No.

SAINT LUCIA

BASIC DESIGN STUDY REPORT
ON
THE PROJECT
FOR
COASTAL FISHERIES DEVELOPMENT
IN
SAINT LUCIA

JANUARY, 2001

JAPAN INTERNATIONAL COOPERATION AGENCY

ECOH CORPORATION

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PREFACE

In response to a request from the Government of Saint Lucia the Government of Japan decided to conduct a basic design study on the Project for Coastal Fisheries Development and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Saint Lucia a study team from July 20 to August 28, 2000.

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

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

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

January, 2001

Kunihiko Saito
President
Japan International Cooperation Agency

January, 2001

Letter of Transmittal

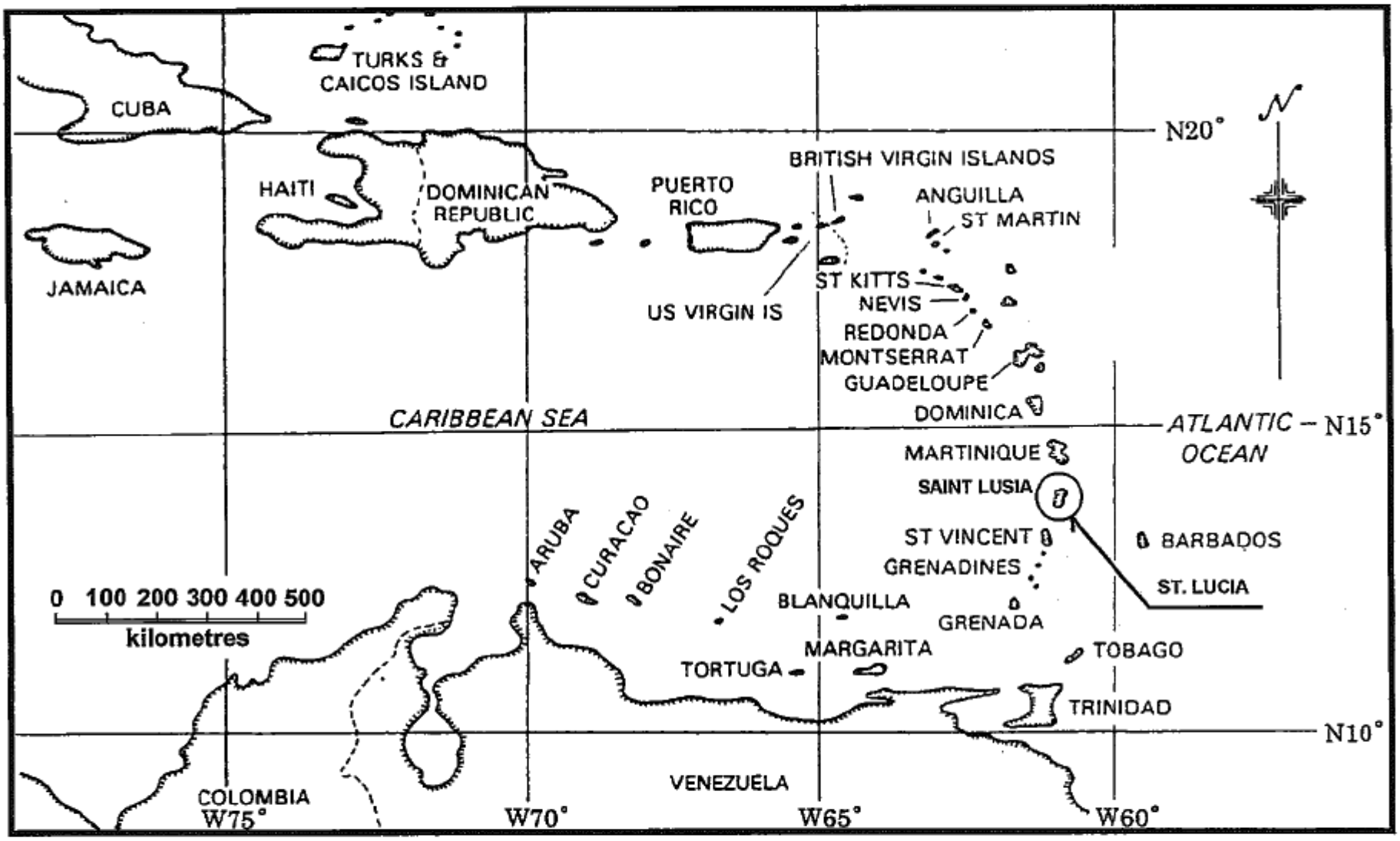
We are pleased to submit to you the basic design study report on the Project for Costal Fisheries Development in Saint Lucia.

This study was conducted by ECOH CORPORATION, under a contract to JICA, during the period from August 3, 2000 to January 31, 2001. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Saint Lucia and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

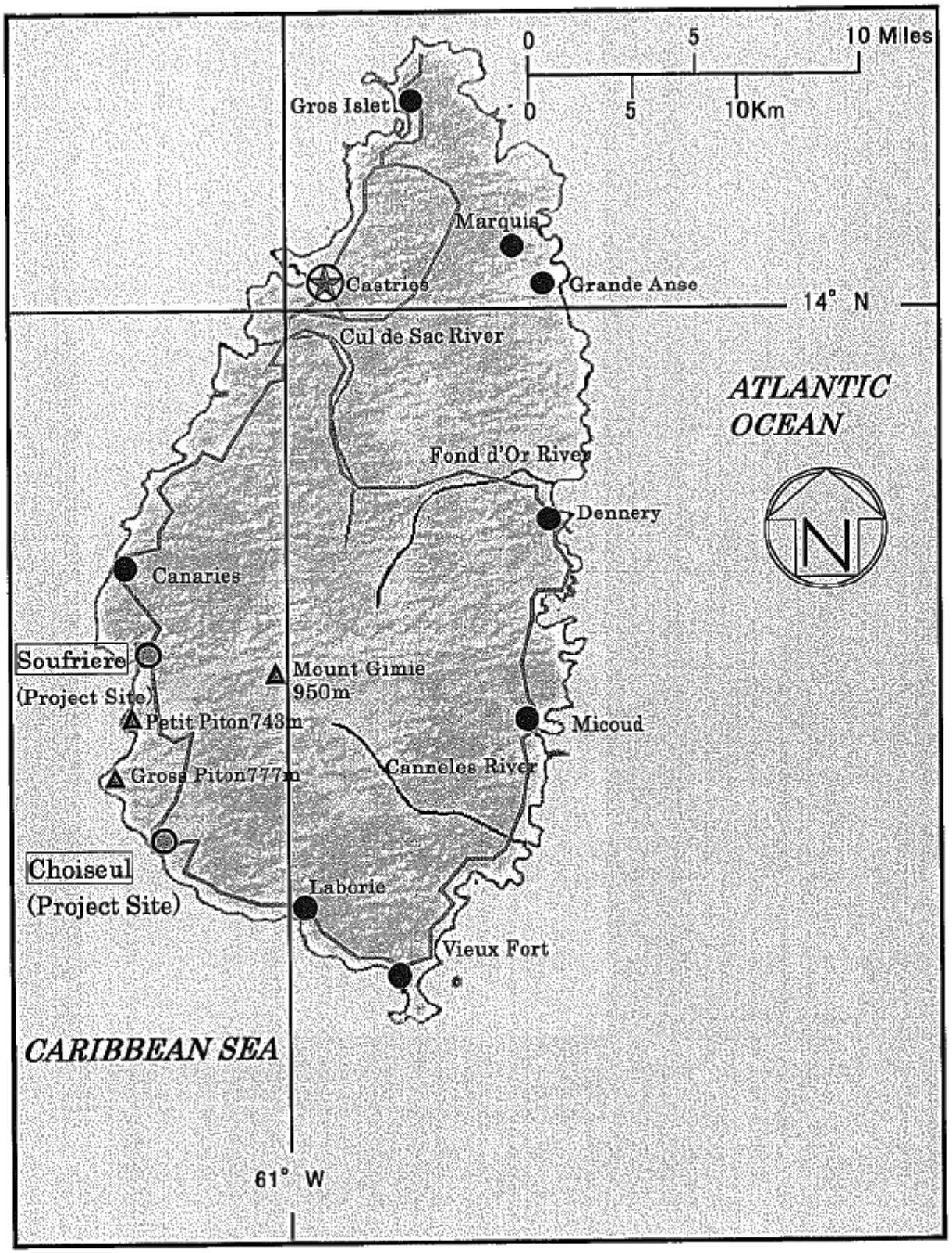
Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

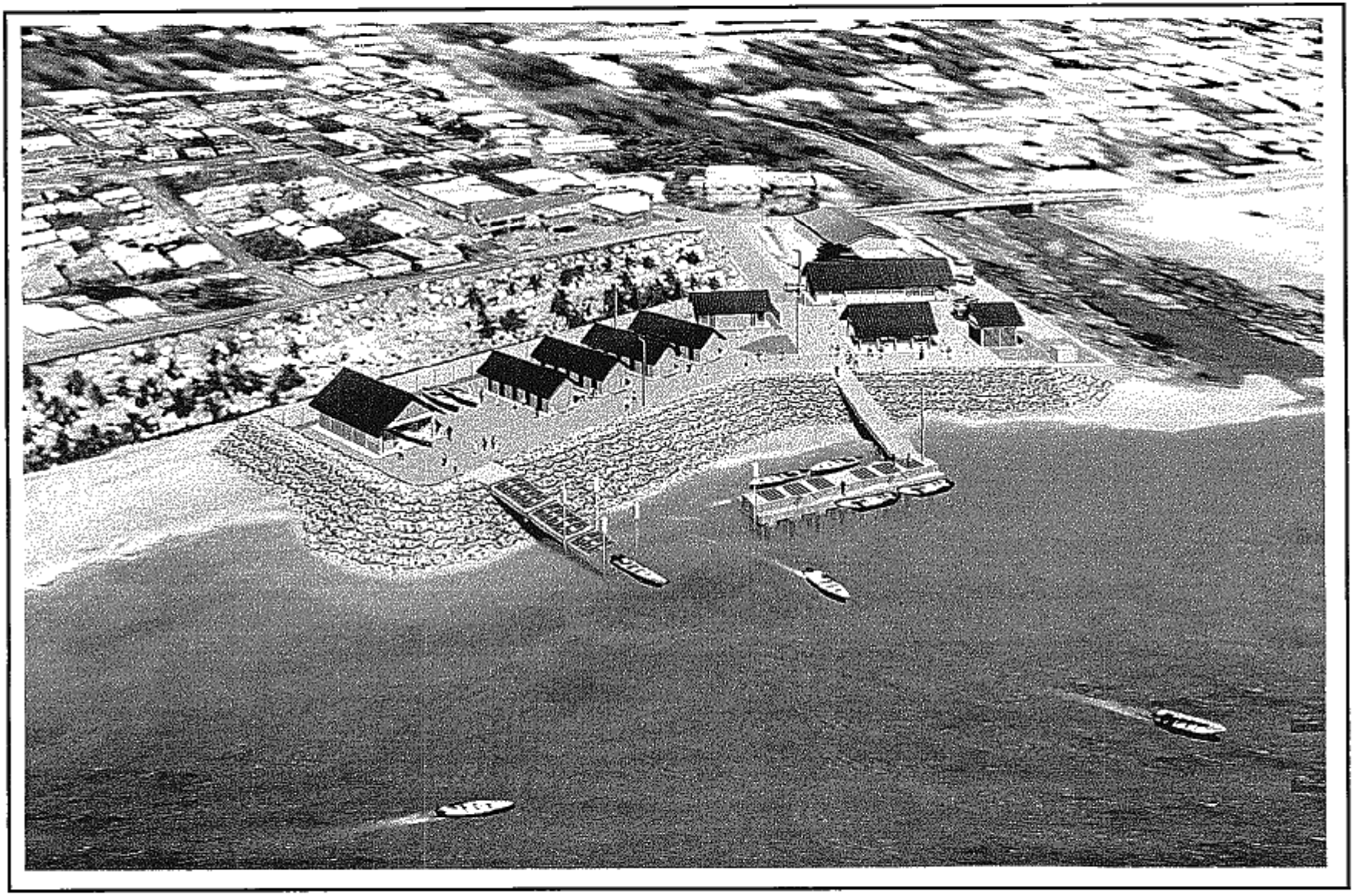
Norio Tanaka
Project manager,
Basic design study team on
the Project for Coastal
Fisheries Development
ECOH CORPORATION



Location of St. Lucia



Location of Soufriere and Choiseul



Soufriere Site

Choiseul Site

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Abbreviations

BOD	Biochemical Oxygen Demand
CDL	Chart Datum Level
CEC	Commission of the European Communities
COD	Chemical Oxygen Demand
CUBIC	Caribbean Uniform Building Code
DO	Dissolved Oxygen
DOF	Department of Fisheries
EEZ	Exclusive Economic Zone
E/N	Exchange of Notes
FMC	Fish Marketing Corporation
FRP	Fiber Reinforced Plastic
GDP	Gross Domestic Product
GL	Ground Level
HACCP	Hazard Analysis and Critical Control Point
HP	Horse Power
JICA	Japan International Corporation Agency
JIS	Japan Industry Standard
LWL	Low Water Level of Ordinary Spring Neap Tide
MDB	Main Distribute Board
MSL	Mean Sea Level for Observed Period
NDC	National Development Corporation
NHHWL	Nearly Highest High Water Level
ODA	Official Development Assistance
OECS	Organization for Eastern Caribbean States
Ph	Hydrogenion Concentration
WASCO	Water and Sewage Company Inc.

Chapter 1 Background of the Project

1-1 Background of the Project

St. Lucia belongs to Lesser Antilles in the Caribbean sea and has the land area of 622km^2. The capital is Castries and the total population is about 154,000 (1999) with the annual population growth of 1.2%. The northern part of the island is fairly flat, while the central part is mountainous and the southern part forms the flat plain. The climate is neo-tropical; the dry season lasts from December to May and the rainy season from June to November. The annual precipitation is about 1,300mm and the average temperature is 27 degrees centigrade. Since the country is located in the north-east trade wind zone, the easterly wind prevails and thus the waves are generally high on the east coast. On the contrary, the sea is rather calm on the west coast. St. Lucia is located in the normal route of hurricanes which originate in the Atlantic Ocean. There have been many damages caused by hurricanes such as high waves and torrents.

The major industry is agriculture, banana being in particular an important commodity which represents some 50% of agricultural production and 55% of the total export value. However, the banana market has been sluggish in recent years due to the abolition of preferential treatments in tariffs by UK and also keen competition in the international market. Tourism is an important source of revenue for the country. Since 1990 the number of tourists visiting the country has increased with an average rate of 6%. In 1999 the share of tourism in DGP represented 13% in 1999.

The Medium Term Development Strategy Plan 2000-2002 stresses the need to revitalize the national economy which heavily depends on agriculture. The Plan emphasizes to keep a balance in development efforts among agriculture, education, human resources, financial services and technology renovation. The contribution of fisheries to GDP account for only 1.0% (1999), but fisheries play an important role in terms of provision of animal protein and employment opportunities. The government considers fisheries as one of the promising industries which will make a significant contribution to restructuring national economies.

St. Lucia has the coast line of 253 km and the Exclusive Economic Zone (EEZ) of about 8,000km^2 . The total area of the continental shelf is 176km^2 , representing 2.2% of the EEZ. The fisheries resources of the country consist of (i) demersal species (e.g. grouper, snapper) and reef fish; (ii) large size migratory fish (e.g. king fish, dolphin, tuna, skipjack) and (iii) coastal migratory fish (e.g. flying fish, sardine, horse mackerel, mackerel). Fisheries in St. Lucia is characterized by large seasonal fluctuations in fish catches. Some 75% of total catches are taken in the peak season from December to May and the great majority of catches consists of large migratory species, while the catches during off-season are mainly demersal species and coastal migratory fishes. Whilst there are favourable fishing grounds around St. Lucia, fishery resources have not been rationally exploited due to the lack of infrastructure facilities in landing sites and prevalence of primitive wooden canoes.

The problems confronting in Soufriere and Choiseul are in some cases common such as (i) no facilities are available for fish landing and marketing; (ii) lack of ice to maintain the freshness of fish;(iii) lack of shore facilities such as gear lockers, slipway; (iv) no facilities are available to moor and shelter boats safely. These problems compel fishermen to undergo laborious work on the beach. In Soufriere the number of full-time fishermen has been declining due to the decrease of fish landings as a result of over-exploitation of coastal resources and rising tourism industry with which fishermen gain part-time employment opportunities. In Choiseul, wooden boats do not have access to offshore fish resources despite promising offshore fishing grounds.

On this basis the Government of St. Lucia has requested a Grand Aid Project to provide fish landing facilities, ice plants and FRP boats for modernization of fishing industry in the proposed sites. The Basic Design Mission was fielded during 20 July to 28 August and the secondary mission was sent from 30 October to 12 November to present the details of the Basic Design Study to the Government of St. Lucia. The items requested by the Government is shown in Table 1.1.

Table1.1 Contents of the Request

	Project Site Facilities	Soufriere	Choiseul
1.	Breakwater	–	○
2.	Reclamation	–	○
3.	Landing Wharf	–	○
4.	Jetty	○	–
5.	Slipway	○	○
6.	Access Road	○	○
7.	Administration Building	○	○
8.	Ice Making Machine	○(2tons/day)	○(2tons/day)
9.	Ice Storage	○(5tons)	○(5tons)
10.	Work Shop	○	○
11.	Fishing gear Locker	○(30units)	○(40units)
12.	Lavatory with Shower	○	○
13.	Fish Market	○(10stalls)	○(12stalls)
14.	Gas Facilities	○	○
15.	Septic Tank	○	○
16.	Standby Generator	○	○
17.	Vehicle	○	○
18.	FRP Vessel with 85HP	–	○(20 Vessels)
19.	Fishing Gear	–	○
20.	Requisite Tools	○	○

1-2 Conditions of the Project Sites

1-2-1 Results of Study of Natural Conditions

A study of natural conditions was conducted with respect to soil sedimentation, bottom materials or types of sediments, water quality, land topography, submarine topography, climates and waves.

(1) Soil sedimentation

Boring work was implemented at two points, i.e. offshore and on land, at the project sites in Soufriere and Choiseul respectively, that is, at eight points in total.

1) Soufriere

The boring points offshore in Soufriere were selected along the alignment line where a pier will be constructed taking into account the assumed depth of the (BH-1) pier on the offshore side. Fig. 1.2-1 (1) shows the boring points and soil column diagrams.

(a) Boring No. BH-1 (offshore)

There was a rather compact coarse sand layer with N-value of 20, at a depth of 4.5m below the sea bed; a loose gravel layer between 4.5m to 7.5m (with N value of 2 at a depth of 5.5m) and a compact gravel-mixed coarse sand layer with N value of around 20 at a depth of more than 7.5m.

(b) Boring No. BH-2 (offshore)

There was a rather compact gravel-mixed coarse sand layer with N value of over 20 at a depth of between the sea bed to around -15 m; a gravel layer and a gravel-mixed sand layer with N values of 37 and 30 respectively between -15 m to -17.5 m; a coarse sand layer, a stone layer and a gravel-mixed coarse sand layer with N values of between 11 to 22 at a depth of more than 17.5 m.

(c) Boring No. BH-3 (on land)

There was a rather compact gravel-mixed coarse sand layer with N value of more than 20 at a depth of 15m; a gravel layer and gravel-mixed sand layer with N-values of 37 and 30 respectively between -15 m to -17.5 m and a coarse sand layer, a stone layer and a gravel-mixed coarse sand layer with N-values ranging from 11 to 22 at a depth of more than -17.5 m.

(d) Boring No. BH-4 (on land)

There was a loose gravel-mixed sand layer from the ground surface to

-7 m. The boring test revealed that N value was less than 10 at a depth of 1 m less, while it ranged between 15 to 55 elsewhere. There was a rather compact silty sand with N value of 15 to 20 at a depth of -7 m to -19.5 m.

2) Choiseul area

The offshore boring points in Choiseul were selected in the vicinity of the site planned for the breakwater and quay. Fig. 1.2-1 (2) shows the location as well as the boring log diagram of each point.

(a) Boring No. BH-5 (offshore)

The water depth was 2.4 m. There were a loose stone-mixed gravel layer with N value of 14 at a depth of 5m below the sea bed; a gravel layer with N-value of 51 at a depth of -5 m to -7 m and a coarse sand layer with N value of 50 at a depth of more than -7 m.

(b) Boring No. BH-6 (offshore)

The water depth was 1.5 m. The soil was of gravel with N value of around 25 up to -5m from the sea bed and of very hard sandy gravel at a depth of more than -5 m.

(c) Boring No. BH-7 (on land)

The altitude was 1.7 m. There were a sand layer with N value of 26 between the ground surface to -3 m, a gravel-mixed silty sand layer with N value of 35 at a depth of -3 m to -4 m and a sandy gravel layer with N value of 50 at a depth of more than -4m.

(d) Boring No. BH-8 (on land)

The altitude was 2.3 m. There were a sand layer containing large boulders from the ground surface up to -2 m, a gravel-mixed coarse sand layer with N value of around 25 at a depth of -2 m to -5 m and a gravel-mixed coarse sand layer of N-value of more than 50 at a depth of below -5 m.

(e) Boring No. BH-9 (offshore)

The water depth was 1.7 m. There were a sand layer containing boulders with N value which largely varies with the minimum of 25 at a depth of up to -4 m below the sea bed, a soft sandy layer with N value of around 5 at a depth of -4 m to -5.5 m and a hard sandy gravel layer at a depth of more than -5.5 m.

(f) Boring No. BH-10 (offshore)

The water depth is 1.5 m. There were a soft sandy gravel layer in the surface layer and a compact sand layer at a depth of more than -4 m.

(2) Sediment Quality Survey

Sediment quality survey was conducted at four points in Soufriere and Choiseul respectively, eight points in total. (See Fig. 1.2-2 (1) and Fig. 1.2-2 (2).) Samples of sediments were collected from a layer of some 10cm below the sea bed of 5m deep. Material 3 shows a diagram of grain size distribution. The nature of the bottom was sandy in both sites, but in Choiseul, it was visually witnessed that there were gravels and boulders along the shore lines and in the shoreline zone.

(3) Water quality examination

Water quality examination was conducted at three points in each project site, six points in total. Twelve samples were taken, two at each point, at a depth of 40 cm below the sea surface whose water depth is 5m. These samples were tested with regard to the temperature, pH, DO and COD. Material 4 indicates the results of the test analysis. The values of pH and DO met the Japanese standard, but the order of the values of COD value was far from the Japanese standard due to differences in the analytical method. The permanganate method is normally used in Japan while the bi-chromate method is employed in the Caribbean area. A comparative study has not been done regarding these two methods in Japan yet. Material 1 shows the diagram of water quality at the survey points. Material 4 shows the results of the analysis.

