b) Development plan

The project, "Lautoka Fishing Port Improvement Project", consists of necessary facilities, to meet the request made by the Government of Fiji, and scope and scale of which are based on the results of basic design. The project site proposed by the Government of Fiji is coastal area of existing King's Wharf, Lautoka, west of Viti Levu Island, the largest island in Fiji. This site was selected by the Fisheries Division based on the recommendation by the Ports Authority of Fiji 19th July 1985. The proposed site is one of the best location in the Western Division not only by social conditions but also physical conditions. The study team made necessary such site investingation as wave, soil and siltation for evaluation of site.

Study results shows that the proposed site is technically feasible for the project.

c) Inventory of Facilities

The project consists of proposed facilities as follows;

(1) 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
8. Accessories (Fender, Bollards etc.)

(2) Building and Office

1. Fisheries Office and Workshop
2. Ice plant shed
3. Canteen
4. Gate room
5. Substation

(3) Machines and Equipment

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

(4) Pavement

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

(5) Utilities

1. Water Supply
2. Sewerage System
3. Drainage
4. Power Supply
5. Lighting
6. Telecommunication
7. Fuel Supply
8. Fire Fishing Hydrant and Extinguisher

(6) Removal and Demolishing

1. Existing Ice Plant (removal)
2. Existing Office/Workshop (demolish)

(7) Others

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

Item 4 of (3) "Machines and Equipment includes;

a. Tools for workshop
b. Equipment for port administration office
c. Mobil workshop and tools for the regional fishing promotion
d. Spare parts for the previous Japanese Grant Aids Programme, ice plants and ice storages.

d) Undertakings by the Government of Fiji

The Government of Fiji are requested to undertake such work as follows per the list on Clause c).

- Item (3)-3
- Item (5) but upto the site (to the main gate of fishing port)
- Item (6)
- Item (7)-2,3
- Item (5)-7

The Government of Fiji is requested by the Government of Japan to provide temporary facilities and yard for the implementation of project as follows.

- Item (5) of previous clause including, Water supply, Power supply and Telecommunication
- Work site in vicinity of the site in scale of 2,000 m².

These works are requested to undertake before the commencemnet of the construction works.
And the Government of Fiji is requested by the Government of Japan to provide to the contractor necessary assistance and measures which are agreed between both Governments.

# CHAPTER 5. BASIC DESIGN

## 5 - 1 PLAN AND DESIGN CONCEPTS

In this chaper a basic design of Lautoka fishing port is carried out based on the following basic design concepts.

(1) Reasonable scale and characters of the initial development of Project
(2) Suitable configuration of the port
(3) Fitness of design to the site conditions
(4) Optimum size of facilities
(5) Fitness of design to the local condition on fish production and distribution through marketplace
(6) Fitness of construction materials and type of structures to Fiji conditions

The study team made an approach to the project through discussions with the governmental officals and those who concerned with each design concept shown above. The exchange of opinions was undertaken on the role of the project and the shape of the project for the coastal fishing industry.

The study team got a lot of suggestions and requirements by the officials concerned with all aspects especially on the fishing port operation and alignment of its facilities. And the study team got a lot of useful information on the production activities of fishermen in the port hinterland and on the present distribution system through a direct survey. Direct interviews were also made with the consumers of fishing productions in order to look into their present tendencies on the way of buying fish and on the daily consumption.

The study team collected necessary information on natural conditions at the site such as winds, tidal current and geotechnical data.
And availability of local construction materials and machines was investigated in order to formulate a possible type of structure.

Wave calmess study has been made on the normal wave conditions and on the cyclone conditions to the need of breakwater was evaluated. Siltation problems have also been analyzed considering the direction and quantity of natural littoral drift.

Detailed design concepts were prepared by the joint study team consisting of the officers of the Fisheries Division and members of the JICA' s study team under the kind assistance of the Ports Authority of Fiji.

(1) Reasonable Scale and Character of the Initial Development of Project

- The demand forecast on the fish consumption and on the number of boats calling has to be carried out.
- An appropriate rate of accommodation to the total number of fishing boats which are to call at the port has to be estimated and scale of the port has to be fixed considering the number of boats at the initial development stage and the project target year.
- In the intial investement cost, a part of the cost which may be supported by the Japanese grant aid programme, has to be estimated based on the method which is shown in the guidelines on financial assistance to developing contries.
- Characteristics of the facilities have to be studied well so as to reduce the running and operation cost as much as possible.
- The project has to generate an economic internal rate of return in an acceptable range.
- Character of facilities to be introduced has to meet the spirit of Japanese grant aid programme and be within the scope of the requests made by the Government of Fiji.

(2) Suitable Configuration of the Port

- Design of port layout has to be principally made in accordance with the requirements of the Government of Fiji.
- Zoning of the port area has to be allocated in order to obtain the maximum effectivenoss of land use considering each function of the

facility such as a fishing port general facility, valuable facility to be secured, port service facilitiy to be controlled by organizaiton other than the Fisheries Division, non-fishing port facility, such as cutter berths and barge berth etc.

- Effective utilization of the limited water front, namely the quaywall and wharf, has to be maintained by means of making them as free as possible from rigid and fixed structures which may affect the effective use and may disturb a flexible utilization of the port in the future.
- Since a larger future demand may be expected for the port utilization, a possibility of future expansion has to be considered.

(3) Fitness of Design to the Site Conditions

- Tidal current and tidal range have to be considered in planning and designing of facilities.
- Offshore waves and shallow water waves have to be analyzed by a wave forecasting method and the design of facilities has to be made so as to give enough strength against such wave attacks during cyclones. Characteristics of waves in the port operation condition have to be analyzed.
- Present siltation phenomenon has to be studied considering wave energy, wave induced current, size of fine materials and direction of littoral drift. The volume of siltation into the dredged area such as the port basin and approach channel has to be estimated considering a size of protection system such as breakwater against deposit of fine materials.
- Geotechnical conditions have to be incorporated into the structural design, especially when soil embankment is needed on the soft layers.
- General conditions and circumstances of the surrounding area of the site have to be evaluated. Effect of othe project, if any in the vicinity of the site, has to be considered, especially on any future project prepared or accepted by the Ports Authority.

(4) Optimum Size of Facilities

- Length and alignment of breakwater have to be carefully studied considering the direction and location of approach channel, the wave calmness in the port basin, silitalton and fine deposit in the port basin and the existing port facilities such as channel of commercial port, pierhead line and the location of mooring bouy for FSC jetty.
- Shape and alignment of quaywall and wharves have to be studied to meet the required berth occupancy by coastal fishing boats calling at Lautoka fishing port. The functions of each berth have to be clearly identified and classified in order to achive their effective use.
- Design depth of the quaywall has to be enough for the draft of the largest boats calling at any tidal conditions.
- Water depth at the approach channel and port basin have to be maintained.
- Specified wave calmness has to be maintained at the port basin.

(5) Fitness of Design to the Local Conditions on Fish Production and Distribution through Marketplace.

- Handling space just behing the quaywall has to be provided to allow fishermen easily to unload and load.
  Traffic circulation at the quaywall and aceess way has to satisfy the economic movement of fishermen and transport of materials including ice, fishing gear and fish catch.
- A port administration office has to be provided with a workshop and necessary tools.
- A ramp facility with necessary mechanical eqiupment has to be provided for fishing boats purpose near the workshop.
- Suitable size of ice plant and its storage facility with shed have to be provided.
- A canteen with a shopping corner has to be provided.

- Necessary utilities have to be provided such as water supply, sewerage system, power supply, etc.
- Necessary spare parts have to be provided based on the guidelines of grant aid programme of the Government of Japan.

(6) Fitness of Constraction Materials and Type of Structures to Fiji Conditions

- Design criteria have to be based on the current Fiji regulations. Design method has to be international standards or Japanese standards.
- Construction materials have to be decided considering the local availability.
- Construction method has to be studied to meet the local capability, if there is any possible method in Fiji in an acceptable economic way.
- Type of structures has to be as simple as possible and with the durable type of structure with a low-maintenance need in operation.

## 5 - 2 GENERAL SITE CONDITIONS

### 5-2-1 Topography

Topographic Survey was couducted by the study team on and around the existing King's Wharf in April 1986; wharf size 90m×20m and wharf height: CD+2.90m, where there are 2 sheds, an ice plant shed (8m ×15m) of the Fishery Division and a Service Shed (11m ×22m) of the Ports Authority. (See Fig. 5-1)

### 5-2-2 Bathymetry

As mentioned before, the King's Wharf has been utilized only at the higher water level due to the shallow water front depth, which was proved by the bathymetric survey by the study team in April 1986.

The existing sea-bed slope in front of the wharf is lenient at 1:100, which becomes steep at 1:30 around C.D-2.0m toward off-shore to CD.-10.0m channel. (See Fig. 5-2)

### 5-2-3 Geotechnical Conditions

Fig. 5-3 shows the soil investigation results in bore log at both sides of the King's Wharf on land and offshore. See datail in Appendix N.

It can be concluded that there are principally 3 soil strata around this area, ie, the very soft and loose soil presumed to be consolidated in the upper layer, medium to stiff in the 2nd layer and stone or rock in the lower layer, and all of these are in general cohesive soils.

Sea-bottom sampling and their sieve analysis results indicate that the black colored soft clay covers the whole proposed area of the wharf, except one location in front of discharge outlet from FSC where the sandy materials are found.

### 5-2-4 Structural Condition of King's Wharf

Structural drawings of the King's wharf were not available, and therefore by the field investigation in April 1986 the front structure can be presumed as shown in Fig. 5-4, where main front-struture is by steel sheet piles with ties and concrete walls behind.

According to the interview about the water depth in front, vessels of 12 ft draft are said to have loaded/unloaded there until ca. 1970, so the

water depth in the original design is deemed to be CD-2.3m (Fig. 5-5) At present, the front sheet piles are deteriorated with holes by corrosion all along the upper part, but the lower part seems still structurally rigid. Furthermore, the lower ties are all loose, which may be indicative of the provision of the upper ties as a reinforcement measure.

### 5-2-5 Meteorological and Oceanographic Aspects

Meteorological and oceanographic conditions are described in the Section 2-1-2.

### 5-2-6 Design Standards

There is no structural regulations, however, the Newzealand regulation, Nzs-4203:1984 is applied correspondingly.

a) Wind Force

Desging wind speed = 66 m/sec

b) Seismic Force (Zone: B)

Horizontal coefficient of seismic force = CRSM = 0.10

When necessary the Japanese standards will be applied correspondingly.

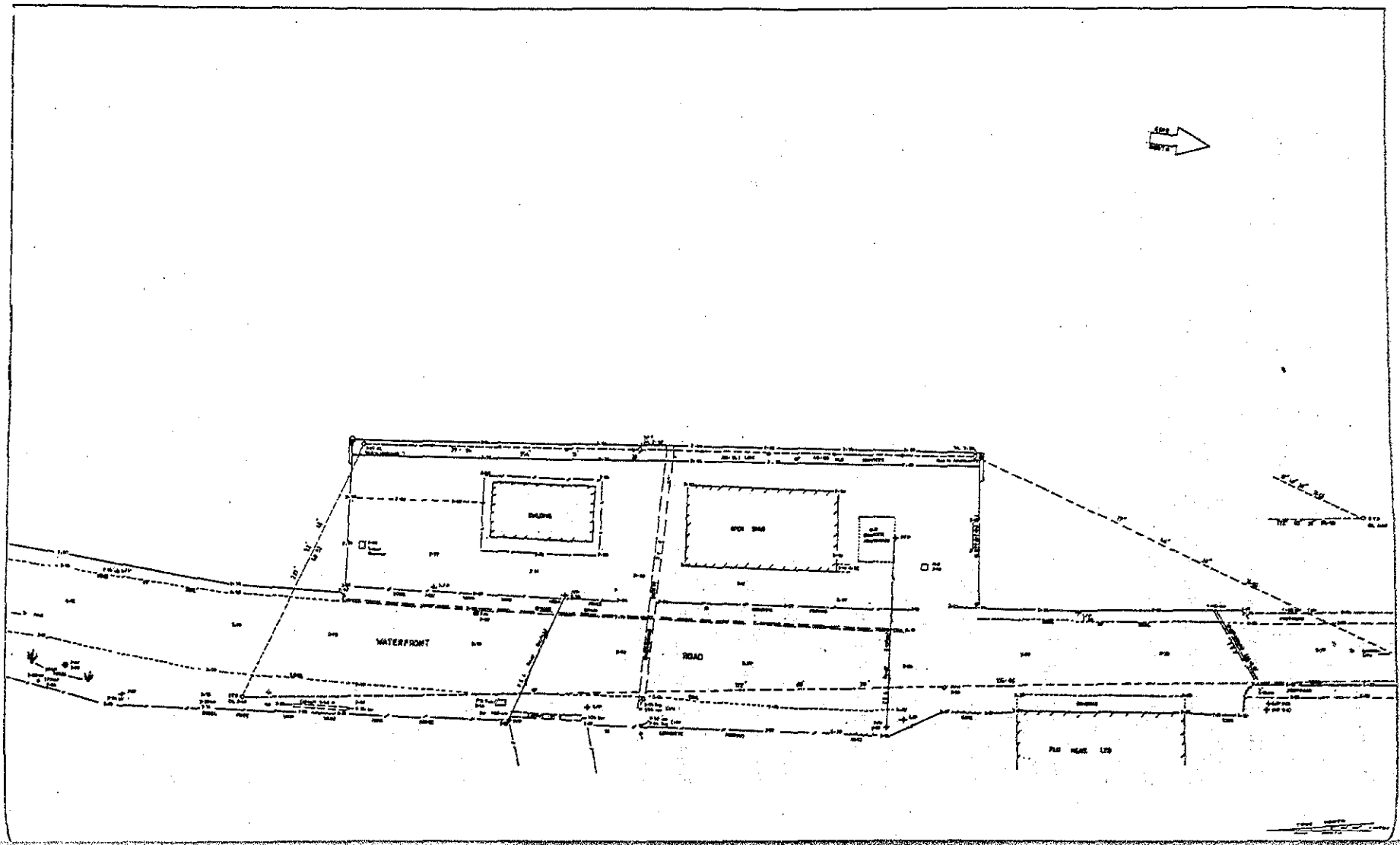
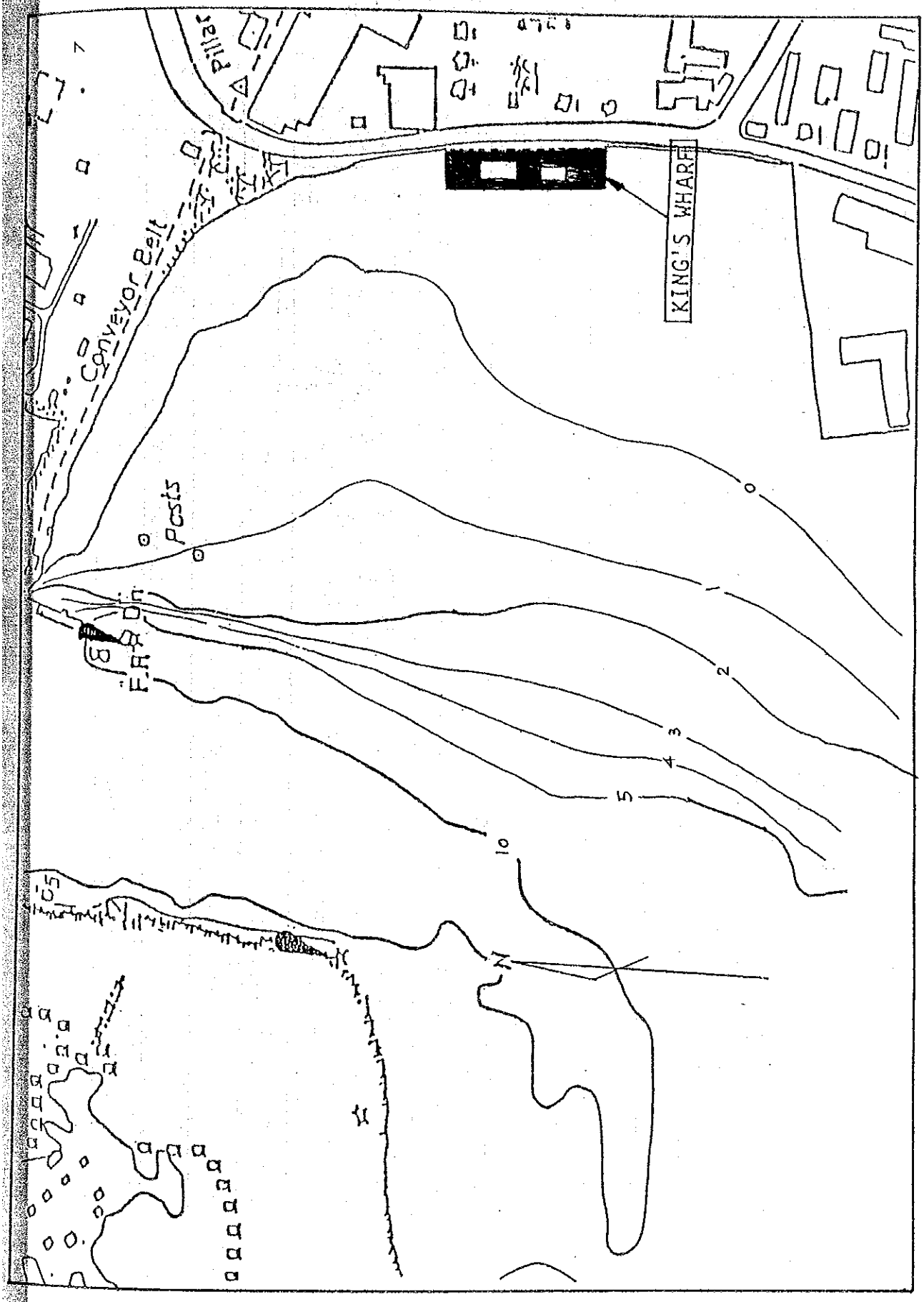
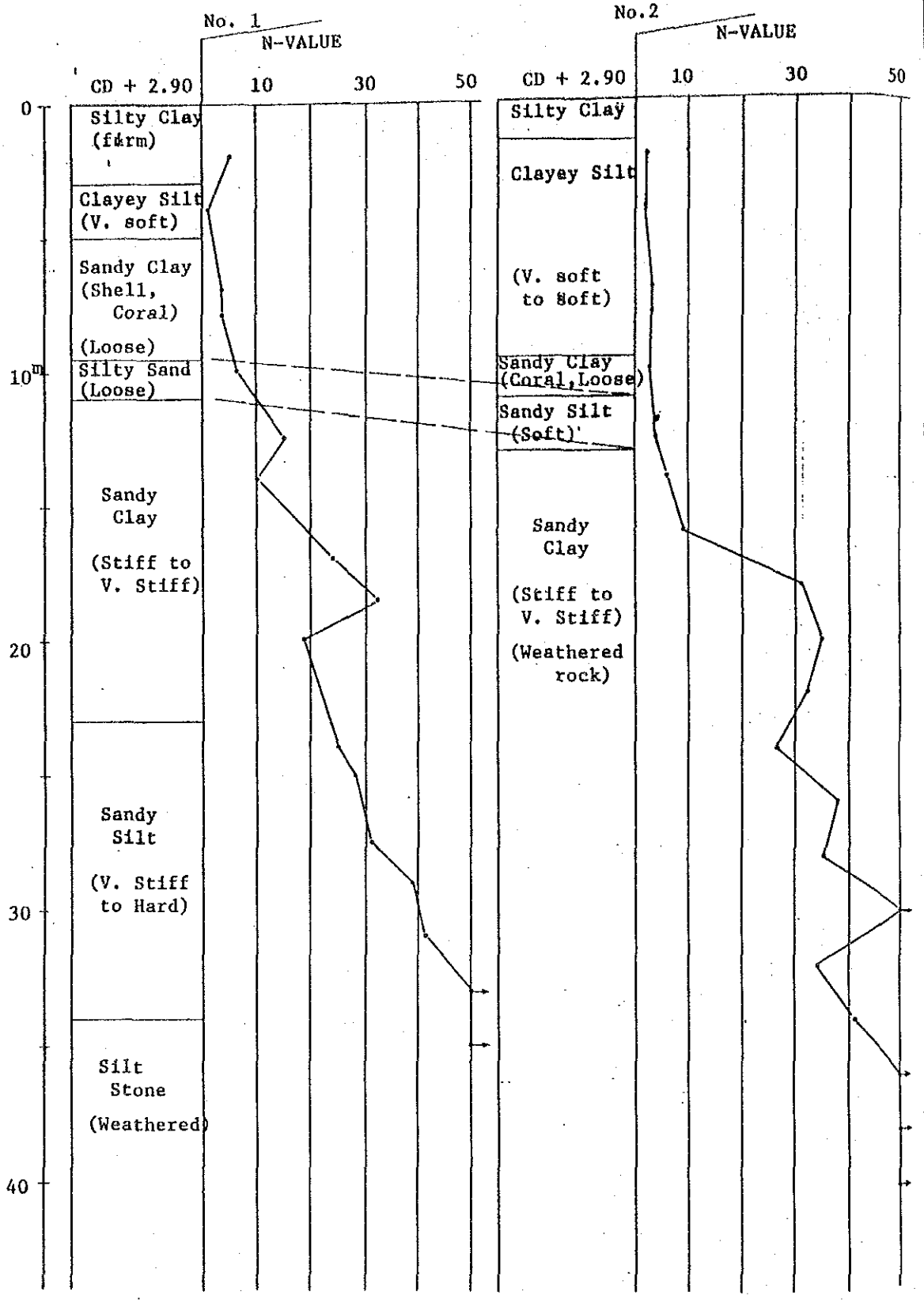

WATERFRONT
ROAD

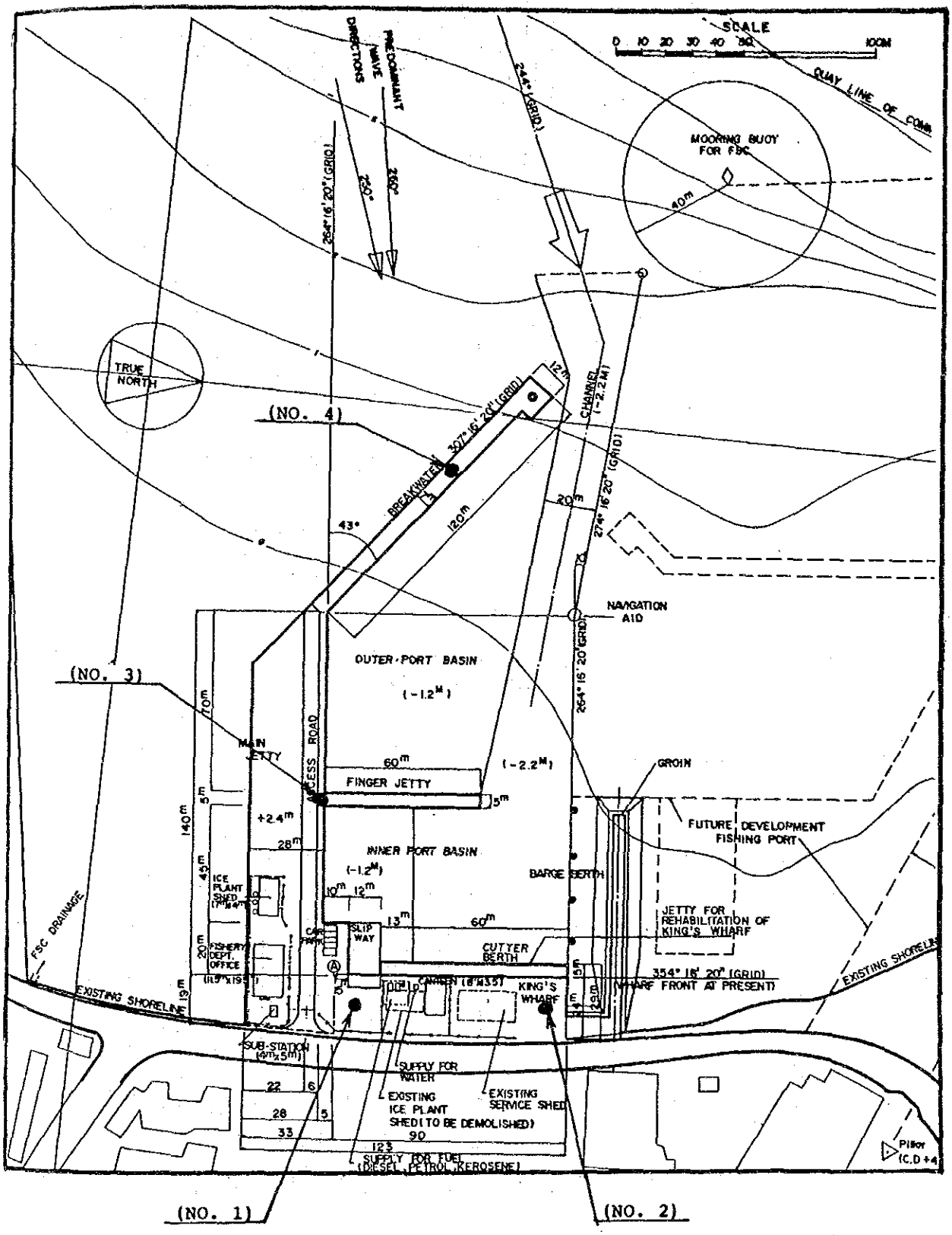
FIG. 5-2 BATHYMETRY DATA



# FIG. 5-3, SOIL PROFILE



## SITE OF SOIL INVESTIGATION



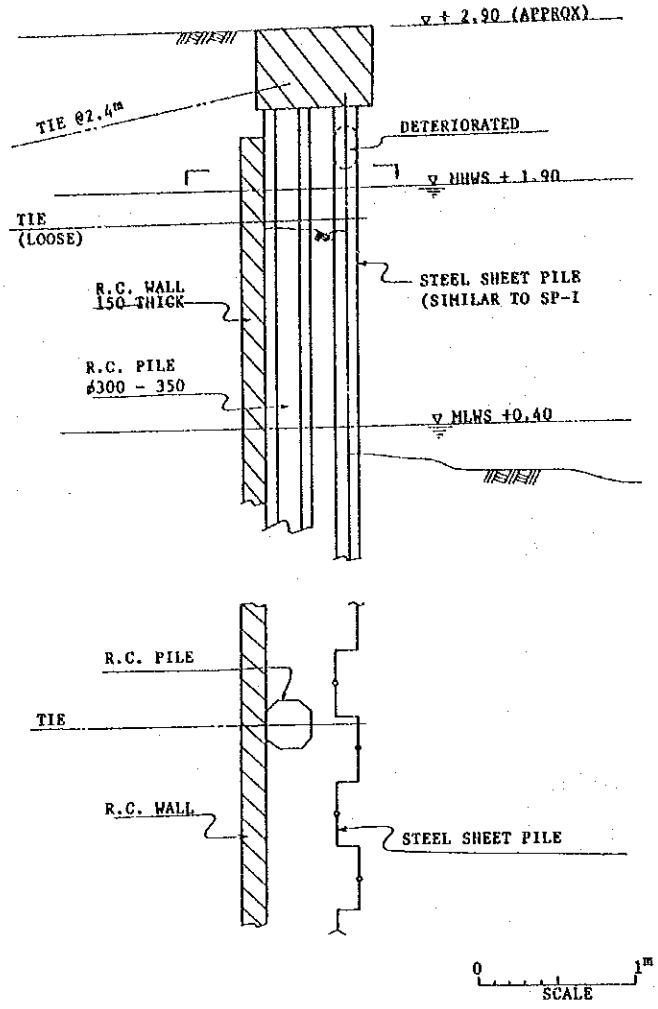



FIG. 5-4, STRUCTURAL SKETCH OF PRESENT KING'S WHARF

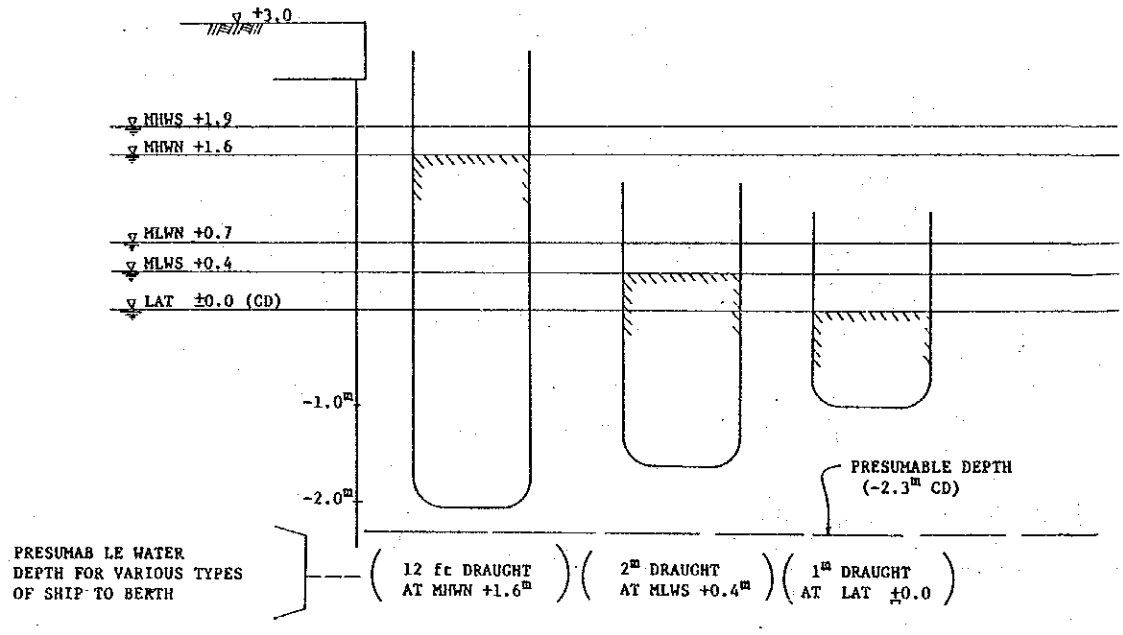



FIG. 5-5, PRESUMPTION OF WATER DEPTH FOR KING'S WHARF IN ORIGINAL DESIGN

## 5-3 SCALE OF THE PROJECT

In this section the scale of main index for fishing port planning, namely annual catch landed there and number of fishing boats, are discussed in detail according to the existing statistical data and information which were collected by the study team.

The scale of the project is interrelated with these indices.

### 5-3-1 Estimation of Future Demands

a) Assumption of Present Fish Catch

The present fish catch are assumed by the combination of the following.

(1) Fish sales indicated in the official record.

(2) Fish catch calculated by unit consumption (kg/head/year) and population.

(3) Fish catch calculated by unit annual catch boat (Kg/boat/year) and number of boats.

(4) Fish catch estimated by average income of fishermen (F$/boat/year)

(1) Fish Sales Indicated in the Official Record.

Recorded quantity of fish sales through the municipal market in Lautoka is 253ton/year (1984) and there was no large fluctuation in the past several years.

The annual catch by one fishing boat is as follows according to the interview survey.

650kgs/month×10months=6,500kgs/year.

The total number of fishing boats in Lautoka is 250 including both registered and non-registered boats, so total catch in Lautoka is.

6,500kg/year×250boats=1,625ton/year

even by 100 registered boats only, the catch is.

6,500kgs/year ×100boats=650ton/year

Those figures are quite different from the official record.

According to the direct interview survey with fishermen, they are not willing to sell their fish through the municipal market, so that recorded quantity is likely to be much less than the actual quantity.

Therefore the fish catch should be estimated by another proper method.

(2) Fish Catch calculated by Unit Consumption and Population.

The hinerland of Lautoka Fishing Port is assumed as Lautoka, Ba, Nadi and its adjoining area.

These areas are divided into five groups by the convenience of access to Lautoka and the total demand of fish in the Lautoka Fishing Port hinterland is to be calculated according to the assumed consumption of fish by the residents in each area.

