CHAPTER 8
CONCLUSIONS AND RECOMMENDATIONS

The conclusions and recommendations with regard to the study for the basic design of the Project are mentioned below.

Conclusions:

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(1) The executing body for the project on the Fiji part is to be the Fisheries Division, the Ministry of Primary Industries.

(2) The project site shall be the coast area and its offshore area in the vicinity of the existing King's Wharf, Lautoka City, Fiji.

(3) The number of fishing boats for the project will be approx. 250 registered fishing boats in the Lautoka region and its vicinity in 1990, but the constantly accommodated fishing boats by the project are approx. 60 in number.(accommodation rate, 25%)

(4) The design boats for the project shall include the cutter boats and barges shipping daily goods and other materialsfor the isolated islanders.

(5) The effective berth length for the mooring of the fishing boats, cutter boats and barges shall be approximately 370m at the initial development.

(6) The breakwater shall be extended at least to the water depth of C.D-1.4m, protecting the approach channel and port basin from waves and sand-drifts. The habour side(inside) of the breakwater shall be used as a quaywall/berth.

(7) A finger jetty shall be constructed, thus contributing to the increase in the number of boats to be accommodated.

(8) The steps or other equivalent measures shall be taken in the front sides of the unloading berth and the loading berth.

(9) The vessels-lift-up facilities (ramp) shall be installed, in the width of 12m, for the purpose of boat-repairs.

(10) The fishing port shall be constructed mainly by reclamation protected with steel sheet pile wall, and partly by the open structures (piled).

(11) The water-depths for the port basin shall be C.D-1.2 and C.D-2.2, for fishing boats and cutters including barges respectively. The water depth of the approach channel shall be deeper than C.D-2.2m.

(12) The necessary navigation aids shall be installed.

(13) An administration office with a repair workshop shall be constructed.

(14) An ice-plant shelter shall be built with a storage capacity of 45 ton.

(15) A canteen together with sales-stand (shopping corner) shall be built.

(16) A guard room shall be installed in the administration office.

(17) Ice-plants(5 ton/day ×3 units) shall be installed.

(18) The vessels-lift-up facilities (ramp) shall be equipped with winch and other accessories for the operation.

(19) As other kinds of machinery and equipment,
- Three years'supply of spare parts and tools for the ice-plants of the project shall be included.
- Traveling work-shop vehicle for the promotion of fishing activities shall be included.
- The spare parts and tools for the ice-plants and refrigerator installations under the previous grant aid projects made by the Government of Japan shall be included.

(20) Various installations within the administration office shall be included..

(21) Various installations for the repair work-shop in the administration on office shall be included.

(22) The pavement construction such as for in-harbour access road, aprons and parking lots shall be included.

(23) The fence and gates shall be constructed.

(24) The following ancillary facilities shall be constructed:

- Water supply
- Sewerage system
- Rainy water drainage
- Power supply
- Lighting
- Communication(telephone)
- Fire-fighting installations
- Fuel supply

(25) Undertakings by the Government of Fiji

- General Furniture and utensils
- Removal of the present ice-plants (equipment and shelter) from the site
- Demolition and removal of the present administrative building from the site
- Various installations up to the main gate from the main sources. (item 24 above)
- Installation of oil supply system (civil works, oil-storage tank, and other mechanical installations)

(26) Project cost

- Undertakings by the Government of Fiji

Construction(including demolition and removal of existing facilities)	6.0×10^6 yen	F$ 40×10^3

(27) Operational/management cost (Fiji Gov's responsibility)

Per year	21.0×10^6 yen	F$	139×10^3
(25 years	525.0×10^6 yen	F$	3.475×10^3)

(28) Financial revenue for Lautoka Fishing Port :

per year	24.9×10^6 yen	F$	165×10^3

(29) Economic Benefit

for 25 years	$2.434.1\times10^6$ yen	F$	16.12×10^3

(30) Economic internal rate of return

EIRR=4.2%

(31) The project will improve the various facilities of the fishing port to their desirable levels of function, thus contributing greatly to the promotion of the coastal fishing industry in the region.

(32) The scope of the project is feasible from both economic and financial viewpoints.

(33) Judging from the above, the project is considered feasible, in respect of its scope and contents, as fisheries cooperation grant aid programme which the Government of Japan provides for the Government of Fiji.

The early execution of the project should be, therefore, recommended.

Recommendations

There still exist various problems to be tackled prior to the commencement of the construction and operation/management of the new Lautoka Fishing Port, none of which can be solved in short period by the Fisheries Division. Such problems are summarized below.

(1) Securing Technical Staff

The responsibility of administering and operating administer/operate the facilities in the fishing port rests upon the staff members of the Fisheries Division. The present Lautoka port might not require so large a staff members yet because of its small scale operation; on the other hand, it requires certain number of qualified technical staff to manage a fishing port with the berth length in the order of 370m.
Especially the needs for the personnel in mechanical, civil (harbour) and safety management might be quite high. The Fisheries Division now intends to request to the Ports Authority to supply such technical service on a part-time basis; however, it should be remembered that to have their own technical staff members is quite prerequisite for the proper operation and management.

Ideally it is better to have the participation of the technical staff from the Fisheries Division not only in the construction supervision stage but also from the earlier design stage, to practically experience the processes of the fishing port development. The technical cooperation of the Government of Japan in this respect is also quite desirable.

(2) Fishing Port Water Area

The land and the water in the vicinity of the present King's Wharf belongs not to the Fisheries Division but to the Ports Authority. That is, under the jurisdiction of the Ports Authority.
The Ports Authority issues the use-permits upon application from public or private oganizations for the use of the water area, only after the appraisal from the financial, organizational, legal, administrative and utilization

viewpoints.
The Fisheries Division should establish the so-called "fishing port area" and should have every discretion to execute any rights to promote their activities within the area thus established.

(3) Securing Port Operation Expenses

The completion of the new port shall necessitate the increase in the staff members and also in operational expenses. The level of such operational and management expenses will be around F$ 140,000 a year.

(4) Institutionalization of Port-use

The rules and regulations for the use of the fishing port should be established for more effective and safer operation and use of the public facilities.
Furthermore, fisheries cooperative(s) and a middlemen organizations should be established for clarification in respect of duties for each to bear. The fish market within the port, though small in scale, might be one of other measures to be taken in the very near future.

(5) Public Fish Market

Presently, the catch are traded in the public markets or on the streets, but it is more desirable in future to have the fish market within the fisheries port as a distribution base. In such instances, the market-use fee (presently 25 cents/kg) should be kept minimum, to keep balance with the municipal markets for this purpose, and the fishermen should be organized to develop a distribution system in good collaboration with the middlemen organization.

Appendices

— contents —

Members of Study Team

Name	Status and Participation	Present Post
Mr. Kunihiro Shinoda	Leader of the team	Ministry of Agriculture. Forestry and Fisheries of Japan.
Mr. Naoyoshi Sasaki	Coordinator	JICA
Mr. Katsumi Yoshida	Coordinator	JICA
Mr. Mamoru Amemiya	Project Manager. Overall Management and Fishing Port Planning	Pacific Consultants International (PCI)
Mr. Hiroshi Nishimaki	Expert. Plants and Fishing Port Operations	PCI
Mr. Toshio Yamada	Expert. Structal Design	PCI
Mr. Akira Kuraoka	Expert. Architectural Design	PCI

Fiji Government's Officers

Ministry of Primary Industries:	Permanent Secretary	: Mr. Robin Yarrow
Fisheries Division	Chief Fisheries Officers	: Dr. Peter C. Hunt
	Principal Fisheries Officers (Technical Service)	: Mr. Surendra Sewak
	Fisheries Division in Lautoka	: Mr. Evening
Ports Authority of Fiji	Director Engineering	: Mr. R. McL. Dickie
	Director Operations	: Mr. M. N. Tora
	Port Engineer	: Mr. Venkat R. Naidu
	Harbour Master Lautoka	: Capt. M. Peckham
Related Aganies	Meteorological Service	: Dr. Reid E. Basher
	Meteorological Service	: Mrs. Sarojni Reddy

APPENDIX ; A , STUDY SCHEDULE

Year / Month / Work Item in Stage	1966 April	May	June	July	August	September
Stage - 1 Preparation Works in Japan						
Stage - 2 Field Survey in Fiji						
Stage - 3 Preparation of the Draft Final Report						
Stage - 4 Submission of the Draft Final Report						
Stage - 5 Preparation and Submission of the Final Report						

Remarks: ——— Preparation ▬▬▬ Study works in Fiji ═══ Study works in Japan

Appendix B

Itinerary for Site Investigation

(7 April ~30 April.1986. for 24 days)

Date	Works (A=In the morning. P=In the afternoon)	
	Team	Individuals
7th Apr.	P : Departure at Narita	
8th	A : Arrival at Nadi and Suva P : Visit at Japan Embassy and JICA with discussion on itinerary	
9th	A : Presentation of Inception Report to Fisheries Division (FD) Request for assistance from Fiji Government	
10th	A : Visit at Mr. Yarrow in MPI Discussion on investigation with FD P : Leave Suva for Lautoka, but fail due to abnormal rain and flood (2 Officials and 2 Consultants)	A : Discussion on soil investigation P : Explain Port Authority (PAF) of Inception Report, and request of data
11th	A : Data collection at FD Summarize basic requirement	A : Discussion on soil investigation ·Fiels survey at market P : Dicussion on soil investigation
12th	A : Discussion on schedule P : Sorting data Team meeting on alternative general layout(1)	P : Preparation of alternative general layout
13th	A : Sorting data Team meeting on alternative general layout (2)	
14th	A : Leave Suva for Lautoka Investigation of ice plant by Grant Aid P : Presentation of Inception Report at FD in Lautoka Discussion on schedule and request for counter-parts Fieid investigation Discussion on requirement	P : Investigation on ice plant, office and work-shop
15th	A : Discussion on optimum general layout	A : Preparation of interview hearing Request for data P : Discussion with Land Survey Department (LSD)
16th	A : Continue discussion on general layout P : Discussion on basic requirement Leave Lautoka for Suva Prepare Minutes of Meeting	A : Data collection at Nadi Airport A/P:Commencement of interview hearing
17th	A : Fail to contact FD. due to flood Preparation of port scale, general layout and cost estimate P : Preparation of utilities list to be provided by each Government	A : Preparation of basic building plan A/P:Preparation of sketch for field investigation Supervision of repair for ice plant
18th	A : Reporting to JICA Finalize Minutes of Meeting	A/P:Setting survey points Start hearing

Date	Works (A = In the morning. P = In the afternoon)	
	Team	Individuals
19th	A : General explanation and signing on Minutes of Meeting with Mr.Yarrow in MPI Leave Suva for Nadi (2 Officials and 1 Consultant) P : Departure at Nadi (2 Officials)	A : Continue supervision of repair for ice plant P : Discussion on schedule Leave Lautoka for Suva (2 Consultants)
20th	A/P:Summarize data Discussion on soil investigation	
21st	A : Discussion on remaining matters at FD P : Quotation of soil investigation obatained	A : Discussion with Department of Public Works and Energy P : Field survey discussion Leave Lautoka for Suva (2)
22nd	A : Discussion at FD on final general Layout P : Revise general layout Preparation of perspective drawing	A : Design standard discussed at PWD P : Soil investigation discussed Basic plant of buildings
23rd	A : Reporting to JICA P : Presentation of final general layout Receipt of list for mechanical parts, etc.	A : Soil investigation discussed Investigation of ice plant at Nairibokasi
24th	A : Leave Suva for Lautoka (2) Receipt of data and presentation of layout at PAF	A : Provision of basic points for survey

Date	Works (A = In the morning. P = In the afternoon)	
	Team	Individuals
25th	A : Collection of data from PAF P : Revision of list for facilities	A/P:Field survey A : Supervision of repaired ice plant at Lautoka P : Presentation of basic building plan
26th	A : Data arrangement Cost/benefit estimated Leave Suva for Lautoka (1)	A/P:Field survey
27th	A : Data arrangement Data sorting	A/P:Team meeting
28th	A : Remaining works Discussion on basic building plan P : Team Meeting	A : Commencement of soil investigation Discussion with harbour master Reporting to JICA Data collection from PAF Discussion on list for facilities with FD P : Leave Suva for Lautoka
29th	A : Summary of hearing interview Presentation of final general layout Farewell meeting with concerned members Preparation for departure	A : Completion of field investigation
30th	A : Departure at Nadi for Narita	

Appendix B-2
Itinerary for Draft Report Discussion
(11 July ~ 20 July, 1986, for 10 days)

Date	Works(A= In the morning, P= In the afternoon)
11th July	P: Three member of Study team, Departure at Narita
12th	Arrival at Nadi and Suva P: Submission of the report to Mr.Sewak. Submission of the report and brief presentation of report to Dr.Hunt.
13th	A: Team meeting
14th	A: Visit Dr.Hunt and Mr.Sewak at their Lami office and discussion of the report. P: Visit JICA's office in Suva and Submission of report. P: Visit the Ports Authority of Fiji and submission of report and brief presentation to Mr.Dickie and Mr.Naidu. P: Meeting with local soil surveyor on additional geotechnical investigation.
15th	A: Visit Dr.Hunt and Mr.Sewak and preparation of supporting data of the Project. P: Two member of Study team, Mr.Shinoda and Mr.Sasaki arrived at Suva. Team meeting and visit JICA's office in Suva.
16th	A: Meeting at Lami office, - General discussion - Detail discussion on the Project P: Preparation of draft minutes of meeting.
17th	A: Visit the Ports Authority of Fiji A: Mr.Nishimaki left for Lautoka A: Discussion on additional soil boring at offshore zone. P: Mr.Kuraoka left for Lautoka P: General explaination and signing of the Minutes of Meeting with Mr.Yarrow in MPI. P: Visit JICA's office and reporting results of discussion with the Government of Fiji.
18th	A: Preparation for departure
19th	A: Three team member, Mr.Shinoda, Mr.Sasaki and Mr.Amemiya left for Lautoka. P: Final team discussion P: Lautoka for Nadi airport
20th	A: Departure at Nadi for Narita

APPENDIX : C

MINUTES OF DISCUSSIONS

The Preliminary Study on Lautoka Fishing Port
Improvement Project in Fiji.

At the request of the Government of Fiji for grant aid for the Improvement Project of Lautoka Fishing Port (hereinafter referred to as "the Project"), the Government of Japan decided to conduct a preliminary study on the Project and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent the Preliminary Study Team headed by Mr. Kunihiro SHINODA from January 20th to February 1st, 1986.

The Japanese Team held a series of discussions and exchanged views with the authorities concerned of the Government of Fiji.

As a result of the study and discussions, both parties mutually agreed to report to their respective Governments the contents attached herewith.

Suva, January 30th, 1986.

篠田邦裕

Mr. Kunihiro SHINODA
Leader, Preliminary Study Team,
Japan International Cooperation
Agency.

Peter C. Hunt. 30.1.1986.

Dr. Peter C. HUNT
Chief Fisheries Officer,
Fisheries Division
Ministry of Primary Industries.

1. Objective of the Project

The objective of the Project is to improve Lautoka Fishing port and its facilities in order to strengthen the commercial artisanal fishery which contributes to the increasing local demand for fish and generating new income earning opportunities for both existing licensed and potential fishermen in the Western Division in Fiji.

2. Organization:

Responsible and Executing Agency:

The Fisheries Division, Ministry of Primary Industries.

3. Project site and the present facilities:

Existing Lautoka fishing port comprising:

A quay about 90m in length, a 10t/24hour ice plant and 20 tonne storage, a workshop and office facilities.

4. Constraints at the Lautoka Fishing Port :

1) Poor accessibility for the fishermen, being dry at low tide and having no shelter against adverse weather conditions, particularly during cyclones;

2) insufficient capacity of ice plant and persistent mechanical problems;

3) unavailability of basic services required by the fishermen due to small and poorly equipped workshop and office facilities;

4) occurrence of siltation.

5. The major requested items for the Project:

1) New quay and ramp

2) New Fisheries office and workshop

3) Ice plant

4) Other functional facilities (e.g. Canteen, fishermen's servicing building, car park)

5) Others

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APPENDIX ; D-1

THE BASIC DESIGN STUDY ON LAUTOKA FISHERY PORT IMPROVEMENT PROJECT

Introductory statement to be made by CFO

1. Welcome to Mr. Shinoda (Team Leader) and his team.

2. Background to the Fiji fisheries sector.
The fisheries sector has played an increasingly important role in the economy of Fiji. Government policy is to significantly expand exploitation in the industrial, commercial and subsistence fisheries to satisfy local demand and increase exports with maximum value added.

3. The industrial fishery is dominated by tuna which is the most important fisheries resource within the declared 200 mile exclusive economic zone of Fiji. Fiji is committed to its development despite a recession in the industry. Exports have averaged $18 million per year during the last five years and the Levuka based cannery has established a reputation for high quality and firm markets.
The Japanese joint-venture Company is withdrawing and Fiji Government is taking 100% shareholding within 1986. To optimise efficiency and assure PAFCO's survival, the throughput at PAFCO will have to be doubled to 15,000 tonnes per year and to achieve this significant investment is required, particularly for improving cold storage and unloading facilities. This is the priority area for the Government of Fiji and a number of requests have been made to the Government of Japan for assistance.

4. Commercial artisanal and subsistence exploitation of the typical multispecies fishery of sub-tropical coral reef and lagoon environments is the second most important area for fisheries development. Japan has provided assistance towards almost all aspects of small scale fisheries development including supplying research equipment and vessels, training facilities, ice plants, collection vessels, marketing facilities and workshops which have contributed very significantly to the increases in fish production of 18% per year in recent years. It is expected that this will continue such that the current estimated 5,000 tonne shortfall in local supply will be produced within DP9. The Lautoka wharf project is an important part of this development being in an area expected to contribute significantly to increased catches and employment.

5. A third area for development is aquaculture. The Government of Japan has also contributed very significantly to aquaculture but commercial application is perhaps some way down the road.

6. The above statement is important in that it places the various components of fisheries development in Fiji into relative perspective. The tuna industry has problems, is the priority area and needs assistance. The small scale commercial fisheries are developing well and consolidation is required. A number of projects need implementation provided they are shown to be economically viable. Aquaculture research will continue but possible commercial application will not be implemented until systems are proved to be economic.
This is the least priority area for development at this stage.

7. The Government of Fiji is extremely grateful to the Government of Japan for the assistance given to the development of small scale fisheries. It is believed that the aid has reflected our needs during the past six years and it is imperative that a donor should reflect fully the needs of the recipient Government ensuring that expenditure, albeit aid, is minimised and has a true economic return, that equipment, plant or structures are compatible with Fiji's needs and that the maximum possible local component is incorporated.

8. This is particularly applicable to the Lautoka wharf project. It is imperative for this Mission to design a simple, efficient structure that is economically justified and which fully meets our needs. When the request was made, it was envisaged such a simple structure would cost about $1.5 million and this was shown to be cost-effective. The preliminary basic design team has proposed broad plans which appear to accommodate our needs fully and the Minister for Primary Industries has directed the Fisheries Division to proceed on the basis that the budget is a maximum of F$3 million and that any further assistance be redirected to the most important development needs in tuna processing. If the Japanese Government is prepared to consider expenditure exceeding $3 million, it is requested to utilise such funds in providing cold storage facilities at Levuka.

9. These matters have been discussed before with the Preliminary Design Team and I am sure you have come fully prepared to accommodate our requirements. Simplicity and cost-effectiveness is essential for the Lautoka wharf project and any possible additional assistance should be redirected to the Government facility at Levuka.

10. I hope you enjoy your visit and trust that a successful conclusion will be reached.

APPENDIX ; D-2

Memorandum of Discussion on: 15th April, 1986

Draft General Layout
"Lautoka Fising Port Improvement Project"
At the Office of Fisheries Division, Lautoka
Presents: Fisheries Division
- Mr. Surendra Sewak
- Mr. Evening

Ports Authority of Fiji
- Capt. Malcolm Peckham (Harbour Master)

Study Team, Japanese Government
- Mr. Kunihiro Shinoda (Leader)
- Mr. Katsumi Yoshida
- Mr. Mamoru Amemiya
- Mr. Hiroshi Nishimaki

The Study Team presented 5 alternative draft general layouts and discussed on them.

(A) Conclusions:

1. "Plan-5" was selected as the most suitable layout by all of participants.

2. Revisions on "Plan-5" were agreed by all or participants that:

a) Administration Office (with workshop) has to be located near Ice Plant. Icen Plant locates behind road access. They will be fenced up.

b) Existing decrepit ice plant will be removed from the Lautoka fishing port.

c) Existing Office and workshop will be demolished out.

d) Canteen will be located near the gate and be separated from the Administration Office.

e) A shed will be constructed near the new cutter boat berths and existing PAF's shed will be utilized as work area for repairing fishing boats.

(B) Others:

a) Necessity of boundary fence will be studied by the Fisheries division and when need construct by Fiji Government.

b) Unloading jetty will be planned with enough space for mini markets/auction shed at the centre of jetty in the future. ("Plan-5" provides 10 m x 50 m space)

c) Fisheries division insists to locate new Ice Plant near the quaywall, however, the team recommends to locate it behind the access to allow more space around the plant and maximum use of quaywall for fishing boats.

d) Fisheries division insists to locate ramps for fishing boats repair at the south-west corner of the jetty to get easier operation. However the team recommends the ramp will be located north of existing fishing port for the maximum utilization of quaywall by fishing boats and other reasons.

e) Port Authority informed that:

- Fairway of plan 5 have enough clearance to the larger vessels which will berth at the existing jetty. (F S C)

- Discharging of fine material through outlet of sugar mill cause siltation problem. And all of agencies concerned have to discuss this problem. One of solution was recommended by PAF to construct sheet pile wall to contain fine material of effluent from the sugar mill.
- PAF requests to construct a shed near the new cutter boat berth if existing PAF's shed will be utilized for other purposes by Fisheries Division.

It is nevertheless noted that all the above contents will be finalised by the basic design study in detail.

APPENDIX ; D-3

THE BASIC DESIGN STUDY ON LAUTOKA FISHING PORT
IMPROVEMENT PROJECT IN FIJI

At the request of the Government of Fiji for grant aid for the Improvement Project of Lautoka Fishing Port (hereinafter referred to as "the Project"), the Government of Japan decided to conduct a basic design study on the Project and entrusted the study to Japan International Cooperation Agency (JICA).
JICA sent a basic design team headed by Mr. Kunihiro Shinoda (hereinafter referred to as "the Team"), from April 7th to April 30th, 1986.

The Team held a series of discussions and exchanged views with the authorities concerned of the Government of Fiji (hereinafter referred to as "the Authorities Concerned").

As a result of the study and discussions, both parties mutually agreed to recommend their respective Governments to take desirable measures towards the successful implementation of the Project as stated in the Minutes of Discussions attached herewith.

Suva, April 19th, 1986

篠田邦裕

Mr. Kunihiro Shinoda
Leader, Basic Design Study Team
Japan International Cooperation Agency

R. H. Yarrow

Mr. Robin Yarrow
Permanent Secretary
Ministry of Primary Industries

MINUTES OF DISCUSSION

1. The objective of the Project is to improve Lautoka Fishing Port in order to strengthen the commercial artisanal fishery which contributes to the increasing local demand for fish and generating of new income-earning opportunities for both existing licensed and potential fishermen in the Western Division in Fiji.

2. The Project site will be in the area of Lautoka Fishing Port.

3. The Fisheries Division, Ministry of Primary Industries will be responsible for the implementation and administration of the Project as specified in procedures for the Japanese Grant Aid Scheme.

4. The Government of Fiji desires to rectify the following constraints at the existing Lautoka Fishing Port:

   i) Poor accessibility for the fishermen, being dry at low tide and having no shelter against adverse weather conditions, particularly during cyclones;

   ii) insufficient capacity of ice plant and persistent mechanical problems;

   iii) unavailability of basic services required by the fishermen due to small and poorly equipped workshop and office facilities;

   iv) occurrence of siltation.

5. The Team will convey the desire of the Government of Fiji to the Government of Japan that the latter will take necessary measures to cooperate in implementing the Project and provide, within the limit of Japan's grant aid, necessary facilities and equipment as listed below. The Government of Fiji desires such facilities and equipment to be designed and constructed to simple engineering standards compatible with Fiji conditions and optimal economic performance with low maintenance costs.

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i) Breakwater, quay and ramp.
ii) New Fisheries office and workshop.
iii) Ice plant.
iv) Other functional facilities (e.g. canteen, fishermen's servicing building, car park).
v) Others.

6. The representative of the Government of Fiji will convey the desire of the Government of Japan to the Government of Fiji that the latter will take necessary measures to cooperate in implementing the Project as follows:

i) To secure lands necessary for the execution of the Project and to provide enough space for such construction as temporary offices, working area, stock yards and others;

ii) to ensure that the sea area necessary for the construction of the facilities be freely accessible;

iii) to provide facilities for distribution of electricity, water supply, drainage and other incidental facilities up to the Project site;

iv) to ensure prompt unloading, tax exemption and customs clearance at the port of disembarkation in Fiji;

v) to exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in Fiji with respect to the supply of the products under the verified contract;

vi) to accord Japanese nationals whose services may be required in connection with the supply of the products and services under the verified contract such facilities as may be necessary for their entry into Fiji and stay therein for the performance of their work;

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vii) to maintain and use properly and effectively the facilities constructed and equipment purchased under the grant; and

viii) to bear all expenses necessary for the construction of the facilities other than those covered by the grant.

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APPENDIX ; D-4

LIST OF FACILITIES

LAUTOKA FISHING PORT IMPROVEMENT PROJECT

The requested items and undertakings by the Government of Fiji

GJ : Government of Japan
GF : Government of Fiji

Item of Facilities	To be covered by GJ	GF
A. Basic Port Facilities		
1. Quaywall	*	
2. Breakwater	*	
3. Seawall	*	
4. Ramp	*	
5. Navigation Aids	*	
6. Fairway (by dredging)	*	
7. Port Basin (by dredging)	*	
8. Reclamation of Land	*	
9. Accessories (Fender, Bollards etc.)	*	
B. Building and Offices		
1. Fisheries Office and Workshop	*	
2. Ice plant shed	*	
3. Canteen	*	
4. Gate house	*	
C. Machines and Equipment		
1. Ice Plant	*	
2. Winch	*	
3. General Furniture (Carpet, Tables, Chairs, etc.)		*
4. Others (see notes)	*	
D. Pavement		
1. Access Road	*	
2. Apron	*	
3. Car Park and Other Yard Pavement	*	
E. Utilities (See Notes)		
1. Water Supply	*	
2. Sewerage System	*	
3. Drainage	*	
4. Power Supply	*	
5. Lighting	*	
6. Telecommunication	*	
7. Fuel Supply (Location)		
8. Fire Fighting Hydrant and Extinguisher	*	
F. Removal and Demolishing		
1. Existing Ice Plant (removal)	*	*
2. Existing Office/Workshop (demolish)	*	*
G. Others		
1. Fence and Gate in the Port Area	*	
2. Fence and Gate on the Port Boundary		*
3. Miscellaneous, if any		*

To facilitate continuous operation, Japanese aid should be for Removal existing ice and office

NOTES

1. This list will be refined based on the results of basic design.
2. The Fiji Government will provide all utilities to the entrance of the site.
3. The Fiji Government will submit to the Government of Japan a separate list showing details of item 4, "Others" of Section C - Machines and Equipment.

28th April 1986

APPENDIX ; D-5 LIST OF MACHINES AND EQUIPMENT

1. Ice Plant

1-1. Ice Making Machine and Ice Storage.

1-2. Spare Parts for 3 years Operation.

2. Equipment for Workshop and Maintenance.

2-1. Engineering Equipment and Tools.

2-2. Vehicles for Maintenance.

3. Equipment for Fisheries Office.

4. Space Parts and Accessories to Supplement the Previous Japanese Aid Programme.

4-1. Block Ice Unit (T-1000)

4-2. Plate Ice Making System (UI-40)

1. Ice Plant

1-1. Ice Making Machine and Ice Storage

Description	Quantity
1. Plate Ice Making Machine Capacity: 5 tons/24 hour	3 units
2. Cooling tower	3 "
3. Cooling Water Pump	3 "
4. Ice Storage 5.4M X 9M X 2.8MH (-5 C)	1 "
5. Scale 50kgs	1 "
6. Pipe Material for water	1 "
7. Material for Electric Wiring	1 "
8. Cooling Tank	1 "
9. Cooling Machine for Ice Storage (Open Type)	1 "
10. Unit Cooler for Ice Storage	1 "
11. Control Panel for Ice Storage	1 "
12. Transformer 125KVA	1 "

1-2. Spare Parts for 3 years Operation

Description	Quantity
A. TS-5U type Ice Making Unit (Junits)	
(For Compressor V-3000)	
1. Valve Plate Assembly	6 sets
2. Connecting Rod Assembly	3 "
3. Shaft Seal Assembly	4 "
4. Suction Valve Lead	36 pcs
5. Discharge Valve Lead	144 "
6. Piston Ring Set	36 sets
7. Connecting Rod Metal	24 pcs
8. Piston Pin Metal	12 "
9. Oil Pump Assembly	1 set
10. Gasket kid	3 sets
11. Oil Strainer Element	2 pcs
12. Crank Case Heater	2 "
(For Unit)	
13. Auto-expansion Valve (ATX-5706)	3 pcs
14. " (TER-A2,K)	2 "
15. Drier core (RC-4864)	3 "
16. Pressure Switch (DHS-D306HD)	1 pce
17. Oil Protection Switch (DHS-C106)	1 "
18. Pressure Gage (50)	3 pcs
19. Timer (H3BA-8)	2 "
20. Magnetic Relay (SRC 50-2V)	2 "
21. Magnetic Switch (SRC 3931-05)	2 "
22. Lamp Bulb	10 "
23. Bulb Cover	10 "

Description	Quantity
B. System	
1. Door Packing Set for Ice Storage	1 set
2. Defrost Heater for Unit Cooler	2 sets
3. Drain Pipe Heater	2 pcs
4. Refrigerant (R-22, 100kg)	5 cyls
5. Refrigerating Oil (4GS)	6 pcs
6. Water Circulating Pump 50LP51.5	2 sets
7. Strainer Element for above	2 pcs
8. Defrost Pump 32, CPO 5.75	1 set

2. Equipment for Workshop and Maintenance

2-1. Engineering Equipment and Tools

Description	Quantity
1. Winch 2.5KW	1 set
2. Carrier for Fishing Boat	3 "
3. A.C. Welding Plant	2 pcs
4. Welding Equipment set	2 "
5. Chain Block, 3 Ton	2 "
6. Engineering Workbench	2 "
7. " Vice	3 "
8. Heavy Duty Battery Charger 100V 50HZ with Transformer	2 "
9. Booster Cable, 5m 15A, 24V	2 "
10. Hydrometer	1 pce
11. Battery Cell Tester	1 "
12. Portable Generator, 220V 50HZ 2KVA	1 "
13. Extension Lead Wire, 10m	3 "
14. Lamp Holder	3 "
15. 25HP Outboard Motor, Long Shaft YAMAHA	1 "
16. YAMAHA F.R.P. Open Boat Type, W:1.46m L: 6,75m Model: J-22Sr	1 "
17. Portable Compressor, 0.75W (with Trans)	2 pce
18. Heavy Duty Pipe Bender (Hydraulic)	1 pce
19. " Bearing Puller, 3 arm	2 sets
20. " Slide Hammer Bearing Puller	2 "
21. Oxy, Acetylene cutting Torch with Gas Hose (0 m) and brazing tip, etc.	1 pce
22. Brazing rod 1 2m/m	4 pkg
23. Gas Welding Rod, 4mm 25kgs/ctn	1 ctn

Description	Quantity
24. Gas Welding Flux 200g/can	2 can
25. Welding Rod 20kgs/ctn	1 ctn
26. Hack Saw Assembly, 250 mm	1 set
27. Hack Saw Blades	5 dz
28. Bench Grinder (240V), 9306 15 mm	1 pce
29. Side Grinder (240V), 9501 B 100 mm 9501 B 200 mm	1 " 1 "
30. Grinder (240V), 9005B, 125 mm	1 "
31. Disc Grinder (240V), GV5000, 125 mm	1 "
32. Sanding & Polishing (Disc) 9218SB, 180 mm	1 "
33. Portable Drill, 240V, 6300NB	2 pcs
34. Press/Floor Drill, 30 mm Chuck 240V with Sleeve, Chuck, Drift	1 pce
35. Engineering Portable Tool Box	2 pcs
36. Engineering Ball Pein Hammer, 2.2K	2 "
37. " 550 g	2 "
38. Metal Saw, 4704	1 pce
39. Electric Soldering Iron, Medium	1 "
40. " Large	1 "
41. Spray Gun with Nozzle	1 "
42. Measuring Tape Rule, 100 m	1 "
43. Measuring Tape Rule, 5 m	1 "
44. Steel Rule, 1 m	1 "
45. Inside Calipers	1 "
46. Outside Calipers	1 "
47. Inside & Outside Micrometer, Small	1 set
" Medium	1 "
" Large	1 "

Description	Quantity
48. Flaring Tool Set, 3 -30	2 pcs
49. Pipe Wrenches, 200 mm	2 "
50. " 450 mm	2 "
51. " 600 mm	2 "
52. Chain Tong	1 pce
53. Screw Extractor Set	1 "
54. Punches Set, Belt Punches	16 sets
55. Pin Punch set	2 "
56. Tin Snips, 300	1 pce
57. " 180	1 "
58. Drill Bit Set	4 pcs
59. Hydraulic Press Machine, 50 Ton (Hydr. Oiljack)	1 pce
60. Cutting Files-Round, 3 pcs/set	3 sets
Half file "	3 "
Flat File "	3 "
Three Corners "	3 "
61. Bearing Scrapper, Flat	2 pcs
Half Round	2 "
62. Thread Chaser (Metric)	1 "
63. Grinding Wheel Dresser	1 "
64. Metric Tap & Dies	1 set
65. " Die Nut Set, 225 mm	1 pce
66. Oil Can	1 "
67. Universal Pliers, 250 mm	2 "
68. Long Nose Pliers, 200 mm	2 "
69. Multi-Grip, 30 mm	1 "

Description	Quantity
70. Revolving Punch (Center Punch Set)	2 pcs
71. Torque Wrench, 460 mm	1 pce
72. Masking Tape (Sealing Tape)	4 rolls
73. Mechanic Screwdriver set, 6 pcs/set	1 set
74. Oil Stone	7 pcs
75. Allen Key Set (Metric)	1 set (6 pcs)
76. Lathe Wire Cutter (Hexagonbar Spanner)	1 pcs
77. Metric Ring Spanners from 6mm to 32mm	2 set
78. " 6mm to 11mm	2 "
79. Box Spanners from 4mm to 32mm with Handle 1/2" Drive	2 "
80. " " 3/4 Drive	1 "
81. Safety Goggles	3 pcs
82. Grinding Shield	2 "
83. Circlip Pliers (Stop Pliers)	2 "
84. Wire Brush	6 "
85. Engineering Chisel, Medium & Large (Cold Chisel)	4 "
86. Protective Welding Gloves	6 pcs
87. Chipping Hammer	6 "
88. Shifting Spanners, 8",8",12",15",18"	2 set
89. Working Apron	3 "
90. Ear Muff	6 set (each 4 pcs)
91. Hose Mask	6 "
92. Safety Helmet	6 "
93. Welding Shield and Goggles	3 "
94. Grease Gun	2 "

Description	Quantity
95. Welding Shield Lens	6 blades
96. Rain Coats	10 pcs
97. Working Overalls, Medium	10 "
" Large	10 "
Extra Large	10 "
98. Working Boots No.8	10 "
No.9	10 "
No.10	10 "
No.11	10 "
No.12	10 "
99. Thread Gauge (Screw Pitch Gauge)	1 "
100. Floor Hydraulic Jack 2 Ton	1 "
101. Power Plus DWT Dewatering Fluid	2 "
102. Portable Hand Pump, Wing Pump, 1-1/2"	1 "
103. Cotton gloves	20 dz
104. Packing Cutter	1 set
105. Combination Pliers (50, 200, 250 mm) 3pces/set	3 sets
106. Adjustable Dividers, Medium, 150 mm	2 pcs
Large, 300 mm	2 "
107. Disc (Depressed Center Wheel), 200 mm	30 "
108. Side Grinder, 230 mm G9000	1 "
109. Disk (Pressed Centre Wheel), 230 mm	20 "
110. Gasket Cement (THREE BOND) 150g	4 "
111. Suction Grinder (Bench Grinder)	4 "
112. Thread File (Metric), 12 pcs/set	2 sets
113. Cross Cut Saw (70 cm)	1 pce
114. Rip Saw (70 cm)	1 "

Description	Quantity
115. Hand Planer No.3	1 "
" No.2	1 "
116. Plane Hand 65m/m	1 "
117. Wood Chisel, 1/4" ~ 1-1/2"	1 set
118. Wood Level Gauge	1 pce
119. Steel Level, 60 cm	1 "
120. Steel Square Level Large	1 "
121. Belly Brace	1 "
122. Expansion Wood Bits, 1" ~ 3-1/2"	2 "
123. Clean Cut Wood Bits, 1/4" ~ 1-1/4"	1 set
124. Makita Planner, 1804K 136m/m	1 "

2-2. Vehicles for Maintenance

Description	Quantity
1. Landcruiser diesel 4 wheel drive	1 only
2. Toyota Hilux Truck diesel 4 wheel drive	1 "
3. Trailer for vessels up to 3 tonnes (9m)	1 "
4. Fork lift 2 tonns	1 "

3. Equipment for Fisheries Office

Description	Quantity
1. SSB Radio Telephone	2 sets
2. Microphone NVT-10A	1 pce
2W NVS-410	10 pcs
Spare Parts & Accessories	1 set
3. Air Conditioning Units 240V (for conference room)	1 pce
4. Portable or Ceiling Fans 240V	10 pcs
5. Overhead Projector 240V	1 pce
Accessories for above (screen 180x180, Transparenty)	1 set
6. Slide Machine	1 pce
Accessories for above	1 set
7. Typewriter, Electric	1 pcs
8. Photo copier	1 pce
Spare Parts & Accessories	1 set
9. Safe Fire Proof (VANLACK YD)	1 pce
10. Punch Time Clock with Cards (200 sheets)	1 "
11. Battery Wall clock	1 "
12. Compact Microfish Readers	1 "
13. Microfish Storing Cabinet	1 "
14. Drawing Machine	1 set
Accessories (French Curves, Drawing Spelling Pattern, Drawing Instrument)	1 "
15. Periodical Recording Cabinet (5 trays) H227 X W493 X D348 m/m	5 pcs
16. IBM PC Computer & Printer (Model PC-XT)	1 set
17. World Ocean Globe	1 pce

