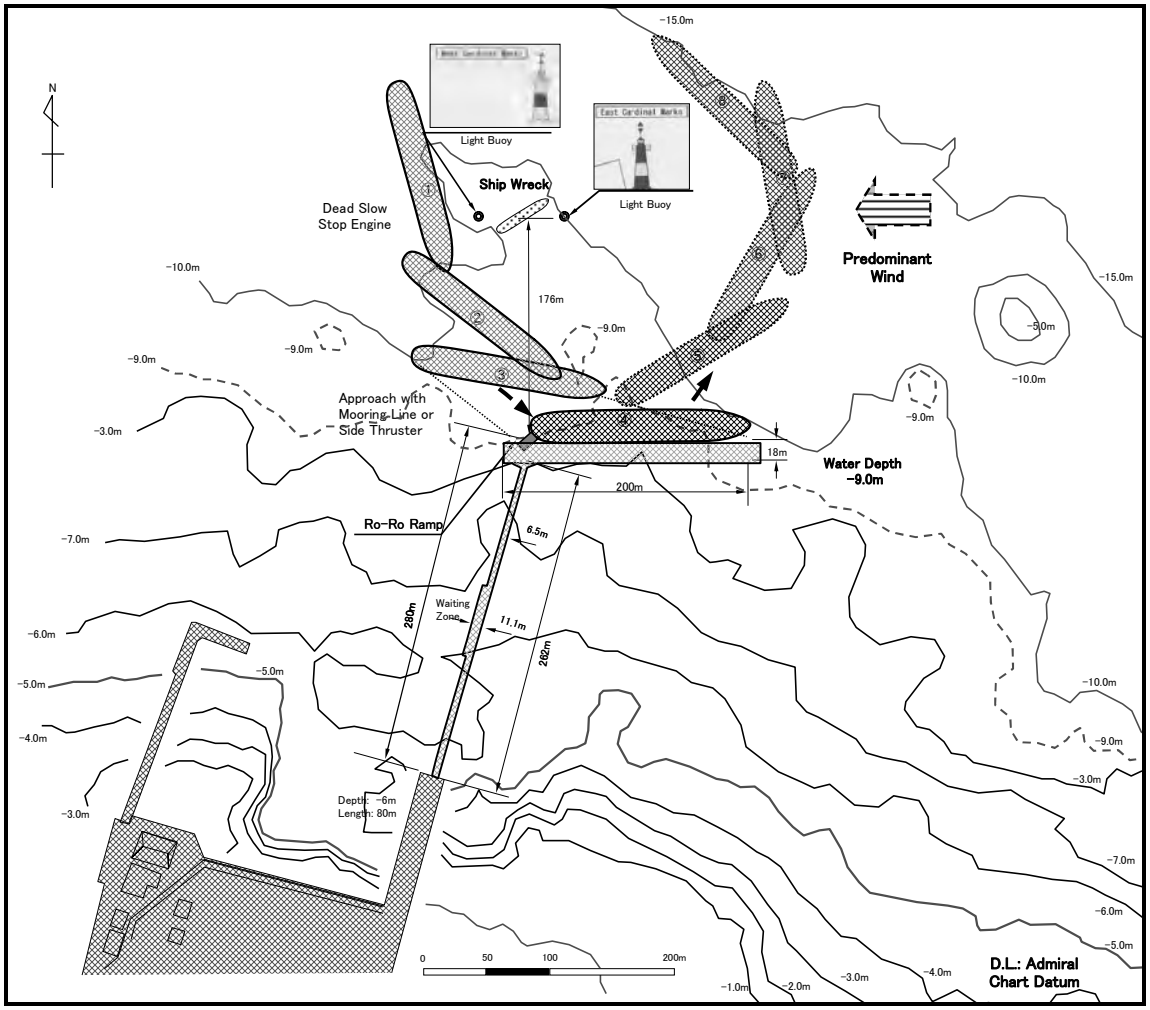


Figure 2.2.2-16 Outline of Pier and Access Trestle

2-2-3 Outline Design Drawing

2-2-3-1 Design Condition

Design conditions of the pier and the access trestle are as per shown below.

(1) Design Ship

Design ships for the pier are as per Table 2.2.3-1.

Table 2.2.3-1 Design Ship for Pier

Target Ship	Max. Design Ship (South Islander)	Min. Design Ship (Matangare)
Ship Length (Loa)	160.7m	68.64m
Breadth (B)	25.0m	11.8m
Design Draft (D)	8.00m	4.2m
Dead Weight Tonnage (DWT)	17,500 m ton	1,295m ton

(2) Design Water Depth and Tide Level

Design water depth and tide level for Pier are as per Table 2.2.3-2.

Table 2.2.3-2 Design Water Depth and Tide Level for Pier

Design Depth	D.L. -9.0m
Tide Condition	
H.W.L.	D.L. +2.33m
M.W.L.	D.L. +1.18m
L.W.L.	D.L. +0.09m

(3) Design Wave

Extreme storm wave in the atoll can be obtained by combining invading wave from outer ocean and wave generated in the atoll reef, as mentioned on Table 2.2.3-3.

Table 2.2.3-3 Dimension of Design Wave in Atoll

Design Wave	Lagoon
Significant Wave Height ($H_{1/3}$)	2.2m
Max. Wave Height (H_{max})	3.5m
Wave Period (T)	5s
Wave Direction	N

(4) Load Condition

Pier

Ship's Approaching Velocity： 0.1m/s

Vehicle Gross Weight： 43,780kg
(Tractor and trailer with 40ft loaded container)