The uint consumption is about 5kgs/head/year by the official record but it does not seem to indicate actual condition, so that the unit consumption will be calculated based on the result of interview survey.

Table 5-1 Population by Area: Project Hinterland

| District | Population | Classified Population | | | | |
|---|---|---|---|---|---|---|
| | | A | B | C | D | E |
| Lautoka | 68,000 | 34,000 | 20,400 | 6,800 | 3,400 | 3,400 |
| | | 50% | 30% | 10% | 5% | 5% |
| Ba | 54,000 | 16,200 | 10,800 | 10,800 | 8,100 | 8,100 |
| | | 30% | 20% | 20% | 15% | 15% |
| Nadi | 44,000 | 13,200 | 8,800 | 8,800 | 6,600 | 6,600 |
| | | 30% | 20% | 20% | 15% | 15% |
| Other | 34,000 | 0 | 6,800 | 6,800 | 3,400 | 12,000 |
| | | 0 | 20% | 20% | 10% | 50% |
| Total | 200,000 | 63,400 | 46,800 | 33,200 | 21,500 | 35,100 |
| | | 31.7% | 23.4% | 16.6% | 10.7% | 17.6% |

Speciality of each area in relation to Lautoka Fishing Port:-

A: Good access to market and high density of population

B: Ordinary access to market and average density of population

C: Inconvenient access to market and average density of population

D: Inconvenient access to market and low density of population

E: No market and very low density of popolation

The demand of fish in hinterland of Lautoka is roughly calculated by unit consumption and population, and the uint consumption obtained by the interview survey (say 30kgs/head/year) is considered equal to those of A- area.

Unit : kgs/head/year

| Area | A | B | C | D | E |
|---|---|---|---|---|---|
| Unit | 30.0 | 15.0 | 7.5 | 1.5 | 1.5 |
| Consumption | 100% | 50% | 25% | 5% | 5% |

Note: Unit consumption by the direct survey is 37.2kg/head/year to 45.5kg/head/year, though unit consumtion to A-area is set at 30.0kg.
Unit consumptions for B, C, D and E area are assumed to proportionally decrease due to the character of the area.

Therefore the total consumption in hinterland of Lautoka is:

unit:kgs

| Area | A | B | C | D | E |
|---|---|---|---|---|---|
| Population | 63,400 | 46,800 | 33,200 | 21,500 | 35,100 |
| Unit Cons. | 30.0 | 15.0 | 7.5 | 1.5 | 1.5 |
| Sub total | 1,902,000 | 702,000 | 249,000 | 32,000 | 53,000 |

Total 2,938,000kgs = about 3,000ton
(average 14.7kgs/head/year)

The average adopted for the whole country, national fish consumption will be:

$$678,000 \times 14.7 = 9,967,000 \text{kgs/year} \fallingdotseq 10,000 \text{ton/year}$$

(3) Fish Catch calculated by Unit Annual Catch per Boat and Number of Fishing Boats.

The numbers of the registerd fishing boats (1985) in Lautoka, Ba, Nadi and Yasawa is 82,77,31 and 37 respectively according to Table 3-1. The number of non-registered fishing boats in Lautoka is about 150 which is 1.8 times of that of registered boats and if the same ratio is applied to the other districts the total number of the fishing boats will be;

227×2.8 =635 Boats

Registered fishing boats : 227 (Monthly catch 650kg)

Non-registered fishing boats : 408 (Monthly catch 650kg×0.65=420kg)

Total 635 boats

Meanwhile, the average catch of a registered fishing boat is 650kgs/month as explained in 3-1-1 a) and if this value is applied to all of/registered fishing boats and 65% of 650kgs to non-registered boats, the total catch will be;

227boat ×650kgs/month×10month/year+408boat ×420kgs/month ×10=3,189,000kg

This value is quite near to the value of (2).

(4) Fish Catch estimated by Average Income of Fishermen.

The average monthly income of a fisherman is F$239 which is calculated and explained in 3-1-1 a) (3). The propriety of this value can be proved as follows:

From the statistical data, the annual income of one worker is calculated as fallows:

Working hours/week×pay for hour×week per Month

=35hr/week ×F$1.50/hr.×4weeks=F$210/worker/month.

The monthly income for one person is F$210 which is very close to the above mentioned F$239.

Therefore the said F$239 and the procedure to calculate this income can be said to be in the reasonable range, that is to say, the assumed fish catch 650kgs/boat/month are also considered proper value.

As the conclusion the total catch of Lautoka and its hinterland is considered to be about 3,000ton/year.

b) Estimation of Present Number of Fishing Boats.

The total number of fishing boats in Lautoka and its hinterland is estimated. The ratio between licensed boats and non-licensed boats takes 1:1.8.

On the other hand, the total number of fishing boats is calculated by the total fish demand in the port hinterland and the average annual catch per

fishing boat. thus:

- Total Annual Demand 3,000 ton/year
  (Sea 5-3-1 a) (2))
- Average Annual Catch per Boat

| | | |
|---|---|---|
| Registered boat | 6,500kg× 1/2.8 | =2,320kg/boat・year |
| Non-Registered boat | 4,200kg×1.8/2.8 | =2,700kg/boat・year |
| Weighted Average= | | 5,000kg/boat・year |

Therefore, the total number of fishing boats is estimated as below.

3,000,000kg ÷5,000kg/boat・year=600 boats

The number of fishing boats for design will be discussed in clause c).

c) Results of Future Demands Forecast

By the combination of the above a)(2) and (3), the fish catch (consumption) and number of fishing boats in future are estimated as follows:-

Basic conditions:-

i) Annual increase of population : 2% a year (Bureau of Statistics)

ii) Unit consumption : As indicated in 5-3-1 a)(2)
(To be constant by 2005 though it may increase)

iii) Target year

Initial Plan 1990 Minimum requirement of facilities to be constructed by investment of grant aid.

Future 2005 20 years after.

iv) Unit catch of fishing boat is 500kgs/month and operating period is 10 months/year.

Results of estimation for fish catch and number of fishing boats in Lautoka and its hinterland are as follows :-

| Year | Fish Catch(ton) | Registered Boat | Unregistered Boat | Total of Boat |
|---|---|---|---|---|
| 1984 | 2,938 | 227 (39%) | 360 (61%) | 587 (100%) |
| 1990 | 3,311 | 454 (69%) | 208 (31%) | 662 (100%) |
| 2005 | 4,453 | 795 | 95 | 890 |

Note:Registered boats in 1990 : 227× 2= 454 (See Section 2-3-2)

Registered boats in 2005 : 454× ( 1+0.05×15) = 795

Table 5-2 Furture Demands Forecast

(Consumption Basis)

Unit rate : kg/head・year

| Area | | Present(1984) Pop. | Unit Rate | ton | 1990 Pop. | Unit Rate | ton | 2005 Pop. | Unit Rate | ton |
|---|---|---|---|---|---|---|---|---|---|---|
| Lautoka | A | 34,000 | 30.0 | 1,020 | 38,000 | 30.0 | 1,149 | 51,500 | 30.0 | 1,545 |
| | B | 20,400 | 15.0 | 306 | 23,000 | 15.0 | 345 | 30,900 | 15.0 | 464 |
| | C | 6,800 | 7.5 | 51 | 7,700 | 7.5 | 58 | 10,300 | 7.5 | 77 |
| | D | 3,400 | 1.5 | 5 | 3,800 | 1.5 | 6 | 5,200 | 1.5 | 8 |
| | E | 3,400 | 1.5 | 5 | 3,800 | 1.5 | 6 | 5,200 | 1.5 | 8 |
| Subtotal | | 68,000 | 20.4 | 1,387 | 76,000 | 20.4 | 1,564 | 103,100 | 20.4 | 2,102 |
| Ba | A | 29,400 | 30.0 | 882 | 33,100 | 30.0 | 993 | 44,600 | 30.0 | 1,338 |
| Nadi | B | 26,400 | 15.0 | 396 | 29,700 | 15.0 | 446 | 40,000 | 15.0 | 600 |
| Yasawa | C | 26,400 | 7.5 | 198 | 29,700 | 7.5 | 223 | 40,000 | 7.5 | 300 |
| | D | 18,100 | 1.5 | 27 | 20,400 | 1.5 | 31 | 27,400 | 1.5 | 41 |
| | E | 31,700 | 1.5 | 48 | 35,700 | 1.5 | 54 | 48,100 | 1.5 | 72 |
| Subtotal | | 132,000 | 11.8 | 1,551 | 148,600 | 11.8 | 1,747 | 200,100 | 13.1 | 2,351 |
| Total | | 200,000 | 14.7 | 2,938 | 225,200 | 14.7 | 3,311 | 334,700 | 14.7 | 4,453 |

$(1.02^{6} = 1.126)$ $(1.02^{21} = 1.673)$

Unit : boat

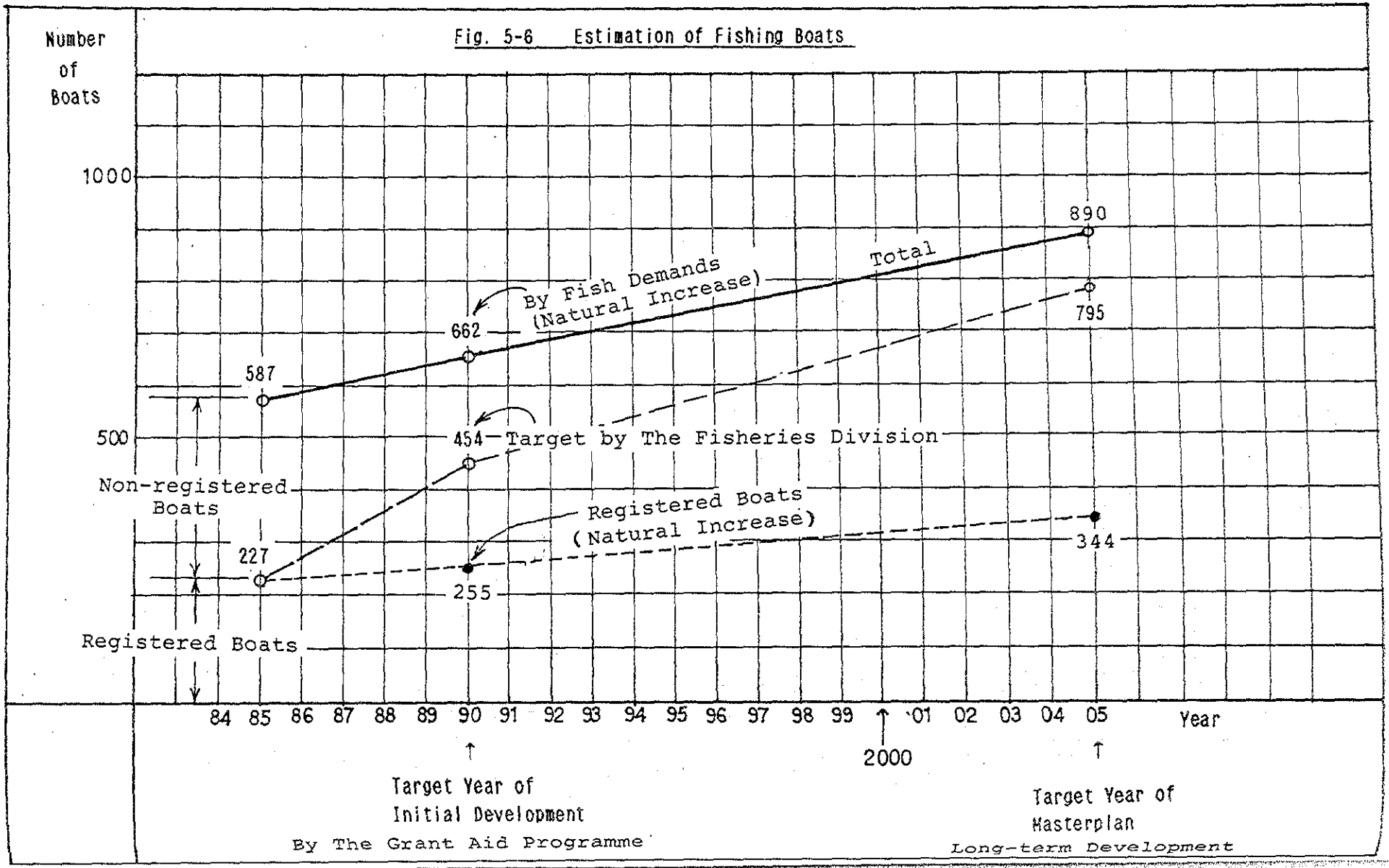
| Number of fishing boats (5.0 t/boat・year) | 1984 | 1990 | 2005 |
|---|---|---|---|
| Lautoka | 277 | 313 | 420 |
| Ba, Nadi, Yasawa | 310 | 349 | 470 |
| Total | 587 | 662 | 890 |

Note. Average annual catch per boat by the direct interview shows following figures.

- Registered fishing boat : 650kg/month×10months= 6,500kg/year
- Non-registered fishing boat : assume 65% of registered fishing boat (4,200kg)

Weighted Average is 5,000 kg/boat・year. See Section 5-3-1 b)

Fig. 5-6 Estimation of Fishing Boats



d) Estimation of Subsistence Catch

Volume of subsistence catch can not be definitely known bacause of lack of data. In this section, a very rough estimation is made for two basic classifications of subsistence catch as follows.

a. Catch made by a pure subsistence fishermen with most of his catch consumed by his own family and close relatives.

b. Catch made by a professional fisherman who sells most of his catch and with only a small portion of it consumed by his own family and close relatives.

(1) Fish

a. By pure subsistence fishermen

Number of the pure subsistence fishermen is assumed in relation with the number of professionals.

Number of professionals in the Lautoka Fishing port hinterland.

| Number of vessel | | Crew a boat | Total crew |
|---|---|---|---|
| Registered Type A | 91 | 3.0 | 273 |
| Registered Type B | 136 | 4.0 | 544 |
| Sub.total | 227 | | 817 |
| Non-Registered | 360 | 2.0 | 720 |
| Total | 587 | | 1,547 |

Number of family members by professionals

1,547 crew×5 persons/family=7,685 head

This figure is about 3.8% of the total poplation of the hinterland, 200,000 heads.

1.5 times of 3.8% is assumed to be the proportion of the member of pure subsistence fisherman's family.

Total number of heads of their families,

200,000 heads ×6%=12,000 heads

Rough estimation is made on the unit consumption rate of fish by them.

12,000 heads × 365 days × 1.5 meals × 0.15kg/means = 986,000kg
= 1,000 ton

Thus, unit annual consumption is,

1,000,000kg ÷ 12,000 heads = 82kg/head · year

National annual fish consumption by the subsistence fishermen and their families are,

678,000 heads × 6% × 82kg/head · year
= 3,336,000 kg
= 3,336 ton

b. By professionals

As described in 3-1-1 d), each professional crew of a fishing boat customarily brings fish of 2 ~3 kgs (average 2.5 kgs) back to his home on every trip.

Share of each type of fishing boats:

| | | |
|---|---|---|
| Registered Type(A) | 39% × 40% | = 15.6% |
| Registered Type(B) | 39% × 60% | = 23.4% |
| Non-Registered | 61% | = 61% |

Annual average number of crew per vessel:

| | crew/baot | trips/week | weeks/year | crew.trip/boat.year |
|---|---|---|---|---|
| Registered Type(A) | 15.6% × 3 | × 4 | × 40 | = 75.2 |
| Registered Type(B) | 23.4% × 4 | × 1 | × 40 | = 37.6 |
| Non-Registered | 61% × 2 | × 2 | × 40 | = 97.6 |
| | | | Crew.trip/boat.year | |
| Weighted Average | | | 210.4 | |

Own consumption by professionals for total number of boats 587 is:

boats crew.trip/boat.year kg/crew.trip

587 × 210.4 × 2.5

= 309,000kg/year

= 300 ton/year

This 300 ton/year is just 10% of the annual fish catch of 3,000 ton. Thus own consumption by professionals for 1990 and 2005 will be,

1990…… 662÷ 587× 300=338 ton 340 ton

2005…… 890÷587 × 300=455 ton 460 ton

(2) No-Fish (crustacea and shell fish)

a. By pure subsistence fishermen

Number of non-fish subsistence fishermen is assumed as the same figure with the fish subsistence fishermen, thus, number of heads of their families is:

12,000 heads

Rough estimation is made on the unit consumption rate of non-fish by them.

heads days meals kg/meal

12,000 × 365 × 1.5× 0.25 =1,643.00kg

= 1,643 ton

Thus, unit annual consumption is,

1,643,000kg ÷12,000 heads= 137kg/head.year

National annual non-fish consumption by the subsistence fishermen and their families is,

678,000 heads ×6%× 137kg/head.year

= 5,573,000kg

= 5,573 ton

b. By professionals

Estimation of number of professionals is made as follows.

Total population ×coastal population×Rate of women
×Rate of fishermen

= 200,000×5%×50% ×1/3

=1,650 fishermen

Rough estimation is made on the annual catch of non-fish by them.

Number of fishermen ×Daily average catch ×Annual working days

=1,650 heads ×7.5kg/day ×200 days/year

=2,480,000kg

= 2,480 ton

Number of heads of their families are.

1,650 heads× 5=8,250 heads

Rough estimation is made on the unit consumption rate of non-fish by them.

| heads | | days | | meals | kg/meal | |
|---|---|---|---|---|---|---|
| 8,250 | × | 365 | × 0.6 | × 0.25 | = | 452,000kg/year |
| | | | | | = | 450 ton/year |

Thus,weight of non-fish for sale is:

2,480 ton−450 ton =2,030 ton/year

Sales by type of markets:

Municipal market 690 ton/year.(see Table 3-6)

Other markets 2,030− 690=1,340 ton/year

e) Summary of Catches

Summary of catches of fish and crustacea in the hinterland of Lautoka Fishing Port is illustrated in Table 5-3. These figures are based on the survey results by the study team and some arbitrary assumption.

Table 5-3 Fish Consumption estimated in the Hinterland (1984/1985)

Unit: ton

| Type of Catch | Type of Circulation | At the Lautoka Hinterland | Unit Rate (kg/head) | % | for the Nation |
|---|---|---|---|---|---|
| Fish | Subsistence Catch by Professionals | 300 | 1.5 | 7.1 | 1,020 |
| | Subsistence Catch by non-professionals | 1,000 | 5.0 | 23.6 | 3,400 |
| | Sub total | (1,300) | 6.5 | | (4,420) |
| | Municipal market | 510 | 2.6 | 12.0 | 930 |
| | Other than Municipal Market | 2,430 | 12.1 | 57.3 | 9,070 |
| | Sub total | (2,940) | 14.7 | | (10,000) |
| | Total | 4,240 | 21.2 | 100.0 | 14,420 |
| Crustacea | Subsistence Catch by professionals | 450 | 2.3 | 10.9 | 1,530 |
| | Subsistence Catch by non-professionals | 1,650 | 8.2 | 39.8 | 5,580 |
| | Sub total | (2,090) | 10.5 | | (7,110) |
| | Municipal Market | 690 | 3.5 | 16.8 | 2,350 |
| | Other than Municipal Market | 1,340 | 6.7 | 32.5 | 4,560 |
| | Sub total | (2,030) | 10.2 | | (6,910) |
| | Total | 4,120 | 20.7 | 100.0 | 14,020 |
| Total | Subsistence Catch by professionals | 750 | 3.8 | 9.0 | 2,550 |
| | Subsistence Catch by non-professionals | 2,640 | 13.2 | 31.6 | 8,980 |
| | Sub total | (3,390) | 17.0 | | (11,530) |
| | Municipal Market | 1,200 | 6.0 | 14.4 | 3,280 |
| | Other than Municipal Market | 3,770 | 18.9 | 45.0 | 13,630 |
| | Sub total | (4,970) | 24.9 | | (16,910) |
| | Total | 8,360 | 41.9 | 100.0 | 28,440 |

Note: 1. Figures in the National level are based on the ratio between the population of hinterland and that of the nation.

678,000 ÷ 200,000 = 3.4 times

2. Catch through the municipal market are the sales recorded there in 1984.
3. "Other than the municipal market" includes those sales in N.M.A. retail shops, supermarkets, restaurants, hotels and "road-side market/floating market". Sales through "Road-sido market/floating market" are estimated predominant over the other sales.

f) Summary of Catch and Boats for the Target Years

Fishing boats to be accommodated by the Project are mainly boats catching fish, not crustacea.

Table 5-4 shows an estimation of catch and boats for the "fish fishing".

Table 5-4 Fish Catch and Number of Fishing Boats

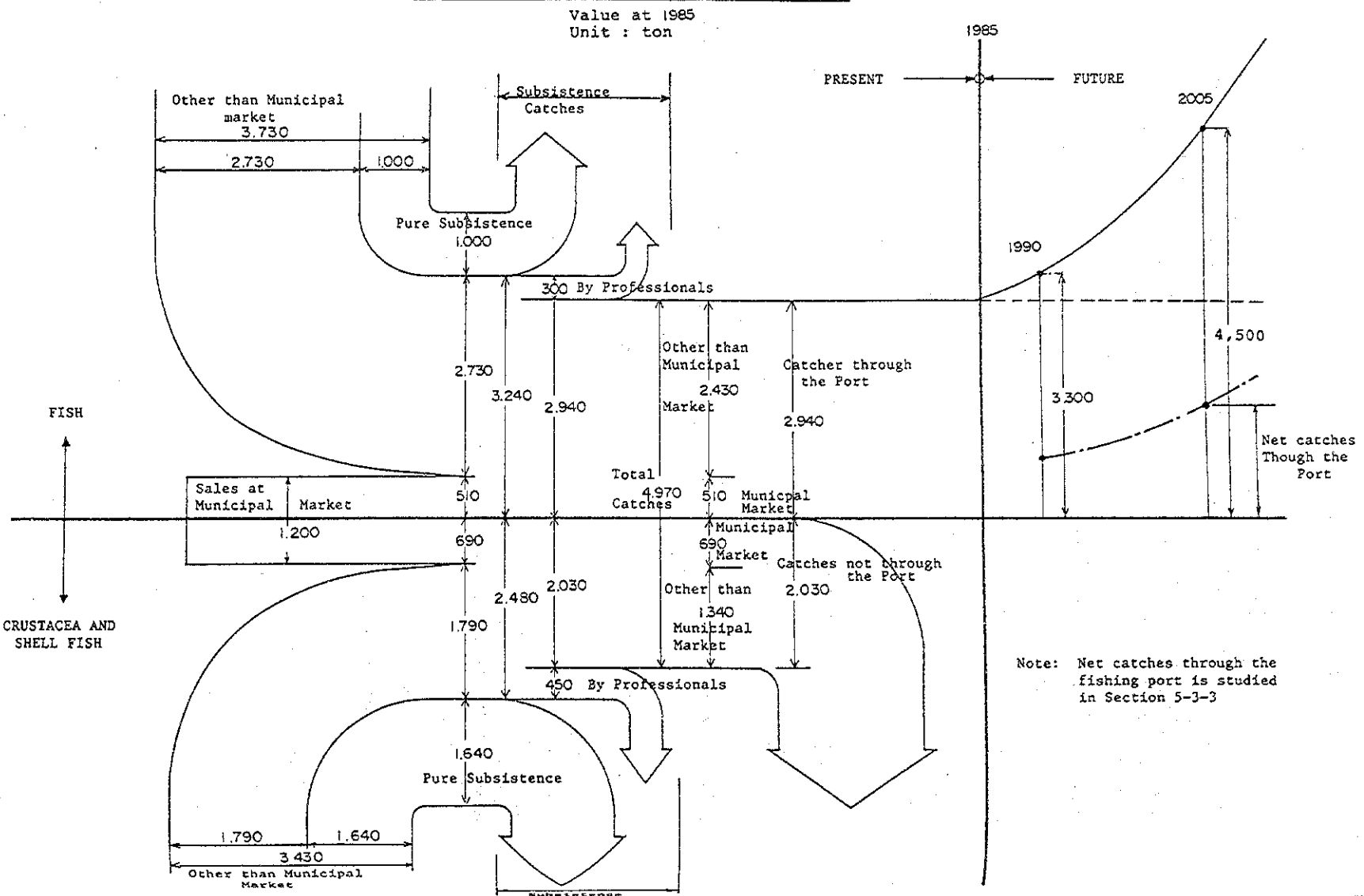
| year | Fish Catch (ton) For sales | Subsistence (a) | Subsistence (b) | Total | Area | Fishing Boats Registered | Non-Registered | Total |
|---|---|---|---|---|---|---|---|---|
| 1985 | 2,938 | 1,000 | 300 | 4,234 | Lautoka | 82 | 130 | 212 |
| | | (1,300) | | | Ba | 77 | 122 | 199 |
| | (69%) | (31%) | | (100%) | Nadi | 31 | 49 | 80 |
| | | | | | Yasawa | 37 | 59 | 96 |
| Sub total | | | | | | 227 | 360 | 587 |
| | | | | | | (39%) | (61%) | (100%) |
| 1990 | 3,311 | 1,126 | 340 | 4,777 | Lautoka | 164 | 75 | 239 |
| | | (1,466) | | | Ba | 154 | 71 | 225 |
| | (69%) | (31%) | | (100%) | Nadi | 62 | 28 | 90 |
| | | | | | Yasawa | 74 | 34 | 108 |
| Sub total | | | | | | 454 | 208 | 662 |
| | | | | | | (69%) | (31%) | (100%) |
| 2005 | 4,453 | 1,516 | 460 | 6,429 | Lautoka | 287 | 34 | 321 |
| | | (1,976) | | | Ba | 270 | 32 | 302 |
| | (69%) | (31%) | | (100%) | Nadi | 108 | 14 | 122 |
| | | | | | Yasawa | 130 | 15 | 145 |
| Sub total | | | | | | 795 | 95 | 890 |
| | | | | | | (89%) | (11%) | (100%) |

Notes 1. Classification of subsistence catch (a) and (b) is based on section 5-3-1 d).

2. Number of licenses issued is almost the same as the number of registered fishing boats.

Scale of the Lautoka Fishing Port will be decided by the figures which are shown in Table 5-4

Fig. 5-7 Catches and Circulation Route in Lautoka



## 5-3-2 Number of Fishing Boats for the Project

In this section, the primary factors of fishing port planning, namely the number of fishing boats to be accommodated at the port and the length of berth required, are studied. As described before, the Lautoka Fishing Port will bemainly utilized by fishing boats for "fish catch", thus, the catch through the port is "fish".

As discussed in Section 5-3-1 "Estimation of Future Demands", there are two types of boats namely, a group of registered fishing boats which are operated by licensed fishermen and a group of non-resistered fishing boats the scale of which is estimated about 1.8 times the former.

One of the government policies on expansion of coastal fishing industriy is to stimulate non-registered boats to be registered. This expansion will be beneficial to the government in various aspects as to control the fishermen, to grasp actual industial activities, to proceed with a technical extension on the firm information and to keep government tax and revenue.
To accelerate this purpose meaningfully, an incentive measure may be introduced by giving higher benefits to the licensed fishermen, namely easy access to the port. This incentive measure may let non-licensed fishermen be licensed and meets the government policies. In this consideration, the licensed fishermen will be provided with higher priority to use the port than The non-registered fishermen.

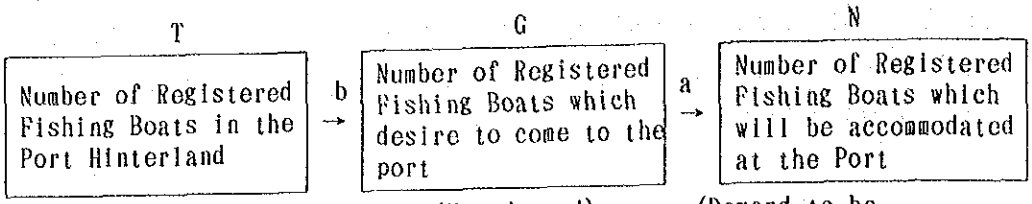
a) Proposed Method to determine the Number of Fishing Boats to be accommodated.

Catch handled at the port will be unloaded restrictively by a part of the registered fishing boats which benefit by utilizing the port, part of the whole boats in the port hinterland.

However, the number of boats which may be accommodated at the port has to be decided by such considerations as the economy of the Project, the budget allocated to the Project and the scale of operation and running

costs to be assured by the responsible owner of the port, the Fisheries Division.

Following flow-chart shows a basic method on decision of the scale of the Project.




Thus, the number of registered fishing boats to be accommocated at the port will be calculated by following formula.

$$N = a \times G \quad , \quad G = b \times T$$

$$N = a \times b \times T$$

where,

N ; Number of Registered Boats to be accommodated at the Lautoka Fishing Port. (Demand to be supported) (boat)

G ; Number of Registered Boats which desire to come to the port. (Net demand) (boat)

a ; Rate of accommodation (%)

b ; Rate of intention (desire) (%)

T ; Number of Total Registered Fishing Boats in the hinterland of the Lautoka Fishing Port. (Gross demand) (boat)

b) Registered Fishing Boats in the Hinterland

As shown in Table 5-4 "Fish Catch and Number of Fishing Boats", a projection of registered fishing boats is made according to the Fisheries Division's target to double the registration of boats within 5 years.

| Registered Fishing Boats | 1985 | 1990 |
|---|---|---|
| In the Western Division | 350 | 700 |
| In the Port Hinterland | 227 | 454 |

note: 1. Number of registered fishing boats is 227 boats in the port hinterland, Lautoka, Ba, Nadi and Yasawa islands.
2. Number of registered fishing boats is regarded almost the same as the number of Fishing Licenses issued.

The number of registered fishing boats estimated for each target year is as shown in Table 5-5 on the assumption that the proportion by area will be unchanged in the future.

Table 5-5 Registered Fishing Boats by Area in the Hinterland

unit: Boat

| Area | Rate of Fishing License issued (1985) | Registered Fishing Boats 1985 | 1990 | 2005 |
|---|---|---|---|---|
| Ba | 34% | 77 | 154 | 270 |
| Lautoka | 36 | 82 | 164 | 287 |
| Nadi | 14 | 31 | 62 | 108 |
| Yasawa | 16 | 37 | 74 | 130 |
| Total | 100% | 227 | 454 | 795 |

c) Required Length of Berths

All of the registered fishing boats in the hinterland will not always come to the port. It depends upon their desire to call at the port in consideration of their own benefits and convenience to their fishing activities.

$$\text{Rate of Intention(b)} = \frac{\text{Boats which desire to come to the port (G)}}{\text{All boats in the Hinterland (T)}}$$

According to the direct interview survey, about 40%～80% of the registered fishing boats in the hinterland desire to come to the port. However, the means of utilization of port services are varied by the characters of fishing method and physical condition such as distance between the port and their villages. Some boats will visit the port only to receive ice; some boats will come to the port only for the purpose

of repairing, and other boats will regard the Lautoka Fishing Port as their mother-port.

This means there are many possible ways of port utilization in accordance with independent benefits of each boats. Thus the size of each type of berth has to be decided proportionally to particular demands on port usage.
In consideration of these the scale of each berth length will be studied for the project target years. The maximum rate of desire for each berth is fixed at less than 80 % based on the survey results.

Table 5-5a Characteristics of Each Berth.

| Type of Berth | Character of Berth | Application to Fishing Boats |
|---|---|---|
| (a) Unloading Berth | Unloading catch to the port | 80% of fishing boats in Lautoka area and 40% of other area |
| (b) Stand-by Berth | Waiting berth for next trip | 80% of Lautoka.<br>20% of others |
| (c) Loading Berth | Preparation works before deberthing | 80% of Lautoka.<br>60% of others |
| (d) Ice Berth | Limited use for ice supply | All fishing boats short-visiting for ice supply |
| (e) Water/Fuel Berth | Limited use for water and fuel supply | All fishing boats short-visiting for water and/or fuel supply |
| (f) Cutter Berth | Limited use for cutter Boats | 8 cutters (1990).<br>16 cutters (2005). |
| (g) Barge Berth | Limited use for barges | 2 barges (1990)<br>4 barges (2005) |

As shown in the list, berths (a), (b) and (c) will be utilized by the boats which regard the Lautoka Fishing Port as their mother-port, but other boats will visit berths (d) and (e) for only a short period.