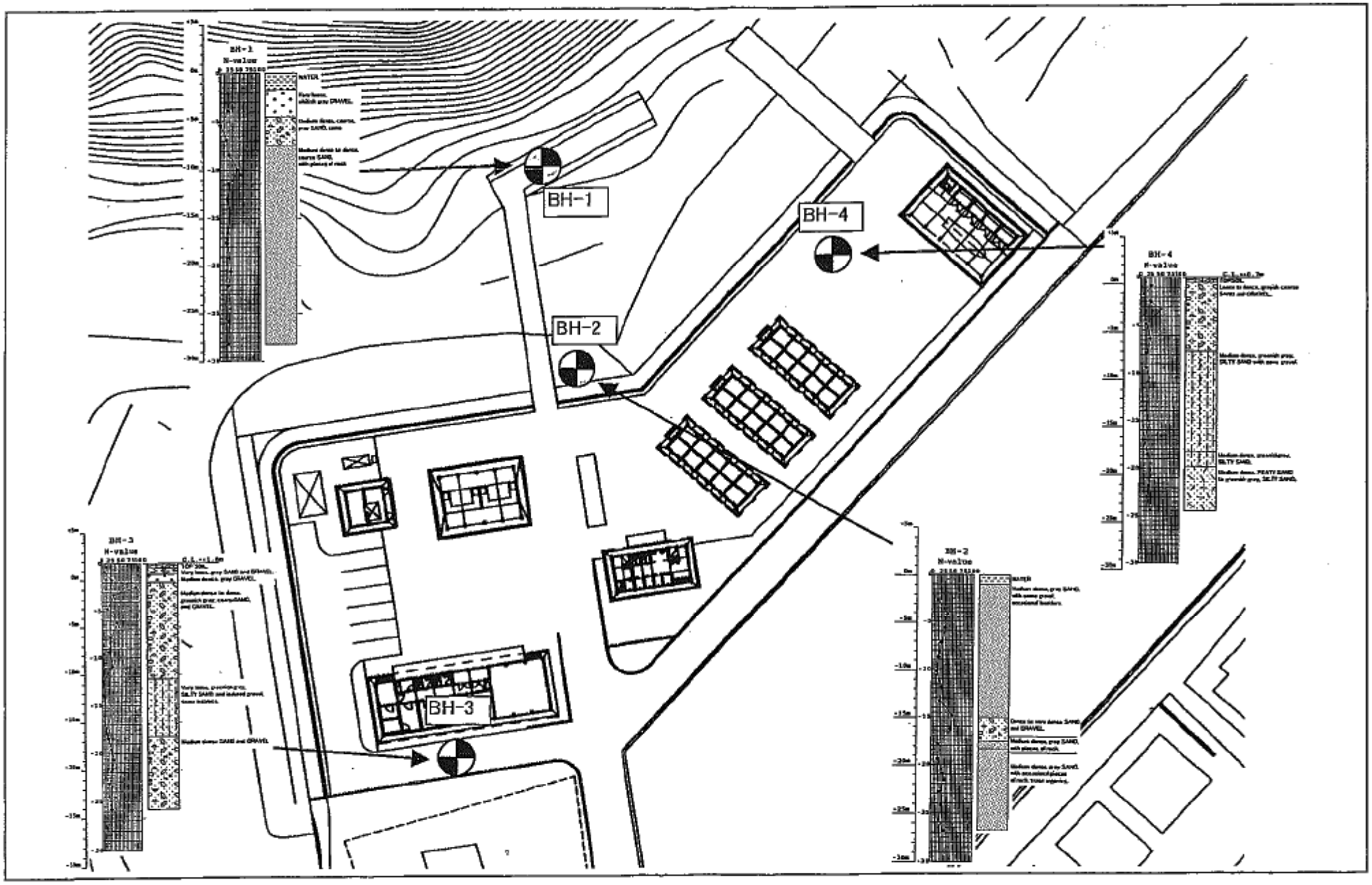


Figure 1.2-1 (1) Boring Points and Boring Logs at Soufriere

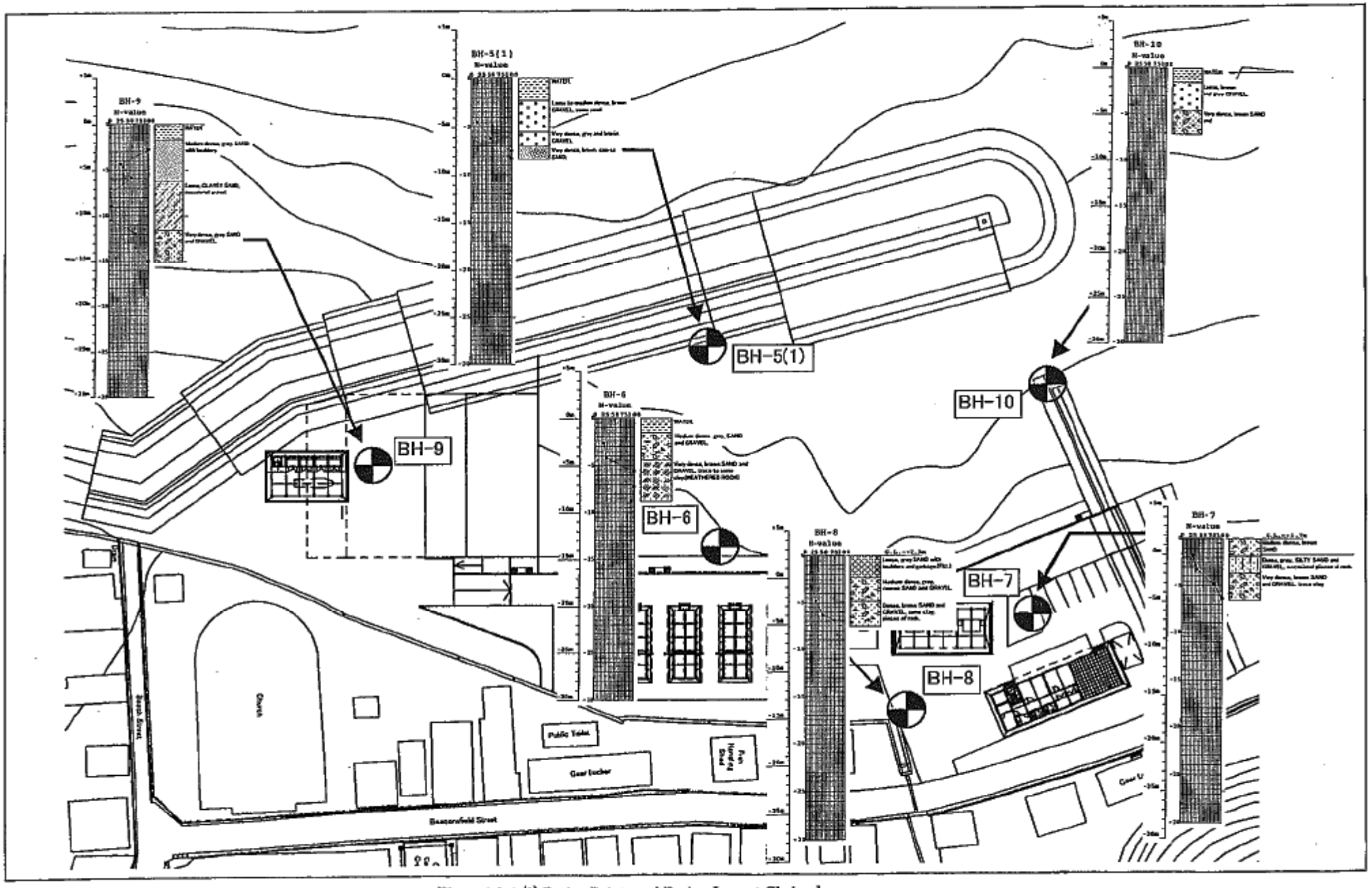


Figure 1.2-1 (2) Boring Points and Boring Logs at Choiseul

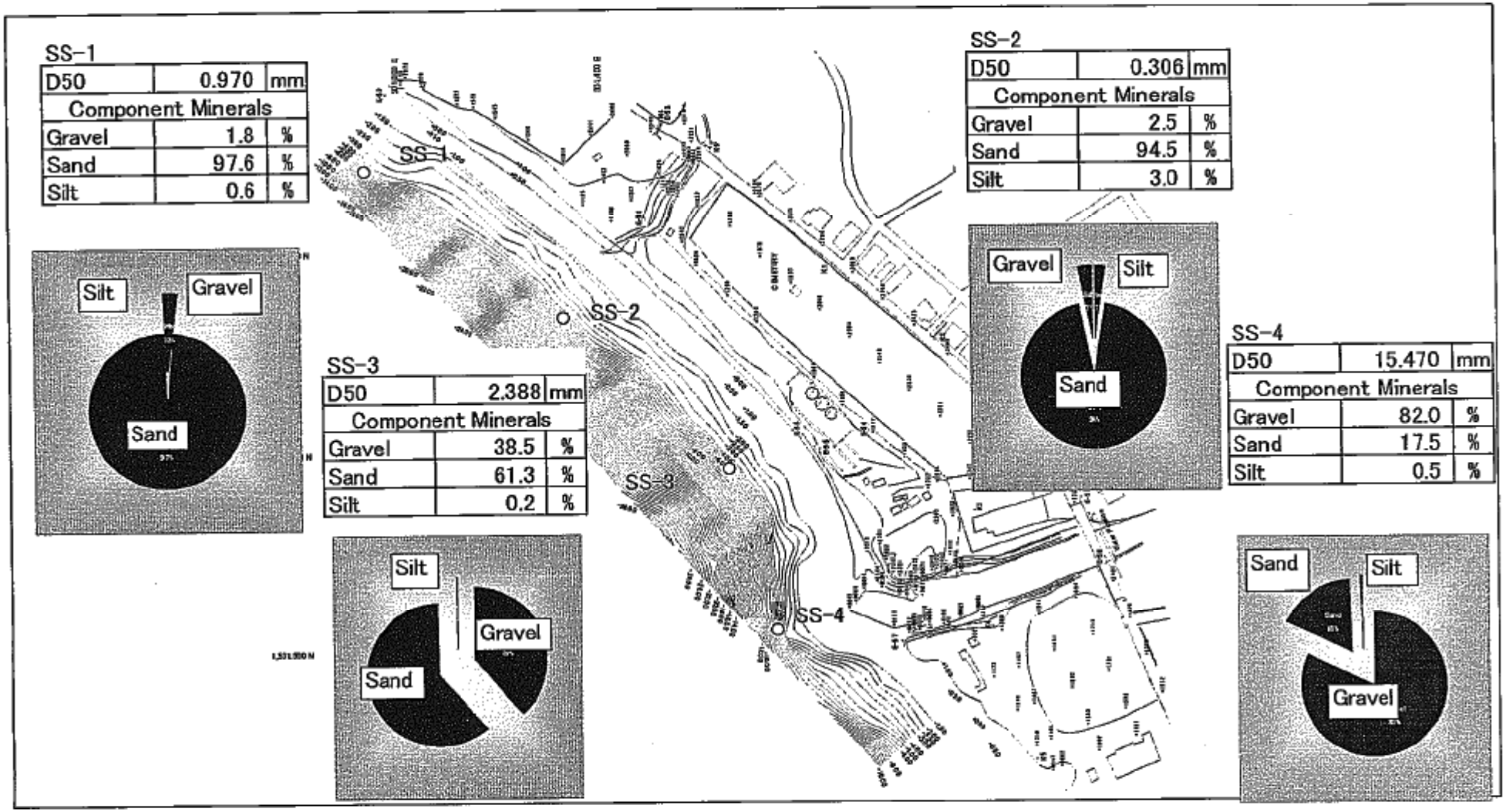


Figure 1.2-2 (1) Result of Sediment Quality Survey at Soufriere

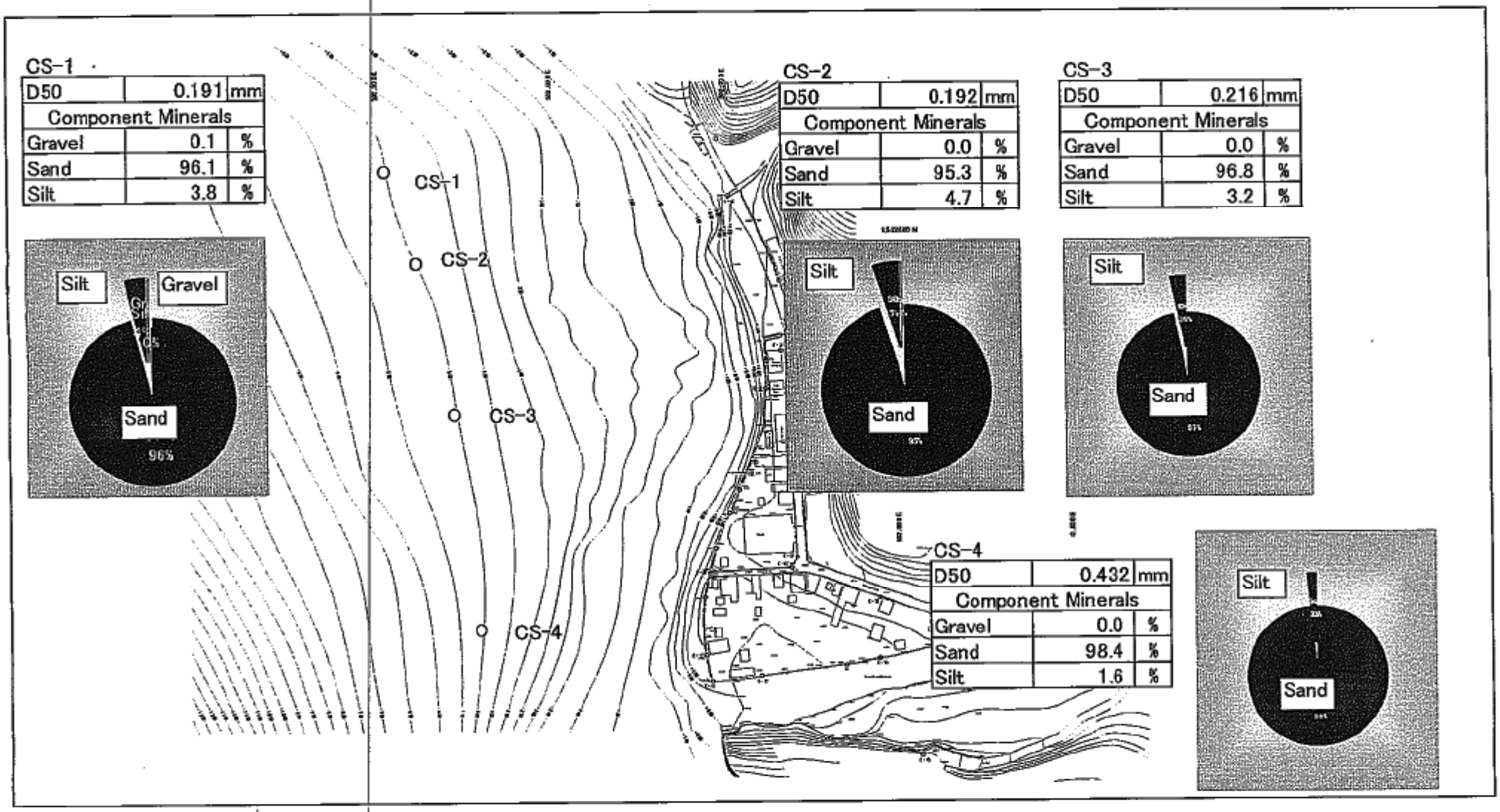


Figure 1.2-2 (2) Result of Sediment Quality Survey at Choiseul

(4) Land and submarine topography

Land and submarine topography surveys were conducted in Soufriere and Choiseul. Appendix 7.4 shows the topographic diagrams of two sites. In Soufriere, the sea bed slope becomes steep all of a sudden at 3.5 m deep at the front of the site, and the slope continues to reach more than 25 m deep. Furthermore, the submarine sand bar created by Soufriere River was detected in the southern part of the site. In Choiseul, the slope rapidly increases from the beach line to 1.0 m deep, but thereafter the slope becomes milder.

(5) Wind directions and velocities

Summarized in Appendix A-37, 38 are the date regarding the wind direction and velocity observed at Vigie Airport in Castries and at Hewanorra Airport in Vieux Fort. Figure 1.2-3 (Wind Rose) shows the wind which occurred at Vieux Fort and Table 1.2-1 shows the wind velocity distribution by the wind directions at Vieux Fort.

These data show that ENE - ESE winds are overwhelmingly predominant throughout the year at both points. Although the westerly wind, which turns into sea breeze at the project sites, occurs in September through November, the rate of occurrence is 2% or less at either point.

The occurrence rates of wind speed at 5.0 m/s, 7.5 m/s, 10.0 m/s are 22.3%, 2.0% and 0.1% respectively at Castries and 77.0%, 37.7%, 2.0% at Vieux Fort. These values prove that strong winds occur more frequently in Vieux Fort than in Castries. This is because there are the hills close to Castries on the eastern side and the easterly wind sharply attenuates in Castries.

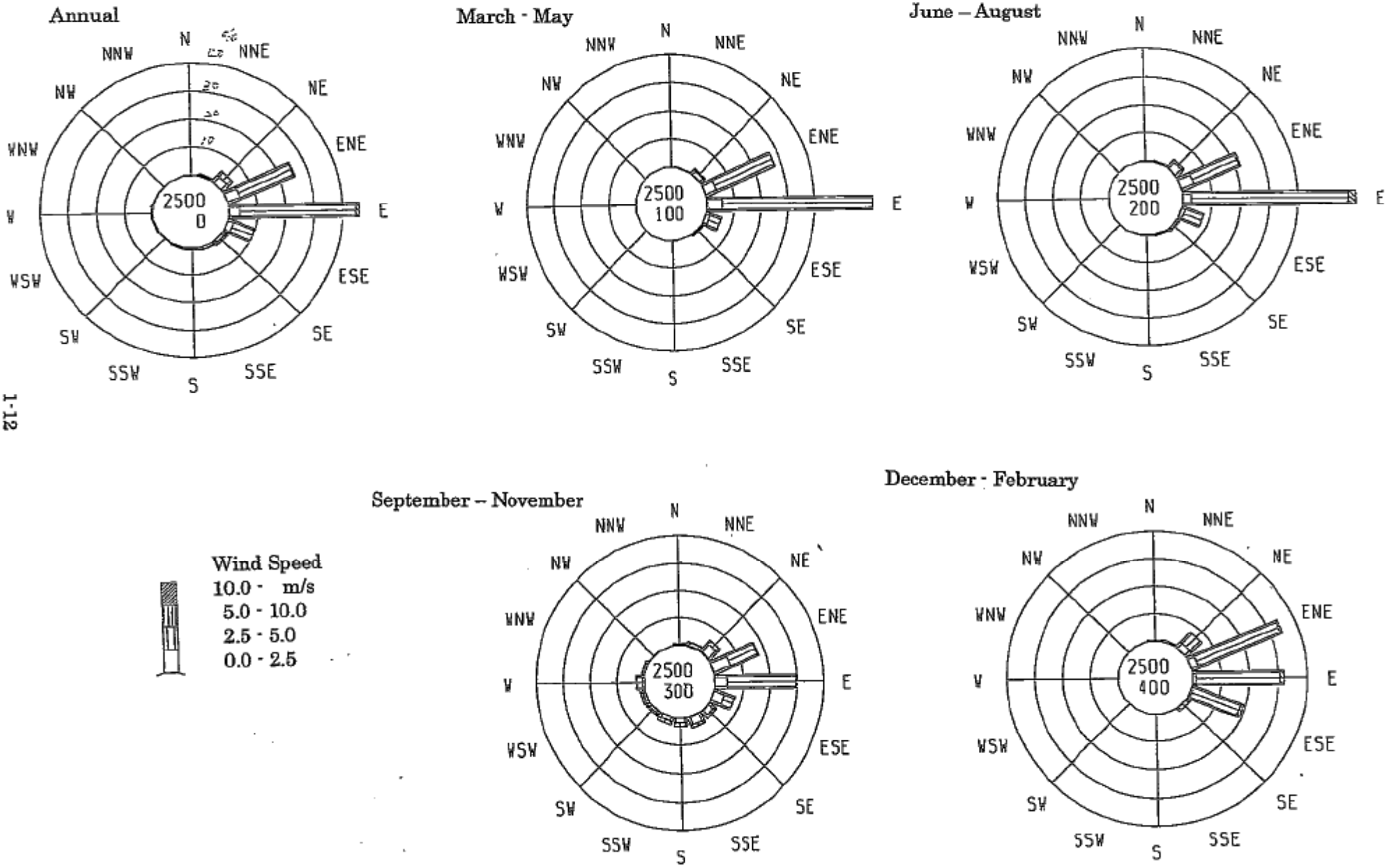


Figure 1.2-3 Wind Rose (Vieux Fort, 1999, 24 times / day)

FORT6

100/10/19

Table 1.2-1 Wind Velocity Distribution by the Wind Direction
(Vieux Fort, 1999, 24 times / day)

YEAR 2500 MONTH 0 KESOK 0

WAVE DIRECTION / WIND SPEED(M/S)	U.K.	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
	381	1	0	1	0	1	0	1	1	0	0	0	0	0	0	0	0	386
CALM	4.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	4.4
	19	7	13	15	9	14	3	1	5	4	0	0	1	0	3	1	1	96
0.0 - 2.5	.2	.1	.1	.2	.1	.2	.0	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	1.1
	16	22	49	239	391	303	167	89	73	45	38	28	25	30	15	3	5	1538
2.5 - 5.0	.2	.3	.6	2.7	4.5	3.5	1.9	1.0	.8	.5	.4	.3	.3	.3	.2	.0	.1	17.6
	0	4	10	119	1008	1796	312	50	34	23	25	8	19	28	9	0	0	3445
5.0 - 7.5	.0	.0	.1	1.4	11.5	20.5	3.6	.6	.4	.3	.3	.1	.2	.3	.1	.0	.0	39.3
	0	0	3	50	788	1836	388	20	3	5	3	5	6	12	3	0	0	3122
7.5 - 10.0	.0	.0	.0	.6	9.0	21.0	4.4	.2	.0	.1	.0	.1	.1	.1	.0	.0	.0	35.6
	0	0	0	0	35	96	28	2	0	1	0	0	1	6	0	0	0	169
10.0 - 15.0	.0	.0	.0	.0	.4	1.1	.3	.0	.0	.0	.0	.0	.0	.1	.0	.0	.0	1.9
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15.0 - 20.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	3
20.0 - 25.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25.0 - 30.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30.0 -	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
	416	34	75	425	2231	4048	898	163	116	78	66	41	52	76	30	4	6	8759
TOTAL	4.7	.4	.9	4.9	25.5	46.2	10.3	1.9	1.3	.9	.8	.5	.6	.9	.3	.0	.1	100.0

(6) Waves, tide levels and currents

The waves were observed for about 30 days by using a self-recording wave height & wave direction recorder in Soufriere and Choiseul to study the nature of waves under normal conditions. Simultaneously, the tide levels and currents were also surveyed by using the same instrument. Appendix A-39 to 51 shows the results of the survey.

1) Waves

(a) Wave observations

Waves were hardly observed in Soufriere during the survey period with the maximum height of only around 0.35 m. The wave period is around 6 seconds on average, but the swell period reached around 15 seconds during 8 to 10 August. Waves were generally from westward direction.

In Choiseul, on the other hand, waves were high during 8 to 9 August with the height of 0.9 m (8 August). The wave period was around 13 seconds, which corresponded to the swell that occurred in Soufriere. It was noted that waves in Choiseul are, in general, higher than in Soufriere, the wave height of the latter being around 0.3 m throughout the survey period.

(b) Prediction of ocean waves

The hurricanes which affected St. Lucia strongly, were analyzed on the basis of the records of the past 30 years. Material 6 shows the details of the analysis of waves. It was concluded that the waves created by Hurricane David in 1979 were the highest on the west coast and Hurricane Lenny in 1999 was the second highest. Based on these data, the occurrence period of high waves was calculated. Figure 1.2-4 shows the results of such calculation. The return period of high waves in offshore waters after 30 years would be as follows.

- significant wave height = 6.1m
- wave period = 10.1 seconds

(c) Changes of waves in shallow waters

When waves reach shallow areas, waves demonstrate different refractions depending on the conditions of the sea bed and the wave height decreases. In this context, a supplementary calculation is required to correct wave height. Appendix A-61 to 70 shows the details of such work. Table 1.2-2 and 1.2-3 show the particulars of waves, which should be taken into account for a design work at Soufriere and Choiseul respectively.

Table 1.2-2 Particulars of Equivalent Offshore Waves (Soufriere)

Particulars of offshore waves			Refraction coefficient	Equivalent offshore wave height	Incident wave direction
Direction	Height(m)	Period (sec)			
SW	6.1	10.0	0.83	5.06	S51.5°W

Table 1.2-3 Particulars of Equivalent Offshore Waves (Choiseul)

Particulars of offshore waves			Refraction coefficient	Equivalent offshore wave height	Incident wave direction
Direction	Height (m)	Period (sec)			
SSW	6.1	10.0	0.96	5.86	S51.4W

2) Tide levels

The tide levels observed at the project sites were analyzed by applying the harmonic method to obtain harmonic constants. Figure 1.2-5 (1) and Figure 1.2-5 (2) are the diagrams of tide levels obtained from the study. The conditions of tide levels are as follows.

Conditions of tide levels in Soufriere

Nearly highest high water level (N.H.H.W.L):	+0.37m
Mean sea level for observed level (M.S.L):	+0.19m
Chart Datum level (C.D.L):	±0.00m
Low water level of ordinary spring neap tide (L.W.L):	+0.15m

Conditions of tide level in Choiseul

Nearly highest high water level (N.H.H.W.L):	+0.46m
Mean sea level for observed level (M.S.L):	+0.23m
Chart Datum level (C.D.L):	±0.00m
Low water level of ordinary spring neap tide (L.W.L):	+0.15m

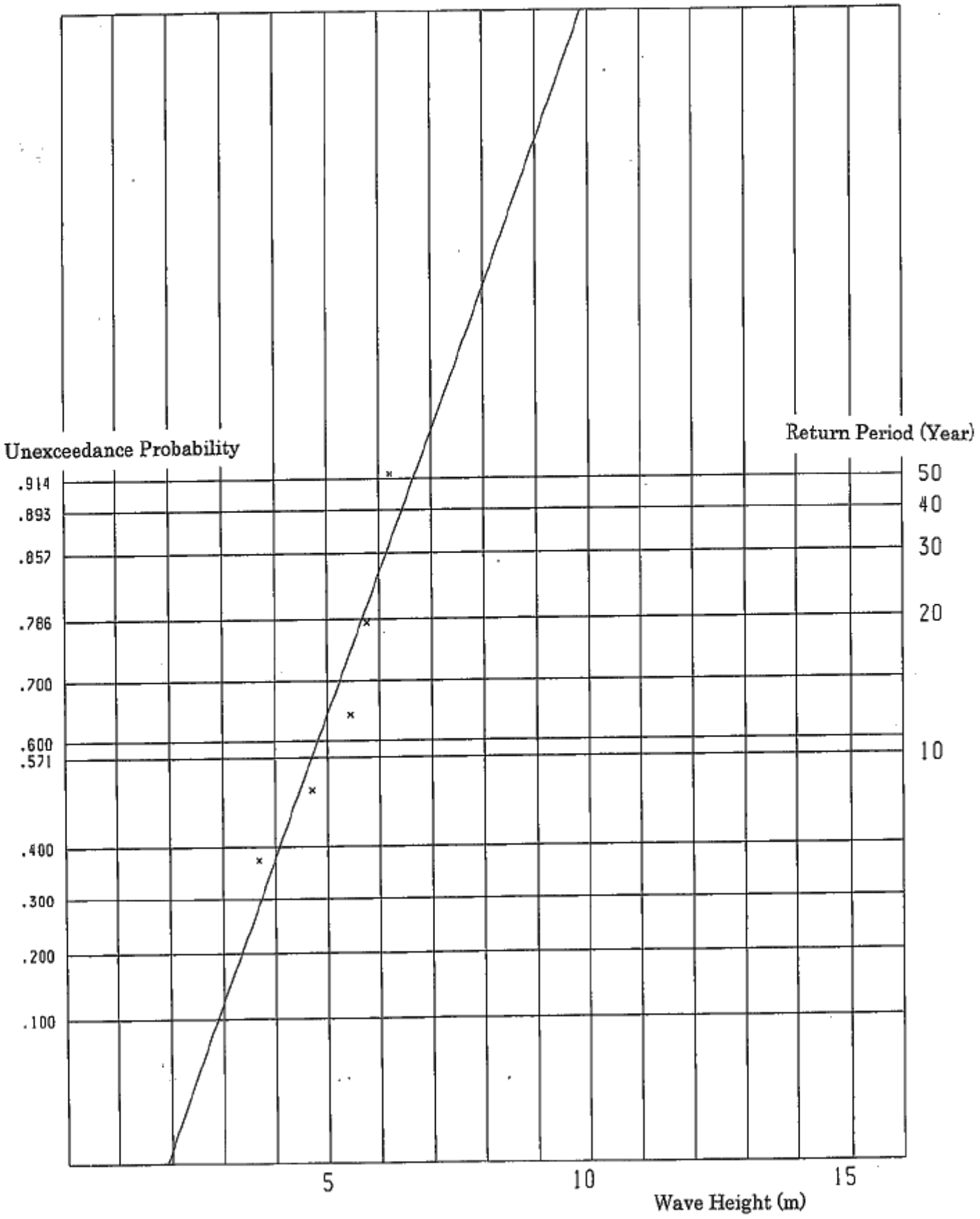


Figure 1.2-4 Return Period (Off Shore Wave Height)

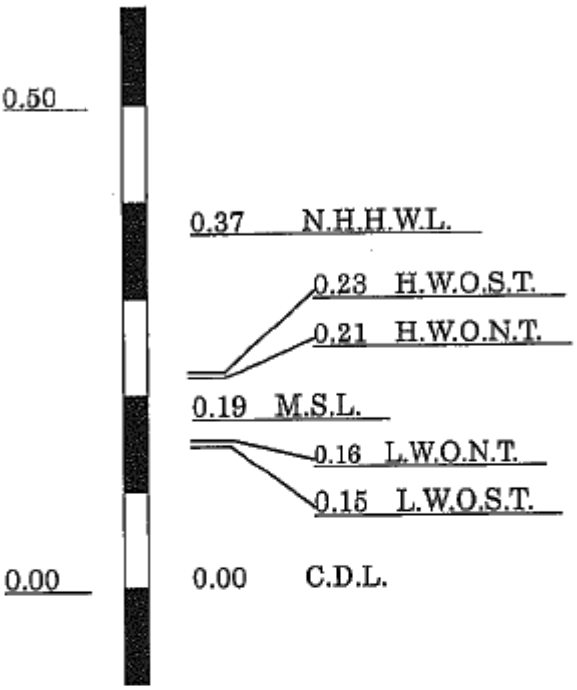


Figure1.2-5(1) Conditions of Tide Levels at Soufriere

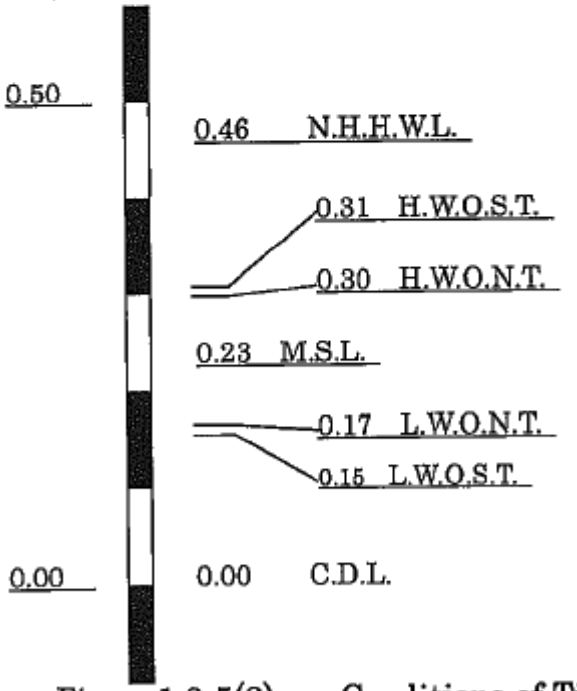


Figure1.2-5(2) Conditions of Tide Level at Choiseul

3) Tidal currents

Appendix A·40 to 41 and A·43 to 45 shows the currents observed during the field survey. The tidal current was weak in Soufriere, the strongest one being around 0.2 m/s. The direction of the current was SSW. In Choiseul the tidal current was somewhat stronger than in Soufriere, the strongest one being around 0.35 m/s. The main direction of the currents was SSW as in Soufriere.

4) Littoral drifts

Since ocean waves were low and the tidal currents were weak in Soufriere, it can be considered that the littoral drifts may not be active. In Soufriere the only source of creating littoral drifts is Soufriere River. The soil and sand discharged from the river are drifted into the deeper areas in the bay or transported cross-shore northward and southward in the bay. It can be assumed that the volume of soil and sand deposited in the deeper part of the bay will be the largest, and cross-shore littoral drifts northwards will be slightly stronger that those which are transported southward.

In Choiseul a small river flows into the sea close to the southern part of the site. However, the catchment area of the river is small and it cannot be assumed that large quantities of soils are discharged to the sea. There are a stretch of wave-eroded cliffs close to the beaches in the vicinity of Choiseul. These cliffs could be possible sources of littoral transport should they be collapsed or eroded by wave actions. Since the waves in Choiseul are not very high, the littoral transport of sediments may not be strong. It is apparent that the littoral drifts flow from south to north, and this fact must be taken into account in the design of a breakwater.

Chapter 2 Contents of the Project

The purpose of this project is to develop the fishing industry in Soufriere and Choiseul, the major fish landing sites along the west and west-south coast of St. Lucia through the improvement of fishery infrastructures.