Traffic Load ： Truck（TT-43）
Forklift（30.5t class）

Container Load： 30.5t (20ft, 40ft ISO container）

2-2-3-2 Outline Design Drawing

(1) List of Drawings of Facilities

(2) List of Drawings of Equipment

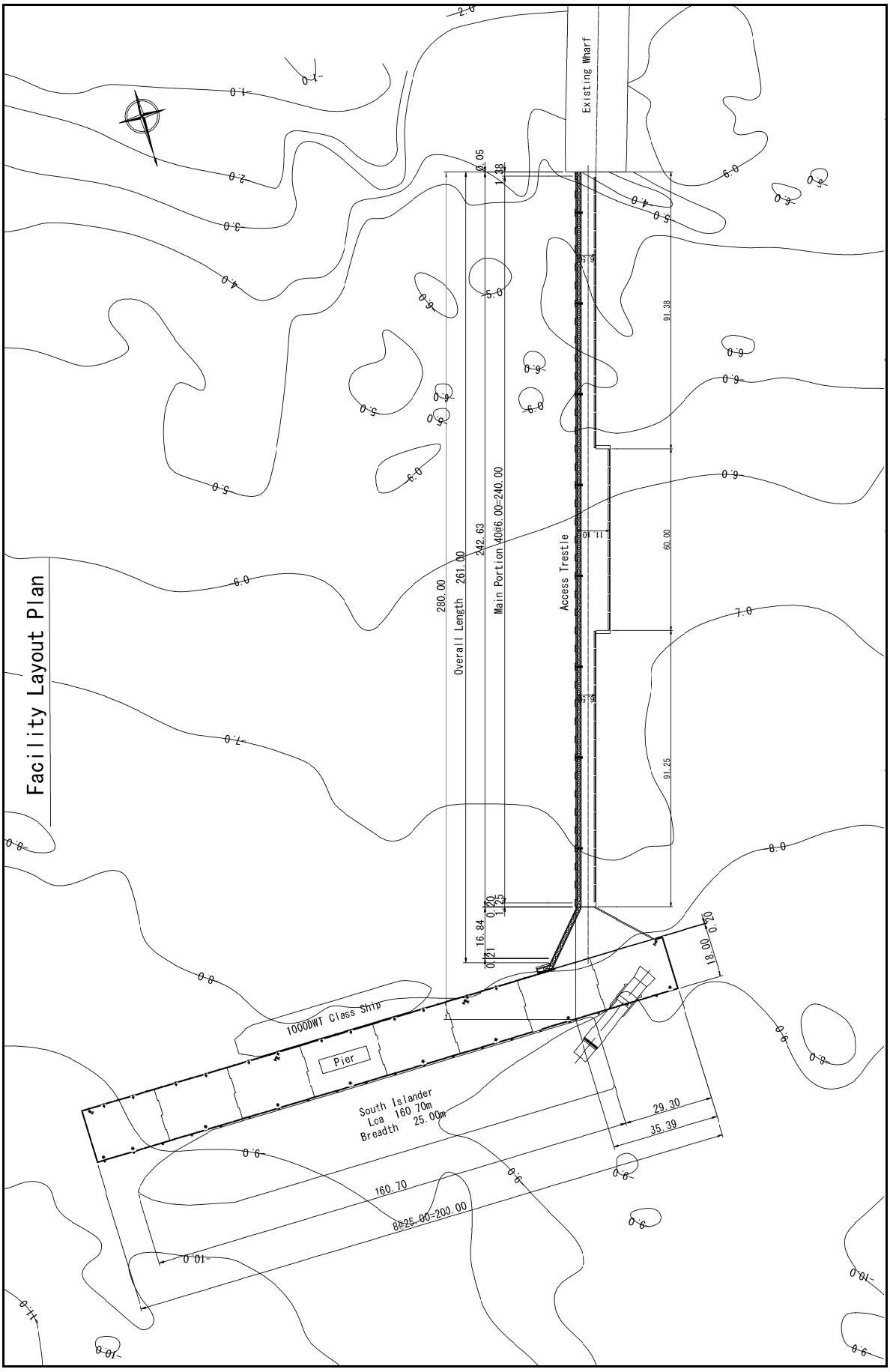


Figure 2.2.3-1 Layout Plan of Pier and Access Trestle

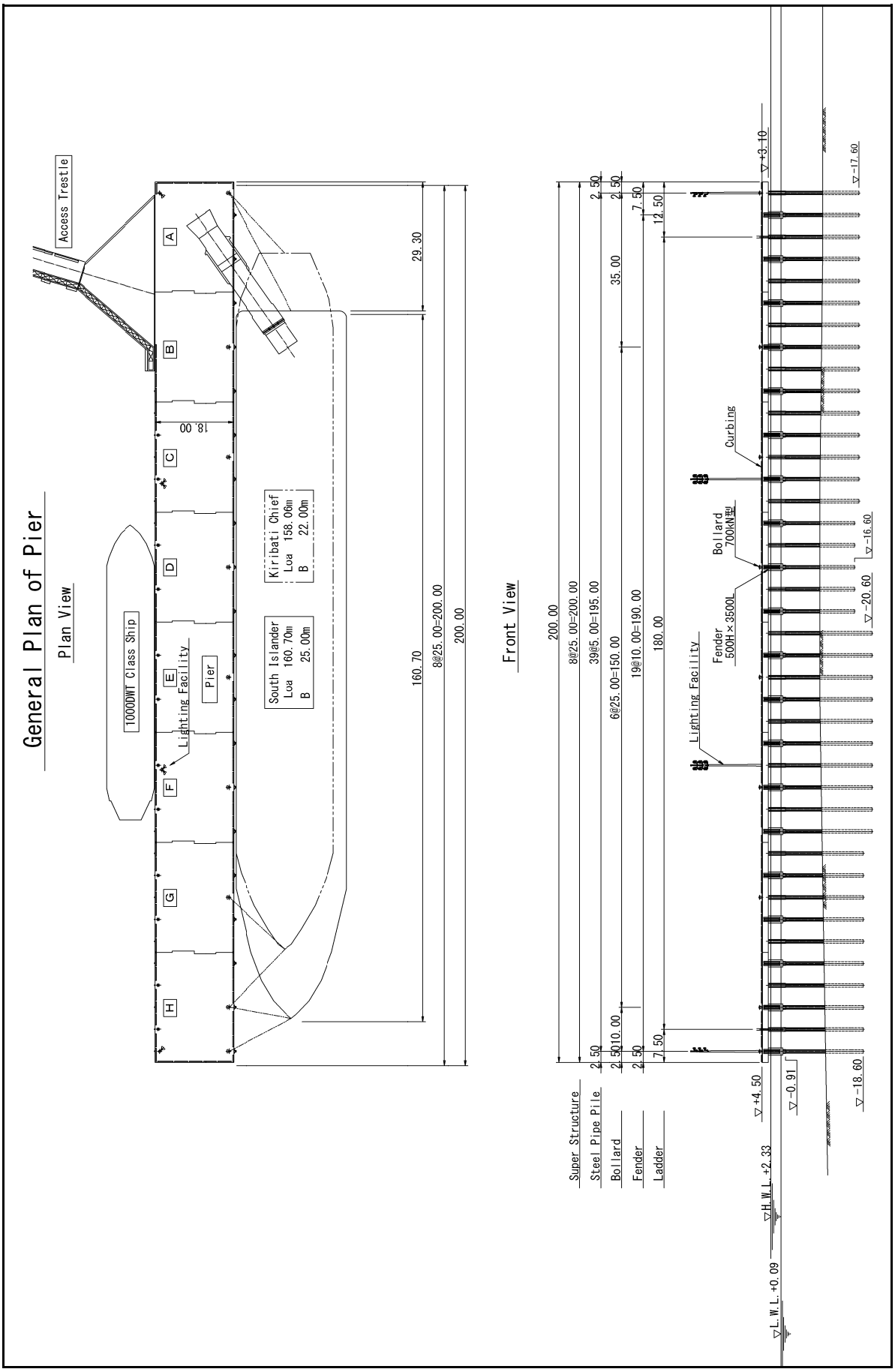


Figure 2.2.3-2 Plan and Front View of Pier

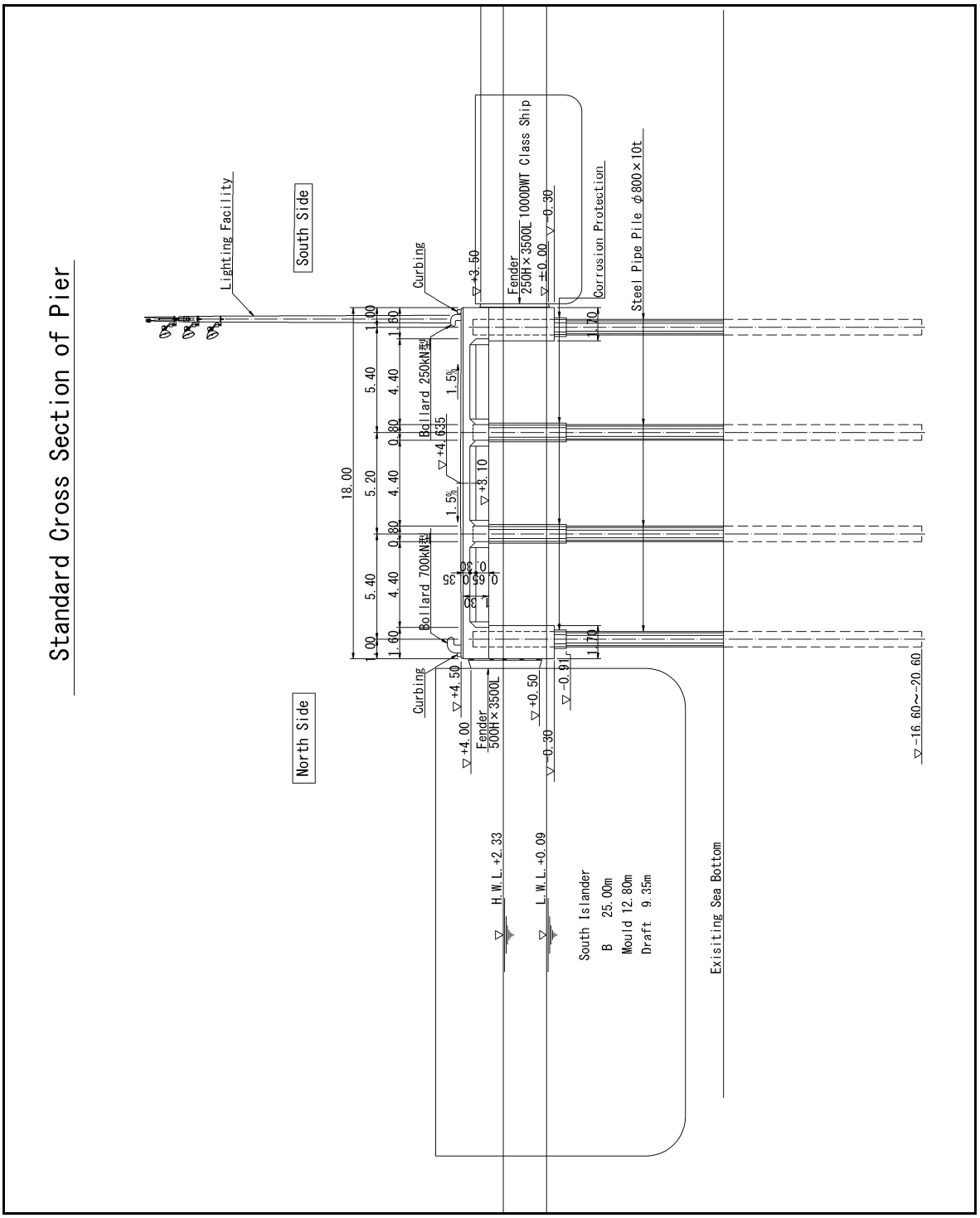


Figure 2.2.3-3 Standard Cross Section of Pier

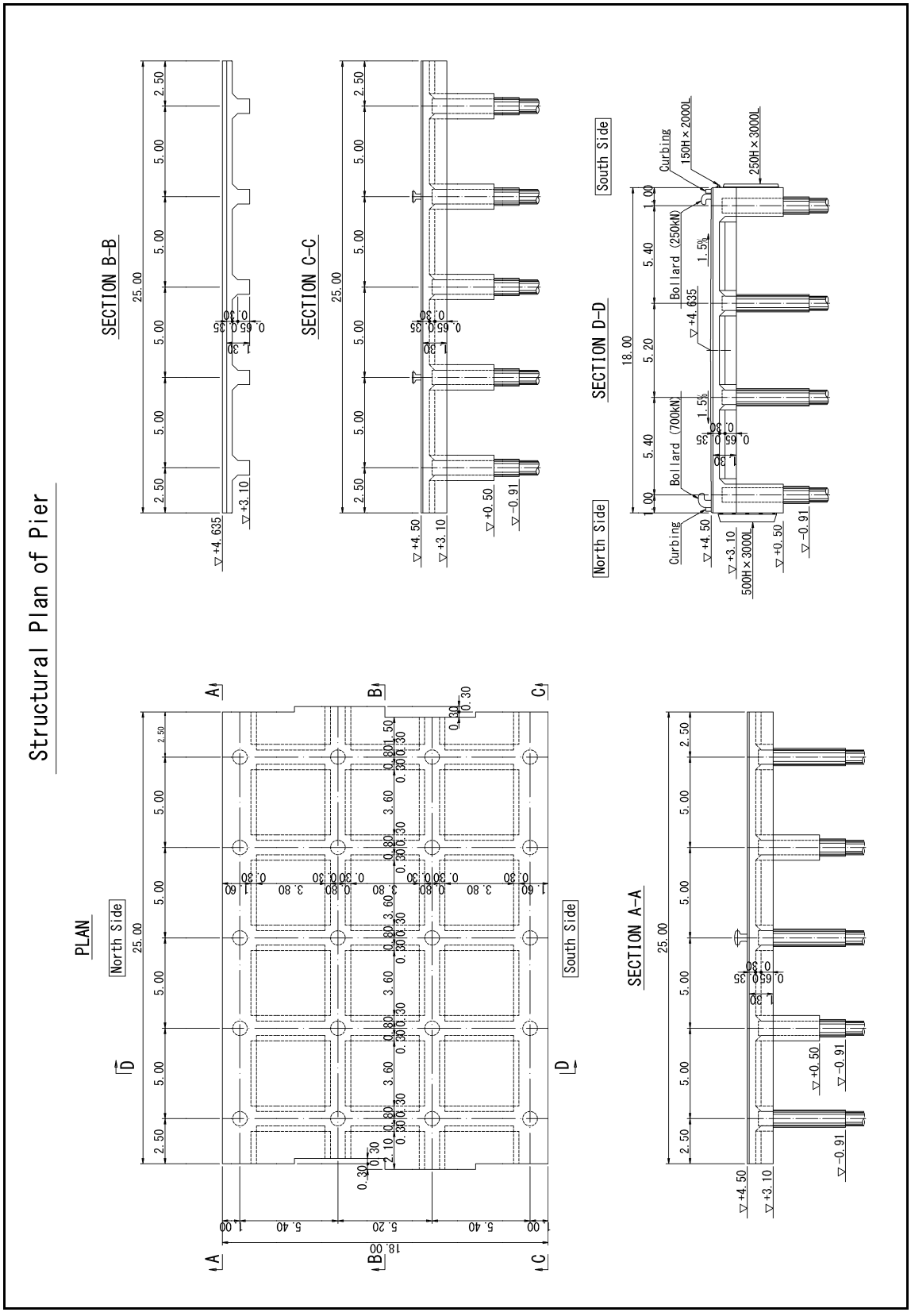