4. Spare Parts and Accessories to Supplement the Previous Japanese Aid Programme.

4-1. Block Ice Unit (T-1000)

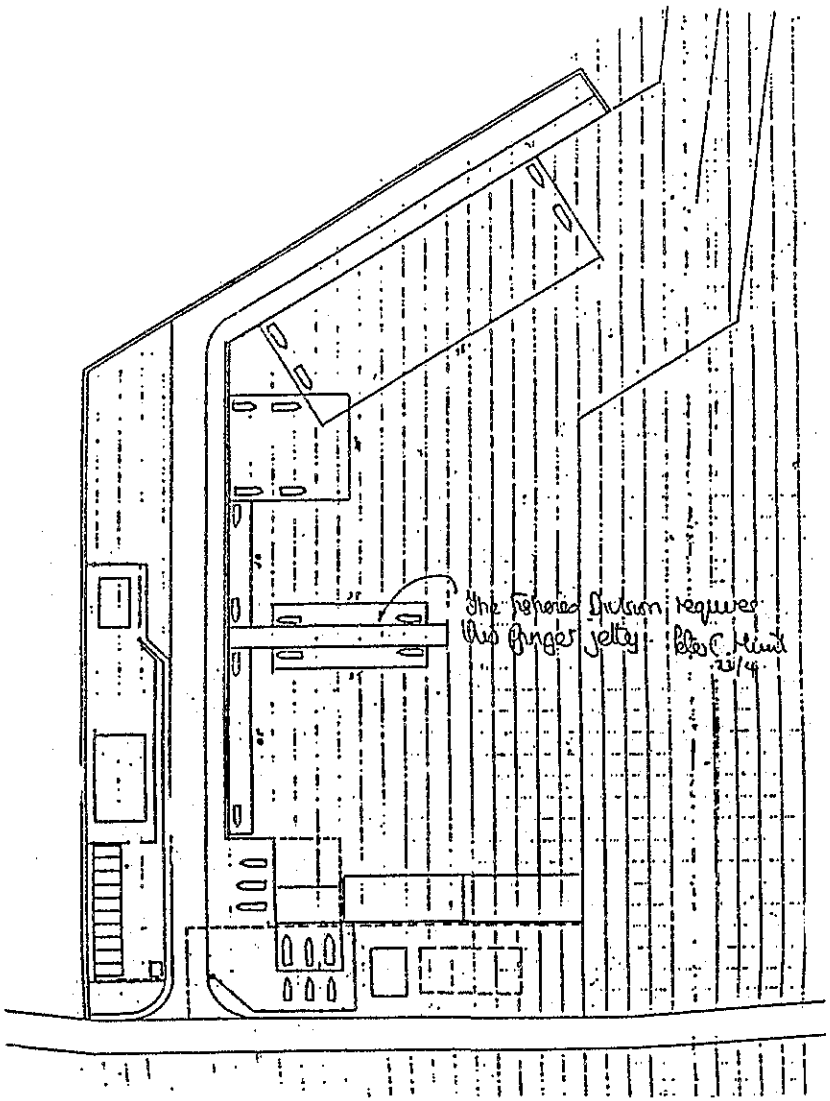
Description	Quantity
1. Piston Rod Assembly	12 sets
2. Suction Filter Element	12 pcs
3. Shaft Seal Assembly	12 sets
4. Roller Bearing	12 pcs
5. Crank Case Heater	6 "
6. Valve Plate Assembly	6 sets
7. Side Cover	3 "
8. Gasket Kid	6 "
9. Roller Bearing	12 pcs
10. Piston Ring (A)	12 "
11. Piston Ring (B)	12 "
12. Oil Ring	12 "
13. Crank shaft R-22	3 "
14. Refrigerant 100kg	6 pcs
15. Refrigerating Oil (JGS)	6 "
16. Electronic Expansion Valve	2 pcs
17. Solenoid Valve (REV-12D5Bx5/8)	6 "
18. Calcium Chloride 25kg	20 Bags
19. Agitator 178 VGH 0.75KW	1 pcs
20. Auto Expansion Valve (TEX-A/3,T)	2 "

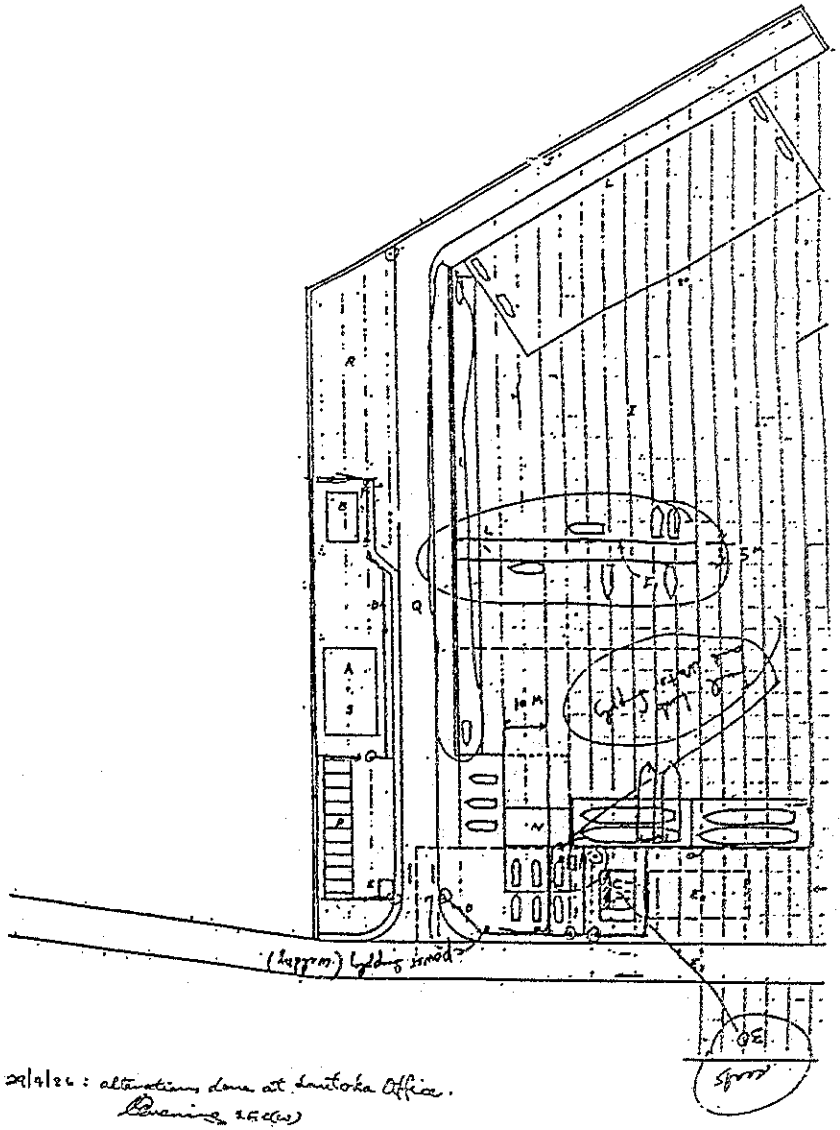
4-2. Plate Ice Making System (UI-40)

Description	Quantity
1. Suction Strainer Element	2 pcs
2. Oil Strainer Element	2 "
3. Oil Pump Assembly	2 "
4. Valve Plate Assembly	30 "
5. Pistons Connecting Rod Assembly	24 "
6. Crank Case Heator	2 "
7. Piston Ring No.1	20 "
8. Piston Ring No.2	20 "
9. Oil Ring	20 "
10. Oil Separator	2 sets
11. Refregerating oil (4GS)	15 cans
12. Fan with Motor for CIA-30NE Type Cooling Tower	2 sets
13. Water circulating Pump (65LPD51.5)	1 "
14. Strainer Element for above (65B)	2 pcs
15. Drier Core (DF81-3G) 120mm	40 "
16. Flare Tool Set	2 sets
17. Cutting Tool for Copper Tube	2 "
18. TS05 Water Circulating Pump 32 0.75KW	2 sets

APPENDIX ; D-6

Other Records





PORTS AUTHORITY OF FIJI
GPO BOX 780 SUVA FIJI

Our ref: PAF (ED) 30/29
Your ref

Cable: PAFIJI SUVA
Telex: 2203 PAF FJ
Telephone: 312700

19 July 1985

Principal Fisheries Officer (Technical)
Ministry of Primary Industries
Fisheries Division
P O Box 358
Suva.

Attention : Mr S. Sewak

Dear Sir,

FISHERIES WHARF FOR WESTERN DIVISION

Further to my earlier letter and subsequent to our discussion on the above I am forwarding herewith drawings showing the recommended location of the fisheries wharf and the layout incorporating provision for local cutters.

Preliminary cost estimate for the project is as follows :

Reclamation (approx 1.65 Ha) @ $10/m^3	$	560,000
Piled Jetty 107m length		600,000
Pavement (approx 12,000m^2)		780,000
Roads approx 1330m^2		86,450
Dredging.		20,000
Buildings		500,000
Timber Jetties		100,000
		$2,646,450

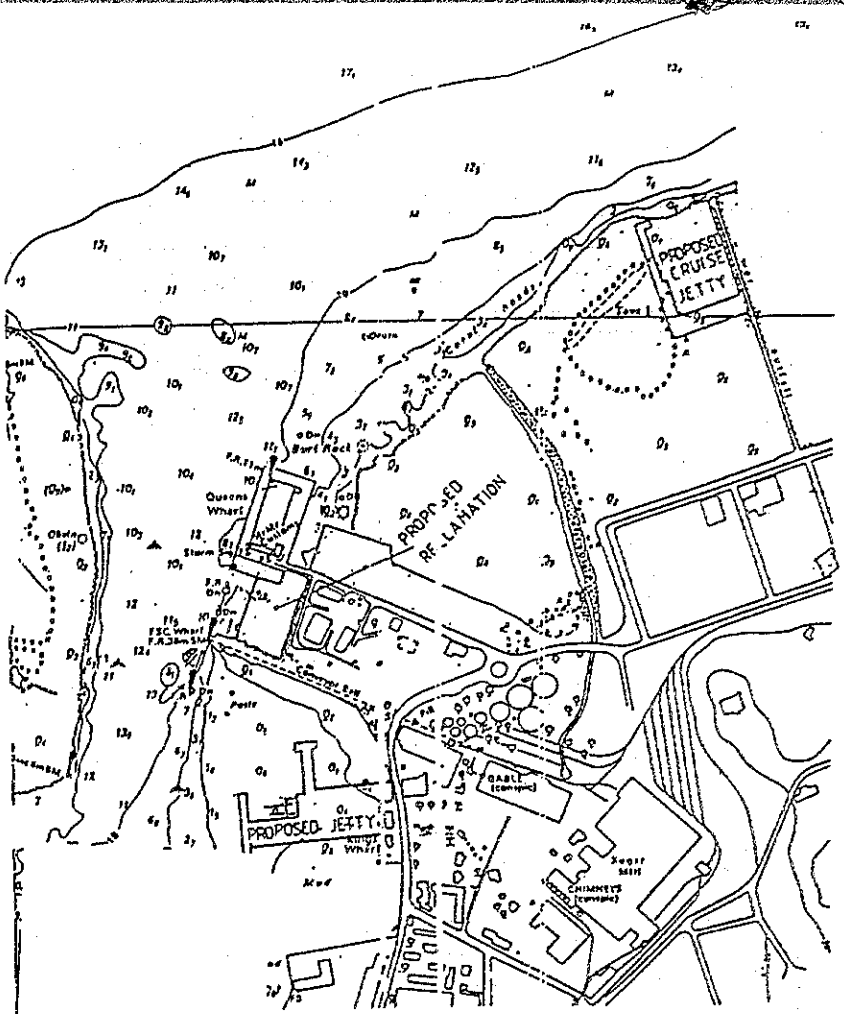
The estimates are very approximate and should be treated as such in the absence of detailed plans and quantities.

Should you need any further clarification please contact the undersigned.

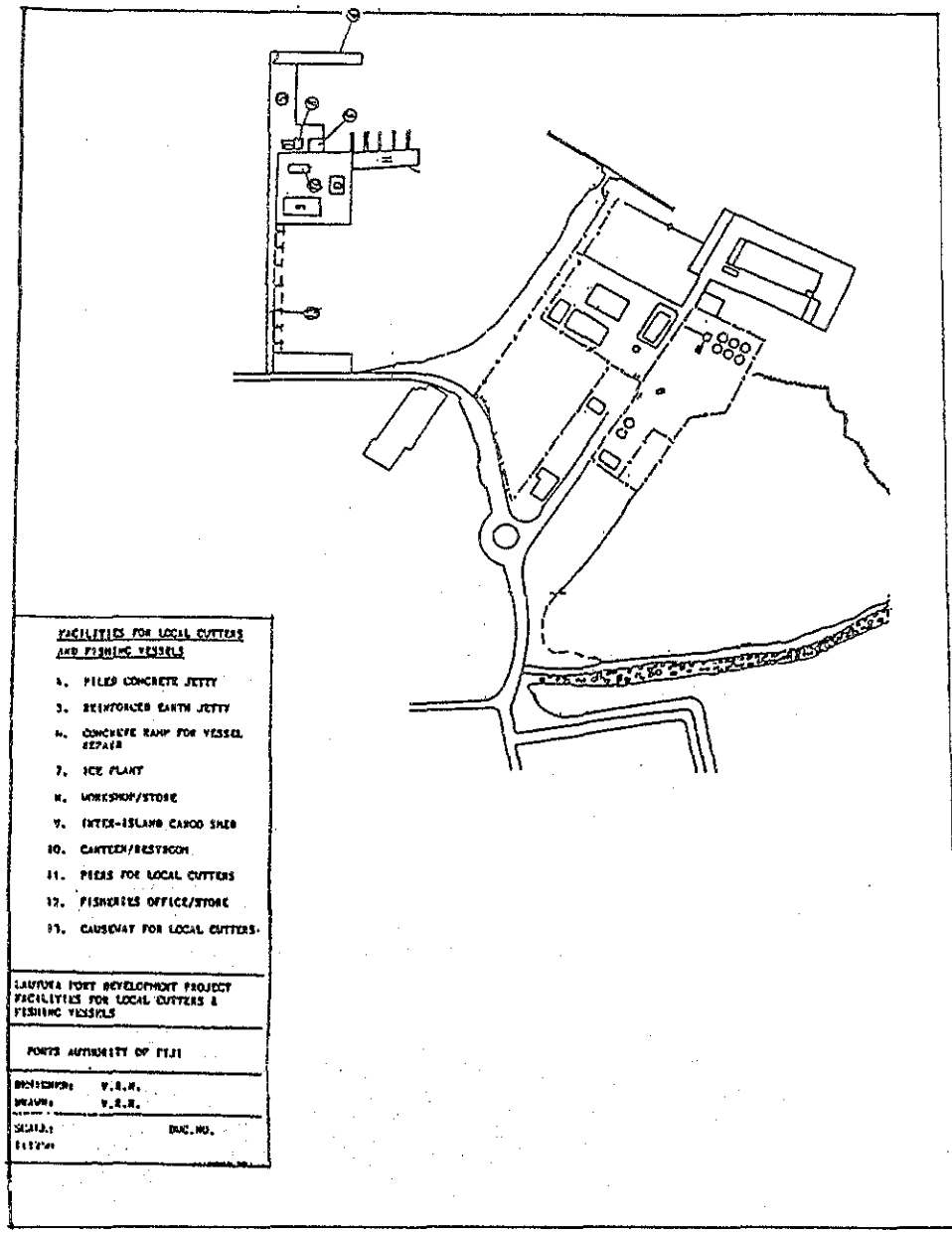
Yours faithfully,
PORTS AUTHORITY OF FIJI

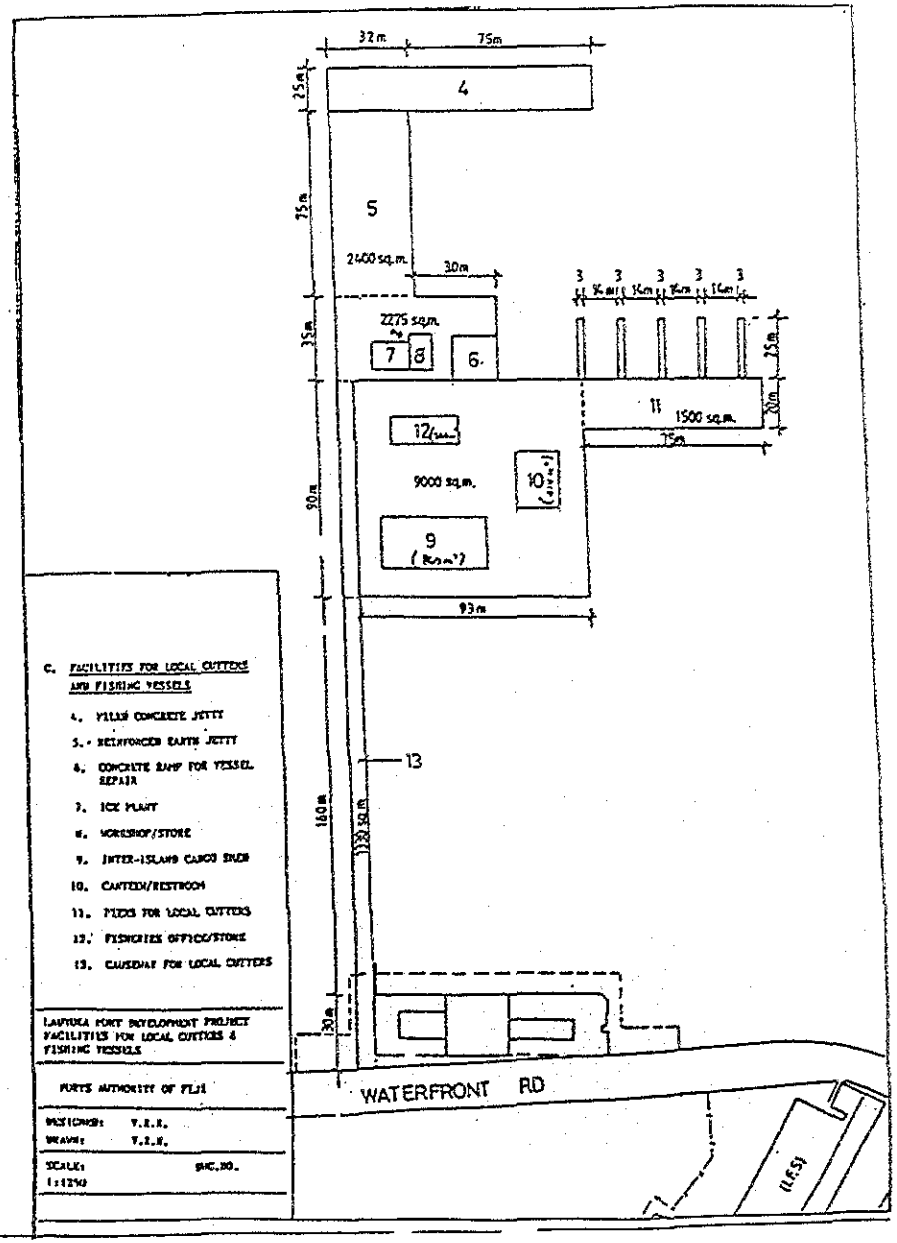
Venket R. Naidu
PORT ENGINEER

VRN/vn



PORTS AUTHORITY OF FIJI	CONTRACT REF 91219	FAWCETT WILTON & BELL Ltd P.O.BOX 9385 NADI AIRPORT FIJI
LAUTOKA PORT PROJECT.	SCALE. 1:7500	
KEY PLAN.	DATE. OCT 1985	DRAWING No. 91219/1.


FACILITIES FOR LOCAL CUTTERS AND FISHING VESSELS
1. PILED CONCRETE JETTY
3. REINFORCED EARTH JETTY
4. CONCRETE RAMP FOR VESSEL REPAIR
7. ICE PLANT
8. WORKSHOP/STORE
9. INTER-ISLAND CARGO SHED
10. CANTEEN/RESTROOM
11. PIERS FOR LOCAL CUTTERS
12. FISHERIES OFFICE/STORE
13. CAUSEWAY FOR LOCAL CUTTERS
LAUTOKA PORT DEVELOPMENT PROJECT
FACILITIES FOR LOCAL CUTTERS & FISHING VESSELS
PORTS AUTHORITY OF FIJI
DESIGNED: V.R.R.
DRAWN: V.R.R.
SCALE: 1:1250
DWG.NO.


32m
75m
25m
4
75m
5
2400 sq.m.
30m
2275 sq.m.
7
8
6
35m
11
1500 sq.m.
75m
12
9000 sq.m.
10
9
90m
93m
13
160m
30m
WATERFRONT RD
C. FACILITIES FOR LOCAL CUTTERS AND FISHING VESSELS
1. PILED CONCRETE JETTY
3. REINFORCED EARTH JETTY
4. CONCRETE RAMP FOR VESSEL REPAIR
7. ICE PLANT
8. WORKSHOP/STORE
9. INTER-ISLAND CARGO SHED
10. CANTEEN/RESTROOM
11. PIERS FOR LOCAL CUTTERS
12. FISHERIES OFFICE/STORE
13. CAUSEWAY FOR LOCAL CUTTERS
LAUTOKA PORT DEVELOPMENT PROJECT
FACILITIES FOR LOCAL CUTTERS & FISHING VESSELS
PORTS AUTHORITY OF FIJI
DESIGNED: V.R.R.
DRAWN: V.R.R.
SCALE: 1:1250
DWG.NO.

APPENDIX ; D-8 UNDERTAKINGS BY THE GOVERNMENT OF FIJI.

LAUTOKA FISHING PORT PROJECT

Preparatory works to be done by the cost of the Government of Fiji. (Rough Estimation)

1. Removal of the existing office and other obstacles of King's Wharf to clear the site.

   F$10,000

2. To provide electricity, water, sewerage, and telephone main to the entrance of the site.

   F$10,000

3. To prepare furniture and accessaries for the fisheries office and canteen.

   F$10,000

4. Miscellaneous, if any.

   F$10,000

Total : Less than F$40,000

APPENDIX D-9 MINUTES OF DISCUSSION
(DRAFT FINAL REPORT) : JULY 17, 1986

MINUTES OF DISCUSSIONS

ON

THE DRAFT REPORT OF THE BASIC DESIGN STUDY

ON

LAUTOKA FISHING PORT IMPROVEMENT PROJECT

IN

FIJI

In response to the request of the Government of Fiji for Grant Aid for the "Lautoka Fishing Port Improvement Project" (hereinafter referred to as 'the Project'), the Government of Japan decided to conduct a basic design study on the Project and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Fiji the team headed by Mr. Kunihiro SHINODA, Deputy Director, Planning Division, Department of Fishing Port, Fisheries Agency, from April 7 to April 30, 1986.

As a result of the study, JICA prepared a draft report and despatched a mission to explain and discuss it from July 11 to July 20, 1986.

The parties had a series of discussions on the Report and agreed to recommend to proceed with the Project to the respective Governments. The major points of understanding are attached:

Suva, July 17, 1986

篠田邦裕

MR. KUNIHIRO SHINODA
TEAM LEADER
JICA STUDY TEAM

R. W. Yarrow.

MR. ROBIN YARROW
PERMANENT SECRETARY
MINISTRY OF PRIMARY INDUSTRIES

APPENDIX: The major points of understanding

1. The draft report satisfies the Government of Fiji subject to appropriate minor amendments as agreed during the discussions being incorporated in the Final Report.

2. The Final Report on the Project in English (25 copies) shall be submitted to the Government of Fiji by the end of September 1986.

3. The Government of Fiji has agreed to the basic design for the civil engineering works, structures and buildings, facilities and equipment proposed in the draft report.

4. The Government of Fiji is responsible for the effective maintenance and operation of the Lautoka Fishing Port upon completion.

5. The Government of Japan will, subject to schedule and quality requirements, maximise the local component of the Project to stimulate employment.

NOTE:

The Government of Fiji will identify its training and technical assistance needs to operate the Project for consideration of the Government of Japan.

K. L

2

PORTS AUTHORITY OF FIJI
GPO BOX 780 SUVA FIJI
Our ref : PAF(ED)30/1/1/1
Your ref :
Cable : PAFIJI SUVA
Telex : 2203 PAF FJ
Telephone : 312700

23 June 1986

The Chief Fisheries Officer
Ministry of Primary Industries
P.O. Box 358
Suva

Attention: Mr. S. Sewak

Dear Sir,

FISHING PORT DEVELOPMENT-LAUTOKA

The draft general layout for the fishing port prepared by Pacific Consultants International was viewed by the Ports Authority of Fiji at its recent meeting.

The Authority appreciates the efforts being made to improve facilities in Lautoka and the benefits deriving from the Aid programme sponsored by the Japanese Government.

The Authority has drawn attention to the use of Kings Wharf by cargo barges, and because the Authority has not planned to provide a barge loading berth at any other location, vessels such as Talofa would still require a loading place at Kings Wharf. The northern end of Kings Wharf (the west face) is the logical place where barges should lower their ramps and provision for this should be made in the fishing port plans.

I had earlier mentioned that a mooring buoy belonging to FSC had been temporarily removed from its location between Kings Wharf and Vio Island but the mooring was still in place. This buoy is to be reinstated on the mooring - see the attached photocopy of the chart and annotations. Pacific Consultants International are aware of this buoy and are adjusting their channel accordingly.

The Authority would grant a licence for the construction of the fishing port facilities, but before doing so had indicated that more detailed plans and specifications would need to be placed before the Authority for its consideration and approval.

It would appear at this stage that the location of of the proposed fishing port at Lautoka will be acceptable, and as requested in your letter of 5 June 1986, I will advise the Director of Lands accordingly.

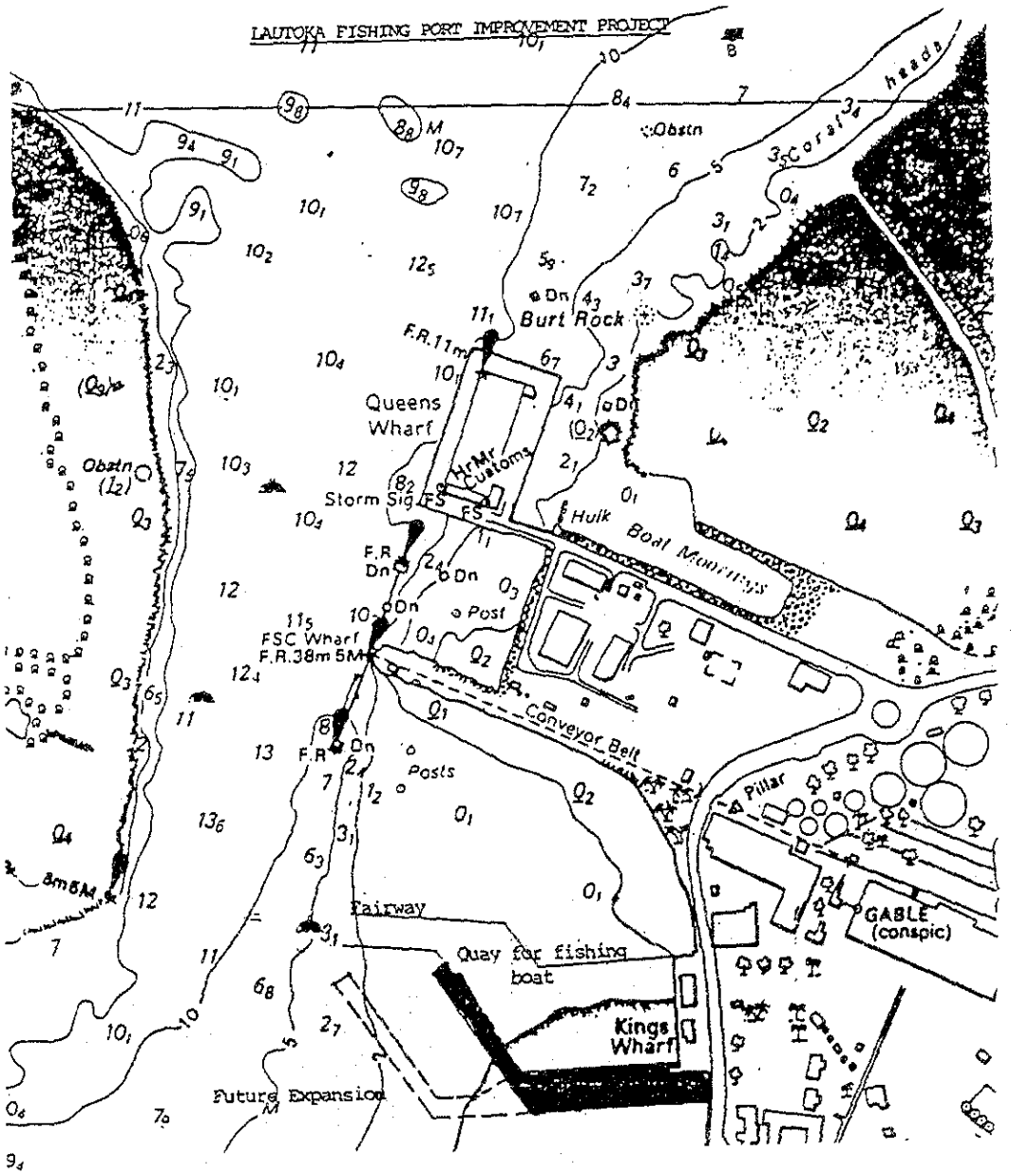
In the meantime your Division should proceed with the initial arrangements for compensating owners for their loss of fishing rights.

Yours faithfully,
PORTS AUTHORITY OF FIJI

R.McL. Dickie
DIRECTOR ENGINEERING

RMcLD/hnh

cc. Director of Lands


LAUTOKA FISHING PORT IMPROVEMENT PROJECT
Burt Rock
F.R.11m
Queens Wharf
Hr Mr Customs
Storm Sig
Hulk
Boat Moorings
F.R
Dn
Post
FSC Wharf
F.R.38m 5M
Conveyor Belt
Posts
Pillar
GABLE (conspic)
Fairway
Quay for fishing boat
Kings Wharf
Future Expansion
Obstn
Obstn (I2)
3m6M
heads

PORTS AUTHORITY OF FIJI
GPO BOX 780 SUVA FIJI

Our ref : PAF(ED)30/11/1/1
Your ref :

Cable : PAFIJI SUVA
Telex : 2203 PAF FJ
Telephone : 312700

30 July 1986

The Chief Fisheries Officer
Ministry of Primary Industries
Fisheries Division
P.O. Box 358
Suva

Attention: Mr. S. Sewak

Dear Sir,

LAUTOKA FISHING PORT PROJECT

Further to my letter dated 29 July 1986 in which I conveyed the agreement of the Ports Authority of Fiji to the location and general layout of the proposed port for local fishing vessels, cutters and barges, I offer the following comments arising from my reading of the draft basic design study.

Breakwater and Quay Southern Side

The height of the outer face of the breakwater is CD+3.5 giving a freeboard of 1.6m. During rough weather a concave profile to the outer edge of the coping would help turn back a wave and reduce spray without adding significantly to the cost. It may be worth considering.

Typhoon Surge

It is highly likely that under typhoon conditions, the surge will overtop the quay at CD2.50. Whilst this in itself is no worry, because the port would be cleared following a warning of an approaching storm, flooding could affect ground floor proposals associated with the ice plant, workshop machinery etc. Some tie down anchorages should be incorporated in the vicinity of the repair ramp and haul out area.

Surfacing(P 180)

The full area from the kerb on Waterfront Road to the face of Kings Wharf should be surfaced preferably using concrete or interlocking concrete paving blocks.

.../2

Asphalt Paving (P 180)

There is no readily available supply of asphaltic concrete or bituminous mixes in Lautoka. Bituminous surfaces are invariably in situ bitumen/chip seals.

Fuel Arrangements

The installation of fuel storage and dispensing equipment must be in compliance with local regulations which include fire protection measures. The plan on P145 of the Basic Design Study Report indicating a fuel supply adjacent to the repair slipway and canteen may be questioned in Fiji. Underground storage could be subject to flotation, whereas surface storage may require bunding.

Dredging

The spoil arising from interim efforts by the Marine Department to maintain access to Kings Wharf will require removal to prevent siltation of the fishing port.

I trust these comments are helpful to the refinement of the Basic Design Study Report.

Yours faithfully,
PORTS AUTHORITY OF FIJI

R.McL. Dickie
DIRECTOR ENGINEERING

RMcLD/hnh

cc. Mr. Mamoru Amemiya
Pacific Consultants International
8-2, 2-Chome, Jingumae,
Shibuya-Ku, Tokyo-150
Japan.

Appendix E: Economic Analysis and Sensitivity Study

1. Economic Costs
   1-1 Initial Investment Costs
   1-2 Operation and Management Costs
   1-3 Present Value of Costs

1. Economic Benefits
   2-1 Direct Benefits
   2-2 Present Value of direct Benefits

3. Economic Internal Rate of Return

4. Sensitivity Analysis

1. Econimic Costs

Three alternative general layouts are studied in order to select the best layout in the economic view point. Detail of these layouts are shown in Section 5-4-3 " Study on Alternatives". Economic costs are estimated for initial investment costs and operation/management costs.

Charactoristics of Alternatives

Alternatives	Number of Boats (N)	Width of Jetty	Length of Breakwater	Number of Finger Jetty
Plan-P	40	20m	90m	Nil
Plan-Q	60	28m	120m	One
Plan-R	80	35m	160m	Two

Thus Plan-Q is mediate scale layout and Plan-P and Plan-Q are smaller scale and larger scale comparing to Plan-Q respectively, costs are estimated for each layout.

1-1 Initial Investment Costs

Unit: 10^6F$

Cost items	Alternatives		
	N=40 (Plan-P)	N=60 (Plan-Q)	N=80 (Plan-R)
Fixed cost	4.00	4.00	4.00
Movable cost	3.89	4.69	5.82
Sub-total	7.89	8.69	9.82
Salvage cost (10%)	-0.79	-0.87	-0.98
Net cost	7.10	7.82	8.84

1-2 Operation and Management Costs

The project life is assumed as 25 years and maintenance cost is estimated as 1.0% of the initial investment costs.

Unit: 10^6F$

Cost items	N		
	40	60	80
Personnel cost	0.048	0.048	0.048
Operation and maintenance cost	0.079	0.087	0.098
Maintenance dredging cost	0.007	0.004	0.001
Annual total cost	0.134	0.139	0.148
Cost for project life	3.350	3.475	3.700

Cost items	N		
	40	60	80
Total Economic Costs	10.45	11.30	12.54
(cost per boat, 10^3F$)	(261)	(188)	(157)

1-3 Present Value

Discount Rate		N		
		40	60	80
0%	I.I. Costs	7.10	7.82	8.84
	O.M. Costs	3.35	3.48	3.70
	Total	10.45	11.30	12.54
5%	I.I. Costs	7.10	7.82	8.84
	O.M. Costs	1.85	1.93	2.05
	Total	8.95	9.75	10.89

2. Economic Benefits

2-1 Direct Benefits

(1) Benefit by reduction of waiting-time: B, Fishermen will have more time-effective use of port due to reduction of waiting-time as a result of securing deeper water-depth in front of the mooring facilites. Further more, calm port basin provided by the breakwater will supply longer working-period.

Type of boat	Working day a week				
	present	future	increase (%)	share (%)	Total increase
Smaller (less 21')	4	5	1 (20)	40	8
Larger (21'-30')	3	4	1 (33)	60	20
	Average increase of time				28%

Number of boasts are as follows.

Total number of boat	250 boats
Permanent use	N boat
Exclusive use (temporary)	250-N boat

Thus, increase of benefit are,

Permanent use - boat	28%
Exclusive use - boat	1/5 ×28% = 6%

Therefore benefit-B, is,

$$B1 = \{N \times 0.28 + (250-N) \times 0.06\} \times 862^{F\$/m} \times 11^{M} \times 25^{Y}$$
$$= (15.0 + 0.22N) \times 0.24 \times 10^{6} \quad F\$$$

N	40	60	80
B1	F$5.71×$10^6$	F$6.77×$10^6$	F$7.82×$10^6$

Note; Average net monthly income a boat

(Type A) 3 crew ×227 F$= 681 F$/m.Boat× 0.4 = F$ 272
(Type B) 4 ×246 = 984 F$/m.Boat× 0.6 = F$ 590
Average F$ 862

(2) Benefit by breakwater: B2

The breakwater will supply shelter and will make reduce boat damages under severe climate conditions.

Type of boat	cost of boat	Life of boat (Year) Present	Future	Benefit Per year	Share (%)	Benefit
Smaller	F$4,000	5	6	F$134	40	F$54
Larger	F$12,000	5	6	F$266	60	F$160
		Average Annal Benefit				F$214

Note: Larger means 21'-31' boats

Number of boats:
Total number of boat 250 boats
Permanent of boat N boat
Exclusive use (temporary) 2N boat

Threrfore benefit - B2 is,

$B2 = 2N \times 214^{F\$/y} \times 25^{y}$
$= 0.01 \times 10^{6} \times N$ F$

N	40	60	80
B2	$F\$0.40\times10^{6}$	$F\$0.60\times10^{6}$	$F\$0.80\times10^{6}$

(3) Benefit by larger fishing boat: B3

More effective use by larger boats will be provided due to deeper water depth. New fishing port will accelerate fishmen's activities and will provide good circumstances for them to carry out their business in effective condition.

Type of boat	Present length of berth(m)	share(%)	Future berth length(%)	share(%)	berth length (m)
Smaller	7.0	40	2.8	20	1.4
Larger	10.0	60	6.0	80	8.0
	Avereage length		8.8m		9.4m

Therefore, an unit length of berth will increase.
9.4 ÷ 89.8 = 1.07 (7% increase)

Meanwhile: catches a boat will increase.