2-1 Purposes of the Project

2-1-1 Present Problems and Constraints in Soufriere and Choiseul

(1) Soufriere

(a) Soufriere is located in the west coast of the island and is not affected by the easterly wind that prevails throughout the year in St. Lucia. The project site is located in the innermost part of the bay and is favored with the calm and safe area for mooring fishing boats. However, the island lies in the area frequently affected by hurricanes. The project sites are not provided with any harbour protection facilities against hurricanes for neither fishing boats nor onshore facilities and suffer from serious damages by hurricanes. At the time of Hurricane Lenny at the end of November 1999, 8 fishing boats were lost and fish landing facilities were seriously damaged.

(b) The hurricane caused damages to the existing fish landing jetties, the fish market and the fishermen's cooperative office to the extent that these facilities can no longer properly used. Currently, the fishermen prepare for fishing trips and unload their catches by pulling their boats up the beach. This situation causes laborious work to fishermen and resulting low working efficiency.

(c) Soufriere is one of the country's main tourist areas which provide a number of facilities for marine leisure of yachting, etc. There are nearby coral reefs under environmental protection and tourist diving is enjoyed. Sea area around Soufriere is utilized for various purposes and accordingly fishing areas are rather limited. In recent years there has been marked depletion of fishery resources in Soufriere with fish catches decreasing, though the national fish production is in the

trend of increase.

(d) With tourism developing in Soufriere area, many fishermen are increasingly engaged in side businesses, and the number of full-time fishermen is therefore decreasing. This trend is particularly high among young generation. Therefore, it is necessary to enhance fishing productivity and revitalize fishing communities by attracting young fishermen to fisheries.

(e) The existing fish landing area is planned to be developed as a tourism oriented urban-type waterfront with promenades and shopping malls. In this connection, the existing fish landing facilities in front of the fisheries cooperative office need to be relocated.

(f) Securing ice is difficult due to lack of ice-making machine and storage facilities. Soufriere is the country's largest tourist area and the demand for fresh fish from the town residents is very high. Unavailability of ice supply deteriorates freshness of fish and thereby lowers fish price. Although there are ice-making facilities in Vieux Fort and Castries, their capacities are not enough to supply ice to the other areas.

(g) There are no basic fishing port facilities as administrative office, a meeting place for training, and repair workshop for fishing boats, engines and fishing gear.

(h) Not all the fishermen live in the vicinity of the fishing port, and they often leave their engines and fishing gear on the beach, since it is difficult for them to bring them back to their homes.

(2) Choiseul

(a) The Government has taken up the exploitation plan of fishing grounds of offshore migratory fish and high-class bottom fish as the most important target in fisheries sector development. However, because most of fishing boats are wooden canoes with a limited

sailing range, it is not presently possible to operate in offshore waters. To achieve this target, the government has set up the policy of modernization of wooden boats by replacing with FRP boats. On this background, the Government has an intention of modernizing the fishing boats in Choiseul, the country's third major fish landing point, in the same pattern as that experienced in Dennery, where such modernization has been rapidly achieved through fishing port development and provision of FRP boats under Japan's Grant Aid.

(b) Choiseul, located on the southwest coast of the island with a straight coast line, is under influence of waves penetrating through St. Vincent Channel from the Atlantic Ocean and frequently affected by waves with a height of about 1 m. Furthermore, there are a lot of boulders scattering on the seabed, which makes mooring of fishing boats in a front water area dangerous. All the fishing boats have to be pulled up onto the beach covered with boulders. This situation is considered to be as one of the factors hampering modernization of the fishing boats in Choiseul.

(c) As there are no suitable waters providing refuge to fishing boats at the time of hurricane waves, they have to be pulled up to slope of a cliff behind a trunk road in order to protect them from the waves. Eight fishing boats were damaged in Choiseul at the time of Hurricane Lenny.

(d) There are presently no facilities at all for landing fish catch and all the fishing boats are pulled up onto the beach. Both in sailing out to sea and in coming back, boat handling needs at least ten men, which makes efficiency of fish catch landing operation low and working condition of the fishermen severe.

(e) Between the shoreline and the cliff behind, there is a single row of houses and the only trunk road within a distance of several tens of meters. Therefore, land area for fishing port development is extremely limited.

(f) An access road to the village is narrow with many bends and steep slopes in some places. Inside the village, the road is also narrow and often congested because of parked vehicles which makes it extremely difficult for large vehicles to pass through.

(g) The fishing port is provided with such minimal facilities as fishing gear lockers, a workshop and fish handling shed, but they have deteriorated due to serious corrosion of steel materials. In fact, the support columns of the fishing gear locker are severed at the foundations, posing the risk of collapsing. As for the fisheries cooperative office, it is very small and deteriorated. Furthermore, there are no facilities used for such purposes as training, conference, etc.

(h) Lack of ice-making and storage facilities poses the problem of securing of ice. Choiseul is a landing point for catches of high-value bottom fish, but because of deterioration of freshness of fish due to lack of supply of ice, those catches can not fetch a price that deserves them. Although there are ice-making facilities in Vieux Fort and Castries, they do not produce enough ice to share with.

2-1-2 Mutual Complementary Relationship Between the Two Areas

Although the two areas lie at a close distance each other (14km by road), they make a distinct contrast with respect to the community and fishing conditions. In Soufriere area tourist development is progressing, resulting in engagement of fishermen in other part-time work and tendency of young fishermen resigning from fishing business. On the other hand, Choiseul area represents a typical fishing village, and modernization of fishing activities and accompanying formation of an active fishing village are main issues in fisheries development. Because of such differences between the two areas, they form a close complementary relationship with respect to the points mentioned below, and simultaneous provision of fishing port facilities at two sites can be expected to further strengthen that complementary relationship between them as explained below.

(1) It is mainly the fishermen of Choiseul that catch the kinds of high-value fish needed by the tourist industry, while the fishing in Soufriere concentrates in catching coastal migratory fish. Because Soufriere is the country's best tourist area with many hotels and restaurants there is a considerable demand for high-value fish. This situation facilitates the close relationship between two areas as regards high-value fish: Choiseul as a production area and Soufriere as a consumption area.

(2) In view of the signs of depletion of the coastal fishery resources in Soufriere, it is necessary for the fishermen there to switch to catching offshore migratory fish and high-class bottom fish as in the case of the fishermen in Choiseul. For this purpose, it is important to have advices from Japanese specialists sent there and guidance by Department of Fisheries, but much is also expected in the way of technical exchanges between the fishermen themselves in two areas.

2-1-3 Purposes of the Project

The purposes of the project are to improve safety and efficiency of operation of the fishing boats and fishery facilities in two sites and freshness of fish by solving current problems in two major landing points of Soufriere and Choiseul. The project is expected to strengthen the mutual complementary relationship between the two sites and raise the living standard of the fishermen as well as to contribute to efficient and sustainable utilization of fishery resources. Project scopes and expected effects in two sites are summarized below;

(1) Soufriere

New fish landing facilities are planned including a fish landing wharf, a slipway, an administration office, a fresh fish market, a workshop, a fishing gear locker, an ice-making facility, a fuel oil supply facility and sanitary facility on the right bank of Soufriere River, the expected effects thereof being:

(a) Improvement of the efficiency of fish landing operation and freshness of fish catches

(b) Development of a fishermen's village having various functions of selling of fresh fish, repairing of fishing gear, fishermen's meetings, fishermen's cooperative activities. Resulting vitalization of fishery activities through improvement of fishing operation and thus improving the standard of living of fishermen.

(c) Complete restoration of fishery facilities functions damaged by Hurricane Lenny in 1999.

(2) Choiseul

A land area will be created by reclamation in the water area in front of the existing fish landing point, and new fish landing facilities will be constructed including a breakwater, wharf, slipway, an administrative building, a fresh fish market, a workshop, a gear locker, an ice-making facility, a fuel oil supply facility and sanitary facilities. Furthermore, provision of FRP fishing boats will be planned for modernization of fishing boats in Choiseul, the following effects being expected thereof:

(a) Development of under-exploited offshore fishing grounds through modernization of fishing boats by introduction of FRP boat and securing of a safe mooring basin.

(b) Higher efficiency of fish landing operation through provision of a wharf in calm waters and thereby improvement of freshness of fish.

(c) Development of a fishermen's village through establishment of infrastructure facilities having various functions such as selling of fresh fish, repairing of fishing gear, fishermen's meetings, fishermen's cooperative activities. Resulting vitalization of fishing activities through improvement of fishing operations.

(d) Ensuring safety of fishing boats and fishermen through provision of a mooring basin at the time of very rough seas.

2-2 Basic Concept of the Project

The Government of St. Lucia has requested the Japanese Government to improve infrastructure and provide related equipment for modernization of the fisheries industry in Choiseul, the third most important fish landing point, and Soufriere, which has a close complementary relationship with Soufriere. In response to the request, the present project is to work out the plan of construction of fisheries facilities and procurement of related equipment in those two sites.

2-2-1 Basic Policy Regarding Construction of Facilities

The project has been formulated according to the following basic policy:

(a) Analysis of the projects in Dennery and Vieux Fort to serve as a basis for careful judgment on whether or not the requested itmes of the project are in line with the aimed fisheries industry modernization policy.

(b) Appropriate determination of project scale through adequate examination of the actual situation regarding number of fishing boats, number of fishermen, volume of fish catches, fishing activities, etc. by means of field study.

(c) Careful consideration on the environmental effects caused by the facilities and their construction works planned in the project, particularly the fish landing facility in Soufriere and the breakwater in Choiseul, and examination of measures to minimize the adverse effects thereof.

(d) Selection of the structural types of the facilities allowing easy maintenance, considering use of materials locally available in St. Lucia for members that deteriorate through corrosion. Careful study to minimize maintenance dredging volume in Choiseul fishing port.

2-2-2 Examination of Requested Items

The results of study on the project content requested by the Government of St. Lucia are summarized below:

(1) Soufriere

The requested and proposed project content for Soufriere are listed in Table 2.2-1, and the components are briefly described in the sections hereinafter.

Table 2.2-1 Request of Project Items (Soufriere)

Request Items		Description	Project Component	Description
1.	Jetty	-	Landing Jetty	23m
2.	Slipway	-	Slipway	Width:4m Length:20m Manual Winch 1pcs.
3.	-	-	Revetment	Sea side 110m River side 66m
4.	Access Road	-	Road in the Port Area	Pavement
5.	Administration Building	Concrete two story COOP Office Ext. Officer Office Meeting Room Retail Shop Storage	COOP Office Ext. Officer Office Meeting Room Retail Shop Storage Lavatory	162m²
6.	Ice Making Plant	2 tons/day	Ice Making Plant	0.75 tons/day
7.	Ice Storage	5 tons	Ice Storage	1.5 tons
8.	Work Shop	-	Work Shop	90m²
9.	Gear Locker	30 units	Gear Locker	30 units
10.	Shower Room Lavatory	For men and Women	Shower Room Lavatory	50m²
11.	Fish Market	10 Stalls	Fish Market	4 units
12.	Gas Facilities	-	Secured Space Only	30m²
13.	Septic Tank	Night soil Treatment	Wastewater Treatment	Discharged Water of BOD 20PPM
14.	Back up Generator	-	———	
15.	Vehicle	Insulated Car	———	
16.	Related Tools	-	Maintenance Tools	1set
17.	-	-	Associated Facilities	Parking Lot Drainage/Plumbing Lighting Facility Light Beacon etc.
18.	Fish Cart Fish Box	-	Fish Cart Fish Box	3 carts (120kgs) 5 boxes (20kg)
19.	Computer and Printer	-	Computer and Printer	Desktop Type 2sets Inkjet Printer 2sets

(1) Civil Engineering Facilities

(a) Landing wharf

The existing fish landing wharf has been seriously damaged by Hurricane Lenny beyond restoration. Therefore, it is necessary to build a new fish landing facility at the site chosen for this project (about 500 m to the north of the existing landing point) in order to improve the efficiency of fish landing operation.

Only one swimming beach in Soufriere is located to the north of the project site and the Government of the St. Lucia has strongly requested that its sandy beach be protected. Therefore, it is appropriate to construct a open type fish landing wharf as requested, since construction of any solid structures could interfere with littoral drift. The design depth of the wharf is determined as 2 m in order to allow an clearance to the draft of FRP fishing boat.

Because there is a water area for mooring yachts very close to the project site on both north and south sides, a light beacon is planned at the end of the wharf for safe navigation.

(b) Slipway

Soufriere can be said to be a good natural port as its water area is usually very calm. Therefore, the fishermen moor their fishing boats either on the convenient sandy beach or nearby water area, and therefore there is not much need to provide any concentrated fishing boat mooring facilities. Therefore it is concluded that a narrow slipway wide enough to haul up a fishing boat is planned for fishing boats for repairs and for refuge at the time of hurricane. A manual winch is provided for efficient up hauling operation and light beacons are installed for safe navigation at appropriate locations.

(c) Protective works in the vicinity of the site

On the south side of the site, a river without embankment flows out. Considering also the fact that the site is expected to be attacked by high waves at the time of hurricane, adequate protection works are necessary in the vicinity of the site (on the south and west sides) in order to prevent beach erosion and destruction, and invading wave.

(d) Emergency storage yard for fishing boats

At the time of Hurricane Lenny, Soufriere fishing port was struck by unexpectedly high waves. In such case, fishing boats with engines can take refuge at safe nearby harbors such as Choiseul or Vieux Fort. For transom and other boats without engines, however it is necessary to provide a space for refuge on land for the event of sudden storms.

(e) In-port road

As there is no road in the site from the national highway to the fishing port presently, a vacant government owned land area between the common cemetery and the warehouse is used for access. Access from the national highway to the port facilities is constructed in this land area.

(2) Functional Facilities

(a) Ice-making and ice-storage facility

Soufriere has no ice supply facility and hence no ice is used in the stages of catching fish and distribution. Therefore, it is impossible to maintain freshness of fish. This is to cause large waste of fish and leads to a lower price In order to reduce loss of fish and obtain higher price and thereby increase fishermen's earnings, ice-making and -storage facility for ice supply is necessary.

(b) Fuel supply facility

In St. Lucia, it is an established local practice that fishermen's cooperatives sell such fuel using the facilities constructed by oil companies. Therefore, land space is allocated in this project for a fuel supply facility in the vicinity of the fish landing facility.

(c) Septic tank

Presently there is no sewage treatment facility in Soufriere and the night soil from households and buildings in town is generally treated in the septic tank and discharged into the earth. However, various domestic wastewater from kitchens and bathrooms is directly discharged into the river or sea untreated. However, in recent years, Ministry of Health has been enforcing the environmental preservation and providing administrative guidance to project owners in the case of a housing

development project or a hotel construction project in a costal conservation area, so that they may install an adequate equipment to treat not only night soil but also various wastewater discharged from the project facilities. In the case of the present project, it is required that the wastewater from fish processing and shower be also treated in addition to night soil.

Although so far there are a few cases of such total treatment in St. Lucia, it is considered that a suitable environment has been established for managing a small sized private wastewater treatment plant appropriately from the following two facts: 1) chlorine products for sterilization are readily available in local markets, 2) Water and Sewage Company Inc.(WASCO) provides sludge collection and treatment services using its vacuum trucks and treatment facility at Rodney Bay.

Now, therefore, it is judged appropriate to provide in this project a wastewater treatment tank instead of a septic tank that has been requested.

(d) Emergency generator

Electric power supply in Saint Lucia is stable and meets the demand. According to the information furnished by the power supply company, power failures have been experienced three to four times in a year due to torrential rains, lightning, hurricane, etc. but the duration of trouble is limited to about six hours in maximum. The project facilities include an ice-making machine and a septic tank with aeration pumps that are designed for 24 hour continuous operation. However, even if they should stop operation due to power failure, any significant functional problem will be expected to both facilities. Because the ice-making machine is equipped with an ice storage facility, while the septic tank may lose biochemical effects only to minimal level. Through above considerations, the necessity and investment effect of the requested emergency generator has been evaluated not high.

(3) Architectural Facilities

(a) Administration building

The operation and maintenance of the project facility after the completion will be put under the responsibility of a council to be jointly

organized by the town council of Soufriere and Soufriere Fishermen's Cooperative Society. The Fishermen's Cooperative will do the day-to-day work of management and running of the project facilities on the basis of the decisions of the council. The Fisheries Department will supervise the council by providing guidance and assigning fishery extension personnel for carrying out extension services regarding fishing gear, fishing methods, fisheries management, etc.

The Fisheries Cooperative has provided support not only to its members, but also to non-members. Its main activities are sales of fishing gear, engine parts, propane gas and fishing boat fuel oil as well as provision of information. After the project is completed, the fisheries cooperatives will undertaken the responsibility of management and running of various facilities.

Presently the Soufriere fisheries cooperative has a two-story wooden building that serves as both an office and a retail shop. However, as the space is too small and the building is dilapidated. As it is located about 500 m away from the project site, it would be both inconvenient and inappropriate to manage and run the new fishing harbor on the basis of continued use of that building. Therefore, it is necessary to build an administration building on the site of new fishing harbor that can serve as the base for the activities of the fisheries cooperative, which needs an office room, a shop and a storeroom for goods.

Since the Fisheries Department undertakes extension services concerning fishing gear, fishing methods, etc. and information dissemination for fishermen, it is necessary to provide a meeting room in the administration building. As things now stand, they have to borrow an empty space in the town whenever they want to hold a course or meeting, because they are without such a facility of their own. Because of that limitation they hold the activities only a few times a year. The Fisheries Department plans to put greater efforts into extension services once such a meeting room is provided and to use it at least once every month for various activities, including fishermen's conventions which will be held for the purpose of propagation of general information. Furthermore, the fishermen's cooperative has a council meeting every month and a general meeting of its members at least once a year, so it is considered that such a meeting room is very much needed.

Besides that, the administration building shall have another office room for a fishery extension service officer, staff washroom, a kitchenette and a storeroom for keeping miscellaneous objects such as cleaning implements and other apparatus needed for maintenance and folding chairs for meetings.

(b) Building for ice-making machine and ice storage facility

Because the ice-making machine shall be installed inside a shelter in order to prevent deterioration by being exposed to the rain and salty air of the seaside, a building is necessary to be built in the project to protect the machine together with the ice storage facility.

(c) Workshop

In St. Lucia it is the fishermen themselves who make fishing gears, repair fishing nets, upkeep fishing boat hulls and daily maintenance of out board engines. Because the fishermen at Soufriere do not presently have any workshop for common use, they have to do such work on the beach under the hot sun or on their boats that have been brought up onto the beach. It is difficult to do such work properly, because painting of fishing boat hulls is often exposed to the direct rays of the sun, and staging cannot be secured for engine repairs. Hence there is the need for a workshop appropriate at Soufriere.

(d) Fishing gear lockers

Since almost all of St. Lucia's fishing boats are small without any cabin or hold, the fishermen there cannot safely keep fishing gear and the like onboard. When there are no facilities in boat mooring area for keeping fishing gear and others, they have to bring their fishing gear, fuel tanks, water tanks, lifesaving jackets, etc. from their homes to their boats whenever they go out to sea back again to their homes. It is the same when they return to the shore and go. This represents a great deal of unnecessary hard work for the fishermen.

Presently at Soufriere there are no fishing gear lockers for the fishermen. Instead, there are only a few temporary sheds illegally built by them on the beach. Therefore, it is needed to construct fishing gear lockers in this project for the sake of more efficient preparations for going

out to sea and putting things away after returning and reduction of hard work of the fishermen.

(e) Shower and lavatory

In St. Lucia it is the practice for fishermen at fishing harbors to take showers before going home and many of its fishing harbors have shower facilities for that purpose. That is quite understandable considering its hot weather all year round. Therefore, it is considered necessary to provide shower facilities at fishing harbors from the standpoint of health management of fishermen.

Furthermore, it is important also from the viewpoint of sanitation control of the project facilities and environmental conservation of the area to provide public toilet facilities for the fishermen and visitors such as middlemen and local residents, who will come to the project facilities to purchase fish. Thus the need for such facilities is great. As there are no public lavatories near the project site, it shall be necessary in this project to provide a shower room and a lavatory.

(f) Fish handling shed

At the fishing ports of St. Lucia the fish that has been landed is taken into a shed, where it undergoes primary processing (sorting, washing and gutting) and is then sold to middlemen or directly to consumers. It is normal for a fishing port to have such a shed serving as a fish market furnished with tables for processing and sales. At Soufriere, too, there is such a facility next to the fisheries cooperative office, and primary processing and sales take place there. But a half of the existing facility has been destroyed by a hurricane, and it remains in that condition. Furthermore, because that location is too far from the project site, it would be inappropriate to continue to use it after completion of the new fishing harbor. Therefore, building of a new facility to replace the existing one has to be included in this project.

(g) Ancillary building facilities and outdoor facilities

Ancillary building facilities such as air conditioning and ventilation facilities, water supply and drainage, sanitation facilities, and electrical facilities are necessary for each building depending on the use

thereof. In addition to those, there are needed a parking space, internal roads, storm water drains, and outdoor lightings for fishermen to set up fishing before dawn and those returning to port after dusk.

(4) Equipment

(a) Insulated car

In Soufriere and Choiseul areas, fish is not distributed to inland area much. The Government of St. Lucia and FMC want the fishermen's cooperatives to take over the role of distribution. For the purpose, the FMC is planning to provide the fishermen's cooperatives with guidance concerning itinerant sales and to supply fish to them at wholesale prices.

However, the fisheries cooperatives do not have any experience of fish selling as routine work in inland area nor have any particularly concrete plan of itinerary sale of fishery products at present. Therefore, it is considered that a time is not matured yet for introduction of the insulated vehicles for inland distribution of fish. Through the consideration above, it has been decided to wait and see how the fishing port will be managed and operated after completion of the fishery facilities planned in the project, before judging whether or not insulated vehicles are of absolute necessity. Therefore, the insulated vehicles are not included in the scope of this project.

(b) Carts and fish boxes

Carts and fish boxes are needed for efficient and sanitary conveyance of fish from the wharf to the retail sales place. The carts would also be used for carrying ice, fishing gear, etc. and would therefore be effective in making the fishermen's work easier.

(c) Workshop equipment

The work for turning over a fishing boat upside down for repairs and lowering outboard engines into the water tank for inspection and repair of requires a lot of labor and is also dangerous. It is necessary to provide a workshop with a chain block for the sake of making the work more efficiently and ensuring safety. A cart with a hunger to carry outboard engines is also necessary.

The following common tools are necessary for maintenance and

repair works of fishing boats and its engines.

Compressor
General Tools
Vise
Speed Cutter
Electric Grinder
Tester
Jack

(d) Computers and printers

The administrative building will house the offices for the Fisheries Department extension service personnel and the fisheries cooperative. The role of the Fisheries Department extension service personnel is that of providing support to the present project through extension service and guidance activities aimed at the cooperative personnel and fishermen. As for the cooperative, its role is that of sales of fishing gear, fuel, etc. and management of those inventories, facility management of the ice-making machine, multi water treatment tank, etc., management of catch volumes, rental management of fishing gear lockers, collection of the related fees, and other management and control functions. Considering the diversity of their work, it is judged to be meaningful to provide computers and printers for the sake of making such office work more efficient. Because there is a difference in the respective work content of those two entities (the Fisheries Department extension service personnel and the fisheries cooperative) and they will have separate offices, it is necessary to provide one computer-and-printer set for each of them, i.e., two sets in all.

(e) Apparatus and tools for the ice-making plant and ice storage facility

Besides their common accessories, the ice-making machine and ice storage facility shall be provided with the necessary maintenance and upkeep equipment as per the following list:

For the ice-making plant:

vacuum pump
charge hose
tube cutter

flare tool
gas detector

For the ice storage facility:

scoop
basket
platform scales

(2) Choiseul

Table 2.2-2 summarizes the project contents requested and planned for Choiseul area, and evaluation of each facility is given in the following.

Table 2.2-2 Request of Project Items (Choiseul)

	Request Items	Description	Project Component	Description
1.	Breakwater	-	West Breakwater North Breakwater	106m 27m
2.	Reclamation	-	Reclamation	11,000m^3
3.	Wharf	-	Gravity Type Wharf	100m
4.	Slipway	-	Slipway	Wide:30m Length:20m Manual Winch 2pcs.
5.	Access Road	-	Temporary Road	Unpaved
6.	Administration Building	Concrete two story COOP Office Ext. Officer Office Meeting Room Retail Shop Storage	COOP Office Ext. Officer Office Meeting Room Retail Shop Storage Lavatory	162m^2
7.	Ice Making Plant	2 tons/day	Ice Making Plant	1.1 tons/day
8.	Ice Storage	5 tons	Ice Storage	2.2 tons
9.	Work Shop	-	Work Shop	90m^2
10.	Gear Locker	40 units	Gear Locker	40 units
11.	Shower Room Lavatory	for Men and Women	Shower Room Lavatory	50m^2
12.	Fish Market	12 Stalls	Fish Market	6 units
13.	Gas Facilities	-	Secured Space	30m^2
14.	Septic Tank	Night soil Treatment	Wastewater Treatment	Discharged BOD 20PPM
15.	Back up Generator	-	———	
16.	Vehicle	Insulated Car	———	
17.	FRP Boats with 85 hp Outboard Engines	20 units	FRP Boats with 85hp Outboard Engines	20 sets 25 feet
18.	Fishing Gear	Long Line	Long Line 300m/unit	60 units
19.	Requisite Tools	-	Maintenance Tools	1 set
20.	-	-	Incidental Facilities	Car Parking Drainage & Plumbing Lightning Light Beacon etc.
21.	Fish Cart Fish Box	-	Fish Cart Fish Box	3 carts 5 boxes
22.	Computer and Printer	-	Computer and Printer	Desktop Type 2sets Inkjet Printer 2sets

(1) Civil Engineering Facilities

(a) Breakwater

Because the coastline on the southwest part of St. Lucia, where Choiseul is located, is flat, it is susceptible to the attack of high waves that come from the Atlantic Ocean through the St. Vincent Passage; waves with a height of about 1 m are quite frequent. In addition to that, there are lots of boulders sitting on the seabed there. They pose the danger of damage to boat hulls when boats hit against them when rolling and pitching in heavy seas. It is not possible for fishing boats to be safely moored and rest in the waters near the shore, and it is necessary for all of them to be hauled up onto the beach, which is also strewn with large rocks.

In the case of wooden boats, it is necessary to bring them onto the land and dry their hulls when they are not in operation as a measure against damage to them by shipworms. In the case of FRP on the other hand, boats is not only unnecessary hauling up the boats on the beach but also undesirable because that can cause damage to their hulls. The necessity of hauling up the boats on the beach is a factor that has retarded modernization of Choiseul's fishing fleet (changeover to FRP boats), which has in turn delayed development of yet under exploited fishing grounds. Therefore, it is necessary to provide a breakwater that will ensure a relatively calm basin where the fishing boats can safely land their catches and moored when not in operation and where they can seek refuge when hurricanes strike or when there are heavy seas. Furthermore, light beacons will have to be provided at the end of the breakwater for the sake of safe navigation.

(b) Wharf and slipway

Since Choiseul does not yet have any catch landing facilities, the fishing boats there have to be hauled up onto the beach, which is strewn with large rocks, for the purpose of landing of catches. That work of bringing them onto the beach is very strenuous work for the fishermen, requiring a dozen men or more a time. It is therefore necessary to provide a catch landing facility for the sake of making that work more efficient, reducing the labor burden on the fishermen and improving safety. Since the catch landing facility will be safely protected by the

breakwater and in view of the fact that the ground foundation of the site is sturdy, it is appropriate to build a wharf there.

It is also necessary to have a slipway for bringing up canoes after they land their catches for grounding fishing boats when they need to be repaired, and for providing safe storage on land for the fishing boats when seas are particularly heavy. The slipway will have to be equipped with the necessary number of hand-operated winches for hauling.

(c) Reclamation

At Choiseul a cliff is located only 30-40 m away from the beach. There are rows of houses in the narrow space with their backs to the cliff as well as a trunk highway next to the sea. Therefore, it is impossible to find any land for new fishery facilities there, leaving only the option of creating a new space for that by land reclamation.

(d) Dredging

In order to keep planned water depth, dredging work is necessary. There is a merit to save construction cost by using the dredge spoil the land fill material of reclamation work.

(e) Construction road

Mountains are looming right behind the Choiseul fishing village, and the road coming into it is full of curves and bends and also narrow. At same junction points, abrupt changes in the road surface level exist. Furthermore, the road is narrow coming into the village from the supply points of materials such as rocks in the south side of the site, where the construction yard is planned. As the road passes through the middle of the village, it is congested almost every day. Moreover, the houses are tightly packed right up to both sides of the road, and the people who live there cannot help being adversely affected by the vibrations and noise that will be caused by the construction vehicles that pass by, which could easily result in trouble with residents. Therefore, the present situation is very unsuitable for efficient and safe transportation of heavy construction machinery and reclamation materials, rubble stones, etc.