Figure 2.2.3-4 Structural Plan of Pier

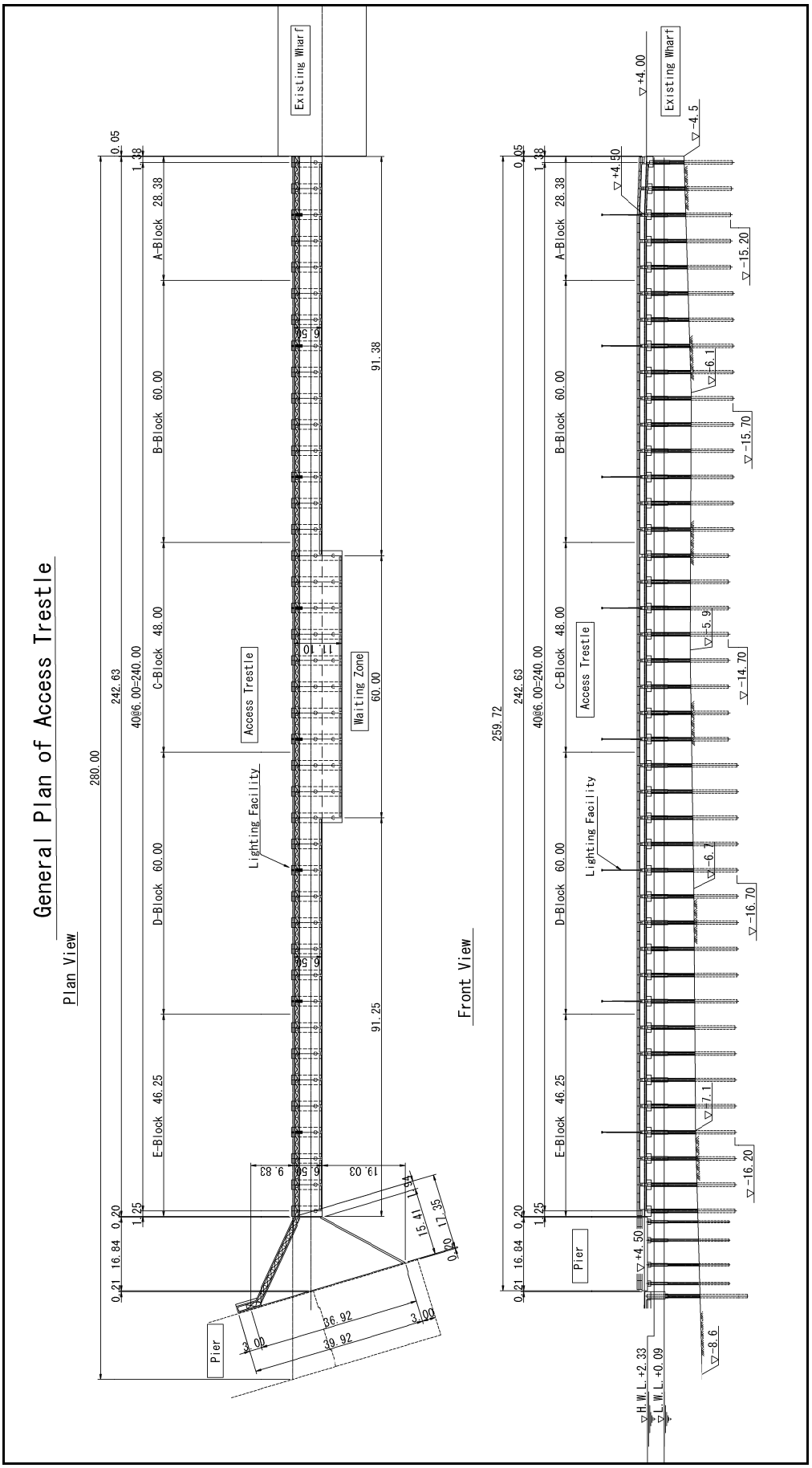


Figure 2.2.3-5 Plan and Side View of Access Trestle

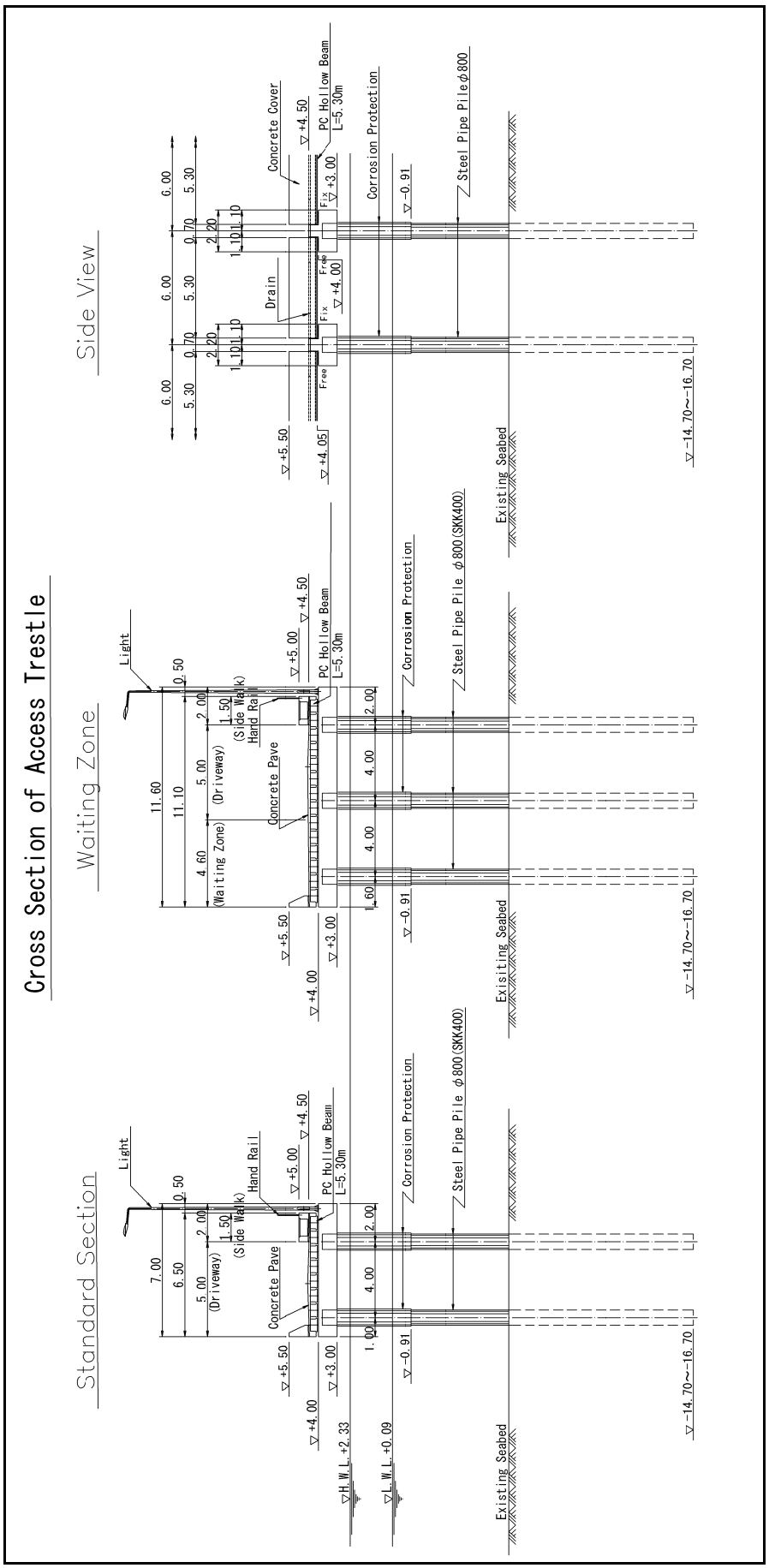


Figure 2.2.3-6 Cross Sections of Access Trestle

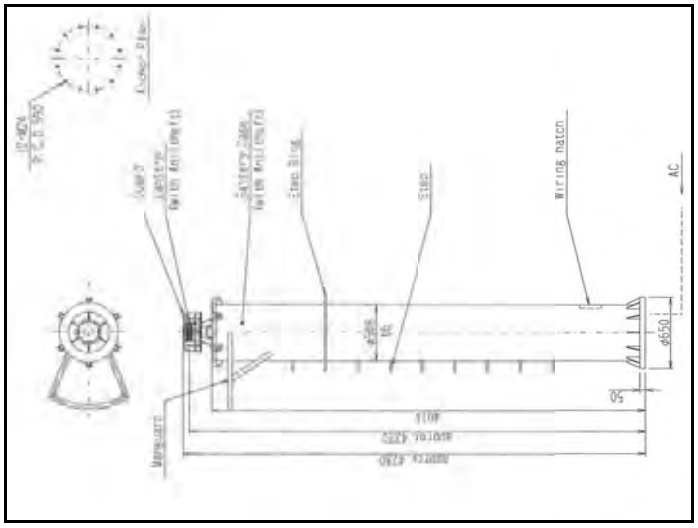


Figure 2.2.3-9 Light Beacon on Pier (for reference only)

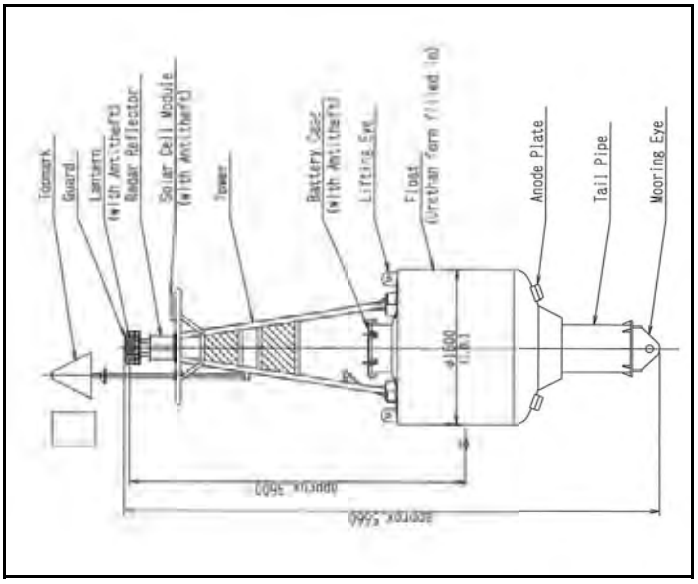


Figure 2.2.3-8 Light Buoy along Access Channel (for reference only)

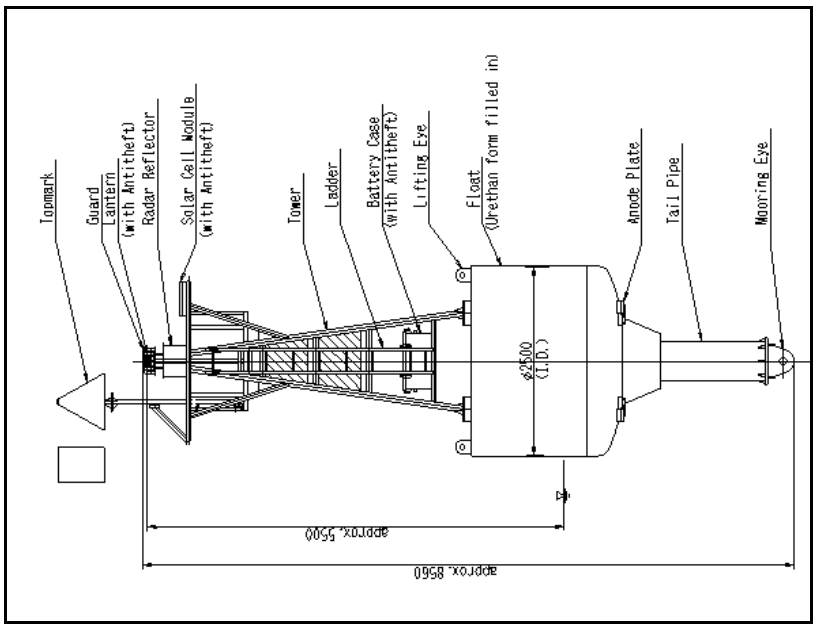


Figure 2.2.3-7 Light Buoy for Channel Entrance (for reference only)