Type of boat	Monthly net income(F$)	Present share(%)	income(F$)	Future share(%)	income(F$)
Smaller	681	40	272	20	136
Larger	984	60	590	80	787
	Average monthly net income		862		923

Therefore increase of net monthly income is,
$923 - 862 = 61^{F\$/m.Boat}$

Therefore benefit —B3 is,

$B3 = 61 \div 1.07 \times 20^{y} \times 10^{n}$
$= 0.01 \times 10^{6}$ F$

N	40	60	80
B3	$F\$0.40\times10^{6}$	$F\$0.60\times10^{6}$	$F\$0.80\times10^{6}$

(4) Benefit by enough ice-supply: B4

Up-keeping of present values of catches and its prices due to the supply of more fresh catches enabled by improvement in ice production and storage capabilities.

Estimation of increase of values;

Enough ice supply will keep catches price higher as possible.

Number of days	Present: Daily sales (%/day)	Present: Unit price of catches (F$/kg)	Present: Sales (F$)	Future: Daily Sales (%/day)	Future: Unit price of catches (F$/kg)	Future: Sales (F$)
the first	65	2.5	1.63	65	2.5	1.63
second	20	1.9	0.38	25	2.3	0.68
third	15	1.5	0.22	10	2.0	0.20
Average unit price (F$/kg)			2.23			2.51

Therefore, rate of increase of unit price is,

$2.51 \div 2.23 = 1.13$

Effect by ice-supply

Type of boat	Number	Rate of increase
Permenent use	N	0.13
Exclusive use	250-N	$1/2 \times 0.13 = 0.07$

Therefore benefit $-$B4 is,

$$B4 = \{N \times 0.13 + (250-N) \times 0.07\} \times 1,450^{F\$/m.Boat} \times 10^{M} \times 25^{Y}$$
$$= (17.5 + 0.06N) \times 0.36 \times 10^{6} \quad F\$$$

N	40	60	80
B4	$F\$7.16 \times 10^{6}$	$F\$7.60 \times 10^{6}$	$F\$8.03 \times 10^{6}$

(5) Benefit by deduction in use of temporary mooring facilities: B5

Fishing boats in Lautoka area are currently moored at other facilities than fishing port. The boats utilizing permanently the new fishing port will not be berthed there.

According to the survey, average monthly mooring charges at such private wharf is about F$25, however, some boat berth at natural river-bank and shore-line. Thus net average charge is set as half of it. F$12.5/boat.month.

$$B2 = N \times 12.5^{F\$/m} \times 12^{M} \times 25^{Y}$$
$$= 0.004 \times 10^{6} N \quad F\$$$

N	40	60	80
B5	$F\$0.16 \times 10^{6}$	$F\$0.24 \times 10^{6}$	$F\$0.32 \times 10^{6}$

(6) Benefit due to improvement cutter berth: B6

Improvement of cutter berth will generate benefit in daily commodities distribution and circulation and ferry-effects between Lautoka and the group of such isolated islands as Mawanuca and Yasawa.

Number of cutter boats—8 boats

By an improvement of the berthing facilities, convenient of sea transport will be more than before. It is expected number of trips are increase by one trip a week.

Average number of customers a cutter boat : 30 head/boat
Charges for a trip : F$10/head

Therefore,

$$B6 = 8^{boat} \times 30^{head} \times 52^{W} \times 25^{Y}$$
$$= 0.31 \times 10^{6} \quad F\$$$

(7) Accumulation of Economic Benefit

Unit: 10^6F$

Item	N		
	40	60	80
B1: Shorter Waiting Time	5.71	6.77	7.82
B2: Calm Wet Basin	0.40	0.60	0.80
B3: Larger Boat	0.40	0.60	0.80
B4: Enough Ice Supply	7.16	7.60	8.03
B5: Temporary Berth	0.16	0.24	0.32
B6: Cutter Berth	0.31	0.31	0.31
Total	14.14	16.12	18.08
(Benefit by a boat, N)	(0.35)	(0.27)	(0.23)

2-2 Ptesent Value of Direct Benefits

Unit: 10^6F$

N	40	60	80
Discount Rate (0%)	14.14	16.12	18.08
Discount Rate (5%)	7.83	8.92	10.01

3. Economic Internal Rate of Return

Unit: 10^6F$

Discount Rate		N		
		40	60	80
0%	Benefits	14.14	16.12	18.08
	Costs	10.45	11.30	12.54
	Difference	+3.69	+4.82	+5.54
5%	Benefits	7.83	8.93	10.01
	Costs	8.95	9.75	10.89
	Difference	-1.12	-0.82	-0.88

Economic Internal Rate of Retutn (EIRR)

N	EIRR (%)
40	3.8
60	4.2
80	4.3

4. Sensitivity Analysis

The direct benefits for mentioned and quantified in money-term, togeghers with the investment cost and operational cost, can be used in the calculation of the economic benefits (economic internal rate of return) as follows:

The following five cases are studied with the number of boats accommodated.
(N) as a prameter:

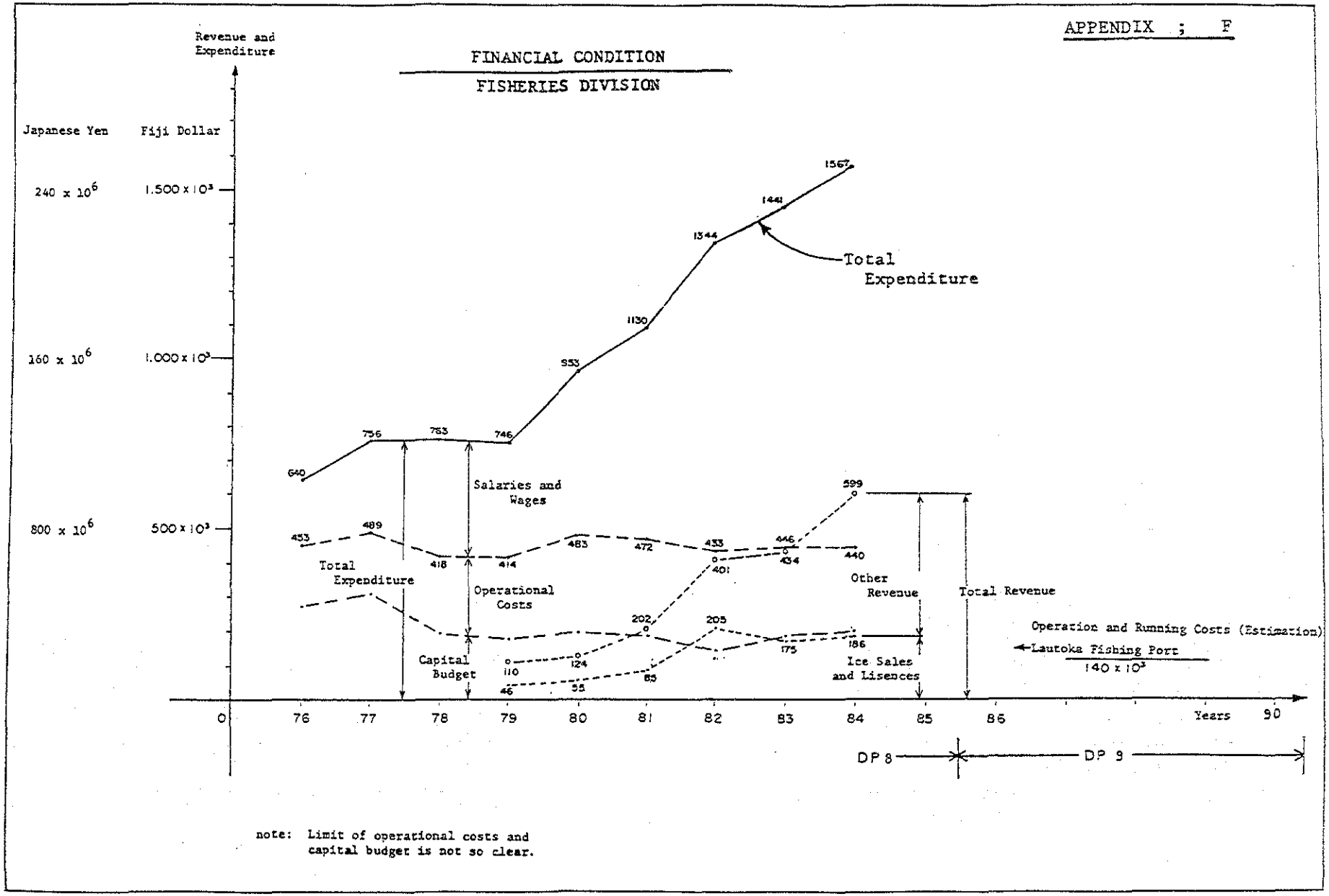
Study cases		Remarks
Basic case	N=40, 60, 80 (N: Number of boats accommodated)	
Sensitivity analysis	Case 1:	Project cost & operational costs 10% increased from the basic case
	Case 2:	Project cost only, 10% increased from the basic case
	Case 3:	Operational cost only, 20% increased from the basic case
	Case 4:	The number of vessels under consideration is decreased by 20% from the basic case

Note: The total number of the object-boats is altogether 250, the number of registered fishing boats intending to come to the port, and only N out of 250 is considered always using and accommodating the fishing port and the rest of them (250-N) are using the port only on temporary and exclusive use basis.

Economic Internal Rate of Return (%)

Case of Study		Number of Registered Boats to be accommodated N		
		40	60	80
Base Case		3.8	4.2	4.3
Sensitivity Analysis	Case 1	3.0	3.5	3.5
	Case 2	3.2	3.7	3.7
	Case 3	3.4	3.9	4.0
	Case 4	1.7	2.0	2.2

APPENDIX ; F

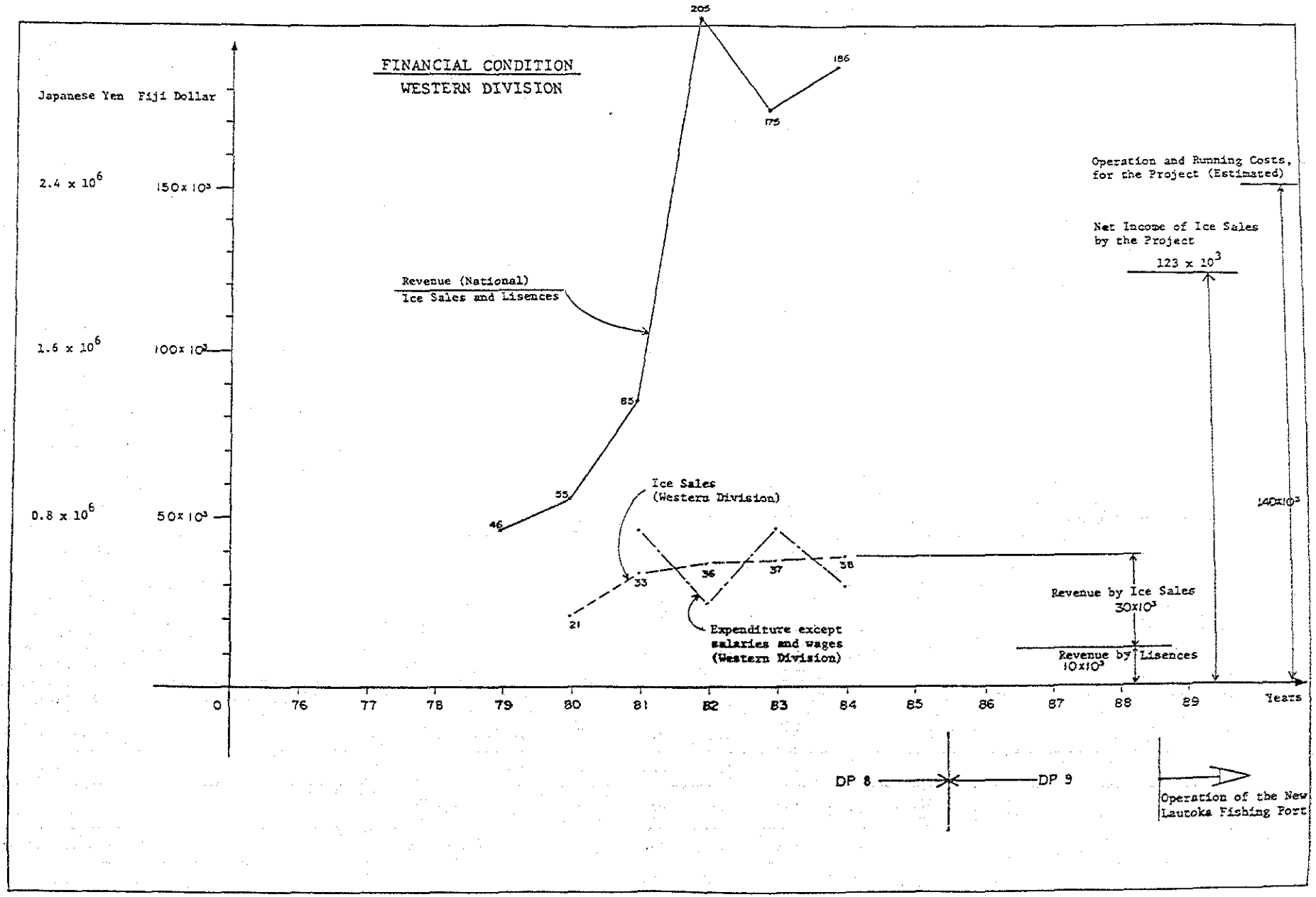

FINANCIAL CONDITION
FISHERIES DIVISION
Revenue and Expenditure
Japanese Yen
Fiji Dollar
240 x 10^6
160 x 10^6
800 x 10^6
1.500 x 10^3
1.000 x 10^3
500 x 10^3
Total Expenditure
Salaries and Wages
Operational Costs
Capital Budget
Other Revenue
Total Revenue
Ice Sales and Lisences
Operation and Running Costs (Estimation)
Lautoka Fishing Port
140 x 10^3
Years
DP 8
DP 9
note: Limit of operational costs and capital budget is not so clear.

FINANCIAL CONDITION

FISHERIES DIVISION

(Unit: x 10^3 F$)

ITEM	YEAR										Notes
	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	
A. NUMBER OF PERMANENT STAFF	67	81	86	89	105	105	109	104	105		
B. EXPENDITURE	640	756	763	746	953	1,130	1,344 (1,644)	1,441	1,567 (3,788)		
1. Salaries	186	268	345	339	470	606	758	983	1,127		
2. Operational Costs	182	182	226	237	286	291	293 (593)	259	240		
a) Travelling expenses/communication				7	11	16	43				
b) Maintenance of ressels and vehicles				84	114	139	96				
c) Fishing operation				44	59		96				
d) Wages (unestablished staff)				99	103	112	140	0	0		
e) Rations aid Caginitoba				3	0						
f) Office equipment				0	-						
g) Machinery				0	-						
h) Purchase of goods/services						13	9				
i) Others						11					
j) Capital grants and transfer							300		200		
3. Capital Budget	271	307	192	177	197	181	140	187	(2,420)		Capital expenditure has declined sharply since 1977
a) Fishing breeding				2	2						
b) Plants and equipment				68	48						
c) Vessels and punts				18	12						
d) Subsidy boats				67	69						
e) Commercial gear subsidy				15	24						
f) Maintenance and running of Seni Niv				8	0						
g) Rations Seni Niv				-	0						
h) National census of agriculture				-	0						
i) Plant and building/capital const.				-	0	131	140				
j) Boat building (rural development)				0	14						
k) Capital purchases						50					
l) Others							48				
4. Training						51	12	12			
C. REVENUE				110	124	202	401	434	595		Revenue collected and payed to Government Revenue
a) Subsidised boat building (trainee/commercial)				40	39	78	179	212	305		
b) Ice sales				36	45	85	91	104	132		
c) Fishing gear sales				18	22		15	24	34		
d) Fishing license fees				10	10	12	15/99	15/60	16/38		
e) Jetty terminal fees				7	9						
f) Other (commision)						27	12	19	73		
D. AID											
a) Japan				2,200							
b) New Zealand				200							
c) Others				(2,400)			(300)		(2,220)		


FINANCIAL CONDITION
WESTERN DIVISION
Japanese Yen
Fiji Dollar
2.4 x 10^6
150x10^3
1.6 x 10^6
100x10^3
0.8 x 10^6
50x10^3
205
186
175
Revenue (National)
Ice Sales and Lisences
85
55
46
Ice Sales
(Western Division)
33
36
37
38
21
Expenditure except
salaries and wages
(Western Division)
Operation and Running Costs,
for the Project (Estimated)
Net Income of Ice Sales
by the Project
123 x 10^3
140x10^3
Revenue by Ice Sales
30x10^3
Revenue by Lisences
10x10^3
0
76
77
78
79
80
81
82
83
84
85
86
87
88
89
Years
DP 8
DP 9
Operation of the New
Lautoka Fishing Port

FINANCIAL CONDITION

WESTERN DIVISION

Fisheries Division (Western): ANNUAL REPORT

(Unit: x 10^3 F$)

ITEM	YEAR						Notes
	1980	1981	1982	1983	1984	1985	
EXPENDITURE		47.4	24.7	47.3	28.7		
a) Law enforcement		1.0					
b) Extension		30.0					
c) Resource assessment & Development		2.1					
d) Capital purchase (motors/gears)		1.5					
e) Capital purchase machinery/equipment		1.1					
f) Education and training		0.6					
g) Stationery, etc.		0.1					
h) Raviravi prawn farm		11.1					
i) Extension			17.0	31.6			
j) Resources			0.8	15.6			
k) Assessment			0.4				
l) Development			1.0				
m) Administration			4.8				
REVENUE	20.8	32.8	35.6	36.6	37.6		
a) Ice sales	16.9	28.9	30.4	31.1	31.6		
b) Fishing license fees	3.9	3.9	5.2	(5.5)	(6.0)		

Appendix: G

Unit Rate/Price of Laborers. Materials and Construction Equipment

Labour Cost
(Direct employment by PWD)

Items	Daily Rate (F$)	Remarks
Unskilled Labour	13.68	Indirect cost excluded
Driver	14.24	"
Average Cost	14.56	"
Mason	15.76	"
Plasterer, Plumber Painter	16.08	"
Carpenter	16.78	"
Supervisor	19.20	"

Labour Cost
(Market Price)

Items	Daily Rate (F$)	Remarks
Unskilled Labour	10.56	Indirect cost excluded
Painter	12.50	"
Carpenter, Plasterer, Bar Bender	12.85	"
Scaffolder	13.38	"
Driver	13.99	"
Welder	14.52	"
Electrician	15.05	"
Truck Driver	15.66	"
Heavy Equipment Operator	16.19	"
Crane Operator	17.86	"
Supervisor	21.21	"
Senior Supervisor	29.04	"
Diver	74.80	"

Material Cost
(Market Price)

Items	Unit	Unit Priece	Remarks
Cement Type I	tons	145.00	At site
Sand	M3	8.80	"
Stone/Aggrigate 25MM	M3	7.70	"
" 40MM	M3	7.10	"
Graded Aggregate CBR 720	M3	14.08	"
Ready mixed Concrete			
- 210 kg/cm^2	M3	86.30	"
- 180 kg/cm^2	M3	83.60	"
- 100 kg/cm^2	M3	71.50	"
Reinforcing Bar (Deformed)	tons	530.00	"
Wire Mesh ϕ6MM, 150x150	tons	1,067.00	"

Material Cost
(Yearly arrangement with PWD)

Items	Unit	Unit Priece	Remarks
River stones	M3	5.50	within 8 km
Fine Sand	M3	6.50	within 8 km
Ready mixed Concrete			
- 20MPa = 204 kg/cm^2	M3	61.96	At site
- 25MPa = 255 kg/cm^2	M3	67.96	"
- 30MPa = 306 kg/cm^2	M3	74.96	"
Concrete Block (Open End Type)			
- 200x200x400	Nos	0.63	Ex-factory
- 150x200x400	Nos	0.50	"
Concrete Pipe			
- ϕ 150	M	8.35	Ex-factory
- ϕ 305	M	18.75	"
- ϕ 915	M	101.35	"

Equipment Cost
(Leased out by PWD)

Items	Hourly Rate (F$)	Remarks
Trailer 4t	6.24	Direct cost for equipment only
" 6t	6.78	"
Truck with Crane 4t	8.62	"
Dump Truck 8t	11.88	"
" 11t	12.60	"
Bull Dozer D6	45.00	"
" D4	40.00	"
Motor Grader	49.17	"
Truck Crane 5t	40.00	"
Diesel Welding Machine 300A	10.69	"

Equipment Cost
(Market Price)

Items	Unit	Unit Price	Remarks
Trailer 4t	Hourly	8.00	Direct cost for equipment only
Dump Truck 6t	"	11.00	"
" 11t	"	15.00	"
Bull Dozer D7	"	48.00	"
" D6	"	38.00	"
" D5	"	32.00	"
Wheel Loader 1.6M3	"	38.00	"
Motor Grader 3.7M	"	38.00	"
Back Hoe 0.2M3	"	28.00	"
Crene 15t	"	20.00	"
Engine Welder 300A	"	300.00	"

Appendix H Wave Hindcasting

(Design Wave Hight and Calmness during rough weather condition)

1. Wave Height during Rough Weather Condition

1-1. Tropical Cyclone at the Lautoka Harbor

1-2. Design Wave Height at the Lautoka Harbor

(1) Wave Hindcasting

(2) Design Wave Height at the Lautoka Fishery Port

(3) Calmness in the Harbor Area during Rough Weather Condition

1. Wave Height during Rough Weather Condition

1-1. Tropical Cyclone at the Lautoka Harbor

Generally, there are no heavy wave condition surrounding Fiji Island Area, that south-east trade wind predominate.

It is caused by that land breeze flow at nnorthern costal area of Viti Island situated on the leeward.

It is recognized that high wave occur by tropical cyclone mostly.

Less than a few tropical cyclone attack Fiji Island(within 500Km area). The center wind of the cyclone flow strongly like Storm or Hurricane, but the scale of these cyclone is comparatively small.

Therefore, there are few cyclone with heavy disaster at the Viti Levu and Vanua Levu.

Based on the Report of Fiji Meteorological service(Reference No.3), the courses of typical Cyclone during 1969~1980 are drawn in Fig-1.

As mentioned in preceding section, Lautoka harbor is sheltered by Malolo Barrier and Mawanutha reefs from offshore wave. Therefore, three is no possibility that offshore wave influences Lautoka harbor, except West to South-West winds flow.

In case of that West to South-West winds flow at Lautoka offshore during tropical cyclone, the center of cyclone is situated between SSE and SE direction of Lautoka.

In addition to the above, it is necessary condition for occuring of high wave action that center of cyclone has to be located near Lautoka.

From Fig.-1, five number of cyclone which have passed through SSE ~SE direction of Lautoka are read during twelve years, that is No.2, No.5, No.7, No.12, and No.15.

Fig.-2～Fig.-5 present distribution of wind and weather map of these cyclone except No.5 cyclone which didn't grow up.
"Wind force" indicated on Figure is defined as follows.

Gale force : 34～47 knots
Storm force : 48～63 knots
Hurricane force : 63～ knots

Isobars on Weather map are estimated from each wind distribution and the Center atomospheric pressure of the cyclone.

It is seen from Fig-2 ～Fig-5 that only Hurricane "Meli" and "Bebe" among five cyclones during 12 years grew up as Gale and Hurricane force at Lautoka offshore.

As explained the above, high wave action caused by wave direction of WSW is limited at the Lautoka. Typical cyclone to be coped with above condition attack Lautoka once for several years.
Therefore, it is difficult to examine maximum wave height statistically.
Thus, it is recommended that design wave height is adopted by mean of maximum wave height in the past.
In this regard, "Bebe" of No 2 cyclone is perfectly satisfied with above condition among nominated fine number of cyclone.

In order to find the same with "Bebe" cyclone, previous data were checked by "Fiji, Nautical Almanac, Fiji Martime Department". However,the same course of its cyclone could not be found even for the similar type.

Finally, it is determined that design wave height is calculated by the data of Hurricane "Bebe".

1-2.Design wave Height at Lautoka Fishery Port

(1) Wave Hindcasting

Based on the Fig.2-1, distribution of wind are estimated on 24th noon as shown on Fig.2-2. Meteorological condition of "Bebe" are presumed on 24th noon as follows.

Atmospheric pressure of the center cyclone: 945mb

The eye of the cyclone in diameter : Approx. 65Km

Maximum wind speeds : 80Knots

Hereunder are consideration of meteorological condition to be read from weather chart.

—Wind direction in the area of left half circle become NE to ENE during approach to Lautoka. While, wind direction change towards SE to W after Cyclone passed Lautoka.

—Maximum wind speeds of 33m/sec is estimated at Lautoka offshore based on Fig.2-2.

—Average distance for estimating maximum wind speeds is adopted to that for cyclone speed, which is 20Km.

—"rm" on the Figure is presumed to be radius of cyclone eye, which is 30Km.

From the all of above finding, offshore wave height is obtained by mean of max wind speeds and effective fetch using S-M-B method as follows.

Maximum wind speeds: 33m/se. Effective Fetch : 11Km
Wave height(Ho) : 2.5m. Wave period (T) : 4.6sec.

(2) Design Wave Height at Lautoka Fishery Port

·Design wave height in front of the harbor can be calculated by using the following formula.

$$H = Ho \cdot Kr \cdot Ks$$

Where. H : Design wave height in front of the harbor
Ho : Deep water wave height
Kr : Refraction coefficient
Ks : Diffraction coefficient

Kr= 0.94 is obtained by Fig-6 of refaction Figure and Ks= 0.95 is read from Figure using Water depth h= 3.0 m and T= 4.8sec.

Thus. design wave height is obtained below.

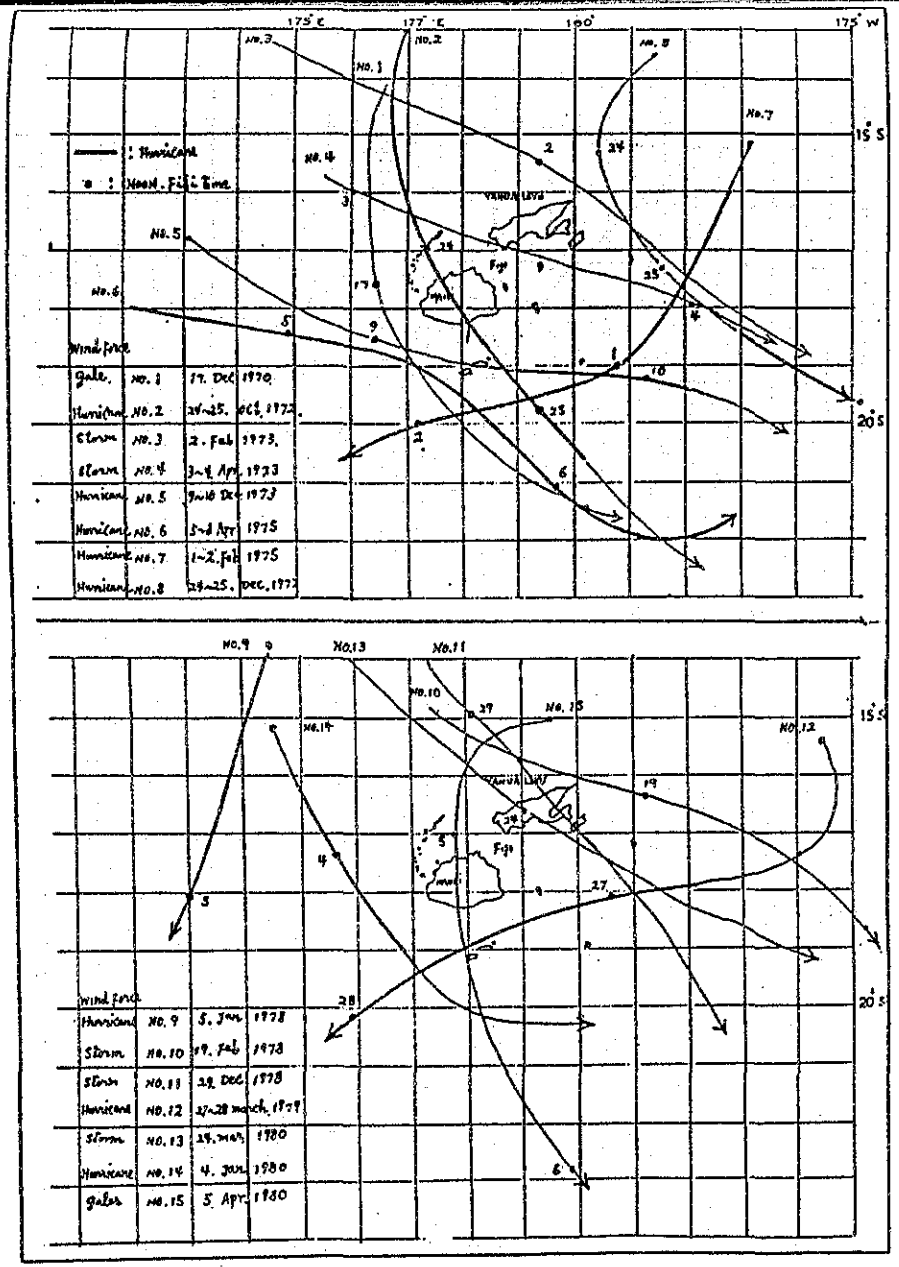
$$H = Ho \cdot kr \cdot Ks$$
$$= 2.50 \times 0.94 \times 0.95 = 2.2m$$

(3) Calmness in the Harbor Area during Rough Weather Condition

Fig.7.1 ~Fig.7.4 illustrate distribution of wave height in the harbor area for the three case mentioned in the preceding section.

Above Calculation condition are as follows.

Design wave Height in front of the Harbor	:	H = 2.2 m
Wave period	:	T = 4.8 sec
Wave direction	:	260°
Average Depth	:	h = 3.6m (MHW)
Maximum value of the parameter	:	Smax= 25



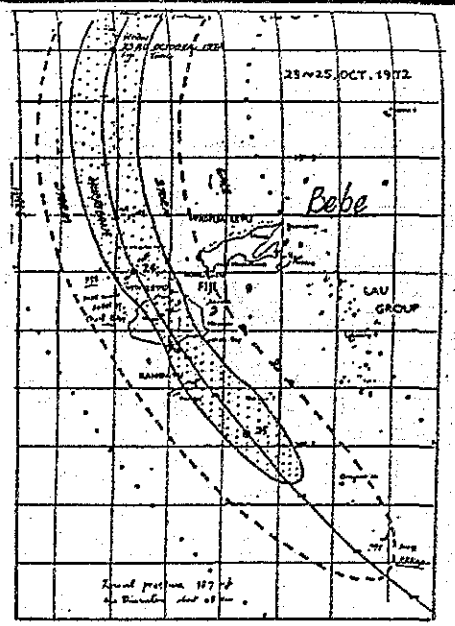


Fig. 2-1 Cyclone Track and Pressure map

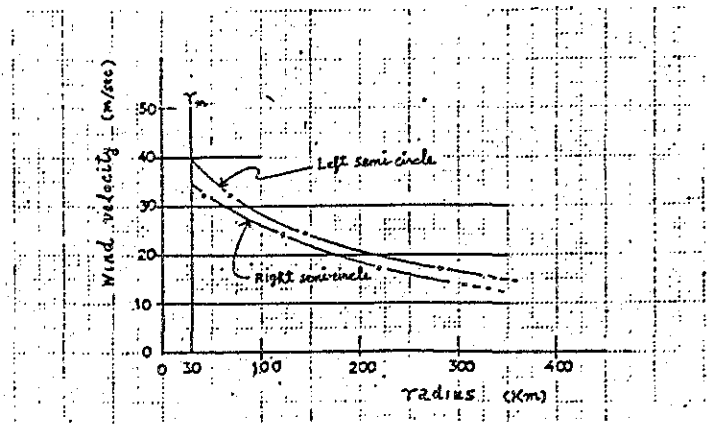


Fig. 2-2 Wind Speed in Cyclone

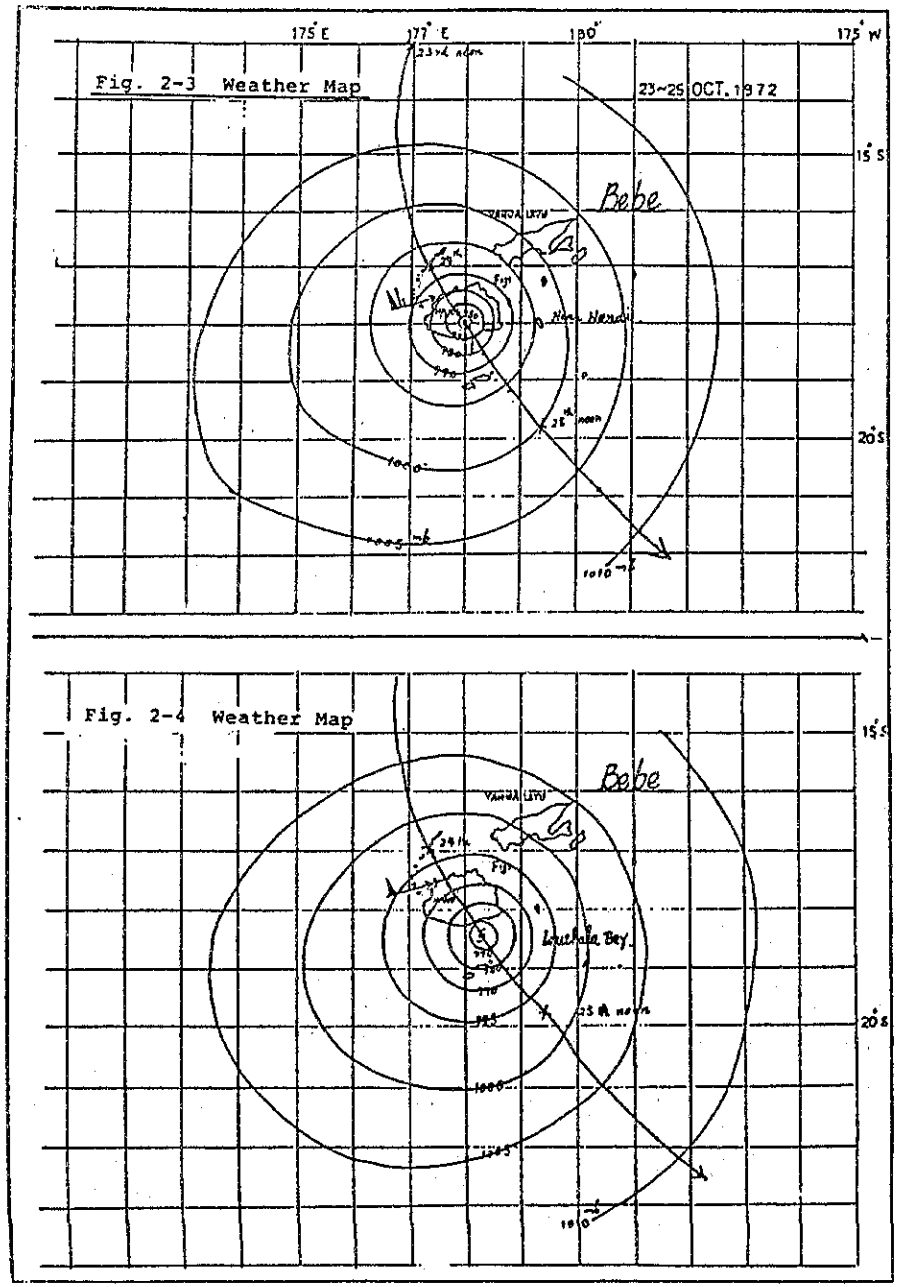
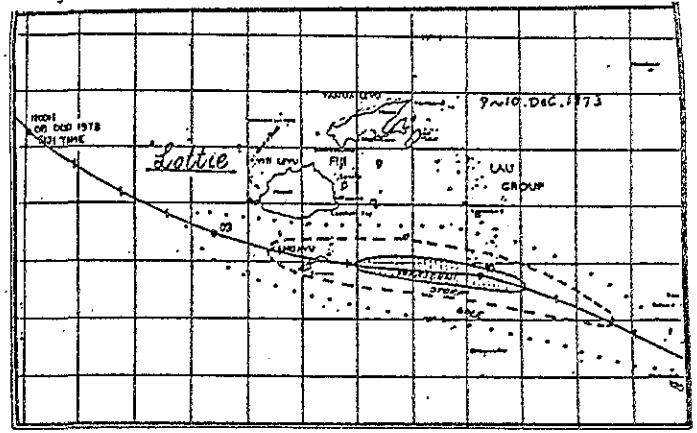


Fig. 2-3 Weather Map 23~25 OCT. 1972

Fig. 2-4 Weather Map

Fig. 3-1 Course of tropical Cyclone and pressure Map



(from Ref. no. 3)

Fig. 3-2 Weather Map

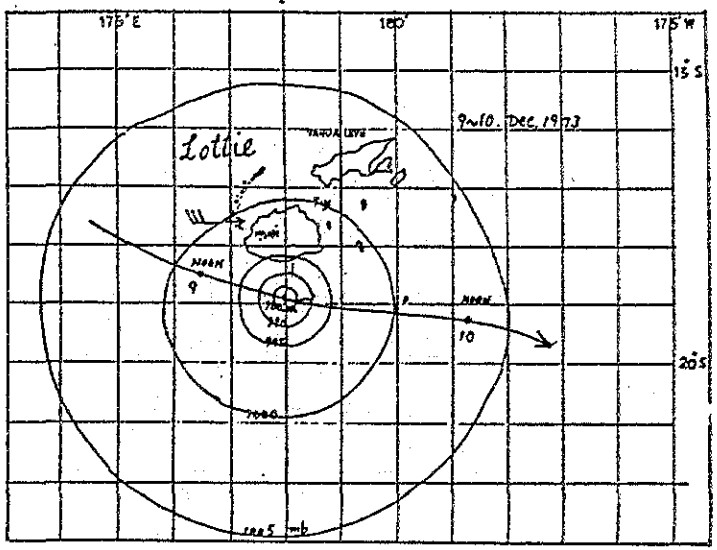
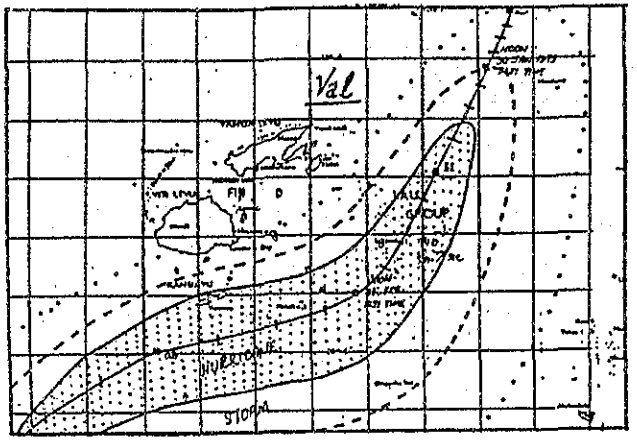