Concerning transportation of construction materials it will be necessary either to build a temporary construction road for

transportation of construction materials transportation along the route that circumvents the village or to bring in the construction materials by sea transportation.

The scheduled site of the possible construction work road is presently privately owned land, but the Government of St. Lucia has basically agreed to use the land, and if necessary, it is planned to purchase it before commencement of the construction work. If the sea transportation option is taken, the place of loading of the construction materials would be the commercial port of Vieux Fort. Calculation of the respective costs of the two options has shown that construction of the temporary road would be more economical. There is a possibility of quarrying materials needed for the reclamation work from the seabed near the site. However, besides environmental problems that that might give rise to, various materials such as rubble stones , concrete blocks, etc. have to be transported breakwater, and getting only reclamation materials from the nearby seabed does not present much advantage.

In view of this study, it has been considered that it is necessary to have a temporary construction road to ensure a smooth execution of construction work.

(2) Functional Facilities

(a) Ice-making machine and ice-storage facility

Choiseul does not have any ice-making facility presently. For the same reasons as stated for the case of Soufriere, it also has to be provided with such a facility.

(b) Space for fuel oil supply facility

As at Soufriere, at Choiseul too, there will be provision of a space next to the catch landing facility for a fuel oil supply facility.

(c) Septic Tank

Choiseul does not accommodate any sewage nor treatment facility. For the same as states for the case of Soufriere, it is understood to have multi-water treatment tank as well.

(d) Emergency Generator

Condition of electric power supply in Choiseul is regarded same as Soufriere, therefore such a generator is not necessary with the same reason.

(3) Architectural Facilities

(a) Administration building

The need for an administration building at Choiseul is the same as explained for Soufriere. As in the case of Soufriere, Choiseul now has also a small and dilapidated fisheries cooperative building which is located 150 m away from the project site. Therefore, it is necessary to build an administration building there in this project.

As the function and the number of operation staff will be the same as in the case of Soufriere, the rooms needed in it will be the same as well.

(b) Building for ice-making plant and ice storage

For the reasons as stated for Soufriere, a building is needed for the ice-making machine and ice storage.

(c) Workshop

The need for a workshop at Choiseul is entirely the same as at Soufriere, but there is already a workshop there that was built in the past under Japanese grant aid, which is still being used. However, there has been severe dilapidation of the structural steel frames of the existing building owing to corrosion. In addition, the location will be too far from the waterfront when the project facilities are constructed. Thus, it will be inappropriate to make continued use of it practical. Therefore, it is necessary to build a new building in this project

(d) Fishing gear lockers

Most of the fishermen of Choiseul live in the hills behind the project facilities. Because it is very hard for them to take their fishing gear and other things back and forth between the harbor and their homes everyday, the need for fishing gear lockers is basically the same as in the case of Soufriere. At Choiseul, however, there are two buildings of a total of 40 fishing gear lockers that were built in the past under Japanese grant aid, but those lockers are severely dilapidated due to corrosion of

their steel frames to the extent of sudden collapse.

It is, therefore, necessary to provide new fishing lockers in the project site in place of existing facilities.

(e) Shower and lavatory

Choiseul has the same needs of shower and lavatory as Soufriere, though there are already such facilities at Choiseul. However, the existing ones are quantitatively insufficient and in addition a half of them has become unusable through dilapidation. Moreover they are located some 150 m distant from the new fishing harbor. Thus, it would be extremely inconvenient to continue to use them after completion of the new fishing harbor. It is therefore necessary in this project to construct a new shower and lavatory facility.

(f) Fish market

Choiseul's need for a fish market is the same as that of Soufriere. There exists such a facility adjacent to the existing workshop, which was built under Japanese grant aid at the same time as the workshop. However, as is the same as the workshop, its steel frame structure has been seriously dilapidated by corrosion. Moreover, as in the case of the workshop, it will be quite distant from the waterfront and inconvenient to use it continuously when the new fishing harbor is completed. Thus, it is necessary in this project to build a new facility to replace it.

(g) Ancillary building facilities and outdoor facilities

As the same as in the case of Soufriere, the same ancillary building facilities and outdoor facilities are needed.

(4) Equipment

(a) FRP fishing boats

The main purpose of planning a new fishing port in the area is that of increasing the income of fishermen and improving their standard of living through increase of sustainable fishery production under resource management on the basis of acceleration of development of undeveloped fishing grounds through modernization of fishing boat fleets (changeover to FRP boats).

In the past, the Japanese aid in the way of construction of fishing ports and provision of FRP fishing boats has been a considerable success in contributing to a rapid modernization of fishing fleet. Thus it is considered that provision of FRP fishing boats and outboard engines in the same quantities (including fuel tanks) is an effective measure for working toward that end.

Those FRP fishing boats furnished in the past were all sold to the fishermen at FOB price, and there has been smooth accumulation of the funds thus generated.

Considering that, in this project there will be provision of twenty FRP fishing boats along with outboard engines (85 Hp) just as requested by the Government of St. Lucia.

(b) Fishing gear

Fishing methods and fishing gear in St. Lucia still need improvement in many respects, and those concerned there are quite aware of that. That is why they are working hard for grooming of their own extension service personnel, chiefly on the basis of the help provided by specialists rent there by Japan. What is particularly desired by the government and fishermen of St. Lucia is that tuna long-line fisheries techniques be learned by them and take roots in their fishery industry.

Although presently there is introduction of all sorts of fishing methods and practical training in their application on the basis of guidance provided by specialists sent by the Japanese Government, such methods have not yet taken hold in actual fishery operations because of the actual fishing gear required for them are not used yet. In this project there will therefore be provision of the necessary fishing gear to the Fisheries Department with the aim of contributing to learning of tuna long-line fisheries techniques and to their wide and ongoing usage.

(c) Insulated vehicles

As in the case of Soufriere, it is considered that refrigerated vehicles are not needed at the present time.

(d) Carts and fish boxes

As in the case of Soufriere, carts and fish boxes for conveyance of fish will be provided in the necessary quantities.

(e) Workshop equipment

Since there is no difference between Soufriere and Choiseul in the functions of the workshop or in the specifications and quantities of the fishing boats, engines, etc. that will need to be repaired, the workshop at Choiseul will be provided with the same kind of chain block and hoist, carts fir conveyance of outboard engine and the following common tools:

Compressor
Vice
Speed Cutter
Electric Grinder
Tester
Jack

(f) Computers and printers

The administrative building will have the offices of the Fisheries Department and the fishermen's cooperative. The work of those two offices will be entirely the same as in the case of Soufriere, and there will be no difference in the number of personnel accommodated either. It is therefore appropriate for each of those two offices to be provided with one set (computer and printer each, i.e., two sets in all,) as in the case of Soufriere.

(g) Apparatus and tools for the ice-making plant and ice storage facility

Just as in the case of Soufriere the following such equipments will be provided:

For the ice-making machine:

vacuum pump
charge hose

tube cutter

flare tool

gas detector

For the ice storage facility:

scoop

basket

platform scales

2-3 Basic Design

2-3-1 Design Standard

(1) Design Standards for Civil Facilities

St. Lucia has no particular established design standards concerning civil engineering work. Therefore in this project use will be made of the Japanese design standard for fishing port structures "Fishing Port Structures Standard Design Methods" and, in supplementation, "Technical Standards for Port and Port Facilities and Explanatory Notes." Furthermore, the following other Japanese standards may be used as standards for the civil engineering facilities:

(a) "Fishing Port Standard Design Methods" of the National Fishing Port Association
(b) "Technical Standards for Port and Port Facilities and Explanatory Notes" of the Japan Port and Port Association
(c) "Concrete Standard Specification" of the Japan Civil Engineering Society
(d) "Japan Industrial Standards" (JIS) of the Japan Standards Association
(e) "Soil Testing Methods" of the Japan Soil Engineering Society
(f) "Road Paving Guidelines" of the Japan Road Association
(g) "Roadway and Road Drainage Works Guidelines" of the Japan Road Association
(h) "Sewer Design Guidelines and Explanatory Notes" of the Japan Sewer Association

(2) Design Standards for Architectural Facilities

In St. Lucia no official building codes are established yet, but guidance is given and inspection of design is conducted by the authorities mostly based on the Caribbean Uniform Building Codes: CUBIC. In the basic design of the project, reference is made to CUBIC and the following standards of Japan.

(a) « Building Codes of Japan, Enforcement Ordinances and Notifications of the Ministry of Construction »
(b) « Guidelines for Structural Analysis and Calculation »
(c) « Guidelines for Designing Foundations of Small Buildings »
(d) « Structural Design Guidelines for Reinforced Concrete Structure »
(e) « Standard for Structural Design of Timber Structures »

(f) « Common Specifications for Building Works, 1997 »
Note: 2), 3), 4), and 5) are published by the Architectural Institute of Japan
(g) is published by Public Buildings Association under the supervision of the Ministry of Construction

2-3-2 Design Concept for Soufriere Area

(1) Design Concept for Civil Facilities

1) Natural conditions for design

(a) Wave conditions

Soufriere is a good natural port that normally does not have too much high waves. On the other hand, the seabed gradient out in front of the port is a very steep bay approximately 1/5, meaning that high waves by hurricane can reach the beach without being attenuated by the seabed, especially from the westerly direction. That is thought to have been the reason why the area suffered so much damage by Hurricane Lenny. It is therefore necessary to take the influence of such waves fully into account in the design of the structures to be provided in the project.

Particularly regarding with the Jetty, it is necessary to fully consider the up lift pressure at the time of high waves.

(b) Littoral drift conditions

Since, as mentioned above, the wave conditions of the Soufriere area are calm, the littoral drift sand activity can be considered not to be very pronounced. However, on the north side of the project site, there is the Soufriere area's only swimming beach, and its preservation is an important task consideration of the area's tourist development aspirations. It is therefore necessary particularly in design of the jetty and slipway to be careful not to select the structures that would not hinder the movement of littoral drift.

(c) Ground foundation conditions

The ground foundation in the Soufriere area is not particularly hard, partly owing, to the fact that the river mouth is located nearby. The ground is comparatively soft particularly at deeper depths, where there are depositions of silty sand layers with the N value below 10. It is therefore necessary to avoid heavy structures.

2) Construction materials to be used

(a) Although it is impossible to avoid use of steel materials in the structure of the wharf, it is necessary to give full consideration to their corrosion by such measures as use of materials with a highly protective coating.

(b) Regarding with the structural members that can be expected to be corroded in a short duration of time, it is necessary to check if the structure is one that allows for easy repair by replacement of such members. Therefore the materials should be those readily available in St. Lucia.

(2) Design Concept for Architectural Facilities

1) Consideration to natural conditions

(a) Preservation of sight

The coastline of St. Lucia has a rich natural endowment. Even the buildings of the villages that dot that coastline well blend in with the nature, weaving beautiful harmony between the artificial and natural scenery. In planning facilities to be constructed at a place like that, scenery considerations are therefore particularly important. It is essential not only that the new architectural elements be in harmony with the natural scenery but also that they be designed so as to avoid a jarring sense of incompatibility with the existing townscape. Therefore, the architectural elements will be designed so as to blend in with the buildings around them by making use of materials and construction methods that are common locally as far as possible.

(b) Consideration to soil condition

Since the site will be prepared by filling on the existing bed near the river where the upper layer of subsoil is not necessarily good, it is desirable that the weight of buildings be as less as possible so as to avoid unnecessary occurrence of uneven settlement. Thus, most buildings will be of single story and of wooden rafter roof structure, which is most popular locally. Care shall be taken to provide adequate treatment of the wooden materials against damage by termite.

(c) Consideration to salty air

Damage by the salty air to the building is more or less inevitable on the seashore and thus, use of iron will be refrained as far as possible, and when it cannot be avoided, galvanized materials will be used.

2) Considerations to environmental aspect

What with the heightened international concern regarding environmental problems in recent years, St. Lucia's Ministry of Health is actively working on improvement of environmental sanitation with the aim of avoiding any more environmental pollution than up to now. Therefore, in this project, the facility plans will be formulated on the basis of awareness of the great importance of environmental considerations. The first such consideration has been, as already mentioned, that of adopting a total system to treat not only night soil but also various wastewater from the project facilities. The second is appropriate disposal of industrial waste. As St. Lucia has completed an island-wide refuse and waste collection network, it will be possible to leave collection and disposal up to the authority. But collection of refuse within the harbor grounds is the responsibility of the entity running the harbor. Appropriate handling of wastes at the stage of treatment of the landed fish and in cleaning up of the premises will also reduce pollutant load in the influent of wastewater treatment tank and will lead to its appropriate management. The Fisheries Department should, in cooperation with the Ministry of Health, work for guidance of fishermen and harbor facility personnel concerning handling of wastes and make sure that they are aware of the problem and abide by instructions concerning it. The need for that shall also be stressed in the wastewater treatment tank maintenance manual.

3) Construction materials

The building materials produced in St. Lucia include aggregate, concrete blocks, roofing sheet iron, wooden doors and fittings, and aluminum windows and doors. Most other materials and building equipment are imported from the U.S. and Trinidad. A characteristic of the country in that respect is that most of the imported building

materials are always available on the local market. Therefore, in view of the fact that maintenance will be easy as long as articles that can be procured locally are used, the facilities shall be so designed as to be constructed in use of only materials and products that can be locally procured.

(3) Study of Layout Plan

1) Project Facilities

The facilities to construct in the Project are shown below.

(a) Civil Engineering Facilities
Landing Jetty, Slipway and Revetment

(b) Functional Facilities
Ice-making Machine, Ice storage facility, Land for fuel oil supply and Multi-water treatment tank

(c) Structural Facilities
Administrative office, Ice-making/storage facility, Work shop, Gear locker, Shower/lavatory facility and Fish market

2) Layout Plan

(a) Layout of civil engineering facilities

i) Landing jetty

Landing jetty is located at the center of the Project area as the core of the facility setting up this on centerline of approach road from existing road to fishing port.

ii) Slipway

Slipway is located at north area avoiding fish market where the area resident often visits and at right angle to shoreline for pulling up fishing boats that need repair and the emergency evacuation. Workshop is located at straight center line from the slipway in order to make pulling- up- work effectively.

iii) Revetment

Land for revetment is kept by developing its land. Soufriere area is struck by heavy wave at the time of unusual situation like hurricane

because, the slope of sea bottom is quite sweep although the wave at usual situation is calm. Therefore, it is necessary to have revetment with gentle slope to reduce the wave overtopping and prevent from the scour in front.

Revetment in river side that is not much affected by wave is stood straight so that the original water streams remain unchanged.

(b) Layout of functional facilities

i) Ice-making and storage facility

This facility is located at being convenient both from landing jetty and car parking. Because, ice is used for at fishing boats and at fish distribution process.

ii) Land for fuel oil supply facility

This facility is for supplying fuel oil to fishing boats from jetty. Therefore, its land is expected to be closer place to jetty however, at the same time, it is necessary to consider the convenience for tank lorry to provide fuel oil as well. This condition is as same as ice-making and storage facility and it can be considered that same staff of fishery cooperative covers the sales works of fuel oil and ice. Therefore, the land is kept next to ice storage facility.

iii) Multi-water treatment tank

This facility is located at the place closer to river as last stage of draining system however, at the same time, it is located at the place being possible to access vacuum cars to take left over out.

(c) Layout of Structural Facilities

i) Administrative Office

This facility is located at center of the port as core facility being easy to contact from any points.

ii) Ice-making and storage building

iii) Work shop

iv) Gear Locker

This is located at near jetty considering transportation of heavy staff like gear and engine. Although, 3 gear lockers are built but they are

located collectively for the purpose of fishermen's communication and information exchange.

v) Shower and Lavatory Facility

This is located as public toilet considering the convenience not only for fishermen but also for residents and brokers who come to buy fishes therefore, the location is closer to both gear locker and fish market.

vi) Fish Market

It is necessary to locate this at closest place from landing jetty and at the same time, his is also a center that people assembles therefore, the location is the place near entrance which is easy to access.

(d) Facility Layout Composition

Judging from the above basic understanding, each location positions as under;

i) Administrative office is located at south of the port namely near to entrance located at left hand side faced to sea from access road. Fish market is located at closest to landing jetty and facing to administrative office.
ii) Open space between administrative office and fish market is the place where fishermen and visitors mix together as common space. Car parking is located at back side of the space but the access to the parking is not through the space. It makes a detour of administrative office and the space is open to visitors.
iii) Ice-making and storage facility is located closer to fish market and the open space.
iv) At north side, shower and lavatory building is located and there still mixed area including visitors, from hence, it is the area where gear lockers and workshop are located for fishermen.
v) It is very important in this project to have surrounding concrete block fence and gate that are scopes of work of St. Lucia side since these facilities are for interception from in and out but at the same time, they are the facilities to naturally induce people into the port.

(3) Data for Setting of Scale

1) Number of fishermen and number of fishing boats

Table 2.3-1 shows the numbers of fishermen and fishing boats in the Soufriere area as found in the local survey. Of the fishing boats, the transoms serve as boats for liaison with fishing boats anchored in the offing and as auxiliary boats for setting of fishing nets. The boats that actually engage in fishing activities are the FRP boats and the wooden canoes, and they are collectively referred to here as "fishing boats proper." Renewal of registration of fishing boats takes place every year, and there are hardly any idle boats (according to Fisheries Department information). Therefore the fishing boats indicated here can be considered to actually be in operation.

Table 2.3-1 Fishermen, Cooperative and Fishing Boats at Soufriere

Number of fishermen	Members of fishermen's cooperative		Number of fishing boats				
	All	Boat owner	FRP Boat	Wooden canoes	Fishing boats	Transoms	Total
155	87	38	30	52	82	38	120

Source: Fisheries Department

2) Standard Boat Types and Dimensions of the Fishing Boats

The standard boat types and dimensions of the boats registered at Soufriere are as shown below.

Fishing Boat Specification

Boat type	Length (ft)	Width (ft)	Outboard engine (HP)	Crew
FRP boats	25	5	75	3
Wooden canoes	18-25	5	30~48	2~12

Source: Interview survey.

3) Rate of Operation of the Fishing Boats

At the Soufriere fishermen's cooperative a record is kept of the fuel oil purchases of the fishing boats, having been issued a quota card and left it in its hands. Because the fishing boats necessarily buy fuel oil for each time they put out to sea, it is possible to get an accurate picture of the situation regarding the operation of fishing boats from their fuel oil purchase records. Calculating the rate of operation of Soufriere's fishing boats (rate of putting out to sea of the fishing boats proper) on the basis of "Information 7," one gets 45% for the fishing season (average for the period January-June of 1998 and 1999) and 16% for the off-season (average for the period July-December of 1998 and 1999).

However, this record is only for 23 fishing boats being a member of the fishing cooperative and quota cards were issued and the cards left with the fishermen cooperative therefore, this record is not for the all fishing boats in Soufriere. Based on the record of in-out to port according to the local survey done by survey team this time, by the classification of fishing boats that registered in the record of fuel oil purchase, boats name are registered in listing and non member boats then found that there was no big difference in rate of putting out to sea between fishing boats registered in the record of fuel oil purchase and other fishing boats. It can be assumed that the record of fuel oil purchase shows activity of total fishing boats as a whole.

Therefore one gets the following figures for the number of fishing boats per day that put out to sea (fishing boats proper) in the Soufriere area for both the fishing season and the off-season:

Fishing season:

82 fishing boats proper x 45% = 37 fishing boats per day

Off-season:

82 fishing boats proper x 16% = 13 fishing boats per day

4) Degree of concentration of operation

Although the average number of fishing boats putting out to sea is shown above, the actual number of fishing boats is fluctuated day by day. Especially, at the time of the highest season (usually March), the number of fishing boats is way over the average number. Therefore, it is necessary

to consider such highest condition when the landing facilities are planned. For that purpose, the definition of the degree of concentration of operation is as below.

$$\text{Degree of concentration of operation} = \frac{\text{Average operation for peak 10-day period in the fishing season}}{\text{Rate of operation}}$$

Here we have used 66% as the average value for the top ten in the rankings of the rate of operation in the fishing season in 1998 and 1999 on the basis of the same thinking as adopted in the Vieux Fort fishing port study. At the same time, by adding standard deviation to the average value for the fishing season, one gets 66%, which is about the same as the above figure. Therefore the degree of concentration of operation comes to 66%/45% = 1.47.

5) Volume of Fish Catch

"The volume of fish catch" means here that be volume of fish caught by the boats and "the volume of catch landed" means the fish volume landed to fishing port.

Table 2.3-2 gives the volumes of catches landed at different points surveyed by the Fisheries Department. Because the fishing boats registered at Soufriere and Choiseul also land catches at Vieux Fort (Figure 2.3-1 indicates the situation regarding the catches and landing thereof of the fishing boats registered at Soufriere and Choiseul), the volume of catches landed at the place of registration is less than the volume actually caught. Therefore, it is necessary to use various methods of estimating the actual volume of catches of the fishing boats registered at Soufriere.

In the Vieux Fort Fishery Complex Facility Construction Plan, it was assumed that in the fishing season the fishing boats of the Soufriere and Choiseul areas return to their port of registration after landing one-half of their catch volume at Vieux Fort. Therefore, the volume of catches of the Soufriere area has been set at twice the volume landed according to the government figures.

As can be seen in Table 2.3-2, the volume of catches fluctuations at

Soufriere has been comparatively stable since 1997 after considerable from year to year in the period 1994-1996. Thus that the average value for volume of catches for the period 1997-1999 (89 tons/year) will be used here. This leads to an estimated figure of 178 tons/year for the volume of catches of the fishing boats registered at Soufriere. Table 2.3-3 summarizes the Soufriere area's figures for volume of catches on the basis of sorting out of the above results.

Table 2.3-2 Volume of Fish Catches of Landing Point

Year / Place	1994	1995	1996	1997	1998	1999
Vieux Fort	260.98	154.2	301.6	459.33	379.6	557.06
Castries	43.09	65.67	100.08	45.56	70.61	63.65
Soufriere	126.98	136.2	52.42	94.97	82.80	88.5
Gros Islet	43.34	54.33	109.12	104.82	153.33	121.23
Dennery	170.59	244.9	313.17	254.65	263.30	435.23
Choiseul	109.43	124.7	159.21			
Laborie	32.44	41.62	37.54			
L'anse La Raye	22.30	19.64	19.17	19.22	36.91	17.17
Banannes	21.56					
Canaries	18.09	80.84	93.02			
Micoud	19.17	59.62	61.02	50.49	70.42	60.72
Praslin			29.63	29.08	52.72	30.02
Savannes			56.02	51.72	52.72	101.49
Totals	867.28	981.72	1,315.45	1,311.11	1,461.97	1,718.14

Source: Fisheries Department

Table 2.3-3 Summary of Fish Catches of Soufriere Area

Total Fish Catch (fishing boats registered at Soufriere)	89,000 (kg/year)	Average from 1997 to 1999	Remarks
Ratio of fish catch (fishing season/off-season)	75:25 (%)	Vieux Fort port study	
Ratio of landed volume (Soufriere/other points)	Soufriere : Other places = 50 : 50 (%)		
Estimated fish catch at Soufriere	89,000 X 1/0.5 = 178,000 (kg/year)		
Number of fishing boats (excluding liaison boats and boats for net setting)	82 boats		Wharf
Rate of operation of fishing boats (number of fishing boats of fishing operation/ number of fishing boats)	Fishing season: 45 (%) Off-season: 16 (%) Highest Season 66(%)	Estimated by fuel sales records of fishing boats	Wharf
Average number of fishing boats of fishing operation in fishing season	82 boats x 0.45 = 37 boats		Gear lockers, Fish market
Volume of catches in fishing season (6 months)	178,000 X 0.75 = 133,500kg/year		
Average daily volume of catches in fishing season	133,500 /6(mon) / 30 (day) = 742 (kg/day)		Ice-making machine
Daily volume of catch per boat in fishing season	742 kg / 37 boats =20 kg/day/boat		
Daily fish catch landed at Soufriere per boat in fishing season	20 kg/day/boat / 2 =10 kg/day/boat		
Average number of fishing boats of fishing operation per day in the off-season	82 boats x 0.16 =13 boats		
Volume of catches in the off-season (6 months)	178,000X0.25 =44,500kg/year		
Average daily volume of catch in off-season	44,500kg/6(mon.)/30 (days) = 247 kg/day		
Daily fish catch per boat in off-season	247 kg / 13 boats =19 kg/day/boat		
Daily catch landed at Soufriere per boat in off-season	19 kg/day/boat / 2 =9.5 kg/day/boat		

The above estimated figure has been verified by comparison with (1) the volume of catches estimated on the basis of the average daily income of the fishermen, (2) the volume of catches estimated on the basis of the quantity of fuel oil purchased for the fishing boats, and (3) the volume of catches estimated on the basis of the population and per-capita consumption of fresh fish. The results are as indicated below.

Estimation Method	Estimated Fish Catch kg/day/boat
1) Value estimated on the basis of the average daily income of the fishermen	53
2) Value estimated on the basis of quantity of fuel oil purchased for the fishing boats	64
3) Value estimated on the basis of the population and per-capita consumption of fresh fish	29

The so-called value of 20kg for the daily volume of catch per boat in fishing season is smaller than the figures calculated by above three methods.

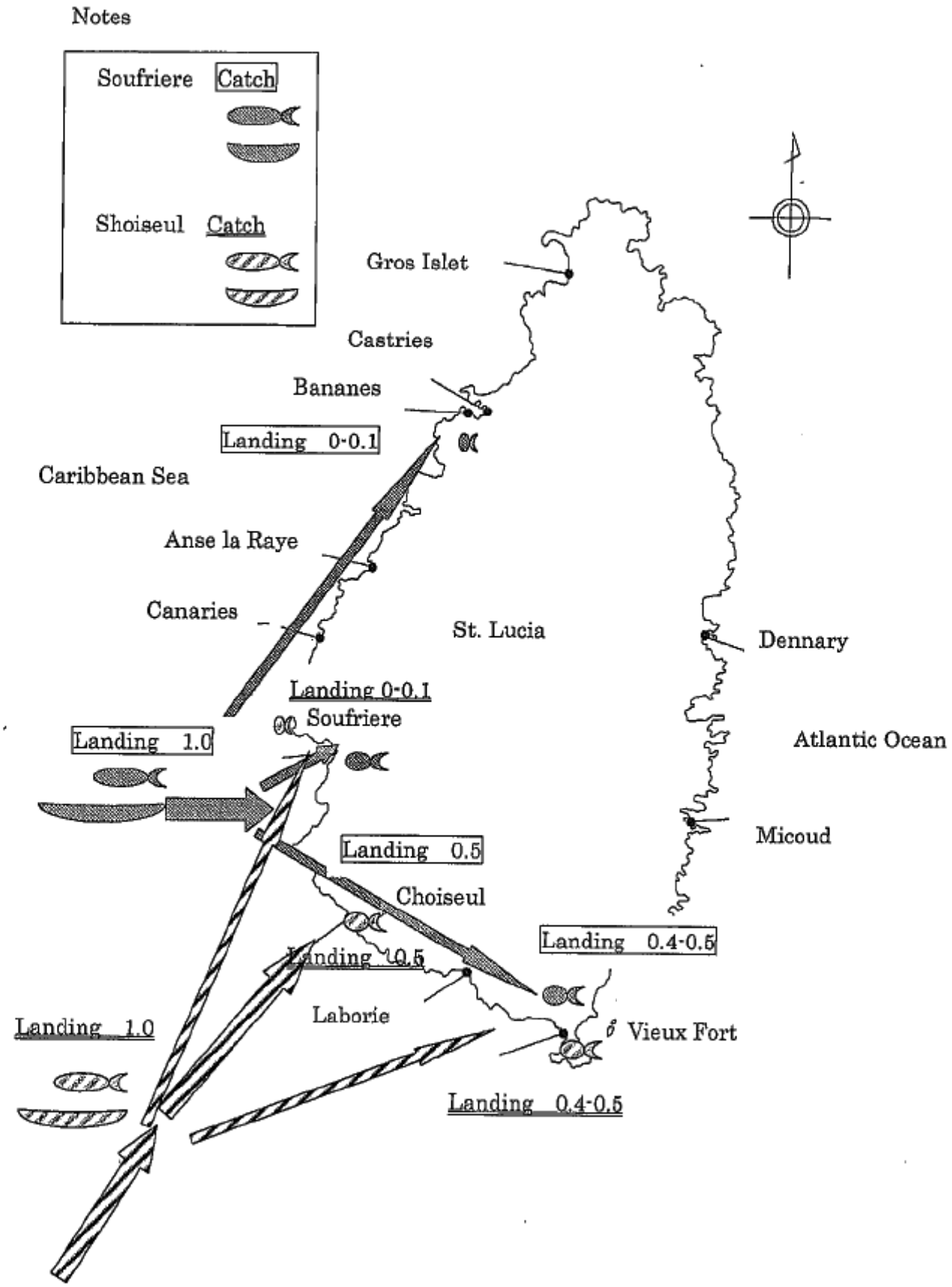


Figure 2.3-1 Situation of Fish Catch and Landing in Soufriere and Choiseul

(4) Basic Facility Plan

1) Civil Engineering Facilities

(a) Landing Jetty

Landing jetty has been adopted considering the area's soil conditions and the need for preservation of the nearby sandy beaches. The dimensions of the jetty will be determined in line with the safety against high waves and with the actual conditions of the catch landing and other work. The jetty will be designed also taking into account the economy and ease of execution of the work.

i) Number of fishing boats in use

A total of 120 fishing boats are registered at Soufriere, i.e. 30 FRP boats, 52 wooden canoes and 38 transoms. The number of fishing boats that will be using the jetty at Soufriere will be therefore be 120.