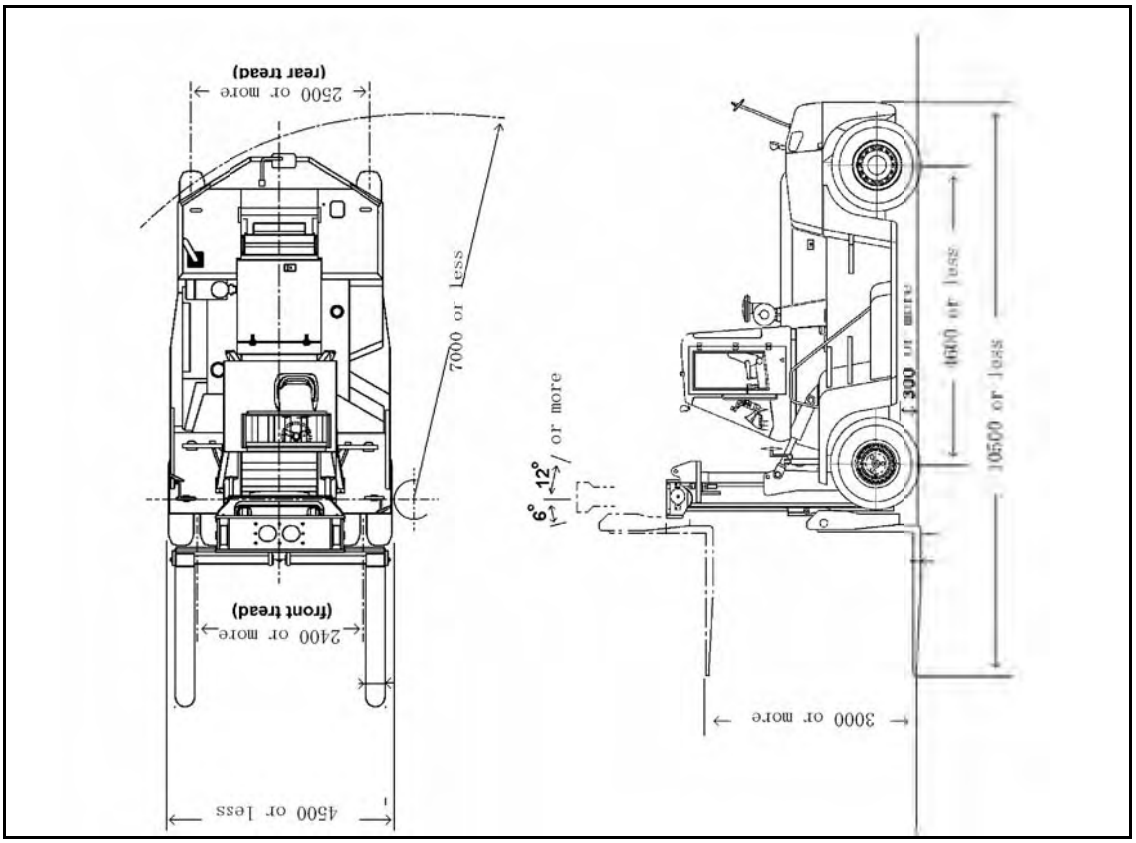


Figure 2.2.3-10 Sketch of Forklift (for reference only)

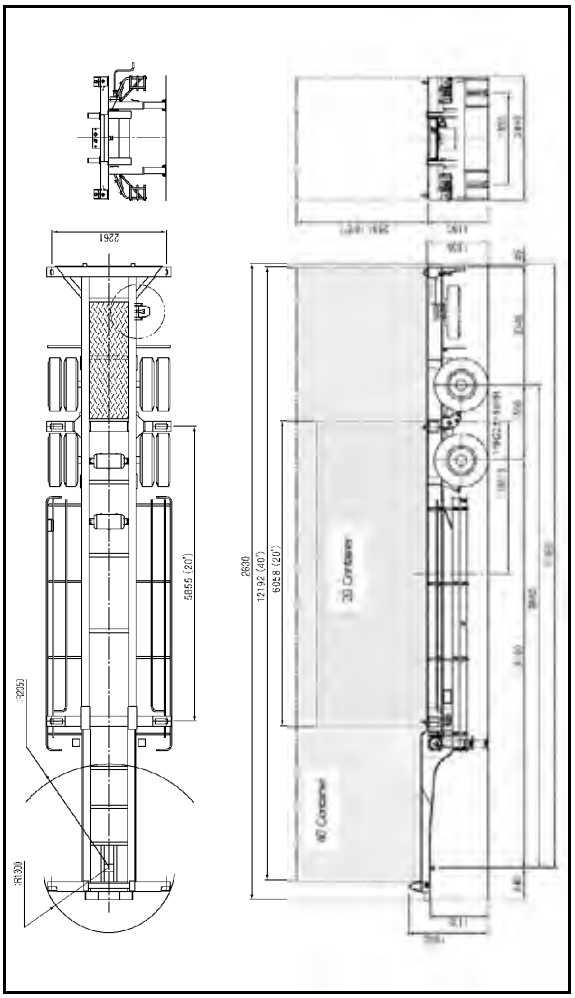


Figure 2.2.3-13 Sketch of Trailer for 20'&40' Container (for reference only)

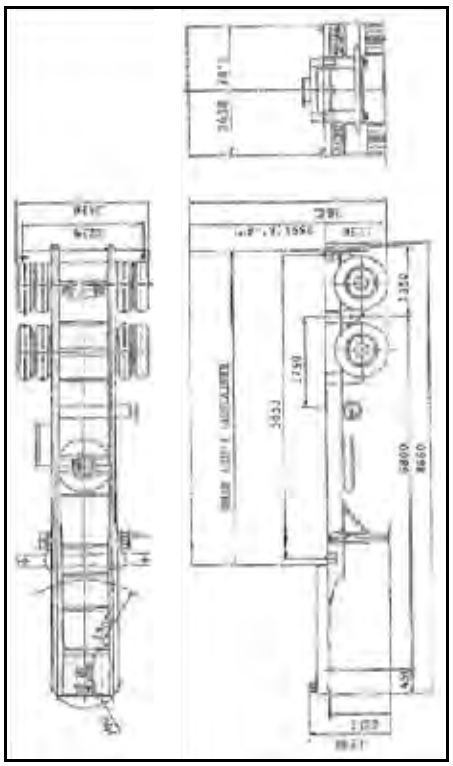


Figure 2.2.3-12 Sketch of Trailer for 20' Container (for reference only)

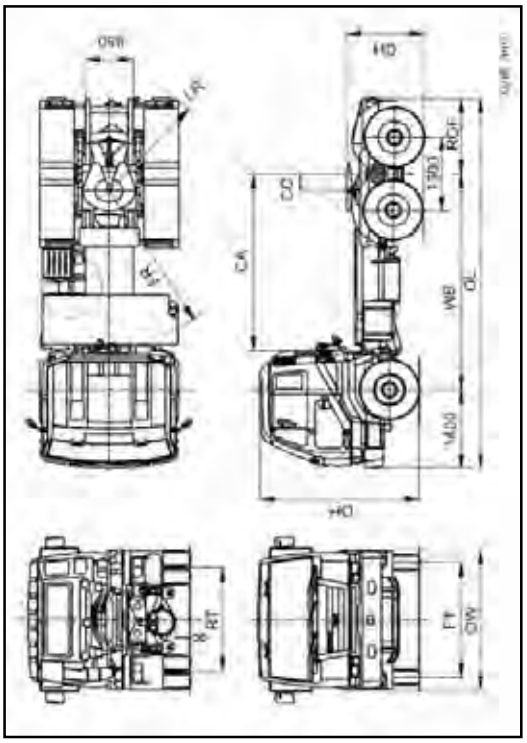


Figure 2.2.3-11 Sketch of Tractor (for reference only)

2-2-4 Implementation and Procurement Plan

Construction and procurement plan are established as premises for the project will be carried out under Japanese Grant Aid Program, taking consideration of natural conditions and social conditions such as actual conditions of local industries and construction companies. The existing situation of Kiribati is that necessary construction materials and construction machinery for the construction project are all relied on import even for concrete aggregate of sand and gravel except water and electricity. The construction and procurement plan must be established by considering the special situation of Kiribati. It is important to carry out the construction work in accordance with appropriate construction plan such as construction methodology, procurement of construction materials and equipment, construction schedule and quality control program.

2-2-4-1 Implementation Policy

(1) Basic Procedures

1) Cabinet Approval

To implement this project under Japanese Grant Aid Program, firstly the project will be decided and approved by the cabinet meeting. Secondly, "Exchange of Notes (E/N)" will be concluded by both governments. Following E/N, "Grant Agreement (G/A)" will be concluded between the Kiribati Government and JICA. The project implementation will be divided in two portions, namely the forthcoming detail design and the tender / construction due to applying the A-type Government Bond. The cabinet meeting, "Exchange of Note" and "Grant Agreement" will be carried out two times.

2) Subsequent to Exchange of Notes (E/N)

After concluding E/N and G/A regarding the detail design, a contract on the detail design will be concluded between the Consultant who has Japanese nationality and the Government of Kiribati. The detail design work will be promptly commenced according to the agreement. Necessary period for the detail design work from concluding the consultant agreement to concluding the construction contract with the contractor is expected to be about 6 months. Followings are approximate expected schedule of the subsequent procedure.

- Cabinet approval on the detail design portion
- 1 month after cabinet approval: E/N and G/A on A-type Government Bond for Detail Design Portion
- 2 months after cabinet approval: Consultant Agreement on Detail Design Portion
- 6 months after cabinet approval: Approval of Construction Drawing by the Government of Kiribati

Ordinarily, 4 month after the cabinet approval on the detail design, the cabinet meeting on the tender and construction portion will be held. Following the cabinet approval, E/N and G/A

on the construction will be concluded. The consulting agreement on the second portion will be concluded between the Kiribati Government and the Consultant by the same procedure. Immediately, the Consultant will commence the tendering procedure and other relevant works. Necessary period from consulting contracting to commencement of the construction is expected to be about 6 months after the above cabinet approval. Followings are approximate expected schedule of the subsequent procedure.

- Cabinet approval on the tender and the construction on A-type Government Bond
- 1 month after cabinet approval: E/N and G/A on for Construction and Supervision
- 2 months after cabinet approval: Consultant Agreement for Tendering and Construction Supervision
- 3 months after cabinet approval: Public Announcement of the Project and Prequalification (P/Q)
- 5 months after cabinet approval: Tender to Select the Contractor
- 6 months after cabinet approval: Commencement of Construction

3) Stage of Detailed Design to Tender

The Consultant prepares drawings and document necessary for construction, such as specifications, cost estimations and tender documents, as well as documents for construction contract. The tender will be conducted to select construction company who has Japanese nationality through pre-qualification of tenderers and selection procedures according to tender documents upon approval of the Government of Kiribati.

4) Tender Method

Tender is carried out according to the JICA's procedure for construction projects.

5) Contract on Construction and Procurement

Construction work is conducted based on construction contract which will be concluded between the Government of Kiribati and the Contractor.

6) Shortening of Construction Period

To shorten the construction period, the construction method will be selected by comparing various considerable construction methods, since this construction work shall be in urgent need. As the construction material will be purchased all from overseas countries, it is important to arrange well in in advance considering the purchasing procedure and transportation.

The construction work needs 36.0 months at minimum.

(2) Construction Policy

1) Attention to Port Activities

This project includes construction work carried out within the port area presently in service, where the water way for small boats and barges for container handling of container ships is located. The existing wharf is also required to be used as loading and unloading facility of material and equipment for the construction works. Therefore, it is important to shorten construction period as possible and to secure the safety first by adjusting with the port activities.