Fig. 4-1 Course of tropical Cyclone and Wind Force Map



(from Ref No.3)

Fig. 4-2 Weather Map

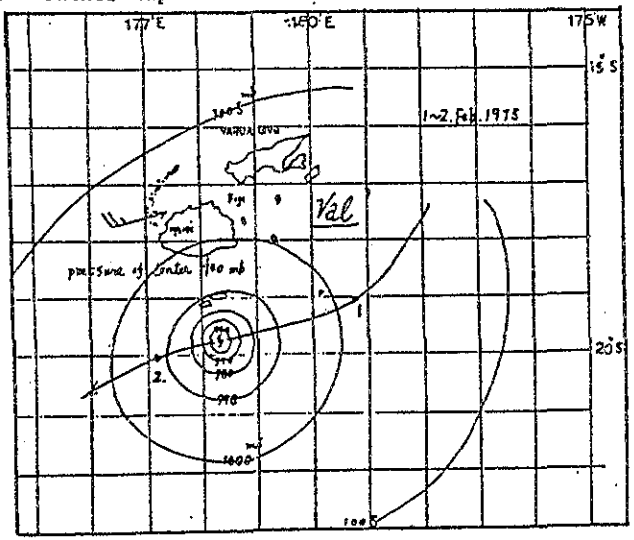
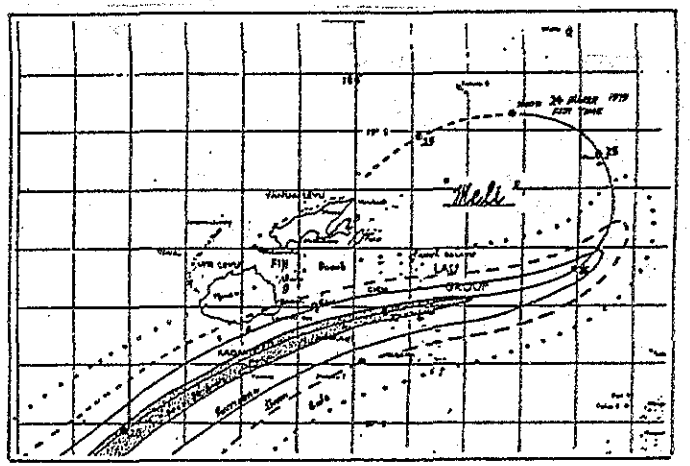
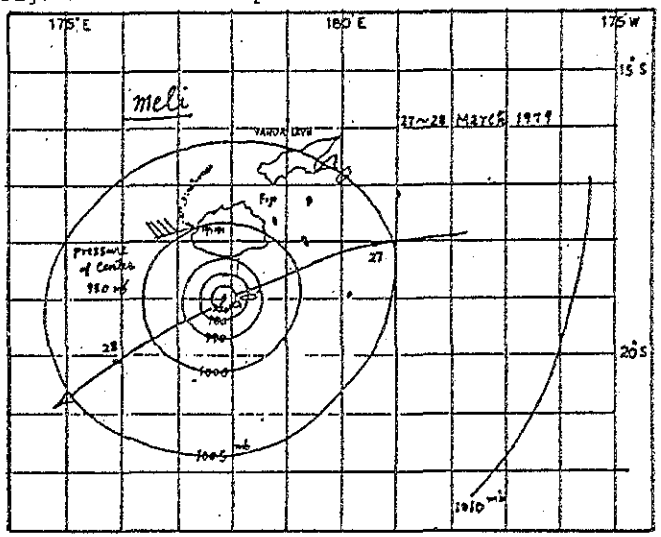


Fig. 5-1 Course of tropical Cyclone and Wind Force Map



(from Ref No 3)

Fig. 5-2 Weather Map



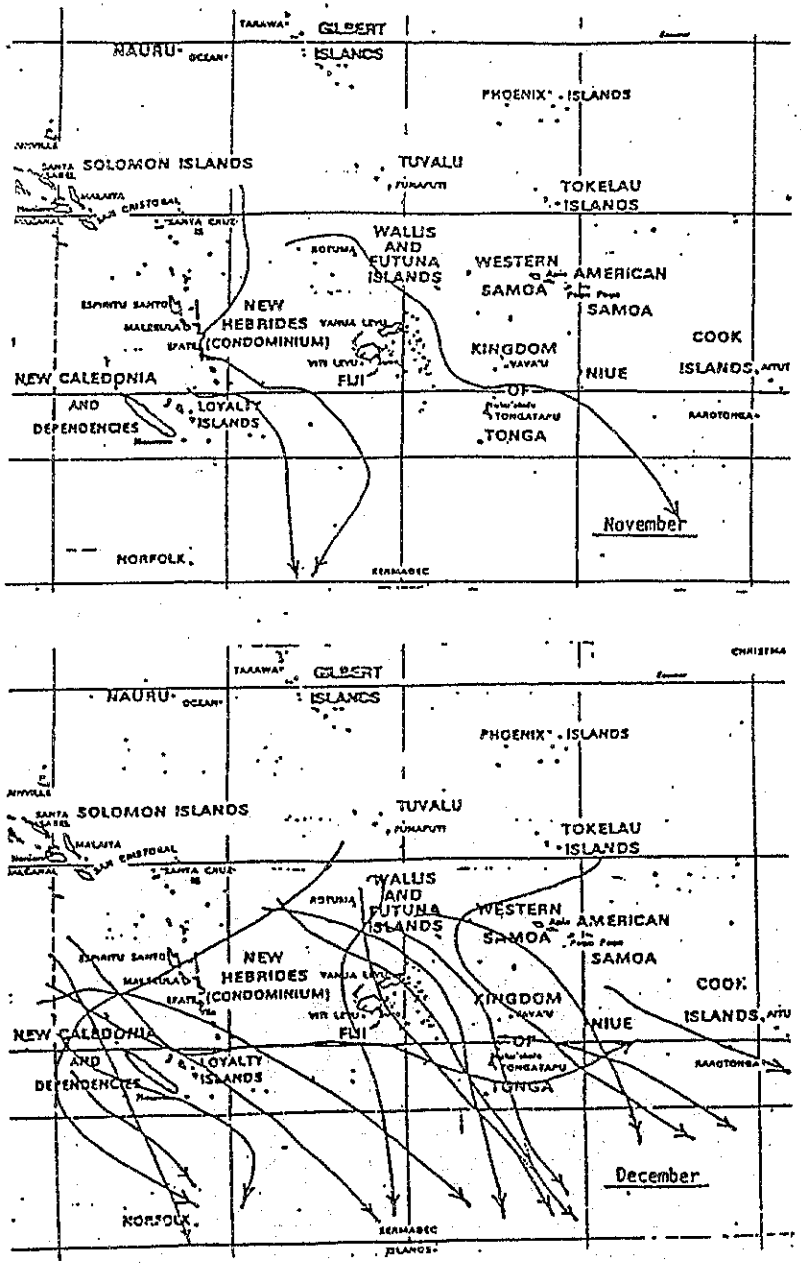


Fig. 5 (1): Courses of Hurricane.
(Source: Fiji, Nautical Almanac, Fiji Maritime Department)

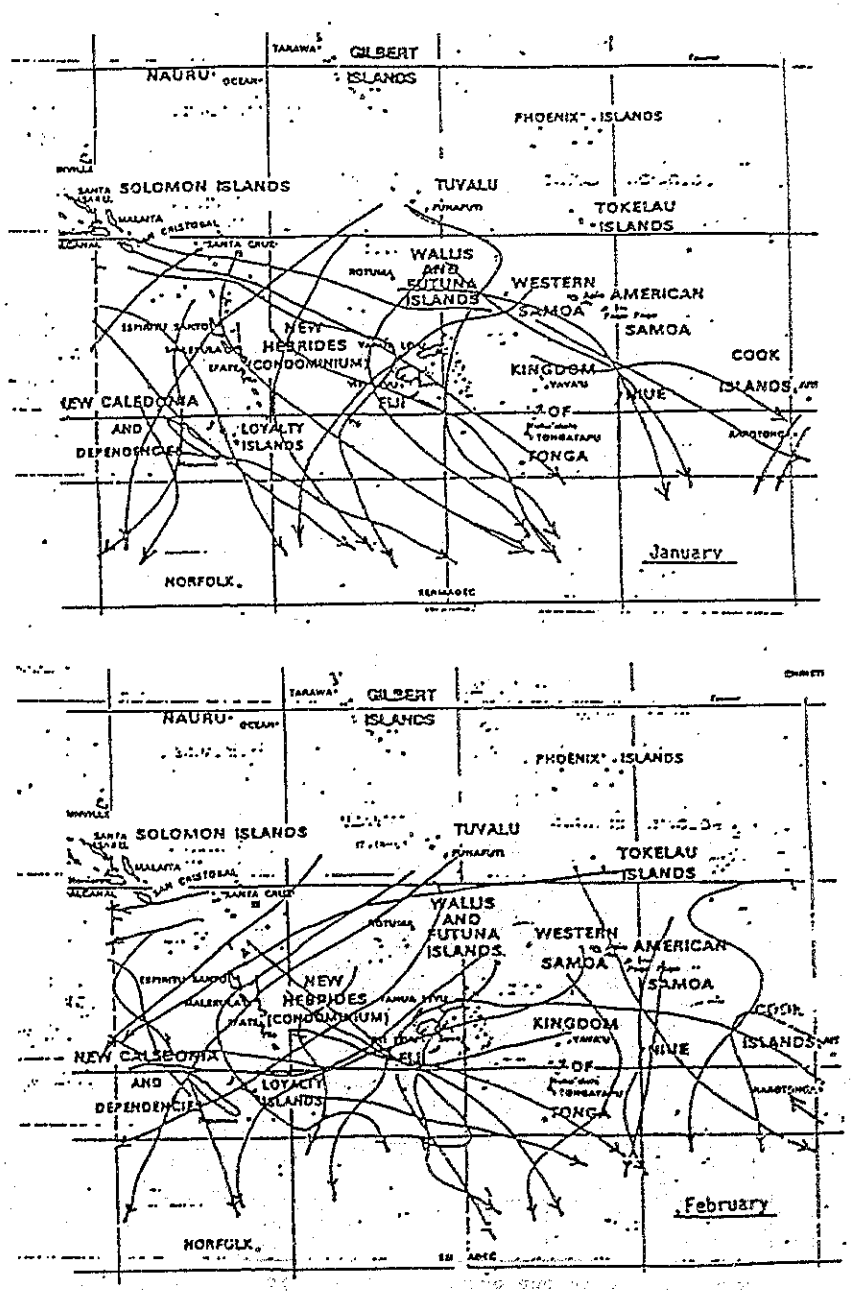


Fig. 5 - (2): Courses of Hurricane.

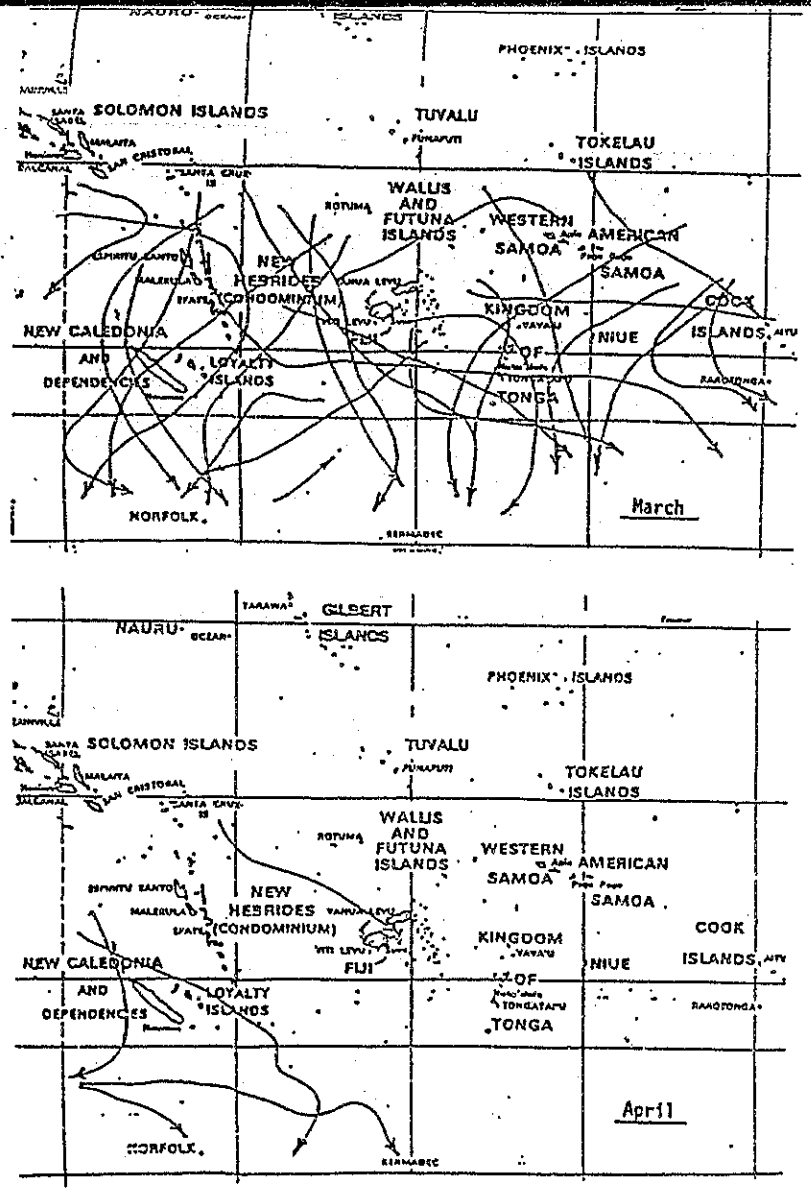


Fig. 5 (3): Courses of Hurricane

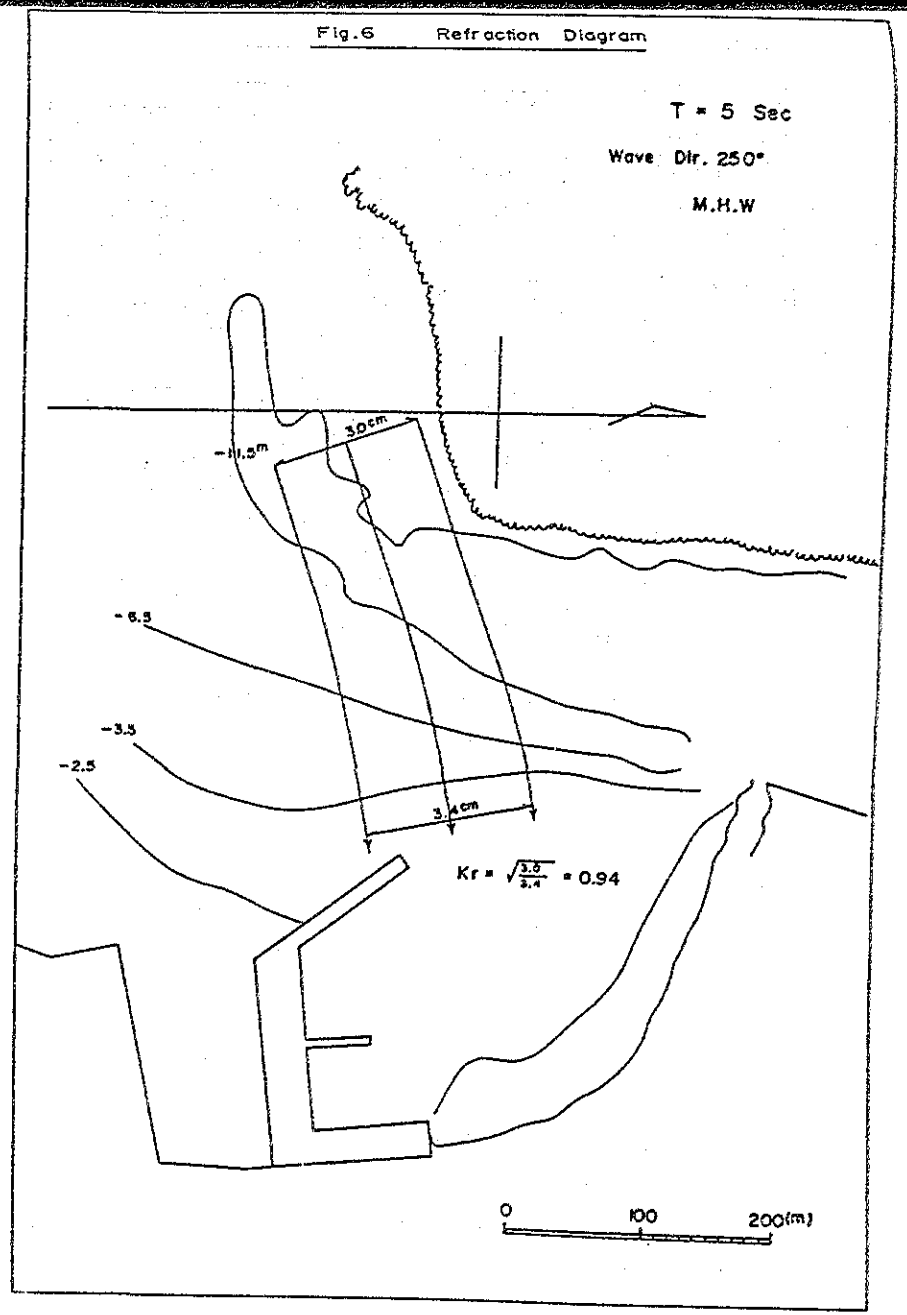


Fig.7-1 WAVE CALMNESS (CYCLONES) CASE A

M.H.W
Smax = 25

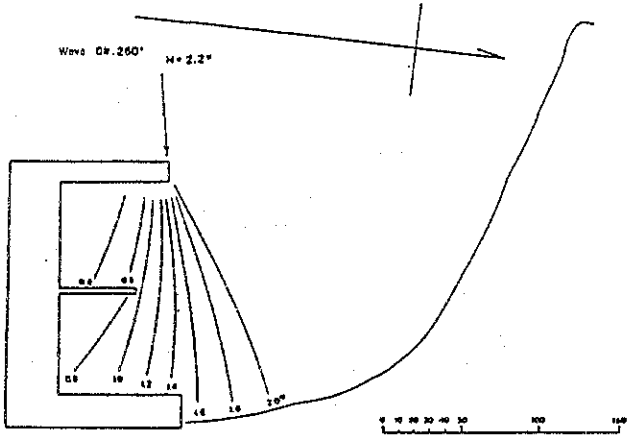


Fig.7-2 WAVE CALMNESS (CYCLONES) CASE B

M.H.W
Smax = 25

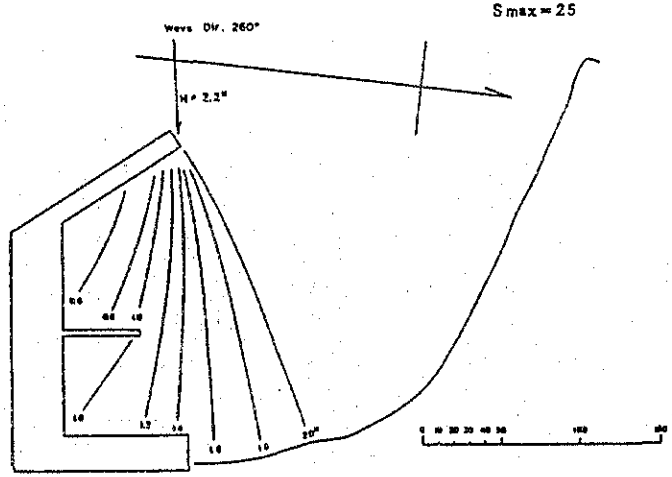


Fig.7-3 WAVE CALMNESS (CYCLONES) CASE C

M.H.W
Smax = 25

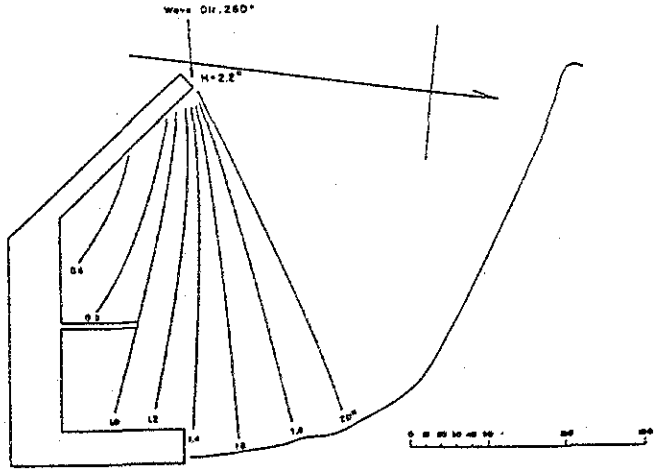
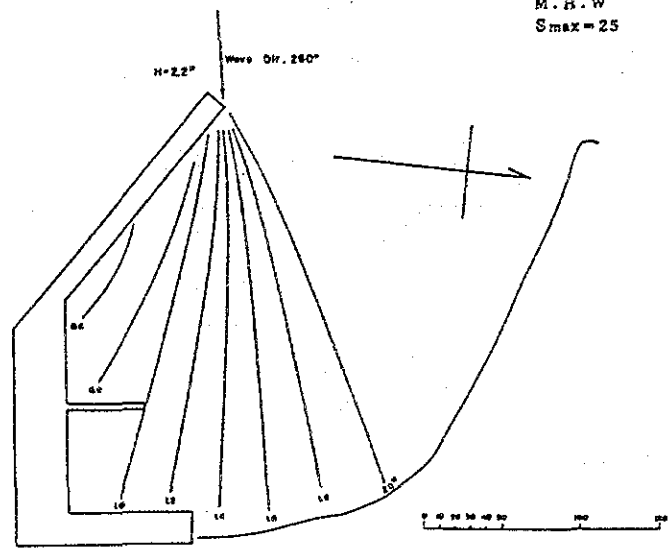


Fig.7-4 WAVE CALMNESS (CYCLONES) CASE D

M.H.W
Smax = 25



Appendix I Analysis of Calmness

1. Wave Hindcasting

1-1. Estimation of Sea Surface Wind
1-2. Wave Hindcasting

2. Calmness in Harbor Area and Effective Working Ratio

1-1. Estimation of the sea surface wind

According to Fiji Meteorological Service Technical Note No.19 (refer to No.1 literature), wave charactor surrounding Fiji is indicated that frequency of swells from S~SW direction which seems to influence Lautoka harbor is little and for the most part is less than 1.0m wave height.

For the above reason, it seems that these swells are abated vigorously due to obstruction by islands of Mamanuca Group.

Therefore, it is considered that the most wave influencing Lautoka habor occur in the sea surrounding circular coral reef.

At standing of this point, wave hindcasting in front of Lautoka harbor is carried out based on the data of NADI airport.

From hourly average wind speeds Table at NADI Airport (refer to No.2 literature), it is found that wind blows strongly during day time but weakly during night time thru the year because of predominant landand and sea breeze.

However, the most wind speeds is less than 9m/sec. from the frequency distribution Table.

Though there is no strong wind in this sea area, maximum gust of average 28.4m /sec. have been recorded on January 14, 1981 at NADI Airport by one of tropical storm or cyclone, which will occur for every a few years.

Distribution of the wind direction and velocity during 1950 ~1979 is summarized in attached Table-1.

From above Table, wind direction of 230° ~ 280° which influences Lautoka harbor is nominated in Table -1 with equivalent from frequency to percentage.

Hereunder are explanation of above literature.

No.1 Literature: "Wave climatology of waters page
Fiji Meteorological Service Technical Note No.19

From all the above finding, multiplying 1.5 times of wind data at NADI Airport is applied to this wave hindcasting.

Thus, multiplying 1.5 times of Table-1 is compiled on Table-2.

Table-1 Station Nadi Airport. Jan. 1960 to Dec.1979
Frequency % for Dir. 230° ~ 290°

V.V m/s / Dir.	1 ~ 3	4 ~ 5	6 ~ 7	8 ~ 9	10~11	12~14	15~	Total
230°	(351)	(277)	(104)	(16)	(1)	(1)	–	(750)
	0.200	0.158	0.059	0.009	0.001	0.001		0.428
240°	(542)	(383)	(153)	(27)	–	–	–	(1105)
	0.309	0.218	0.087	0.015				0.630
250°	(433)	(445)	(249)	(31)	(6)	–	–	(1164)
	0.247	0.254	0.142	0.018	0.003			0.664
260°	(721)	(1057)	(548)	(52)	(6)	(2)	(1)	(2387)
	0.411	0.603	0.313	0.030	0.003	0.001	0.001	1.362
270°	(1422)	(2761)	(1346)	(104)	(7)	(4)	(2)	(5646)
	0.811	1.575	0.768	0.059	0.004	0.002	0.001	3.220
280°	(1171)	(3296)	(1845)	(88)	(5)	(3)	(1)	(6409)
	0.668	1.880	1.052	0.050	0.003	0.002	0.001	3.656
290°	(936)	(2555)	(1665)	(102)	(14)	(6)	(2)	(5280)
	0.534	1.457	0.950	0.058	0.008	0.003	0.001	3.102
Total	(5576)	(10774)	(5910)	(420)	(39)	(16)	6	(22741)
	3.180	6.145	3.371	0.240	0.022	0.009	0.003	12.97

Total Numbers 175320

No. 2 Literature: "Extreme wind Gust in Fiji "
Data of Average wind speeds at NADI Airport, Fiji

In order to obtain wave height from wind data at NADI Airpot, the wind has to be changed to sea surface wind in the stage of estimating process.
A ratio between sea surface wind and land surface wind is different dependent on the location of an observatory, ie.coastal line or inner land area.
In case that wind blows from sea area toward land side, wind speeds on coastal area and inner area are obtained by multiplying 0.8 and 0.65 of sea surface wind speed respectively.

If wind blows strongly in such a case as Typhoon or Hurricane, It is generally said that above land surface wind speed reaches to the same as sea surface wind Speed.

In addition to the above, the following are applied in relationship between sea surface wind and land surface wind by No.3 and No.4 Litereture.

- sea surface wind Speed becomes 1.25 ~ 1.35 times of that for land surface wind in case of strong wind from sea area towards land side.
- sea surface wind Speed becomes 1.5~1.6 times of that for land surface wind Speed in case of strong wind from land area towards sea side.
- In case of not so strong wind, sea surface wind Speed becomes 1.5 ~ 1.8 times of that for land surface wind.

No. 3 Literature: "Report of Defence Disaster Institute KYOTO University . by KOUDA and YAMAMOTO 5-A. 1962 "

No. 4 Literature: "Godske. C. L and others. Dynamic Meteorology and Weather forecasting. 1957 "

NADI Airport is located at approximately 1.5km from coastal line but each distance become different dependent on the direction. That is, distance upon WNW direction on the map is located near coastal line.
While, extent of WSW~SW direction is influenced by inner land area due to far distance from coastal line.

Table-2 Frequency of sea surface wind (yearly Average)

W.V m/s / Dir.	<2 ~ 5	6 ~ 8	9 ~ 11	12 ~ 14	15 ~	Total
230°	0.20	0.16	0.06	0.01	–	0.43
240°	0.31	0.22	0.09	0.02	–	0.64
250°	0.25	0.25	0.14	0.02	–	0.66
260°	0.41	0.60	0.31	0.03	0.01	1.36
270°	0.81	1.58	0.77	0.06	0.01	3.23
280°	0.67	1.88	1.05	0.05	0.01	3.86
290°	0.53	1.46	0.95	0.06	0.01	3.01
Total	3.18	5.15	3.37	0.25	0.04	12.99

1-2 Wave Hindcasting

(1) Determination of Effective Fetch

In principle, the S-M-B method, modified by the Wilson's 1965 formula, is applied for wave estimation using an effective fetch and wind speeds.

Effective fetch at every direction is obtained by the following formula because this sea area is located in the vicinity of foreland and many small islands.

$$Fe = \frac{\sum_{i=0}^{j} Fi \cos^2 i \, \Delta\theta}{\sum_{i=0}^{j} \cos i \, \Delta\theta}, \quad i = 0.1.2.3\cdots\cdots$$

where, Fe : Effective fetch length

Fi : Actual fetch length

$\Delta\theta$: Every 10 degree direction with extent of 30 degree both side from wind direction

Fig.-1 presents actual fetch for every direction from "O" point in front of Lautoka Harbor.

Effective fetch length are summed up for every direction in Table-2 using above formula.

Table-3 Effective Fetch

Wind direction	230°	240°	250°	260°	270°	280°	290°
Fe (km)	9	11	11	11	10	8	5

(2) Frequency Distribution of Deep-Water Wave Direction and Height

Frequency distribution of Deep-Water wave direction and height are obtained from Table-2 and effective fetch using S-M-B Method, as shown on *Table -3*.

However, offshore wave direction with range of 230° ~ 250° will be concentrated into a dection of 250° due to influence of Naikokoro Pt and wave direction of with range of 260 ° ~ 290° also be into 260° due to influence of Vio Island and Tivoa Island.

From Table-3, frequency distribution above two kind direction is arranged in Table-4.

Table-3 Frequency Distribution of Deep-water Wave Direction and Height at "O_1" point

Dir.	WIND vel. m/s	6～8	9～11	12～14	15～	Fe (km)
230°	H (m)	0.33～0.47	0.54～0.69	0.76～0.90	–	9
	T (sec)	2.3	2.7	3.1	–	
	n (%)	0.16	0.06	0.01		
240°	H (m)	0.36～0.51	0.59～0.75	0.83～0.98	–	11
	T (sec)	2.6	2.9	3.3	–	
	n (%)	0.22	0.09	0.02	–	
250°	H (m)	0.36～0.51	0.59～0.75	0.83～0.98	–	11
	T (sec)	2.6	2.9	3.3	–	
	n (%)	0.25	0.14	0.02	–	
260°	H (m)	0.36～0.51	0.59～0.75	0.83～0.98	1.06～	11
	T (sec)	2.6	2.9	3.3	3.5	
	n (%)	0.60	0.31	0.03	0.01	
270°	H (m)	0.35～0.49	0.58～0.72	0.80～0.94	1.02～	10
	T (sec)	2.4	2.7	3.2	3.4	
	n (%)	1.58	0.77	0.06	0.01	
280°	H (m)	0.32～0.45	0.52～0.66	0.72～0.85	0.92～	8
	T (sec)	2.2	2.7	3.0	3.1	
	n (%)	1.88	1.05	0.05	0.01	
290°	H (m)	0.26～0.37	0.42～0.53	0.58～0.69	0.74～	5
	T (sec)	2.1	2.3	2.6	2.8	
	n (%)	1.46	0.95	0.08	0.01	

Table-4 Frequency Distribution of Wave Direction and Height in front of harbor (O_1 point)

H(m) / Dir. T(sec)	0.3 ～ 0.4	0.4 ～ 0.5	0.5 ～ 0.6	0.6 ～ 0.7	0.7 ～ 0.8	0.8 ～ 0.9	0.9 ～ 1.0	1.0～
	2.2	2.5	2.6	2.8	3.0	3.2	3.3	3.5
250°	0.44	0.28	0.21	0.16	0.06	0.05	0.02	–
260°	3.96	2.67	1.84	0.96	0.30	0.08	0.05	0.02

2. Calmness in Harbor Area and Effective Working Ratio

Calmness in harbor area and effective working ratio are examined for the following three case.

Length of Breakwater

case-A : 135 m
case-B : case-A + 35 m
case-C : case-A + 70 m

The most part of wave action in this harbor area are caused by wave energy between Tivoa Island and Naikorokoro. As indicated in Table-4. wave direction are stood for two kind direction of 250 ° and 260 ° Each case of distribution of wave height ratio are obtained by two kind wave direction as shown on Fig.2 ～Fig.5.
Thus. based on the above Figure. Fig.6～Fig.9 illustrate the effective working ratio under the condition of $H \leq 0.3m$.

There. calculation of diffraction coefficient are obtained from the diagram with $S_{max} = 10$ among diffraction diagrams by irregular wave.

Attached Table – 1 TABLE 3a SURFACE WIND SUMMARY*

STATION NAME AIRPORT JANUARY 1960 TO DECEMBER 1979

FREQUENCY TABLE FOR ALL OBSERVATIONS COMBINED

SPEED IN KNOTS WHERE 2 REPRESENTS 1 AND 2 KNOTS ETC.