Of that number, 82 are "fishing boats proper" (which category does not include the transoms since they are used only as liaison boats between the shore and fishing boats anchored in the offing and as auxiliary boats for setting fishing nets).

ii) Rate of operation of the fishing boats

The rate of operation of the fishing boats (ratio of number of fishing sorties to the number of fishing boats proper) has been calculated as 45% for the fishing season and 16% for the off-season.

iii) Concentration rate of operation

The degree of concentration rate of operation in the fishing season has been taken as 1.44.

iv) Cycle time of berthing facilities

Since it is not possible to measure the time it will take to land catches at Soufriere in view of the fact that it presently does not have any landing facility, the idea concerning that adopted in the Vieux Fort Fishery Complex Facilities Construction Plan will be used. The time required for a fishing boat to land its catch is taken as 20 minutes (5 minutes for alongside, 10 minutes for landing the catch and 5 minutes for leaving the wharf), for a turnover rate of 3 boats an hour.

According to the findings of the interview survey concerning entering and leaving of the port by the fishing boats, 70% of such activity is concentrated in the 4-hour period between 12 o'clock noon and 4 o'clock in the afternoon. In this project it is therefore assumed that the average time span for entering port is 4 hours.

v) Dimensions of the fishing boats

. FRP boats: Length: 7.20 m Width: 2.0 m
. Wooden canoes: Length: 6.50 m Width: 1.8 m

vi) Required wharf length

Calculation formula:

Number of operating fishing boats A
= registered number of fishing boats x rate of fishing operation
x concentration ratio
=82 boats × 45 % × 1.47
=54.2 boats

Necessary number of berths N
= A / (berth cycle time × period of returning to port)
=54.2 / (3 cycle × 4 hours) =4.5 ≒ 5 berths

Required wharf length L
= Rate of operating FRP boats x Number of berths
x (FRP boat length + allowance) + Rate of operating canoes
x Number of berths × (Canoe length + allowance)
= (3/8) 5 × (7.2m +1.15) + (5/8) 5 x (6.5m + 1.15) = 39.57m ≒ 40m

where, Number of operating FRP boats
= (Number of FRP boats/Number of all boats) × A
=(30/82) ≒ (3/8)
Number of operating canoes
= (Number of canoes/Number of all boats) × A
=(52/82) ≒ (5/8)

According to the above calculation, the required length of landing jetty is determined as L = 40 m with 5 berths.

(b) Slipway

The boats to use the slipway are considered to be either the fishing boats needed repair at the workshop or the transoms (auxiliary boats);the latter do not have their own means of propulsion and seek refuge at the time of very rough seas, judging from the actual conditions of rest and mooring of fishing boats in Soufriere.

In case that 38 transoms evacuate from emergency situation, it takes 10 minutes to bring up transom one onto land (presently it takes about 10-15 minutes to bring one transom up onto the beach) and it will take approximately 6 hours to finish all of them. But, as the weather station issues a warning of rough seas 6 hours in advance, there should be enough time for safe evacuation of all transoms.

Therefore, it is planned to build a slipway that can handle only one boat at a time. Furthermore, a beacon light shall installed at the end of the slipway as a safety measure for navigation and hauling up of the fishing boats.

i) Width of the slipway

The width of the slipway is set at the necessary width for hauling up one fishing boat, i.e. the width of the boat, or 2 m, plus a margin of 1 m on each side, for a total of 4 m.

ii) Gradient of the slipway

The gradient of the slipway is set at 1/6 as stipulated in the fishing port technical guidelines and also from the aspect of construction being done to landside.

iii) Depth of bottom end and elevation of top end

The bottom end depth of the slipway is set at 1.0 m below the mean ebb tide water level considering the draft of the boats, and the top end height on the land side is set at +2.3m.

2) Functional Facilities

(a) Ice-making machine

i) Selection of type of machine

The types of ice-making machines according to the shape of the ice produced are the block ice machines, flake ice machines and plate ice machines. The characteristics of each are presented below:

- Block ice machines

  This kind of facility requires a lot of space because a large brine tank (secondary cooling tank) is needed. Also needed are a large number of ice-making boxes, a lifting crane, ice removal equipment, etc., making the facility as a whole large-scale for its ice-making capacity.

- Flake ice machines

  In this kind of ice-making machine the input water is dripped onto the surface of a drum-shaped ice-making metal sheet, forming ice on it, and that ice is scraped off by a rotating blade. Characteristic of this type of machine is production of ice without stoppage, but since the ice is formed in only a short amount of time, it is not of very low temperature and melts very soon. Therefore, with it the ice storage facility needs to have its own cooler.

- Plate ice machines

  In this type of ice-making machine the input water is made to flow on the surface of the icing plate to form ice on it, and water or hot gas is periodically made to pass by a timer to strip the plates of ice from the icing plate.

Characteristic of this type of ice-making machine is the possibility of increasing the quantity of ice produced by adding to the number of icing plates. Furthermore, the thickness of the plate ice can be adjusted by timer setting. In other words, its ice production capacity is adjustable, and the machine is compact, which means that it can be installed even where there is little space, and besides that, its maintenance is easy.

After considering the respective characteristics of the three types as mentioned above, in this project the choice goes to the plate ice type of ice-making machine because of its smaller scale and ease of maintenance as well as the fact that the ice does not melt as readily as flake ice does. In fact, ice-making machines which were induced to St. Lucia were this type.

ii) Setting of the capacity (scale) of the ice-making machine

The ice is used for the purpose of being brought by fishing boat and being kept freshness of fish after landed. For the setting the capacity of this facility it has been considered 50% of the volume of the catch since the boats go to comparatively closer fishing ground and return to harbor within a day. It has been also considered that the necessary ice consumption at the time of catch landed as consuming in fish market since the ice is used outside of building so it is easy to melt therefore, same quantity with the volume of catches. That is as follows;

Required ice for fishing operation　　Fish : Ice = 1 : 0.5
Required ice for distribution　　Fish : Ice = 1 : 1

Thus,

Required daily ice quantity
= required daily ice for fishing + required daily ice at fish landing
= 742kg/day × 0.5 + 371kg/day × 1.0
= 742kg/day = 0.75ton/day

Therefore, the daily capacity of ice-making machine is now 0.75 tons

(b) Ice storage facility

i) Study of structure

Using a heat-insulated panel with a thickness of 100 mm, the surface on both sides shall be a stainless steel finish. On the inside there shall be a partition between the ice storage space and space for keeping fresh fish. The walls shall be provided with protection board (for prevention of injury), and the floor shall be provided with an aluminum plate.

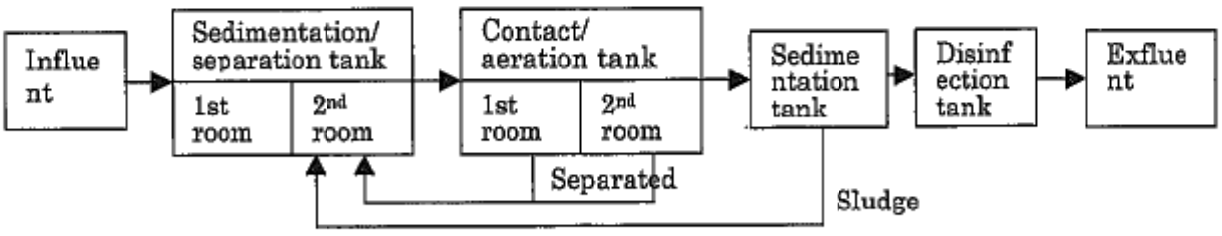
ii) Capacity of the ice storage facility

Considering conditions like fluctuation in ice consumption and times when the ice-making machine is out of order or operation stoppage by power outage or maintenance, it is essential to secure an ice storage capacity in excess of one day's ice consumption. In fact, the existing ice-making machines equip ice storage facilities with the capacity of 2-3 times against ice-making capacity at Castries, Anse la Raye, Laborie, Vieux Fort, Dennery and others in St. Lucia. Therefore its capacity shall be doubled to a daily capacity of 1.5 tons learning from existing facilities.

(c) Wastewater Treatment tank

i) Treatment system

The wastewater treatment tank adopted to the project is a small sized wastewater treatment plant so designed as to treat not only soil water from toilet but also miscellaneous wastewater from showers, fishing gear wash basins, and fish handling process at the fish market in combination. The system has been developed in Japan and its treatment process is categorized as Separation-contact Aeration Process, one of those defined by the Notifications No.2094 (revised in 1995) of the Ministry of Construction of Japan. The treatment system consists of the following processes; 1) separation of liquid and solid, 2) aerobic biological treatment, 3) sedimentation, 4) disinfection and as shown in the figure below:



ii) Pollutant load and treatment capacity

The daily amount of wastewater to be discharged from the project facilities at Soufriere and its pollutant load are calculated as shown in the list below:

Source Facility		Design Unit	Unit Water Volume	Waste water	BOD	Pollutant Load
Operation Staff	Toilet	6 pers	20 ltr.	120 ltr.	260 mg/l	31 g
	Others	6 pers	30 ltr	180 ltr	75 mg/l	14 g
Fishermen	Shower	56 pers	20 ltr	1,120 ltr	75 mg/l	84 g
	Toilet	56 pers	20 ltr	1,120 ltr	260 mg/l	291 g
	Others	111 pers	10 ltr	1,110 ltr	75 mg/l	83 g
Broker Residents	Toilet	25 pers	20 ltr	500 ltr	260 mg/l	130 g
	Others	74 pers	10 ltr	740 ltr	75 mg/l	56 g
Gear Wash	Fishing Boat	29 boats	100 ltr	2,900 ltr	75 mg/l	218 g
Fish Market	Water for Processing	72 m^2	10 ltr	720 ltr	400 mg/l	288 g
Total				8,510 ltr		1,195 g

The average BOD value of discharged water is calculated from the values above as follows:

BOD=1,195 g / 8,510 liter = 140 mg/ltr.

iii) Production and construction of septic tank

Most of small sized wastewater treatment tanks are FRP ready-made in Japan. The ready-made tank is compact in shape and size but complicated in structure with intensive function. Therefore, it requires less area for the installation, but it needs professional knowledge and technique for the proper maintenance, that is usually supported by manufacturers.

In St. Lucia, the wastewater treatment tank mostly means the concrete made septic tank which is to treat night soil only. Thus, ready-made tanks, even simple septic tanks, are not yet popular in the country and there is no agent of ready made tank manufacturers of the United States, not to speak of Japan.

Under the circumstances, it is not adequate to introduce a ready-made treatment tank, because it is difficult to obtain the maintenance services from the manufacturer. Therefore, in this project,

wastewater treatment tanks of concrete made should be constructed on site.

3) Scale of Architectural Facilities

(a) Administration building

The administration building will accommodate an office room for the extension officer of the Department of Fisheries, another office room for the fishermen's cooperative, a shop, a storeroom for goods, and a meeting room to be mainly used for extension activities. In addition to those, staff washrooms, a kitchenette, and a storeroom to accommodate cleaning implements, maintenance apparatus and meeting chairs are also needed. The size of each room is set as follows:

i) Extension officer's office room

This office room will be used jointly by an extension officer of the Department of Fisheries and his assistant (e.g. facility maintenance technician).

2 persons × 10 m²/person = 20 m²

ii) Meeting room

It is expected that the number of persons participating in courses held there will vary approximately between 30 and 70, with an average of about 40. Therefore, the scale of the meeting room will be set on the basis of the assumption of lecture type courses participated in by about 40 persons being held there.

40 persons × 1.3 m²/person = 52 m²

iii) Fishermen's cooperative office room

It will be used jointly by the chairman of the cooperative and its manager.

2 persons × 10 m²/person = 20 m²

iv) Fishing gear shop

Referring to the previous examples in Choiseul and Dennery Fishery Ports, 10 m^2 is given as a suitable floor area for a shop to be operated by one salesclerk.

v) Storeroom for goods

The same as above, also 10 m^2 is given as a suitable floor area of storeroom for goods.

vi) Staff lavatories

Two separate lavatories are needed for men and women. As the number of staff is very limited, the size is minimum with a water closet and a washbasin. Required floor area is about 4.0 m^2.

vii) Kitchenette

The same size as the staff washroom, 4.0 m^2 is given to the kitchenette.

viii) Storeroom for miscellaneous items

About 10.0 m^2 is required for the storeroom of this purpose.

- Corridor and entrance hall

20 % of the total of floor areas above is given to the corridor and entrance hall, that is;

$$(20+20+10+10+52+4x2+4+10) \times 20\% = 134\ m^2 \times 0.2 = 26\ m^2$$

As a result, the total floor area of the administration building is calculated as follows;

$$S=134+26=160\ m^2$$

(b) Building for ice-making machine and ice storage

The scale of this building shall be set at 50 m^2 with two stories based on the capacity, shape and size of the ice-making machine and ice storage, and the space for accommodation of the related equipment, as well as working space around the machine.

(c) Workshop

Referring to the existing workshops at Choiseul and Dennery a simple shed is proposed as the structure of the workshop, which will be used for multiple purposes such as for hull repairs, work on engines and making of fishing gear. However, for the sake of higher work efficiency and less labor, improvement is added to the existing workshop as follows:

- An engine-testing tank
- A hoist rail at the ceiling level to hook a chain block for hoisting an engine or a boat
- 4 storerooms for tools and materials that can be locked for appropriate management

i) Work space for boat repair

- Workload

It is difficult to accurately grasp the workload of the workshop without activity records of the existing workshops. However, interviews at Choiseul and Dennery suggest as follows:

A fishing boat is brought into the workshop about once every year for repairs including painting. The period of stay of a boat is usually from one day to one week. As a result, it is assumed that the workshop workload will average three days for each boat each year.

Operation days for boat repair = 82 boats x 3 days/boat = 240 days

This requires a space for hull work on one boat, which can be used for repairing fishing nets and making fishing gear when it is not being used for repairs on fishing boat hulls.

- Required Space

Required workspace:

Floor area = 10.2 m x 4.8 m = 49.0 m^2.

Where,

Length = (1.5 x 2 + 7.2) m = 10.2 m.
Width = (1.5 x 2 + 1.8) m = 4.8 m.
Boat length = 24 feet = 7.2 m.
Boat width = 1.8 m.
Width of working space = 1.5 m.

ii) Work space for engine repair

- Workload

As a result of interviews at Choiseul and Dennery, it is assumed that daily check and simple repair of engine is done by fishermen on board and such works and repairs in the workshop takes place about once every 3 months, of which the time required on each occasion averages 1 day.

Workload of engine repair space is therefore calculated as follows:

The total number of working days for engine repair
= 82 boats × 1 day/(time·boat) × 4 times/year = 328 days/year

Therefore, enough space is needed for work on one engine at a time.

- Required Space

Assuming an area of about 4 m^2 for the water tank for trial test of the engine, required area is calculated as follow.

Area = 3.6 m x 3.6 m + 4.0 m^2 = 17.0 m^2
Where,
Engine dimensions = 0.6 m x 0.6 m
Work space width = 1.5 m.
Work space: Length = (1.5 × 2 +0.6) m = 3.6 m
Width = (1.5 × 2 + 0.6) m = 3.6 m.

c) Storage area

- Storage rooms

Engine repair tools, Hull repair equipment and materials, Fishing gear and materials, and General storage.

- Size

Area of about 4 m^2 for each type of storage space.

-Working space

About 1 m wide space is required in front of storage doors.

- Area

Required area = 4 × 4.0 m^2 + 1.0 m × 10.2 m = 26.2 m^2.

-Floor area

From the above the floor area of the workshop (S) will be as follows:

$$S = 49.0\ m^2 + 17.0\ m^2 + 26.2\ m^2 = 92.2\ m^2$$

(d) Fishing gear lockers

i) Type of locker

Although there are a few types of fishing gear storage depending on the management system, the proposed fishing gear lockers are of separate type that each user shall be responsible for the maintenance of each booth

ii) Size of one booth

Up to now most of the fishing gear lockers provided at fishing ports in St. Lucia have measured 2 m across the front and 2 m in depth. But questioning of fishermen at Choiseul and Dennery has revealed that many of them are not necessarily satisfied with that size, saying that they would like the front side to be wider. That tendency is particularly strong on the part of fishermen that engage mainly in fishing using nets.

In view of that the width of the front side will be increased 50 cm in this project and the size is 2.5 m wide × 2.0 m deep.

iii) Number of booths

Since the fishing gear locker is a facility for appropriate

management of fishing gear and the like to be loaded on board the fishing boat, a maximum of 1 booth for each fishing boat is needed if it is arranged for all of the fishermen to have access to it. It will be 82 in Soufriere. But since some fishermen can store there fishing gears at home, it is not always necessary to provide the fishing gear lockers for serve all of the fishing boats.

Taking this into account, a total of 30 lockers are requested. Thus, the planned quantity is set at 30.

(e) Shower and lavatory building

i) Shower booths

- Number of users of the facility

From the results of interviews at some fishing ports, it is assumed that 50% of the fishermen on duty will make use of shower and the average number of crews of a fishing boat is 3.

$$37 \text{ boats} \times 3 \text{ persons/boat} \times 50\% = 56 \text{ persons}$$

- Time span of utilization of the facility

It is assumed that the shower is used during 4 hours in the afternoon and two-thirds of users are concentrated in 2 hours of the evening.

- Turnover

Assuming 12 minutes' use per person, the cycle time is taken as 10 persons in 2 hours.

From the above,

Number of showers

$=56 \text{ persons} \times (2/3) / 10\text{persons}/2\text{hours}$

$= 3.7 \longrightarrow$ 4 shower booths

In addition to the above, one shower booth will be provided for use by women engaged in fish processing at the fish market.

ii) Men's lavatory

The necessary quantity of toilet bowls will be calculated for the morning period, when there is greatest concentration of users. For calculation only fishermen will be considered as users thereof, though the users are not only fishermen but also middlemen and local resident who come to buy fish and other visitors, because there are neither middlemen nor local residents there at that time.

- Number of users of toilet bowls

From the results of interviews at Choiseul and Dennery it appears that 50% of the fishermen on duty make use of the toilet bowls. However, it is not very likely that fishermen who live outside Soufriere Bay area will come by boat to use the toilet facilities there on the way to fishing. Thus, only the fishermen living in Soufriere Bay area (77.4% of the total) will be considered as users.

Number of person
=37 boats (average of high season) × 77.4% × 3 persons/boat × 50%
= 44 persons

- Time span of use

It is assumed that two-thirds (2/3) of use thereof is concentrated in the two hours before going out to sea at that time.

- Cycle Time

A turnover rate of 10 users per hour (a total of 20 users in the 2-hour period) is assumed.

Required number of toilet bowls
= 44 persons × (2/3) / 20 = 1.47 2 toilet bowls.

- Number of washbasins and umber of urinals

Since generally in establishments the number of urinals is 2/3 times to 1.0 times the number of toilet bowls and that of washbasins is 1.0 - 2.0 times the number of toilet bowls, the two are respectively set as follows:

Number of wash basins = 3

Number of urinals = 2

iii) Women's lavatory

The users of toilet facility for women are local residents who come to buy fish and women working at the fish market. As the number of users is quite small, the lavatory will be minimally equipped, i.e. with one toilet bowl and one washbasin.

As a result based on the above a), b) and c), it has been determined that approximately 50 m^2 of floor area is required.

(f) Fish market

i) Number of sales counters

- Users

The sales counters will be used by fishermen, who have come back from fishing to treat, display and sell the catches of the day. Thus, the owner or crews of each boat on duty can use one sales counter.

- Time span of use

It is set as 4-hour period in the afternoon.

- Open period

The use time of a sales counter provided to a fishing boat is set at 30 minutes for up to 10 kg catches and an additional 2 minute/kg for the amount exceeding 10 kg.

Volume of catches per boat = 371 kg / 37 boats = 10.0 kg
Use time = 30 minutes + (10.0 kg - 10 kg) × 2 minutes = 30 minute

- Cycle Time of the sales counters

= 240 minutes / 30 minutes = 8 times

- Number of sales counters

= 37 counters / 8 times = 4.6 4 counters

ii) Size of sales counter

At existing fishing ports, two to three persons are working on the catch of a fishing boat for processing and selling. However, the size of the existing sales counters of generally 1.6 m x 1.6 m provides enough work space for one person only and is not enough for efficient division of labor between 2 to 3 persons. Since in this project the use time of a sales counter is set at 30 minutes per 10 kg of catch, such work has to be efficiently organized. Therefore, the workspace has been increased so as to enable efficient work by 3 persons. The needed floor space for one sales counter has been determined as follows:

· Sales counter area	2.5 m × 3.0 m
· Fish handling space	2.5 m × 2.1 m
· Purchasers' corridor area	2.5 m × 2.1 m
Total area	2.5 m × 7.2 m = 18.0 m^2

iii) Required floor area of fish market

Total floor area of the fish market:

18.0 m^2/counter × 4 counters = 72.0 m^2

iv) Arrangement of the sales counters

Two sales counters will be arranged linearly symmetrically to one another, and the wall between them will be removed for mutual effective use of space. By so doing, it will also be possible to make use of two counters simultaneously by 3 fishing boats in case of greater concentration than expected of returning fishing boats.

(4) Design of Architectural Facility

(a) Basic concept

i) Both in Soufriere and in Choiseul the architectural facilities in this project consist of buildings separated by function.

ii) Six (6) buildings, say an administration building, an ice-making machine and ice storage building, a workshop, fishing gear storehouse, a lavatory with showers, and a fish market, will be constructed at each project site.

iii) These buildings have their respective functions and will compose the

overall function as fishing port facilities by having supplemental relations to each other. Thus, they will design so as to hold the same structural system, materials and color in common as much as possible unless the respective functions are hampered.

(b) Layout plan

i) Basic module

As a result of study on the basic dimensions of each building, a common value of 2.5 m has been found in the width of a fishing gear locker and that of a sales counter of the fish market. This dimension also nearly corresponds to the double of suitable width of a shower and lavatory booth. Thus, 2.5 m is adopted as the basic module of the floor planning and set as the dimension between two columns to the ridge direction, which will be applied to all buildings. The module will also be applied to span dimensions as much as possible, unless building function is hindered.

ii) Layout plan of each building

- Administration building

The office rooms are arranged at a location from which the entire area of the fishing port is visible as much as possible. At the opposite side of the center corridor arranged are the staff lavatory and the kitchenette. The fishing gear shop is to be near the entrance. The meeting room, which will be used for multiple purposes, is designed as an open space without exterior walls and arranged at one of the side ends of the building.

- Ice-making machine and ice storage building

The ice-making machine shall be installed above the ice storage so that ice manufactured drops into the ice storage automatically by gravity. Thus, the building is designed to be two-storied. The ice-making machine and relevant equipment are installed at the 1st floor and the ice storage is installed at the ground floor. The surplus spaces around the ice storage at the ground level will be used for carts and fish boxes.

- Workshop

Three sides of the working space for fishing boat hull and engine repair are open without any wall. Along the remaining side arranged are the water tank for engine test and storage rooms for equipment, tools and materials for repair.

- **Fishing gear locker**

Two rows of 5 gear lockers are arranged back to back in double rows so that a fishing gear storehouse consists of 10 lockers of which entrances are lined up on the both sides of the building. The partition walls are made of concrete block up to 3 m high, of which upper part is made of PVC lattice blind board so as to ensure natural ventilation between lockers.

- **Lavatory and showers**

Both lavatories for men and women are arranged in one building and separated with a partition wall made of concrete block up to 3.2 m high, of which the upper part is made of the same PVC lattice blind board as used in the fishing gear storehouse but used in double here for the security.

In order to keep it out of sight and ensure the natural ventilation and lighting as much as possible, the building has no windows at the ordinary window level but there are openings with burglarproof grilles at the higher part of wall. In addition, some walls are made of ventilation bricks at whole part and the entrance doors are made of steel lattice. Moreover, the gables are completely opened, though it is inevitable in case of heavy rain to have spray fall inside. However, it may be acceptable because this is the place to use much water and designed so as to stand moisture. Thus, natural ventilation and lighting is given much more priority.

- **Fish market**

This is the facility where fishermen bring, select, wash, gut, display and sell their catches. It consists of the fish handling space, the fish processing and sales counter area, and the purchasers' passage. Since the activities inside have close contact with those outside and people always repeat being in and out, the building is opened without any wall.

The fish processing and sales counters are arranged at the center of the building in order to separate the space into fishermen's zone and customers' zone which are different in function each other.

iii) Required floor area of building

Table 2.3-4 Required Floor Area of Building

Building	Room	Dimension (m)	Floor (m^2)
Administration Facility	Service officer room	5.00 × 4.00	20.00
	Meeting room	7.50 × 7.20	54.00
	Cooperative room	5.00 × 4.00	20.00
	Fishing gear shop	2.50 × 4.00	10.00
	Storage of shop	2.50 × 3.20	8.00
	Staff lavatory (2)	2.50 × 1.73 ×2	8.65
	Kitchenette	2.50 × 1.73	4.33
	Storage room	5.00 × 1.73	8.65
	Corridor/entrance		28.37
	Sub-total	22.5 × 7.2	162.00
Ice-making plant and ice storage	Machine-room (1st flr)	5.00 × 5.00	25.00
	Ice storage (ground flr)	5.00 × 5.00	25.00
	Sub-total	5.00 × 5.00	50.00
Workshop		12.50 × 7.20	90.00
Fishing gear locker	Soufriere: 3 buildings	12.50 ×4.00 ×3	150.00
	Choiseul: 4 buildings	12.50 ×4.00 ×4	200.00
Lavatory with Showers	For men	7.50 × 5.00	37.50
	For women	2.50 × 5.00	12.50
	Sub-total	10.00 × 5.00	50.00
Fish market	Soufriere	10.00 × 7.20	72.00
	Choiseul	15.00 × 7.20	108.00
Total floor area	Soufriere		574.00
	Choiseul		660.00
Grand total			1,234.00

(c) Sectional design

i) Shape of roof

In order to emphasize a unity of facilities, all roofs have the same slope of 7:10 and are finished with the same material of colored galvanized iron sheet.

ii) Floors

Although a two-storied building has been requested for the administration building, it is designed to be single story for the following reasons:

- A single storied building is easier than the two-storied in respect to having the activity flow lines simpler in floor planning.
- The function is simple and the building is not so big, a single storied building is functionally more suitable than a two-storied building.
- The site is large enough to arrange as many single story buildings as necessary.

Other buildings are simpler than the administration building in function, thus they are single storied except for the ice-making machine and ice storage building, which is required to be two-storied due to the mechanism of ice-making and storage.

iii) Height of floor and floor level

- Principles for floor height

The dimension between two columns or walls to the ridge direction that is 2.5 m is common to all the buildings and the spans are 7.2m, 5.0m, and 4.0m as shown in the table above. In order to emphasize unity of the facilities, floor height is determined so that buildings of the same size in span have to have the same floor height as far as possible.

- Floor level

Since activities in the buildings other than the administration building need easier contact with outdoors, the floor level of those buildings is equally set at GL+100mm. That of the administration building is, however, set at a higher level of GL+640mm for the

convenience of the management.