2) Utilization of Local Construction Company

In view of creation of employment opportunity, promotion of technical transfer and vitalization of local economy, it is necessary to utilize local engineers and workers and construction materials and equipment to a maximum extent. Local construction company has no experience of large scale construction works including maritime construction works. Their works are limited to general building work, utility work and road construction. Therefore, hiring common workers and unskilled labors included in the construction work can be utilized positively.

3) Necessity of Expert's Dispatch

Operator for large sized crane and skilled labors are required to be dispatched for the construction works of piling, reinforced bar assembling and formwork carpenter.

4) Transportation Plan of Construction Material and Equipment

It is integral to establish the transportation plan and schedule so as not to delay construction schedule, since the transportation of material and equipment is depended on liner cargo service from Japan by every other month and monthly service from Australia through Fiji..

2-2-4-2 Implementation Condition

(1) Concerns on Safety Management

The project site is facing to front water area of the existing port, where many fishing boats and small boats in addition to barges and tag boats for container handling are navigating arround. It is desired to have enough safety measures such as putting security boat at the construction site of the pier and the access trestle and other surrounding water.

(2) Compliance of Related Regulation

1) Environment Licence and Environmental Conservation

Environment Licence related with this project is the prior condition for the implementation of construction work. Ministry of Communications, Transport and Tourism Development was submitted necessary documents for taking out Environmental Licence including comments from Ministry of Environment, Lands and Agricultural Development in July, 2008. And the

Environmental Licence is issued in October, 2008. The comments incidental to Environmental License and environment related regulations is required to respect when construction work implemented and during construction.

2) Work Permit for Japanese Engineer

The application for work permit shall be submitted by the staff relevant to the project after entering Kiribati.

(3) Concerns on Construction Work

1) Preparation Work

At least about 6 months is necessary for the preparation work since the purchase of steel pipe pile takes 5 months for ordering and manufacturing and about 1 month for the transportation.

2) Site Clearance

Prior to implementing the construction work, the site clearance responsible by the recipient country must be completed. Meanwhile, crawler crane on the existing wharf has been removed during basic design field survey period in June, 2008.

3) Temporary Construction Yard

Temporary construction yard for the construction works needs to secure enough area for storage of construction materials and equipment and stockpile of imported concrete aggregate. The vacant land located at south side of KPA yard and owned by the Government can be used for the purpose. Coordination among the government organizations for the use of the said land before the commencement of construction work is required.

Temporary construction yard located in the east area of the container yard is required for stock yard of steel pipe piles and processing workshop.

4) Traffic Safety during Construction Period

Construction related vehicle can be possible to pass through inside of container yard of KPA. However as it is bonded area and congested by port cargo handling operation, the construction vehicle considers to pass through the in-port road allocated at periphery of container yard to access to the existing wharf. As shown on Figure 2.2.4-1, 3 points will be deemed to be congested by construction vehicles, port vehicles and public vehicles judging from the port utilization status in Betio Port. It is necessary to have special consideration for traffic safety of surrounding public traffic.

In addition, the existing wharf shall be separated in two areas with barricade where the east side is allocated for construction vehicles and the west side is for port operation.

Photo 2.2.4-1 shows key places on traffic flow planning related with construction work, waste disposal site in Betio District and waste recycle facility located nearby.

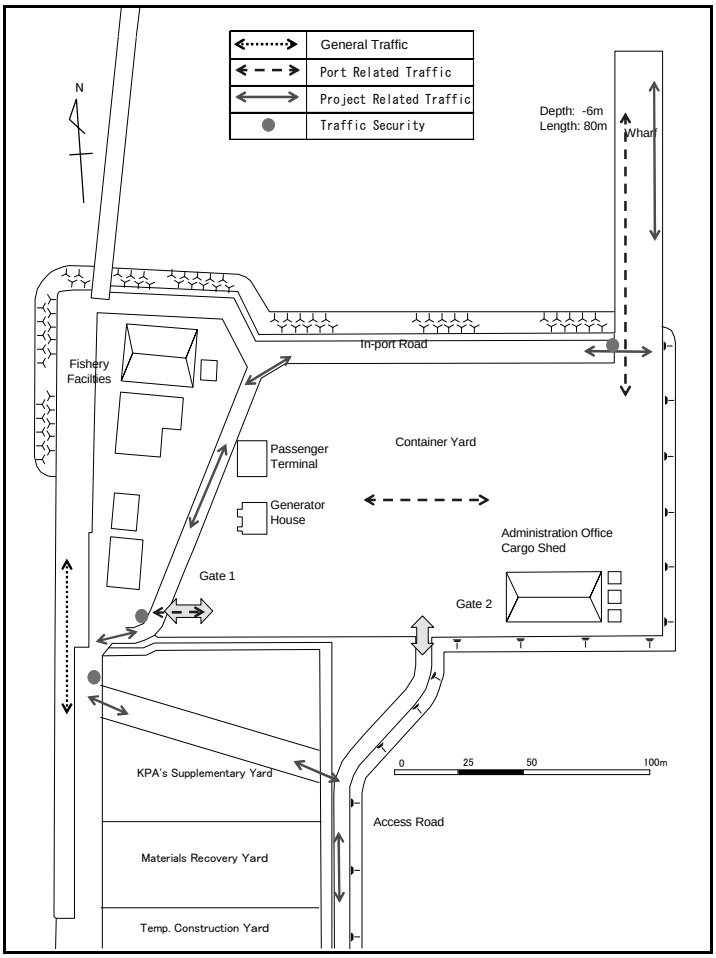


Figure 2.2.4-1 Route of Construction Related Traffic and Allocation of Traffic Security

Photo 2.2.4-1 Key Places Related to Construction

(4) Concerns on Procurement

1) Construction Machine

Main construction machineries and working boats to be used in the construction work shall be procured from Japan or other third countries, since there are no such machineries locally except road construction related machineries owned by Ministry of Public Works and Utilities for road maintenance.

2) Construction Material

All construction materials such as steel pipe pile, cement, steel reinforcing bar, wooden product and so forth can not be procured locally and must be imported from Fiji, Australia, Japan and other third countries. And concrete aggregate such as sand and gravel shall be procured also from overseas from view of environmental preservation of Tarawa. In importing concrete aggregate, fumigation in export country before shipment is imposed for quarantine.

3) Construction Prices

Construction prices are determined, considering inflation rates and economic growth rates in Fiji and Kiribati estimated by IMF.

The inflation rate for 8 years from 2000 to 2008 is marked as 10% in Kiribati. The annual inflation rate is converted to 1.25%. And the monthly average inflation rate is estimated as 0.104% (1.25%/12months).of being recorded. The labor cost and the material costs procured in Kiribati is evaluated by introducing the expected inflation rate of 2.60% in the period of 25 months from the cost estimation to the forthcoming tender.

In Fiji, the inflation rate for 8 years from 2000 to 2008 is marked as 30%. The annual and monthly inflation rates are also converted to 3.75% and 0.312% respectively. The labor cost and the material costs procured in Fiji is set, including the expected inflation rate of 7.80% in the period of 25 months from the cost estimation to the forthcoming tender.

2-2-4-3 Scope of Works

(1) Japanese Side

① Consultant services for detail design support to tender, construction supervision and etc.

② Provision of all construction materials and labors being necessary for the construction work of Japanese side in this project.

③ Marine transportation and marine insurance necessary for importing material and equipment in the construction work and equipment procurement of Japanese side in this project.

④ Quality inspection being necessary for the construction work and equipment procurement of Japanese side in this project.

(2) Responsibility of Japanese side

① Construction of Pier
② Construction of Access Trestle
③ Provision of Cargo Handling Equipment
④ Installation of Navigation Aids

(3) Responsibility of Kiribati side

① Removal of crawler crane discarded in the wharf top (Removal was completed on June 27, 2008)
② Removal of UXO (unexploded ordinance) near or within the construction site of the project, if found. (No UXO was found by UXO survey carried out during the field survey)
③ Reservation of temporary construction yards
④ Port charges for importing construction materials and equipment such as Literage, wharfage, loading and unloading charge, barge with tug hire cost for loading and unloading in Betio Port.
⑤ Free provision of flat barges comprising KPA-1, KPA-2 and Kiritimati with associated tug boats owned by KPA including necessary crew for operation and maintenance for the construction work of the Project during idle time of cargo handling operation.

2-2-4-4 Consultant Supervision

In accordance with the policy of Grant Aid Cooperation by the Government of Japan, the Consultant who understands the details of Basic Design Study well shall conduct consistent and smooth implementation of detailed design and construction supervision.

At the time of construction supervision, the Consultant shall dispatch a resident engineer who has enough experience on construction works to supervise construction work and communicate with the related organization and the head office of the Consultant. In addition, the Consultant will dispatch expert to support inspection and supervision of construction work when necessary.

(1) Detailed Design and Construction Supervision

Main services conducted by the Consultant are as follows.

1) Tender Documents

According to the results of this basic design report, following documents are prepared and get approval from MCTTD, after executing Detailed Design for each facility.

- Design Drawings
- Tender Documents

2) Tender Works

MCTTD and KPA select the Contractor who holds Japanese nationality by executing Tender. The representative from the Government of Kiribati who attends this Tender and concludes the construction contract has to have approval authority for all the matters concerning construction contract and tender. The Consultant supports MCTTD and KPA for the following works.

- Announcement on Prequalification for Tender
- Preliminary Qualification and Screening
- Tender and Tender Evaluation
- Contract Negotiation

3) Construction Supervision

Upon receiving the contract verification of Japan International Cooperation Agency (JICA), the Consultant issues commencement of works to the Contractor and undertakes construction supervising work. In the supervising work, the Consultant reports construction progress directly to MCTTD and KPA and JICA Fiji Office. The consultant executes the administration works for construction progress, quality control, safety control and payment. As well as the technical improvement measures on construction works is instructed and proposed to the Contractor.

The Consultant executes one year after inspection from completion of construction supervision work to finalize the Consultant services.

(2) Supervision Policy and Concerns

1) Close Communication and Report with and to Concerned Parties

The Consultant closely communicates with the related government organizations of Kiribati and their persons in charge and reports to them in timely manner in order to complete the project facilities without undue delay based on construction schedule.

2) Positive Direction to the Contractor

The Consultant executes effective and proper directions to the Contractor aiming to construct the project facilities as per design drawings.

3) Technical Transfer

The Consultant tries to transfer the construction method and construction techniques and works on the project as Grant Aid Cooperation.

4) Advice on Maintenance

The Consultant properly advises and trains on the maintenance works after completion of facilities for smooth management and operation.

(3) Construction Supervision Works

1) Assistance on Construction Contracting

The Consultant executes selection of the Contractor, conclusion of the construction contract method, drafting of construction contract, detailed checking for breakdown of construction works and attesting to construction contracting.

2) Checking and Confirmation of Shop Drawing and Others

The Consultant checks shop drawings, construction materials, finishing condition and fixing material.

3) Supervision Works

The Consultant examines the construction plan and the construction schedule. And inspection of the construction works, instruction to the Contractor and reporting of the construction progress to the Client are included.

4) Assistance for Payment

The Consultant assists to check the invoices for the payment during construction works and after completion of the works according to the payment procedures.

5) Quality Control

As this project is the expansion works of existing port facility and marine construction works for the pier and the access trestle are main works, the quality control shall be executed by paying careful attention on the following points.