DIR	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	37+	TOT
010	105	123	229	227	234	173	121	53	42	28	11	5	9	9	2	1	2	2		1615
020	99	161	243	241	195	172	139	68	31	31	8	9	3	6	1	1		1	5	1454
030	142	197	279	258	213	168	117	75	35	22	6	8	5	3	3		5	2	6	1534
040	140	174	235	172	105	86	57	22	17	9	1	3	1	2	7	2	3	2	2	1049
050	135	165	208	108	58	36	17	21	7	3	1				1	3		3		798
060	304	410	373	142	63	31	18	4	4	1				1	1		2	1		1377
070	333	472	439	145	65	41	9	9	3	2	1		1	1			1			1514
080	559	903	800	235	94	55	15	9	2	2	1		2							2874
090	1297	1958	2044	512	251	123	54	51	10	8	1	1								6332
100	2281	2196	2524	762	323	287	162	106	43	11	3	4			1	1				9904
110	1005	2148	2844	1321	939	578	310	177	71	12	7	2	1				1			9451
120	1466	2503	3796	2214	1732	1098	575	281	110	38	10	9	2	1		1				13935
130	858	1785	2781	2160	1582	854	458	192	58	34	6	1		1	2				2	10712
140	644	1257	2277	1674	982	509	223	95	36	19	1		1						1	7759
150	644	1367	2533	1514	666	279	161	68	17	2		1	1						2	7257
160	387	872	1886	998	487	265	128	67	19	9										5013
170	287	613	1256	645	371	303	160	99	17	5	1	1								3759
180	293	649	926	517	379	206	155	69	16	1	1		2						1	3125
190	150	257	464	257	206	158	92	79	8						1				2	1615
200	102	184	365	237	185	161	74	121	5	2			1							1222
210	118	197	336	238	157	138	66	50	4			1	1				1		1	1319
220	82	159	228	174	124	82	36	17	1	2		1	1							937
230	52	111	169	143	114	63	43	35	1	1				1						755
240	95	156	293	214	169	113	60	21	6											1195
250	70	115	268	229	216	183	49	26	5	3	3									1154
260	77	193	451	314	269	200	148	60	12	6		1	1		1					2327
270	167	329	926	1260	1493	1014	342	89	15	6	1	1	1	2	1				1	5665
280	93	265	813	1297	1933	1355	490	78	10	4	1	1	2		1					6639
290	59	219	657	1112	1543	1217	448	57	20	12	2	3	2	1	1	1				5210
300	154	276	559	873	1312	1020	427	129	24	10	3	4	4		4					4961
310	87	169	359	451	619	561	270	75	23	7	2	1	2		1					2617
320	95	180	336	396	453	394	236	91	29	11	3	4	4	3						2235
330	131	229	445	490	357	460	228	137	46	25	5	1	2							2756
340	128	203	411	389	452	445	256	126	43	21	8	4	1	2	1					2457
350	83	196	307	352	377	341	216	136	64	26	6	4				1			1	2054
360	133	182	372	324	375	281	210	137	57	36	6	6	3	1	4	1	1	1	8	2140
TOTAL	11778	21432	33410	23093	19481	13782	6378	2780	901	411	99	76	55	34	33	12	16	12	32	
																		CALM		41125
																		TOTAL		175329

* Table courtesy of New Zealand Meteorological Service

Fig. 1 FETCH LENGTH

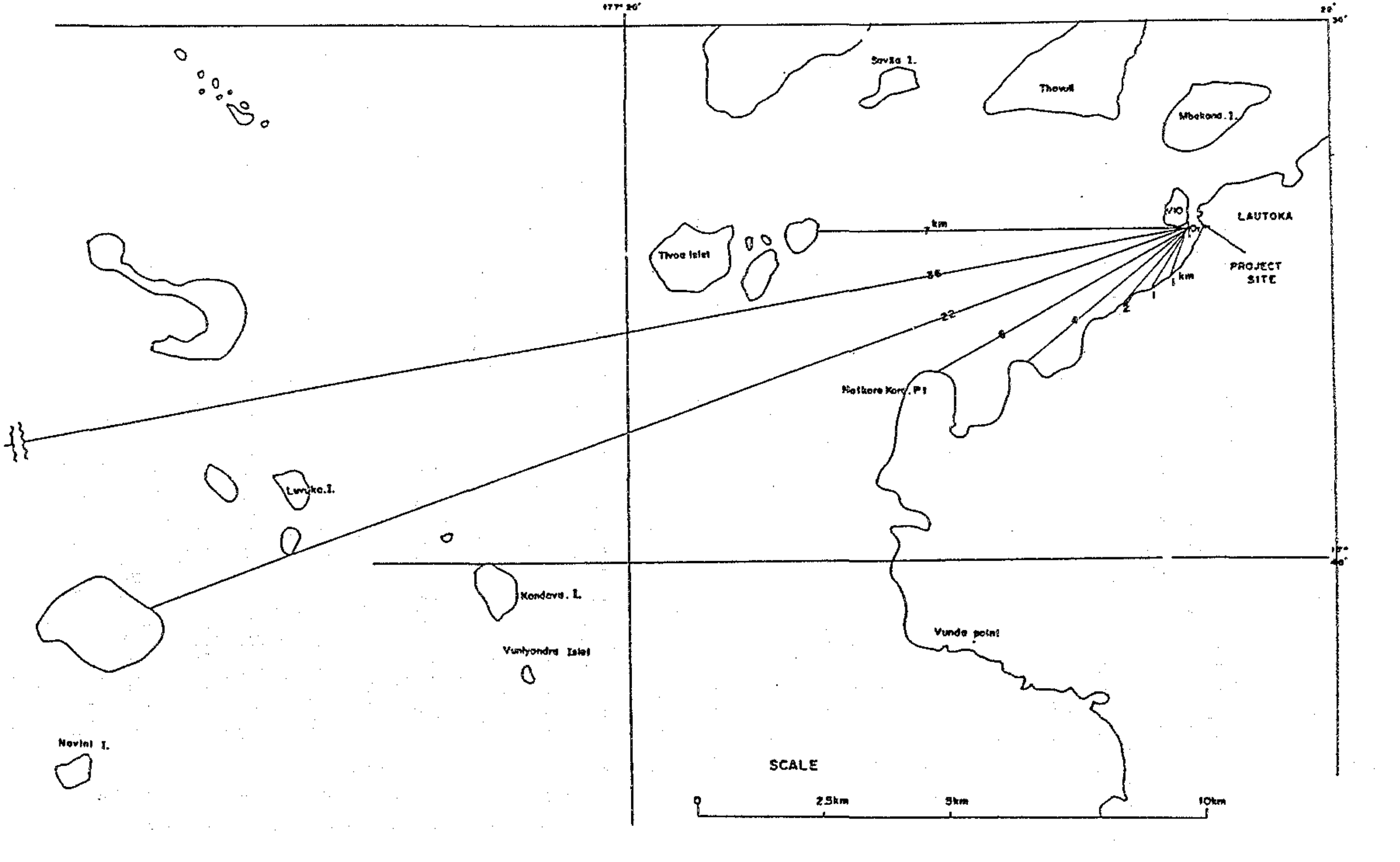


Fig. 2 (1) WAVE CALMNESS IN THE PORT Type "A"
mean sea level
Smax = 10

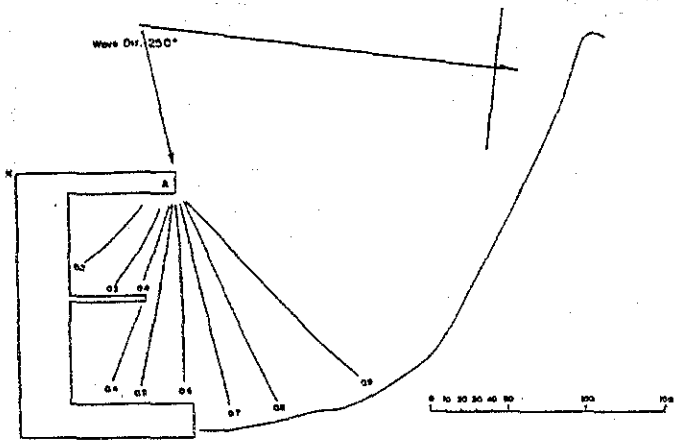


Fig. 2 (2) WAVE CALMNESS IN THE PORT Type "B"
mean sea level
Smax = 10

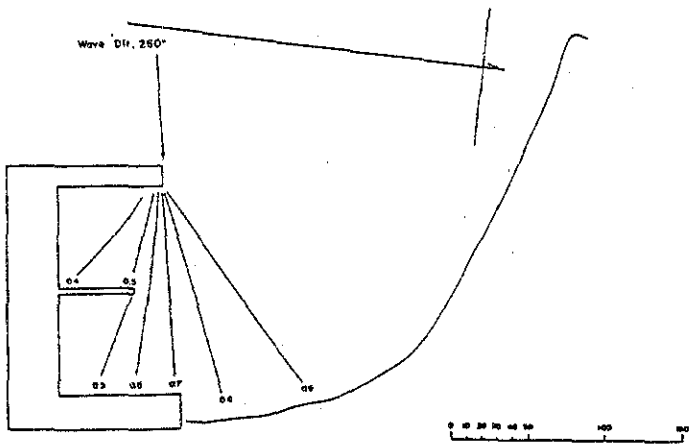


Fig. 3 (1) WAVE CALMNESS IN THE PORT Type "B"
mean sea level
Smax = 10

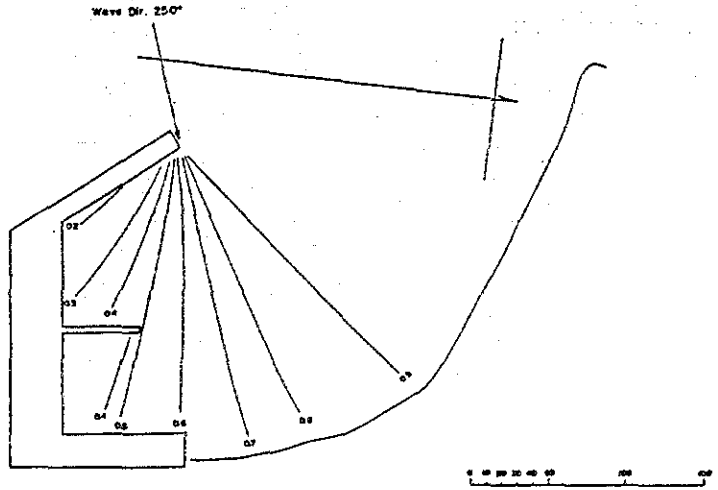


Fig. 3 (2) WAVE CALMNESS IN THE PORT Type "A"
mean sea level
Smax = 10

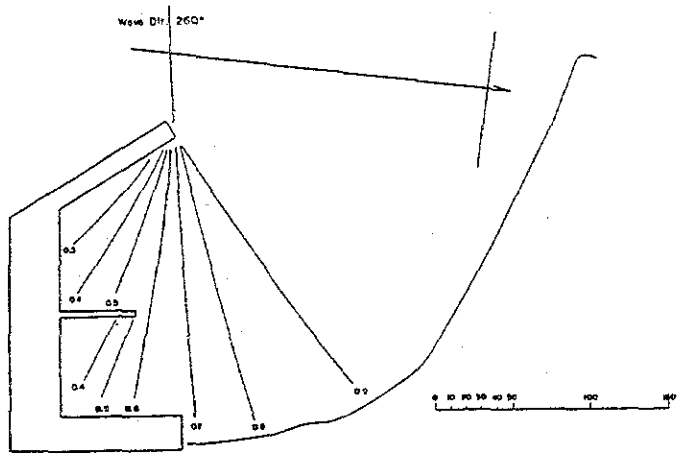


Fig. 4 (1) WAVE CALMNESS IN THE PORT Type "C"

mean sea level

Smax = 10

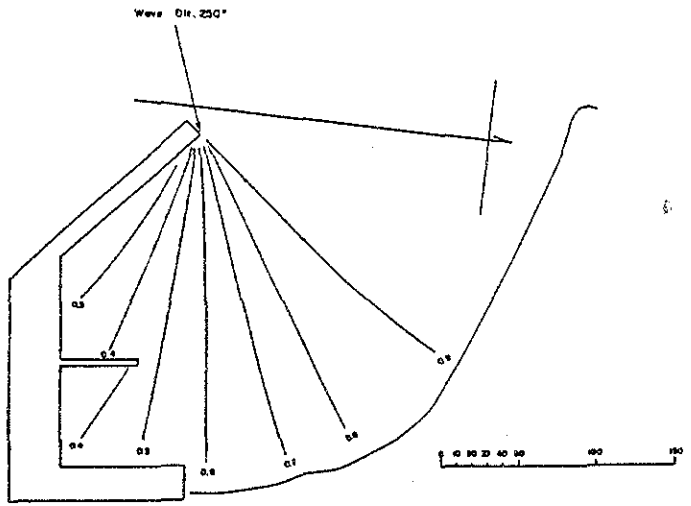


Fig. 4 (2) WAVE CALMNESS IN THE PORT Type "C"

mean sea level

Smax = 10

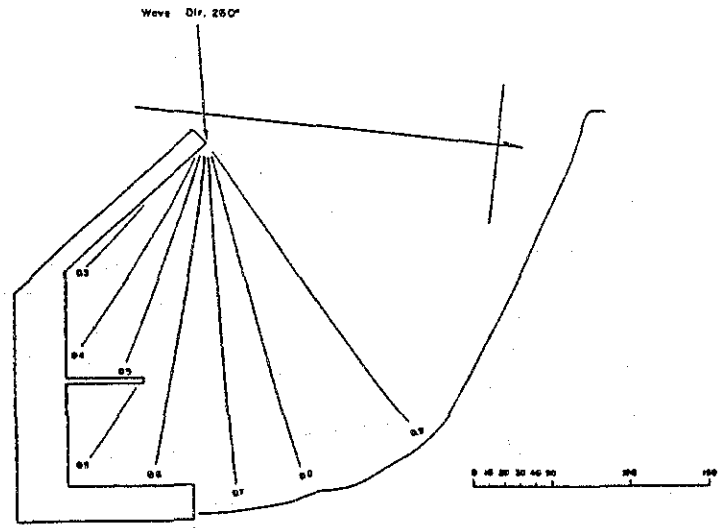


Fig. 5 (1) WAVE CALMNESS IN THE PORT Type "D"

mean sea level

Smax = 10

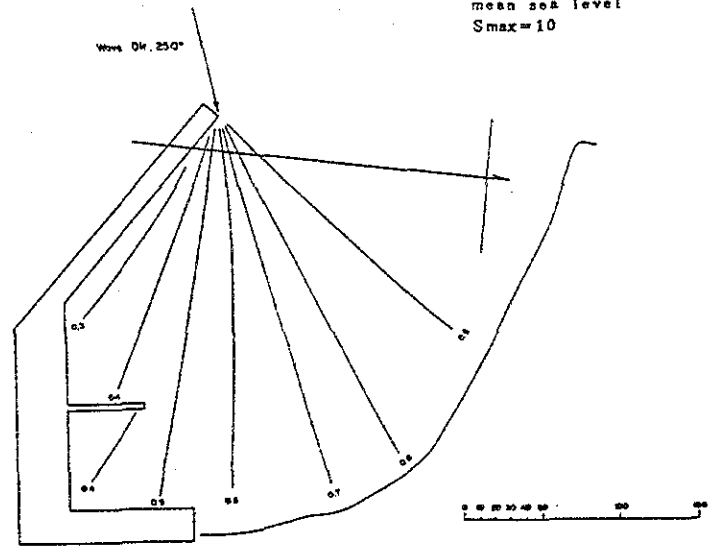


Fig. 5 (2) WAVE CALMNESS IN THE PORT Type "D"

mean sea level

Smax = 10

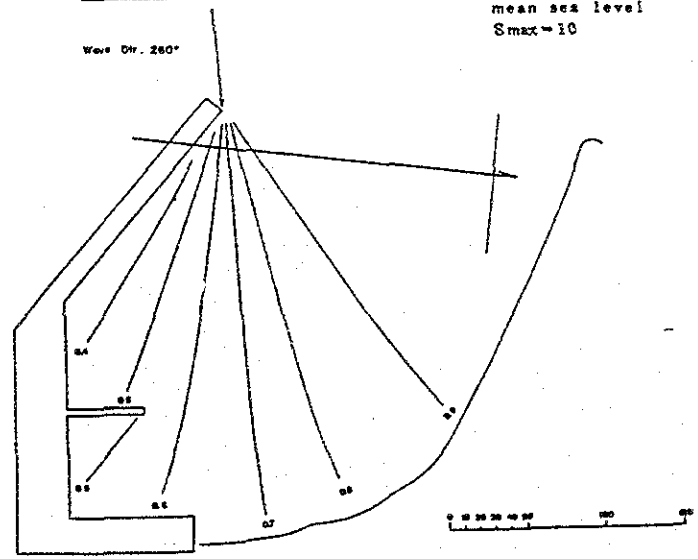


Fig. 6 WORKABILITY Type "A"
(H≤0.3 m)

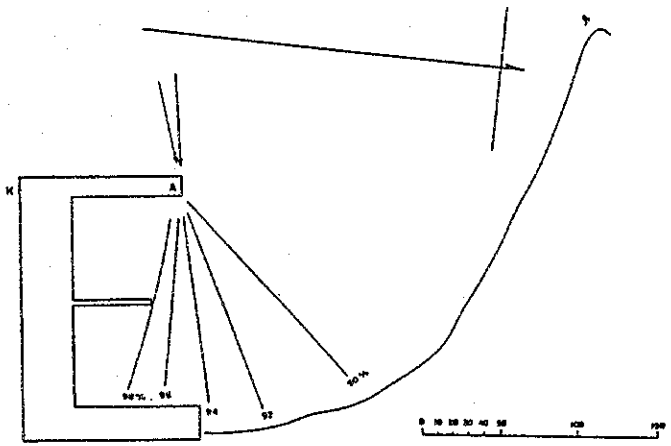


Fig. 7 WORKABILITY Type "B"
(H≤0.3 m)

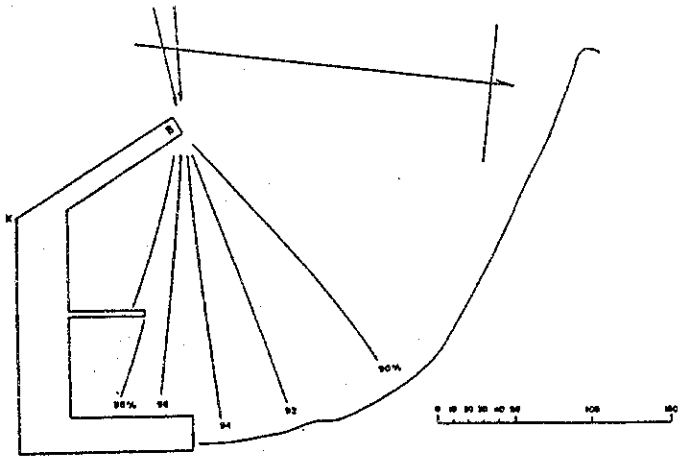


Fig. 8 WORKABILITY Type "C"
(H≤0.3 m)

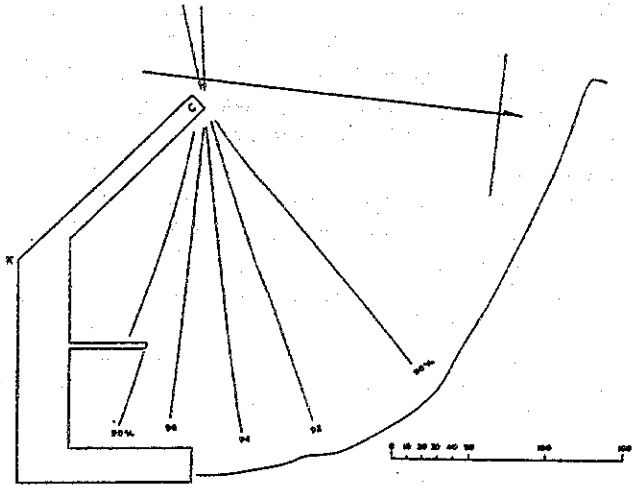
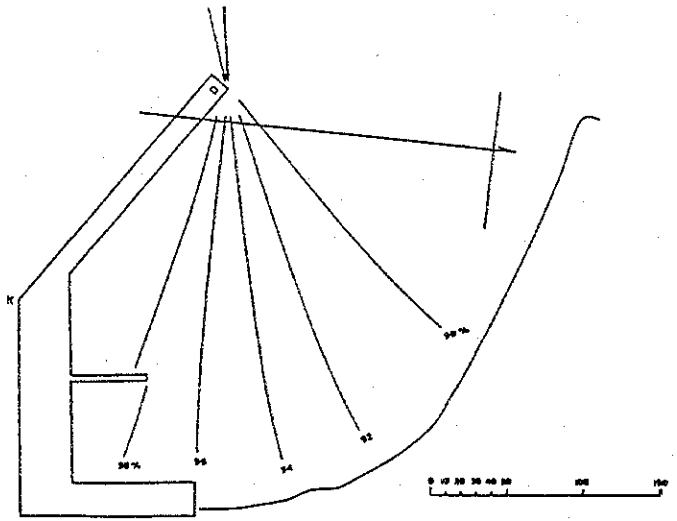


Fig. 9 WORKABILITY Type "D"
(H≤0.3 m)



Appendix J. Analysis of Sand Drifting

C-1. Volume of coastal sand drifting
- (1) Wave at south and north of King's Wharf
- (2) Wave energy component E1 at coastal direction
- (3) Volume of sand drifting in the port

C-2. Volume change based on bathymetric survey results
- (1) In front of King's Wharf
- (2) In front of Queen's Wharf
- (3) Sea-bottom sampling

C-3. Sedimentation in the dredged fairway
- (1) Sedimentation without breakwater
- (2) Sedimentation with breakwater

C-4. Environmental affection by breakwater

— General

Direction of wave at the site is limited to WSW ~WNW due to Vio Island, Naikorokoro Cape and Tivoa Island. Therefore, wave height is lower at PWD reclamation in the south and higher at sugar jetty in the north, mainly due to Vio Island. Under this circumstance, coastal drifting is prone to taking place from the point with higher wave height to that with lower one. Projection of reclaimed area for PWD into the seaward may have accelerated drifting in the secluded area.

All of these site conditions will easily produce sand drifting in the area, if there are frequent higher waves. However, as shown in Appendix H and I, the site has rarely such wave as causing large sand drifting due to diffraction by islands against predominant winds.

1. Coastal sand-drifting volume

Volume of coastal sand-drifting is proportional to component of energy transportation in coastal direction (E1). In order to compute the volume change, the sand drifting at a few points must be calculated. Therefore, E1 at points O_1, O_2 and O_3 will be computed, that wave at O_3 is as shown in Appendix I, and those at O_2 and O_3 are as below.

(1) Wave forecasting at O_2 and O_3

Table C-1.2 show wind frequency for speed and direction, effective fetch, and wave height and period computed by SMB method at point O_3, which is assumed 300m to the South of point O_2. It is seen that frequency over 0.3m wave height is higher by 2% than that at point O_1, in Appendix I.

At point O_2, waves approaching point O_1 with 250° ~ 260° direction will all have a direction of 250° due to diffraction at Vio island. Wave height ratio at points O_1 and O_2 is deemed equal to diffraction ratio (KD), which can be obtained by angular spreading method.

For wave of 250°, aproaching range is:

$$\theta_1 = \angle V_1\ O_1\ O'\ ,\ \sim \angle V_1\ O'\ ,\ O_1\ P$$
$$= 23° \sim -68°$$

θ_2 = $\angle V_1$, θ_2 P

= 0° ～ −70°

from the attached figure for Smax = 10 .

KD at θ_1 = 0.88

KD at θ_2 = 0.71

For wave of 280 ° , as with the above

θ_1 = 13° ～ −78°

θ_2 = −10° ～ −88°

KD at θ_1 = 0.80

KD at θ_2 = 0.62

Therefore, frequency of wave height at θ_2 can be obtained by that for θ_1 in Appendix I multiplied by 0.71 / 0.86 for 250 ° and 0.62/ 0.80 for 280 ° .

Table C-3. Frequency % of Wave height (θ_2)

H (m)	0.3 ～ 0.4	0.4 ～ 0.5	0.5 ～ 0.6	0.6 ～ 0.7	0.7 ～ 0.8	0.8 ～ 0.9
250°	4.55	1.37	0.67	0.20	0.09	—

(2) Computation of Ei

Ei is given by the following equation.

$$Ei = \frac{H_b^2 L_o W_o}{16T} \sin \alpha b \cdot \cos \alpha b \quad \cdots\cdots\cdots\cdots\cdots\cdots (1)$$

Where H = Wave height around breaking point

L_o , T = Off-shore wave length and period

W_o = Unit weight of sea water (1.03 t /m^3)

αb = Angle between wave crest and shore-line around breaking point

Therefore, when αb is known at each point, Ei can be calculated.

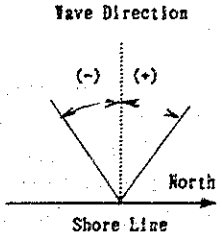
Around this area is 1.5 m of tidal range and lenient of sea-bed level shallower than 0.5m, which hardly gives exact shore-line shape and breaking point. Thus shore-line is presumed parallel to contour line of 0.5～1.0m, which is rather stable.

Water depth of breaking point is 0.5～ 1.0m under the conditions of 0.3～ 0.7m wave height and 3 sec. period. Therefore, littoral drift are taken place for approximate 12 hrs between MSL and LWL, and to water level of MSL CD+1.0m.

Table C-4 shows αb at each points, based on lines for wave crest and 0.5m water depth in Fig C-1.

Table C-4

Dir Wave	250°	260°	270°	280°	290°
θ_1	−29°	−19°			
θ_2	− 5°				
θ_3	−47°	−37°	−27°	−17°	− 7°



Refraction is however negligible due to small period. Inserting wave height, frequency, period and αb into equation (1) gives each Ei as below :

Point θ_1 :

$$\Sigma Ei = -\!- 0.15 \{ (\Sigma nH^2)_1 \sin (2\times 29°) + (\Sigma nH^2)_2 \sin (2\times 19°) \} \times 3.65 \times 12\times 3600 (t.m/yr)$$

$$-\!- 39380 (t.m/m.yr) \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots (2)$$

$(\Sigma nH^2)_1$: for wave with 250 ° direction = 0.330

$(\Sigma nH^2)_2$: for wave with 280 ° direction = 2.284

symbol(-) : for North direction of wave energy. (+) for South.

Point O_2 :

$$\Sigma Ei = -\!- 0.15 \{ (\Sigma nH^2)_1 \sin (2\times 47°) + (\Sigma nH^2)_2 \sin (2\times 37°) + (\Sigma nH^2)_3 \sin (2\times 27°) + (\Sigma nH^2)_4 \sin (2\times 17°) + (\Sigma nH^2)_5 \sin (2\times 7°) \} \times 3.65 \times 12\times 3600 = -\!- 60050 (t.m/m.yr) \cdots\cdots (3)$$

$(\Sigma nH^2)_1$ 、 $(\Sigma nH^2)_2$ ……、 $(\Sigma nH^2)_6$:

0.352, 0.396, 1.002, 1.227 and 1.282 for each wave direction of 250° , 260° , 270° , 280° and 290° , respectively.

Point O_2 :

$$\Sigma Ei = -\!- 0.15 (nH^2)_1 \sin (2\times 5°) \times 3.65 \times 12\times 3600$$

$$-\!- 5060 (t.m/m.yr) \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots (4)$$

$(nH^2)_1$: for wave with 250° direction 1.233.

(3) Volume change in the port

It is known that wave energy component of coastal direction E1 is related with littaral sand drift Qx by the following formula:

$$Qx = A \cdot E_1 \qquad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \quad (5)$$

Where constant A is 0.2 ~ 0.4 at the area with higher wave facing Off-shore, and 0.05 ~ 0.10 in the inner port with lower wave. In Lautoka, 0.05 ~ 0.10 is adopted. Volume of littoral drift sand is then calculated as below:

In front of PWD reclaimed area Q_3 : $Qx = 0.05 \sim 0.10\ E_1$
$= 0.05 \sim 0.10 \times 60050 = 3,000 \sim 6,000 m^3/yr$

In front of King's Wharf Q_1 : $Qx = 0.05 \sim 0.10 \times 39880 = 2,000 \sim 4,000 m^3/yr$

Sugar Wharf north Q_2 : $Qx = 0.05 \sim 0.10 \times 5060 = 250 \sim 500 m^3/yr$

Due to a certain range of constant A value, there must be some allowance in the absolute volume, but the tendency of littoral drift can be imaged. Difference in volume at 2 points gives littoral drift sand volume expected, ie. 1,000 ~ 2,000m^3 at the south side of King's Wharf, and 1,750 ~ 3,500m^3 at the north side. This phenomenon continue till sea-bed level being stable, that the King's Wharf front becomes shallower by drifted sand, which necessitates maintenance dredging to some extent.

C-2 Volume change based on bathymetric survey

(1) In front of King's Wharf

Although bathmetric survey at this area has been carried out in 1967, 1968 and 1980 by now, it is hard to discuss on volume change by littoral drift due to some maintenance dredging being done, the detail record of which is not available but may be discharged to FSC conveyor side, etc..

Since the direction of littoral drift seems to the north, discharged soil at FSC conveyor side, even if so, may not return to the area of King's Wharf front. Thus, the actual sedimented volume can be estimated to be sedimentation volume at present plus dredged volume.

Fig C-3 and C-4 show the profiles of sea-bed level from 1967 to 1980, and from 1968 to 1980.where the difference in level can be obvious such. This is indicative that maintenance dredging may have been conducted in 1968 in front of King's Wharf and in 1980 at the fairway. By this survey results, total volume change in this area is about 1000m^3 from 1967 to 1980 and 700m^3 from 1968 to1980, which leads that the actual sedimented volume may be the order of 10,000 ~20,000m^3added by the presumed dredgy volume.

(2) In front of Queen's Wharf

It is said that there is a tendency of sedimentation in front of Queen's Wharf. Because of low wave height behind Vio Island and about 10m deep water depth, sea-bed soil may not be moved by the wave.However, suspended soil disturbed by higher wave from WSW around FSC sugar jetty and the proposed site may be transported by current and sedimented in the canal. In the ordinary time, the current speed there is 15cm/sec, which may not be strong enough to transport the soil.

Bathymetric survey was conducted here in 1962, 1968 and 1979. Under less dredging, the change of sea-bed level profile is probably due to the natural phenominum. Fig C-5 and -6 shows the water depth change from 1962 to 1979 and from 1968 to 1979, respectively, where the average is 20cm. In general, it can be said of less change in sea-bed level. The total volume change is 900 $m^3$from 1968 to 1979, and -17,000m^3 from 1962 to 1979. The errosion can be observed at the mouth of canal, which may be by the extraordinary current of about 2 knots, which is reported as a experience by the master in the port.

In order to grasp the phenominal condition of current and sea-bed charge, it is recommendable to exercise the constant observation in this area.

(3) Sea-bottom sampling

Analysed results of sea-bottom sampling is attached hereinafter, which shows the classification of silty fine sand with 0.1mm D50, except at the coastal area between King's Wharf and PWD reclaimed area, that sand and gravel are found around the disharge pipe of" Bagasse" from FSC. Due to ordinary small wave, such a varied distribution of sea-bottom in a small area may be taken place. Thus, distribution of sea-bottom soil is mainly dependent upon the abnormal higher wave.

C-3. Sedimentation in the dredged fairway

Hereunder estimate the sedimentation volumes in the dredged fairway with and without the breakwater.

The average wave height and the critical water depth for sand movement are then calculated below.

Average wave direction at O' is 255° and frequency of each wave height is as shown in Table C-3. according to Appendix I:

Table C-3. Frequency of Wave (Point O_1)

H (m)	0.3 ~ 0.4	0.4 ~ 0.5	0.5 ~ 0.6	0.6 ~ 0.7	0.7 ~ 0.8	0.8 ~ 0.9
Frequency n (%)	4.4	3.0	2.1	1.1	0.4	0.2

Representative wave height is presumed the average wave height by $\Sigma nH_2 / \Sigma n$. as below.

Representative wave: H = 0.5m、Probability per anum 11.1%

Direction = 255°

Period、T = 3.0sec

Length、L_o = 14.0m

From D50 = 0.1mm in the sea-bed sampling results. the net critical water depth for sand movement hi is calculated:

d 50 = 0.1mm . H = 0.5m . T = 3.0sec

$d\ 50 / L = 7.1 \times 10^{-6}$. $H / L = 0.057$

hi = 1.7m

(1) Sedimentation without breakwater

Length of fairway 250m

Depth of fairway -2.5 m LAT= -3.6m MSL

Since the water depth in the fairway is deeper than the critical water depth for sand movement -1.7m. there may not be a movement of sand from the fairway. and on the contrary the littoral drift sand from PWD reclaimed area side will be transported and sedimented in the fairway.

From the above estimation. the volume of littoral drift sand through King's Wharf front is 2000~4000m^3/year. and the average thickness Δh of sedimentation is therefore:

$$\Delta h = \frac{2000 \sim 4000}{250 \times 25} = 0.34 \sim 0.64m$$

This result indicates that the dredged fairway will be filled up by sedimentation for 3 ~6 years. unless preventive measure provided. which is thus required.

(2) Sedimentation with breakwater

It is obvious that the littoral drift movement is more active in the area shallower than the critical water depth for sand movement. Position of breakwater head is therefore preferable at the area with deeper than this water depth. and the direction of breakwater must be decided taking the predominant direction of wave into account.

Fig C-7 shows the plan of each location of breakwater and fairway.

Plan KD is most expensive but preferable with less sedimentation. Plan KC shows the position of breakwater head around the critical water depth for sand movement. Plan KB needs less cost than for plans KC and KD. but requires some maintenance dredging. Plan KA is not practical.

Taking plan KB. sedimentation volume is now estimated below. Littoral drift seems disturbed and complicated by the reflected wave at breakwater. Therefore. sedimentation volume in the fairway is calculated by wave height and current speed.

Wave height H = 0.5m

Period T = 3.0sec

Probability $t = 11.1\times\ 2.85\ \times 24 \times 3600sec = 3.5 \times 10^{6}$ sec

Direction = 255°

Current Speed = *0.15 m/sec*

Grain size D50 = 0.1mm

Average water depth at MB = 2.3m (MSL)

Dredged depth = 3.5m (MSL)

Under a small wave and current. sand is to be transported by bedload. Assuming the fairway is isolated as a pool. the sand is transported only through MB.

Equation by E.W.Bijker is.

$$QB = \frac{BDV\sqrt{g}}{C} e \times p \left(-\frac{0.27\ SDC^2}{\mu V^2 \{1+1/2\ (\xi u_0/v)^2\}} \right) \qquad (1)$$

Where:

D : the grain size of the bed material

g : acceleration of the earth gravity

B : 5, μ : 0.45

S : relative density of the bed material

C : Chezy's resistance coefficient= 18log (12h/r)

h : water depth. r : 0.05

ξ : $C\sqrt{fw/2g}$.

fw : Jonsson's friction Coefficient

μ_0 : $\frac{\pi H}{T} \frac{1}{\sinh \frac{2\pi h}{L}}$, L : wave length

V : velocity of flow + momentum velocity $\overline{U}$

U : $\frac{\pi^2 H^2}{2LT} \frac{\cosh 2k(h+z)}{\sinh 2kh}$ $K = \frac{2\pi}{L}$

Therefore:

$h_1 = 2.3m$, $L = 11.77$, $C = 49.3$

$\mu_0 = 0.338$, $fw = 0.163$, $= 4.489$

$$Q^b = \frac{5\times10^{-4}\times(0.15+0.02)\times3.13}{49.3} \times \left\{\exp\left(-\frac{0.27\times1.65\times10^{-4}\times49.3^2}{0.45\times0.17_2\times40.36}\right)\right\} \times 3.5\times10^6$$

$= 15.4 m^3/m \cdot yr$ (2)

Total volume $= 15.4 \times MB\ Sin\ 21°$

$= 554 m^3/yr$ (3)

Summarized as below

	Breakwater	Total volume in the fairway
KA	MA´Sin21° = 53m	ΣQ = 15.4×53 = 816m^3/ year
KB	MB´Sin21° = 36m	ΣQ = 15.4×36 = 554m^3/ year
KC	MC´Sin21° = 21m	ΣQ = 15.4×21 = 323m^3/ year
KD	MD´Sin21° = 7m	ΣQ = 15.4× 7 = 108m^3/ year

With some allowance taken into account. it may be prudent to consider twice the above figure.

Reference:

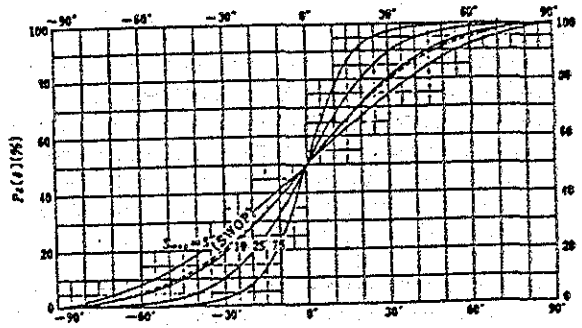
—"Bijker.E. W. 1968: Littoral drift as function of waves and current. proc.11 vastal Eng.conf. ASCE"

—Report by Mr.Irie.

C-4 Environmental affection by breakwater

Littoral drift sand from PWD reclaimed area side will be obstructed by the breakwater and transported off-shore with less sedimentation.

On the other hand. "Bagasse Fobre" discharged from PSC may be suspended or sedimented at the narrow and calm area between PWD reclaimed area and the proposed jetty. which may require another discussion and preventive measure in future. In the proposed port area. the drift movement is much less under the normal wave. which is weaken by the provision of breakwater.. But the extraordinary high wave may cause drifting from the north. that may require some prevention measure for drifted sand to be transported from the north to the port area.