Table 5-6 and Tabel 5-7 show the number of boats to each berth. (a)

unading berth, (b) stand-by berth and (c) loading berth.

Table 5-6 Fishing Boat Demand by Each Type of Berth (1990)

unit: Boat

| Registered Fishing Boats | | Berth (a) Unloading Berth | | Berth (b) Stand-by Berth | | Berth (c) Loading Berth | |
|---|---|---|---|---|---|---|---|
| Ba | 154 | 40% | 62 | 20% | 31 | 60% | 92 |
| Lautoka | 164 | 80 | 131 | 80 | 131 | 80 | 131 |
| Nadi | 62 | 40 | 25 | 20 | 12 | 60 | 37 |
| Yasawa | 74 | 40 | 30 | 20 | 15 | 60 | 44 |
| Total | 454 | | 248 | | 189 | | 304 |

Total 741 boats ( 247 boats in average )

Table 5-7 Fishing Boat Demand by Each Type of Berth (2005)

| Registered Fishing Boats | | Berth (a) Unloading Berth | | Berth (b) Stand-by Berth | | Berth (c) Loading Berth | |
|---|---|---|---|---|---|---|---|
| Ba | 270 | 40% | 108 | 20% | 54 | 60% | 162 |
| Lautoka | 287 | 80 | 300 | 80 | 300 | 80 | 300 |
| Nadi | 108 | 40 | 43 | 20 | 22 | 60 | 65 |
| Yasawa | 136 | 40 | 52 | 20 | 26 | 60 | 78 |
| Total | 795 | | 503 | | 402 | | 605 |

Total 1,510 boats ( 503 boats in average )

a) Design Boats and Size of Berths

There are three types in the registered boats, namely the Launch 28 feet long, the Half Cabin 21 feet long and the Out-board Punt. Proportion and size of these boats in 1985 are as follows.

| Item | Launch | Half Cabin | Out-board Punt |
|---|---|---|---|
| Western Division | 10% | 65% | 25% |
| Hinterland (Lautoka) | 10% | 80% | 10% |
| Length | 8.6m | 6.4m | |
| Beam | 2.6m | 2.3m | |

Considering the future tendency of application of larger size boats, the size of design boat is assumed as following figures by averaging the Launch and the Half Cabin.

| Item | Design Size |
|---|---|
| Boat Length (L) | 7.5m |
| Boat Beam (B) | 2.5m |

The required unit berth length is calculated as follows;

a. Unloading and Loading Berth ( parallel berthing )

Unit berth length ; $\ell_1$

$$\ell_1 = 1.15 \times L = 1.15 \times 7.5 = 8.6 \text{ m}$$

b. Stand-by Berth (perpendicular berthing )

Unit berth length ; $\ell_2$

$$\ell_2 = 1.5 \times B = 1.5 \times 2.5 = 3.7 \text{ m}$$

b) Rate of Accommodation

The rate of accommodation in the initial port development is a matter of decision. Generally speaking, the rate of accommodation is related with the social environmental conditions such as characteristics of fishing

port, budget allocation, future expansion of the port and other factors to affect the port size.

$$\text{Rate of Accommodation (a)} = \frac{\text{Number of registered boats to be accommodated at the Lautoka Fishing Port (N)}}{\text{Number of registered boats which desire to come to the port (G)}}$$

Normal rate of accommodation ranges between 20% and 40 % in the initial development. The proposed rate of accommodation is 25 % for the Project in 1990 and 30 % in 2005.

c) Required Berth Length

Based on the previous assumption and design criteria, the required berth length is proposed for each target years.

Table 5-8 Length of Berth to be Provided (1990) ,a=25%

| 1990 | Berth | | | Remarks |
|---|---|---|---|---|
| | Unloading Berth | Stand-by Berth | Loading Berth | |
| Number of Boats | 62 boats | 47 boats | 76 boats | 61.7 boats in average |
| Berthing per day | $\frac{4 \text{ hours}}{0.75 \text{ hours}} = 5$ | – | $\frac{4 \text{ hours}}{0.5 \text{ hours}} = 8$ | |
| Required Berth Length | 62 ÷ 5× 8.6 = 107m 105m | 47÷ 2× 3.7 =87m 90m | 76÷ 8× 8.6 =81m 80m | total Berth Length 275m |

Table 5-9 Length of Berth to be Provided (2005) ,a=30%

| 2005 | Berth | | | Remarks |
|---|---|---|---|---|
| | Unloading Berth | Stand-by Berth | Loading Berth | |
| Number of Boats | 151 boats | 121 boats | 182 boats | 151.3borts in average |
| Berthing per daysame as above 5 | | – | same as above 8 | |
| Required Berth Length | 151÷ 5× 8.6 = 260m 260m | 121÷ 2× 3.7 = 222m 225m | 182÷ 8× 8.6 = 196m 195m | total Berth Length 680m |

The scalof the loading berth is be reanalyzed in next paragraph d) considering the exclusive berths for ice loading and fuel/water supply.

Macro study has been made to evaluate the study results by the past experience of fishing port planning.

Macro Estimation of Berth Length

| Item | | 1990 | 2005 |
|---|---|---|---|
| Annual Catch | (ton) | 444 | 1,082 |
| Unit Rate | (m/ton) | 0.27 | 0.20 |
| Required Length of | (m) | 120 | 216 |
| Unloading Berth | | | |
| Size of Boat | (ton) | 2.5 | 2.5 |
| Number of Boats: N | (boat) | 60.0 | 150.0 |
| Total tons of Boats | (ton) | 120.0 | 375.0 |
| Unit Rate | (m/ton) | 2.9 | 2.9 |
| Required Total Length of Berth | (m) | 350 | 1,090 |

Macro Estimation of Unloading Berth Length by Total Annual Catch

| Catch Unloading (ton) | Unit Required Length of Unloading Berth (m/ton) | (ton/ m) |
|---|---|---|
| 250 | 0.50 | 2.0 |
| 500 | 0.33 | 3.0 |
| 1,000 | 0.20 | 5.0 |
| 10,000 | 0.033 | 30.0 |
| 100,000 | 0.010 | 100.0 |

Relationship between Boat's Size and Unit Required Length of Berth (m)

| Size of Boat (ton) | Required length of Berth (m/ton) | (ton/ m) |
|---|---|---|
| 2 | 3.6 | 0.28 |
| 5 | 2.2 | 0.45 |
| 10 | 1.3 | 0.77 |
| 50 | 0.3 | 3.30 |
| 100 | 0.15 | 6.70 |

(Guideline of Fishing Port Facilities, Part 1/2 by Tokyo Suisan-shinkokai 1981.)

These reviews support the previous study result.

d) Detailed Study for the Loading Berth

As mentioned in 5-3-3 c), there are two types of boats to be accommodated in the port, namely those permanently use it as a mother-port and those use it only for ice supply etc.. Following table shows proposed length of each loading berth including the exclusive-use berths for ice supply, fuel and water supply.

Table 5-10 Breakdown of Loading Berth

| Target year | | Type of loading Berth | | | |
|---|---|---|---|---|---|
| | | For Home Port Users | Ice | Water and Fuel | Total |
| 1990 | Number of boats | 76 | 84 | 152 | |
| | Operation hours per day | 4 | 6 | 6 | |
| | Occupation by boat(hour) | 0.5 | 0.3 | 0.25 | |
| | Berthings a day (times) | 8 | 20 | 24 | |
| | Way of berthing | Parallel | Perpendicular | Perpendicular | |
| | Berth length per boat (m) | 8.6 | 3.7 | 3.7 | |
| | Total berth length (m) | 80 | 20 | 25 | 125 |
| 2005 | Number of boats | 182 | 212 | 303 | |
| | Operation hours a day | 4 | 6 | 6 | |
| | Occupation per boat(hour) | 0.5 | 0.3 | 0.25 | |
| | Berthings per day (times) | 8 | 20 | 24 | |
| | Way of berthing | Parallel | Perpendicular | Perpendicular | |
| | Berth length per boat (m) | 8.6 | 3.7 | 3.7 | |
| | Total berth length (m) | 195 | 40 | 50 | 285 |

e) Exclusive-use Berths

The Lautoka Fishing Port will be regularly utilized by 62 boats as mother-port. The figure has been set to obtain a minimum size as the initial development and to meet financial considerations.

Therefore only 62 boats out of the registered 454 boats in 1990 will stay at the port as mother-port users, but other 392 boats will visit the port temporarily only for the exclusive-use.

| 1990 | Total Number of Fishing Boats in Hinterland | Fishing Boat Demands to Lautoka Fishing Port | Number of Fishing Boats to be Accommodated | Balance |
|---|---|---|---|---|
| Total number of Boats | 662 | | | |
| Registered | 454 | 247 | 62 | 185 |
| Non-registered | 208 | 0 | 0 | 0 |

Note; As discussed in Section 5-3-3 C), the number of permanent-stay boats are 62,47 and 76 for unloading berth, stand-by berth and loading berth respectively. And the average number of these figures is about 62.

Permanent-use boats (62) account for about 25 % of the registered boats desiring to belong to the port (247), thus rest of the boats ( about 185) can not use the port as their mother-port. As a policy of fishing port planning, it is strongly recommended to provide the possibility of necessary services these 185 boats. They have to be provided with such port services as ice, fuel and water supply. In this consideration the exclusive-use berths for the supply services are provided.

(1) Exclusive-use Ice Berth

The unit time cycle per boat for ice supply is assummed as from berthing to deberthing.

| Actions | Time (minutes) |
|---|---|
| — Berthing | 3 |
| — Move to Ice plant | 2 |
| — Stuffing ice, measurement and payment | 7.5 |
| — Move to boat | 2 |
| — Deberthing | 3 |
| Total | 17.5 |
| | ≒18 |

Number of boats for ice supply (5-3-4a)). 243 boats

Number of boats for the Ice Berth. 243−76= 167 boats

Number of boats per day (estimated 50%) 167× 0.5=84 boats

Length of the service time per day 6 hours

Therefore necessary number of ice berths is.

$$84^{\text{boat}} \times 0.30^{\text{hr}} \div 6^{\text{hr}} = 4.2 \fallingdotseq 5 \text{ berths}$$

Required length of ice berths for 1990 for perpendicular berthing.

$$5^{\text{berth}} \times 3.7^{\text{m}} = 18.5 \text{ m} \fallingdotseq 20 \text{ m}$$

For 2005 year.

Number of boats for ice supply . 605 ( 1 − 0.3) =424 boats

Required ice berth length is.

$$424^{\text{boats}} \times 0.5 \times 0.30^{\text{hr}} \div 6^{\text{hr}} \times 3.7^{\text{m}} = 27.9 \text{ m} \fallingdotseq 40 \text{ m}$$

(2) Exclusive-use Fuel/Water Berth

Fuel and/or water supply will be made through the exclusive-use berth for the purpose of port safety and effective charge collection by the organization such as a fishing cooperative.

The unit time cycle per boat for fuel and water supply are estimated as shown in the table from berthing to deberthing.

| Actions | | Time (minutes) |
|---|---|---|
| – Berthing | | 3 |
| – Fuel/Water supply and payment | | 7.5 |
| – Deberthing | | 3 |
| | Total | 13.5 |
| | | ≒15 |

Berth length required in 1990 ;

Number of boats for fuel/water supply 304 boats

Number of boats per day (estimated 50%) 304 × 0.5 = 152 boats

Service time per day 6 hours

Therefore necessary number of fuel/water berths is,

$152^{\text{boats}} \times 0.25^{\text{hr}} \div 6^{\text{hr}} = 6.3 \fallingdotseq 6$ berths

Required length of fuel/water berth for 1990 for perpendicular berthing,

$6^{\text{berths}} \times 3.7^{\text{m}} = 22.2\ \text{m} \fallingdotseq 25\ \text{m}$

For 2005 year,

Number of boats for fuel/water supply, 605 boats

Required fuel/water berth is,

$605^{\text{boats}} \times 0.5 \times 0.25^{\text{hr}} \div 6^{\text{hr}} \times 3.7^{\text{m}} = 46.7\ \text{m} \fallingdotseq 50\ \text{m}$

(3) Exclusive-use Cutter Berth

For 1990,

Number of cutter boats 8 boats

Required berth

One berth of parallel berthing (1.15L =1.15×25=30m)

2 berths of perpendicular berthing (1.5B=1.5 ×3.0 =4.5m)

Total berth length is estimated;

$1^{\text{berth}} \times 30^{\text{m}} + 2^{\text{berth}} \times 4.5^{\text{m}} = 39\ \text{m}$

By 2005, users will increase by 1.5 times the current figure, thus the number of cutter berths will be doubled.

Two berths of parallel berthing

4 berths of perpendicular berthing

Total berth length is estimated;

$2^{\text{berth}} \times 30^{\text{m}} + 4^{\text{berth}} \times 4.5^{\text{m}} = 78\ \text{m}$

(4) Barge Berth

For 1990, Number of barges…… 2～3 barges.(2 ～3 barges/week).

Required berth, one berth of perpendicular berthing: 9m

Four mooring dolphines are also provided.

For 2005 2 berths: 18m

f) Summary of Berth Length

Following table shows the study results of berth length required for each target year.

Table 5-11 Summary of Required Berth Length

unit: meter

| Type of Berth | | Target year 1990 | Target year 2005 |
|---|---|---|---|
| Unloading Berth | | 105 | 260 |
| Stand-by Berth | | 90 | 225 |
| Loading Berth | | 125 | 285 |
| Boats (Permanent stay) | | (80) | (195) |
| Boats (short visit) for ice supply | | (20) | (40) |
| for fuel and water | | (25) | (50) |
| For Fishing Boats | Sub total | 320 | 770 |
| For Cutter Boats | | 39 | 78 |
| For Barges | | 9 | 18 |
| | Total | 368 | 866 |

Total berth length of approx. 370 m will be provided in the initial port development by the Japanese Grant Aid Programme.

In 2005 the total berth length will reach approx. 870 m.

## Fig. 5-8 Activities of Fishing Boats (1990)

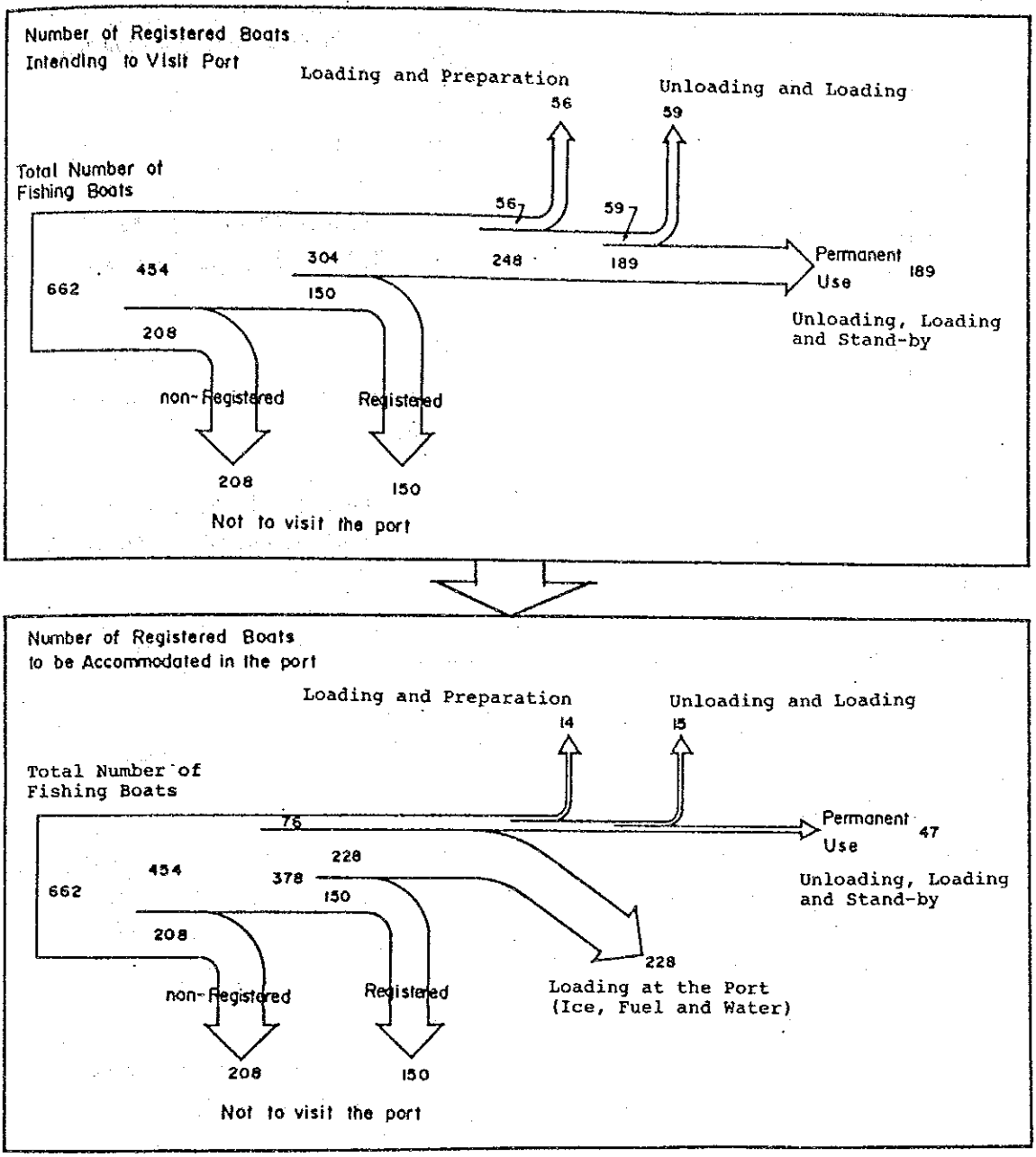


Fig. 5-9 Fish Demands Forecast

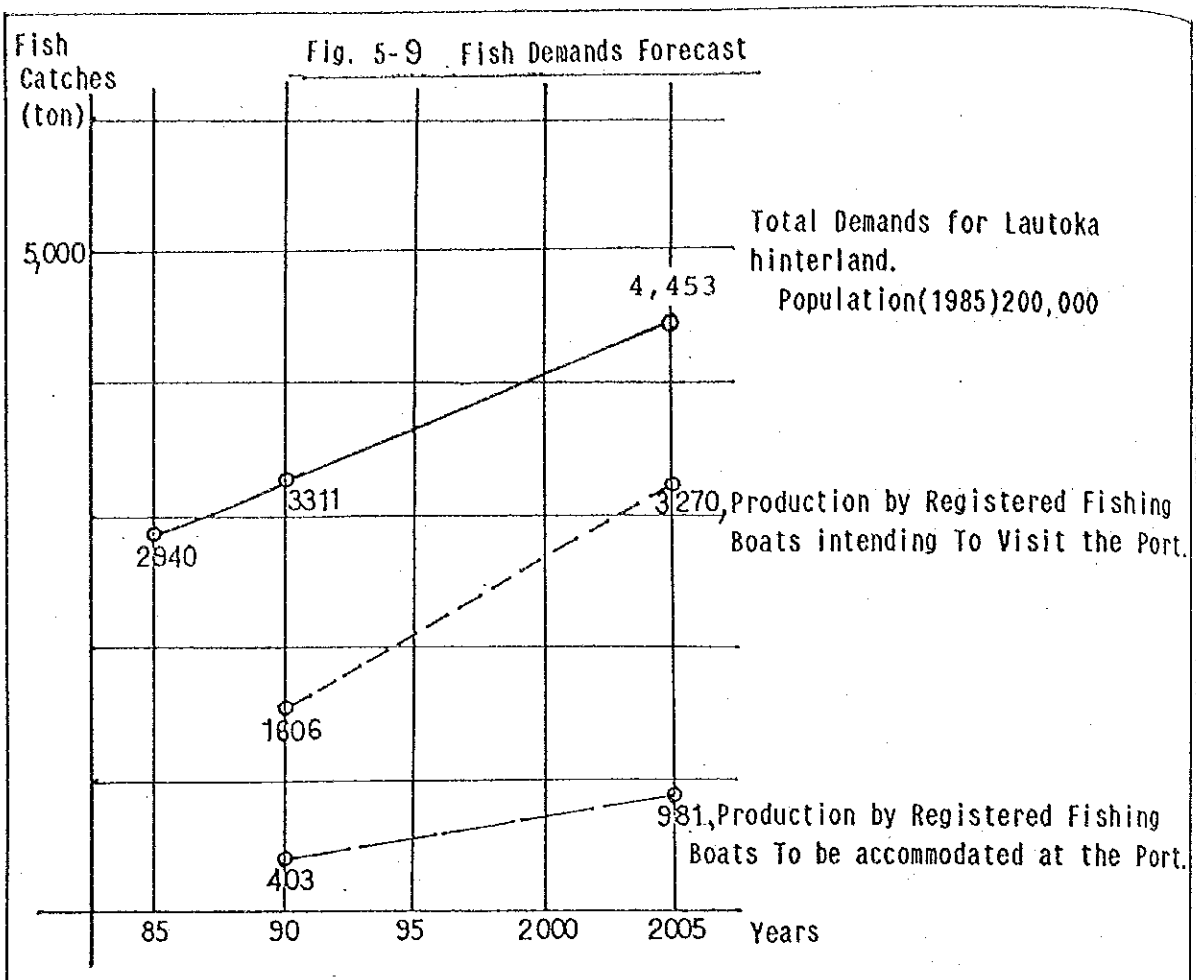
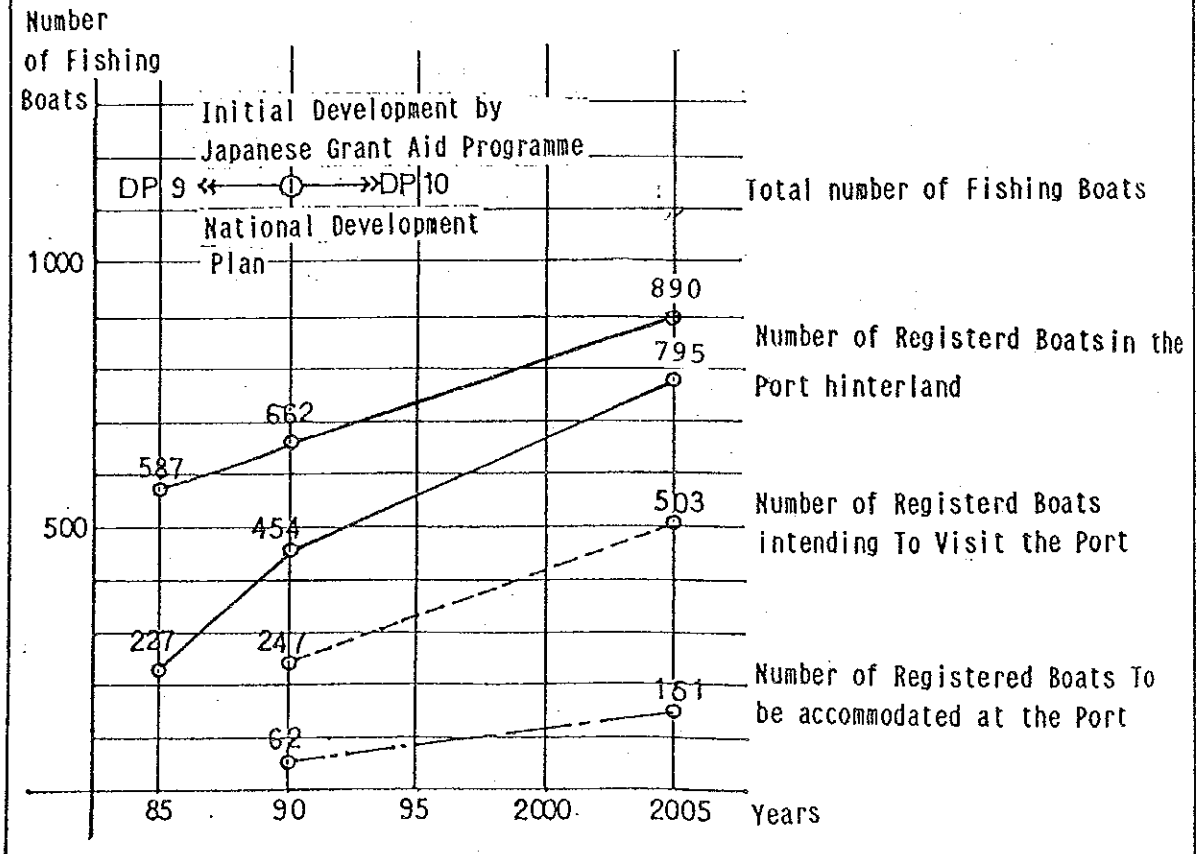



Fig. 5-10 Fishing Boats Forecast



g) Summary of Fish Catch and Fishing Boats in the Port

Summary of the fish catch throuth Lautoka Fishing Port and number of registered fishing boats to be accommodated there are summarized in Table 5-12 as follow.

Total demands in the port hinterland;

Total fish catches and number of registered fishing boats in the Lautoka Fishing Port's hinterland, Lautoka, Ba, Nadi and Yasawa islands.

Total Demand to the port;

Among the total demands in the port hinterland, number of registered fishing boats which desire to use the port and their catches.

Catch and Boats to be accommodated by the port;

Among the total desire to the port, number of registered fishing boats to be accommodated by the Lautoka Fishing Port and their catches.

Table 5-12 Summary of Catch and Boat through Lautoka Fishing Port

unit: Catch (ton), Boat (number)

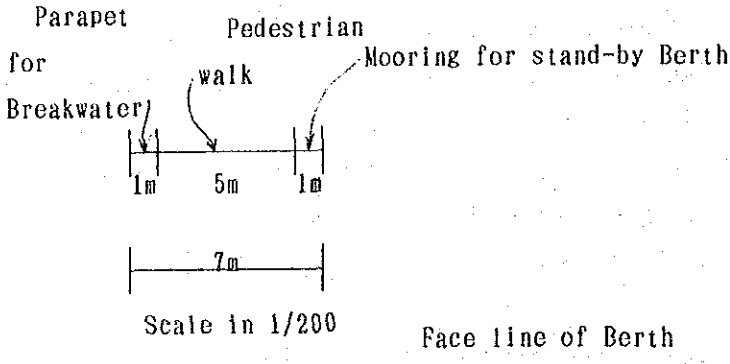
| Target year | For Sale | Subsistence | Total | Registered | Non-registered | Total |
|---|---|---|---|---|---|---|
| (1990) | | | | | | |
| Total Demands in Hinterland | 3,311 (90.7%) | 340 (9.3%) | 3,651 (100%) | 454 | 208 | 662 |
| Total Demands to the port | 247× 6.5 = 1,606 | 165 | 1,771 | 247(100%) | 0 | 247 |
| Catch and (permanent use) | 403 | 41 | 444 | 62(25.0%) | 0 | 62 |
| Boats to be (Ice Supply) | | | | 247 | 0 | 247 |
| accommodated (Fuel/Water | | | | 247 | 0 | 247 |
| by the Port Supply) | | | | | | |
| (2005) | | | | | | |
| Total Demands in Hinterland | 4,453 (90.7%) | 460 (9.3%) | 4,913 (100%) | 795 | 95 | 890 |
| Total Demands to the port | 503× 6.5 = 3,270 | 335 | 3,605 | 503(100%) | 0 | 503 |
| Catch and (permanent use) | 981 | 101 | 1,082 | 151(30.0%) | 0 | 151 |
| Boats to be (Ice Supply) | | | | 503 | 0 | 503 |
| accommodated (Fuel/Water | | | | 503 | 0 | 503 |
| by the Port Supply) | | | | | | |

not: Annual fish cach by a registered boat is 6.5 ton.(5-3-1 b).

h) Scale of Major Fishing Port Facilities

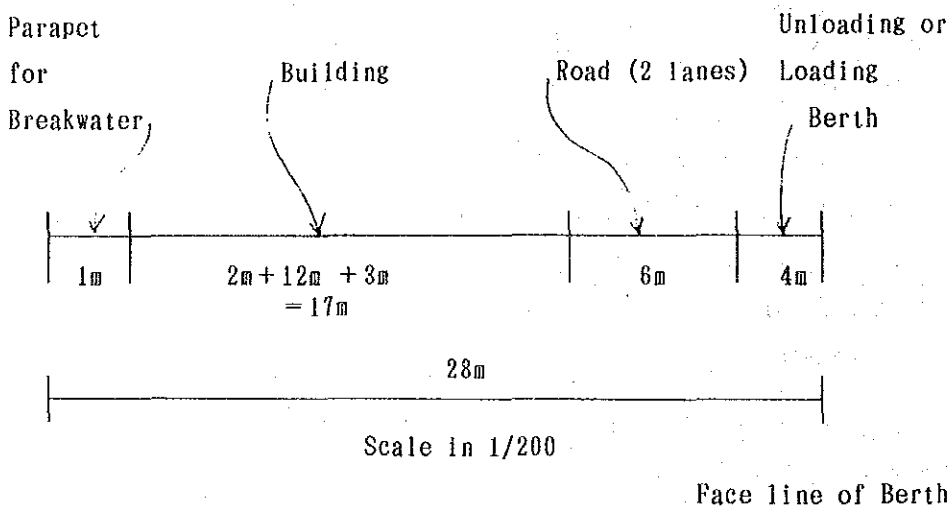
(1) Breakwater

This breakwater will be utilized as a mooring or stand-by berth at the port ward. Therefore it may not be necessary to consider vehicles entering this area generally, but of pedestrians only. It requires 7m width as below. However, in order to facilitate vehicles U-turning at the breakwater head in emergency, it must be widened to 12m.




(2) Main Jetty

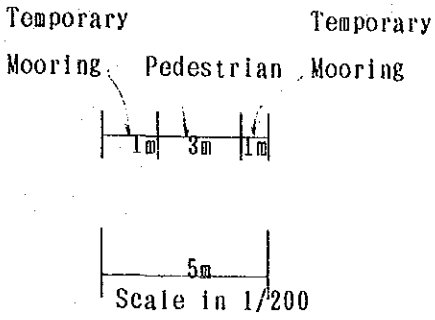
The function of main jetty is divided into such parts as breakwater, building, stock yard, access road loading and unloading or preparation which lead to required width of 28m.



(3) Finger Jetty

Here unloading or preparation works will be taken place.

However, due to rather nearer and easier access to ice plant and main jetty, it may not be needed to consider vehicles entering this area . Therefore, width 5m will be sufficiant as below.



1) Water Depth, Berth Height

(1) Design Boats

The boats to be accommodated in this improved fishing port are as follows;

- Unloading Berth, Stand-by Berth and Loading Berth

| | 21 ft fishing boat | 28 ft fishing boat | |
|---|---|---|---|
| L | = 6.4m | = 8.6m | (Length) |
| D' | = 0.9m | = 1.0m | (Freeboard) |
| D | = 0.9m | = 0.9m | (Draft) |
| B | = 2.3m | = 2.6m | (Beam) |

- Cutter Berth

L = 25 m

D' = 1.0m

D = 1.5m

B = 3.0m

- Barge Berth

= 20m (max 32m)

= 2.5m

= 1.5m

= 7m (max 8m)

IKA boats will not be taken into consideration for the initial development.