- Floor height and floor level of each building

Building	Span	Room Height	Floor level
Administration building	7.2 m	3.3 m	0.64 m
Ice-making/ice storage	5.0 m	5.0 m	0.10 m
Workshop	7.2 m	3.3 m	0.10 m
Fishing gear locker	4.0 m	3.1 m	0.10 m
Lavatory with showers	5.0 m	3.3 m	0.10 m
Fish market	7.2 m	3.3 m	0.10 m

(d) Structural design

i) Structural system

- Upper structure

In order to ensure both the structural safety and durability, the main structure of building is designed to be reinforced concrete rigid frame for buildings other than the fishing gear storehouse. For the fishing gear storehouse, reinforced concrete block wall structure is more suitable and economical, because the building shall be separated into 10 rooms with concrete block walls.

Also for the structural safety, the roof must be as light as possible. Thus, wooden rafter coupling roof is applied to all the buildings

- Foundation

According to the soil investigation done during the field survey, the subsoil conditions near the earth surface are as shown below:

Table 2.3-5 Subsoil Conditions

Site	Bore Hole No.	Elevation	Material	N-value	EBCS
Soufriere	No.3	+1.0m	Sandy gravel	10	10 ton/ m^2
	No.4	0.0m	Sandy gravel	10	10 ton/ m^2
Choiseul	No.7	0.0m	Silty sand	26	26 ton/ m^2
	No.8	+0.8m	Sandy gravel	17	17 ton/ m^2

*EBCS: Expected Bearing Capacity of Soil

Other detailed data show that the soil condition of lower layers is gradually better as a whole.

According to the above table, it can be pointed out both for Soufriere and Choiseul that the sub-soil at sea level (El=0.0m) is suitable for bearing layer for such light buildings as the proposed buildings. However, because the ground level will be raised by site preparation or reclamation up to El= 2.3m at Soufriere and 2.2m at Choiseul, it will be uneconomical to set the bottom of foundation at El=0.0m by digging deeply. An economical depth of foundation is considered to be 0.8 m from the designed ground level. Therefore, the bearing layer shall be set at GL-0.8m by reducing the bearing capacity of soil as shown in the following table:

Table 2.3-6 Soil Conditions

Project Site	Soufriere	Choiseul
Expected Bearing Capacity of Soil	10 ton/ m^2	17 ton/ m^2
Bearing Layer Depth	0.0 m	0.0 m
Ground Level	+2.3 m	+2.2 m
Foundation Bottom Level	+1.5 m	+1.4 m
Soil Density	1.6 ton/ m^3	1.6 ton/ m^3
Dry Soil Density	2.4 ton/ m^3	2.3 ton/ m^3
Reduced Bearing Capacity of Soil	7 ton/ m^2	14 ton/ m^2

As the foundation bottom will be laid on filled layer both at Soufriere and Choiseul, in order to prevent buildings from uneven settlement and ensure their stability, strip foundations to the direction of ridge that are connected by footing beams are adopted.

ii) Structural materials

Concrete will be mixed on site both at Soufriere and Choiseul. The type of concrete shall be FC-250 in JIS and its four-week compressive yield strength is more than 250 kg/cm^2. Concrete blocks shall be equivalent to Type-B in JIS of which compressive strength for gross area is 60 kg/cm^2.

Reinforcement bars shall be products available in the local market and equivalent to SD345 in JIS of which tensile yield strength is 4,200 kg/cm^2.

iii) Loads and external force

Taking into consideration the use of each building and the natural conditions of the country, the loads and external forces to be applied to the structural calculation are set as follows:

- Dead load
  - Roof ···· 60 kg/ m²
  - Floor ·· 370 kg/ m²
  - Wall ··· 310 kg/ m²

- Surcharge
  - Roof ····· 90 kg/ m² (for slab and beam)
  - 60 kg/ m² (for girder, column and foundation)
  - 30 kg/ m² (for seismic condition)
  - Ice-plant Floor····· 180 kg/ m² (for slab and beam)
  - ····· 130 kg/ m² (for girder, column and foundation)
  - ····· 60 kg/ m² (for seismic condition)

- Special load (Loads of ice making plant)
  - Ice-making machine ·· 2,000 kg
  - Compressor ·····750 kg
  - Control panel ·····250 kg

- Wind force

The wind pressure is calculated in use of following formula.

$W = C \times q \times A.$

Where

C = Wind force coefficient depending on building.

A = surface area in m^2.

q = pressure given by the following:

$q = 1/2\,\rho \times V^2$

Where,

$\rho = 0.125$ kgf·s^2/m^4

$V = V_0 \times (h/h_0)^{\alpha}$

$V_0 = 60$ m/sec

h = 1/2 × (Beam height + Max. bldg. height)

$h_0 = 10$ m, $\alpha = 0.1$(for coastal area)

- Seismic force

The seismic force is calculated in use of the following formula.

$$Q = Ci \times W.$$

Where, Ci = 0.1 (seismic co-efficient)

W = Weight of building

(e) Building service facilities

i) Electrical facilities

In St. Lucia, electricity supply service is conducted by St. Lucia Electricity Services Ltd (LUCELEC). The power generation capacity exceeds the demand and the supply is stable. The electrical facilities of this project are designed as follows:

- Distribution system

Low voltage power of 240/415 V, 50 Hz, 3-phase, 4-wire will be received from the aerial service network at a pole to be installed near the entrance of the site. It will be then transmitted through underground cables to the main distribution board in the administration building. From the main distribution board, power will be separated into three-phase line and single-phase line and distributed to each branch panel.

- Power supply equipment

The 3-phase 415V power will be supplied to the ice-making machine, blower pumps of the wastewater treatment tank and some tools in the workshop.

- Indoor lighting and socket outlet

The proposed illumination intensity, lighting fixtures, and socket outlets are outlined in the table below. Appliances and materials used in the workshop, lavatory with showers and fish market are anti-salt and moisture-proof type.

Table 2.3-7 Indoors Lighting and Socket Outlet

Building /	Room	Illumination Intensity	Lighting Fixture	Socket Outlet
Admin. Bldg.	Office room	300 lx	2-Fl 40W × 4	3+1AC
	Meeting room	200 lx	1-Fl 40W × 12	1
	Gear shop	200 lx	2-Fl 40W × 2	1
	Storeroom	50 lx	1-Fl 40W × 1	1
	Toilet	100 lx	1-Fl 40W × 1	
	Kitchenette	100 lx	1-Fl 40W × 1	2
Ice-making plant room	1st floor	50 lx	1-Fl 40W × 2	
	Ground floor	100 lx	1-Fl 40W × 1	1
Workshop		50 lx	1-Fl 40W × 6	2+2φ3
Gear locker	Each booth	50 lx	1-Fl 40W × 1	
Fish market	Soufriere	100 lx	1-Fl 40W ×12	6
	Choiseul	100 lx	1-Fl 40W × 8	4

- Telephone

Two telephone service lines will be received from the outside aerial network at a pole to be installed inside the site and led by aerial wire to the terminal board in the administration building. Then the two lines are respectively connected to each telephone outlet to be provided at the fishermen's cooperative office room and the extension officer's office room.

- Outdoor lighting

For the convenience of such fishermen as going to sea before dawn and coming back after dusk, outdoor lighting fixtures will be installed in the vicinity of the front entrance plaza, the pier or wharf and the fishing gear storehouses.

A 400 W mercury lamp will be fixed on an 8 m high lighting pole so as to give a luminance of about 20 lux at a place 5 m away the pole foot.

ii) Mechanical facilities

- Air-conditioning and ventilation facilities

The two office rooms of the administration building will be provided with air conditioners, and the kitchenette and the staff washrooms will be provided with ventilation fans. All other buildings will

have natural ventilation and no air conditioning.

- Water supply facility

In St. Lucia, the water supply service is provided by Water and Sewage Company (WASCO). As the country is rich in water resource and mostly surface water is used by gravity, there is hardly water supply cut, especially in the areas of low altitude like the project site location. In accordance with the guidance of the Fire Service Headquarters, a fire hydrant 4 inch in diameter will be provided to each site. This will ensure sufficient supply with necessary pressure always even in case of heavy simultaneous use unless the fire hydrant is used. In this view, adopted is a direct supply system that is to connect internal service pipelines to the city main without water tank.

Pipelines will be composed of PVC water pipes available in the local market.

- Sanitary installations

The proposed sanitary installations are the following: showers, wall mounted urinals toilet bowls, and water taps at wash sinks in the lavatory with showers; a kitchen sink, washbasins, and toilet bowls in the administration building; water taps at the sink of the fish processing and sales counter, and those at the fishing gear wash sinks. In the staff lavatory, a mirror will be provided. The toilet bowls are low water tank type for easier maintenance reason.

- Drainage facilities

The proposed drainage facilities are to drain soil water from toilets and wastewater from various sources to the wastewater treatment tank and to discharge the effluent from the wastewater treatment tank to the sea. The sources of wastewater are the kitchenette sink, the washbasins in the lavatories, the fish market sink, and fishing gear washbasins as well as showers. They consist of PVC drain pipelines and concrete catch basins.

(f) Construction method and building materials

The construction method to be applied to the project and finish of

proposed buildings have been examined in comparison with local popular method and finish. The results with the reasons of adoption are clarified in Table 2.3-8 and Table 2.3-9 below.

Table 2.3-8 Comparison of Construction Method

Element	Local Method	Applied Method	Remarks
Roof	Wooden rafter coupling structure	Same method	Low cost, skilled in method
Main Frame	Reinforced concrete	Same method	Solidity, durability
Walls	Concrete blocks	Same method	Low cost, skilled in method

Table 2.3-9 Comparison of Finishing Method

Element	Local Method	Applied Method	Remarks
Roof	Colored galvanized iron sheet	Same method	Low cost, easy maintenance
Exterior wall	Paint on mortar	Same method	Low cost, Easy maintenance
Exterior door	Wooden, Aluminum, Steel	Wooden panel door, Alum. glass door	Low cost, Easy maintenance
Windows	Aluminum sash	Same method	Durability, Tightness
Ceiling	Mineral fiber board	Paint on board, Paint on thin mortar	Low cost, Easy maintenance
Interior wall	Paint on mortar	Same method	Low cost, Easy maintenance
Interior door	Wooden	Same method	Low cost, Easy maintenance
Floor	Ceramic tile	Same method	Low cost, Easy maintenance

(5) Equipment to be furnished

(a) Insulated vehicles

Insulated vehicles has been decided not to include in this project with the reason mentioned 2.2.2 study of the request (1) 4) (a).

(b) Carts and fish boxes

It is used mainly for carrying fish therefore, the necessary quantity will be determined by the volume of the catch of fishing boats.

i) Required number of fish boxes

It is the assumption of this project that the daily average of 37 fishing boats operates in fishing season and they return to the fishing port within 4 hours in the afternoon and one boat finishes the landing in 20 minutes. Therefore, necessary average number of fish box will be 3 with the following calculation.

Daily operated number of fishing boat	37 boats
Fishing boats landing per hour	37boats/4 hours=9 boats
Fish box cycle time	once every 20 minutes
Required number of fish boxes	9 boats/3 times/hour= 3 boxes

However, judging from the congestion at the time of highest fishing season and/or the time fluctuation of daily return of fishing boats to harbor, another 2 boxes as spares are necessary.

ii) Size of fish boxes

It is assumed that the daily average catch of one fishing boat is 10kg, but the fishing boxes of 20kg size is to be providing considering the fluctuation of the catch.

iii) Required number of carts

Mutual use of carts is possible at the time of any congested situation like fishing boats return to the fishing port together. Therefore, there is no need to have any margin for the number.

The necessary number is 3 carts.

iv) Size of carts

The type with smallest capacity is the 120kg type. This is the type that will be used.

(c) Workshop related equipment

Although the Martinique type fishing boat weighs approximately 650kg and the canoes each have about same weight when dry, they are heavier when they absorb water. Considering that, one workshop chain block of the 1-ton class will be needed. Furthermore, one cart to carry outboard engine will be furnished.

The following tools will be provided for the purpose of repair for boat hull and engine.

Compressor (pressure 5kg/c m²) ----------1
Common tools (hanger board type)----------1
Speed cutter (whetstone OD 305mm) ----------1
Electric grinder (whetstone OD 100mm) ----------1
Tester (Testable voltage 12 to 600V)----------1

(d) Computers and printers

Since the work of the Fisheries Department and that of the fishermen's cooperative are different from one another, each of the two offices needs its own computer-and-printer set.

The computers will be of the desktop type, and the printers of the ink-jet type.

(e) Ice-making machine and ice storage facility

The following is the minimally necessary equipment for maintenance of the ice-making machine and for the ice storage facility:

i) Ice-making machine:

Vacuum pump (exhaust speed 231 /minute) ---------- 1
Charge hoses (Pressure meter 0-1.7Mpa)----------1
Tube cutter (Cutting Capacity 3-28 mm)---------- 1
Flare tool (Flare size 3/16 – 3/4 inches)----------1
Gas detector ----------1

ii) Ice storage facility:

Scoop (Stainless Overall Length 1075 mm) ----------2

Basket (30 liters)----------2

Platform scales (100 kg) ----------1

2-3-3 Design Concept for Choiseul Area

(1) Design Policy

1) Design Policy of Civil Engineering Facilities

(a) Study of Natural Conditions

i) Waves conditions

Choiseul area is topographically open to the ocean. Being located south of Soufriere area. It is subjected to the effect of diffracted waves caused by the offshore waves generated in Atlantic Ocean. According to the study of location, topography and predominant wave direction of both project sites, higher waves are observed at Choiseul with the comparison at Soufriere. Therefore it is necessary to take the influence of such waves fully into the design of the structures.

Particularly regarding to the construction of the breakwater, it is necessary to design the solid structure to secure the stability against stormy waves.

ii) Littoral drift conditions

Construction of protective facilities shall be considered for securing the area of calm water at Choiseul. According to the results of field surveys, littoral drift from southeast to northeast was prevailed. In case of construction of the breakwater there, there is possibility of coastal erosion of the northwest part, i.e. the down drift side of the sediment. The location and the structure of the breakwater has to be studied with the viewpoint of preventing occurrence of erosion.

Also Sediment accumulation at the port entrance area and basin has to be studied.

iii) Conditions of strata

Because the Choiseul area has rock or gravel layers with N value greater than 50, gravity type structure is more economical than steel structure for the breakwater.

(b) Study of work execution conditions

i) Road for construction

It is necessary to construct the temporary road to cut the steep cliff and cross the river mouth. It is also necessary to provide slope protection

there to prevent collapse during the construction period of temporary road or after completion of the road. Moreover, it is required to pay attention to the possibility of damages caused by the construction of temporary road flooding at backside land area where the road cross the river mouth.

ii) Temporary yard

In the vicinity of the project site, there are no places that can be utilized as the yard for construction equipment, stock piling of materials and field office. Therefore it is necessary to provide the closed yard for the initial stage of the construction works.

2) Policy of Architectural Design

Policies, scales and functions of building facilities, equipped at Choiseul will be resembled such facilities in Soufriere.

(2) Study of Layout Plan

1) Project facilities

The facilities to be provided in the project are described below.

(a) Civil engineering facilities

Breakwater, Revetment, Reclaimed land, Landing wharf, Idling wharf and Slipway

(b) Functional facilities

Ice-making facility, Ice storage facility, Lot for fuel supply facility, Multi-water treatment tank

(c) Structural facilities

Administrative office, Ice-making and storage facility, Workshop, Gear lockers, Shower and Lavatory facility and Fish market

2) Layout plan

(a) Layout of civil engineering facilities

i) Breakwater

Main breakwater (west breakwater) is constructed to close

southwest side and open northwest side to the sea preventing the waves from southwest that is prevailed wave direction at Choiseul. On the other hand, sub-breakwater (north breakwater) is constructed to intercept waves from northwest and keep calmness of the basin.

The port plan is described as long and narrow paralleled to shoreline. The reasons of such layout are based on the necessity of basin with calm waters, land area for facilities and the design to make cross section of breakwater smaller by locating in shallow water area.

ii) Reclamation

Land facilities are developed by reclaimed existing beach. The reclamation is limited to minimum necessary area to construct land facilities. As the result, the plan of reclaimed area become long and narrow paralleled to shoreline.

iii) Wharf

Landing wharf and idling wharf are located at the edge of reclaimed area.

iv) Slipway

Slipway is located at inner bay enclosed by breakwater and wharf for the purpose of pulling up fishing boats and wooden canoes. Workshop is located at southern area in the project site.

(b) Layout of Functional Facilities

i) Ice-making and storage facility

This facility should be located at being convenient both from idling wharf that prepares putting out to sea and car parking since ice is used for at fishing boats and at fishing distribution process however, it is rather difficult to make satisfied both judging from land condition therefore, the priority goes to idling wharf. But, this is located facing to apron of idling wharf so that the access by cars is possible enough.

ii) Lot for fuel supply facility

This facility is located next to ice storage facility same as Soufriere.

iii) Multi-water treatment tank

This is the final stage of draining system and it is necessary to locate the place, which enable to discharge water to the sea outside of the port. Also the place is required to be able to access by vacuumed vehicle to take left over out.

(c) Layout of Architectural Facilities

i) Administrative office

This facility is located closer to entrance as core of the fishing port being easy to contact from any points in the project site.

ii) Ice-making and storage facility

iii) Workshop

iv) Gear lockers

These are located near wharf considering transportation of heavy stuff like gear and out boat engine. Although, 4 flats of gear lockers are built, they are located collectively for the purpose of fishermen's communication and information exchange.

v) Shower and lavatory facility

This is located as public toilet considering the convenience not only for fishermen but also for residents and brokers who come to buy fishes. Therefore, the location is closer to both gear locker and fish market.

vi) Fish market

It is necessary to locate this at closest place from landing wharf. This is also a center that people gathers, therefore, the location is near entrance that is easy to access.

(d) Facility layout composition

Judging from the above basic understanding, locations are described below.

i) Fish market as a core facility of fishing port is located in front of landing wharf and open the front to existing road so that keeps smooth access.

ii) Administrative office is located next to fishing market facing backside to existing road. The reason for this is to observe whole of the fishing port from this office.

iii) The open space in front of fish market is the place, which is the common space for fisherman and visitors. This open space is strictly for pedestrian only.

iv) Facing to that open space and its south side, shower and lavatory facility is located. Ice-making and storage facility and the lot for fuel supply facility are located in front of shower and lavatory facility facing to the wharf. Fishermen and visitors are staying together there. However, 4 flats of gear lockers located in the south of the project site are for fishermen only.

(3) Figures for Setting Scale

1) Number of fishermen and fishing boats

Number of fishermen and fishing boats in Choiseul as determined by the field survey are indicated in Table 2.3-10. Regarding to the fishing boats, the transoms serve as boats for liaison with fishing boats anchored in offshore and as auxiliary boats for setting of fishing nets. The boats that engage in fishing activities actually are the FRP boats and the wooden canoes, and they are collectively referred to here as "fishing boats proper." Renewal of fishing boats registration takes place every year, and there are few idle boats (according to Fisheries Department information). Therefore, the fishing boats indicated below can be considered to be in operation actually.

Table 2.3-10 Numbers of Fishermen and Registered Fishing Boats in Choiseul

Number of fishermen	Members of fishermen's cooperative		Number of fishing boats				
	All	Boat owner	FRP Boat	Wooden canoes	Fishing boats	Transoms	Total
136	80	48	8	51	59	1	60

Source: Fisheries Department

2) Standard type and dimensions of the fishing boats

The standard boat types and dimensions of the boats registered at Choiseul are shown below.

Table 2.3-11 Standard Boat Types and Dimensions at Choiseul

Fishing Boat Boat type	Length	Width	Outboard engine (horsepower)	Crew
FRP fishing boats	25 ft	5ft	75HP	3 person
Wooden canoes	18-25 ft	5ft	30 – 48HP	2 - 12person

Source: Interview survey.

3) Operational Rate

In the same way as Soufriere, the operational rate of the fishing boats (ratio of fishing sorties to number of fishing boats proper) has been calculated from the situation regarding their operation indicated in the records of purchases of fuel for them. The figures obtained as the operational rate (operational rate against fishing boat proper) were 60% for the fishing season and 50% for the off-season. The fuel purchase records obtained concerned 31 fishing boats. As same in the case of Soufriere, operational rate has been studied on the basis of the assumption that this 31 fishing boat's situation of operation is same for whole fishing boats.

Therefore, numbers of operational fishing boats ("fishing boats proper") per day at Choiseul in fishing season and in off-season are described below:

Fishing season: 59 (fishing boats proper) × 60% = 36 boats
Off-season: 59 (fishing boats proper) × 50% = 30 boats

4) Degree of concentration of operation

In the same way as Soufriere, the average operational rate for the peak 10 days in the fishing season in 1998 and 1999 has been studied, these figures are coming to 78%. With addition of standard deviation to the average operational rate in the fishing season, a figure of 78% is obtained, which is about the same as above-mentioned figure. Therefore the degree of concentration of operation has been studied at 78%/60% = 1.30.

5) Fish Catch

Fish catch has been studied on the basis of landed at the different points surveyed by the Fisheries Department as indicated in Table 1.3-2.

As the indication in Table 2.3-2, the figures for the fish catch landed at Choiseul were obtained only for the years 1994-1996. While fish catch was trending upward in that 3-year period, if the total figure of fish catch in 1997 and thereafter is estimated, the figure will be obtained about the same as the average figure for the mentioned 3-year period. Therefore it has been decided to use 131 tons a year as the average figure for fish catch from 1994 to 1996. And fish catch of the fishing boats registered in Choiseul is estimated at 262 tons a year.

Below summarized the above-mentioned results regarding the fish catch in Choiseul.

Table 2.3-12 Summary of Fish Catches of Choiseul Area

Total Fish Catch (fishing boats registered at Choiseul)	131,000 (kg/year)	Average from 1997 to 1999	Remarks
Ratio of fish catch (fishing season/off-season)	75:25 (%)	Vieux Fort port study	
Ratio of landed volume (Soufriere/other points)	Choiseul : Other places = 50 : 50 (%)		
Estimated fish catch at Soufriere	131,000 x 1/0.5 = 262,000 (kg/year)		
Number of fishing boats (excluding liaison boats and boats for net setting)	59 boats		Wharf
Rate of operation of fishing boats (number of fishing boats of fishing operation/ number of fishing boats)	Fishing season: 60 (%) Off-season: 50 (%) Highest Season 78(%)	Estimated by fuel sales records of fishing boats	Wharf
Average number of fishing boats of fishing operation in fishing season	59 boats x 0.60 = 36 boats		Gear lockers, Fish market
Volume of catches in fishing season (6 months)	262,000 x 0.75 = 196,500kg/year		
Average daily volume of catches in fishing season	196,500 /6(mon) / 30 (day) = 1,092 (kg/day)		Ice-making machine
Daily volume of catch per boat in fishing season	1,092 kg / 36 boats =30 kg/day/boat		
Daily fish catch landed at Soufriere per boat in fishing season	30 kg/day/boat / 2 =15 kg/day/boat		
Average number of fishing boats of fishing operation per day in the off-season	59 boats × 0.50 =30 boats		
Volume of catches in the off-season (6 months)	262,000 x 0.25 =65,500kg/year		
Average daily volume of catch in off-season	65,500kg/6(mon.)/ 30 (days) = 364 kg/day		
Daily fish catch per boat in off-season	364 kg / 30 boats =12 kg/day/boat		
Daily catch landed at Soufriere per boat in off-season	12 kg/day/boat / 2 =6.0 kg/day/boat		

(4) Facility Basic Plan

1) Civil Engineering Facilities

(a) Wharf

The wharf is provided in Choiseul. Based on the result of design comparison in terms of stability of structure, construction cost and easiness of construction work, the gravity type is adopted.

a) Length of landing wharf

A: Calculation conditions

i) Number of fishing boats

The total number of fishing boats registered in Choiseul is presently 60, the breakdown being 8 FRP boats, 51 wooden canoes and 1 transom.

The ratio of FRP boats to wooden canoes is presently 8:51 ≒ 1:6, but after provision of new FRP boats, it will be 28:31 ≒ 1:1.

It is considered that FRP boats are substituted for old wooden canoes.

ii) Operational rate of fishing boats

Operational rate of fishing boats in calculated by the same method as Soufriere.

In Choiseul operational rate in the fishing season in 1998 and 1999 were 62.8% and 57.7%, respectively and was about 60% on average.

iii) Degree of concentration

The average of operational rate of fishing boats at highest 10 days in fishing season is 78% and the degree of concentration of working is taken as 1.30.

iv) Turnover rate of the wharf

The turnover rate of the wharf in Choiseul is calculated by the some method as Soufriere. The time required for a fishing boat to land fish is taken as 20 minutes (5 minutes for berthing, 10 minutes for landing fish and 5 minutes for leaving the wharf), and turnover rate is 3 boats per hour.

The time span for landing of fish has been assumed 4 hours same as in Soufriere.

v) Typical size of the boats are as follows;

FRP Boat: length; 7.2 m, width; 2.0 m

Wooden Canoe: length; 6.5 m, width; 1.8 m

B: Number and length of berth required

Number of berths required and berth length are calculated as follows according to "Guidelines for Planning of Fishing Ports".

i) In case of present FRP boats and Wooden Canoes

Number of berths

N=number of fishing boats x average rate of operation x degree of concentration of operation/(berth turnover rate x time span for landing fish)

= 59 boats × 0.6 × 1.3/(3 times/hour × 4 hours}

= 3.83≒ 4 berths

Berth length

L = rate of operating FRP boats × number of berths × (FRP boat length + allowance) + number of operating canoes × number of berths × (canoe length + allowance)

= (1/7) × 4 berths × (7.2m + 1.15m) + (6/7) × 4 berths × (6.5m + 1.15m)

≒ 31.0m

ii) In case after supply of FRP boats

Number of berths 4 berths (same as present one)

Berth length

= (1/2) × 4 berths × (7.2m+1.15m) + (1/2) × 4 berths × 6.5m + 1.15m)

≒ 32m

Taking the result after supply of FRP boats, total length of wharf berths is 32 m.

b) Length of idling wharf

Only FRP boats berth to idling wharf for mooring and idling and wooden are pulled up to slipway. Assuming longitudinal mooring, length of lay-by wharf is calculated as follows according to "Guidelines for planning of Fishing Ports";

Present situation

Total length idling wharf

= number of FRP boats × boat operational rate × (boat width + allowance)

= number of FRP boats × boat operation rate × (boat width + 0.5 x boat width)

= 59 boats × (1/7) × (2.0m + 0.5 × 2.0m) ≒ 30m

After provision of FRP boats:

Length of idling wharf

= number of FRP boats x boat operational rate × (boat width + 0.5 × boat width)

= 59 boats × (1/2) x (2.0 + 0.5 × 2.0) = 84m

Length of idling wharf is 84m considering the situation after provision of FRP boats.

c) Total length of wharf

Total length of wharf is 32m for landing and 84m for idling making a total 116m. However, it is not necessary to secure all the length for fishing boats in landing wharf during the whole day. It is enough to make one berth at minimum for the returning boats out of regular hours or for the sake of emergency. Therefore, the same type of structure will be utilized for both the landing and the idling wharf so that the total length of wharf is 100m.

b) Slipway and boat yard

i) Required width of slipway and area of boat yard

Wooden canoes are accommodated at slipway and boat yard. The required area is calculated based on "Guidelines for planning of Fishing

Ports". It is assumed that numbers of FRP boats are 32 boats decreasing 20 boats from the present situation (52 boats) since wooden canoes will be substituted by FRP boats after provision. Slipway can accommodate one boat at above average water level. The followings are area required slipway and boat yard.

Calculation conditions are shown as below;

Number of registered canoes:	32 boats
Boat length:	6.5m
Boat width:	1.8m
Longitudinal allowance of width:	0.6m
Horizontal allowance of width:	0.5m
Number of rows:	3 rows

Necessary width of slipway and boat yard
= (number of boats using slipway/number of rows) × boat width + {(number of boats using slipway/number of rows) + 1} × allowance of width
= (32 boats/3rows) × 1.8m + {32 boats/3 rows} + 1} × 0.5m ≒ 25m

In addition to the above, two passages to make boats in and out from the yard are necessary.

Width of passages = 2.5m × 2 = 5.0m
Therefore, total width of slipway becomes 25m + 5m = 30m

Necessary depth of slipway and boat yard
= number of rows × boat length + longitudinal allowance × (number of rows – 1)
= 3 rows × 6.5m + 0.6m (3 rows – 1) ≒ 21.0m

2) Functional facilities

a) Ice-making machine

i) Type of ice-making machine

Ice-making machine with the same reason at Soufriere is adopted plate ice type.

ii) Setting of the capacity (scale) of ice-making machine

Production capacity of ice is 1.1 ton per day in the same way as Soufriere.