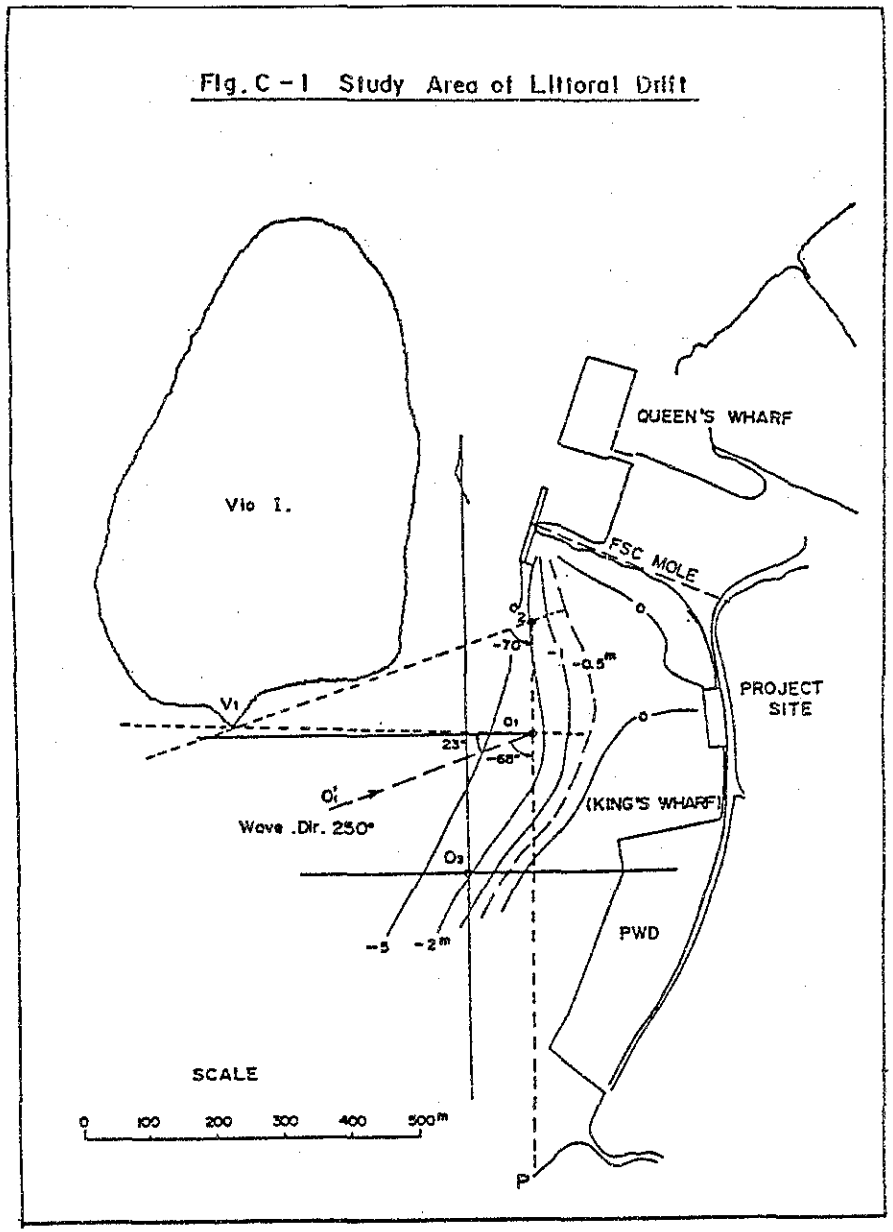


Fig. C - 1 Study Area of Littoral Drift
Vio I.
V1
QUEEN'S WHARF
FSC MOLE
PROJECT SITE
(KING'S WHARF)
PWD
O1
O2
O3
O1'
Wave .Dir. 250°
-70
-0.5m
23°
-60°
-5
-2m
P
SCALE
0 100 200 300 400 500m

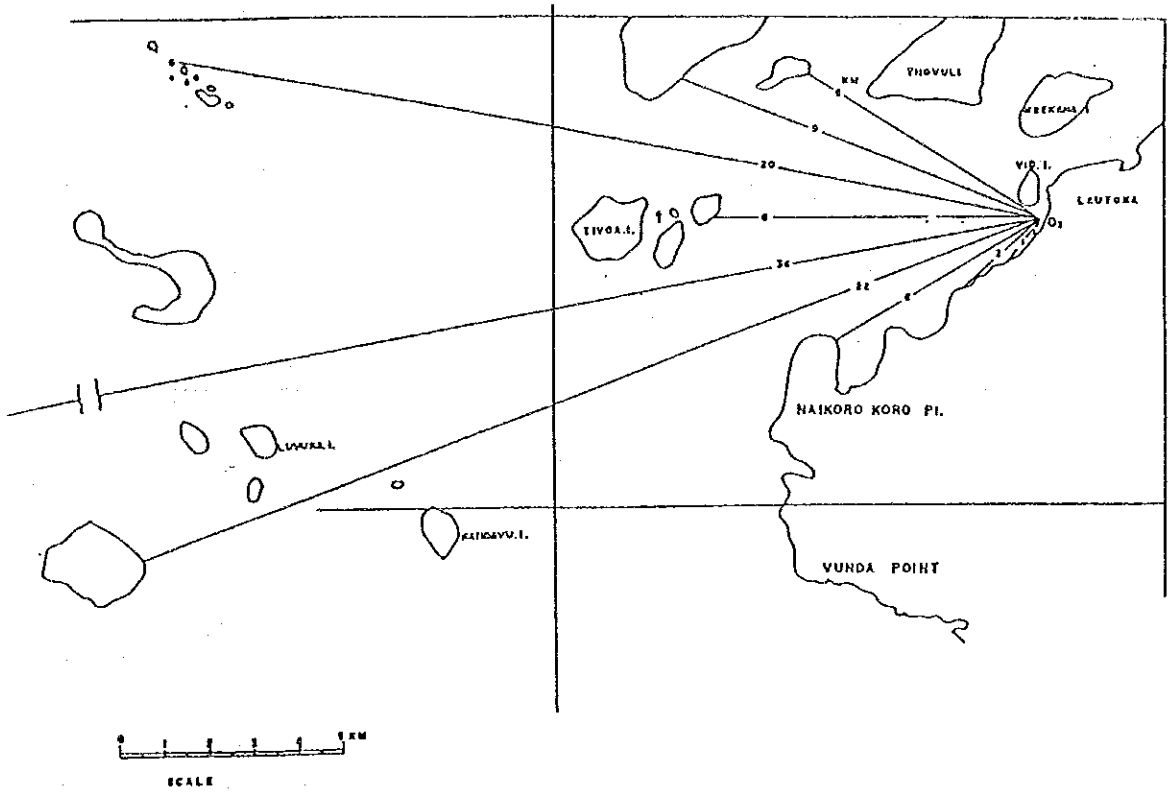


Fig. C-2 FETCH LENGTH (Point O_3)

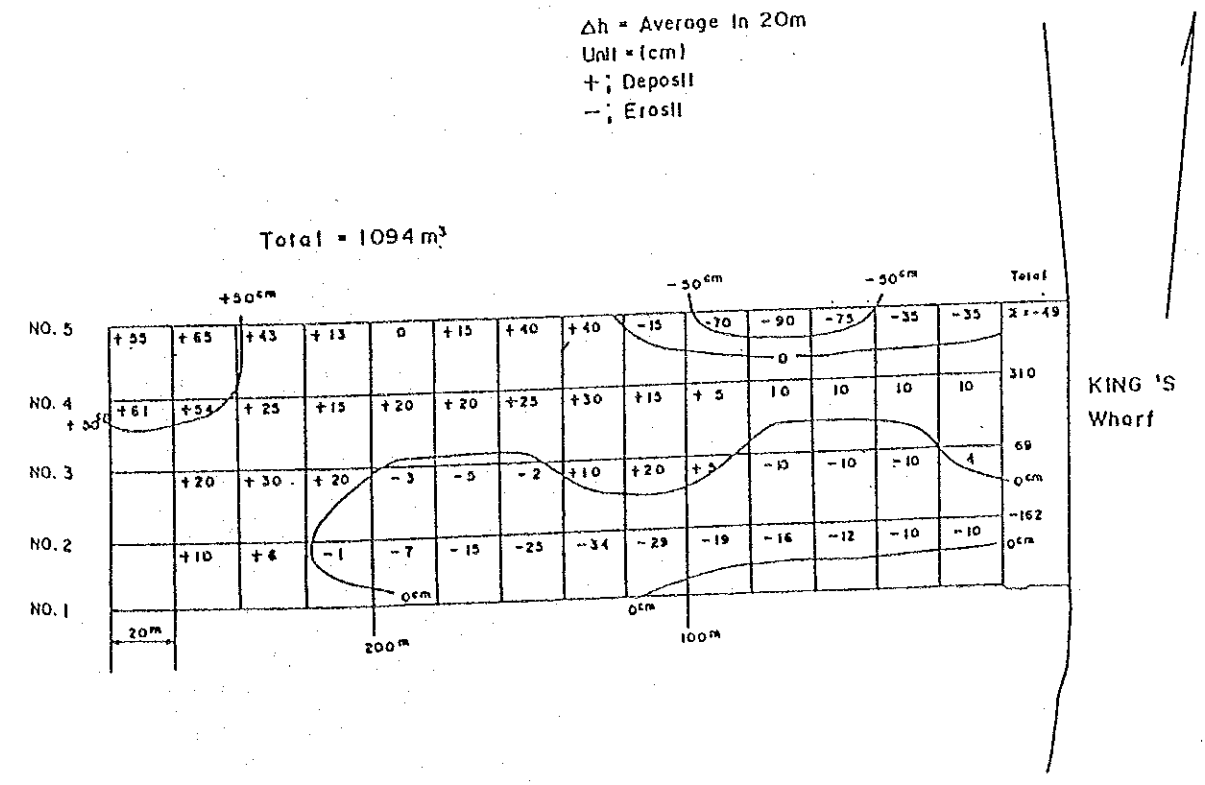


Fig. C-3. Changes of Depth ; Δh (1967-1980)

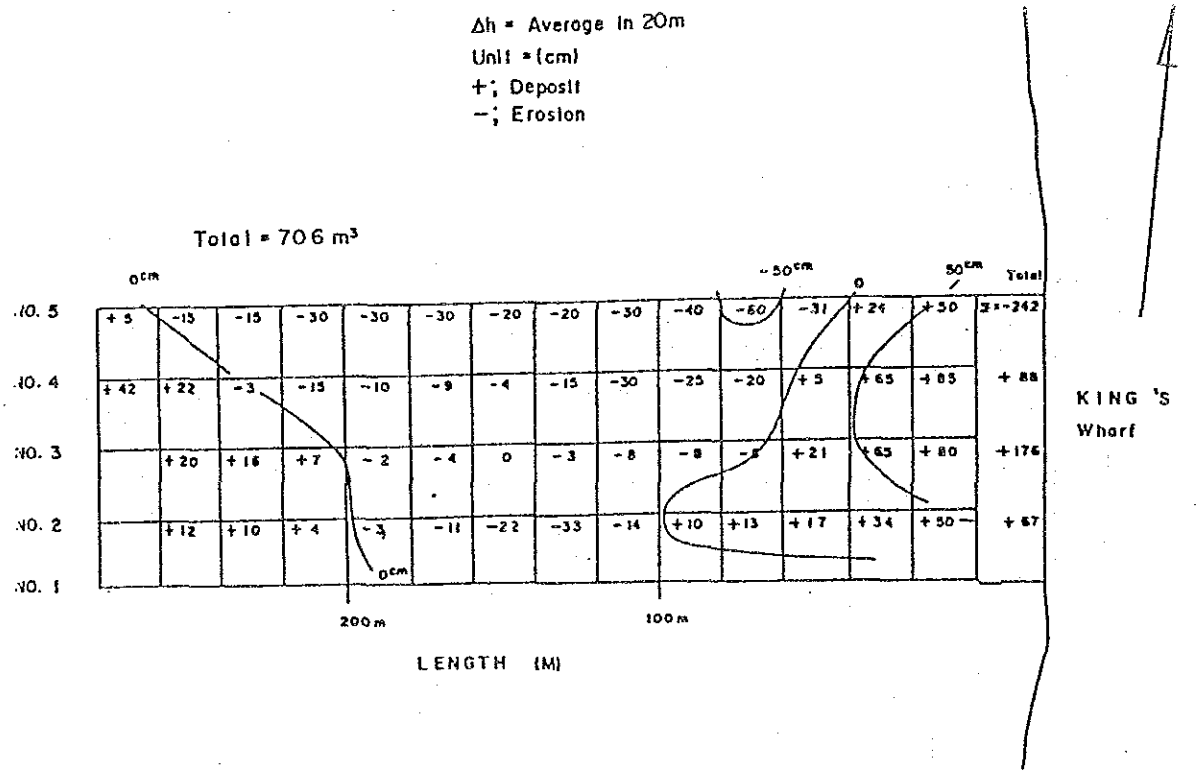


Fig. C-4 Changes of Depth; Δh (1966-1980)

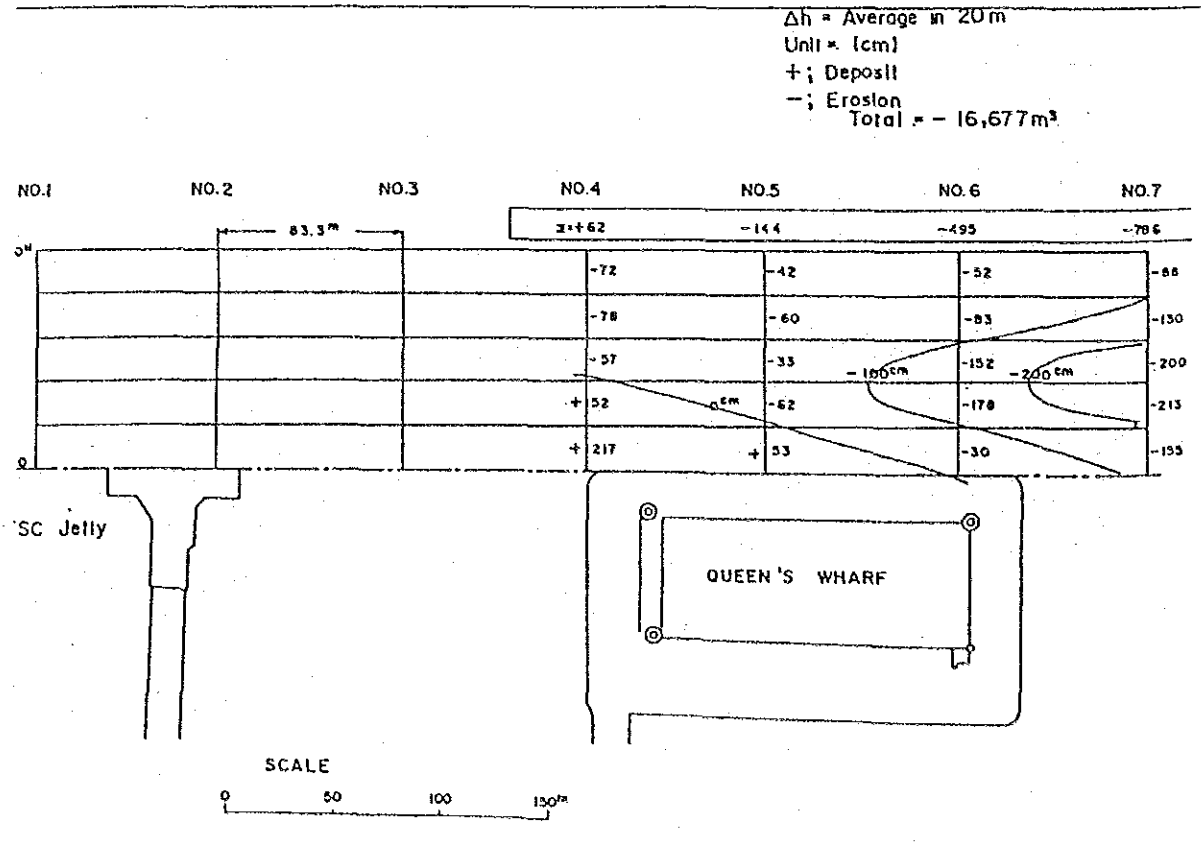


Fig. C-5 Changes of Depth; Δh (1962-1975)

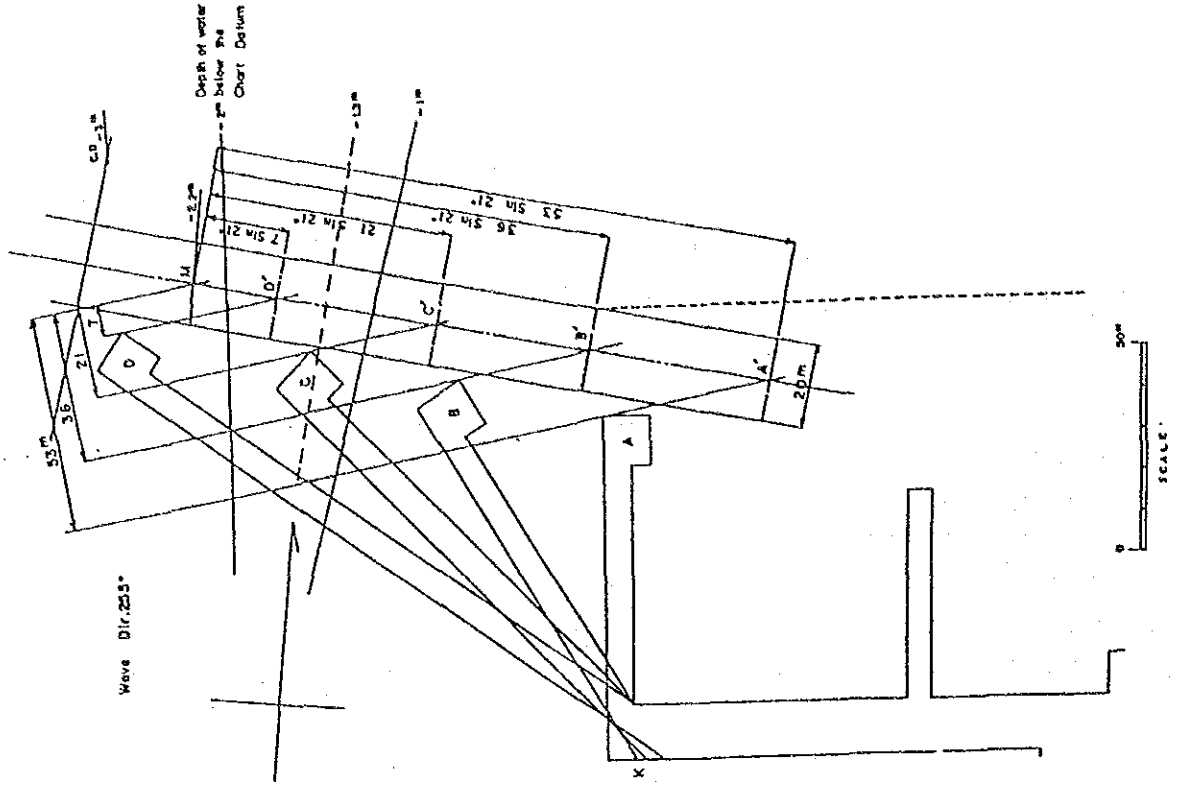


Fig. C-7 Approach Channel and Alternatives of Breakwater

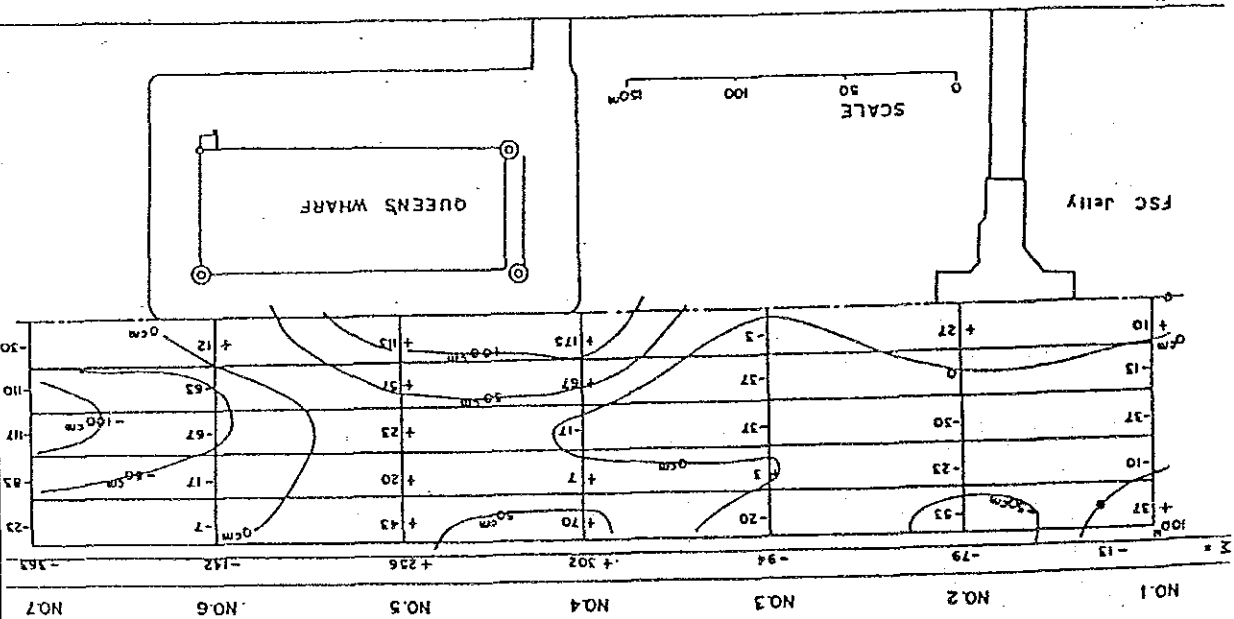
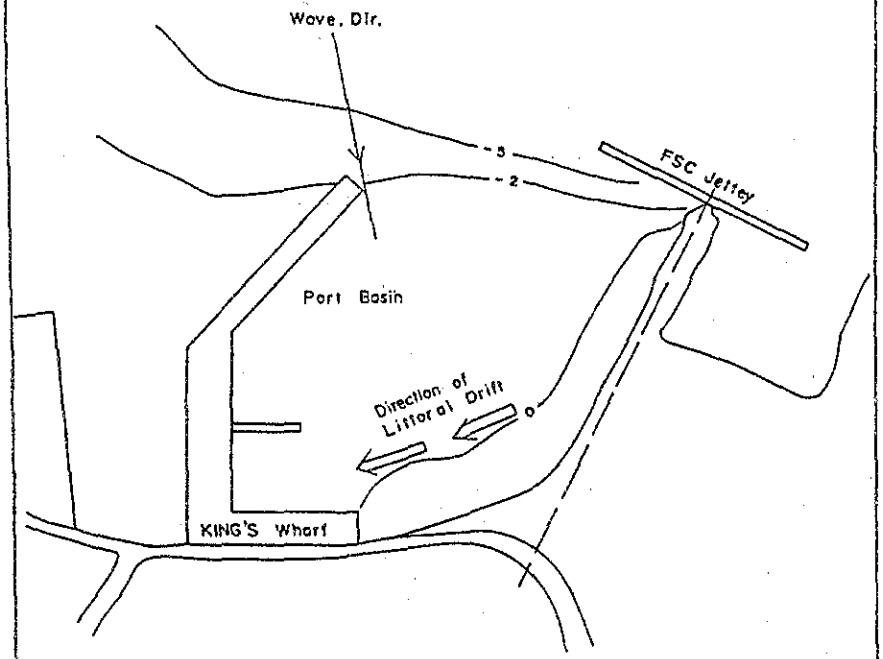


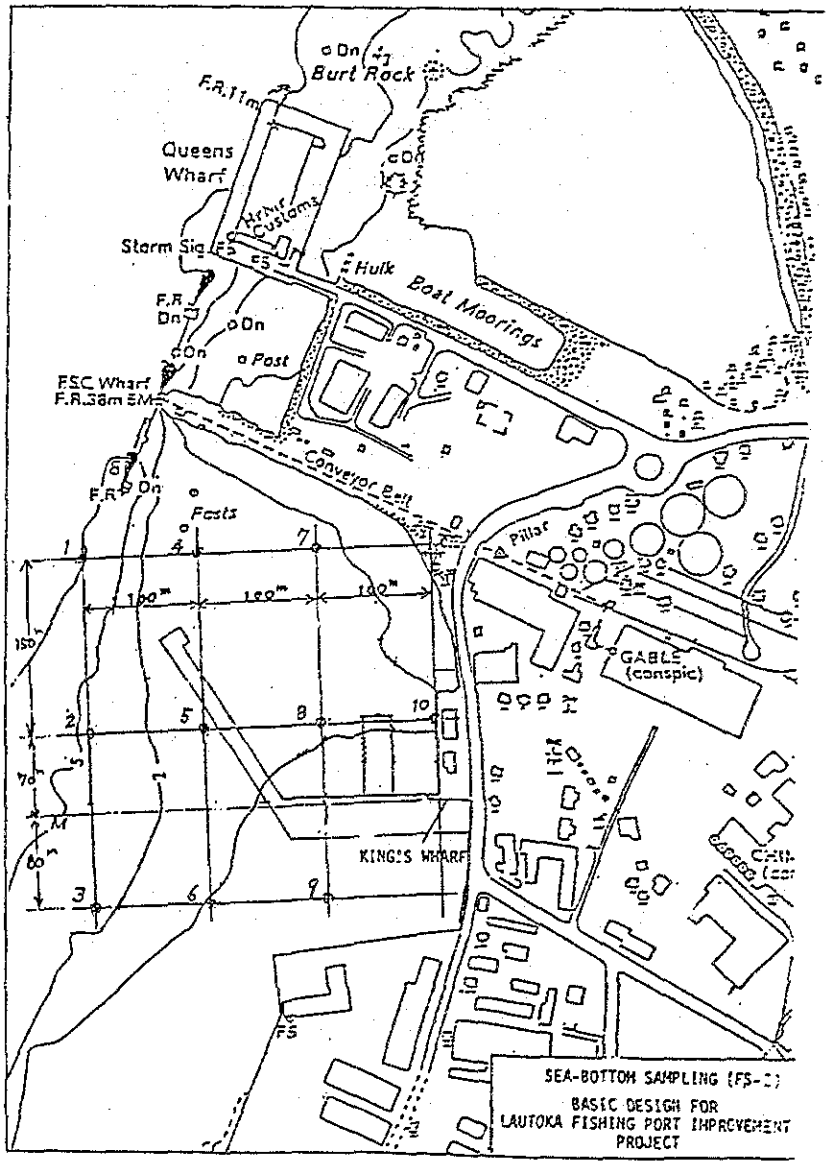
Fig. C-6 Changes of Depth ; Δh (1968-1979)

Δh = Average in 20m
Unit = (cm)
+ ; Deposit
- ; Erosion

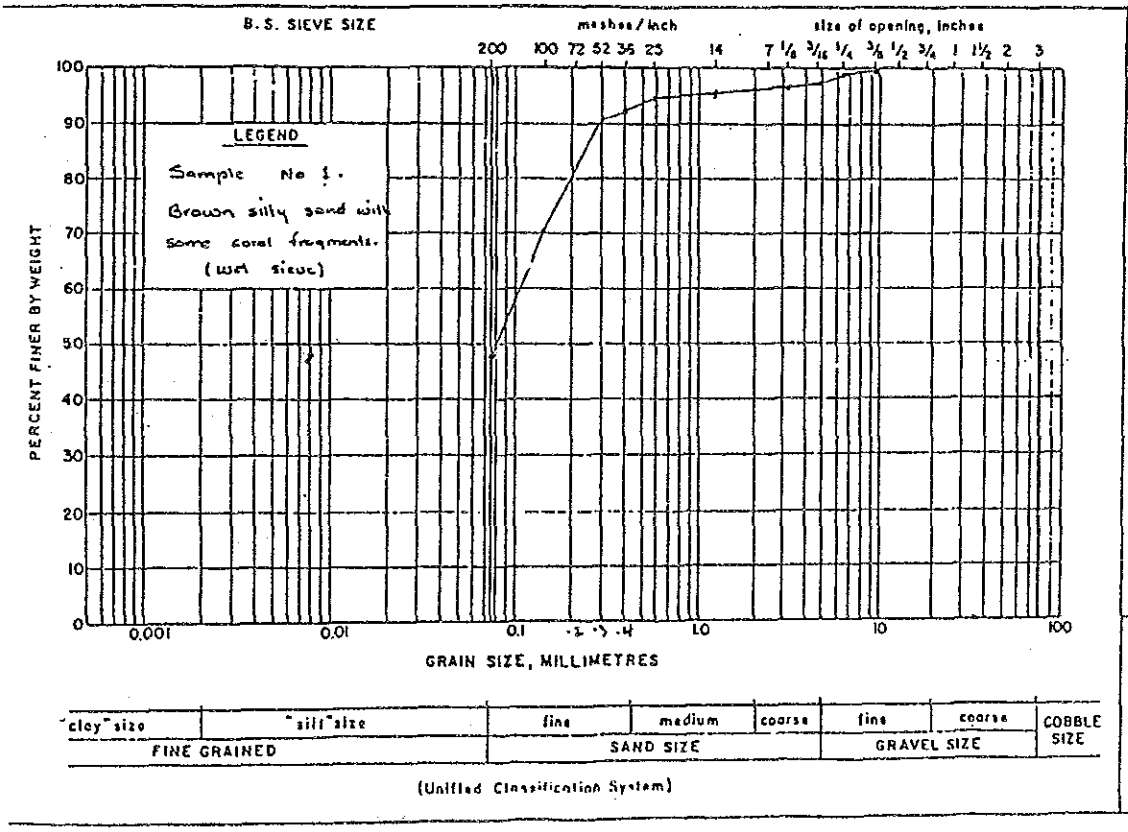
Total = 916 m³

Fig. C-8 Secondary Littoral Drift inside port





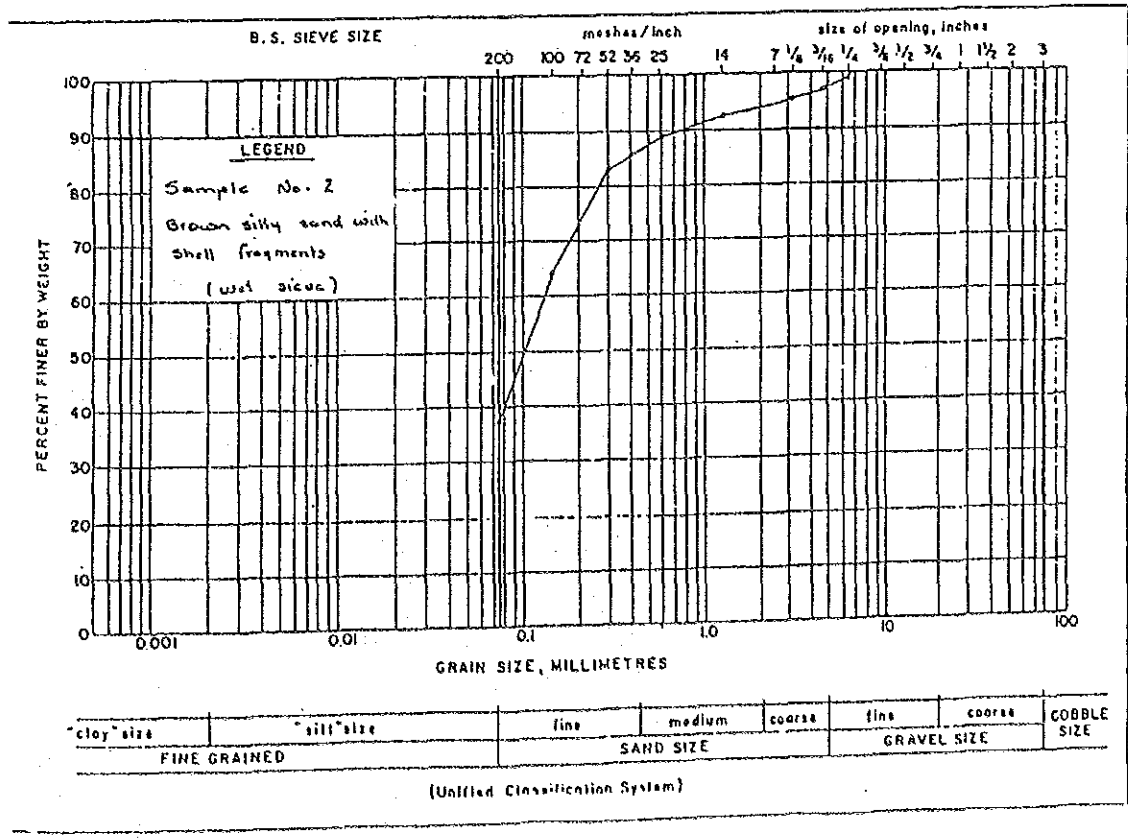
CLIENT Yamada LOCATION H A G BY C.S CHECKED DATE 4-5-82



GRADING CURVES

FIGURE 1.0

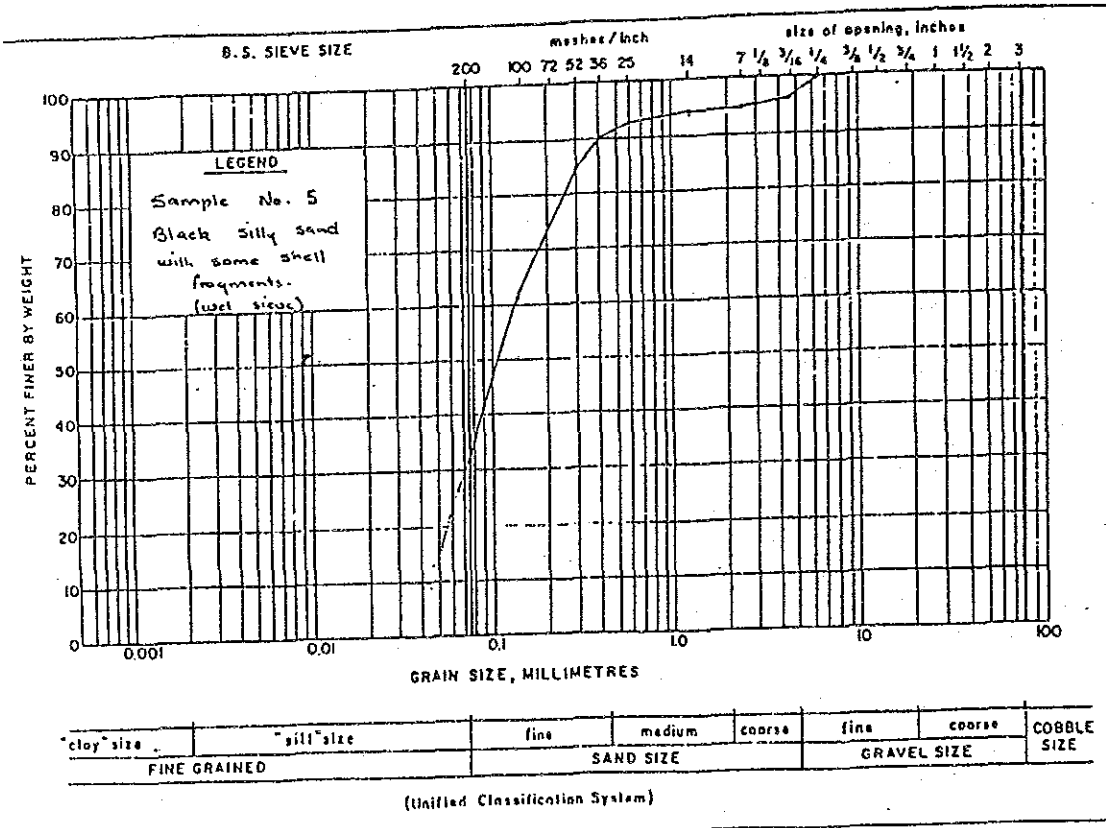
CLIENT Yamada LOCATION H.G BY C.S CHECKED DATE 4-5-82



GRADING CURVES

FIGURE 2.0

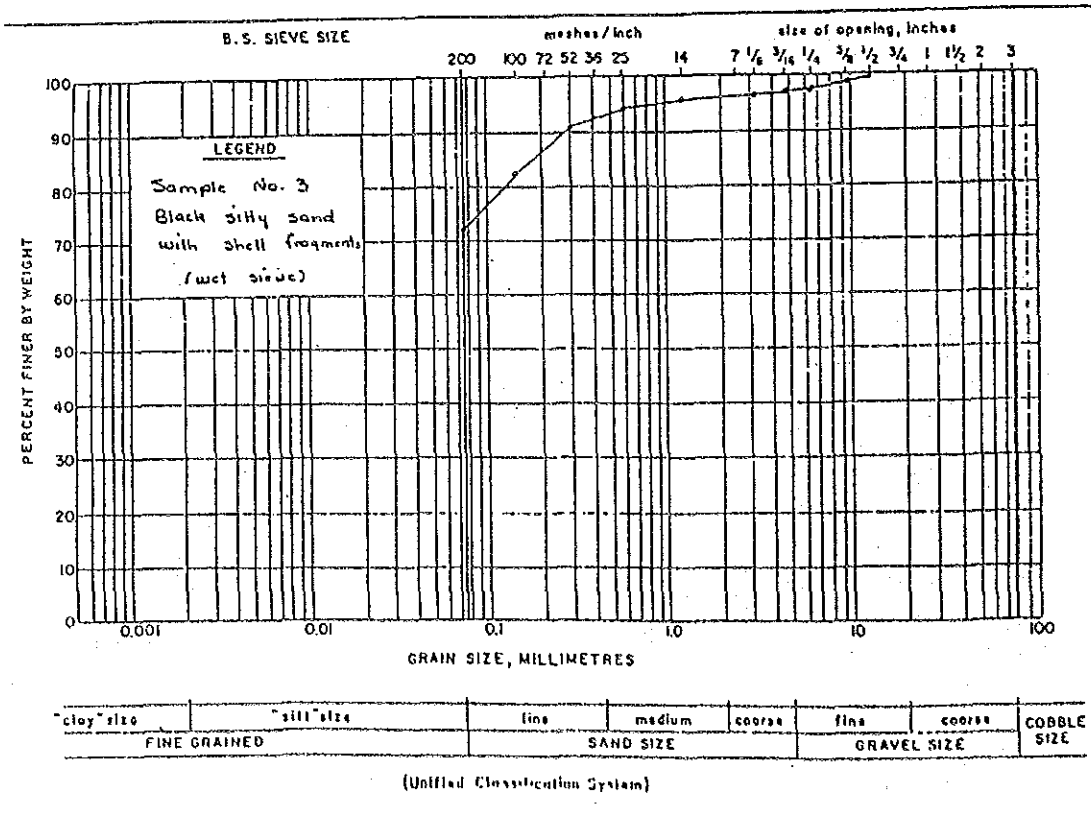
CLIENT Yamada LOCATION BY CHECKED DATE



GRADING CURVES

FIGURE 4-0

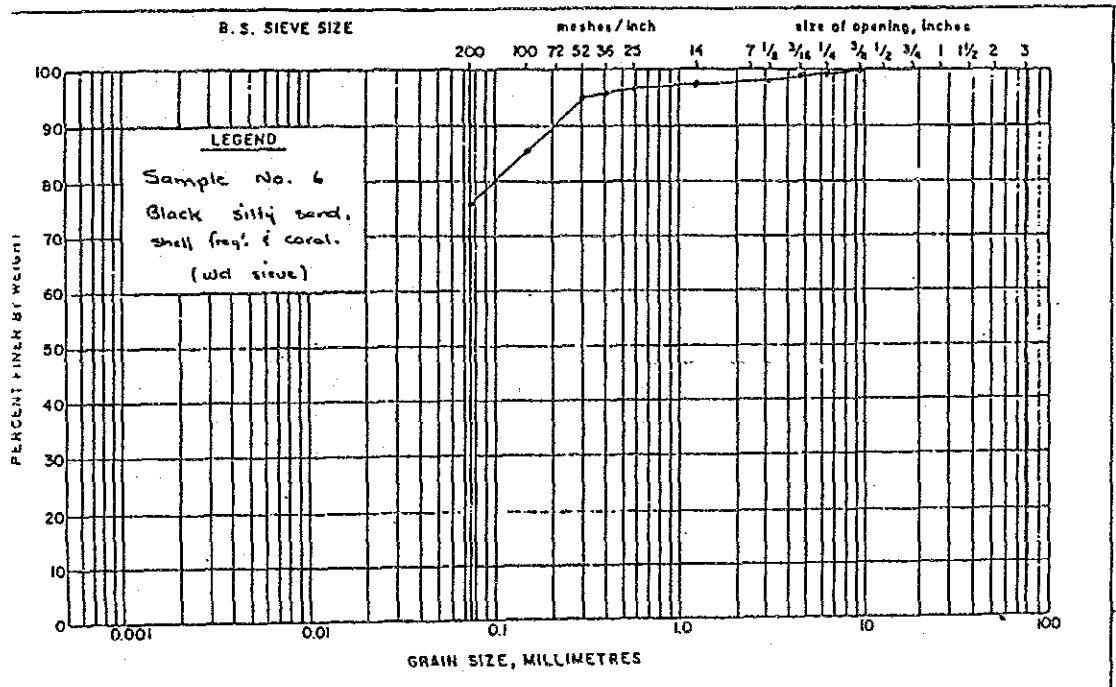
CLIENT Yamada LOCATION H.S.G BY C.S. CHECKED DATE 4-5-81



GRADING CURVES

FIGURE 3-0

CLIENT Yamaoka LOCATION H&G BY C.S. CHECKED DATE 6-5-85

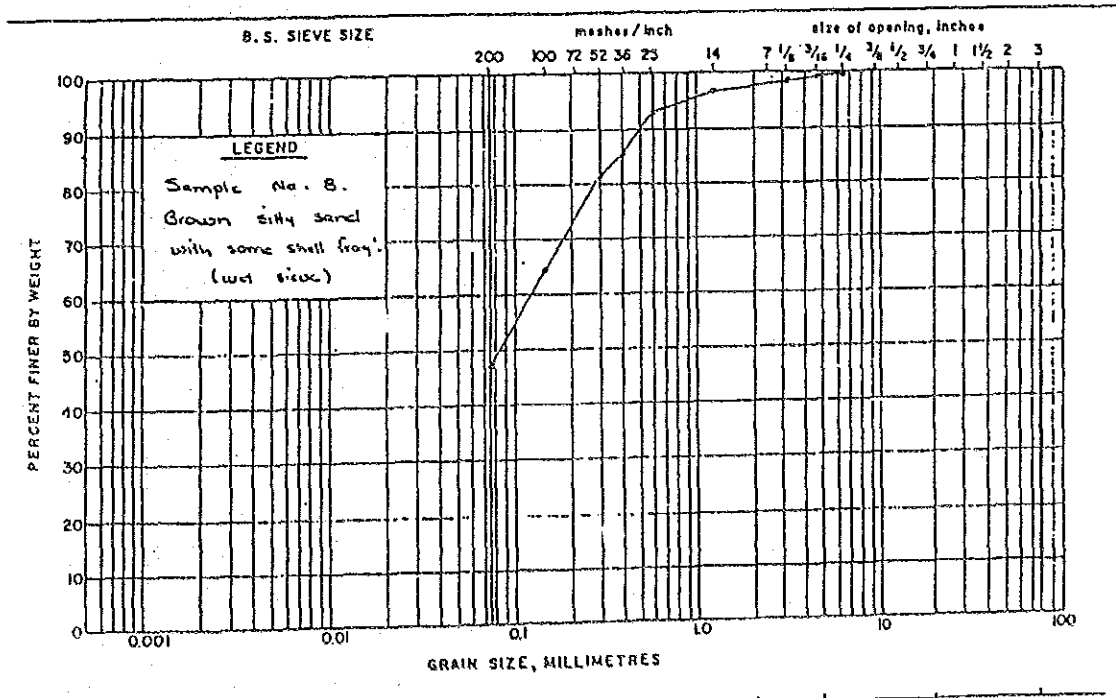


(Unified Classification System)