(2) Water Depth

In order to ease the boats berthing and deberthing of boats safely, the appropriate water depth must be provided in the port basin and fair-way as follows;

- Unloading Berth, Stand-by Berth and Loading Berth

Maximum design boat =28 ft fishing boat

H =Draft +Allowance

= 0.9m + 0.5m = 1.4m

Therefore, sea-bed level=CD-1.2m

- Cutter Berth/Barge Berth

Maximum objective boat=Cutter Boat

H =Draft +Allowance

= 1.5m +(0.5m ~ 1.0m)

= 2.0m ~ 2.5m

Therefore sea-bed level =CD-2.2m (Fig. 5-11)

(3) Berth Height

In principle, the lower the berth height is the better because of smaller height difference to boat deck when boarding, etc.
However, on the contrary, it shall not be lower than the highest water level due to over-topping onto wharf deck by sea-water, which is CD + 1.9m MHWL and CD + 2.2m HAT.
Moreover, it shall not differ much from the height of the existing King's Wharf, which is CD + 2.9m.
After considering all of the above, the top level of wharves is now decided as CD + 2.4m. (Fig. 5-11)

(4) Fairway Width

The width of safe fairway is generally recommended as 5B~8B where B is maximum design boat's beam. Since both the current speed and the wave height are not estimated not to be so critically strong, 6.5B is now adopted in this port.

maximum design boat's beam: Cutter ……3m

Thus, Fairway width $=6.5B \fallingdotseq =6.5 \times 3m = 20m$

Barge is not considered as the maximum design boat, because of so limitted visitting the port.

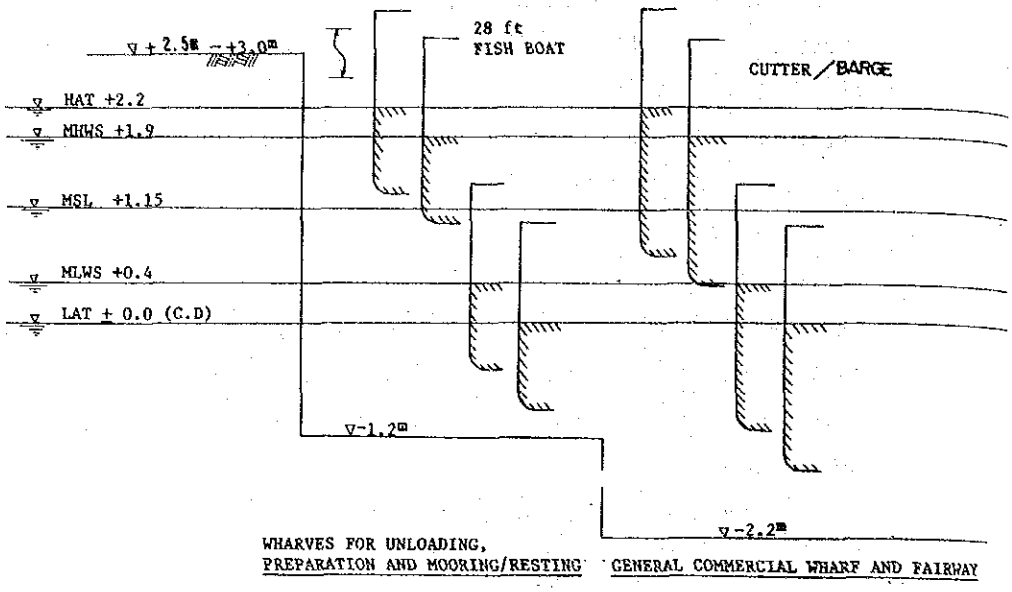



FIG. 5-11, HEIGHT & DEPTH OF WHARF AND FAIRWAY

j) Ramp Facilities

Ramp facilities will be provided for the purpose of boats repair in the port.

- Width of slip way 12 m
- Number of boats 3 unit of 28 footers

Ramp facilities shall be near the workshop.

k) Stacking Area

The required area for stacking the catch in the port varies by the characteristics of port and volume of catch. From past experience, average unit area per ton of catch is about 2.5 sq.m for the fishing ports with annual catch in the range of 500ton to 1,000ton.

| Item | | 1990 | 2005 |
|---|---|---|---|
| Annual Catch | (ton) | 444 | 1,082 |
| Unit Rate | ($m^2$/ton) | 2.5 | 2.5 |
| Stacking and destacking Area | ($m^2$) | 1,110 | 2,700 |

In the initial development of the port, the stacking area will be in the west of main jetty as follows.

$$90^{m} \times 12^{m} = 1,080 \ m^2$$

## 5-3-4 Determination of Ice Making Capacity

The sales of ice in the Lautoka district has been very steady for the past several years and it was more or less 650ton/year.
In view of the numbers of fishing boats in Lautoka and its hinterland, this sales quantity is considered not showing the demand but only meaning the limit of ice making capacity. The actual capacity of Lautoka Ice Factory was only less than 2ton/day which was measured by the study team on April 1986.
The Table 5-13 shows sales records of Lautoka Ice Factory for 1985.

*Table 5-13 Ice Sales of Existing Lautoka Ice Factory(1985)*

unit: kgs

| Group Fishing | Individual Fishing | Others | Fisheries Division Boat | Fisheries Station | Marine Dept. Vessel | Raviravi | Feeder | TOTAL |
|---|---|---|---|---|---|---|---|---|
| 102,709 | 349,349 | 58,235.5 | 5,526 | 480 | 18,539 | 2,435 | 2,240 | 536,531.5 |

The demand for ice at the end of 1990 when the new fishing port will have been completed and DP9 will have been accomplished can not be estimated based on the past records. Because the ice is mostly consumed in the field of fishing as shown in Table.5-13, the future demand should be estimated relating to the development of fishing industry, namely increase of the registered fishing boats.

a) Demands Forecast

If "the doubling scheme" by the Fisheries Division's policy for the registered fishing boat can be accomplished, the number of fishing boats which will utilize the new Lautoka Fishing Port to ship ice, fuel and water, etc. is expected to be maximum of 304 boats in total as described in 5-3-2 c) Table 5-6.
Meanwhile, the vessels for the diving fishing are considered to use no or only a little ice as explained in 3-1-1 a)(4).
Though the percentage of such boats will be 40% (Table 3-3) but some diving fishermen also engage in gillnet or hand line fishing, so the actual number of fishing boats which do not require ice is assumed to be

20% of total fishing boats.

Therefore the total number of boats which will be supplied ice at the Lautoka fishing port is 304 ×(1−0.2)=243boats.

An analysis was made on the movement of the fishing boats on a weekly basis using the data indicated in 3-1-3 a)(1).

The typical pattern of ice consumed for 10 vessel unit is demonstrated as below;

| | A Group (1 day trip) | | B Group (3 day trip) | | |
|---|---|---|---|---|---|
| | Vessel. Ice(kgs) | Sub total(kgs) | Vessel. Ice(kgs) | Sub total(kgs) | Total |
| Mon. | − | − | 2× 221 | 442 | 442 |
| Tue. | 2×18 | 36 | 2× 221 | 442 | 472 |
| Wed. | 2×18 | 36 | 2× 221 | 442 | 920 |
| Thu. | 2×18 | 36 | − | − | 36 |
| Fri. | 2×18 | 36 | − | − | 36 |
| Sat. | − | − | − | − | − |
| Sun | − | − | − | − | − |
| | Total | 288 | | 1,768 | 2,056kgs |

Note : This table shows a typical movement of 10 fishing boats.

Total ice demand at the Lautoka fishing port will be as follows.

| day | | | Daily Demand |
|---|---|---|---|
| Mon. | 243÷10× 442 | = | 10,741 |
| Tue. | 243÷10× 472 | = | 11,470 |
| Wed. | 243÷10× 920 | = | 22,356 |
| Thu. | 243÷10× 36 | = | 825 |
| Fri. | 243÷10× 36 | = | 825 |
| Sat. | | | 0 |
| Sun | | | 0 |
| | Total | | 46,317kg/week |

In addition to this ice demand for fishing purpose, ice demand for other utilization such as catch preservation and general city use are considered. Catch preservation/general city use which is assumed 20 % of

ice for fishing purpose are added.

Table 5-14 Daily Total Ice Demand (1990)

| day | Fishing | Fish Preservation and City Use | Subtotal | Accumulation |
|---|---|---|---|---|
| Non. | 10,741 | 1,500 | 12,241 | 12,241 |
| Tue. | 11,470 | 1,500 | 12,970 | 25,211 |
| Wed. | 22,356 | 1,500 | 23,856 | 49,067 |
| Thu. | 875 | 1,500 | 2,375 | 51,441 |
| Fri. | 875 | 1,500 | 2,375 | 53,817 |
| Sat. | — | 1,500 | 1,500 | 55,317 |
| Sun | — | 1,500 | 1,500 | 56,817 |
| Total | 46,317 | 10,500 | 56,817 | |

Thus weekly ice demand is about 60 ton.

b) Required Capacity of Ice Making Plant

Based on the total daily ice demand (1990), necessary capacity of ice making plant and its storage are studied. Required capacity of the ice making plant and its storage are as follows.

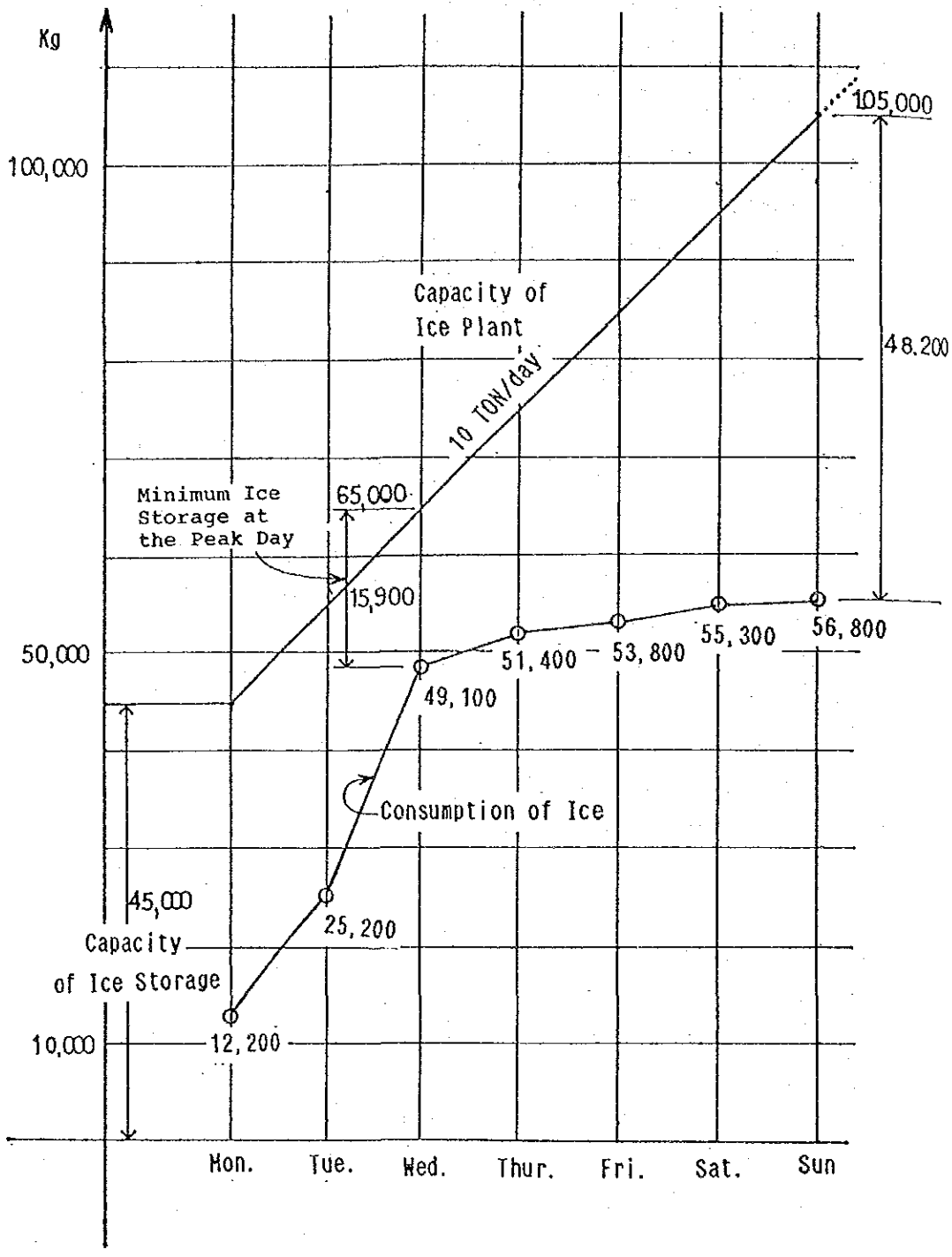
| | | |
|---|---|---|
| Ice Making Plant | 15 ton/day | (3 units×5 ton/day) |
| Ice storage | 45 ton | |

As shown in Fig. 5-12, a combination of a 10 ton/day ice making plant and 45 ton ice storage seems reasonable, but the capacity of ice making plant is to be enlarged up to 15 ton a day in view of following considerations.

(a) to provide a room for the demand increase after 1990,
(b) to provide a room for the demand by non-registered boat,
(c) to provide a room for the demand increase by the day-trip fishing boats,

In normal operation, two units of five ton per day plant will be operated for ice making and one of them will be for the reserve to cope with any mechanical problems that may happen.

Fig. 5-12 Ice Plant and Ice Storage




| | | |
|---|---|---|
| Ice making a Week | 5 Ton/day × 7 DAYS | = 35 Ton |
| | 10 Ton/day × 7 DAYS | = 70 Ton |
| | 15 Ton/day × 7 DAYS | = 105 Ton |

## 5-3-5 Determination of Scale of Building and Infrastructures

It is necessary to grasp fully the existing conditions of the fishing industry, marine product distribution system, etc. in the region of the Project hinterland before entering the phase of building and utility planning. Also, depending on the type of facility, it is necessary to study a structural system which may permit enlargement of facility when required by changes in its utilization.

First of all, the content and scale of each facility were planned after conducting a study comparing the scale estimated to some extent here in Japan prior to departure for site investigation.

Recent site investigation was conducted bearing in mind the above study and general concept for planning of each facility.

As a result of the site investigation, several points of discrepancy in previous assumptions for content of facility and the actual condition of utilization became apparent. Furthermore, previous grasp of the fisherman's pattern of livelihood differed. However, these assumptions were taken up as object of direct interviews so in the end it was possible to gather accurate and detailed information, so, it was decided to proceed with planning of facilities with above results considered.

In order to proceed with planning of buildings and utilities, site investigation on following was conducted:

a. Existing condition of the fisheries office's facilities at the King's Wharf of Lautoka and the Western Division local office.
b. Existing function and outlook of Western Division and the King's Wharf.
c. Average pattern of fisherman's livelihood in the vicinity of Lautoka .
d. Facilities assumed necessary for planning.
e. Basic design for the facilities.

Decision was made to give concrete form to the contents of the facilities based on the results of the investigation.

On the other hand, planning of layouts for various facilities was also necessary in overall planning of the fishing port. However, the planning was conducted while studying the relationship of each facility's function to other facilities.

a) Conditions of Existing Facilities

The existing facilities serve as a local office and an administration office for the fishing port and these facilities consist of facility located in the port area and administration office in the town district.

Tabe 5-15 List of Existing Facilities ;Lautoka

| Type of facility | Floor area ($m^2$) | Remarks |
|---|---|---|
| Administration Office (Fisheries Division's Western Division Office Lautoka Fishing Port Administration Office) | 166.12 | Located in 2nd-floor of mid. Town private office bld'g 1.5km from the Site |
| Ice Making Plant Building (structural steel, 2 floors) | 40.60 | Located at the Site |
| Workshop Building (Wood 2 floors) | 91.90 | 〃 |
| Waiting Shed(struct. steel, C.B.) | 206.46 | 〃 |
| Total | 529.08 | |

Points of problem of existing facilities are as follows

(1) Much inconvenience due to distance between wharf and office. Arrangement for transportation and adjustment of time is necessary whenever contact or discussion is to be held at the port, resulting in great loss of time.

(2) Due to the problem of distance, communication between officer-in-charge of the fishery office and the fishermen is not smoothly conducted, so invery many cases, detailed information regarding fishing activities cannot be obtained or exchanged.

(3) Training course for fishing license holders and other periodic training are necessary; but space limitation in existing administration office prevents execution of the programme according to schedule.

(4) Storage space for statistical information and books is lacking, so information cannot be filed properly.
Classifications by year and region must be prepared and stored systematically a certain place.

(5) Ice making capacity comes up resulting in insufficient supply of ice during peak fishing season.

(6) Repair workshop space is small and does not meet the requiremnts for this fishing port.

Above are existing conditions of the facilities and problem points. For example, the repair workshop was not originally planned for the purpose: At any rate, the only existing facility that can be appropriated to be used in the future is the waiting shed for cutter boats, so it is desirable to provide new building facilities to meet the need for stimulating fishing activities, promotion of fishing industry and production.

b) Existing State of Function and its Future

(1) Function as Local Office of the Fisheries Division
Office for the fishing port is required to function as local office of the Division and the functions includes:

- Issuing and renewing fishing license and collecting statistics.
- Investigating fishing grounds and fish resources by region.
- Inspecting and reparing ice making plants in Western Division.
- Maintaining control over unlicensed fishermen and giving guidance to licensed fishermen.
- Selling fishing boats and gear and giving guidance in their uses.
- Contacting and assisting local officer-in-charge for the Western Division.
- Holding classes and contact guidances on instructions and guidances issued by the Fisheries Division, Suva.
- Accounting of expenses and payrolls, etc. in the Division under charge.
- Others.

(2) Function as Lautoka fishing port

Office for the fishing port must function as operator and manager of the Lautoka fishing port.

- Anchoring and admininstering fishing boats
- Furnishing necessary information relative to fishing grounds, and supplying necessities

  (necessities for fishing)

  ① Ice for preserving freshness of fish

  ② Engine fuel

  (gasoline, kerosene, engine oil)

  ③ Fishing gear and spares, check and replenish

  ④ Baits

  ⑤ Food and drinking water
- Inspecting and servicing fishing boats
- Inspecting and repairing fishing gear
- Giving guidance to fishermen cooperative(provisional name)and periodic training
- Inspecting and maintaining port facilities
- Others

(3) Personnel for the Fisheries Division

At present, personnel for Lautoka district, Fisheries Division are as follows:

Table 5-16 Personnel for Lautoka Fishing Port

| Duty | | Number | Future Addition |
|---|---|---|---|
| Senior Fishery Officer | | 1 | |
| Senior Fishery Assistants | | 3 | (3 additional in future) |
| Accounting Officer | | 1 | |
| Technical Officers | | 2 | |
| Research/Laboratory | | 2 | |
| Typist | | 1 | |
| Workshop/ice sale | | 1 | (3 additional in future) |
| Total | Present | 11 | |
| | Future | 17 | For the Project |

There is no problem from personnel viewpoint under the present arrangement; but at completion of the fishing port, adequate maintenance of various facilities must be continued, so present number must be increased. Basic planning of building and office is based on increased personnel.

(4) Preparation work prior to deberthing and sailing for fishing ground

Fishing boats will require preparation work for fishing as follows:

(a) Check weather report and Tidal Table(High and low tides)

(b) Replenish engine fuel

(c) Check and supply gear and baits

(d) Ice supply

average of 140 kg(amount required for one trip to fishing ground)

(e) Purchase meals and food (including drinking water)

(f) Maintenance of fishing boats and gear

(g) Others. Meeting of fishermen cooperative and periodic training

There are two types of fishing boats that will utilize the Lautoka fishing port and they will have the following characteristics:

Permanent use: Fishing boats for which the Lautoka fishing port is the mother port, so every item mentioned above becomes part of the preparatory works for them.

Temporary use: Boats making temporary stop-over at the Lautoka fishing port for preparatory works or making periodic port call to replenish fuel, water, ice, etc. or making emergency call for repair, and other service.

As shown in (5-3-2) for determination of the scale of fishing port facilities, the number of boats utilizing each berth (1990) is as follows:

| Wharf | Boats | |
|---|---|---|
| Unloading | 62 | 61.7 boats on an average |
| Stand-by | 47 | |
| Loading and Preparation | 76 | |

From above, the following can be stated:

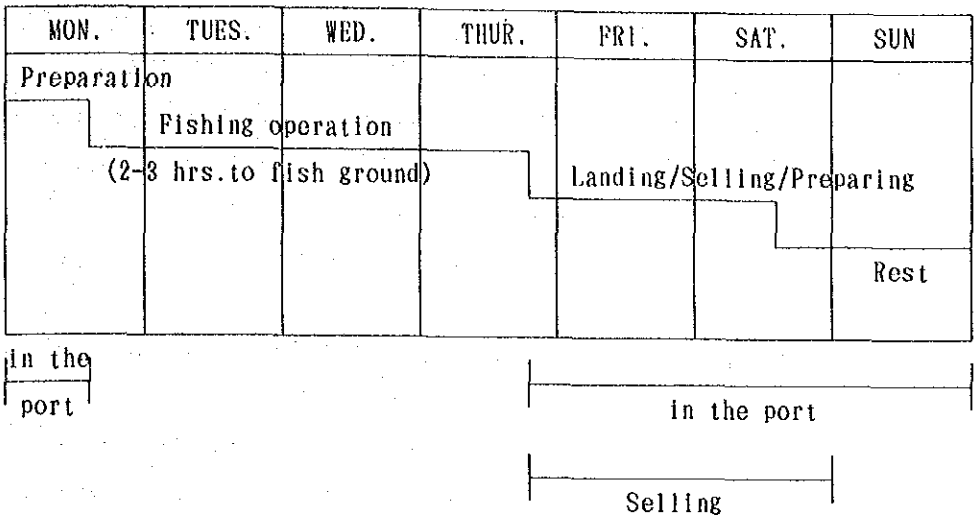
| | | |
|---|---|---|
| Permanent use | about | 60 Boats |
| Temporary use | about | 240 Boats |
| Total | | 300 Boats |

c) Standard Pattern of Fishermen's Livelihood

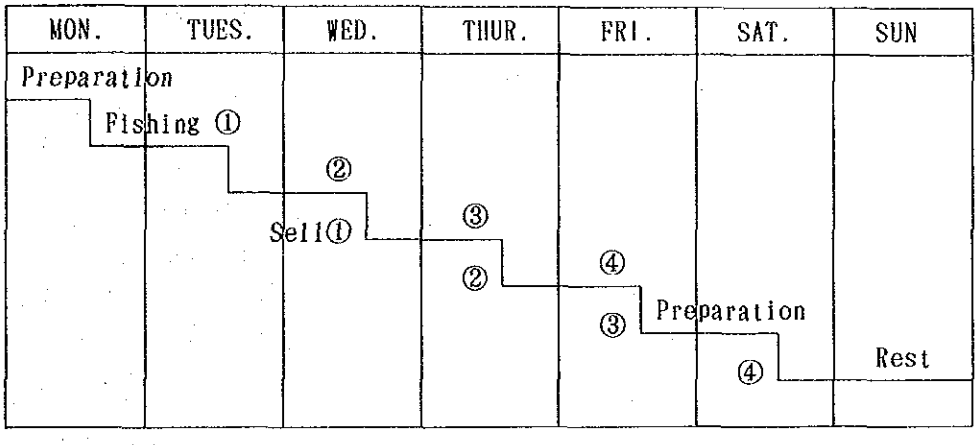
There are two types of fishing activity, A type (one day trip) and B type (three day trip) and their main activities are presented as follows:

Fig. 5-13 Standard Pattern of Fishermen's Livelihood

B type fishing boats




A type fishing boats




※ Above is an average pattern, so this will not necessarily apply to every fishing boat.

See Table 3-9 for each type of fishing bort.

d) Facilities contemplated as necessary for the programme

From the present site investigation, the number of boats that will be berthed was estimated at approximately 60 boats or as stated above. Therefore, planning of functional facilities was started with this as a basis.

Study of necessary functional facilities was conducted based on data collected from recent invesigations and other information and with maximum utilization of usable existing facilities considered.

(1) Fishing port administration office and local office of the Fisheries Division.

(2) Complementing structure for maintenance and repair of fishing boats and gear and providing repair and workshop.

(3) Complementing ice making facility (study of facility made in 5-3-3.)

(4) Canteen to serve meals to fishermen and to be used as meeting place for fishermen and containing a small shop to increase efficiency of prepara-tory works.

(5) Lighting system and guard room facility to maintain security of fishing port and to control fishing boats at anchor.

(6) Fuel and water supplying system to increase efficiency in preparatory works.

(7) Stacking area and open storage area

e) Functional Facilities

A fishing port should contribute to increase of fish catch and rationalization of services to fishermen through complete improvement of fishing port's functional facilities.

e-1 Content of facility planning

1. Administration Office (functions as fishing port administration and local office)
2. Repair and workshop to maintain and repair fishing boats and gear.
3. Building to house ice making equipment and to store ice.
4. Building to serve as canteen, store and meeting place.
5. Guard room in the Administration Office
6. Substation

7. Appurtenant equipment and systems for above structures (site lighting system included)

The various facilities mentioned above are expressed more concretely, but from the viewpoint of efficient utilization of port area, each facility, although dependent on the type, will not necessarily have to be housed individually; and, in overall planning of the fishing port, individual facility will be arranged rationally.

e-2 Scale of facilities planned

The scale of each functional facility is as follows:

Table 5-17 Scale of Building and Office

Unit : m²

| | |
|---|---|
| Office /Workshop/Guard room (2 Floors) | 448.50 (104.16 Balcony, Stairway) |
| Building for Ice Plant (2 Floors) | 180.00 (21.00 Canopy portion) |
| Dining/Meeting Hall (1 Floor) | 108.00 |
| Substation | 20.00 |
| Total | 756.50 (125.16 Balcony, Stair, Canopy) |

The scale of each facility was determined with the existing condition of the facilities and future utilization considered. Floor arrangements of these facilities are shown in the layout plan Fig. 5-14 and the structures and other items for these facilities are shown in separate plans. See Appendix.L.

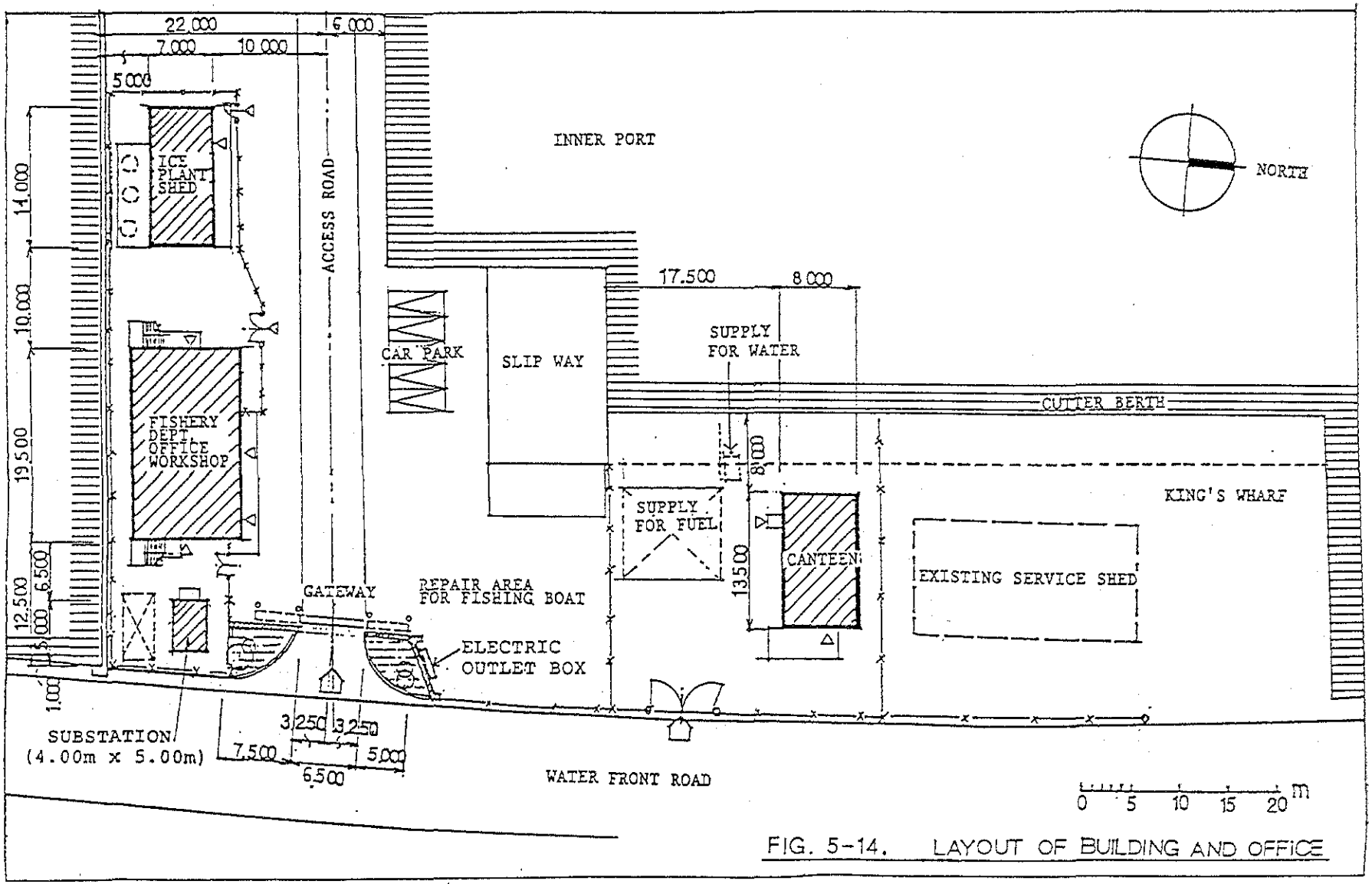



FIG. 5-14. LAYOUT OF BUILDING AND OFFICE

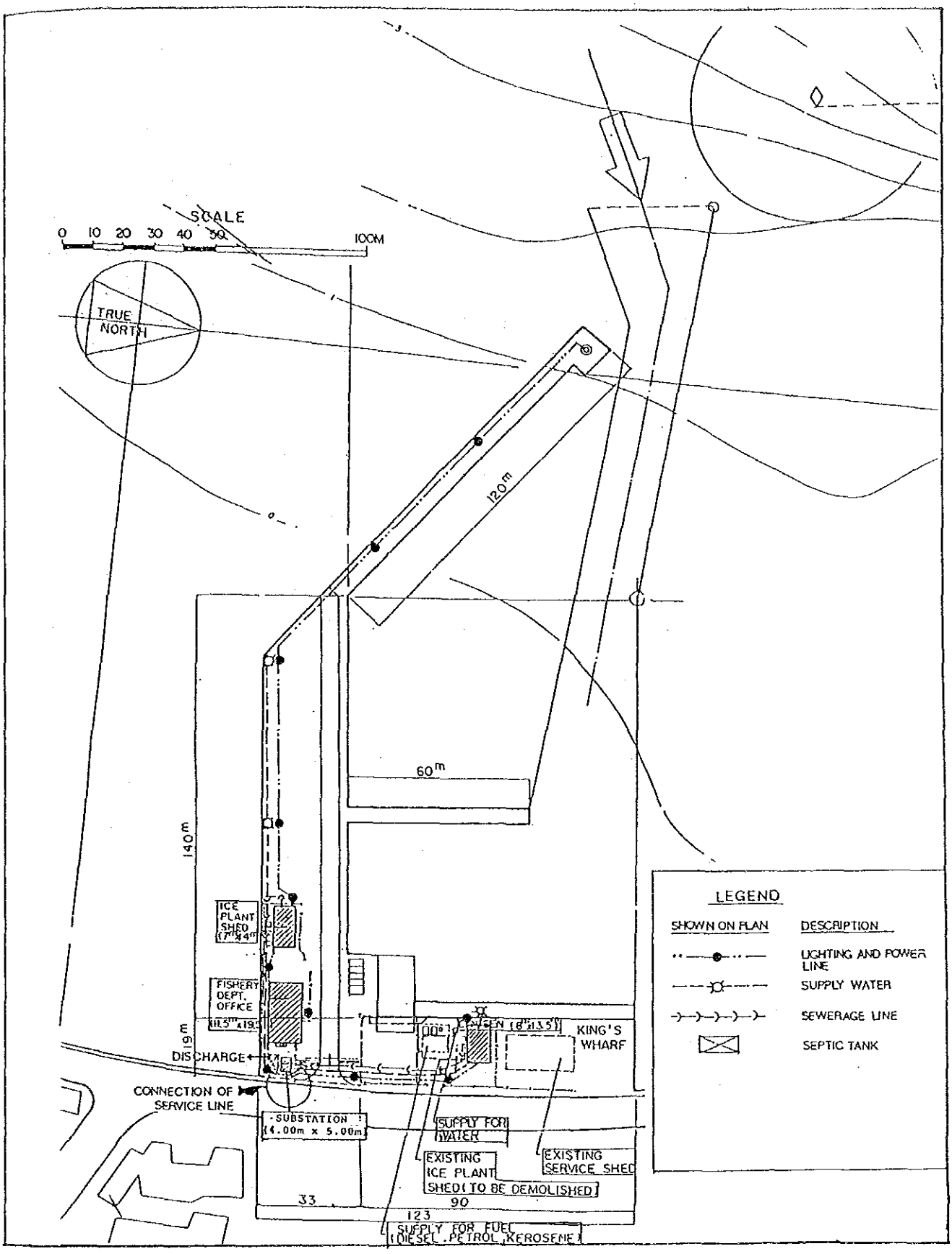



FIG.5-15. LAYOUT OF UTILITIES

e-3 Determination of scale

(1)(2)Administration Office/Workshop/Guard Room

As mentioned above, this fishing port needs an office that will serve the function of both administrative office for fishing port, and local office for Western District of the Fisheries Division. During planning stage, the floor area of the office and work shop became almost identical, so a two storied building with workshop on the ground floor and office above was planned. Two storied building was adopted for its advantage seen from effective utilization of limited land area and problem of free function and administration.

| | |
|---|---|
| 1st Floor portion | Workshops |
| 2nd Floor portion | Office Spaces |

The functions of repair and workshop are as follows

① Inspecting and serving fishing boat engine
② Repairing and supplying fishing gear
③ Storing and supplying spare parts
④ Storing and maintaining tools for repairing engines and boats
⑤ Inspecting and maintaining ice plant
⑥ Inspecting and servicing fishing boats in the port hinterland

Others, such as rest room, toilet, locker room, etc. are necessary. It will be necessary to provide a chain hoist of 2-3 ton capacity in ceiling portion of the workshop.