Necessary daily capacity

= daily necessary ice volume at the catch

+ daily necessary ice volume at the catch landed in this project

= 1,092kg × 0.5 + 546kg ≒ 1.1 ton/day

b) Ice storage facility

i) Study of structure

The structure of ice storage facility is same one with Soufriere.

ii) Capacity of the ice storage facility

As same idea as Soufriere, assuming two times of ice-making capacity, it is 2.2 ton.

c) Septic tank

i) Treatment system

The same system as Soufriere is also applied to Choiseul.

ii) Pollutant load and treatment capacity

The daily amount of wastewater to be discharged from the project facilities in Choiseul and its pollutant load are calculated as follows:

Table 2.3-13 Pollutant Load in Choiseul

Source Facility		Design Unit	Unit Water Volume	Waste water	BOD	Pollutant Load
Operation Staff	Toilet	6 pers	20 ltr.	120 ltr.	260 mg/l	31 g
	Others	6 pers	30 ltr	180 ltr	75 mg/l	14 g
Fishermen	Shower	54 pers	20 ltr	1,080 ltr	75 mg/l	81 g
	Toilet	54 pers	20 ltr	1,080 ltr	260 mg/l	281 g
	Others	108 pers	10 ltr	1,080 ltr	75 mg/l	81 g
Broker Residents	Toilet	24 pers	20 ltr	480 ltr	260 mg/l	125 g
	Others	72 pers	10 ltr	720 ltr	75 mg/l	54 g
Gear Wash	Fishing Boat	36 boats*	100 ltr	3,600 ltr	75 mg/l	270 g
Fish Market	Water for Processing	108 m^2	10 ltr	1.080 ltr	400 mg/l	432 g
Total				9,930 ltr		1,319 g

The average BOD concentration of influent is calculated from the above as values:

BOD=1,319 g / 9,930 liter = 138 mg/l

The proposed wastewater treatment tank is of the same capacity as stipulated by the said Ministerial Notifications. The BOD removal efficiency is 90% or BOD concentration value of effluent is 20 mg/l.

3) Scale of Architectural Facilities

(a) Administration building

Since the scale and system of operation are the same as in the case of Soufriere, the content and scale of this building are the same as there.

i) Extension officer's office room	20 m^2
ii) Meeting room	52 m^2
iii) Fishermen's cooperative office room	20 m^2
iv) Fishing gear shop	10 m^2
v) Storeroom for goods	10 m^2
vi) Staff lavatories (x 2)	approx. 8.0 m^2
vii) Kitchenette	approx. 4.0 m^2

viii) Storeroom for miscellaneous items	10 m^2
ix) Corridors and entrance hall	26 m^2
Total floor area = 134 m^2 + 26 m^2	160 m^2

(b) Ice-making machine and ice storage facility building

The size of ice-making machine and ice storage facility at Choiseul is almost the same as that at Soufriere, though the capacity is different each other. Thus, the size of the building is the same, that is 50 m^2 of floor area and 2 story building.

(c) Workshop

The same content and scale as at Soufriere is given to the workshop at Choiseul.

$S = 49.0\ m^2 + 17.0\ m^2 + 26.2\ m^2 = 92.2\ m^2$

(d) Fishing gear lockers

i) Size of one booth

Although there is some difference between the fishing at Choiseul and that at Soufriere, with difference in the fishing gear used, the size of locker booth is set the same as at Soufriere (2.5 m x 2.0 m) since there is no big difference between them in what is stored at this facility.

ii) Number of booths

The number of lockers is set at 40, the same as the requested quantity by the Government of St. Lucia, which is less than the probable maximum demand of 59, the same number of active fishing boats.

(e) Shower and lavatory building

The same size as at Soufriere is given to the shower and lavatory building at Choiseul, because the demand is almost the same as shown by the basic number of users that is, 111 in Soufriere and 108 in Choiseul, applied to the calculation.

(f) Fish market

i) Number of sales counters

- Users

The same rules as mentioned at Soufriere will also applied to the sales counter management system at Choiseul.

- Time span of use

It is set as 4-hour period in the afternoon.

- Exclusive use period

The same rules as at Soufriere are also be applied to at Choiseul.

-Volume of catches per boat = 546 kg / 36 boats = 15.2 kg

-Use time = 30 min. + (15.2 kg - 10 kg) × 2 min. = 40 min.

- Turnover rate of sale counters

Turnover rate of sale counters

= 240 mi. / 40 min. = 6

- Number of sales counters

Number of sales counters

= 36 counters / 6 = 6.0 6 counters

ii) Size of sales counter

The same size as at Soufriere is given, that is 2.5 m × 7.2 m = 18.0 m^2

iii) Total floor area of fish market

18.0 m^2/counter × 6 counters = 108.0 m^2

iv) Arrangement of the sales counters

The same type of sales counters as at Soufriere are to be used at Choiseul.

(4) Design of Architectural Facility

Design ways used at Soufriere are to be used at Choiseul.

(5) Equipment to be furnished

(a) Fishing boats

Presently of the FRP fishing boats used in St. Lucia are the Trinidad and Martinique types. Proliferation of the Trinidad type is greater because of its lower price. However, as the results of our fishermen interview surveys it is clear that most of fishermen would like to have a fishing boat of the Martinique type, because its broad bottom makes for high stability and it is very sturdy. It is interesting to note that the Martinique type of FRP boat, which is made by shipbuilders in the French overseas department of Martinique, is modeled after a Japanese type boat designed by Yamaha Motors.

In the project, the assumption of the type of FRP fishing boat is same with has the past at Dennery in St. Lucia. Basically its structure will be fishing port project outstanding in terms of safety taking into account the needs to ride the waves well and to navigate a long time at high speeds. Furthermore, it will be made of light-weight, high-strength materials, and the structure will be adequate enough work space for numbers of the crew, space for fishing gear and a fish tank that can be loaded with catches and ice.

The essential points concerning the fishing boats to be furnished in the project are as follows; boat length is about 25', boat width is about 6', boat height is about 2.6', total tonnage is about 1.5 tons and total quantity to be furnished is 20 boats. They will be furnished in a set along with 20 outboard engines of 85 HP, 20 fuel tanks and 20 compasses.

(b) Fishing gear

The Government of St. Lucia is continuing to periodically offer fishermen instruction courses for improvement of fishing methods and fishing gear, and in that connection it intends to make learning of tuna long-line fisheries techniques as the major object. Therefore, the Fisheries Department and the specialist are strongly desirous of furnishing gears of tuna long-line fisheries.

Only three sets (approximate 300 m per set) have been taken as the quantity of tuna long-line fisheries gear that fishing boats can be equipped with considering the space required for crews, ice and fish catches. That makes a total of 60 sets for the 20 fishing boats to be

furnished.

(c) Insulated vehicles

In the same ways of Soufriere, no insulated vehicles will be provided.

(d) Carts and fish boxes

In the same ways of Soufriere, 5 fish boxes (20kg) and 3 carts (120kg) will be provided.

(e) Workshop related equipment

One chain block of 1 ton class and one cart to carry outboard engine will be provided at work shop as same as Soufriere. The following tools as necessary equipment for repair of boat hull and engine at work shop will be also provided.

Common tools

1 number of compressor (pressure 5kg/cm^2)
1 set of common tool (hanger board type)
1 number of speed cutter (grind stone OD 305mm)
1 number of electric grinder (grind stone OD 100mm)
1 number of tester (12·600v voltage)

(f) Computers and printers

In the same way as Soufriere, the two offices will each have a computer-and-printer set. The computers will be desktop type, and the printers of the ink-jet.

(g) Accessories

The following items are minimum necessary equipment for maintenance of ice-making and storage facility

Ice-making machine:

Vacuum pump (1)	(exhaust speed 23l/minute)
Charge hoses (1 set)	(pressure meter 0·1.7Mha)
Tube cutter (1)	(Cutting Capacity 3·28mm)

Flare tool (1)	(Flare size 3/16-3/4 inches)
Gas detector (1)	

Ice storage facility:

Scoop (2)	(Stainless length 1075mm)
Basket (2)	(30 litters)
Scales (1)	(100kg)

2-3-4 Basic Design Drawing

Soufriere/Choiseul Fishing Port

Figure 2.3-2	General Layout Plan at Soufriere
Figure 2.3-3	Plan of Access Way at Soufriere
Figure 2.3-4	Plan of Jetty at Soufriere
Figure 2.3-5	Plan and Section of Slipway at Soufriere
Figure 2.3-6	Section of Sea Side Revetment at Soufriere
Figure 2.3-7	Section of River Side Revetment at Soufriere
Figure 2.3-8	Plan and Section of Administration Building at Soufriere/Choiseul
Figure 2.3-9	Elevation of Administration Building at Soufriere/Choiseul
Figure2.3-10	Plan and Section of Ice Making Plant and Ice Storage Building at Soufriere/Choiseul
Figure 2.3-11	Elevation of Ice Making Plant and Ice Storage Building at Soufriere/Choiseul
Figure 2.3-12	Plan and Section of Workshop at Soufriere/Choiseul
Figure 2.3-13	Elevation of Workshop at Soufriere/Choiseul
Figure 2.3-14	Plan and Section of Fishing Gear Storehouse at Soufriere/Choiseul
Figure 2.3-15	Elevation of Fishing Gear Storehouse at Soufriere/Choiseul
Figure 2.3-16	Plan and Section of Lavatory with Showers at Soufriere/Choiseul
Figure 2.3-17	Elevation of Lavatory with Showers at Soufriere/Choiseul
Figure 2.3-18	Plan and Section of Fish Market at Soufriere
Figure 2.3-19	Elevation of Fish Market at Soufriere
Figure 2.3-20	General Layout Plan at Choiseul
Figure 2.3-21	Section of West Breakwater (A) at Choiseul
Figure 2.3-22	Section of West Breakwater (B) at Choiseul
Figure 2.3-23	Section of West Revetment (A) at Choiseul
Figure 2.3-24	Section of West Revetment (B) at Choiseul
Figure 2.3-25	Section of North Breakwater at Choiseul
Figure 2.3-26	Section of North Revetment at Choiseul

Figure 2.3-27 Section of Landing Wharf at Choiseul
Figure 2.3-28 Plan and Section of Slipway at Choiseul
Figure 2.3-29 Plan and Section of Fish Market at Choiseul
Figure2.3-30 Elevation of Fish Market at Choiseul