GRADING CURVES

FIGURE 5.0

CLIENT Yamaoka LOCATION H&G BY C.S. CHECKED DATE

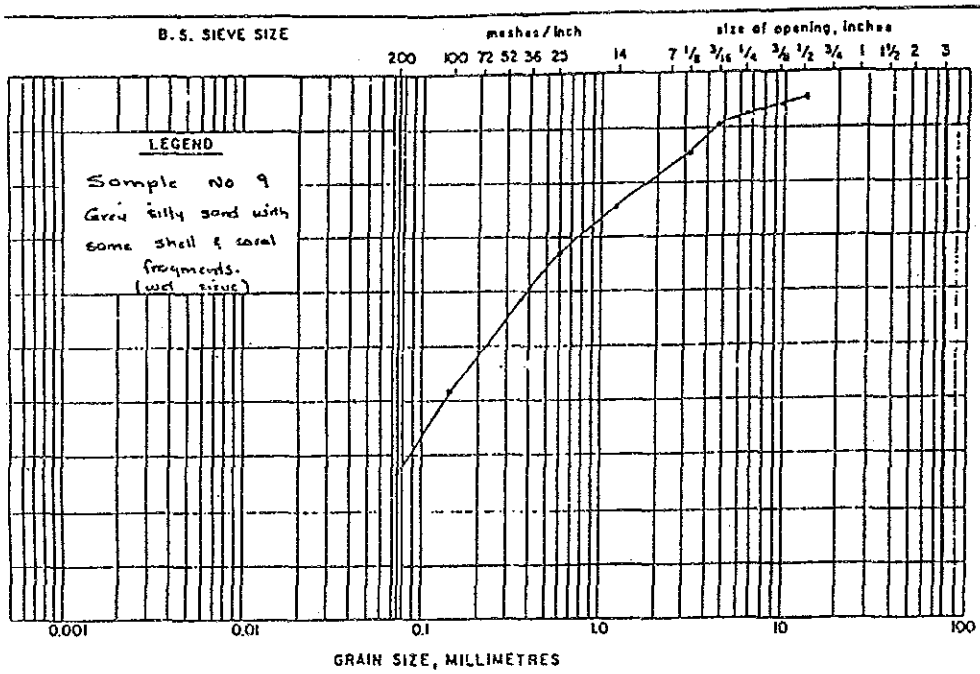


(Unified Classification System)

GRADING CURVES

FIGURE 6.0

CLIENT Yamaha LOCATION U.K. BY C.S. CHECKED _____ DATE 4-5-86

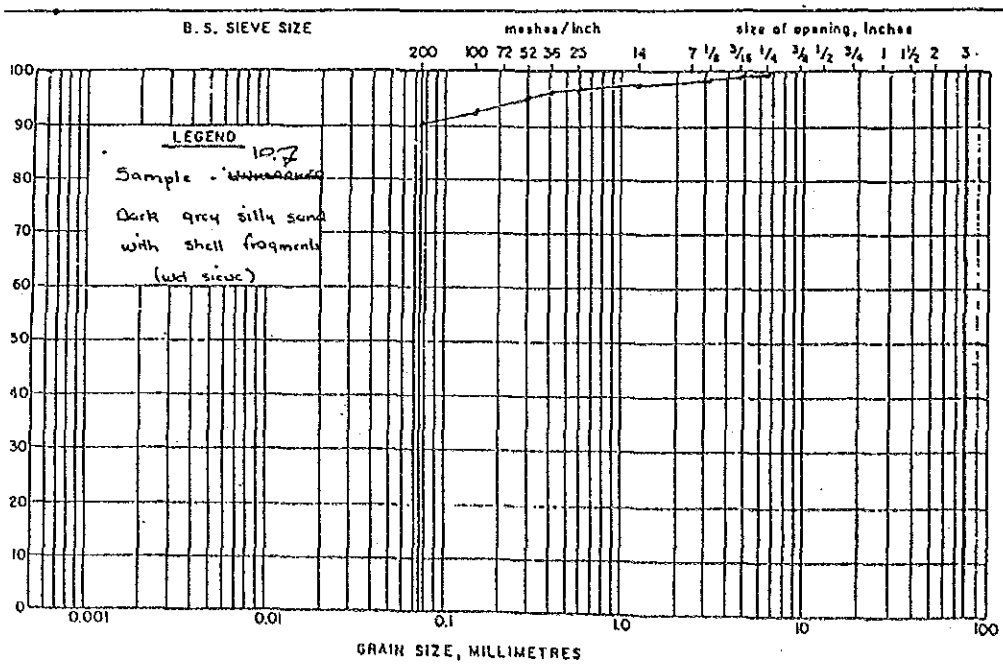


(Unified Classification System)

GRADING CURVES

FIGURE 7.0

CLIENT Yamaha LOCATION U.K. BY C.S. CHECKED _____ DATE 4-5-86



(Unified Classification System)

GRADING CURVES

FIGURE 8.0

APPENDIX ; K

Questionnaire to Private Sector

For the purpose of obtaining more detailed information, direct hearing will be undertaken for fish industries and consumers of fisheries products.

Counterparts of the Government Fiji are requested to assist the JICA study team on this survey.

Direct hearing will be undertaken by following procedures.

Subject	Number of Hearing
Q1; Fishermen	50
Q2; Consumers in small scale (families)	30
Q3; Consumers in large scale (Supermarkets Restaurants and Hotels)	10

Q1; Direct Hearing to Fishermen

1. Face sheet

- Age _____ years old
- Number of family members 1 2 3 4 5 6 7 8 9 10 or more
- Monthly family income by Fishing FD _____
  by Other means FD _____
- Distance from King's Wharf _____ km

2. Fishing (General)

- Registration Yes No
  if no why? _____
  _____
- Size of boat (length) _____ meters
- Number of fisherman on boat 1 2 3 4 5 or more
- Major fishing method _____
  _____
- Length of fishing experience _____ years
- Desire to change jobs Yes No
- Frequency of usage of existing Lautoka Fishing Port per week 1 2 3 4 5 6 7 days

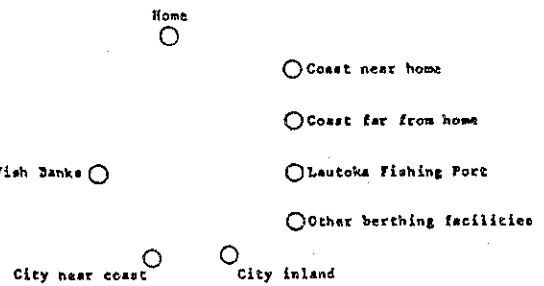
3. Fishing

- Kind of fish (major three) _____ _____
  _____
- Major fishing banks (major three) _____ _____
  _____
- Average working days for fishing per week 1 2 3 4 5 6 7 days
- Average working hours a day
  home to home 1 2 3 4 5 6 7 8 9 10 more
  at fishing banks 1 2 3 4 5 6 7 8 9 10 more

4. Consumption and Sales

- Average gain of fish per day _____ kg
- Percentage of family use _____ %
- Place of sales
  - at the Lautoka Port
  - at the Municipal Market
  - to N.M.A.
  - at non-established market (incl. roadside and floating market)
  - to the shop/restaurants
  - by other ways

5. Movement (Fisherman, Boat and Gain)
(Please put lines for three items as indicated kinds of lines)



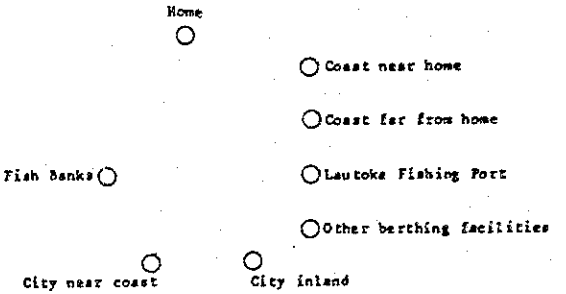
If the boat does not call at Lautoka Fishing Port, why?

_____

6. Gain

- Max. gain per day _____ kg
- Average gain per day _____ kg
- Min. gain per day _____ kg
- Max. gain per month _____ kg
- Average gain per month _____ kg
- Min. gain per month _____ kg
- Max. income by fishing per month FD _____
- Average income by fishing per month FD _____
- Min. income by fishing per month FD _____

7. If Lautoka Fishing Port is improved what will be happened for you?
Please trace lines of movement (Fisherman, Boat and Gain)



If the boat calls at Lautoka Fishing Port, why?

- Longer working time and more gain of fish products
- Good access to city market and buyers offices
- Supply of ice
- Supply of fuel
- Maintenance and repair of boats and fishing tools
- Safety of boat inside port
- Other reasons

If the boat does not call at Lautoka Fishing Port, why?

- No need for longer working time and more gain
- No sales at the city market
- No need of ice supply, or ice supplied by others
- Safety berthing place is keeping at other place than port
- Port is too far from home
- Need to keep boat near home
- Fishing banks is far from Lautoka Fishing Port
- Other reasons

Q2: Direct Hearing to Consumers (Families)

1. Face sheet

- Monthly average income for faimily — FD _____
- Number of family members — 1 2 3 4 5 6 7 8 9 10 more
- Distance from king's Wharf — _____ km

2. Shopping

- Access for shopping — on foot by buses by own-car by taxi by bicycle by others
- Place for shopping fish — _____

3. Consumption of fish

- What kinds of fish do you consume? — _____
- How many times do you consume fish per week? — _____ times
- How much fish does your family consume a meal? — _____ kg

  and average amount you spend for fish per meal — FD _____
- Storage of fresh fish — by refrigerator; by ice cube; by drying of fish; by salting of fish; by other ways
- Market price of fish — Expensive Average Cheap

4. Future of fish products

- Possibility of consuming more fish — Yes No

if yes — like much; if much cheaper price of fish; if more fresh fish supply; if able to buy fish near home; by other reasons _____

if no — expensive (high market price); not so fresh; home is far from the market; not so like fish; by other reasons _____

Q3: Direct Hearing to Consumers (Larger consuming bodies such as supermarkets, restaurants, hotels)

1. Face sheet

- Business — _____
- Distance from King's Wharf — _____ km

2. Shopping

- Place for shopping fish — _____
- What kinds of fish to sale — _____

3. Sales

- Monthly sales of fish — _____ kg _____ FD
- Storage of fresh fish — _____
- Market price of fish — Expensive Average Cheap

4. Future of fish products

- Possibility to sale more fish — Yes No

if yes — like much; if much cheaper price of fish; if more fresh fish supply; if able to buy fish near office; by other reasons _____

If no — expensive (high market price); not so fresh; office is far from the market; not so like fish; by other reasons _____

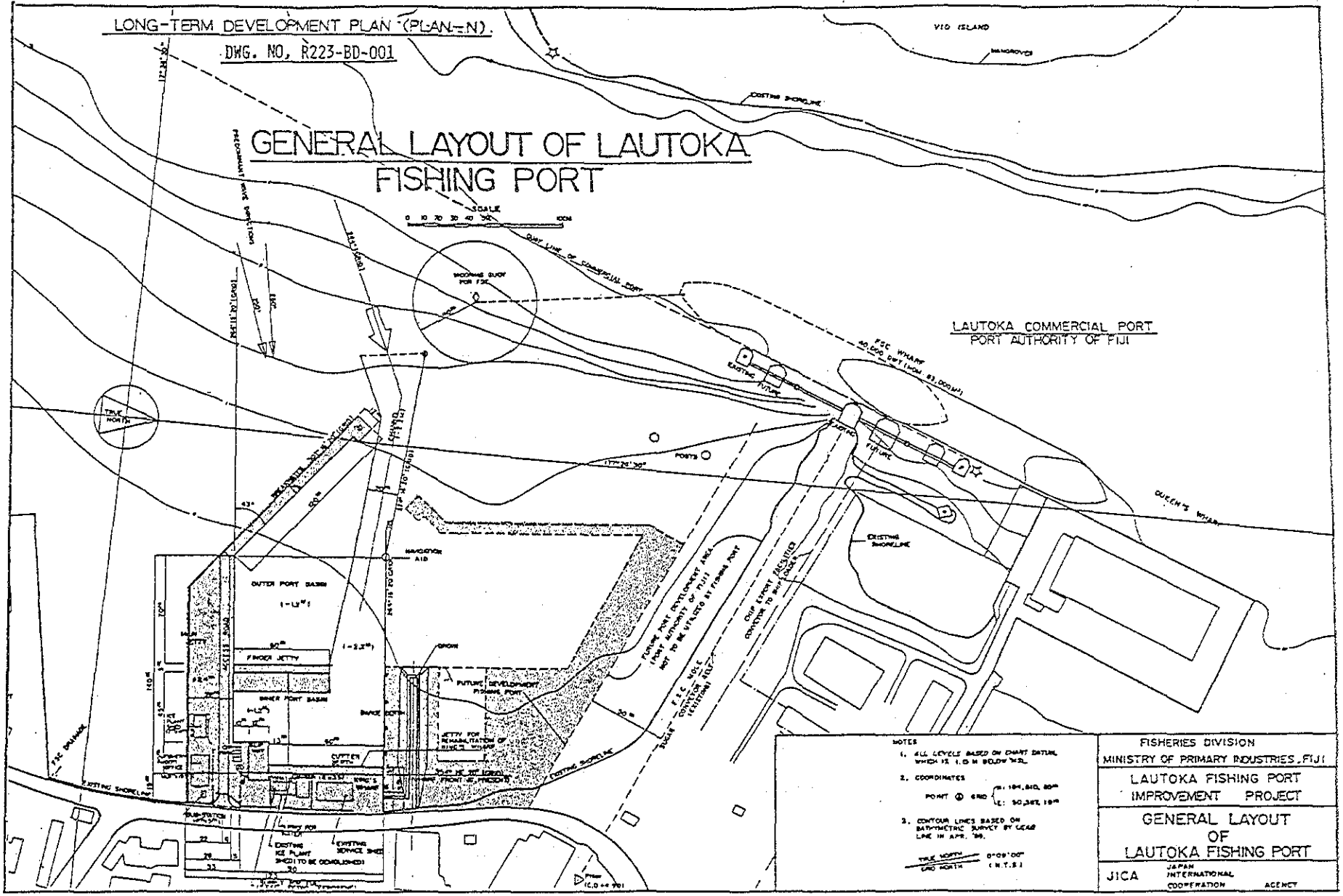
Appendix: L - Drawings

- CONTENTS -

LONG-TERM DEVELOPMENT PLAN (PLAN-N)

DWG. NO. R223-BD-001

GENERAL LAYOUT OF LAUTOKA FISHING PORT



NOTES

1. ALL LEVELS BASED ON CHART DATUM WHICH IS 1.0 M BELOW M.S.L.
2. COORDINATES
   POINT ① GRID (N: 184,840.80m, E: 50,345.19m)
3. CONTOUR LINES BASED ON BATHYMETRIC SURVEY BY LEAD LINE IN APR. '88.

TRUE NORTH / GRID NORTH 0°09'00" (W.T.S.)

FISHERIES DIVISION
MINISTRY OF PRIMARY INDUSTRIES, FIJI

LAUTOKA FISHING PORT IMPROVEMENT PROJECT

GENERAL LAYOUT OF LAUTOKA FISHING PORT

JICA JAPAN INTERNATIONAL COOPERATION AGENCY

FINAL GENERAL LAYOUT

DWG. NO. R223-BD-002

GENERAL LAYOUT OF LAUTOKA FISHING PORT

SCALE 0 10 20 30 40 50 100M

LIST OF FACILITIES
(INITIAL DEVELOPMENT 1990)
LAUTOKA FISHING PORT

A. Basic Port Facilities
1. Quaywall
2. Breakwater
3. Seawall
4. Ramp
5. Navigation Aids
6. Fairway (by dredging)
7. Port Basin (by dredging)
8. Reclamation of Land
9. Accessories (Fender, Bollards etc.)

B. Building and Offices
1. Fisheries Office and Workshop
2. Ice plant shed
3. Canteen
4. Gate house

C. Machines and Equipments
1. Ice Plant
2. Winch
3. General Furniture (Carpet, Tables, Chairs, etc.)
4. Others

D. Pavement
1. Access Road
2. Apron
3. Car Park and Other Yard Pavement

E. Utilities
1. Water Supply
2. Sewerage System
3. Drainage
4. Power Supply
5. Lighting
6. Telecommunication
7. Fuel Supply (Location)
8. Fire Fighting Hydrant and Extinguisher

F. Removal and Demolishing
1. Existing Ice Plant (removal)
2. Existing Office/Workshop (demolish)

G. Others
1. Fence and Gate in the Port Area
2. Fence and Gate on the Port Boundary
3. Miscellaneous, if any

V10 ISLAND
MANGROVES
EXISTING SHORELINE
OFFSHORE BERTH
17° 36' 30"
PREDOMINANT WAVE DIRECTIONS
244°-(GRID)
269°
250°
264°16'20"(GRID)
MOORING BUOY FOR FSC
40m
QUAY LINE OF COMMERCIAL PORT
LAUTOKA COMMERCIAL PORT
PORT AUTHORITY OF FIJI
FSC WHARF
40,000 DWT L100M 83,000M³
EXISTING
FUTURE
TRUE NORTH
BREAKWATER 307°16'30"(GRID)
CHANNEL 12.2M↕
177°26'30"
POSTS
QUEEN'S WHARF
EXISTING SHORELINE
43°
120m
20m
354°16'20"(GRID)
NAVIGATION AID
OUTER PORT BASIN
(-12M)
MAIN JETTY
60m
FINGER JETTY
(-2.2M)
GROIN
ACCESS ROAD
70m
140m
45m
+2.4m
28m
INNER PORT BASIN
(-12M)
FUTURE DEVELOPMENT FISHING PORT
FUTURE PORT DEVELOPMENT AREA (PORT AUTHORITY OF FIJI) NOT TO BE UTILIZED BY FISHING PORT
CHIP EXPORT FACILITIES CONVEYOR TO SHIP LOADER
F.S.C. MOLE CONVEYOR BELT (EXISTING)
50m
PUBLIC WORKS DEPARTMENT
ICE PLANT SHED (1990 WORK)
10m 12m
13m
60m
BARGE BERTH
JETTY FOR REHABILITATION OF KING'S WHARF
SLIP WAY
CUTTER BERTH
FISHERY COOPT. OFFICE
CAR PARK
CANTEEN
KING'S WHARF
354°16'20"(GRID)
WHARF FRONT AT PRESENT
F.S.C. DRAINAGE
EXISTING SHORELINE
SUB STATION (415.5KVA)
SUPPLY FOR WATER
EXISTING ICE PLANT SHED TO BE DEMOLISHED
EXISTING SERVICE SHED
22 6
28 5
33 90
123
SUPPLY FOR FUEL
P.180r (C.D.+4.90)

NOTES
1. ALL LEVELS BASED ON CHART DATUM, WHICH IS 1.15 M BELOW MSL.
2. COORDINATES
POINT (A) GRID { N. 184,610.85m / E. 50,387.19m }
3. CONTOUR LINES BASED ON BATHYMETRIC SURVEY BY LEAD LINE IN APR. '86.

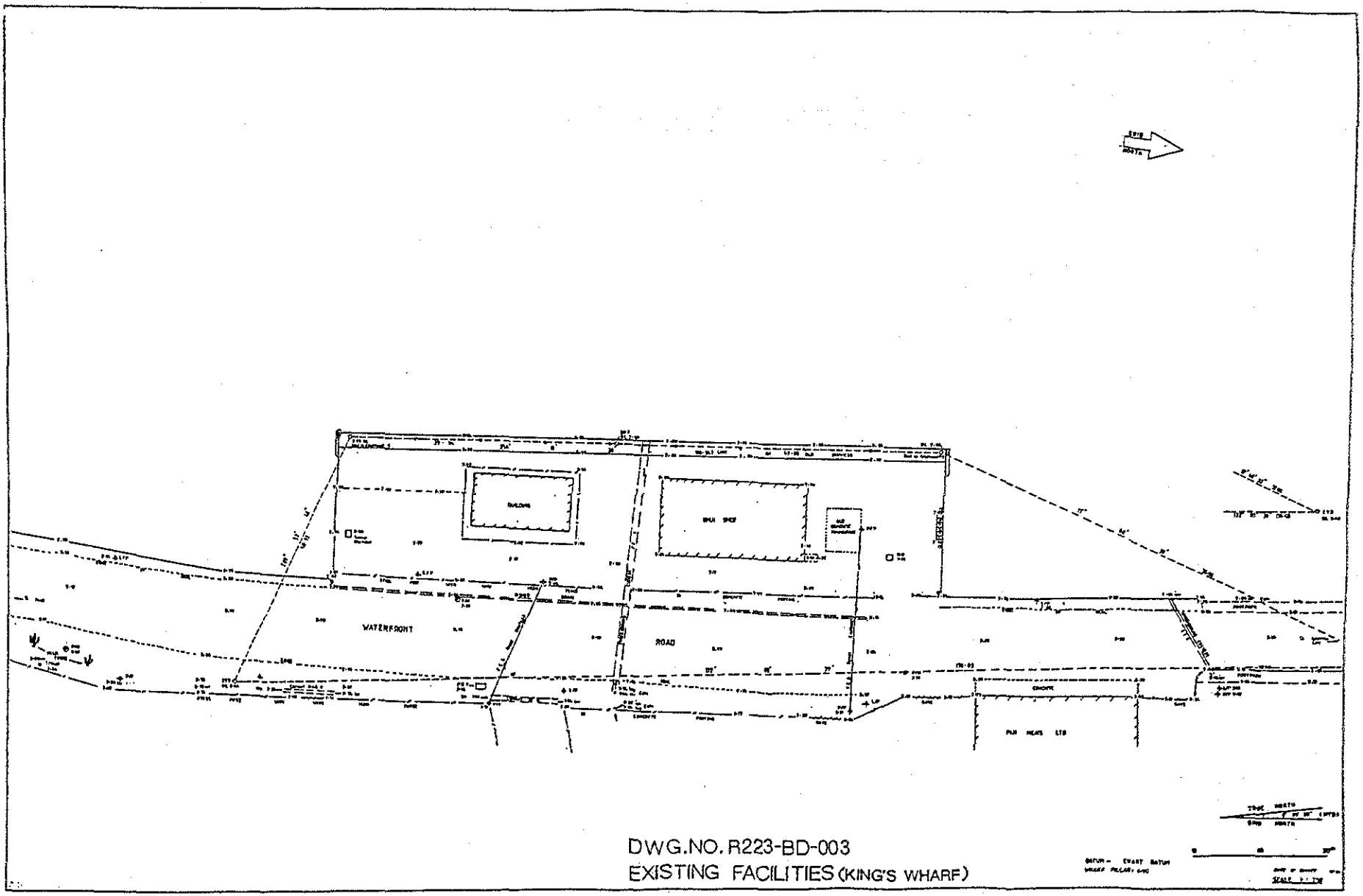
TRUE NORTH / GRID NORTH 0°09'00" (NTS)

FISHERIES DIVISION
MINISTRY OF PRIMARY INDUSTRIES, FIJI

LAUTOKA FISHING PORT IMPROVEMENT PROJECT

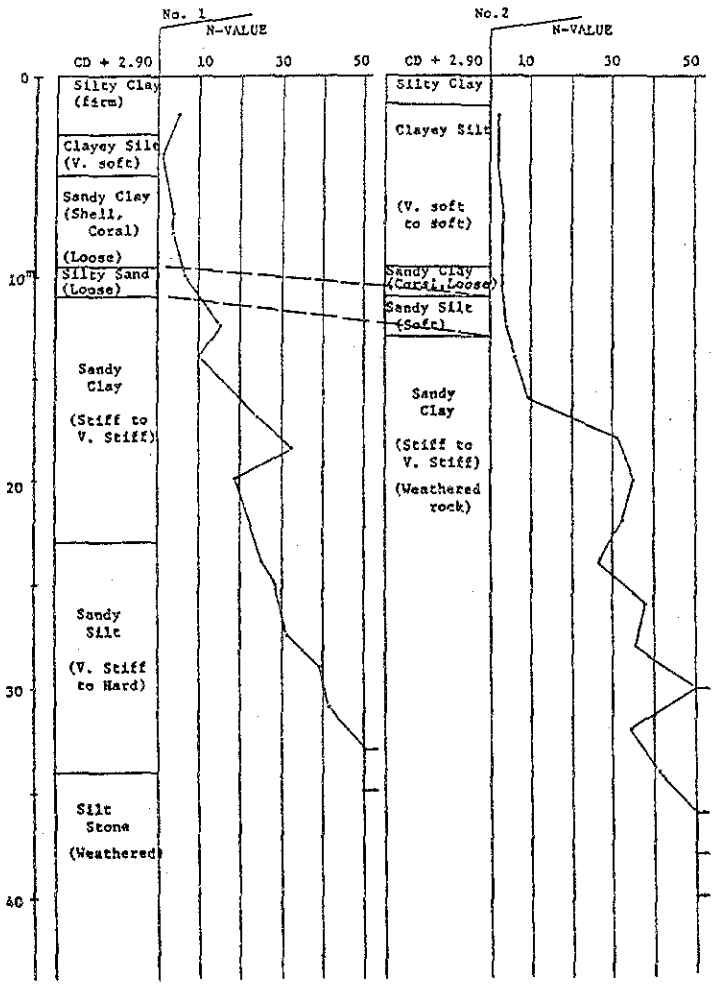
GENERAL LAYOUT OF LAUTOKA FISHING PORT

JICA JAPAN INTERNATIONAL COOPERATION AGENCY

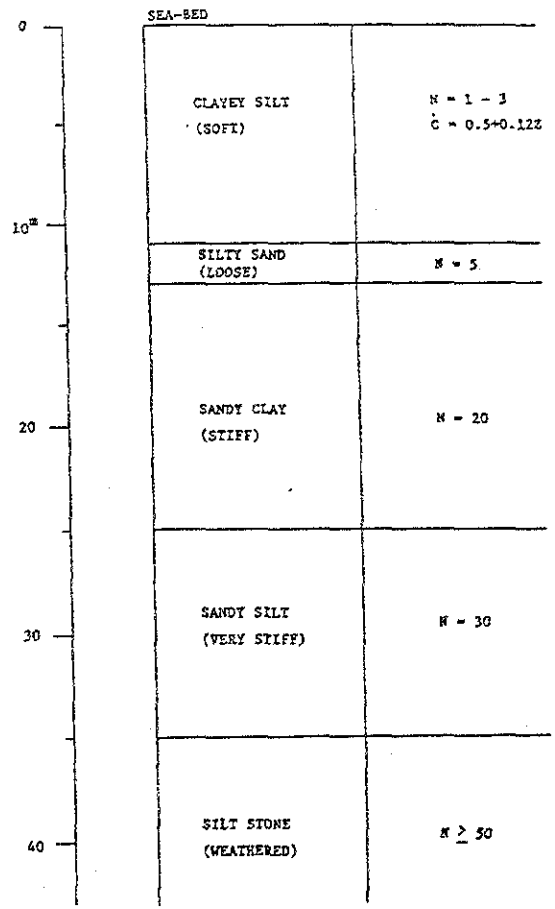


DWG.NO. R223-BD-003
EXISTING FACILITIES (KING'S WHARF)