① Main construction works comprises steel pipe piling and concrete works. The Consultant confirms the bearing capacity of steel piles for piling works, proper re-bars arrangement, concrete mixture rate, compaction of casting work for concrete works

② Resident supervisor is selected from Japanese engineers who experienced supervision of marine construction or similar works and more than 3rd class person of JICA Engineer's classification.

③ The Contractor selects Japanese project manager who experienced supervision of marine works or similar works and more than 3rd class person of JICA Engineer's Classification.

④ The Consultant firmly executes the supervisions on acceptance inspection, stage inspections and final inspection in accordance with design drawings (Particular Specification, Drawings and Technical Specification) and attains qualifying construction achievement.

6) Construction Schedule Control

① In order to secure the construction schedule, the Contractor takes care of necessity of skilled workers and stable supply of construction materials and equipment.

② The Consultant directs and supervises the Contractor to establish construction management system that is flexible and realistic to utilize construction material and equipment including surrounding countries.

③ The Consultant makes the Contractor to arrange and allocate a security boat for marine works to instruct work stoppage or launch properly for the safety of calling ships to Betio Port.

7) Safety Control

① Resident supervisor of the Consultant and the project manager and other management staff in the Contractor establish safety control system, taking marine construction work into consideration.

② As temporary road connecting the temporary yard and the existing wharf is congested by existing public and port vehicles and additional construction related vehicles, construction management plan so as to place strict control on the safety including the third party is drawn up.

③ So as to eliminate unsafe activities of construction workers, the accident prevention is required by daily safety training before it happens.

④ As marine works itself is congested with the vessels using Betio Port, the safety measure such as security boat and so forth is arranged and the work stoppage during vessel's navigation is considered when necessary.

8) Inspection Works

The Consultant inspects the work at each progress stage during construction period as may be necessary and directs the Contractor. The Consultant completes the work upon confirming the performance of contractual coverage after completion of construction work and witness of taking over all the contractual objectives and obtaining acknowledgement of the Client.

In addition, the Consultant reports necessary issues to the concerned Japanese Government organizations regarding the work progress during construction, payment procedure and the taking over.

(4) Procurement of Cargo Handling Equipment

The followings are the points of concern regarding procurement of the cargo handling equipment.

① Execution of procurement control by the Consultant

② Execution of pre-shipment inspection by Third Party

③ Execution of taking over upon operation training cargo handling equipment

2-2-4-5 Quality Control Plan

The quality control methods how to arrange control items, control contents, control methods, quality standard, control frequency and the results concerning material quality control to be used in this project is in accordance with "Particular Specification (Tender Documents, Drawings, Questions and Answers and etc.)" and the "Criteria of Quality Control for Port Construction Work" stipulated in "Common Specifications for Port Construction Works in Japan".

Table 2.2.4-1 Quality Control Item and Inspection Method

Major Construction Works		Quality Control	Control Items
Foundation Works	Pile Driving Works	Material	Chemical Contents, Physical Property, Apparent Condition, Feature Size
		Process	Driving Records, Elevation of Pile Head, Deviation of Pile Head, Inclination of Pile
Reinforced Concrete Works	Re-bar Works	Material	Chemical Contents, Physical Property, Feature Size
	Casting Works	Material	Property of Cement, Water, Aggregate
		Process	Slump, Air Content, Compression Strength, Chloride Ion Content, Mixing, Casting & Curing Temperature
Fender Setting Works	Fender	Material	Physical Property of Rubber, Feature Size
Bollard Setting Works	Bollard	Material	Chemical Contents, Physical Property, Feature Size

2-2-4-6 Procurement Plan

(1) Procurement of Construction Material

Most of construction materials are imported in Kiribati and the locally available material is quite limited. Main procurement sources of construction materials are as per Table 2.2.4-2.

Table 2.2.4-2 Procurement Sources of Construction Materials

Facility	Construction Material	Local	Japan	Third Country
Civil Facility	Steel Pipe Pile & Steel Products		○	
	Concrete Aggregate			○
	Reinforcing Bar		○	
	Cement			○
	Wooden Formwork, Lumber		○	○
	Fuel (Gasoline, Diesel)	○		
Ancillary Facility	Navigation Aids		○	
	Fender		○	
	Bollard		○	

(2) Construction Machinery

In consideration of local procurement condition of construction machines, construction machines for main works are procured in Japan. Procurement sources of necessary construction machines are as per Table 2.2.4-3.

Table 2.2.4-3 Procurement Sources of Construction Machinery

Construction Machinery & Equipment	Local	Japan	Third Country
Crane Berge (35t to 45t Crane)		○	
Flat Berge (200t,300t Capacity)	○	○	
Tag Boat (450PS)		○	
Anchor Boat		○	
Transportation Boat		○	
Backhoe (1.0m^3)		○	
Wheel Loader (1.5m^3)		○	
Dump Truck (10t)		○	
Crawler Crane (80t)		○	
Rough Terrain Crane (25t, 35t)		○	
Vibration Hammer (125kw)		○	
Tractor & trailer (20t)		○	
Batching Plant (300m^3/hr)		○	
Agitator Truck (4.4 m^3)		○	
Clam Shell Bucket (0.8 m^3)		○	
Welding Machine		○	
Generator (400~25KVA)		○	

2-2-4-7 Operational Guidance Plan

Forklift and tractor and trailer provided as port cargo handling equipment are the equipment that KPA is actually using for container handling operation. The certain explanation for operation and maintenance is necessary and such instruction and explanation are considered within as normal delivery service.

2-2-4-8 Implementation Schedule

In case that this project is implemented by Japanese Grant Aid Program by the Government of Japan (A-type Government Bond), agreement on detailed design services is concluded between the Government of Kiribati and Japanese Consultant after conclusion of Exchange of Notes (E/N) and Grant Agreement(G/A). Based on this agreement, the Consultant executes Detailed Design and prepares tender documents.

And, again E/N and G/A for project implementation is concluded by both countries. The Government of Kiribati selects Japanese Consultant for main construction works and the construction supervision agreement is concluded between the Government and the Consultant.

After that, a Japanese construction company and others are selected by Tender. Construction contract by the assistance of the Consultant is concluded by the Government and the Contractor. The project is completed through the construction works.

(1) Detail Design Work

The Consultant implements detail design works after concluding the consultant service agreement between the execution organization of Kiribati and Japanese Consultant through verification of the agreement by the Government of Japan. Detail design drawings, specification and tender documents like tender procedure and etc. are prepared in the detailed design works based on this basic design study report. During this time, the Consultant discusses the contents with the Government of Kiribati and finally the complete set of tender documents is approved by the Government of Kiribati. Necessary duration for detailed design works is about 5.0 months.

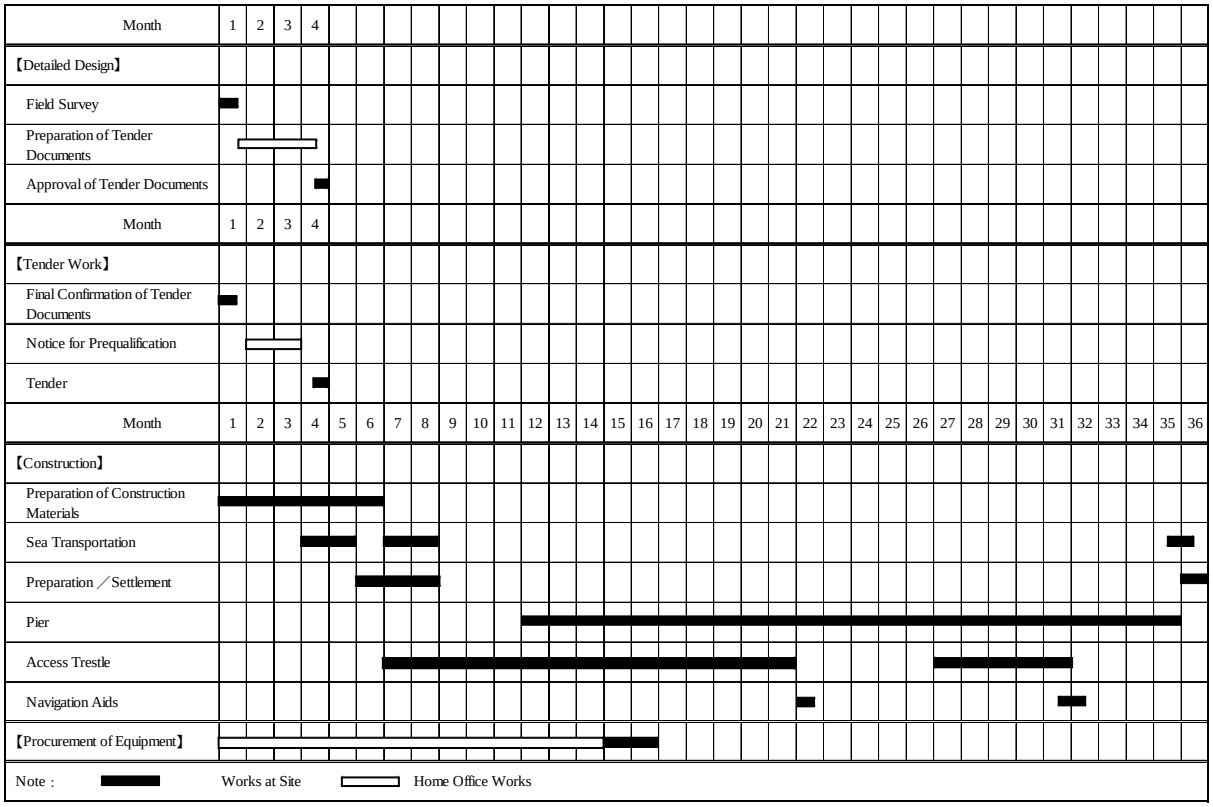
(2) Tender

The Contractor (Japanese Construction Company) of this project is selected by the tender. The tender is executed in the order of Tender Announcement, Receipt of Concern, Preliminary Qualification Examination, Distribution of Tender Documents, Tender, Tender Evaluation, Nomination of the Contractor, Construction Contract. It takes 4.0 months.

(3) Construction Works

The Contractor implements construction work through verification of the contract by the Government of Japan after conclusion of construction contract. As the result of estimation of construction period based on the premise that there will be no causes beyond its control considering facilities size, content and local construction circumstances of this project, approximately 4.0 month for detail design, 4.0 month for tendering procedure and 36.0 months construction period is necessitated. Table 2.2.4-4 shows implementation schedule of the project.

Table 2.2.4-4 Implementation Schedule



2-3 Obligations of Recipient Country

The outline of obligation of recipient country confirmed by Minutes of Discussion (M/D) and others during Basic Design Study is as follows.

(1) Development Consent

In accordance with Environmental Law established by MELAD, the environment licence of the Project is required. The environmental licence has already issued in October, 2008. The conditions attached to the licence will be amended according to the final scope of the Project.

(2) Temporary construction Yard

The adjacent land for temporary construction yard and the east area of the container yard being necessary in this project is leveled and provide with free cost.

(3) Exemption of Port Charges

Port handling charges (cargo handling charge by barge in offshore, loading charge onto wharf, cargo loading and landing fee, barge transportation and tug usage) concerning construction materials and equipment are exempted. The concerned cargos are all construction materials and equipment except stone, aggregate and cement when they are imported as loose cargo.