Floor areas of various rooms needed to carry out the functions are as follows;

Office/Workshop 2 Floors

Unit : m²

| | | |
|---|---|---|
| Office (2nd Floor) | Senior Fisheries Officer Room | 16.25 |
| | S.F.A.Room | 16.25 |
| | Statistics Room | 16.25 |
| | Laboratory/Research Room | 16.25 |
| | Library/Conference | 32.50 |
| | Clerical Officer<br>Licensing Law Enforcement | 61.75 |
| | Hallway | 38.75 |
| | Toilet(men・women) | 16.25 |
| | Pantry | 4.00 |
| | Storage(stationery, others) | 6.00 |
| | Total | 224.25 |

Unit : m²

| | | |
|---|---|---|
| Workshop (1st Floor) | Engineering Workshop | 32.50 |
| | Fishing Gear Work Area | 74.75 |
| | Ration Store | 16.25 |
| | Store For Parts and Tools | 49.375 |
| | Rest Room | 16.25 |
| | Locker Room(shower, toilet) | 16.25 |
| | Hallway | 4.875 |
| | Guard Room | 14.00 |
| | Total | 224.25 |
| Grand Total (1F+2F) | | 448.50 |

Port Observation Balcony and Outside Stair

Uuit : m²

| | | |
|---|---|---|
| 1～2 Floor | Balcony | 80.16 |
| | Outside Stair | 24.00 |
| | Total | 104.16 |

(3) Building to house ice machine and ice storage

In planning of building for ice plant, the shape of the ice determines the ice making machine, so it will be necessary to clarify the type of ice plant prior to planning. The basic items based on aforementioned determination of ice making capacity in 5-3-3 are as follows:

| | Facilities | Specifications |
|---|---|---|
| ① | Ice making capacity | Daily : 5.0 tons×3 sets=15 tons/day |
| ② | Shape of ice | Plate shape ice |
| ③ | Sales method | 40~50kg unit, bagged/weigh Method |
| ④ | Ice storage capacity | 45 tons |

Facility necessary for above conditions is as follows:

Ice Plant Building

Unit : ㎡

| | | |
|---|---|---|
| 1st Floor | Ice Storage | 70.00 |
| | Ice Selling Corner | 8.00 |
| | Maintenance Tools Storage | 5.00 |
| | Toilet/Lavatory Hallway | 5.00 |
| | Total | 88.00 |

Unit : ㎡

| | | |
|---|---|---|
| 1~2nd Floor | Stair Case | 22.00 |
| | Canopy | (21.00) |
| | Total | 43.00 |

Unit : ㎡

| | | |
|---|---|---|
| 2nd Floor | Ice Machine Room | 70.00 |
| | Grand Total | 180.00 |

(Canopy 21.00)

(4) Canteen Building to serve as dining room, store and meeting room.

Above will be planned as part of fishing port facilities for the port having the capacity to berth 60 fishing boats.

The purpose of this facility is to serve meals (charged) and provide store space to sell necessary fishing gear and provisions to the fishermen preparing to leave for fishing ground.

At present, there is no facility necessary for fishing preparation works in the vicinity of the proposed site. When a fisherman needs to eat, he musttravel by taxi or on foot from the port to downtown which is about 1.5km away.

On the other hand, place to hold training classes and cooperative meetings is necessary, so a facility that will also serve these needs will be planned.

For determination of the scale, the assumption of 60 boats×3 crew per boat results in average of 180 fishermen boarding the boats. But for this facility utilization rate of 25% was adopted.

Therefore:

180 Men ×25% =45 Men using the facility at the same time

45 Men× 2.0㎡=90㎡ Dining and kitchen

Others: Corner store 18 ㎡ (located in canteen area )

Canteen/Meeting Room

Unit : ㎡

| | |
|---|---|
| Dining, Meeting Room | 54.00 |
| Corner Store | 18.00 |
| Kitchen | 17.00 |
| Office, Toilet | 9.00 |
| Total | 108.00 |

(5) Guard Room

Guard room is to be located near the main entrance gate to check vehicles and unauthorized persons entering and leaving the port area. Round the clock surveillance is proposed to prevent thefts at night. One guard will stay at post at all times (guard duty in 3 shifts of 8hr/shift). The guard room is posted at the north-east corner of the administration office.

Guard Room

Unit : m²

| | |
|---|---|
| Guard Room, others | 11.00 |
| Toilet, Lavatory | 3.00 |
| TOTAL | 14.00 |

(6) Substation

Power supply for port facilitie will be made through the existing high-voltage supply line along to the water-front road behilind the fishing port.

According to the government officess, there is necessity to install a substation in the port area considering the power capacity expected to be supplied to the fishing port facilitie.

The size of the substation is estimated of following.

Substation(flat) 4.00m ×5.00m =20.00 m²

All of the necessary installations before the substation will be executed by the Government of Fiji ; the Fiji Electric Authority.

f) Utilities and Infrastructures

For safe and efficient operation with each functional facilities in a fishing port, it is necessary to consider infrastructure with a viewpoint of whole construction site.

(1) Plan of the Site Infrastructure

Based on the result from site investigation and other data, infrastructure plan on the site is considered with the following items.

(a) Rain water drainage system
(b) Fire fighting system
(c) Water Supply system
(d) Lighting
(e) Sewerage system
(f) Power supply system
(e) Telecommunication system

(2) Basic design concept for (a)-(e) of the above article.

(a) Drainage System for Rain Water

The drainage system can be divided into two; one is from the roof of buildings, and the other is for the site surface. Rain water from the roof is collected through drain ditches in the port area, and directly discharged to the sea.

(b) Fire Fighting Equipment

Fire fighting equipment is plannned for the port itself and for the appurtenant facilities. The object of the port fire fighting is for fishing boats. The fire hydrant for that is planned with under-floor stowed type.

(c) Water Supply system

Water supply system is planned for fishing boats leaving the port. It is planned with portable type flow meter furnishable.
Places to install are shown in Fig. 5-15.

(d) Lighting system.

Measures for safe working at night and for prevention of burglary in the port area.
Though the present fishing port cannot be used during the time of low tide, new fishing port can be used 24 hours when the construction work is completed. As a matter of course, especially during good fishing season, night fishing work will be expected. Because of that, lighting system is planned for safe sailing in the port at night. Concrete plan is shown in Fig.5-15.

. 10 Lighting Point : 100 W of each

(e) Sewerage System

Treatment system of the sewage from toilet and other places of the facilities.
About 5.0 ton/day of sewage volume from the facilities is anticipated. Problem is discharging water at the system end, as there is no drain- pipe laid under the area near the site and no project is planned for that. The drainpipe is laid about 500m from

the road in front of the site. Judging from these circumstances, it is planned to install a separate treatment tank of united type and then discharge the treated water to the sea.
It is planned to make B.O.D(biochemical oxygen demand) value of the port drain water 60 p.p.m. at the highest.

## 5 - 4 GENERAL LAYOUT

### 5-4-1 Planning Concepts

The objectives of port improvement/development are as per shown in Chapter 4 "Outline of the Project".

(1) To secure safety for the fishing vessels.
(2) To give not only unloading facilities but also the opportunity for loading and stand-by purpose.
(3) To cope with the demands for ice, water, and fuel by making available the supply facilities.
(4) To plan such facilities as to promote fishing activities.
(5) To meet demands for repair/maintenance of fishing gear.
(6) To become a center for the promotion of the coastal fishing.

Furthermore, the following points must be well observed as shown in Section 5-1 "Plan and Design Concepts":

(1) To keep the overall project scope to a proper level.
(2) To have proper general layout.
(3) To take into account all the objective situations surrounding the project site.
(4) To have proper scope/size for each facility.
(5) To make the facilities suitable to available production/destribution mechanism at the project site.
(6) To make the structures, materials and construction methods well suited to on-site conditions.

In this section, the project target years shall be specifically discussed with good attention to the above(2) "to have proper general layout "and the project scope for Phase I shall be determined.
The project years shall be as follows per sectiom 3-5 "Target Year of the Project":

Phase I: Year of 1990, a target year(Japanese grant aid project)
Year of 1990 is also the final year of Ninth National Development Plan(DD9) and well coordinated with various plans by the Fisheries Devision.

Phase II: Year of 2005, a target year.( Long-term Development)
This is a long-term development plan and will not be considered as a Japanese grant aid project.

The size/scope of fishing port shall be as follows as per 5-3-3 " Scall of the Port facilities".

| | occupancy of boats | Number of boats accommodated |
|---|---|---|
| Phase I | 25% | About 60 |
| Phase II | 30 | About 150 |

In the final comparison stage under the plan study, the case with 60 boats as the number of accommodation and the case with 40 boats and 80 boats shall be studied.

The necessary berth length in each of the target years will be as per the figures shown in 5-3-3.

Table 5-11 Necessary Berth Length unit: meters

| Kind of Berth | Project Years 1990 | 2005 |
|---|---|---|
| Unloading(landing) | 150 | 260 |
| Resting(Stand-by) | 90 | 225 |
| Loading(preparation ) | 125 | 285 |
| As mother port boats | (80) | (195) |
| other (water supply) | (20) | (40) |
| (oil & water supply) | (25) | (50) |
| For fishing boats Sub Total | 320 | 770 |
| For cutters | 39 | 78 |
| For barges | 9 | 18 |
| Total | 368 | 866 |

note: Numbar of boats: 60

In Phase I (1990), the total berth length shall be therefore 370m, and about 870m for PhaseII (2005).

## 5-4-2 Methodology

The objectives of the study shall be to make a general layout for Phase I, and the study shall be conducted in the following manner. The stages of the study are divided into seven steps, leading to the selection of the final alternative plan.

Step(1) Study on formal line of the Jetty
Step(2) Comparison of overall alignments under Phase I
Step(3) Study on future extension and utilization of wet basin
Step(4) Study on land use/facilities utilization
Step(5) Study on long-term development plan
Step(6) Setting-up of Phase I plan (1990 as target year)
Step(7) Study on the final alternatives and draft-up of final Phase I plan.

## 5-4-3 Study on Alternatives

Below are shown the study contents and study results.

### a) Step(1) Study on formal line of the Jetty

Three alternatives A,B & C have been studied and the explanation of each alternative and respective evaluations are shown in Fig.5-20.
The conclusion is such that the main jetty shall be located directly to the south of the present King's Wharf. Plan A is superior to the others in respect that the present wharf can be still in use while the new port is under construction and that there is much wider space for future expansion of the port toward the north.

b) Step(2) Study on overall alignments under Phase I

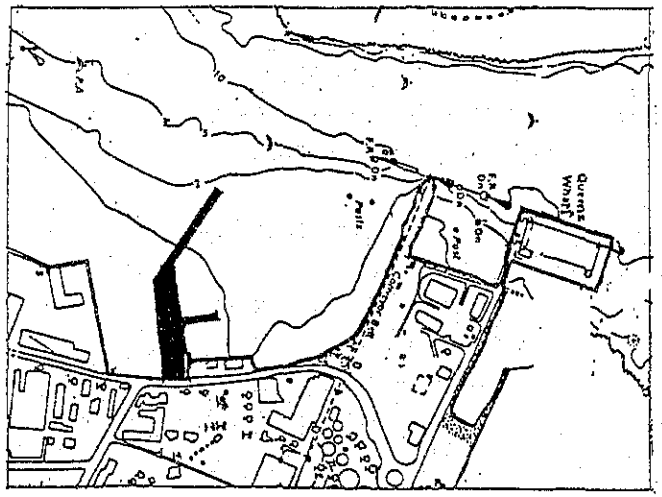
Three alternatives D,E & F, have been evaluated, the layouts of which are shown in Fig. 5-21. Plan E has been concluded best, especially with less siltation and better protection of the channel and the basin from the adverse wave-effects.

c) Step(3) Future extension and utilization of wet-basin

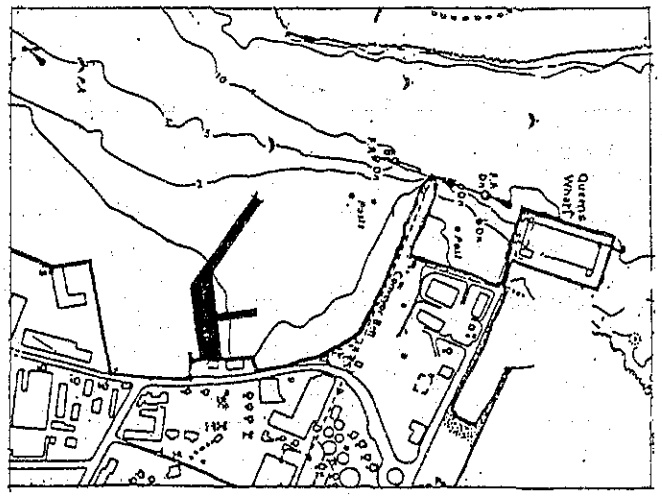
Three alternatives, G, H & I ,were evaluated and details of each alternative are as per Fig.5-22. Each has approximately 870m for the effective berth length.

The Ports Authority has a plan to utilize the area within 50m to the south from a line of present FSC sugar loading conveyor, and plan G & I have no problems in that respect.

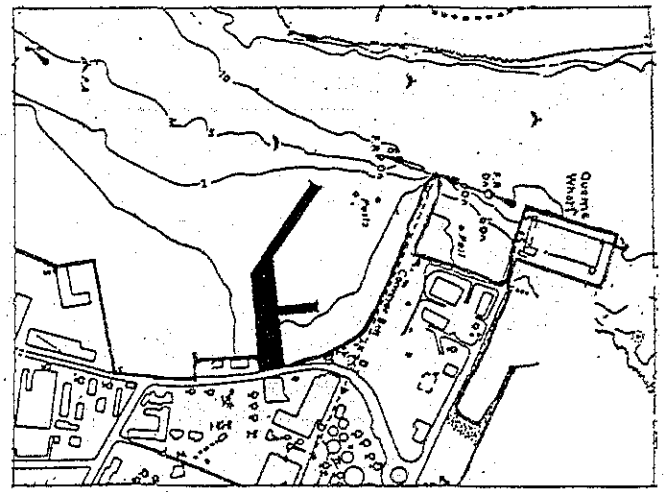
Plan -A



Plan -B



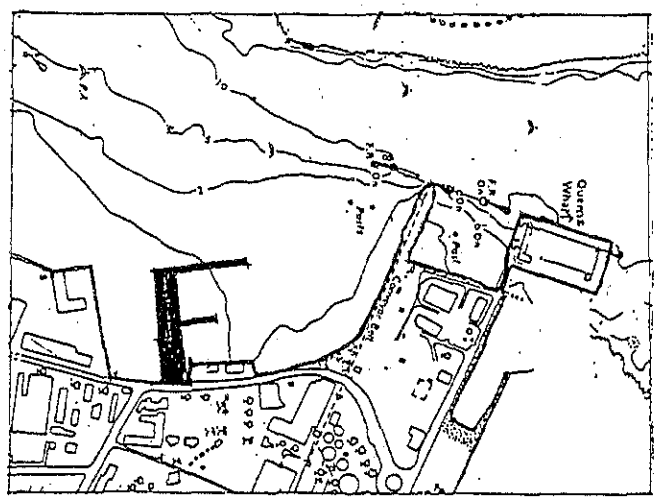
Plan -C



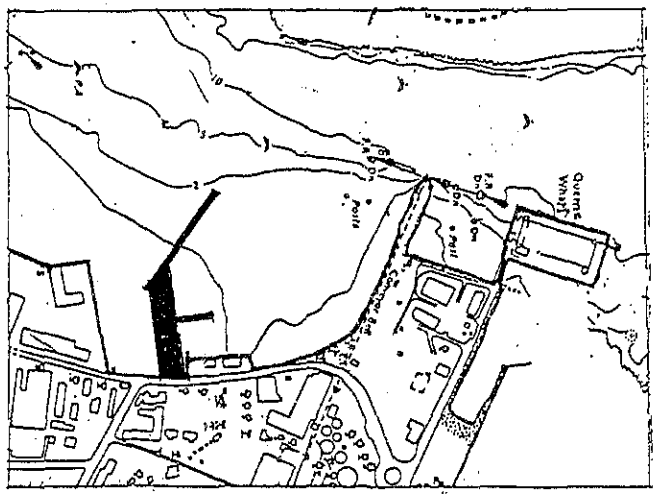
| Conditions to be Evaluated | A (South) | B (Middle) | C (North) |
|---|---|---|---|
| (a) Utilization of Existing Wharf | Excellent | Fair | Poor |
| (b) Approach channel | Good | Fair | Poor |
| (c) Future Expansion | Good | Fair | Poor |
| Total Evaluation | Good | | |

Fig. 5-21 Layout of Initial Development

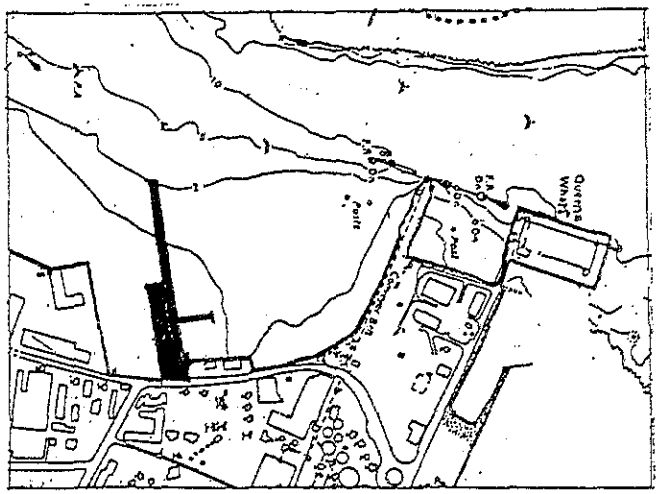
Plan -D



Plan -E



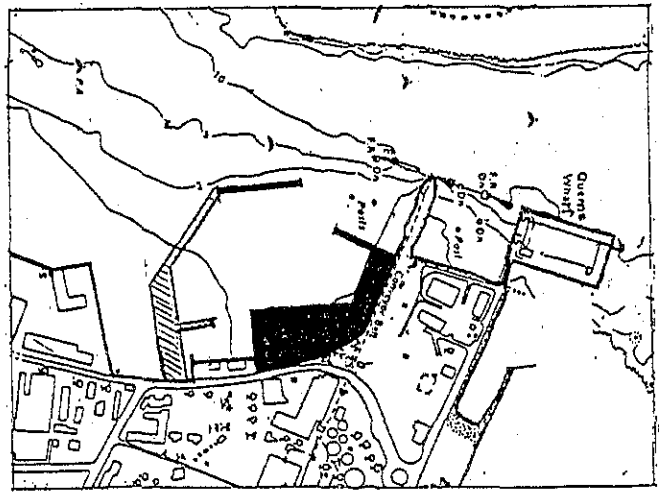
Plan -F



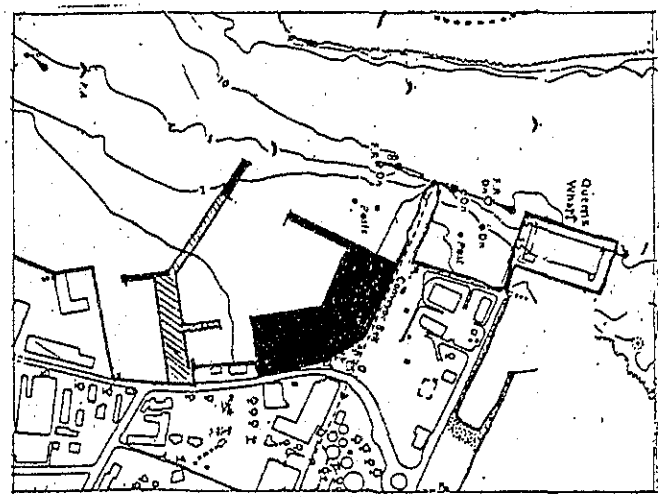
| Conditions to be Evaluated | Plan D | Plan E | Plan F |
|---|---|---|---|
| (a) Constraction Cost | Same | Same | Same |
| (b) Maintenance Cost | Poor | Excellent | Good |
| (c) Wave Calmness | Good | Good | Poor |
| (d) Area of Calm Condition | Fair | Good | Fair |
| Total Evaluation | | Good | |

Fig. 5-22 Future Expansion / Utilization of Sea-area

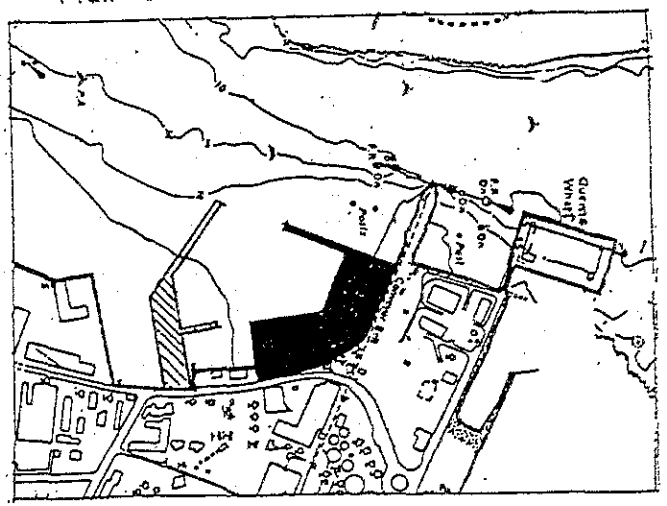
Plan -G



Plan -H



Plan -I



| Conditions to be Evaluated | Plan G | Plan H | Plan I |
|---|---|---|---|
| (1) Approach channel | Poor | Fair | Good |
| (2) Utilization of Sea・area | Not to be Accepted by Port Authority | To be Acceped by Port Authority | To be Accepted Port Authority |
| (3) Siltation | Good | Poor | Good |
| (4) Wave Calmness | Good | Good | Good |
| Total Evaluation | | | Good |

d) Step(4) Land use/facility layout

Four alternatives J,K,L & M were studied, the layouts of which are as per Fig.5-23. Plan L is superior to others in respect that the area just behind the quaywall is left open and still each facility is functionally detached from the others.
The open space behind the quaywall can make the quaywall/wharf better utilized and also gives the plan more flexibility in dealing with future changes.
The ice-plant is not necessarily located immediately behind the quaywall because ice will be bagged, measured and carried away by purchasers after payment; that is, small amount (50kgs ~200kgs a boat) will be purchased by many customers. The boats lift-up device (ramp facility) for the repair must be installed close to the workshop and must be still detached from the centre of quaywall so as not to disturb busy unloading/loading operation by fishermen there.

The ice-plants, the administrative building/workshop and the boat-lift-up facilities should be located close to each other, not for functional purposes but for convenience in assuring of the safety of the facilities (including theft/fire-protection), and also for easier and faster port-management due to the shorter distance for the administration staff.

The canteen including sales-stand shall be situated at the place close to the existing ice-plants and the exclusive-use berth for the oil and water-supply will be located nearby, thus making possible concentration of functions. The operation of the canteen including the sales-stand and oil- and water-supply may be possibly commissioned to the private sector and, in that occasion, must be separated from the Fisheries Div.-operated facilities such as the quaywall, the adiministrative building and the ice-plants.
The cutter berth and the existing transit shed remain where they are, thus separated from the fishing port facilities.The barge barth will be located at the north end of the King's Wharf.

Use-division of the berth is as follows;

| Location | Use |
|---|---|
| A) Inside the breakwater | berth |
| B) Main jetty | berth |
| C) Finger jetty | berth provided portion will be allocated to ice-supply use only. |
| D) Present King's Wharf | boats ramp facility and exclusive-use berth for fuel and water supply and cutters/barges uses. |

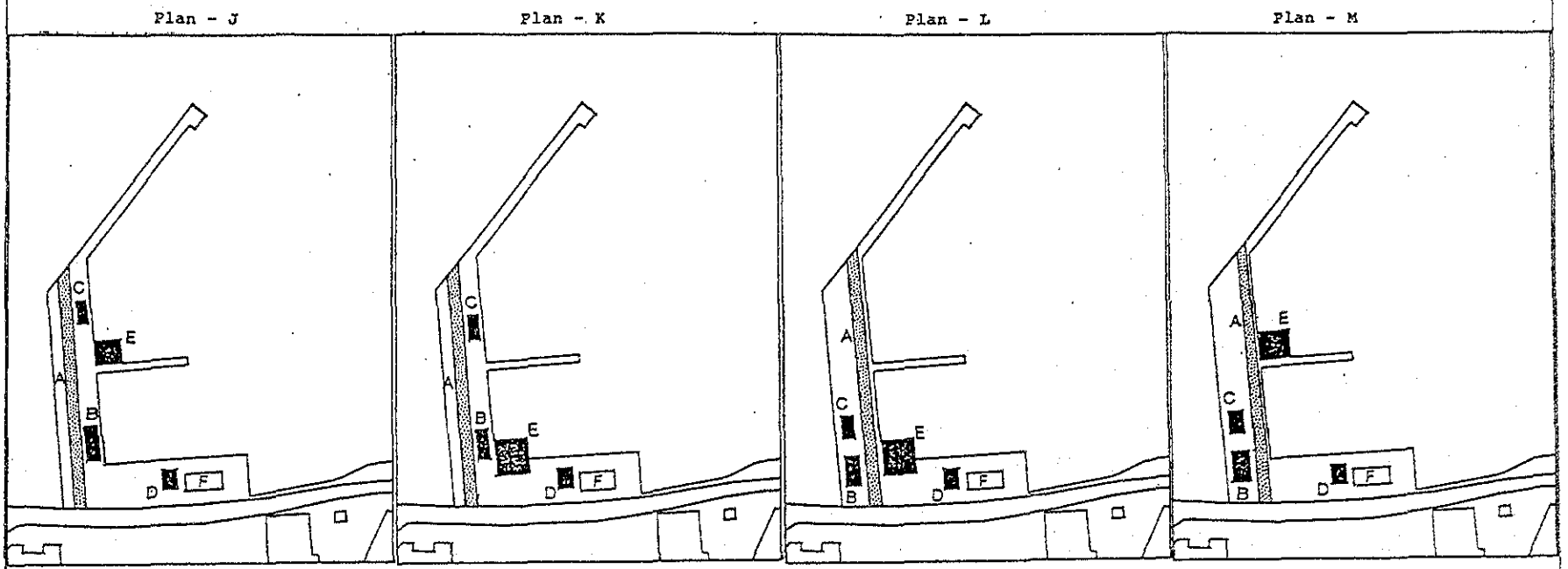
Plan L and M have wider space behind access road, which will be utilized as stacking area and other purposes. This area will be suitable yard for the auction in the port.
Therefore, Pland L is superior to others.

## Fig. 5-23 Land Use and Facility Layout

Remarks

A : Access Road  B : Fisheries Office and Workshop  C : Ice Making Plant

D : Canteen  E : Ramp  F : Cutter Shed




| Condition to be Evaluated | Plan J | Plan K | Plan L | Plan M |
|---|---|---|---|---|
| (1) Effective use of Wharves | Fair | Fair | Good | Good |
| (2) Traffic Circulatim | Fair | Good | Good | Fair |
| (3) Control | Poor | Fair | Good | Fair |
| Total Evaluation | | | Good | |

e) Step(5) Study on long-term development plan

By summing up the previous studies, a long-term development plan was drafted(Fig.5-24). The purpose of the plan is to set up a guideline for future extension of the port and still to coordinate well with the general layout of Phase I. Subsequent to the year 1990, in executing the long-term development plan, it must take into consideration the them government policy,fishing industry activities, fishermen's needs, type & number of boats, etc.The plan must be also well coordinated with the future utilization plan of the water area by the Ports Authority, and the mooring buoy and navigational channel in the west and the existing pier head line of the Ports Authority's facilities.

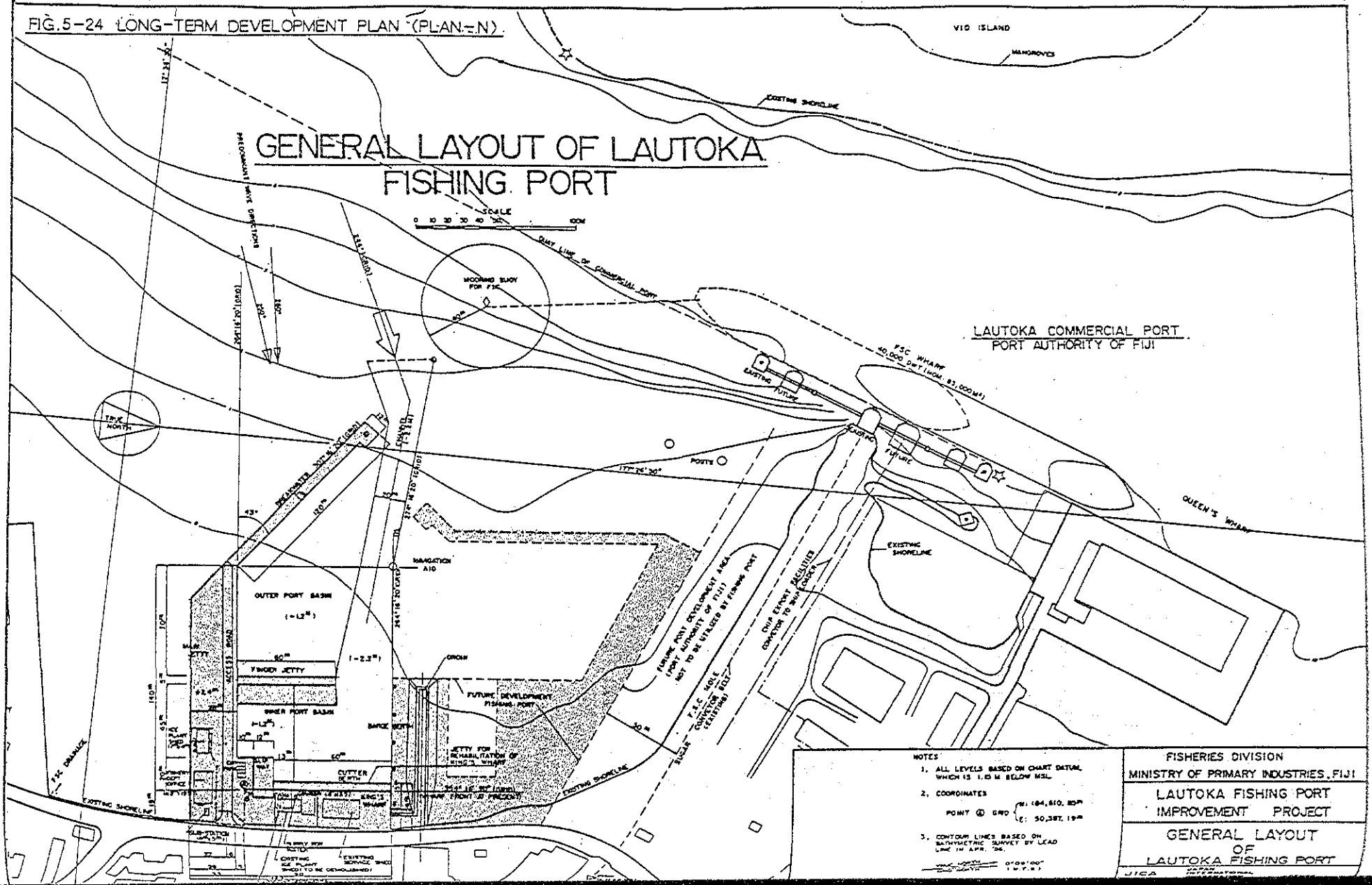
It is also necessary to reach some agreement between the Ports Authority and the FSC plant which is located to the south of the port about the disposal of the industrial refuse water from the sugar refinery.
The project year for the long-term development plan is 2005 and the berth length required is approximately 870m. About 370m out of 870m is to be completed in Phase I and the remaining 500m shall be apportioned to the new construction further north.