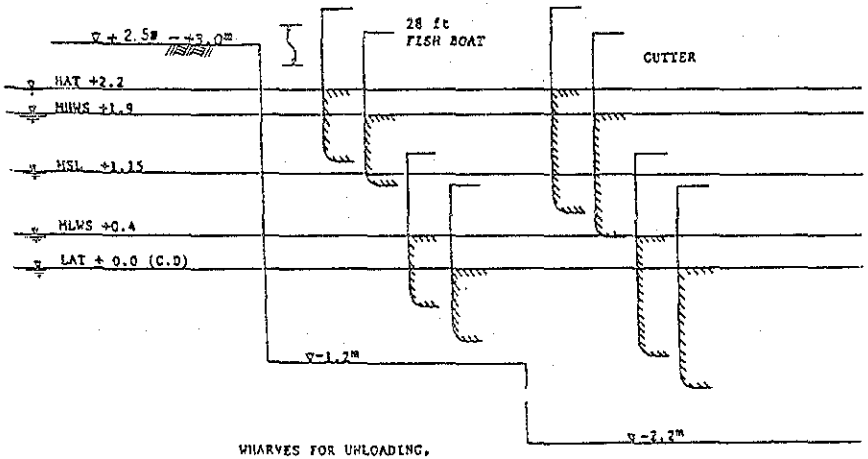
SOIL PROFILE



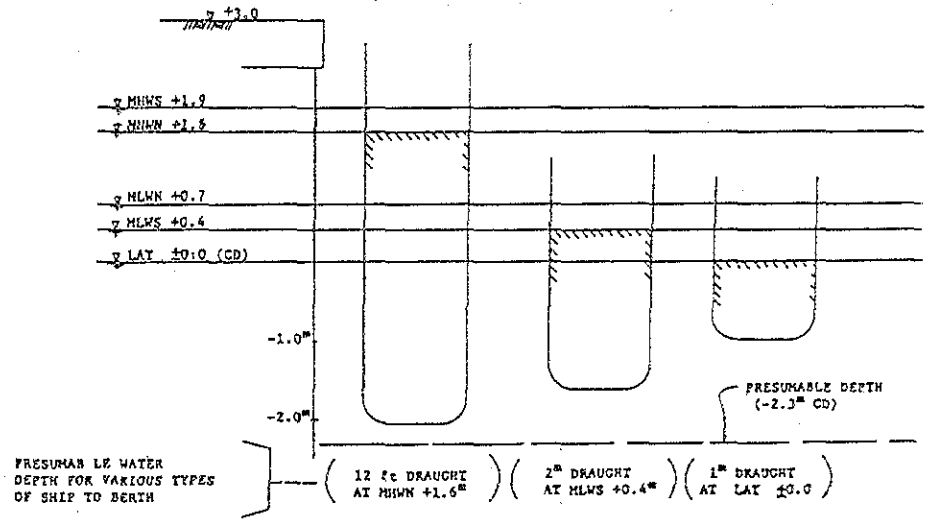
DESIGN SOIL CONDITION



DWG. NO, R223-BD-004 SOIL PROFILES

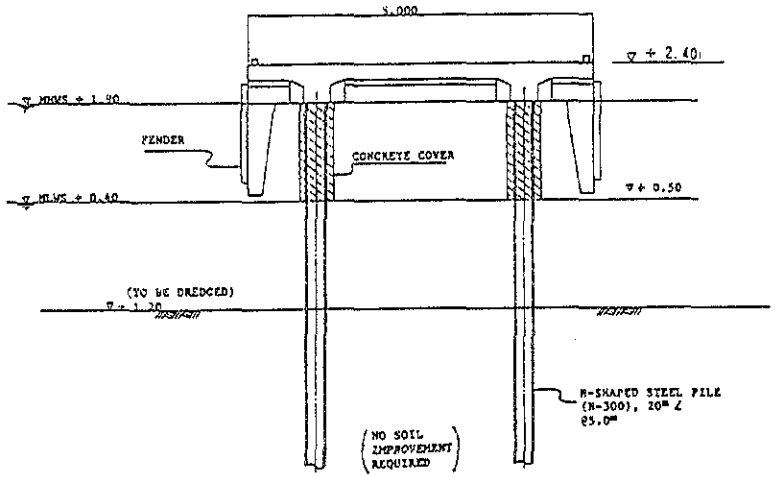


HEIGHT & DEPTH OF WHARF AND FAIRWAY

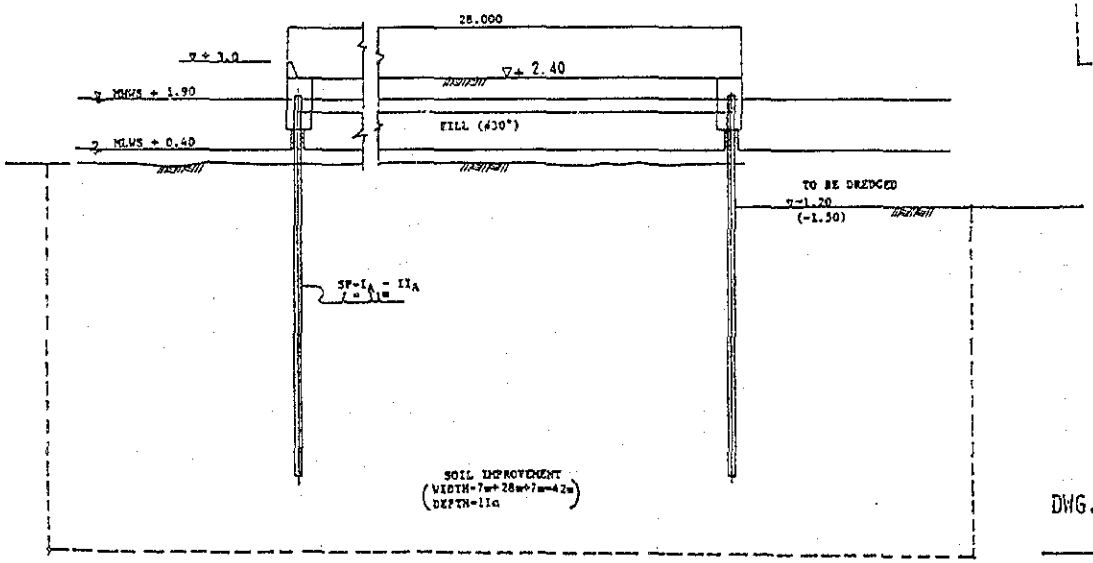


PRESUMPTION OF WATER DEPTH FOR KING'S WHARF IN ORIGINAL DESIGN

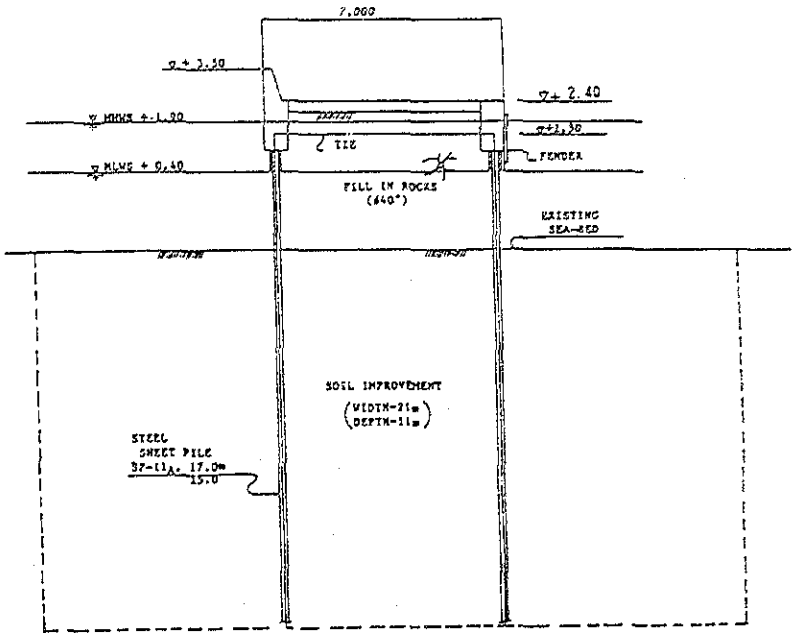
DWG. NO, R223-BD-005 HEIGHT AND DEPTH OF WHARF AND FAIRWAY



TYPICAL SECTION OF FINGER JETTY



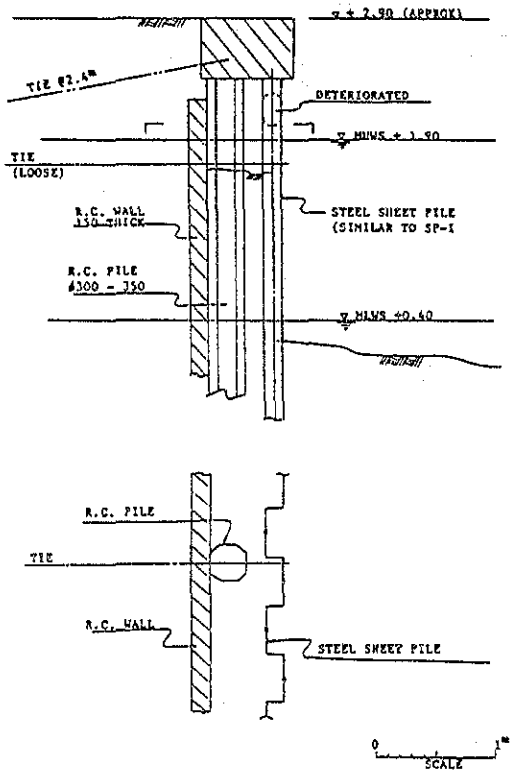
TYPICAL SECTION OF MAIN JETTY



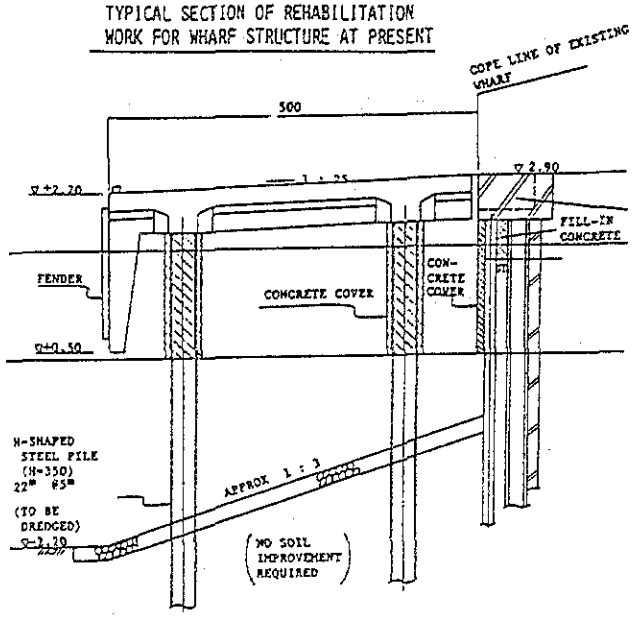
TYPICAL SECTION OF BREAKWATER

DWG. NO, R223-BD-006 TYPICAL SECTION OF BREAKWATER, MAIN JETTY AND FINGER JETTY

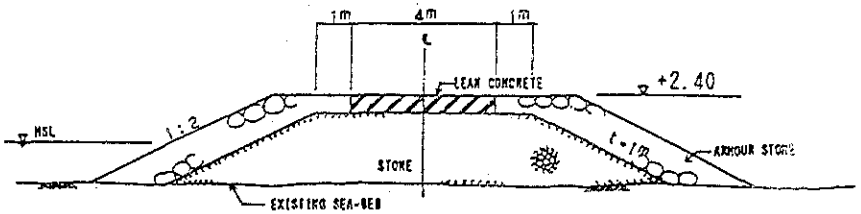
STRUCTURAL SKETCH OF
PRESENT KING'S WHARF



TYPICAL SECTION OF REHABILITATION
WORK FOR WHARF STRUCTURE AT PRESENT

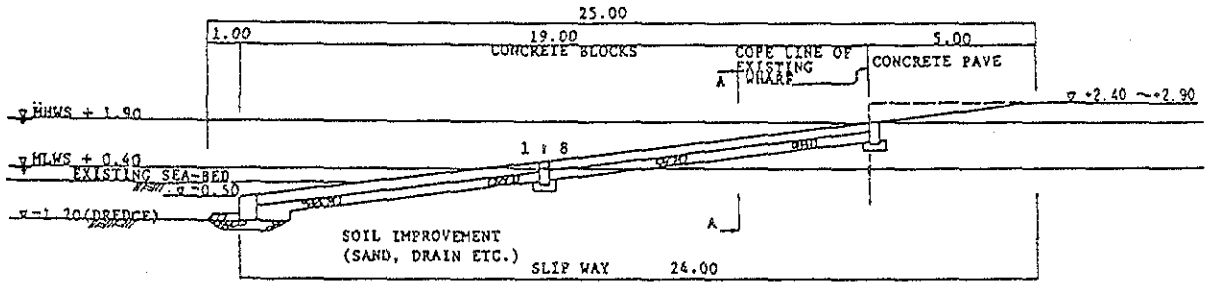


TYPICAL SECTION OF REHABILITATION WORK
FOR WHARF STRUCTURE AT PRESENT

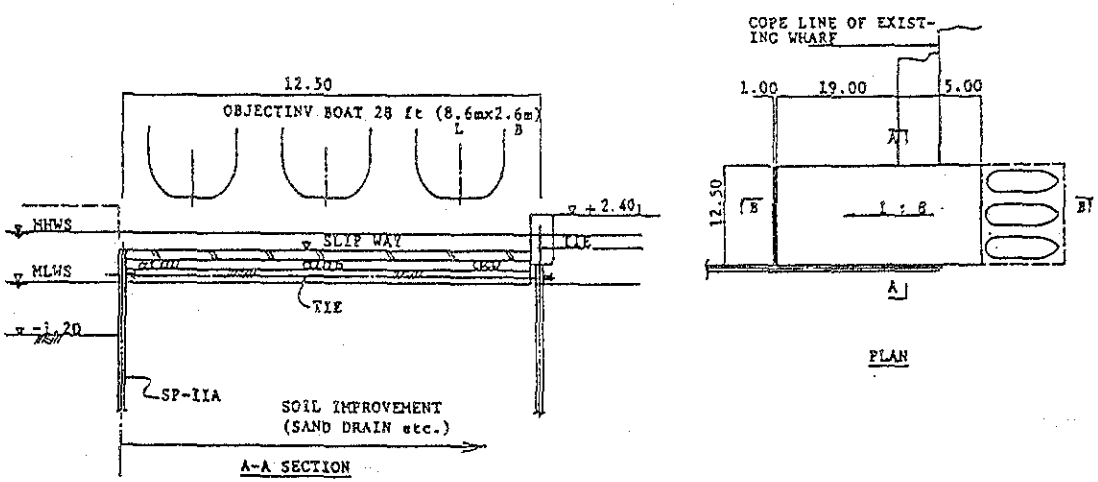


TYPICAL SECTION OF GROIN

DWG. NO, R223-BD-007 REHABILITATION OF EXISTING KING'S
WHARF AND TYPICAL SECTION OF GROIN



B-B SECTION

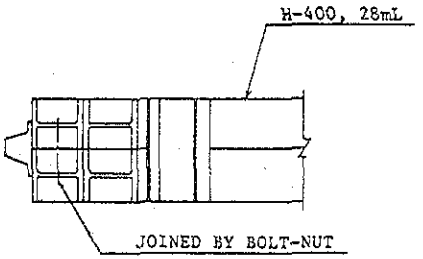


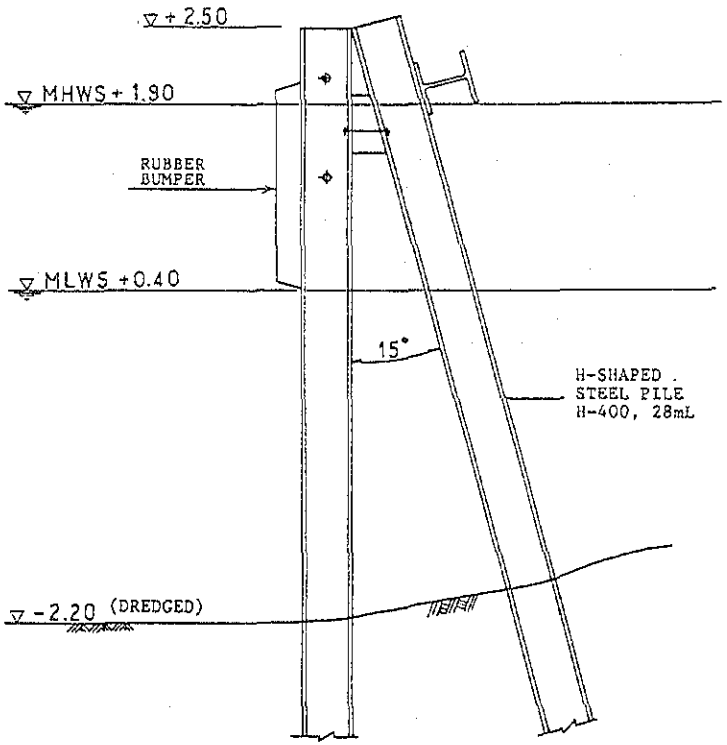
A-A SECTION

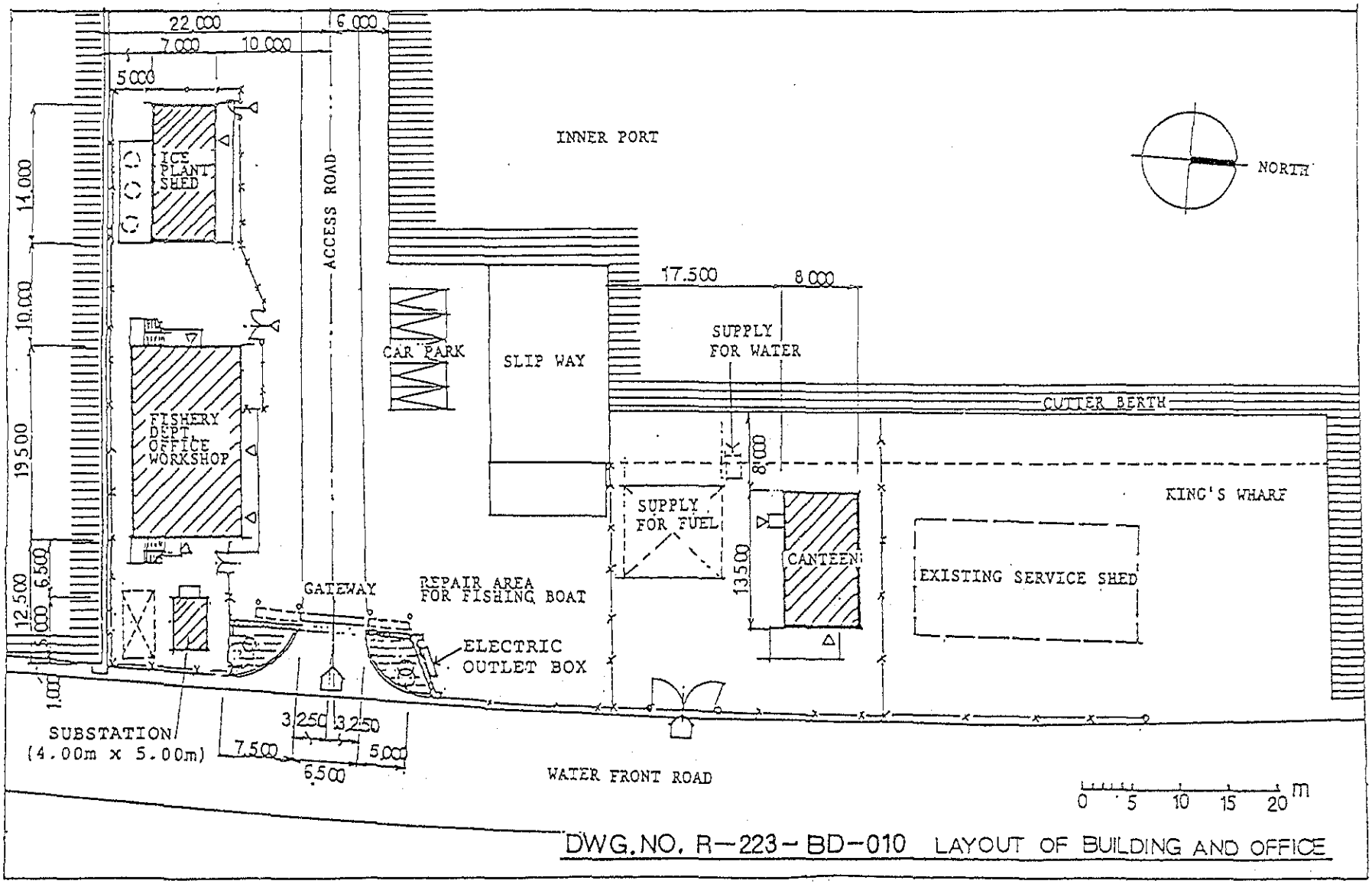
PLAN

DWG. NO. R-223-BD-008 TYPICAL SECTION OF SLIP WAY RAMP

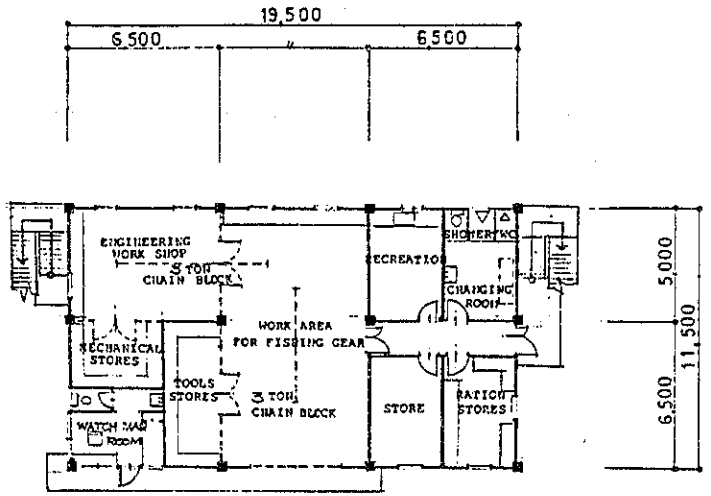
Fig. FENDER PILE SYSTEM



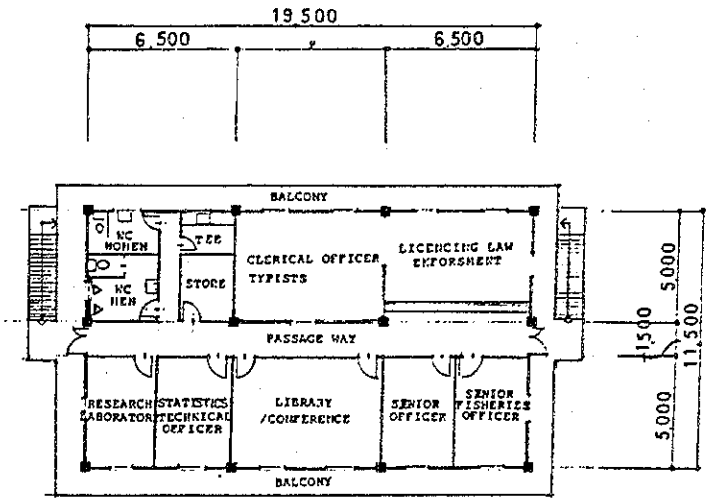




DWG. NO. R-223-BD-010 LAYOUT OF BUILDING AND OFFICE



GROUND FLOOR PLAN



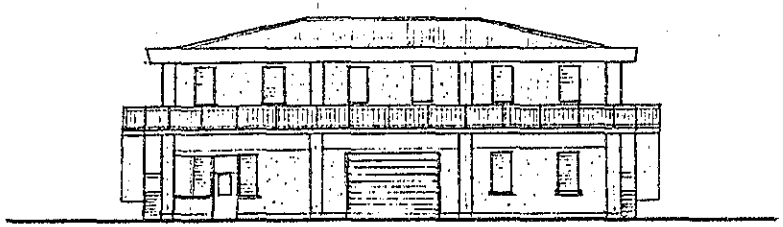
1ST, FLOOR PLAN

OFFICE/WORK SHOP

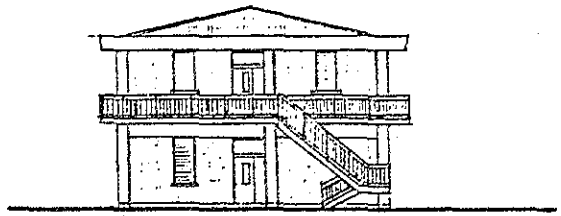
0 1 2 3 4 5 10 m

LAUTOKA FISHING PORT IMPROVEMENT PROJECT

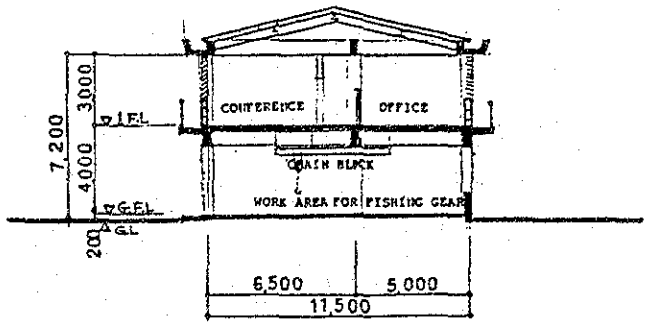
DWG. NO, R-223-BD-011 OFFICE/WORKSHOP; PLAN



NORTH ELEVATION



WEST ELEVATION



SECTION

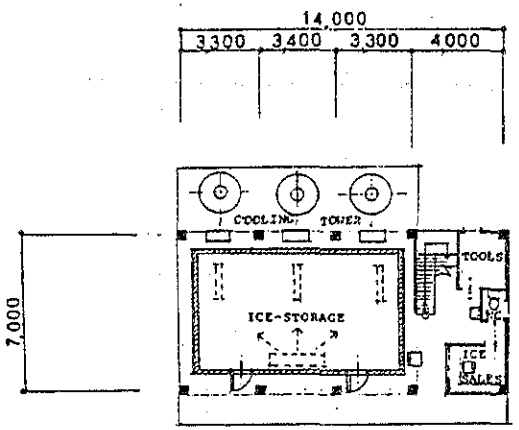
0 1 2 3 4 5 10m

OFFICE/WORK SHOP

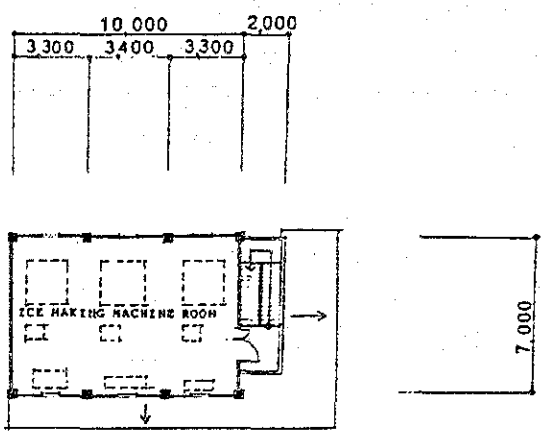
LAUTOKA FISHING PORT IMPROVEMENT PROJECT

DWG. NO. P-223-BD-012 OFFICE/WORKSHOP; ELEVATION AND SECTION

PACIFIC CONSULTANTS INTERNATIONAL



GROUND FLOOR PLAN



1ST. FLOOR PLAN

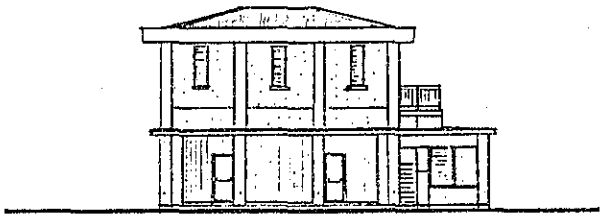
0 1 2 3 4 5 10m

ICE PLANT

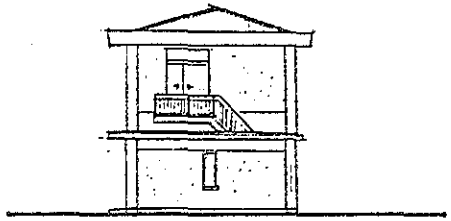
LAUTOKA FISHING PORT IMPROVEMENT PROJECT

DWG. NO, R-223-BD-013 ICE PLAN SHED; PLAN

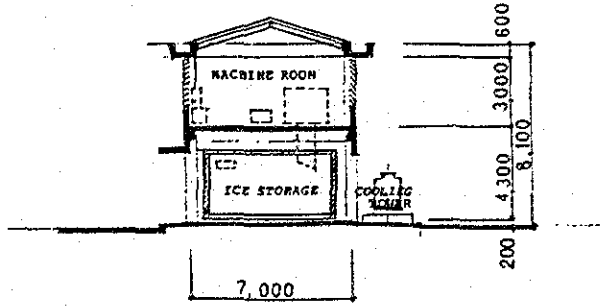
PACIFIC CONSULTANTS INTERNATIONAL



NORTH ELEVATION



WEST ELEVATION



SECTION

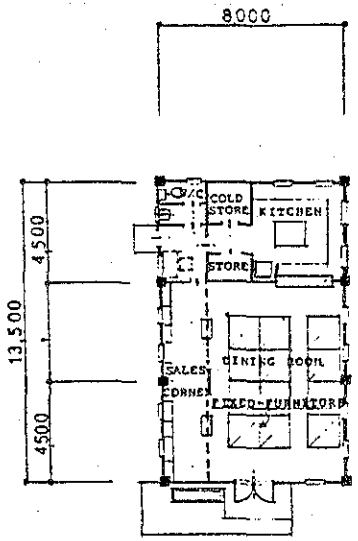
0 1 2 3 4 5 10m

ICE PLANT

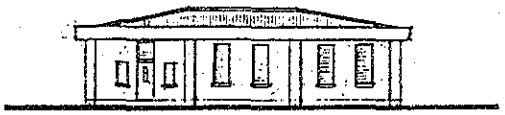
LAUTOKA FISHING PORT IMPROVEMENT PROJECT

DWG. NO, R-223-BD-014 ICE PLAN SHED; ELEVATION AND SECTION

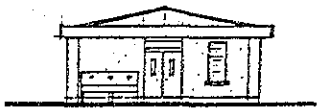
PACIFIC CONSULTANTS INTERNATIONAL



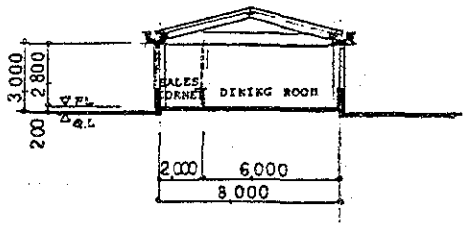
PLAN



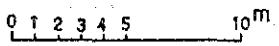
SOUTH-ELEVATION



EAST-ELEVATION



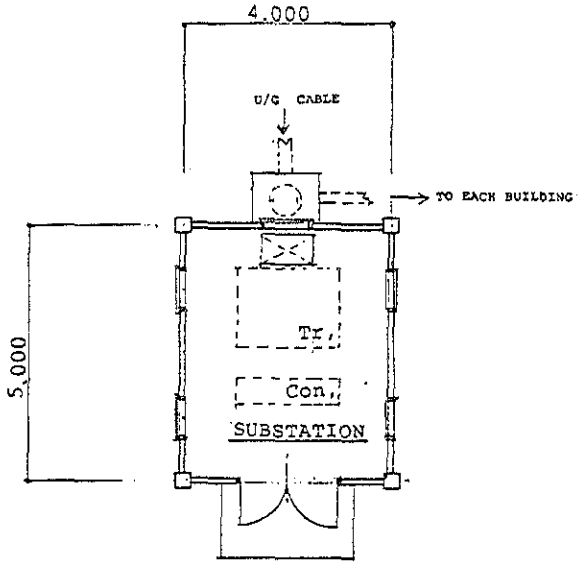
SECTION



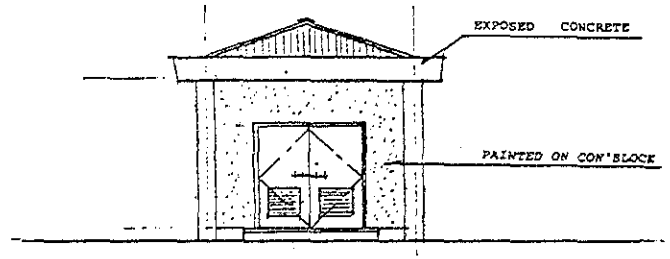
CANTEEN

LAUTOKA FISHING PORT IMPROVEMENT PROJECT

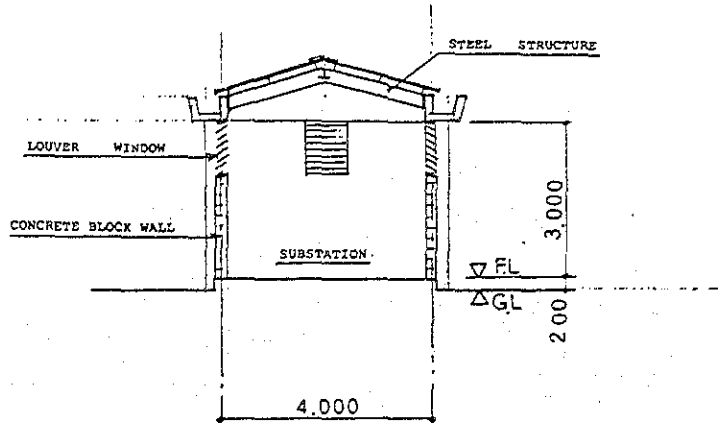
DWG. NO, R-223-BD-01S CANTEEN; PLAN AND ELEVATION



PLAN



ELEVATION



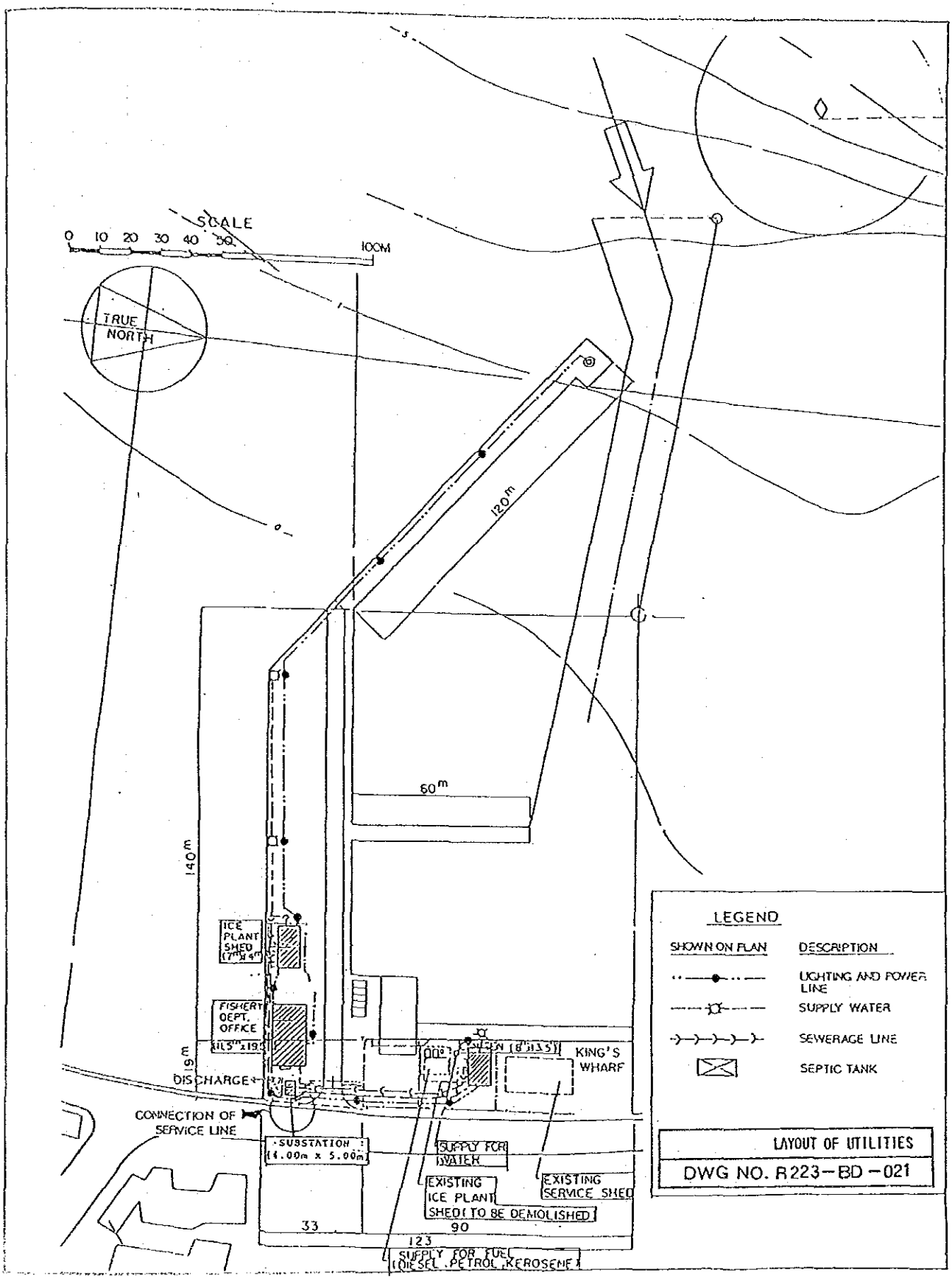
SECTION

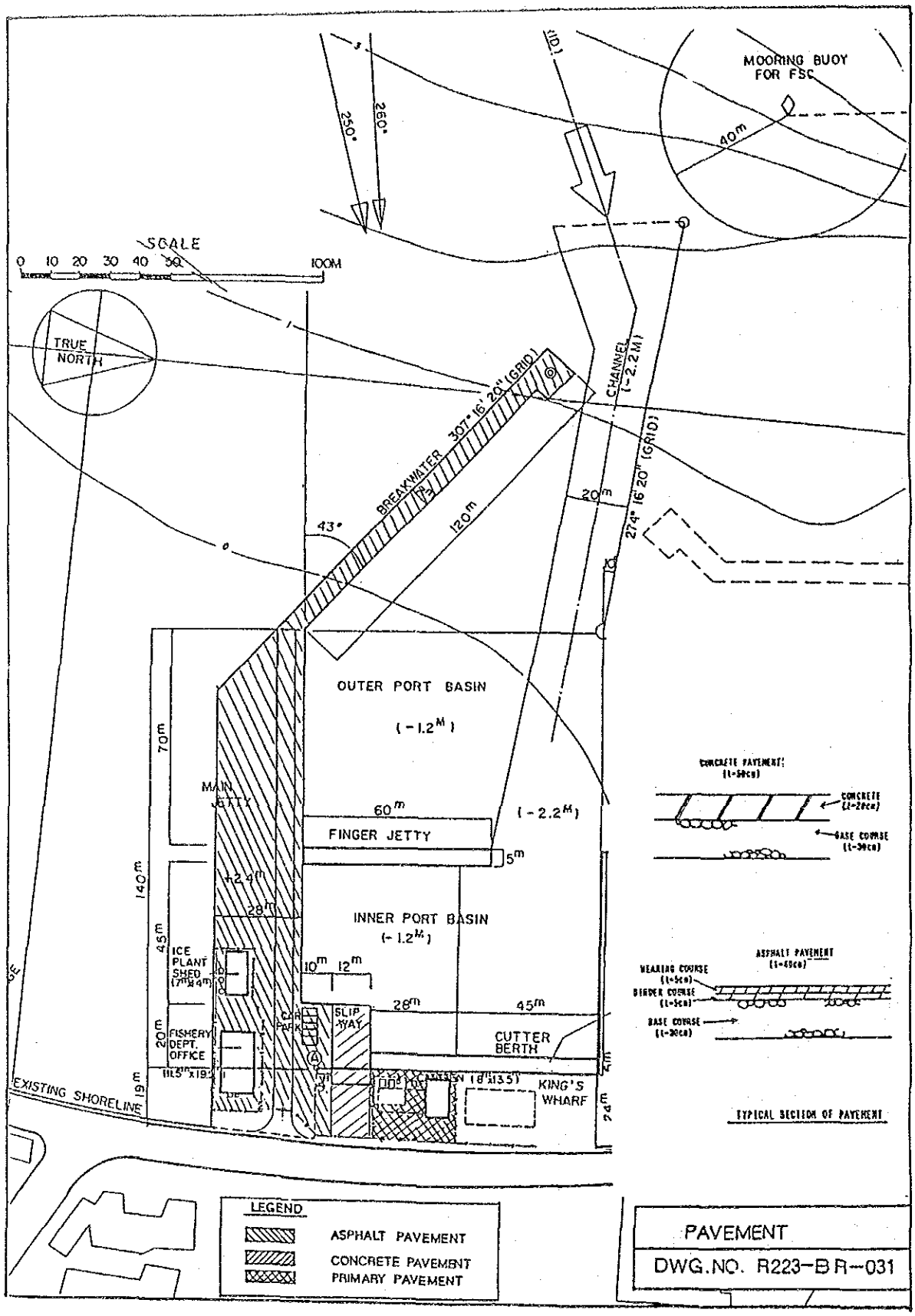
0 1 2 3 4 5 m

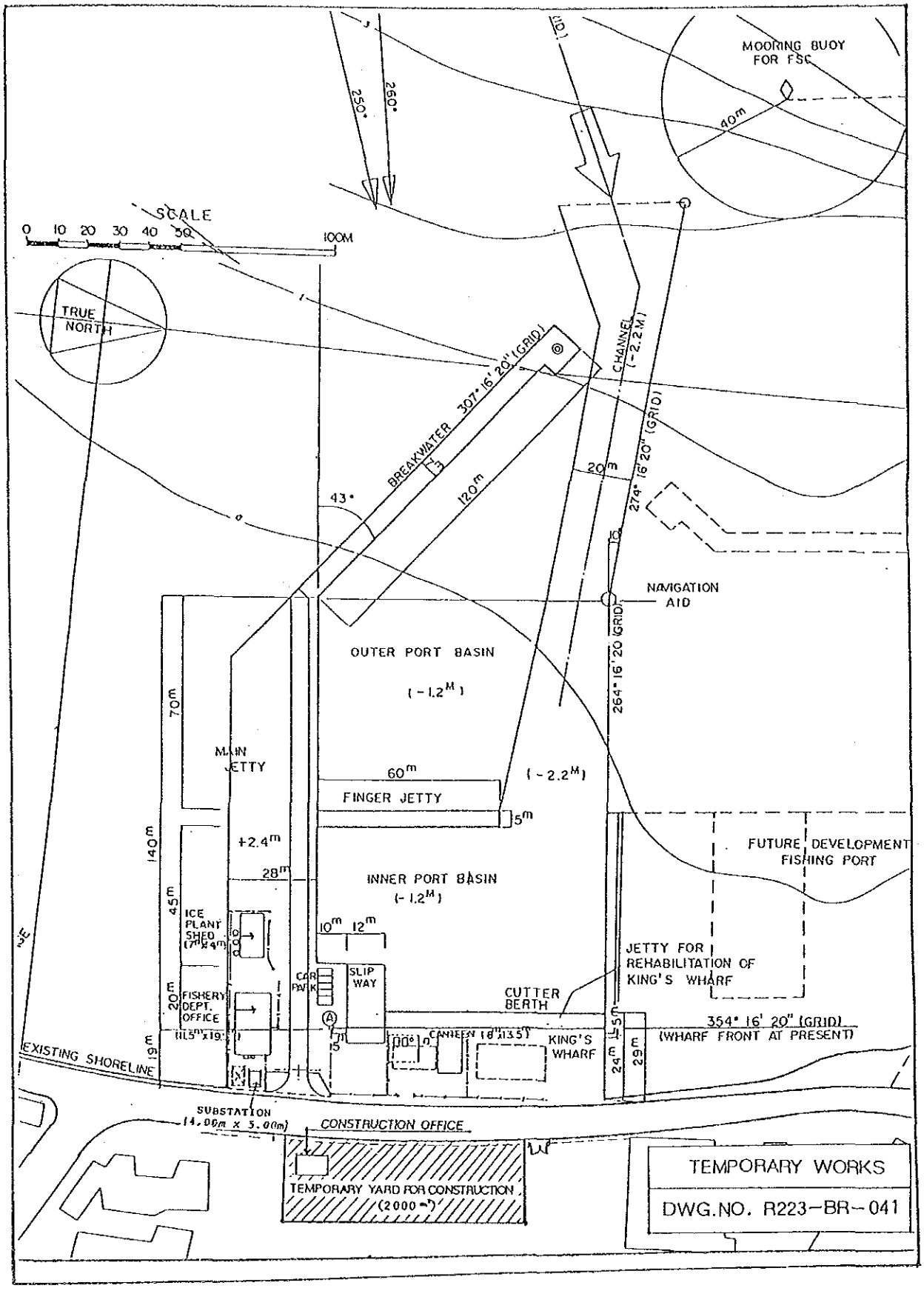
SUBSTATION

LAUTOKA FISHING PORT IMPROVEMENT PROJECT

DWG. NO, R-223-BD-016 SUBSTATION


SCALE
0 10 20 30 40 50 100M
TRUE NORTH
120m
60m
140m
ICE PLANT SHED (17m x 4m)
FISHERY DEPT. OFFICE (11.5m x 19.5m)
DISCHARGE
KING'S WHARF
CONNECTION OF SERVICE LINE
SUBSTATION (4.00m x 5.00m)
SUPPLY FOR WATER
EXISTING ICE PLANT SHED TO BE DEMOLISHED
EXISTING SERVICE SHED
33
90
123
SUPPLY FOR FUEL (DIESEL, PETROL, KEROSENE)
LEGEND
SHOWN ON PLAN
DESCRIPTION
LIGHTING AND POWER LINE
SUPPLY WATER
SEWERAGE LINE
SEPTIC TANK
LAYOUT OF UTILITIES
DWG NO. R223-BD-021


MOORING BUOY FOR FSC
40m
250°
260°
SCALE
0 10 20 30 40 50 100M
TRUE NORTH
CHANNEL (-2.2M)
274° 16' 20" (GRID)
307° 16' 20" (GRID)
BREAKWATER
120m
20m
43°
OUTER PORT BASIN
(-1.2M)
(-2.2M)
MAIN JETTY
60m
FINGER JETTY
5m
+2.4m
28m
INNER PORT BASIN
(-1.2M)
70m
140m
45m
20m
ICE PLANT SHED (7m x 4m)
10m
12m
28m
45m
FISHERY DEPT. OFFICE
CAR PARK
SLIP WAY
CUTTER BERTH
KING'S WHARF
EXISTING SHORELINE
CONCRETE PAVEMENT
CONCRETE
BASE COURSE
ASPHALT PAVEMENT
WEARING COURSE
BINDER COURSE
BASE COURSE
TYPICAL SECTION OF PAVEMENT
LEGEND
ASPHALT PAVEMENT
CONCRETE PAVEMENT
PRIMARY PAVEMENT
PAVEMENT
DWG.NO. R223-BR-031


MOORING BUOY FOR FSC
SCALE
0 10 20 30 40 50 100M
TRUE NORTH
CHANNEL (-2.2M)
BREAKWATER 307° 16' 20" (GRID)
120m
43°
274° 16' 20" (GRID)
264° 16' 20" (GRID)
NAVIGATION AID
OUTER PORT BASIN
(-1.2M)
MAIN JETTY
70m
60m
FINGER JETTY
5m
(-2.2M)
+2.4m
28m
INNER PORT BASIN
(-1.2M)
140m
45m
20m
19m
ICE PLANT SHED (7m x 4m)
FISHERY DEPT. OFFICE
CAR PARK
SLIP WAY
10m
12m
CUTTER BERTH
JETTY FOR REHABILITATION OF KING'S WHARF
FUTURE DEVELOPMENT FISHING PORT
354° 16' 20" (GRID)
(WHARF FRONT AT PRESENT)
CANTEEN (18m x 13.5m)
KING'S WHARF
24m
29m
15m
EXISTING SHORELINE
SUBSTATION (4.00m x 5.00m)
CONSTRUCTION OFFICE
TEMPORARY YARD FOR CONSTRUCTION (2000 m²)
TEMPORARY WORKS
DWG.NO. R223-BR-041