(4) Site Clearance

Crawler Crane discarded at the top of the existing wharf is removed. (This was already removed in June, 2008)

(5) Disposal of UXO

As the result of UXO (unexploded ordinance) survey at offshore area of the project site in Basic Design Study, UXO was not found so far. However, removal and disposal of UXO are executed in case that UXO is found during the construction works.

(6) Tax Exemption

During the implementation stage of the project, tax exemption procedure for imported materials and equipment is conducted based on the verified contract, and smooth customs clearance is guaranteed. Duty and tax imposed in domestic or other assessment are exempted for Japanese, Japanese Company and the third country person related with the project implementation.

(7) Banking Arrangement

Banking Arrangement is concluded and commission for Irrevocable Authorization to Pay (A/P) is born.

(8) Stay Permit

Entry permit or staying permit for construction work by Japanese and or the third country persons are obtained.

(9) Installation of Pipeline

This project provides the installation space for pipe lines of oil transportation from tanker, copra oil loading, water and fuel supply to ships. These installation works are conducted by KOIL, Kiribati Copra Mill Company, Ministry of Public Works and other related organization.

(10) Free Provision of Barge and Tag Boat owned by KPA

KPA will provide flat barges comprising KPA-1, KPA2 and Kiritimati with associated tug boats owned by KPA free of charge including necessary crews for operation and maintenance for the construction work of the Project during idle time of cargo handling operation.

2-4 Project Operation Plan

(1) Operation and Maintenance Body

Betio Port is currently operated by KPA. And the operation of facilities and equipment except navigation aids in this project is operated and maintained by the responsibility of KPA. The navigation aids belongs to Marine Department, Ministry of Communication, Transport, Tourism Development. Therefore, there will not be necessary to establish new operation structure.

1) Pier and Access Trestle

The pier and the access trestle are designed with 50 years life time and basically the maintenance is not required. The bottom topography adjacent to the pier is considered much unchangeable judging from bathymetric change comparing current and past maps and wave condition of surrounding area. However, maintenance works such as periodical inspection and repair works of necessary part by KPA after the project is completed is requested since it is inevitable to find damages at early stage and treat it properly in order to maintain the pier and the access trestle into the future. KPA is possible to conduct simple repair work and yard pavement by himself though as there is no civil engineering staff, it is necessary to ask the cooperation of Ministry of Public Works when the repair work of facilities is necessary.

2) Cargo Handling Equipment

Existing cargo handling equipment is maintained and repaired by Stevedoring & Literage Department of Operation Division, KPA. Cargo handling equipment provided by this project are maintained by each department. As cargo handling system is changed from the current one and there increase cargo handling equipment, it is necessary to relocate unnecessary crane operator and others and increase the number of operator for new equipment. Daily maintenance work of the cargo handling equipment is important and it is vital to enhance spare parts stock in preparation of unexpected troubles in addition to the execution of daily checkup before starting operation and periodical inspection.

3) Navigation Aids

Navigation Aids are maintained by Marine Department, Ministry of Communication, Transport, Tourism Development. Pilot of KPA board on vessels calling to Betio Port in most of the time and the daily monitoring by pilots is available. Navigation Aids are important facilities in the aspect of securing safety, so that immediate reporting by pilots to Marine Department is possible when damages, wash out and etc. are found.

(2) Maintenance Method

In maintenance of facilities and equipment in this project, management plan is drawn up with the following content and necessary action is taken when abnormal situation is occurred.

1) Pier and Access Trestle

Water Depth:	Water depth change of adjacent area of the pier,
	Confirmation of water depth D.L. -9.0m or more
Pipe Pile:	Damage, deformation, rust
Super Structure:	Crack, damage
Fender:	Crack, damage, fixing bolt
Bollard:	Crack, damage
Lighting Facility:	Damage, lighting condition

2) Port Cargo Handling Equipment

Maintenance and check-up in accordance with manual

Enhancement of spare parts stock and early supply

3) Navigation Aids

Body damage and lantern, lighting condition

Abrasion condition of mooring chain

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

The total project cost by the responsibility of the Government of Kiribati is about 29 million Japanese Yen when this project is implemented by Grant Aid Cooperation of the Government of Japan However, this project cost is provisional amount before the content, which is further examined as the project cost of Grant Aid Program by the Government of Japan.

In addition, this project cost estimation does not mean directly to show the grant amount limit on Exchange of Notes. Each breakdown of the cost based on the obligation demarcation between the Government of Japan and the Government of Kiribati as previously described are estimated as follows according to the estimation conditions.

(1) Obligation of Kiribati

Content, quantity and cost of obligation of Kiribati are shown at Table 2.5.1-1. Total cost of obligation is estimated to A$299,200 (Yen 21.1 million).

Table 2.5.1-1 Estimated Cost for Obligation of Kiribati

Project Cost Estimation Approximately 21.1 million Japanese Yen

Items	Amount (A$)	Amount (thousand Yen)
1. Bank Commission for Opening of Authorization to Pay and Payment	44,200	3,100
2. Exemption of Port Charges and Stevedoring Charges	108,000	7,600
3. Free Use of Construction Vessel (Flat Barges)	144,000	10,200
4. Demolishment of Crawler Crane on Wharf	3,000	200
Total	299,200	21,100

(2) Condition of Cost Estimation

1) Time of estimation: The time of cost estimation is the end of June, 2008, which is one month before the completion of local study in B/D.
2) Exchange Rate: 1A$＝70.68 yen, 1US$=96.59 yen
3) Construction period: Schedule of detailed design and construction work is as per construction schedule.
4) Others : This project is implemented by Grant Aid Program of the Government of Japan.

2-5-2 Operation and Maintenance Cost

(1) Increase of Pot Revenue

Implementation of this project leads to change cargo handling system from existing loading and unloading in offshore to direct loading and discharging at the pier which shorten the port time of calling ships considerably. In addition, port charges as well as wharfage accessed to calling ships become the port revenue.

Existing port charges are consisted of pilotage, berthing fee, port charge and wharfage. Out of the port charges, berthing fee can be expected as increasing port income by construction of the pier. According to the current port tariff of berthing fee set as A$2.00/24 hours x Loa of ship, the berthing fee of Kiribati Chief and South Islander is estimated as per Table 2.5.2-1. Annual revenue of berthing fee becomes A$5,402 subject to less than 24 hours berthing time by each ship.

Table 2.5.2-1 Berthing Fee Income after Construction of Pier

Ship Name	Ship Length (Loa)	Berthing Fee / 24Hr	Annual Ship Call	Revenue
Kiribati Chief	158.1 m	A$ 316	11	A$ 3,476
South Islander	160.7 m	A$ 321	6	A$ 1,926
		Total		A$ 5,402

Berthing fee in Betio Port is set being cheaper than the one of Japanese main ports, so that it is considered to review it until the time of construction completion. And, as the tariff rate of cargo handling fee is set with the premise of cargo handling in offshore, a tariff rate is necessary to be renewed due to the new cargo handling system.

(2) Operation and Maintenance Cost

Maintenance cost to be necessary for the project facilities and equipment is as per shown below.

1) Electricity

Lighting Facility on Pier:	A$100/day × 5 day/month＝	A$500/month
Lighting Facility on Access Trestle:	A$60/day ×30 day/month＝	$1,800/month
Total		A$2,300/month

2) Fuel

Forklift:	A$50/hour × 120 hours/month× 1 set ＝	A$6,000/month
Tractor:	A$30/hour ×120 hours/month × 3 sets＝	A$10,800/month
Total		A$16,800/month

3) Maintenance Cost

Pier and access trestle:	Maintenance cost will not be necessary for the time being for civil facilities. However, annual inspection cost for wharf water depth, pipe pile, super structure and ancillary facilities is required.
Cargo handling equipment:	5% of equipment cost is allocated
Navigation aids:	Cost is not allocated, as pilot usually monitor the condition.

As stated above, estimation of annual operation and maintenance cost by the implementation of this project is summarized as per Table 2.5.2-2.

Table 2.5.2-2 Annual Operation and Maintenance Cost

Items	Amount (A$)
Electricity Charge	27,600
Fuel Charge	201,600
Maintenance Cost	87,600
Total	316,800

2-6 Other Relevant Issues

The following is the relevant issues for the smooth implementation of the project.

1) Consideration by Japan Side

- Instruction to the Contractor for the compliance for environmental regulations

2) Consideration by Kiribati Side

-Obtaining environmental license

-Provision of temporary yard

-Exemption of port cargo handling charge

-Disposal of UXB

-Speedy duty free custom clearance

-Free provision of barges and tug boats with crew owned by KPA

Chapter 3 Project Evaluation and Recommendations

3-1 Project Effect

Kiribati is located in the Pacific Ocean, comprising Gilbert Islands, Phoenix Islands and Line Islands. 33 atolls distribute widely in the vast water area of 4,500km from east to west and, 1,800km from north to south. Kiribati is isolated geographically from the international market in the most prominent. The land area is so flat and limited that agriculture is not suitable. Most of daily necessities including food must be imported from foreign countries. Maritime transportation, therefore, is performing as important lifeline to support the lives of people and economic activities. The port is functioning as an essential infrastructure of the international and domestic transportation base for cargo flow.

Betio Port is functioning as not only the merely international gateway but also the domestic transportation base connecting isolated islands such as London Wharf of Christmas Island and other internal islands. Any expansion and rehabilitation of the port facilities have not been implemented, since the construction of the old port for a small sized vessel in 1950. In 2000, Japan's Grant Aid comprising wharf of 6.0m water depth and 80m extension, container yard of 17000m^2 area, administration office, container freight station and related facilities were constructed. These port facilities are well utilized as transportation base for international and domestic cargoes and fishery base.

Meanwhile, due to further advancement of international containerization, container cargo volume of Betio Port has increased to account for more than 90 percents of the entire cargo handling volume. Ocean liner container ship is forced to unload and load cargoes by off-shore transshipment by flat barges not directly to the wharf, because the ocean liner, of which arrival draft and overall length are around 8.0m and 160m respectively, cannot berth alongside the existing wharf with insufficient water depth and berth extension. Off shore container handling continues throughout day and night even under rough wave condition with strong wind, which causes the problem in terms of cargo handling safety and efficiency. Offshore container handling takes 3 or 4 days, more operation time than direct loading and unloading to the wharf, which attributes to raise the transportation costs. Due to poor financial status of KPA, the existing cargo handling equipment and tugboats are aging and deteriorated with a lot of trouble and introduction of the major cargo handling equipment is limited to be at second hand. In case of trouble of key cargo-handling equipment such as mobile cranes and forklifts, loading and unloading operation of containers is ceased completely, which affects the people's life and economic activities due to disruption of imported commodity.

In addition, Betio Port is only the port of water depth less than 9.0 m and berth extension less than 100 m in neighboring countries, which cannot cater for container ships to berth directly alongside the wharf. It is a very urgent need to improve the berthing facility to enable the ocean liner container ship to berth directly alongside the wharf.

Following direct and indirect effects are expected by installation of pier and access trestle and replacement of navigation aids. Table 4.1-1 shows expected project effects for each project component.

(1) Direct Effects

1) Safe and Efficient Container Operation without Offshore Transshipment

All of the container ships of regular services to Betio Port can berth alongside the pier. Container can be loaded and unloaded directly to the container ships through the pier without offshore transshipment. Cargo handling safety and efficiency will be improved distinctly due to no offshore cargo handling work.