The north berth (reclaimed area ) shall be outside the Ports Authority's future development area and the land use of this reclaimed area to the north shall be determined after considering many factors prevalent then, including possibility to open a fish auction market there and smooth traffic circulation.

The north breakwater shall function to keep calmness within the port to the desired level and also to protect the siltation from the north.
In case it becomes necessary in future to accommodate larger boats such as IKA Boats, then port shall be extended to the north thus obtaining easily the wider wet basin required.

The berth for the cutters, barges and the ice-plants shall be re-located or be constructed newly at some other place.

FIG.5-24 LONG-TERM DEVELOPMENT PLAN (PLAN-N)



f) Step(6) Phase I Planning

The plan for the Phase I is shown in Fig.5-25.
The necessary effective berth length is supposed to be about 365m is Phase I ; that is, out of the long-term development plan, only the southern half will be developed.

The location of the navigational channel is exactly the same as in the long-term development plan, and also to the south from the mooring buoy of the Ports Authority.

The width of the finger jetty is narrowed by 5m to 25m thus reducing the project cost for the Phase I development.
The utilization of berth is as follows;

| Location | Utilization |
|---|---|
| A) Inside the breakwater | Resting berth (Stand-by berth) |
| B) Main jetty | Unloading/Loading berth |
| C) Finger jetty | ditto,provided & portion shall be for ice-supply exclusive use. |
| D) Present King's Wharf | for boat-lift-up, for supply (water and oil) and for cutters/Barges |

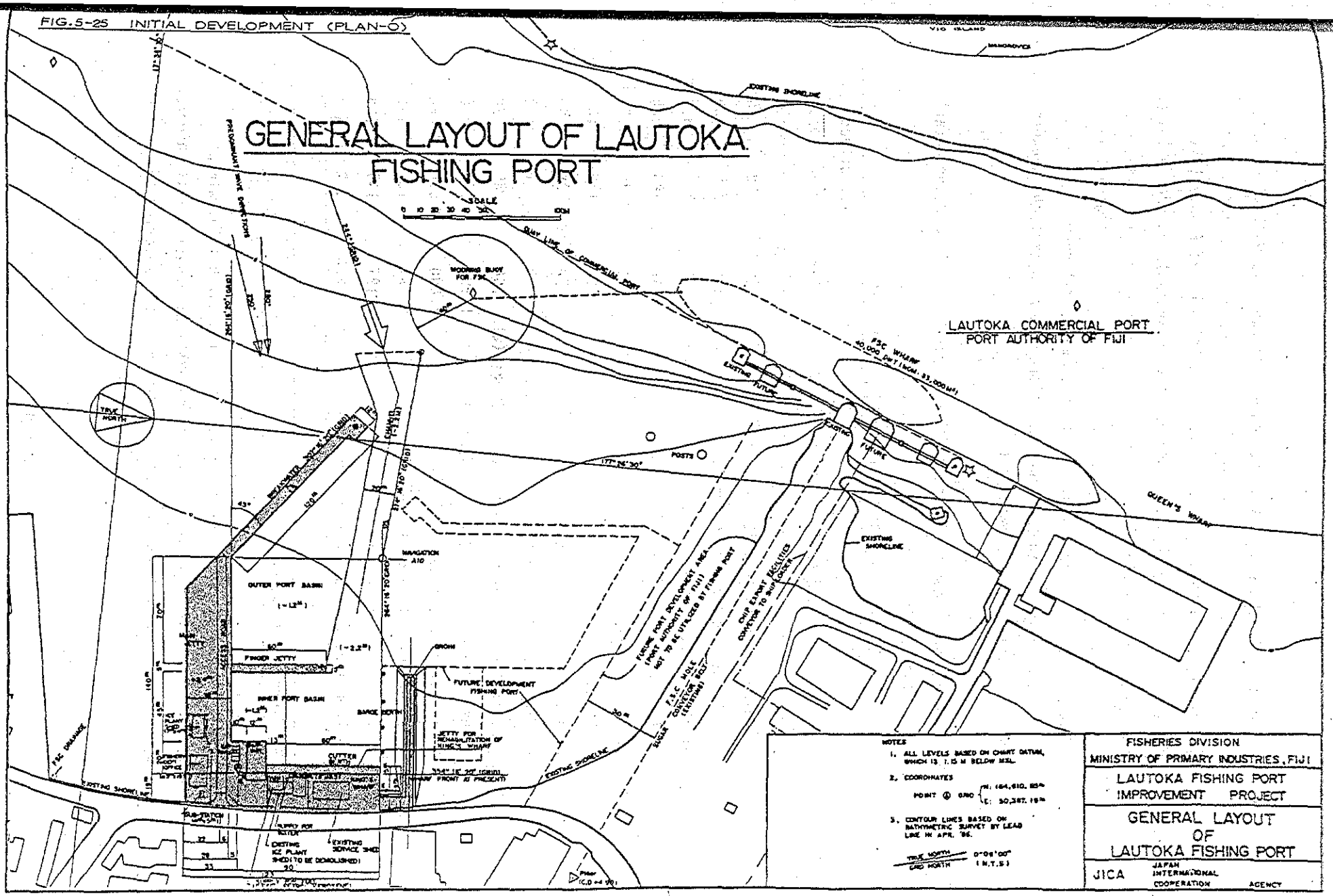
Note: The ice-supply berth will be utilized by the boats coming solely for ice-supply purpose.

Most of the sand-drift from the south can be stopped by the breakwater ; however, the sand-drift from the north, especially the southerly movement of siltation at the southern edge of the FSC jetty, must be stopped by the construction of a groin on the north side of the King's Wharf.
The quaywall length required shall be approximately 365m

Unit: meter

| Location | Effective quay Length | Exclusive use | | | | |
|---|---|---|---|---|---|---|
| | | Unloading | Stand-by | Loading | Cutters Barges | |
| Main jetty | 105 | 105 | — | — | — | — |
| Inside breakwater | 90 | — | 90 | — | — | — |
| Finger jetty | 100 | — | — | 80 | — | 20 |
| King's Wharf | 70 | — | — | — | 45 | 25 |
| Total length | 365 | 105 | 90 | 80 | 45 | 45 |

FIG.5-25 INITIAL DEVELOPMENT (PLAN-O)



g) Step(7) Study on the Final Alternatives and Overall Evaluation

Under Step(6), the Phase I plan has been studied and the feasibility of the Phase I plan is hereby studied quantitative analysis on the following three points: See Section 5-4-5.

Analysis(1) ..... Analysis about harbour basin calmness
〃 (2) ..... Study on the siltation of the navigational channel.
〃 (3) ..... Economic analysis

The alternatives under study are P,Q & R as per Fig.5-26, and the details of each plan are shown below.

Table 5-20 Comparison Table of Alternatives

| Items Compared | Alternatives plan P | plan Q | plan R |
|---|---|---|---|
| a) Number of fishing boats accommodated | 40 | 60 | 80 |
| b) Effective berth length required | 230 | 365 | 450 |
| c) b) ÷a) (m/boat) | 5.8 | 6.1 | 5.6 |
| d) Annual catches (t/yr) | 240 | 360 | 480 |
| e) d) ÷b) (t/m,yr) | 1.04 | 0.99 | 1.07 |
| f) Breakwater length(m) | 90 | 120 | 160 |
| g) Width of main jetty(m) | 20 | 28 | 35 |
| h) Finger jetty (number) | 0 | 1 | 2 |
| i) Un-protected navigational channel length(m) | 100 | 50 | 20 |
| j) Maintenance dredging volume ($m^3$/yr) | 1,108 | 646 | 216 |
| k) Initial project cost($10^3$ F$) | 7,890 | 8,690 | 9,820 |
| l) Annual operation cost ($10^3$ F$) | 134 | 139 | 148 |
| m) k) ÷a) ($10^3$ F$/boat) | 197 | 145 | 123 |
| n) Economic internal rate of return(%) | 3.8 | 4.2 | 4.3 |

## 5-4-4 Overall evaluation

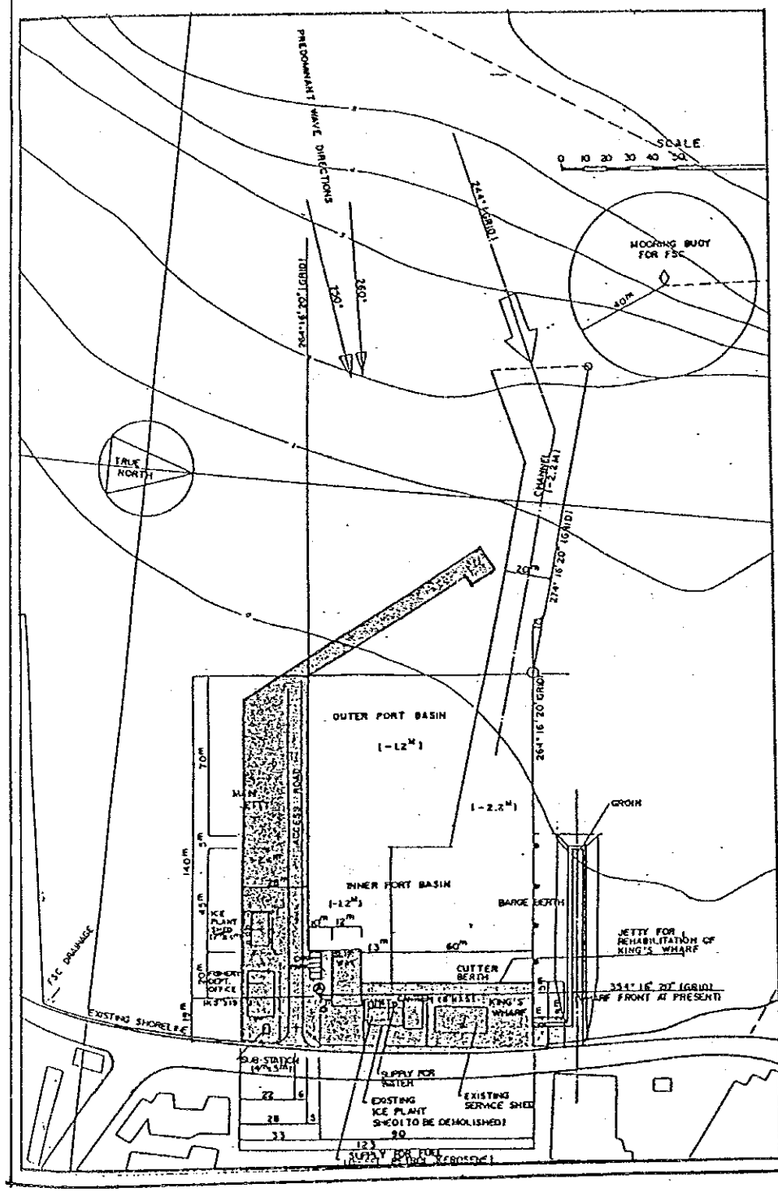
Alternative P is good in lower initial project coast but investment efficiency is low with lowest EIRR. In summary, alternative P is inferior to the other two, although alternative Q is a little inferior to

alternative R in respect of lower utilization of the project cost. It is rather a well- balanced good plan. Alternative R is best in the utilization of the project cost/investment, but highest in the project cost itself.
In summary, alternative Q with 60 boats to be accommodated is considered most feasible.

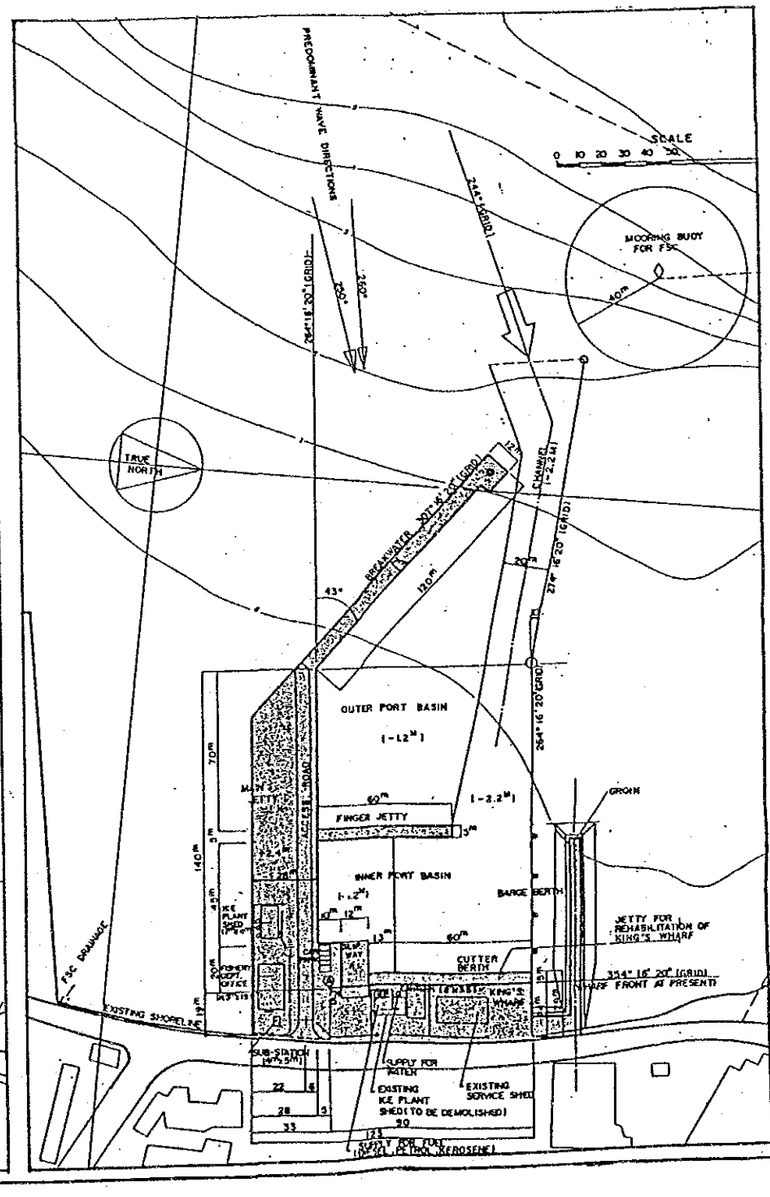
Fig.5-27 shows the final general layout of Lautoka Fishing Port.

FIG. 5-26 FINAL EVALUATION OF ALTERNATIVES

PLAN-P




PLAN-Q




PLAN-R

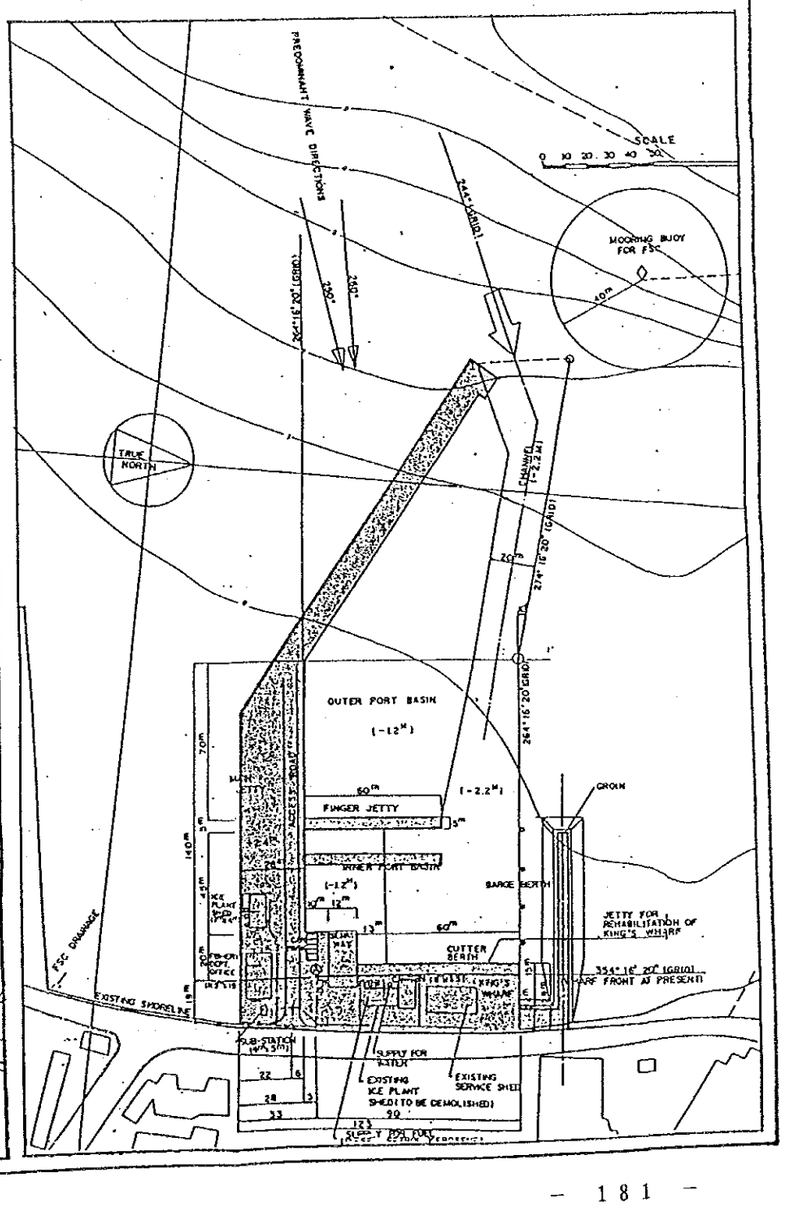


FIG. 5-27 FINAL GENERAL LAYOUT (PLAN-S)

# GENERAL LAYOUT OF LAUTOKA FISHING PORT

LIST OF FACILITIES
(INITIAL DEVELOPMENT 1990)
LAUTOKA FISHING PORT

1. Basic Port Facilities
   1. Quaywall
   2. Breakwater
   3. Seawall
   4. Jetty
   5. Navigation Aids
   6. Fairway (by dredging)
   7. Port Basin (by dredging)
   8. Reclamation of Land
   9. Accessories (Fenders, Bollards etc.)
2. Building and Offices
   1. Fisheries Office and Workshop
   2. Ice plant shed
   3. Canteen
   4. Gate House
3. Machines and Equipment
   1. Ice Plant
   2. Winch
   3. General Furniture (Carpet, Tables, Chairs, etc.)
   4. Others
4. Pavement
   1. Access Road
   2. Apron
   3. Car Park and Other Land Pavement
5. Utilities
   1. Water Supply
   2. Sewerage System
   3. Drainage
   4. Power Supply
   5. Lighting
   6. Telecommunication
   7. Fuel Supply
   8. Fire Fighting Hydrant and Extinguisher
7. Removal and Demolishing
   1. Existing Ice Plant (removal)
   2. Existing Office/Workshop (demolish)
8. Others
   1. Fence and Gate in the Port Area
   2. Fence and Gate on the Port Boundary
   3. Miscellaneous, if any

VIO ISLAND
MANGROVES
EXISTING SHORELINE
OFFSHORE BERTH
17° 36' 30"
PREDOMINANT WAVE DIRECTIONS
SCALE 0 10 20 30 40 50 100M
QUAY LINE OF COMMERCIAL PORT
MOORING BUOY FOR FSC
60m
244° (GRID)
260°
264° 16' 20" (GRID)
LAUTOKA COMMERCIAL PORT
PORT AUTHORITY OF FIJI
FSC WHARF
40,000 DWT (NOM: 83,000M³)
EXISTING
FUTURE
TRUE NORTH
BREAKWATER 307° 16' 20" (GRID)
120m
12m
CHANNEL (-12.2M)
20m
274° 16' 20" (GRID)
177° 26' 30"
POSTS
43°
NAVIGATION AID
OUTER PORT BASIN
(-12M)
MAIN JETTY
ACCESS ROAD
70m
60m
FINGER JETTY
5m
(-2.2M)
GROIN
140m
42.4m
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 SUGAR CONVEYOR BELT (EXISTING)
50 m
QUEEN'S WHARF
EXISTING SHORELINE
PUBLIC WORKS DEPARTMENT
ICE PLANT SHED (16m×8m)
10m
12m
BARGE BERTH
JETTY FOR REHABILITATION OF KING'S WHARF
FISHERY DEPT. OFFICE (11m×18m)
SLIP WAY
13m
60m
CUTTER BERTH
354° 16' 20" (GRID)
WHARF FRONT AT PRESENT
FSC DRAINAGE
EXISTING SHORELINE
KING'S WHARF
SUB-STATION (4m×5m)
SUPPLY FOR WATER
EXISTING ICE PLANT SHED (TO BE DEMOLISHED)
EXISTING SERVICE SHED
SUPPLY FOR FUEL (DIESEL OIL, KEROSENE)
Pillar (C.D.+4.9m)

NOTES
1. ALL LEVELS BASED ON CHART DATUM, WHICH IS 1.15 M BELOW MSL.
2. COORDINATES
   POINT (A) GRD { 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" (N.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

## 5-4-5 Wave Calmness, Siltation and Economic Evaluation

### a) Analysis(1) In-harbour wave calmness analysis

The datails of the analysis are as per Appendix I and can be summarized as follows:

(a) The effective fetch of wind blow on the off-shore wave is approximately 11 km.

(b) The predominant directions of wind wave are between 250 ° and 260°

(c) The wave reaching the King's Wharf vicinity is within 250° and 260.

(d) The frequency of wave height of 0.3m or more is approximately 11% in the water area in front of the King's Wharf in case of no breakwater.

(e) The in-harbour calmness can be obtained at frequency of wave-height of 0.3m or less.

(f) The inharbour calmness will be improved by the construction of the breakwater.

| Breakwater length(m) | Efficiency(%) | Calm Water Area($m^2$) |
|---|---|---|
| 70 | 94.5 | 9,450 ( 56%) |
| 90 (Plan P) | 95.0 | 12,880 ( 77%) |
| 120 (Plan Q) | 95.5 | 16,650 (100%) |
| 160 (Plan R) | 96.0 | 19,950 (120%) |

Note: Calm water area is defined the area with efficiency of 95% or more, and the efficiency is defined the percentage of occurrence with wave-haight of 0.3m or less in the port basin.

### b) Analysis(2) Study on Siltation (in the approach channel)

The details of the study are shown in Appendix J and can be summarized as follows.

(a) The annual sand-drift volume off the King's Wharf is estimated at approximately 2000~4000$m^3$.

(b) Between the King's Wharf and the reclamation area of Public Works Department to the south, annual sand drift volume is estimated at approximately 1000～2000$m^3$.

(c) Between the King's Wharf and FSC Pier, approximately 1750 ～3500$m^3$ will be accumulated annually.

(d) The critical water depth of the sand movement is estimated at about C.D-1.3m.

(e) The breakwater, if constructed, can reduce the accumulation in the above(c).

(f) There is a need to cope with the secondary sand-drifts to the south direction within the port basin necessitated by the groin construction.

| Alternative on Breakwater length(m) | Water-depth at breakwater toe | Maintenance dredging volome ($m^3$/yr) |
|---|---|---|
| 70 | C.D-0.4 | 1,632(756%) |
| 90 (Plan-P) | C.D-0.8 | 1,108(520%) |
| 120 (Plan-Q) | C.D-1.4 | 646(300%) |
| 160 (Plan-R) | C.D-2.7 | 216(100%) |

Note: C.D: chart Datum(m).
70m long breakwater means "F-shape" ; as Plan-D of Fig.5-21, but it is omitted in the comparison study because of a large volume of siltation.

c) Analysis(3) Economic Analysis

The details of the analysis are described in Chapt.7 " Evaluation of the Project " and in Appendix E. Only the summary is given here.

| Benefit/Cost | Number of boats to be accommodated(N) | | |
|---|---|---|---|
| | 40 | 60 | 80 |
| Economic benefits (in mil. F$) | 14.14 | 16.12 | 18.08 |
| Economic costs (in mil. F$) | 10.45 | 11.30 | 12.54 |
| Economic internal rate of return | 3.8 % (plan-P) | 4.2 % (Plan-Q) | 4.3 % (Plan-R) |

Note: By sensitivity analysis, the case with N=40 is shown more sensitive than others.

## 5 - 5 BASIC DESIGN OF MARINE FACILITIES

### 5-5-1 Design Criteria

Major basic design conditions for marine facilities are as follows;

a) Design boats

(1) Berths for unloading,Stand-by and loading;

Fishing boats of 21 ft as 28 ft in Section 5-3-3 a) and.

(2) Public Wharf (Cutter Berth and Barge Berth)

Cutter boat and berges as in Section 5-3-3 1).

b) Live Loads

(1) Berths for unloading and loading

Q = 1.0t/m2 and 2t truck

(2) Berths for Stand-by

Q = 0.5t/m2

As for seismic case, 50% of them to be applied.

c) Tidal Range

| | | |
|---|---|---|
| HAT | + | 2.20m |
| MHWS | + | 1.90 |
| MHWN | + | 1.60 |
| MSL | + | 1.15 |
| MLWN | + | 0.70 |
| MLWS | + | 0.40 |
| LAT | ± | 0.00 (Chart Datum) C.D |

d) Seismic Coefficient (See Section 5-2)

Horizontal seismic coefficient= 0.10

Vertical Seismic Coefficient = 0.0

e) Wind Speed (See Section 5-2)

Design wind speed =66m/sec

f) Wave (See Section 2-1-2)

(1) Ordinary Case

Equivalent off-shore wave height Ho'≦ 1.0m

〃 period To = 3.5sec

(2) Extraordinary Case

Equivalent off-shore wave height Ho'= 2.35m , Ho= 2.50m

〃 Perios To = 4.8sec

g) Soil

The soil conditions for basic design purpose as shown in Fig 5-28 are concluded by the soil investigation results carried out by the study team in April and Augast 1986 and for adjacent areas. Four borings were made, two bore holes at the King's wharf and other two bore holes at offshore of the wharf. See Appendix N.

h) Materials

Particulars for the major materials to be used in the project are as follows:

(1) Concrete

*Normal Portland Cement Concrete*

Compressive Strength Fc (at 28 days)= 210kg/cm2～240kg/cm2

(2) Reinforcing Bars

| Items | Standard | Yield Strength |
|---|---|---|
| Round Bar | SR-24 | 2400kg/cm2 |
| Deformed Bar | SD-30 | 3000 〃 |
| | SD-35 | 3500 〃 |

JIS(Japanese Industrial Standard) JIS.G-3112

(3) Structural Steel

| Items | Standard | Yield Strength |
|---|---|---|
| Structural Steel | SS41 | 2400kg/cm2 |

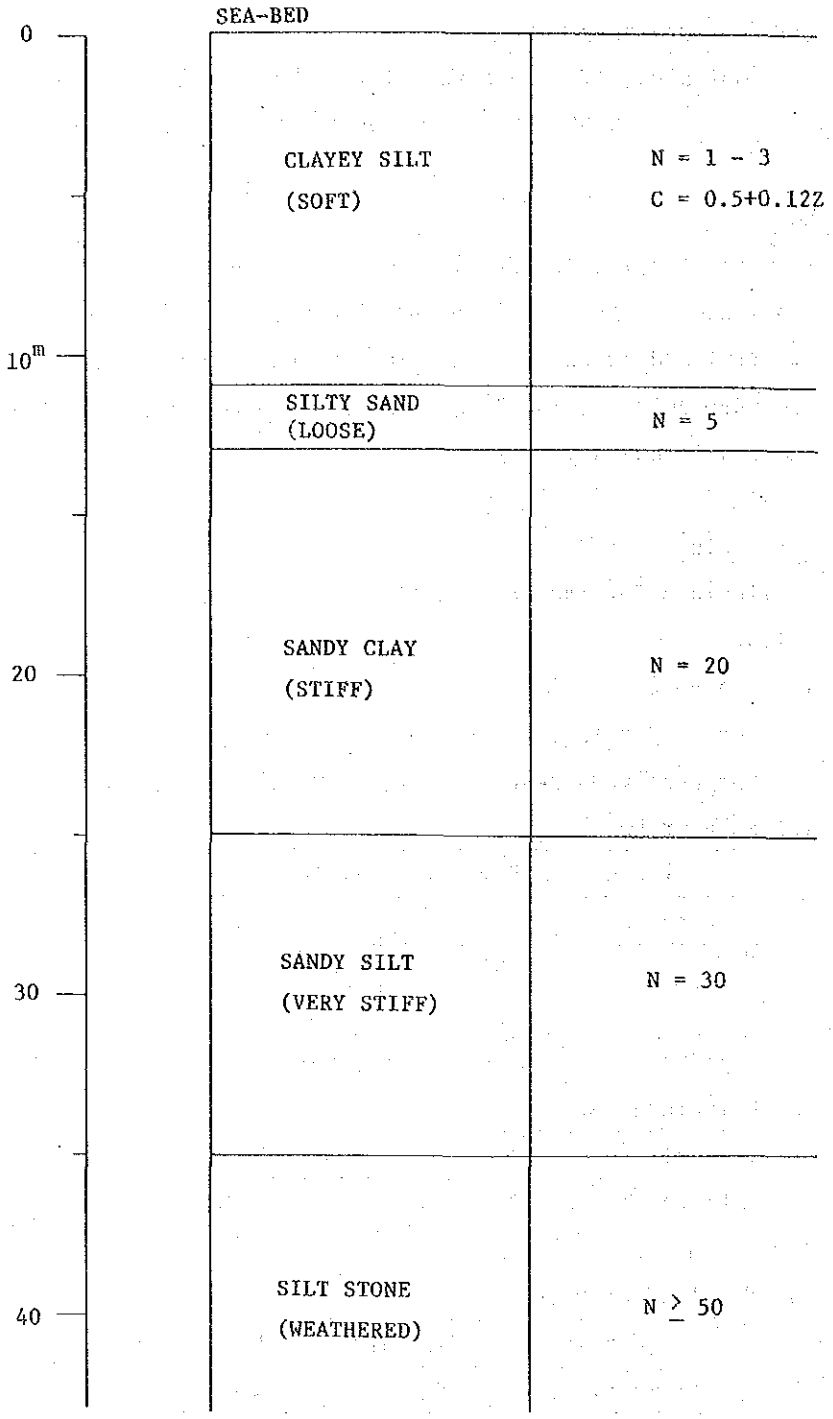
JIS.G-3101

(4) Steel Sheet Pile

| Items | Standard | Yield Strength |
|---|---|---|
| Seel Sheet Pile | SY-30 | 3000kg/cm2 |

JIS.A-5528

FIG. 5-28, DESIGN SOIL CONDITION



a) Comparison of Structure Type.

Comparison study of structure type for the major structure (Breakwater and Main Jetty) is conducted hereunder and the optimum type of structure is to be recommended.

Major conditions to be taken into consideration for the comparison study are:

- Soft and loose upper layer 10m thick, where consolidation is highly expected.
- Shallow water depth (CD-1.2m) required due to design of small boats
- Very shallow existing sea-bed level as CD ± 0.0m average (CD-2.0m~ + 0.5m)
- Difficulty in obtaining marine construction equipment and specialized equipment in Fiji.
- Short working period due to rainy or cyclone season from December to March

With the above site conditions in mind, 3 types of structures as below are to be compared: ie,

(1) Pile foundation open structure
(2) Sheet pile double wall with sand fill, gravity structure
(3) Concrete block gravity structure

As discussed and studied in the comparison table (Table 5-21), sheet pile double wall with soil improvement is now recommended as an optimum type of structure for breakwater and main jetty.

b) Breakwater (Fig. 5-29)

Length 159m, Width 7m Water Depth CD-1.2m sheet Pile Double Wall is adopted as above.

As for soil improvement method on upper soft layer, sand-drain method will be envisaged due to simpleness and low cost. Fill in rocks must be placed in between the walls so as to have rigid resistance against wave force. Furthermore, concrete must be lowered down to LWL to cover at least the front part of steel sheet piles as corrosion preventive means.

c) Main Jetty (Fig. 5-30)

Lenghth 120m+39m, Width 28m, and 38m, Water Depth CD-1.2m.
As with breakwater, sheet pile double wall is to be adopted.
In addition to the concepts above, supporting piles to prevent longer tie-rods at areas with 28m and 38m wide from slanting down must be provided.

d) Finger Jetty (Fig. 5-31)

Length 60m, Width 5m, Water Depth CD-1.2m
Simpler type of structure will be designed at finger jetty, because of small scale of loads by wave, berthing force, live loads, etc.
Concrete deck with steel pile foundation is therefore preferred.
Adoption of this piled jetty does not entail soil improvement work, but concrete cover around piles.
Preventing the small boats from slipping in under the deck will necessitate the provision of front protective wall.

e) Rehabilitation of King's Wharf (Fig. 5-32)

Length 72m, Water Depth CD-1.2m, -2.2m
The following two rehabilitation works for the decrepit King's Wharf will be envisaged;

- To enlarge coping concrete so as to integrate sheet pile with concrete wall behind.
- To place cover concrete on deteriorated sheet pile so as to prolong their life.

Moreover, the pile foundation jetty will be designed in front to keep the required front water depth of CD-1.2m and -2.2m for accommodating small boats, and the reasons such a type of structure is choosen are that;

(1) The existing wharf structure may, even after dredging down to CD-1.2m, and -2.2m, still be safe, since the water depth in the original design is deemed about CD-2m. However, it will be preferable that the existing wharf, the structure of which cannot be clarified, be left as it is without exposing it to additional forceces.

(2) The existing service shed on the wharf does not seem strong enough to withstand forces arising from civil works nearby on land, which

therefore should be preferably avoided. As for the cope height, it will be lowered gradually to CD+2.7m at front from the existing height of CD+2.9m.

f) Ramp (Fig. 5-33)

Keeping the capacity for 3 small boats will require the width of 12m at slip way.

Simple slope of uniform gradient 1 in 8 and the water depth of CD-0.5m will be designed because of small design boats.

Structurally, retaining wall at water front, slip-way side and top of slip way are by concrete blocks, sheet piles and by concrete slabs with rock base below, respectively.

g) Groin (Fig. 5-34)

Groin is to be constructed at the north of King's Wharf as a protective mean against siltaion from the north under the abnormal rough weater. The simple structure by stone bund, which allows for some settlement, will be preferable, since no fishery activity be exercised there.

h) Pavement (Fig. 5-35)

Taking into account some residual settlement even after soil improvement, the light asphalt pavement will be suitable for the reclaimed area in the double sheet pile wall, under the lighter live load in the whole fishery port facility.

However, the ramp and the maintenance yard will be paved by concrete due to the heavier load expected. On the other hand, the canteen area be treated by the primary pavement of stone, because the petroleum products will be handled around there.

No treatment may be required in the cutter berth area and barge berth area for the present use, where must be designed in the future plan.

i) Soil Improvement

Soil investigation results carried out on the Kaing's Wharf and its offshore show that the upper cohesive layer has 1 ~3 of N-value and is deemed consolidated. However, the same soil, upon which the proposed port facilities be constructed, may not be consolidate yet. This necessitates

the soil improvement work, the type of which is selected as below. The rather simpler and popular method, which seems applicabel at the site, are:

- Replacing method
- Pre-load method
- Drain method

The site conditions to be considered for application are same as mentioned before and as below:

- 10m thick of consolidation layer
- Specialized equipment not available locally
- About half a year in a rainy and cyclone season

Replacing method may not be applicable due to thick consolidation layer. And pre-load method seems not applicable due to longer work period and bigger earth bund required as a slope. Drain method will be applicable at this site, because of relatively lighter equipment, shorter period and lower cost.

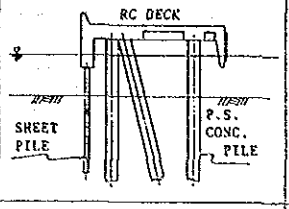
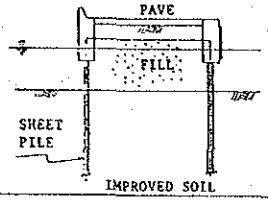
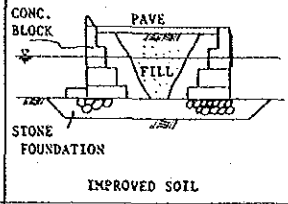
Diameter…… $\phi$ 40cm sand pile
Pitch …… 2～2.5m
Length……11m from the existing sea-bed
Width ……to 7m each outside of structure

j) Fender System For Barge

In order to prevent the barge (L×B ×D =$32^{m}$ × $8^{m}$ × $1.4^{m}$ )from drifting into groin, fender pile system is provided beside the groin. Taking into acount the possibility of the port expansion of the said area, the fender pile structure is prefered simple, that the coupled pile with steel raker pile is adopted. (Fig. 5-36)

Easier access from the rear of barge to groin is designed as cat-walk also by steel.

TABLE . 5-21, COMPARISION TABLE OF STRUCTURE TYPE

| TYPE OF STRUCTURE | | PILE FOUNDATION JETTY | SHEET PILE DOUBLE WALL | CONCRETE BLOCK BULK QWAY |
|---|---|---|---|---|
| STRUCTURAL SECTION | |  |  |  |
| STRUCTURAL DESIGN | MERIT | • SUITABLE TO SOFT SOIL LAYER WITH EXPECTED CONSOLIDATION. | • RELATIVELY SIMPLER STRUCTURE<br>• SUITABLE UNDER RESIDUAL CONSOLIDATION EXPECTED. | • CORROSION PROTECTION NOT REQUIRED<br>• RELATIVELY SIMPLER STRUCTURE |
| | DEMERIT | • LONGER PILE (20-30m) NESDED.<br>• CORROSION PROTECTION REQUIRED. | • CORROSION PROTECTION REQUIRED<br>• SOIL IMPROVEMENT NEEDED. | • UNSUITABLE UNDER RESIDUAL CONSOLIDATION<br>• SOIL IMPROVEMENT NEEDED. |
| CONSTRUCTION WORK | | • JOINING PILES REQUIRED<br>• MODERATE CONSTRUCTION PERIOD<br>• RELATIVELY BIGGER EQUIPMENT REQUIRED. | • SHORTER CONSTRUCTION PERIOD<br>• SIMPLER CONSTRUCTION AND RATHER SMALLER EQUIPMENT REQUIRED. | • CASTING YARD TO BE OBTAINED.<br>• VARIOUS WORK ITEMS AND LONGER CONSTRUCTION PERIOD.<br>• RATHER SMALLER EQUIPMENT.<br>• SIMPLER CONSTRUCTION |
| COST INDEX | | 110 | 100 | 120 |
| ADOPTION | | △ | ○ | × |

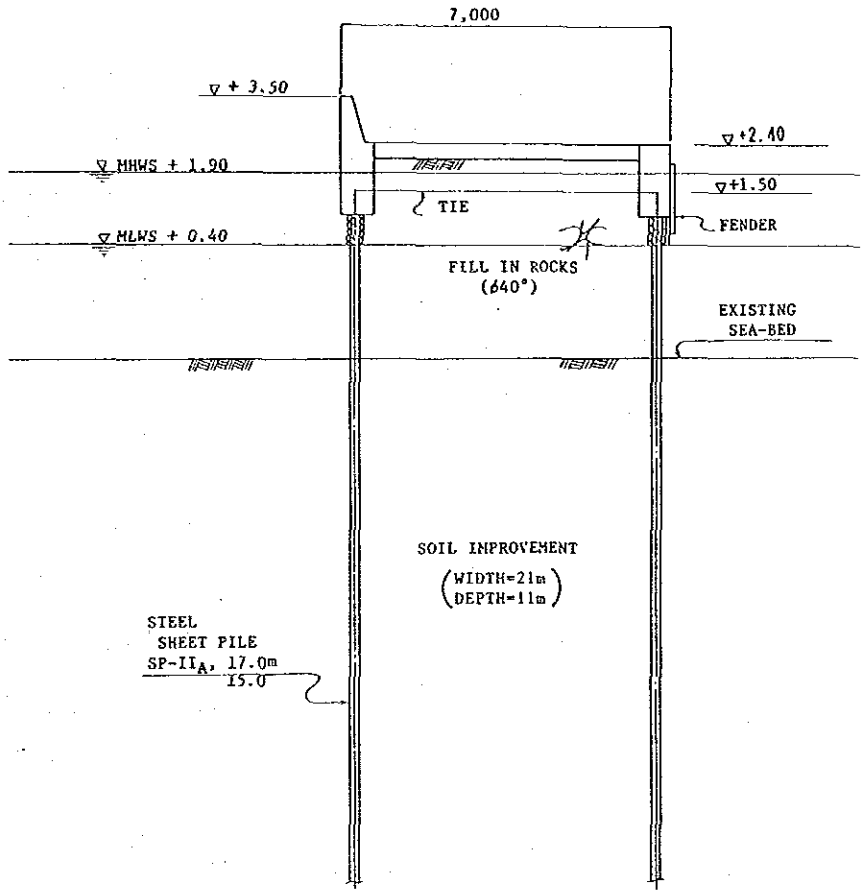



FIG. 5-29, TYPICAL SECTION OF BREAKWATER

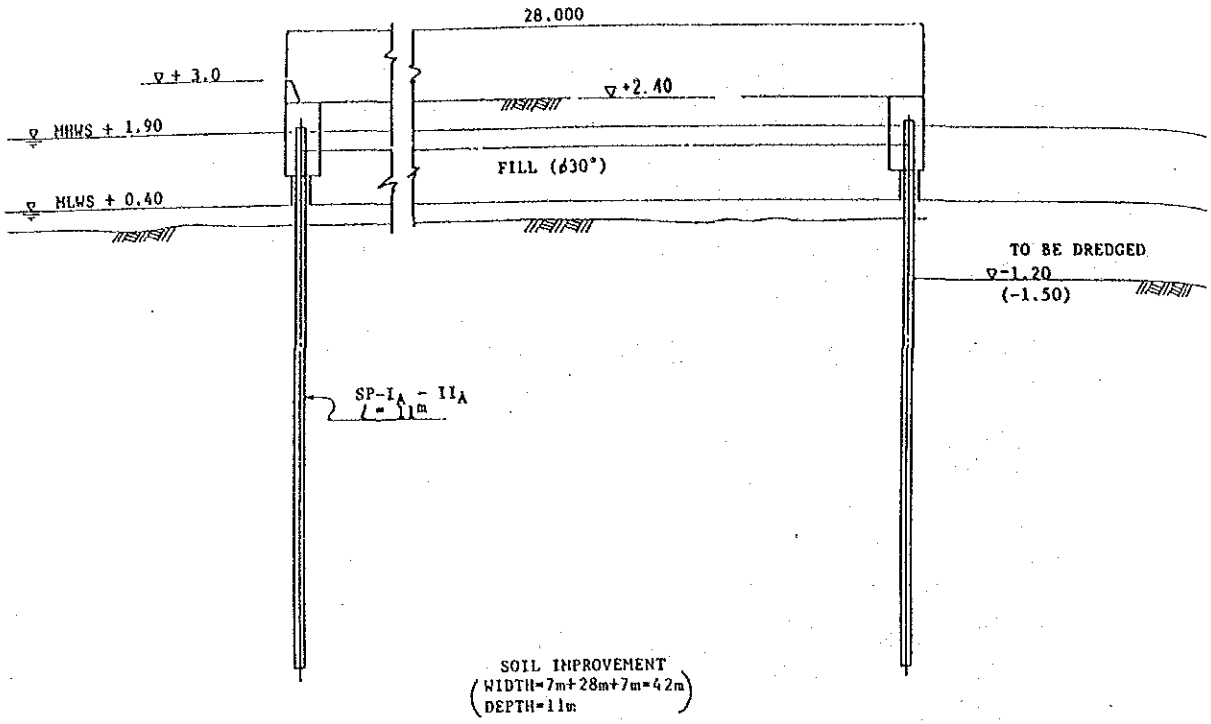



FIG. 5-30, TYPICAL SECTION OF MAIN JETTY

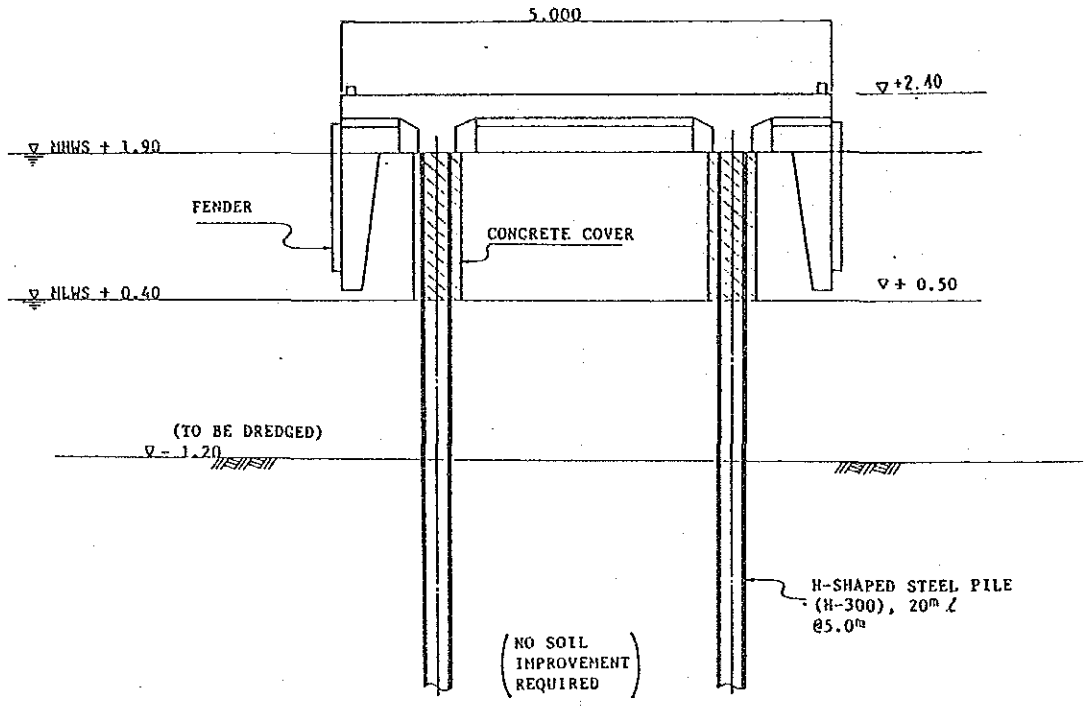
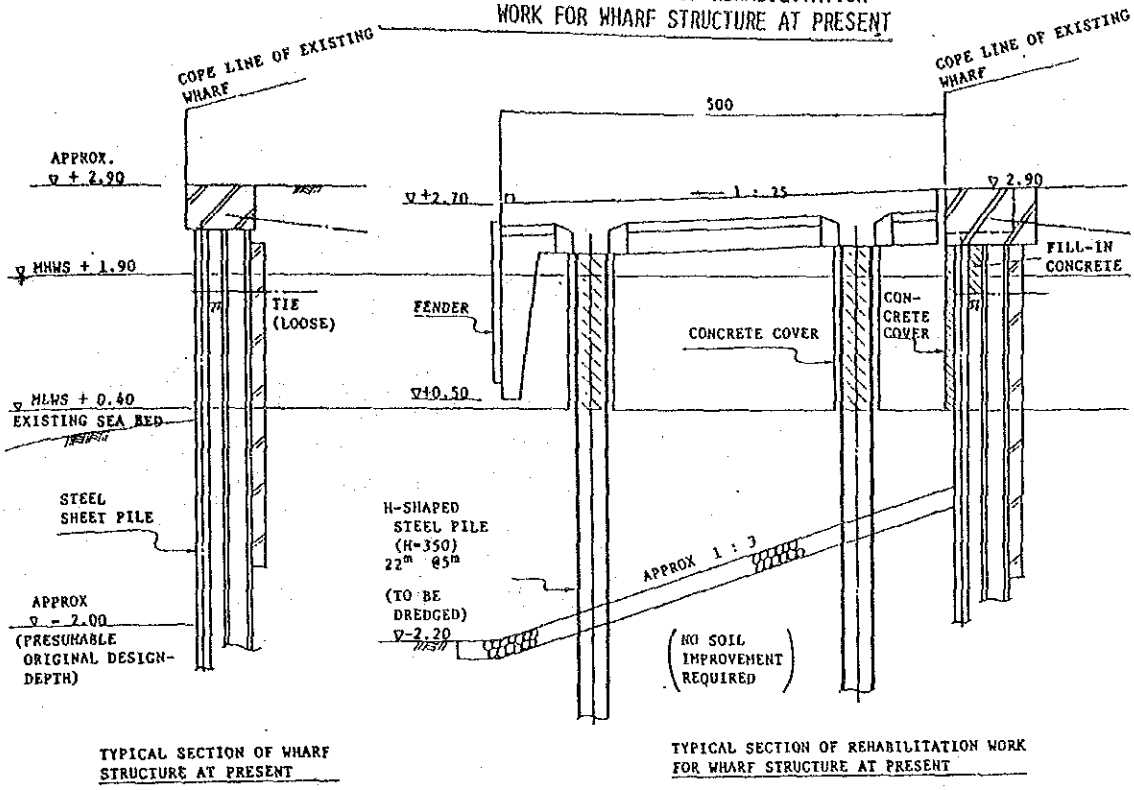
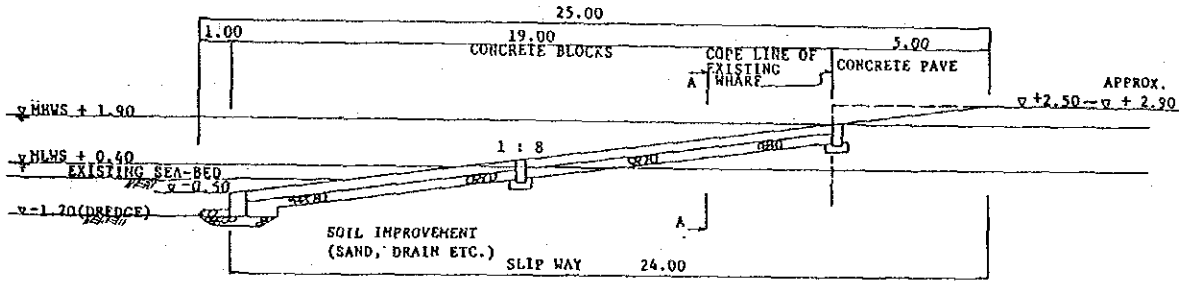



FIG. 5-31, TYPICAL SECTION OF FINGER JETTY

FIG. 5-32, TYPICAL SECTION OF REHABILITATION WORK FOR WHARF STRUCTURE AT PRESENT



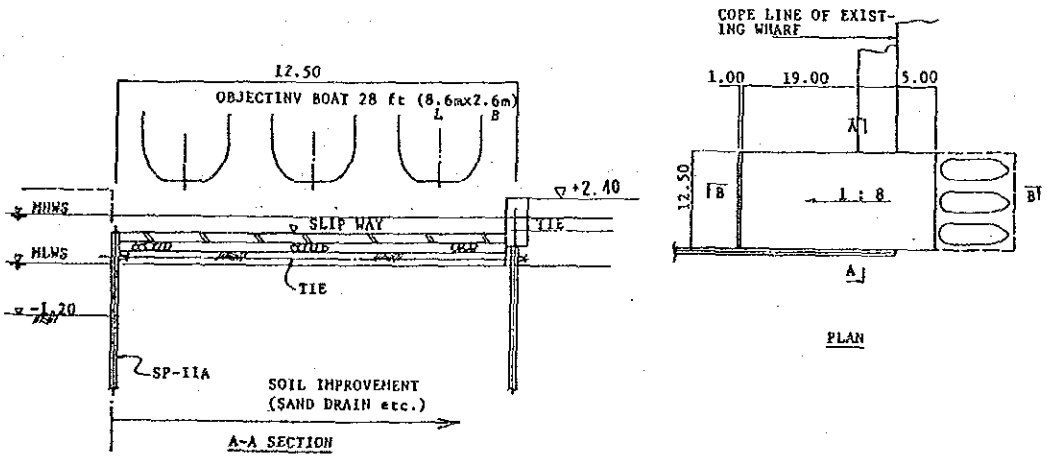




FIG. 5-33, TYPICAL SECTION OF SLIP WAY RAMP

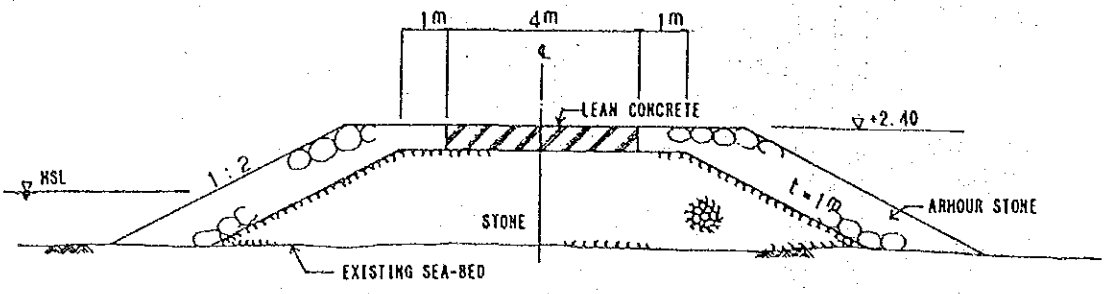



Fig.5-34 TYPICAL SECTION OF GROIN

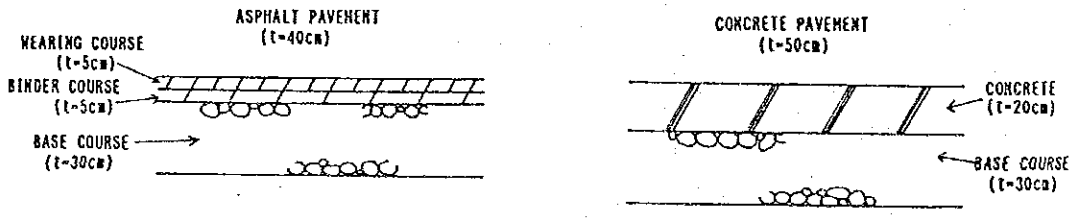
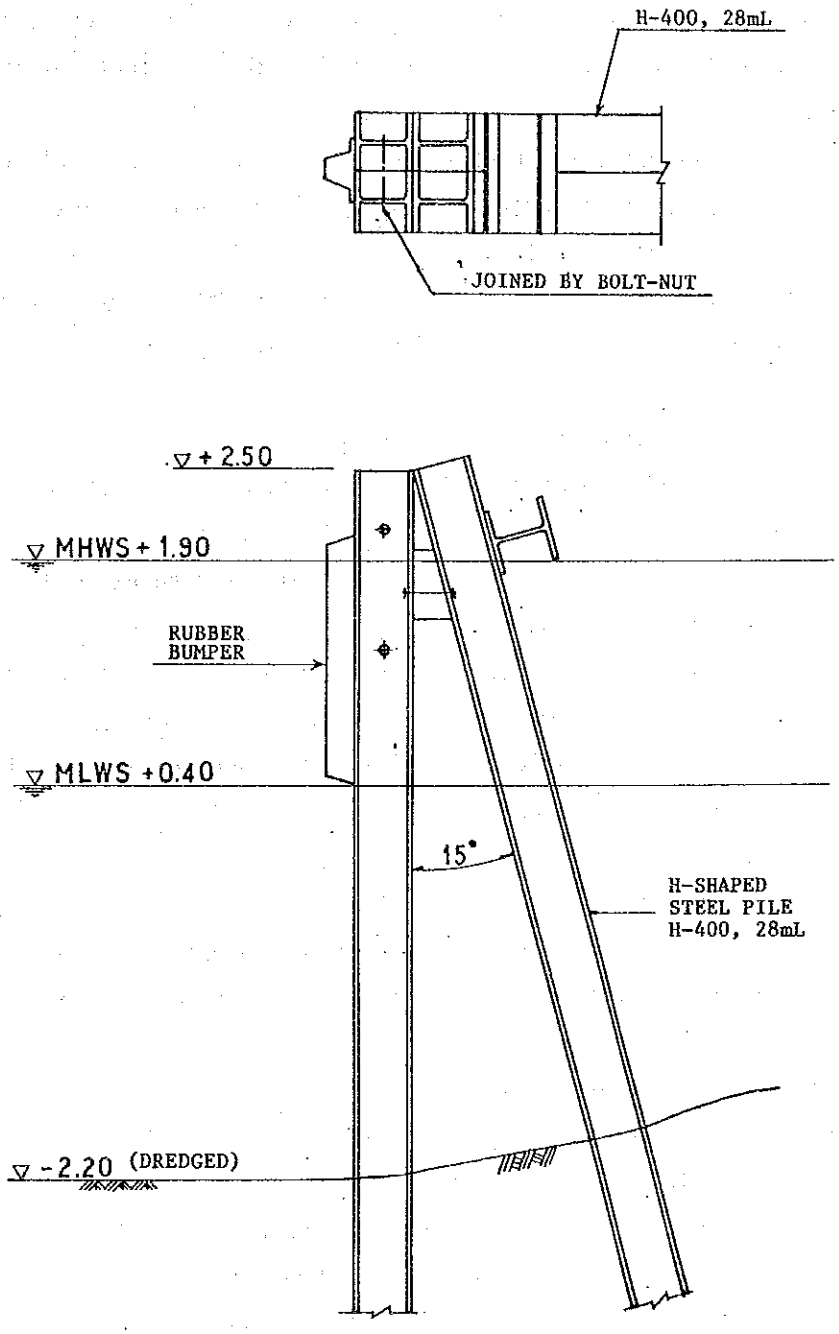



Fig.5-35 TYPICAL SECTION OF PAVEMENT

Fig. 5-36 FENDER PILE SYSTEM



## 5 – 6 DESIGN OF ICE MAKING FACILITY

### 5-6-1 Ice Making Equipment

a) Mode of Ice Making

Considering easy operation and minimum operation cost, an automatic ice making system is desirable.

Though the existing Lautoka Ice Factory is equipped with the Flake Icer, it is recommended the new factory to be equipped with Plate Icer for the following reasons.

i) The Plate Icer can make thicker ice than flake icer, and thicker ice is advantageous to prevent useless melting because many fishing boats are using ice box.

ii) The Plate Icer has no moving parts like ice scraper, so that this type of ice maker is favourable for maintenance.

b) Economy of Ice Making Equipment

For following reasons, the total capacity of 15ton/day to be divided into 3 units of 5ton/day.

i) It is enough to operate one or two units only according to demand except in the busiest season.

ii) Even if one of 3 units may develop trouble, two thirds of the total capacity can be kept.

iii) Each unit can be overhauled individually without any disturbance to the whole ice making units.

c) Outline of Specifications

Considering the points mentioned above a) b) the equipment shall be designed and selected in accordance with the following specifications.

(1) Plate Ice Maker with Control Box 3set

| | |
|---|---|
| Ice Making Capacity | : 5ton/day |
| Refrigerant | : R-22 |
| Motor | : 19KW for Compressor |
| | 1.5KW for Crusher |
| | 0.75KW for Raw water pump |

0.75KW for Defrost pump
0.1KW for Ventilation fan

(2) Cooling Tower 3set

Capacity :

Motor : 0.6KV for Fan
1.5KW for Cooling water pump

## 5-6-2 Ice Storage Facilities

a) Structure

To simplify the construction work at site, pre-fabricated system with insulation panel is desirable.

Two insulation doors shall be equipped and the inside of each door should be protected by the removable insert boards.

b) Capacity

Effective storing capacity shall be not less than 80$m^3$ and enough working space shall be reserved above the ice for stacking full capacity (45tons)

c) Cooling System

The system shall be of fan and coil unit which shall have enough capacity to maintain the room temperature at − 5℃, and easy defrost device.

## 5 - 7 DESIGN OF BUILDINGS AND OFFICES

### 5-7-1 Building Layout

1. Administration Office/Workshop/Guard Room
2. Ice Plant
3. Canteen-Meeting Hall

Layout plan for the above-listed facilities is fixed with through consideration of the following matters. General Layout is shown in Fig.5-14. Appendix L.

① In the limited site space, the facilities work effectively and allow any future expected expansion.

② To create good efficiency, the minimum interference occurs with working flow lines of each functional facility.

③ By understanding each separate facilitiy's operation and management system definitely, the building arrangement is planned.

④ For the purpose of whole port control, the administration office is located at the position where all the port area can be observed.

### 5-7-2 Architectural Design Policies

As the result of inquiries at the Public Works Department, building design standard, the related regulations, and other conditions of the site are known as follows.

In Fiji, "the New Zealand Design Standard" is generally used when necessary the Japanese standards will be used. Wind force, earthquake, and other external conditions are as described in "5-2 General Site Conditions."

a) Building Safety Standards (Laws of Fiji, Chapter 111)

There is no particular restriction concerning this project. When the detailed design work starts, it is planned to have a technical discussion

on the design standards at the Public Works Department with the Fishery division's person in charge.

b) Condition of the Site Infrastructures

(1) Electricity

415/240V, 50Hz

Electric supply and distribution is conducted and administered by the Fiji Electricity Authority under the Ministry of Energy and Mineral Resourses. Design code is based on the Australian Standard (SAA). Take-in wire can be connected from the existing road at the land side of this fishing port.

(2) Telephone

Telephone service is operated and administered by the Post & Telecommunications Department under the Ministry of Communications and Works.

Telephone drop is possible to connect from the said road. For that, it is necessary to make previous arrangement together with the person in charge and apply installation as early as possible.

(3) Water Supply

Water is supplied and administered by the Public Works Department. A pipe runs under the road in front of the site. According to the person in charge, it can be connected with a pipe up to A 100mm size. There is no problem in water pressure and flow volume.

(4) Sewerage

Sewerage seystem is managed by the conference of the Public Works Department and the local municipal office.

No drainpipe is laid under the roads close to the construction site of this fishing port. Therefore, it is planned to install a separate treatment tank and discharge the treated effluent to the sea.

(5) Gas

Butane gas 4,000~7,000kcal/m3, cylinder size 10, 30, 50kg/bot. are supplied by private companies.