Vulnerabilities of cargo handling operation including failure-prone mobile crane for container handling and work boats for container transshipment will be settled by installation of the pier and the access trestle. In consequence, container cargo handling operation will be stabilized.

2) Less Transportation Distance of Containers

Container unloading and loading operation will be shifted from offshore to the pier, so that the transportation distance to the container yard will be shortened. Transportation distance of the offshore transshipment is 700 m on sea and 200 m on land is shortened to 600 m on land with direct loading and unloading.

3) Speedy Transportation of Containers to Container Ship through Pier and Access Trestle

Offshore transshipment sequences comprising container unloading works from a container ship to barges, barge towing by tugboat and container landing works at the existing wharf by mobile crane will be replaced by onland transportation by tractor and trailers from the pier to the existing wharf through the access trestle, which significantly shorten transportation time of container from container ship to the existing wharf, in consequence.

Transportation time of the offshore transshipment by barge and tugboat takes 86 minutes for 10 loaded containers per barge (8.6 minutes/unit), 206 minutes for 30 empty containers per barge (8.6 minutes/unit). Vehicle unloading operation from a ship takes 126 minutes per barge (10.5 minutes/unit). After installation of the project, transportation time of each operation will be shortened as 2.4 minutes for loaded and empty container and 1.7 minutes for vehicle discharged through Ro-Ro rampway equipped on a container ship.

4) Efficient Container Handling Operation

Number of handled container for each hour will be increased from current 5.7 units of loaded container and 8.0 units of empty container to 18.5 units by 5 units of tractor and trailer comprising 2 existing units and 3 newly introduced units for loaded and empty container at maximum by model simulation of container handling operation. Number of unloading vehicles

will be improved from current 5.1 units per hour to around 30 units by direct discharging through Ro-Ro ramp way of a ship to the pier.

5) Reduction of Port Time of Container Ship

Port time of the container ships will be reduced by improvement of container handling efficiency. Following reductions of port time on typical case will be expected on the assumption that unloading and loading works and transportation of containers are conducted smoothly and efficiently.

Required port time of Kiribati Chief, in case of 300 loaded container unloading and 300 empty container loading, will be reduced current 109.8 hours to 39.9 hours for 5 sets of tractor and trailers after project implementation. Regarding another container ship of South Islander, her port time will be expected from current 44.4 hours to future 15.2 hours in case of 100 loaded containers unloading, 100 empty containers loading and 30 vehicle discharges. South Islander will finish her cargo handling operation within one day and will leave the port in the same day, expectedly. Accordingly, port time of container ships is expected to be reduced as approximately 1/3 of the current situation by installation of the project.

6) Ripple Effects on Merchandise Price

Merchandise price distributing in Kiribati will be less by reducing the transportation cost, which contributes to decrease the price index. Large amount of cargo will have an advantage to reduce transportation cost by accepting more 40 footer containers due to smooth and efficient handling.

7) Improvement of Ship Navigation Safety

Ship navigation safety through the existing access channel to the port set on complicated coral bathymetry will be improved by upgrade and replacement of lighted buoys. Consequently, ship accident, which affects seriously port activities, occurring in the access channel will be avoided.

8) Night Navigation and Emergency Evacuation

Night navigation will be allowed by introducing new navigation aids of lighted buoys, so that adjustment of the ship schedule to enter or depart in daytime will not be necessary. In case of emergency, navigating ship in the vicinity area will be able to enter the port even in night time for evacuation.

(2) Indirect Effects

1) Improvement of Maritime Transport Services

As to the advantage of shipping companies, trip time of ocean liner will be reduced by less port time in Betio, which contributes to improve maritime transportation services with more frequent ship allocation.

Table 3.1-1 shows direct and indirect effects due to project implementation and the extent of improvement of current situation.

Table 3.1-1 Effects of Project Implementation and Extent of Improvement

Current Status and Issues	Countermeasures	Direct Effects and Extent	Indirect Effects and Extent
Offshore transship work includes safety problem, particularly night time operation and operation under rough sea condition with strong wind.	Construction of pier and access trestle.	① Direct unloading and loading operation on pier will be enabled.	①Safety and efficient cargo handling operation will be improved.
Low efficiency of cargo handling operation through offshore transshipment.	Construction of pier and access trestle. Introduction of cargo handling equipment	① Transportation distance between container ship and container yard will be shortened from 700 m on sea and 200 m on land to 600 m on land.	① Efficiency of cargo handling operation will be improved.
Long port time of container ships due to inefficient offshore transshipment.	Construction of pier and access trestle. Introduction of cargo handling equipment	①Offshore transshipment sequences from container ship to existing wharf will be replaced by onland transportation through pier and access trestle, which distinctly shortens transportation time of container. ② Cargo handling efficiency of loaded and empty container will be improved from 5.7 and 8.0 units/hr respectively to both 18.5 units/hr by separate introduction of 5 sets of tractor and trailers. Unloading of vehicles will be increase expectedly from 5.1 units/hr to 30 units/hr. ③ Port time of container ship will be reduced to be 1/3 of the current situation at modeled standard container volume, such as from 109.8 hours to 39.9 hours as of Kiribati Chief and from 44.4 hours to 15.2 hours as of South Islander.	① Contribute to reduce transportation costs. ② Contribute to reduce a price of imported commodities.

Failure and accidents of large key cargo-handling equipment easily affect cargo handling operation and cause further trouble to port function such as outage of port.	Construction of pier and access trestle. Introduction of cargo handling equipment	① Cargo handling system will become consistent by introduction of pier and access trestle, because no more large sized crane and work boats with frequent trouble stop are required.	① Vulnerability of cargo handling system will be settled. ② Imported commodity will be supplied consistently.
Navigation safety issues in access channel situated in complicated coral reef bathymetry.	Installation of navigation aids.	①Navigation safety in access channel to Betio Port will be improved. ②Decrease marine accidents in access channel.	① Affects of ship accident in access channel, such as closedown of port and cease of port activities will be avoided..
Night navigation of container ships in access channel is prohibited.	Installation of navigation aids.	①Night navigation safety will be improved. ②Night departure and arrival of ship will be allowed. ③ Emergency night entry to Betio Port will be operatable .	① Departure and arrival of ship will be made at any given time. ②Navigation safety of ships sailing surrounding water will be improved.

3-2 Recommendations

After the completion of the project facilities, Kiribati Ports Authority, implementation agency and Ministry of Communication, Transport and Tourism Development, responsible agency will be requested to operate and manage Betio Port, considering effective utilization of the project facilities and settling forthcoming issues, as followings.

3-2-1 Recommendations and Actions of the Recipient Country

(1) Enhancement of Operation / Management Body and Relocation of Personnel

After the introduction of port facilities, enhancement of management and operation institution of Kiribati Ports Authority will be expected according to the new cargo handling system. In other words, staff engaged in tugboats and crane operator will be reallocated to another section due to elimination of offshore transship operation. It is recommended that the operation and management structure will be modified or re-established beforehand for smooth transition to the new system.

(2) Safety Management of Port Facility

Regarding operation and management of the port faculties including maritime area, following items must be considered to keep for safety management with complete site arrangement to prevent accidents in port activities.

- Port regulation or guideline regarding the project facilities will be formulated to allow safe and secured ship call to receive necessary port services.

- Maneuvering of container ships for berthing and deberthing need very careful attention for the ship wreck located off the pier. It is recommended to remove the ship wreck in early stage for ship's safety.
- During rough wave condition under stormy weather, the utilization of the pier must be prohibited and all the ships mooring along the pier must leave and evacuate in offshore anchoring area.
- Because of the access trestle comprising single lane road, careful attention will be paid to the container traffic to avoid accident on the trestle. To prevent traffic congestion on the trestle, it is recommended to allocate traffic control staff, as well.
- Back and forth traffic lines of tractor and trailer are crossed at the connection of the pier and the access trestle, which must be informed to all the port staffs and users to prevent traffic accident. Temporary stopping at the crossing point is preferable for the traffic safety.
- Number of cargo handling equipment will be increased significantly in comparison with the current system. Special attention on traffic accident in the port area will be required. Particularly in the pier and the access trestle, serious accident will be expected by falling down in the sea.

(3) Appropriate Use and Maintenance of Facilities

Appropriate use and proper maintenance of the project facilities is important to prolong the life year.

- The pier is designed by load condition of a forklift with loaded container. Cargo handling equipment in excess of design load, such as a side lifter, cannot be introduced. In addition, the access trestle is designed for the load of tractor & trailers with loaded container and forklifts with no load. Forklift loading a loaded container can not pass through the access trestle. For future introduction of cargo handling equipment, load condition of the pier and the access trestle must be secured.
- It is considered that the sedimentation phenomenon is not significant in offshore of the pier and the access channel, because wave condition is very calm and the water depth is more than 8.0 m in the said area. However, periodical sounding survey in offshore and adjacent area of the pier and the access channel is recommended to confirm the sufficient water depth for ship calls. In case of the area less than required water depth found by sounding works, immediate actions and countermeasures including maintenance dredging must be implemented.

- In case of trouble of the cargo handling equipment, cargo handling operation have to be interrupted. Procurement system and efforts to stockpile spare parts is important to recover quickly and to shorten idle time.
- Light buoys installed as navigation aids are easily moved and washed away by collision of ships. Daily monitoring on the situation of buoys is recommended. As soon as defects or incident is recognized, appropriate action and countermeasure must be employed. As beacons installed offshore access channel is easily damaged by robbery, the reminder is required.
- It is important to respect the environment condition attached to the Environmental Licence on the project and carry out monitoring actions for water pollution, such as oil spill and etc.

(4) Financial Soundness of Institution

Financial condition of KPA is supposed to be less sound according to the financial statement available so far. Following items are considered for sound operation and management of the institution with appropriate balance of revenue and expenditure.

- Current main revenue of KPA depends on port charges of container ship and stevedoring fees of containers. After the completion of the project, the revenue based on the current tariff will be reduced by change of cargo handling system. Tariff table is recommended to be reviewed and reorganized by referring the port tariff and stevedoring charges of the adjacent international ports.
- Fuel pipeline to connect tanker to the oil depot base and copra oil pipeline will be installed by each responsible institution under the supervision of MCTTD and KPA. Occupancy charge of these pipelines may be imposed to each responsible institution.
- Financial soundness of KPA is desirable to be secured by proper operation of the project facilities.
- Expansion of the container yard is recommended to be considered to cater for further increase of port demands.

(5) Recommendations on Environmental and Social Considerations

Although Environmental Act stipulates the necessity of environmental monitoring for development projects, there is no solid analysis technique or functional institution for the evaluation of environmental impacts such as ambient air, water quality, noise, etc. in Kiribati. With regard to the formulation of environmental monitoring plan for the project, it is important to consider the fact

mentioned above and determine monitoring parameters and set up a functional monitoring team in collaboration with competent authority of environmental conservation, namely MELAD.

3-2-2 Technical Assistance and Collaboration of Other Donors

Container handling efficiency of Betio Port will be improved significantly by introduction of the project facilities, namely the pier and the access trestle. As for port operation and management, there is some room to review a new port tariff on the pier utilization referring neighboring international port after implementation of the project and to revise the organization of KPA according to the new cargo handling system.