Considering the local conditions (especially climatic condition, land situation, possibility to obtain materials, and construction method in Fiji, etc.), the building materials are carefully examined when selecting. Furthermore, to make maintenance easy after completion of the construction, the materials which are possible to be obtained in Fiji when necessary are used.

a) Exterior Finishing (Common Part)

Roof-Galvanized steel sheet, Paint finish
(Partly with heat insulation material under the sheet)

Exterior Wall-

Post, Beam : Fair faced concrete

Wall : Concrete block, Mortar First Coating, Paint Finish

Fittings-

Windows : Louver windows with wooden-frame.
(some with steel frame included)

Entrance : Wooden doors, Oil paint

b) Interior Finishing (Common Part)

Floor-Polyvinyl tile

Skirting-Plastic material

Wall-Vinyl paint finish
(Face concrete block)

Ceiling-Plasterboard, Oil paint finish

Concerning washing room, shower room, kitchen, and other places, watertightness and fireproofness are taken into account in selecting materials.

c) Building Structure Policy

In Fiji, there are no regulations nor codes for building structure or methods. Most buildings are designed according to the New Zealand Standard (NZS)which is based on the British Standard (BS).

Building codes are principally based on the New Zealand Standard, modified to accommodate the conditions existing in Fiji. Furthermore, where

necessary, the British Standard (BS Code) or the Japanese Standard are used as reference.

(1) Structure Planning

1) Structure

The structure design is based on reinforced concrete rigid frame structure and concrete block structure which are usually practiced in Fiji. The floor slab is of reinforced concrete. The roof is steel frame structure.

2) Foundation

Considering the geotechnical conditions and load intensity, the foundation is planned with continuous footing, underground beam, foundation pile, etc..

(2) Structure Design Standard

1) Structure Analysis

The most suitable analysis method for the structure is employed.

2) Cross-section Design

Reinforced concrete structure is designed by the ultimate strength method. The steel structure for the roof is designed by the allowable stress method.

3) Load condition

a. Live Load

Table 5-22 Live Load for Building

| Room | Live Load (KN/m2) |
|---|---|
| 1. Office, Meeting Room | 2.5 |
| 2. Library | 4.0 |
| 3. Canteen | 3.0 |
| 4. Kitchen | 4.0 |
| 5. Machinery Room | 5.0 |

b. Seismic force

The structure is designed by referring to the New Zealand Standard. Design of the Structure is based on criteria in section 5-2.

(3) Structural Material and Material Strength

Structural Design for concrete, reinforcement, and steel frame is based on the design standards as shown in Section 5-5-1 h).

## 5-7-4 Mechanical Equipment Plan

a) Water supply pipe is to be branched from the water pipline running under the road in front of the construction site of the fishing port.
Through flow meter, the water is distributed to each building in the port area and led directly to the various equipment of the Office/Workshop, Ice Plant and Canteen, and necessary places for kitchen equipment, ice making machine, cooling tower of ice plant, etc.

Table 5-23 Daily Water Consumption

| Place | Consumption a day |
|---|---|
| Office/Workshop | 17 persons ×50ℓ = 850ℓ |
| Ice Plant | 2 persons ×50ℓ = 100ℓ |
| Canteen (Officers) | 3 persons × 110ℓ = 330ℓ |
| (Customers) | 45 persons × 2times ×40ℓ = 3,600ℓ |
| Watchman Room | 1 person × 3times × 100ℓ = 300ℓ |
| Subtotal | 5,180ℓ |
| Ice Making Machine | 5,000ℓ × 3units =15,000ℓ |
| Cooling Tower of Ice Plant | 19,570ℓ |
| Total | 39,750ℓ = 4.0m3/day |

Note; Sewage volume to be treated is estimated at 5,180 ℓ =5m3/day.

b) Hot Water Supply System

At the lounge in the Fisheries Office/Workshop building, a small electric water heater is installed for drinking hot water. For the kitchen of the canteen, butane gas water heater is provided.

c) Drainage System

Sewage from toilet and other places is collected through separate pipelines within the buildings and collected in the No.1 sewage tank located outside the building. The sewage from this tank is piped to a treatment tank, and after treatment, the treated sewage is discharged to the sea forward the south.

When the present plan of public sewage pipline system is completed in future, the sewage will be discharged directly. As it cannot be completed before completion of the construction of this fishing port, above-mentioned treatment tank system is adopted.

Rain water is collected through rain troughs and drains, ditches in the port area, and directly discharged to the sea.

d) Sanitary Equipment

Sanitary equipment such as urinals, toilet stools, washing basins, and cleaning basins, are provided at necessary places.

e) Ventilation Installation

Air conditioning equipment is not provided in this installation plan, and natural draft is secured. As mechanical ventilation equipment, overhead fans are provided for the rooms accommodating many persons such as office, library/conference room, laboratory, kitchen, and canteen. Ventilation fans are provided for the rooms where smell and moisture evolve such as laboratory and kitchen, to make the air especially well-ventilated.

f) Gas Installation

Butane gas is supplied to the kitchen equipment through a pipe from a 50kg high pressure cylinder located outside the kitchen.

g) Kitchen Installation

A sink is provided at the lounge in the Fisheries Office/Workshop building for the office staffs.

Kitchen installation is provided to prepare meals in the canteen.

The meal preparation capacity is planned for 90 persons. Each meal is assumed to be taken in two shifts of one hour. As minimum kitchen equipment, preparation table, washing basin, and rice cooker are provided

to enable usual cooking in Fiji.

h) Fire Fighting Equipment

Fire extinguishers are provided in accordance with the Japan Fire Prevention Code with reference to the New Zealand Fire Prevention Code.

i) Sewage Treatment System

Treatment tank of contact-aeration system is installed in the port area to treat the sewage. Treatable sewer capacity is 5m3/day and discharging water's BOD is less than 60p.p.m.

## 5-7-5 Electrical Installation Plan

a) Power Take-in Installation

The electric power is to be taken-in from the overhead powerline, of the Fiji Electric Authority, running alongside the road in front of the site to the take-in pole within the site through a 415V-240V low voltage overhead powerline of 3-phase 4-line 50 hertz, with the capacity of 150KVA.

b) Main Line System

Low voltage switchboard is provided near the take-in pole, and through the switchboard, the main line supplies power to the Fisheries Office/Workshop building, Ice Plant, and Canteen through a cable. Wiring system is 3-phase 4-line 415-240V, 50HZ, and voltage drop is less than 5% at the end.
A vinyl pipe is used for outer conduit to protect from saltwater and corrosion.

c) Lights and Electric Sockets

(1) Wiring is made according to the technical standard for electric installation and the Australian Wiring Standard.
The wires are vinyl insulated wires or cables.

(2) Vinyl pipes normally used in Fiji are employed for conduits.

(3) The lighting for each room is designed considering utilization of natural light and frequency of turning on/off of lights.

(5) Sockets are provided with switches.

(6) The illumnation standards for main parts of the buildings are as follows.

Table 5-24 Illumination Standards

| Place | Illumination Standards (Lux) |
|---|---|
| Office | 300 |
| Workshop | 400 |
| Corridors Stores | 20～50 |
| Canteen | 100～ 200 |

d) Telephone Line Installation

Telephone drop is to be up to the electric take-in pole within the site. Then the underground cable connects to the outlet boxes provided at each building of the Fisheries Office/Workshop, the Ice Plant, and the Canteen. For conduits, vinyl pipes normally used in Fiji are employed.

e) Interphone System

In office area of the Fisheries Office building, bothway interphones are provided for communication between each room of Licencing Law Enforcement, Library/Conference, Senior Officer, and Watchman.

## 5 - 8 Discussion with the Ports Authority

The Ports Authority has the right and responsibility to control effectively its territory by legal power and contributes to the development of national economy. Since 1984 the Fisheries Division has kept close cooperation with the Ports Authority in accordance with the development of Lautoka Fishing Port.

The Ports Authority provides appropriate suggestion not only technical aspects but also management aspect to the Fisheries Division. The study team would appreciate the efforts made by the officers of Port Authority to the Project.

Mr. R. McL. Dickie, Director Engineering
Mr. M. Tora , Director Operation
Mr. V. R. Naidu , Port Engineer

It is reported that the Fisheries Division was conveyed the agreement of the Ports Authority to the location and general layout of the fishing port proposed by the study team.

In this section major results of discussion between the Ports Authority, the Fisheries Division and the study team are described.

Appendices D-10 and D-11 show the Ports Authority's letters to the Fisheries Division.

a) Comments; 23 June 1986

In the official meeting between the Fisheries Division and the study team on 14th July 1986, the Fisheries Division showed a letter prepared by the Ports Authority. The letter indicated that the location of the proposed fishing port at Lautoka was acceptable to the Ports Authority with specified conditions as below.

Each conditions and its countermeasure prepared by the study team are as follows;

Comment 1.

A barge berth should be planned in the general layout of fishing port, preferably at the northern end of the King's Wharf.

(Countermeasure) The Fisheries Division and the study team studied this comment and decided to accept it. New general layout was presented to the Ports Authority and was agreed.

Comment 2.

A FSC's mooring buoy locating between the King's Wharf and Vio Island has to be taken into consideration of general layout of fishing port, especially to the approach channel to the port.

(Countermeasure) This comment has been informed to the study team by the Ports Authority through a telex in May, 1986.

So that general layout in the draft final report submitted to the Fisheries Division was revised accordingly, and was accepted by the Ports Authority.

Comment 3.

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

(Countermeasure) The Ports Authority accpeted accuracy and scope of study of the report for their consideration and approval.

b) Comments; 17 July 1986

In the official meeting held on 17 July 1986, the Ports Authority gave their comments to the study team through the Fisheries Division.

Comment 4.

The dumping area of spoil may be obtained in the open-see within 5 km off the King's Wharf, however, the Fisheries Division should proceed with necessary arrangement to do so.

Comment 5.

Joint management team between the Ports Authority and the Fisheries Division will be established.

Comment 6.

The Ports Authority will reclaim at the northern part of coastal area between the headline of the King's Wharf and the existing water-front road for providing a temporary space for safety handling of cargo to be transported by barges.

(Countermeasure) The study team has no objection if this land reclamation is not affected to the implementation of fishing port project.

Comment 7.

Structural design depth of finger jetty and cutter berth has to be C.D.-2.5m.

(Countermeasure) This study will be made at the detailed design. The study team said that any major structural change will not be necessary.

Comment 8.

The Ports Authority requested the study team to undertake alternative study of additional work on the breakwater structure when the portward depth of it become C.D.-2.5m in the future comparing to the initial depth of C.D.-1.2m.

(Countermeasure) This study will be made at the detailed design. The study team said that additional structural works might be necessary so as to reduce horigontal wave pressure at the outer face of breakwater. Even if any structural change is required due to deepening the depth, such additional works will not be implemented in this Project.

Comment 9.

The Ports Authority said that they were afraid of occurrence of heavy siltation in front of their port facilitie due to the adverse influence by environmental changes based on construction of fishing port.

(Countermeasure) The study team said that any heavy siltation in front of the existing facilitie would not happen based on following reasons.

(a) New breakwater head is detached enough distance from existing port facilities.

(b) Natural tidal current in front of existing port facilities is intensified by a narrow channel between Vio Island and present port facilities and seems to blow off the fine material.

(c) The head of proposed breakwater is scheduled to be located in the landward of the quayhead line of existing port facilities so as not to interfere with the tidal current at present.

It is strongly recommended that any spoil material is not dumped in the southern front of FSC mole because such spoil are assumed to be one of the

major sources of fine material which may travel to other places and making water shallow.

c) Comments; 30 July 1986

The Ports Authority sent a letter dated 30 July 1986 to the Fisheries Division and the letter was received by the study team at their head office in Tokyo on 10 Augast 1986.

In this letter the Ports Authority said that they conveyed already the agreement of them to the location and general layout proposed by the study team through the Fisheries Division.

The letter contained not only the agreement but also their comments on technical aspects as follows;

Comment 10.

Provision of the concave profile to the outer edge of the breakwater coping would help turn back a wave and reduce spray of seawater.

Comment 11.

Top of the quaywall would be higher than C.D. 2.4m to prevent heavy overtopping of water to the paved area.

(note; C.D. 2.50 in the letter is not correct, plase read C.D. 2.40 as shown on Map.3 "General Layout".)

Comment 12.

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

Comment 13.

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

Comment 14.

The installation of fuel storage and dispensing equipment must be in compliance with local regulations which include fire protection measrures. The plan on P145 of the Basic Design Study Report (draft)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.

Comment 15.

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

These comments were one of the items which were discussed by the study team. however these comments could not be related with the final report because most of comments might be studied in detailed design stage.

# CHAPTER 6. PROJECT IMPLEMENTATION

## 6 - 1 SCOPE OF WORKS

The project consists of proposed facilities as follows:

(1) Basic Port Facilities
(2) Buiding and Office
(3) Machines and Equipment
(4) Pavement
(5) Utilities
(6) Removal and Demolishing of Existing Facilifies
(7) Others

Detailed list of these facilities are presented in Section 4-3.

## 6 - 2 CONSTRUCTION ENVIRONMENT IN FIJI

It is revealed by the site investigation in April 1986 that the following local conditions must be taken into account for studying the marine construction works in Fiji.

a) Marine Coustruction Equipment

There are less marine construction works done so far, except commercial ports. It can be consequently concluded that availability of crane barge, piling barge, flat barge, etc. in Fiji is very low, and there are only dredging fleet for maintenance at commercial ports and rivers owned by the relevant governmental department. And tug boats, for another example, are utilized at Suva port when bigger vessels are rthing and deberthing, but not at Lautoka port at all.

b) Construction Equipment on Land

Ordinary construction equipment, except bigger crane (over 40ton) and specialized equipment, are owned by PWD and private companies, which can be leased out. However, due to the limited number of these equipment, it will be difficult to obtain the equipment on time during coustruction.

c) Labour

Supply of local labour power is sufficient and their skill is reasonably appropriate.

It however must be born in mind that most of them join the labour union, which occasionally goes on strike.

Mimimum wage is indicated by the Ministry of Employment, which is however lower than that in the present market and varies in each project.

d) Construction Materials

There is a political recommendation to fully utilize the local products and coustruction materials, and even imported materials are preferred to be limited to the raw materials and fabricated locally. It is not a firm policy, but customs check is rather strict accordingly.

Major construction materials locally available are cement, re-bars, aggregates, sand, wood, etc., all of which are sufficient in quality and quantity. Structural steels are to be imported principally from Australia and New Zealand, so placing the order must be sufficient in advance.

e) Local Contractor

There are a couple of construction companies with several million dollars output per annum, all of which seem technically appropriate, but due to less experience in marine construction, full construction supervision will be needed.

f) Regulations in Construction

As with design standard, there is no authorized regulations or codes for construction, but those by Australia and New Zealand are applied.

Cousequently Japanese codes and regulations, which are generally similar to the above, can be applied.

## 6 - 3 CONSTRUCTION PLAN

a) Coustruction Method

As discussed before, there is difficulty in obtaining marine construction equipment and larger land construction equipment, and there is necessity to minimize construction period due to 3~ 4 month rainy season.

With the above situation taken into account, construction from on land will be preferred for this project that is, temporary land fills are spread and all are be done in so-called dry work.
More details for major parts of works are as described below;

(1) Dumping and spreading temporary land fill from on land by dump-trucks and bulldozer to provide and secure the access and/or working space.

(2) Placing soil improvement by sand drain into 10m thick upper soft stratum to minimize the residual consolidation and to increase soil strength.

(3) Driving steel sheet piles by land crane equipped with vibration hammer, installing tie-rods and coping concrete, and to increase soil strength.

(4) Removing temporary fills and dredging.

When dumping and spreading land fill in the first stage, special precaution must be practised against sliding in the upper soft layer by overburden by fills.

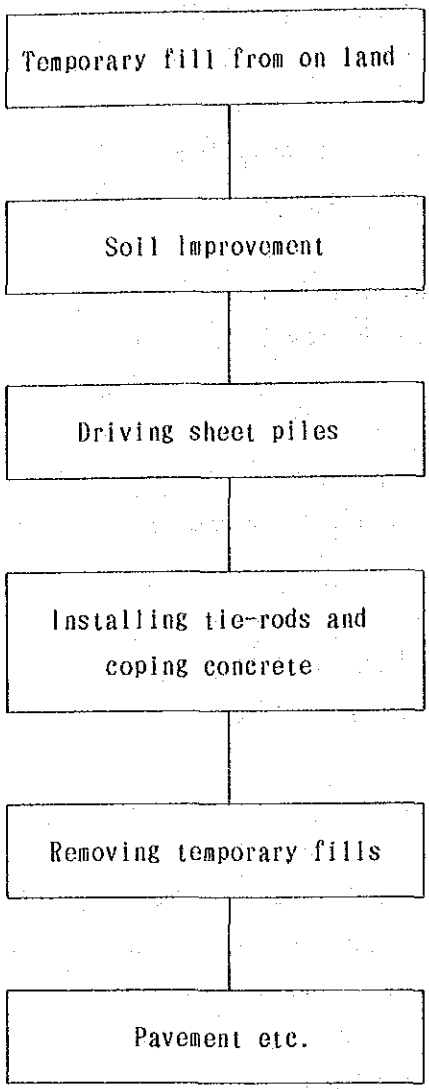
b) Work Yard

It is advantageous for work yard to be provided nearby the proposed construction area. And there is the limited area under control of the Fisheries Dvision. Thus, a part of King's Wharf and the temporarily filled area nearby will then be utilized as a work yard. Addition to these yard, a part of FSC yard will be utilized for temporary works, about 2,000m$^2$ as show in DWG. NO.R223-BD-041.

c) Work Flow of Construction

It is a basic concept that building and plant works is carried out after most of major civil works is completed.
Work flow for major parts of civil work, i.e, main jetty and breakwater, will be as below;

Fig. 6-1 Work Flow Diagram



## 6 - 4 CONSTRUCTION SCHEDULE

### 6-4-1 Overall Schedule of Project

After signing an agreement between both governments, consultancy contract will be signed, which includes Detail Design and Documentation. It needs approx.3 months.

Upon tendor evaluation, construction contract will be signed and actual construction work will commence, which requires about 1.0 months from tender offer to signing contract and 14 months is estimated for construction.

Table.6-1 Overall Schedule

| Months | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| • Consultancy Contract, Detail Design and Documentation | ▽ | | | | | | | | | | | | | | | | | | | | | | | |
| • Tendor | | | | ⊢ | | | | | | | | | | | | | | | | | | | | |
| • Tender Evaluation | | | | — | | | | | | | | | | | | | | | | | | | | |
| • Construction Contract, and Construction Work | | | | | ▽ | | | | | | | | | | | | | | | | | | | |
| | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | | | | | | |

## 6-4-2 Construction Schedule

Construction Schedule for 14 months will be estimated as below:

Table. 6-2 Construction Schedule

| MONTHS / ITEMS | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MOBILIZATION AND PREPARATION | | | | | | | | | | | | | | | | | | |
| MAIN JETTY | | | | | | | | | | | | | | | | | | |
| FINGER JETTY | | | | | | | | | | | | | | | | | | |
| BREAKWATER | | | | | | | | | | | | | | | | | | |
| REHABILITATION OF KINGS WHARF | | | | | | | | | | | | | | | | | | |
| FAIRWAY AND BASIN | | | | | | | | | | | | | | | | | | |
| MISCELLANEOUS | | | | | | | | | | | | | | | | | | |
| FISHERY DEPT. OFFICE | | | | | | | | | | | | | | | | | | |
| ICE PLANT | | | | | | | | | | | | | | | | | | |
| CANTEEN AND OTHERS | | | | | | | | | | | | | | | | | | |
| DEMOBILIZATION | | | | | | | | | | | | | | | | | | |

## 6 - 5 DETAIL DESIGN AND CONSTRUCTION SUPERVISION

Estimated schedule is as mentioned before and as below:

- Detail design ..... 3 months
- Tender and evaluation ..... 1 months
- Construction ..... 14 months

and the overall project schedule is then 18 months.

Major works in each stage are itemized as follows:

(1) Detail Design

- Site investigation
- Detail design
- Cost estimate
- Construction schedule
- Tender documentation
- Assistance in tender evaluation
- Others

(2) Construction Supervision

- Construction supervision
- Progress supervision
- Quality control
- Achievement checking
- Arrangement for design change
- Others

Manning schedule is estimated for each stage that (1) detail design stage needs project manager, engineers for building, port and utility, and document specialist, and (2) construction supervision stage does project manager, engineers for building, port and utility.

## 6 — 6 ESTIMATION OF PROJECT COST

Project Cost to be born by the Government of Fiji.

$$F\$\ 40\times10^{3}$$

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.
- Installation of oil supply system (civil works, oil-storage tank, and other mechanical installations)

## 6 － 7 OPERATION AND MAINTENANCE COST

Operation and maintenance cost are estimated as follows:

| Item | Cost ($10^3$ F$/year) |
|---|---|
| Personnel | 48 |
| Operation/maintenance (Facilities) | 87 |
| Maintenance dredging | 4 |
| Total | 139 |

Note: in case of N-60 boats.

Detailed breakdown are shown in Section 7-3-1 b).

# CHAPTER 7 EVALUATION OF THE PROJECT

## 7 - 1 EVALUATION POLICY

The Lautoka fishing port will be the only fishing port to be administered for the public use by the Fisheries Division of the Government of Fiji. The port is also one of the facilities envisaged in the national development plan. These two facts together tend to give an impression that the success of the project can be widely expected. However, the feasibility of this project can only be determined after evaluating both the economic benefits the project brings after the service commencement, and the capabilities of the Government of Fiji in administering/operation and in the execution of the project.

The feasibaility of the project and the potentiality for the Japanese grant aid programme are discussed below by surveying the economic benefits, financial considerations, and administrative organizations.

## 7 - 2 ECONOMIC EVALUATION

The economic investment benefits to accrue naturally as a result of an improvement of the Lautoka fishing port are studied by dividing them into the direct and the indirect benefits.

### 7-2-1 Direct Benefits

The direct benefits can be considered as follows:

a) Increase in length of time for fishing activities due to the freely available departures and landing whenever fisherman likes.

b) Effects brought by the calm water occasioned by the breakwater construction.

c) Increase in catch by utilization of larger boats.

d) Price-sustaining effects made possible by the adequate supply of ice to keep freshness of the catch on the boats and at the marketplace.

e) Reduction in the use of temporary mooring facilities owned by the private sector.

f) Improvement in daily commodities distribution/circulation and ferry-effects between Lautoka and the group of such isolated islands as Mamanuca and Yasawa.

### 7-2-2 Indirect Benefits

The indirect benefits can be considered as follows:

a) to give various conveniences to fishermen

b) to increase protein sources for the consumers by supplying more and fresher catch.

c) to improve the productivity of the fishing activities by area concentration and intensification by installing an attractive activity base at the port.

d) to give more effective promotion of the fisheries by concentrating the training bases at the port.

e) to give the opportunity for the long-term transition from small-scale domestic and self-consumption fishing to more commercial-type fishing.

The above benefits are correlated to each other indirectly, and still the quantification in moneyterms can not be considered proper.

In addition to the above, the Fisheries Division itself shall be afforded an opportunity where they acquire the know-how/expertise with regard to the administration/operation of fishing ports. This will therefore give an immeasurable stimulus to the Fisheries Division in activating the central national organization, an essential body for the promotion of the coastal fishing industry in Fiji.

## 7-2-3 Numerical Analysis of Direct Benefits

The direct benefits mentioned and quantified in moneyterms, together 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 parameter:

Table 7-1 Economic Evaluation

| Study cases | | Remarks |
|---|---|---|
| Basic case | N=40, 60, 80 | (N:Number of boats accommodated) |
| Sensitivity analysis | Case 1 | Project cost & operational cost 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 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 being accommodated at the fishing port and the rest of them(250-N) use the port only on a temporary and exclusive use basis.

Table 7-1a Economic Internal Rate of Return(%)

| Case of study | | Number of Registered Boats to be accommodated permanently 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 |

Note: The calculations for economic costs and benefits are shown in Appendix E.

## 7 – 3 Financial Evaluation

The financial balance after the construction of the Lautoka fishing port must be on a proper level and such that the Fisheries Division can cope with it.

The financial revenue and expenditure are calculated accordingly in the sections that follow.

### 7-3-1 Financial Expenditure

The financial expenditure can be divided into the depreciation of the initial investment costs, and operational/management costs.

a) Depreciation of Initial Investment

The initial investment is shown with the number of accommodated (boats) as a parameter, and for the depreciation period of 25 years.

At the end of 25 years, an amount of the 10% of initial investment costs shall be the value to remain (Salvage value).

Table 7-2 Investment Cost

unit: mil.F$

| Item | Number of Accommodated N (boats) | | |
|---|---|---|---|
| | 40 | 60 | 80 |
| Initial investment | 7.89 | 8.69 | 9.82 |
| Salvaged value | 0.79 | 0.87 | 0.98 |
| Depreciable value | 7.10 | 7.82 | 8.84 |
| Depreciation period | 25yr. | 25yr. | 25yr. |
| Annual depreciation | 0.28 | 0.31 | 0.35 |

Note: This project may be a Japanese government grant aid programme. Therefore, actually there is no need for depreciation.
See Section 6-2-2 for Total Project Cost..

b) Operational/management expenses

The operational costs for the Lautoka fishing port are roughly estimated as follows:

(1) Personnel cost

An average individual wage(1985) is estimated.

| Item | 1976 | 1982 | 1985 (assumed) |
|---|---|---|---|
| Number of personnel | 67 | | — |
| Total wage | F$ 186,000 | F$ 758,000 | — |
| Unit annual wage | F$ 2,776 | F$ 6,954 | F$ 8,000 |

(Annual Reports)

Present number of personnel 11

Future increase 6

Additional cost: $6 \times F\$\ 8,000 = 48,000\ F\$/yr$

$25\ yr \times 48,000\ F\$/yr = F\$\ 1,200,000$

(2) Operation and maintenance costs

The annual operational/maintenance costs are assumed to be 1.0% of the initial investment for such working items as lighting/heating, consumables, etc. excepting maintenance dredging cost.

| Item | First 12.5yrs | Last 12.5 yrs | Average/yr |
|---|---|---|---|
| Facilities operation/repair | 0.75% | 1.25% | 1.00%/yr |
| Ice-plant operation ($ 20/ton assumed) | $2,900\ t \times 20\ F\$/t = 58,000\ F\$/yr$ | | |

(3) Maintenance dredging cost

The volume of fine material to accumulate in the navigational channel can be calculated as follows, while considering natural conditions, particle gradation of the sea bottom fine materials, and general layout of the port: *See Appendix J*

| Breakwater | Not-Protected Channel length | Annual accumulation( $m^3$) | Cost (F$/yr) |
|---|---|---|---|
| Long breakwater (Plan-R) | 20 | 216 | 1,300 |
| Medium breakwater (Plan-Q) | 50 | 646 | 3,880 |
| Short breakwater (Plan-P) | 100 | 1,108 | 6,650 |

Note: dredging unit price:6F$/$m^3$ (assumed)

(4) Sub-total operational/management cost unit: $10^3$ F$

Table 7-3 Annual Operation/Management Cost

| items | N=40 | N=60 | N=80 |
|---|---|---|---|
| Personnel | 48 | 48 | 48 |
| Operation/maintenance | 79 | 87 | 98 |
| (ice-plants) | (58) | (58) | (58) |
| Maintenance dredging | 7 (Plan-P) | 4 (Plan-Q) | 1 (Plan-R) |
| Subtotal | 134 | 139 | 148 |
| Total for 25 years | 3,350 | 3,475 | 3,700 |

In any case, annual operational/management cost of F$ 140,000 are required.

c) Summary of Expenditure

The initial investment and operational/management costs are added together.

Table 7-4 Total Eependiture unit: $\times 10^3$ F$

| Expenditure | N 40 | 60 | 80 |
|---|---|---|---|
| Depreciation of initial investment | 7.100 | 7.820 | 8.840 |
| Operational/management cost | 3.350 | 3.475 | 3.700 |
| Total | 10.450 | 11.295 | 12.540 |
| Annual Expenditure | | | |
| Initial investment cost | 280 | 310 | 350 |
| Operational management cost | 134 | 139 | 148 |
| Total | 414 | 449 | 498 |
| Annual Expenditure (If grant project) | | | |
| Initial investment cost | 0 | 0 | 0 |
| Operational/management cost | 134 | 139 | 148 |
| Total | 134 | 139 | 148 |

Note: For the government of Fiji, in addition to the above, another intial investment cost in the sum of approx.F$ 40.000 (6.omil.yen) is required accounting for about 0.5% of the total initial investment cost.
From the above, in any each, the yearly operational/management expenses are approximately F$ 140.000.

## 7-3-2 Financial Revenue

The income conceivable as financial revenue are such items as proceeds from ice-sale, port-usage fee, tool charge, utility charge, etc., as shown below.

(1) Revenue of ice-plant

Price F$ 50/ton, provided the purchase/installation cost of the equipment and personnel expenses are accounted for in the expenditure; therefore, proceeds from ice sale are accounted here as they are.

Annual sales volume 2,900ton( 57ton/week×52week=2,960ton)

The actual income/net proceeds is assumed to be 85%, therefore ;

$$2{,}900^{t} \times 50^{F\$/t} \times 0.85 = F\$123{,}000/yr.$$

(2) Income from fishing license issuance. (Western Division)

F$ $6 \times 10^{3}$ /yr. by the past records, refer to Appendix.F.

(3) Port-usage fee (new income assumed)

60 (boats)×F$5.0 ×12mos.=F$3,600/yr.……for boats which permanently use the port.

190 (boats)×F$1.0 ×10mos.=F$1,900/yr.……for boats which exclusively use the port.

subtotal=F$5,500/yr.

(4) Other income

a. repair of machinery and boats (new income assumed)

250(boats)×50% × F$10.0/yr.=F$1,250/yr.

b. ramp-up usage fee (new income assumed)

250(boats)×25% × F$20/yr.=F$1,250/yr.

subtotal F$2,500/yr.

(5) Subsidy from the Fisheries Div. to the Lautoka Fishing Port 5% of the present revenue of the Fisheries Division may be allocated as subsidy.

F$550.000/yr. × 5 % =F$28.000/yr.

(6) Total Financial Revenue

Total F$165.000/yr

In the financial point of view, the project is feasible.

Note: A summary of the financial statements of the Fisheries Division is shown in Appendix F.

## 7 - 4 EVALUATION AS A GRANT AID PROJECT

From an economical viewpoint, the scope of this project should be kept at a minimum level necessary to give a proper impact to the fishing industry in the Lautoka region. Keeping this in mind, the scope of Phase I development (grant aid project) can be studied as follows:

| Number of registered boats (G) | Scale of Fishing Port number N | Occupancy (accommodation) |
|---|---|---|
| 247 | 40 boats | 15% |
| See(5-3-2 c) (2) | 60 boats | 25% |
| | 80 boats | 30% |

note; "G" is net demand of port use by fishing boats.

Generally speaking, the occupancy of 20% or lower can not be considered enough as the impact on the fishing industry is rather limited; therefore, the occupancy for Phase I should be kept at least on 25% ~30% level. With this in mind, the cases with N=60 or 80 are deemed more desirable.

By an economic analysis, EIRR is in the range of 4%, rather low, but not too bad judging from the character of the project. Of course the higher rates are more desirable.

As mentioned earlier, in this kind of project the with the occupancy less than 100%, the higher occupancies are, the higher EIRR'S are. This holds true for this project as well, and the case when N=80 is higher than the one with N=60 with regard to EIRR, even though there is only a small difference in EIRR between N=60 and N=80. Therefore, the case with N=60 can be considered comparatively more feasible.

From financial viewpoint, there is little difference by the variations in the project scope.
The initial operational/management expenses are approximately F$140,000/year, but out of this amount, F$123,000/year can be made up for by the sale of ice from the new ice-plants; therefore, only the balance, F$17,000/year, must be secured by some measures.. Very possibly this amount can be, as mentioned before, appropriated from the Government Of Fiji (the

Fisheries Division, the Ministry of Primary Industries).

As to the installation of the number of technical staff required for the proper operation/management, due recognition and effort on the part of the Fisheries Division is quite necessary, calling for urgent and specific actions.