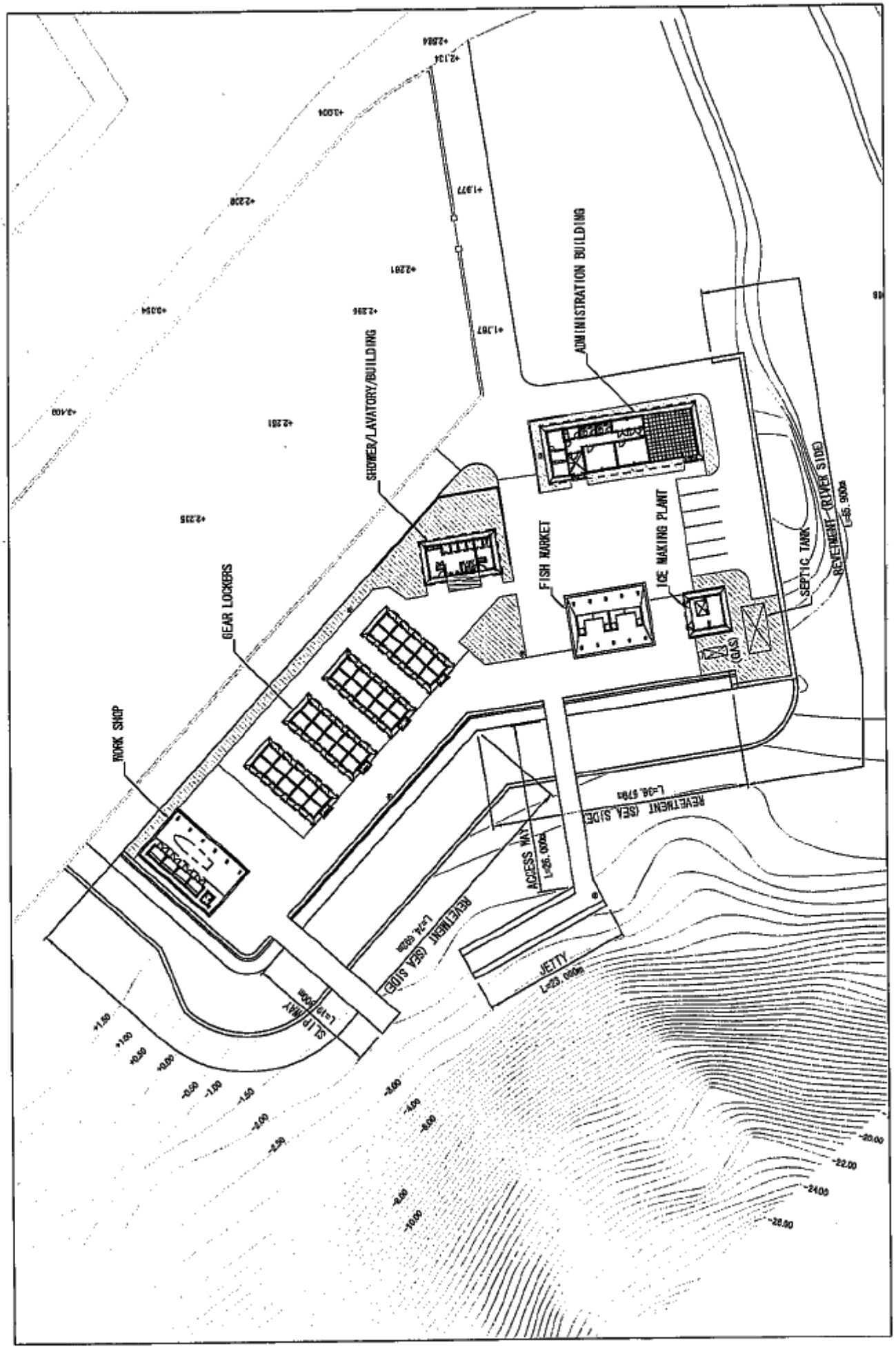


Figure 2.3-2 General Layout Plan at Soufriere

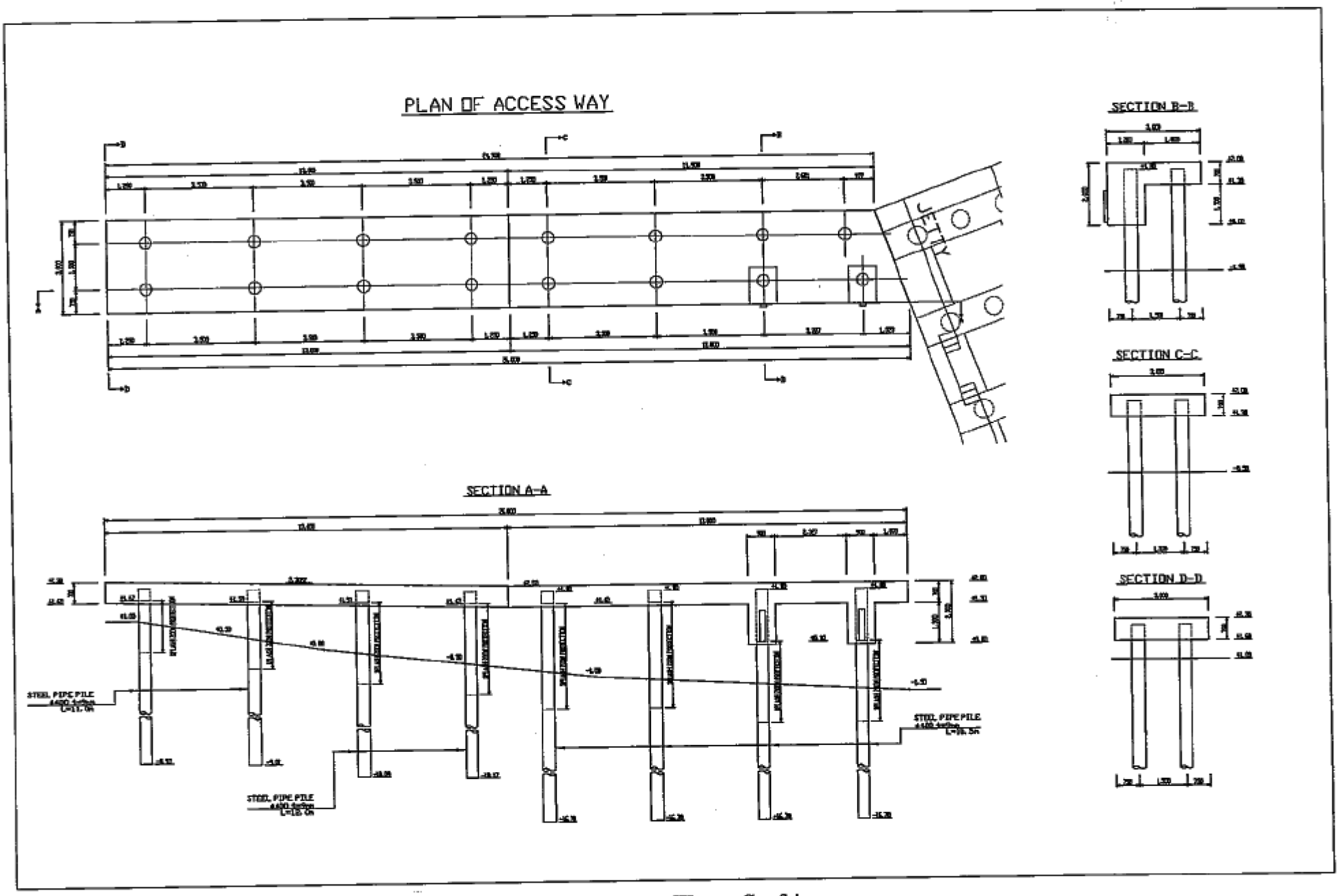


Figure 2.3-3 Plan of Access Way at Soufriere

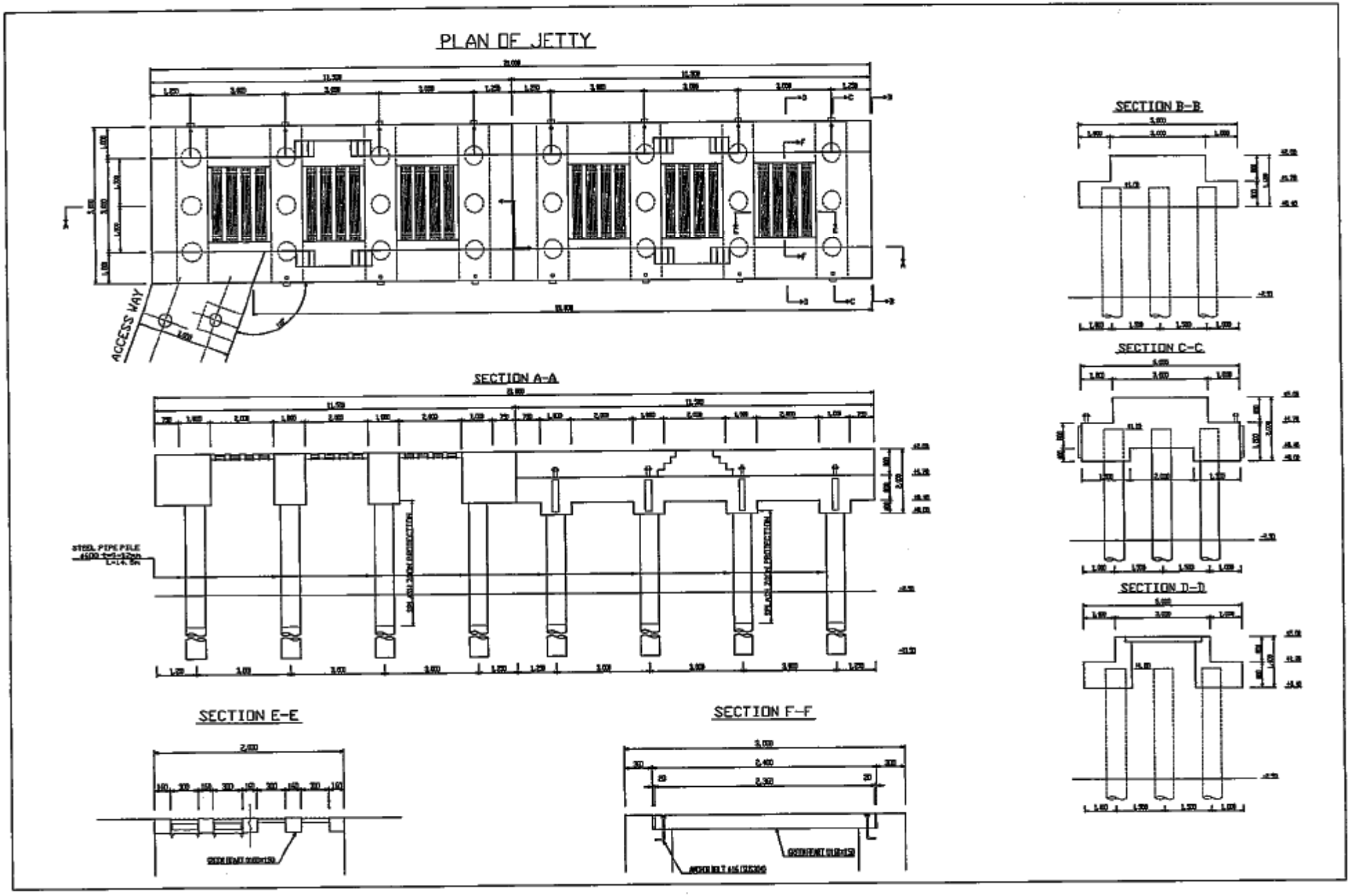


Figure 2.3-4 Plan of Jetty at Soufriere

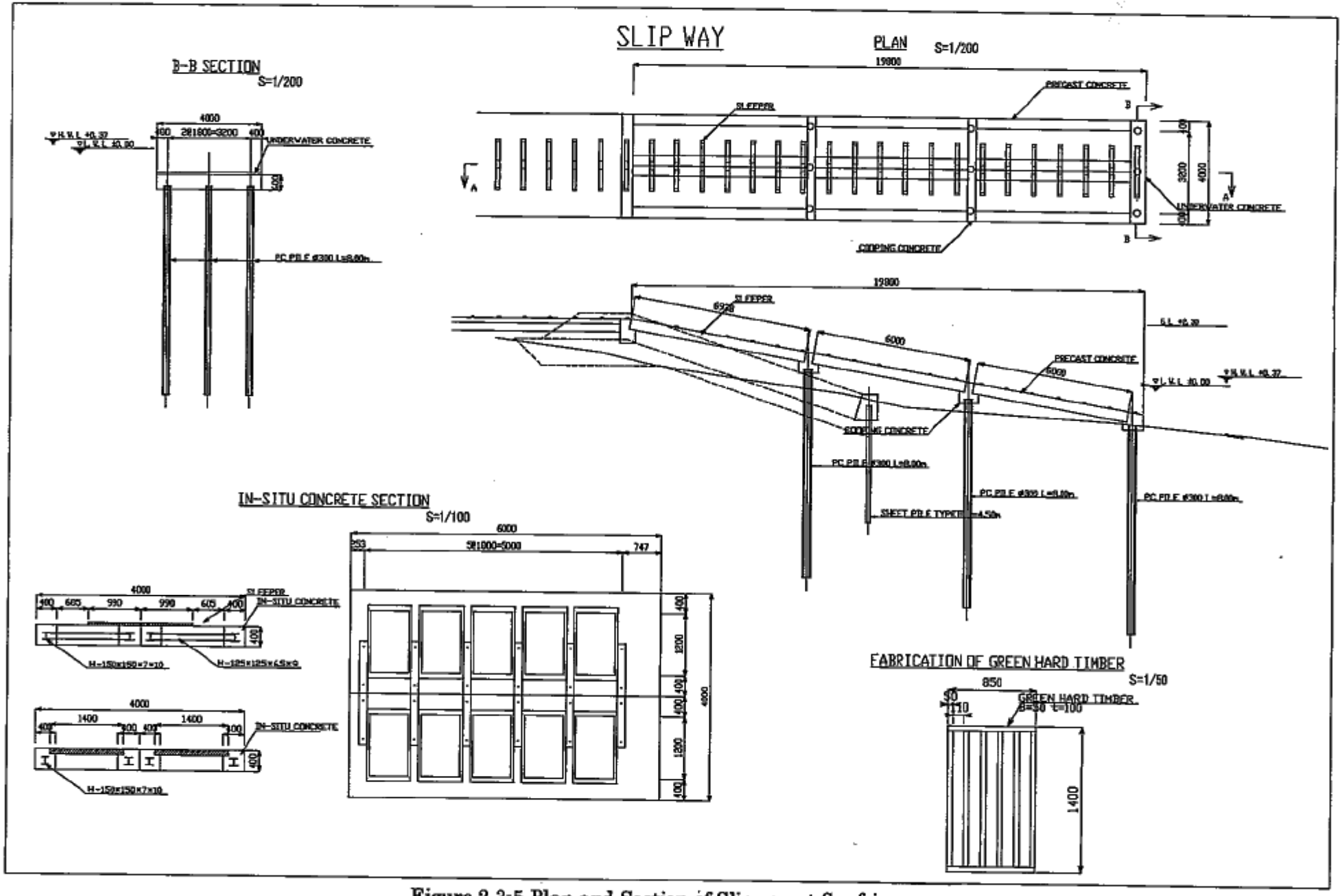


Figure 2.3-5 Plan and Section of Slipway at Soufriere

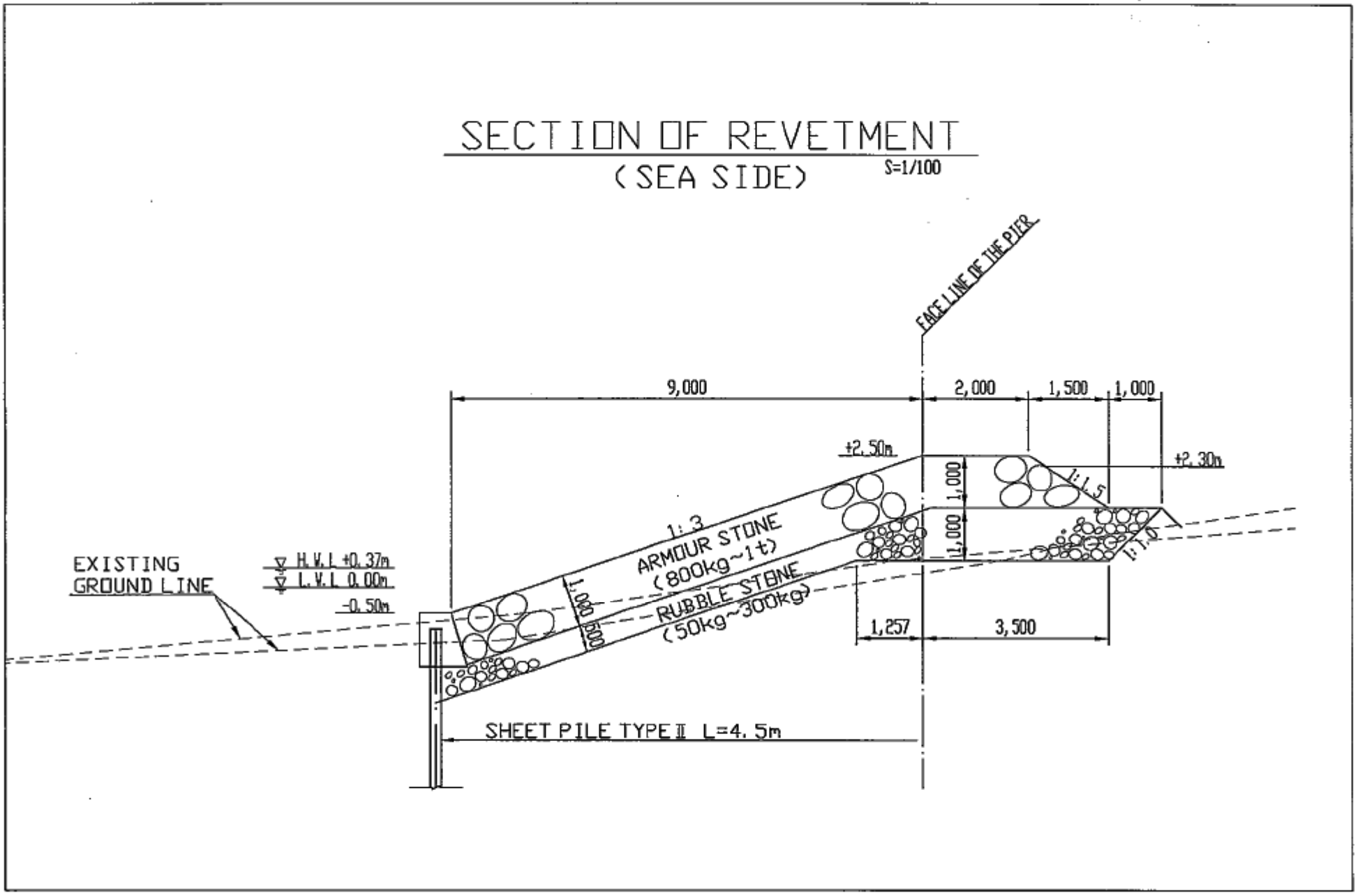


Figure 2.3-6 Section of Sea Side Revetment at Soufriere

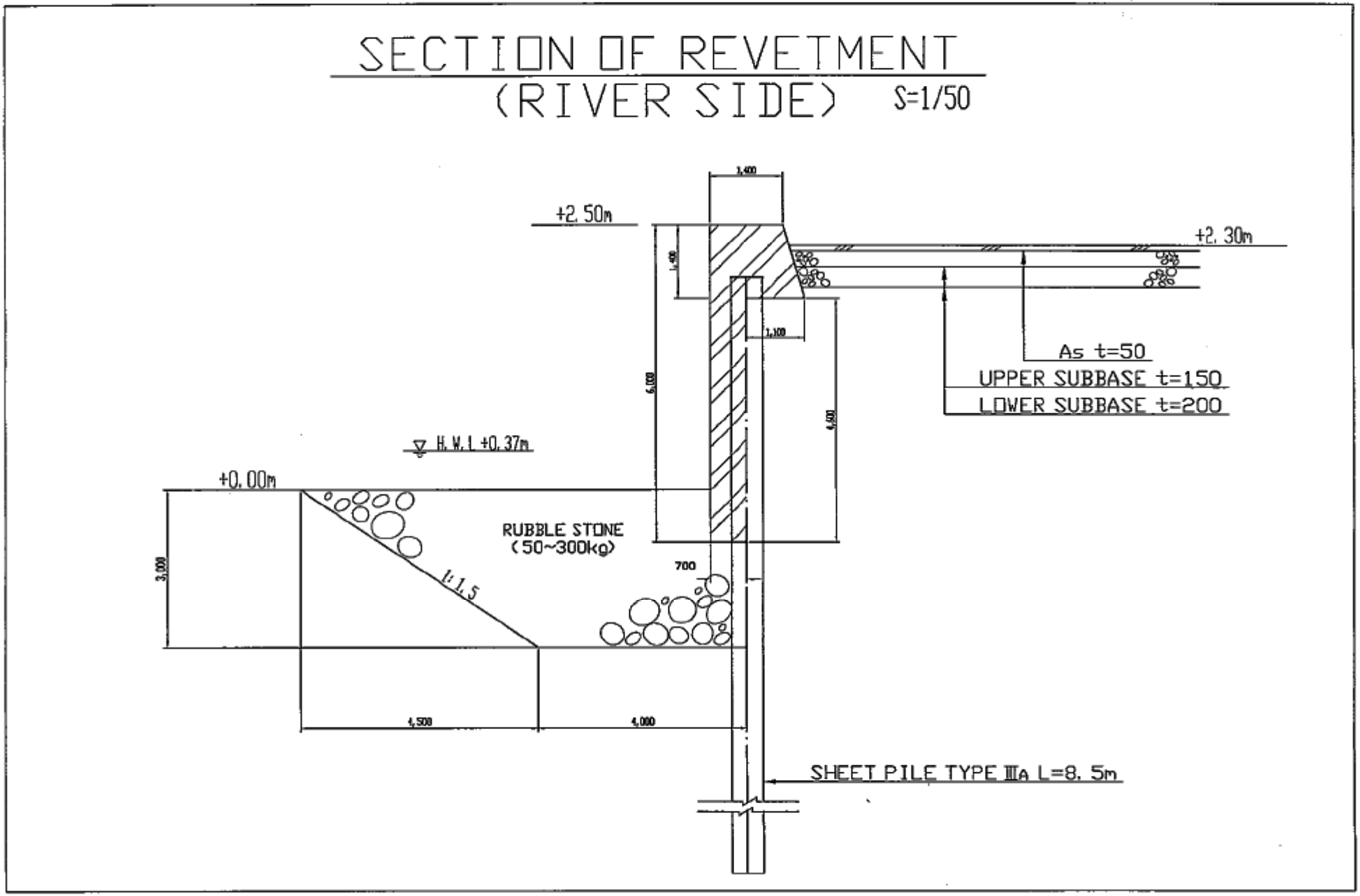


Figure 2.3-7 Section of River Side Revetment at Soufriere

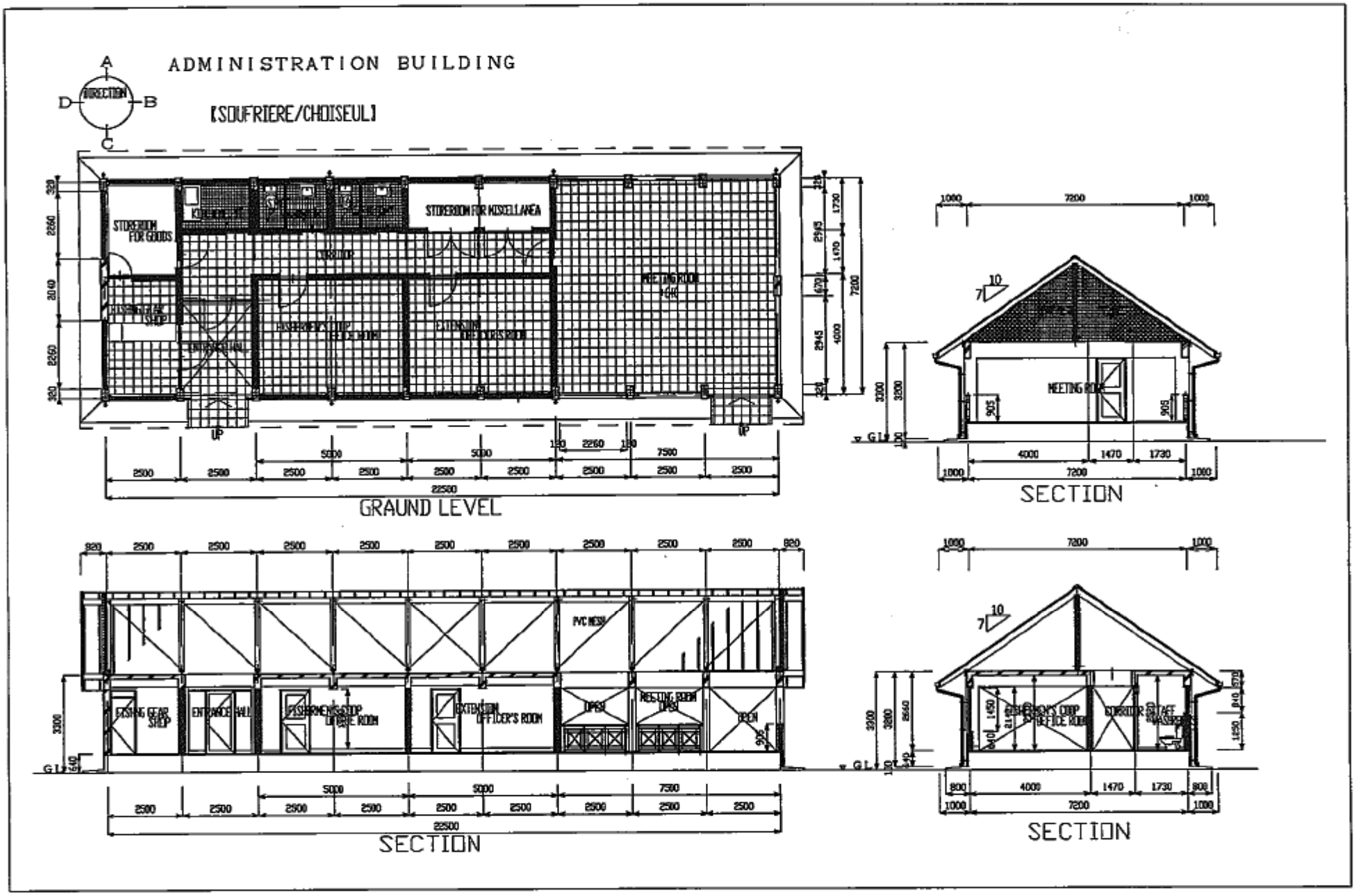


Figure 2.3-8 Plan and Section of Administration Building at Soufriere/Choiseul

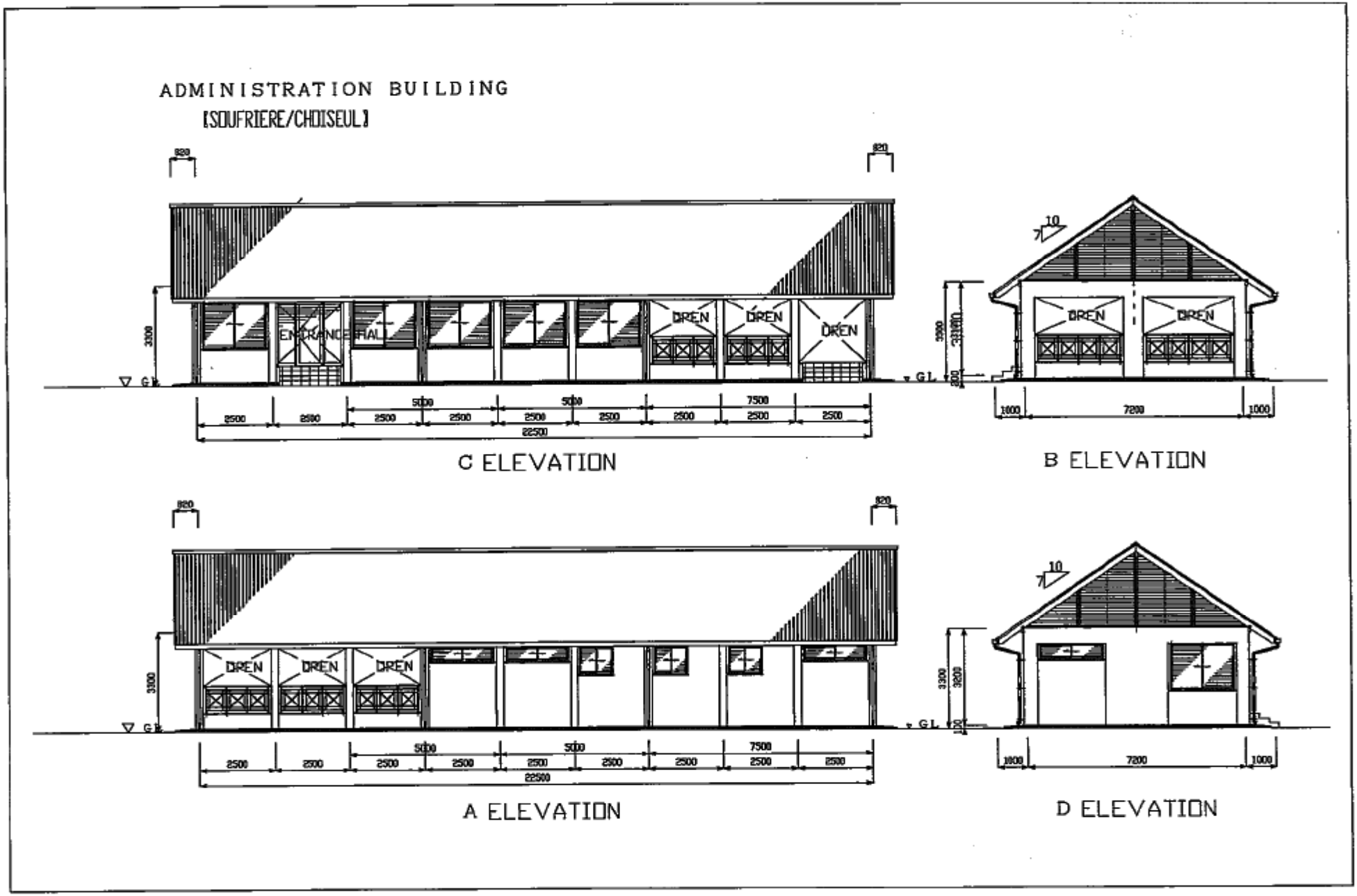


Figure 2.3-9 Elevation of Administration Building at Soufriere/Choiseul

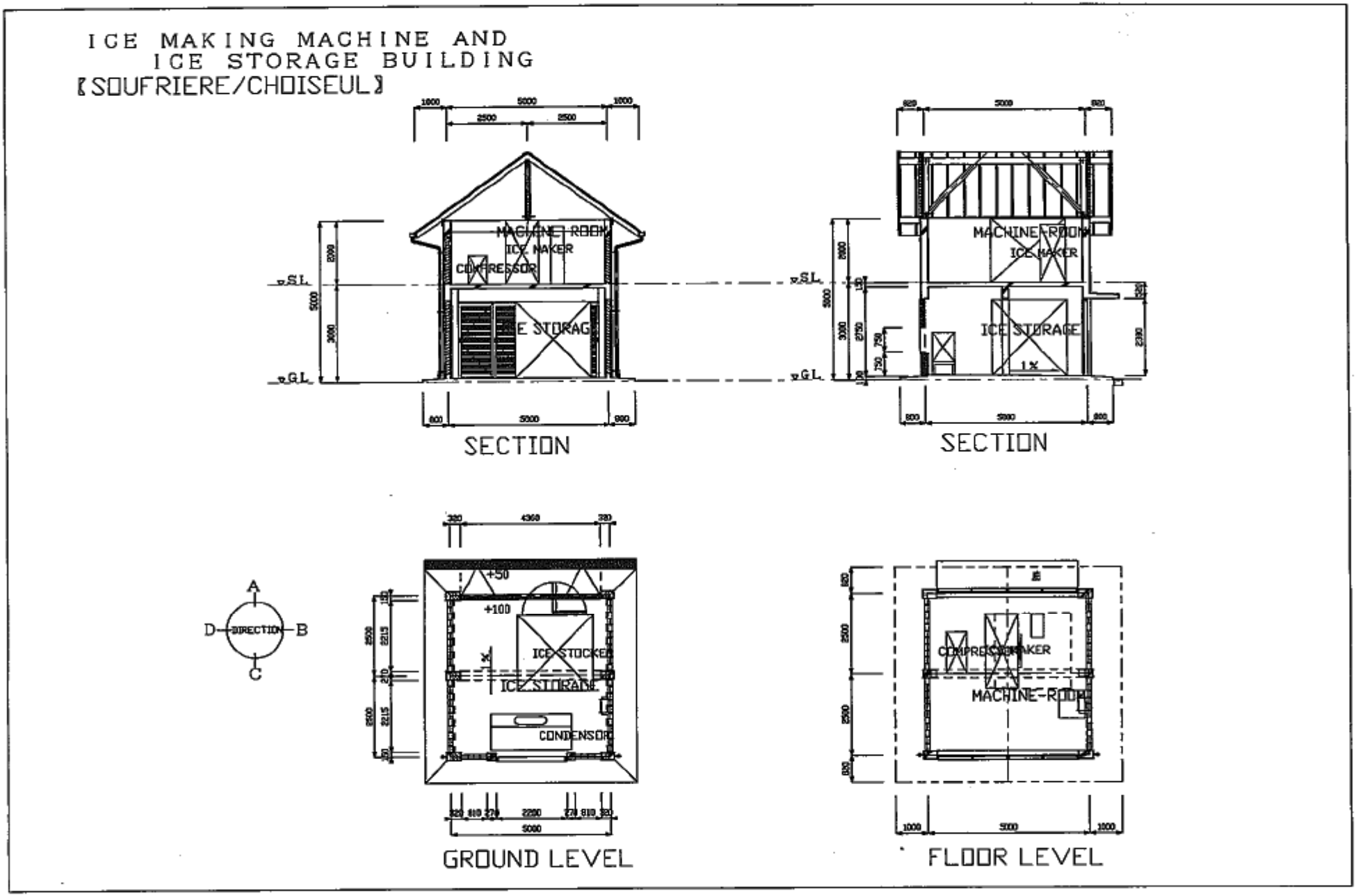


Figure 2.3-10 Plan and Section of Ice Making Plant and Ice Storage Building at Soufriere/Choiseul

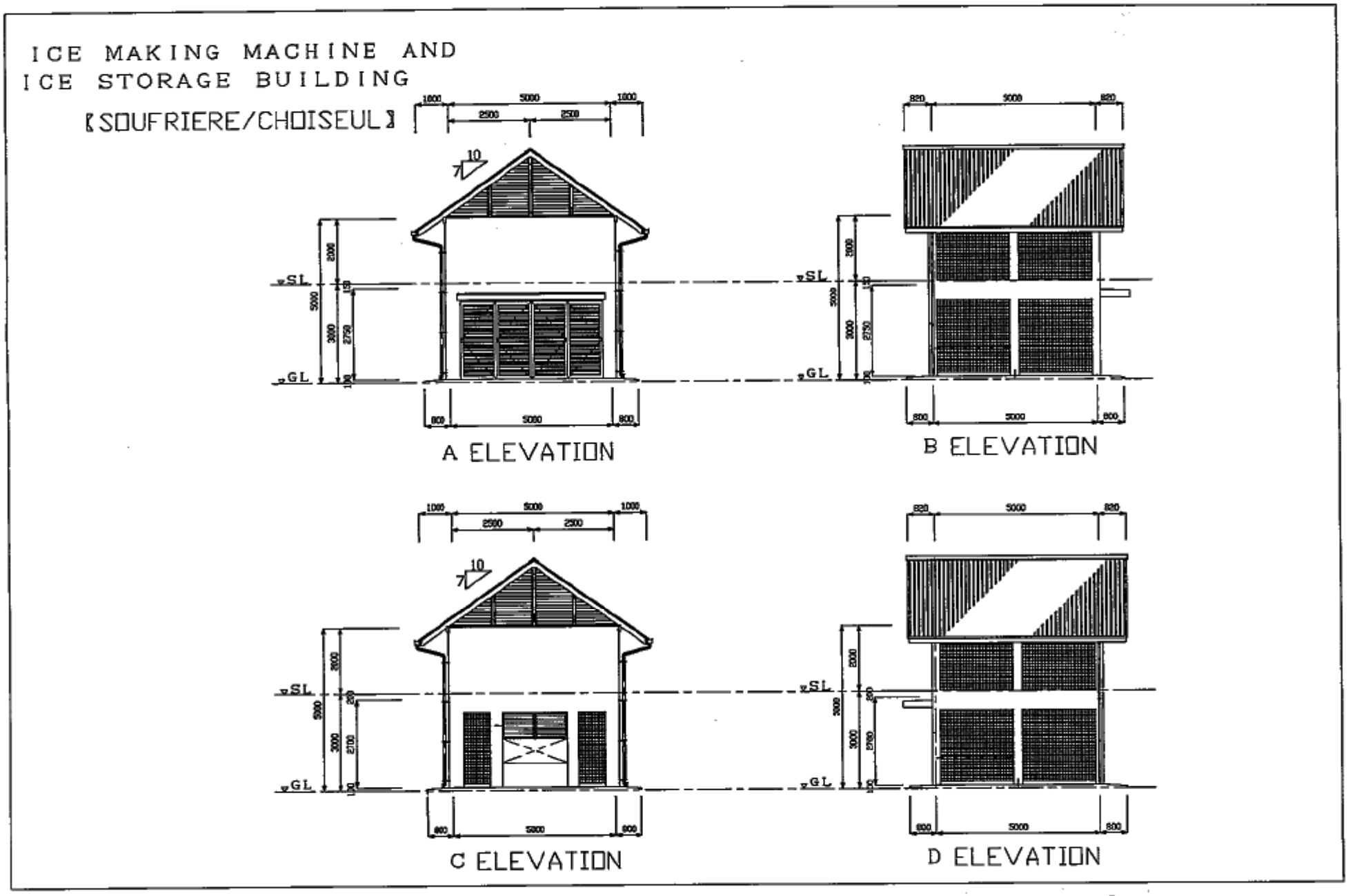


Figure 2.3-11 Elevation of Ice Making Plant and Ice Storage Building at Soufriere/Choiseul

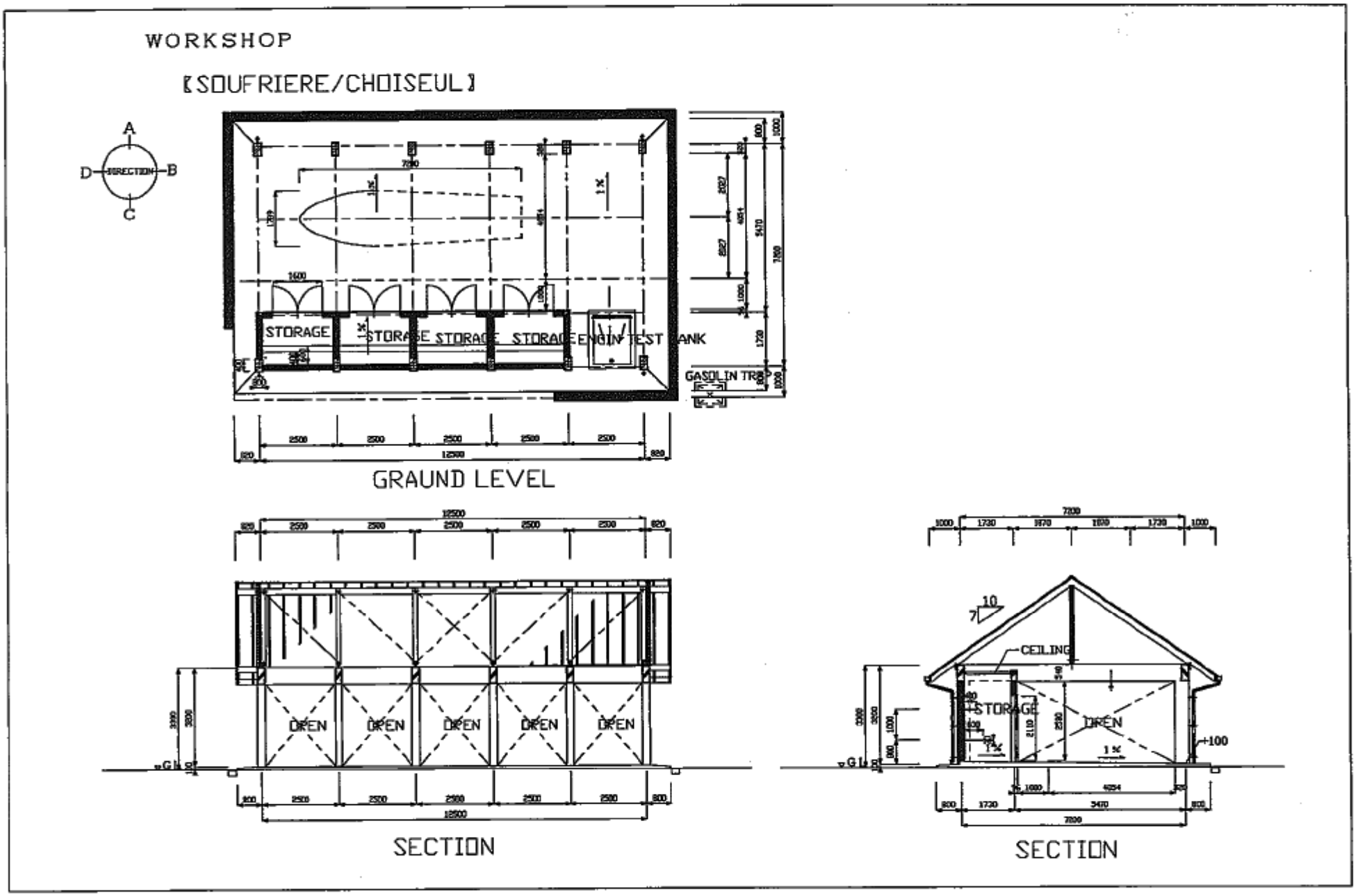


Figure 2.3-12 Plan and Section of Workshop at Soufriere/Choiseul

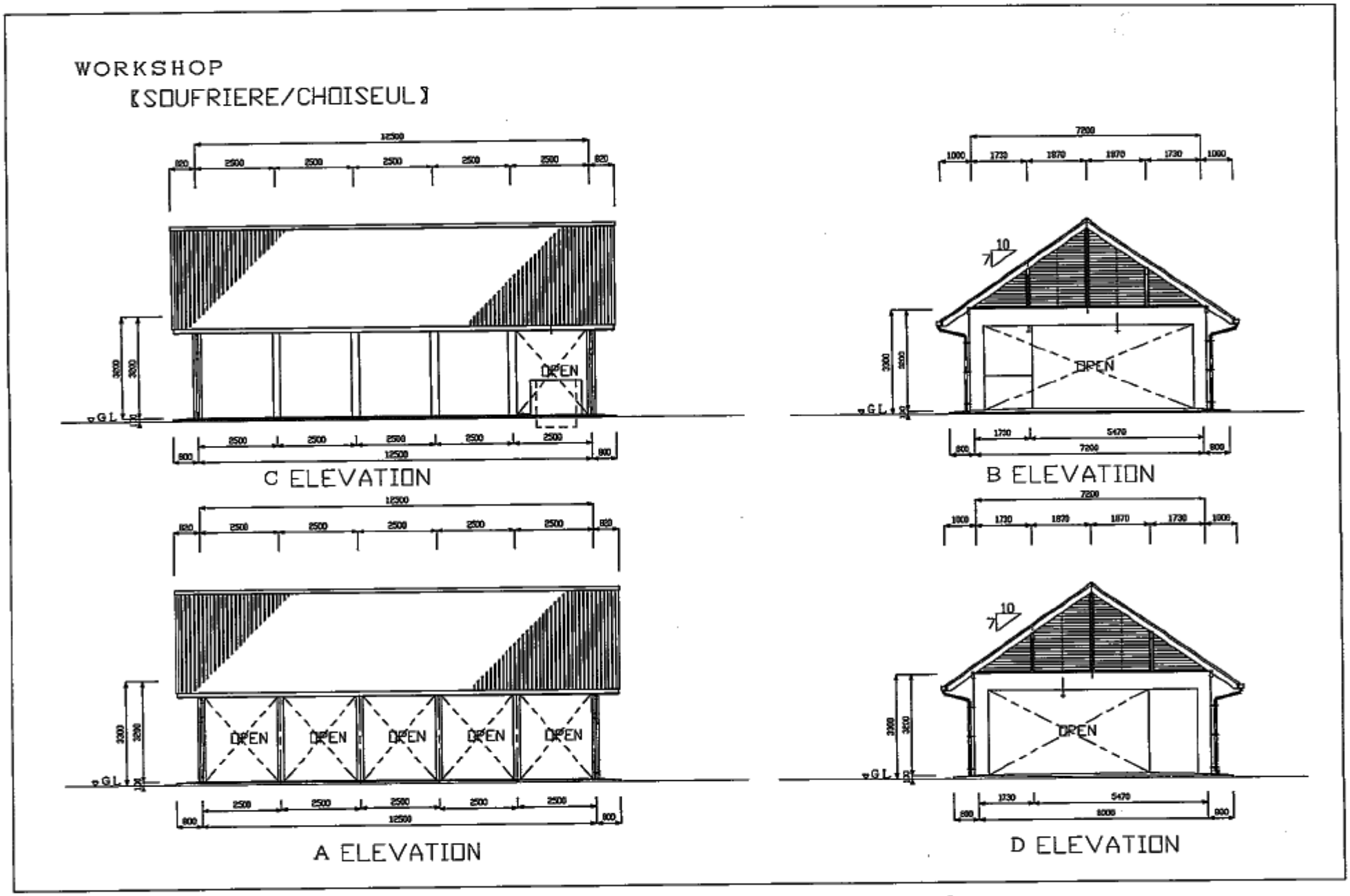


Figure 2.3-13 Elevation of Workshop at Soufriere/Choiseul

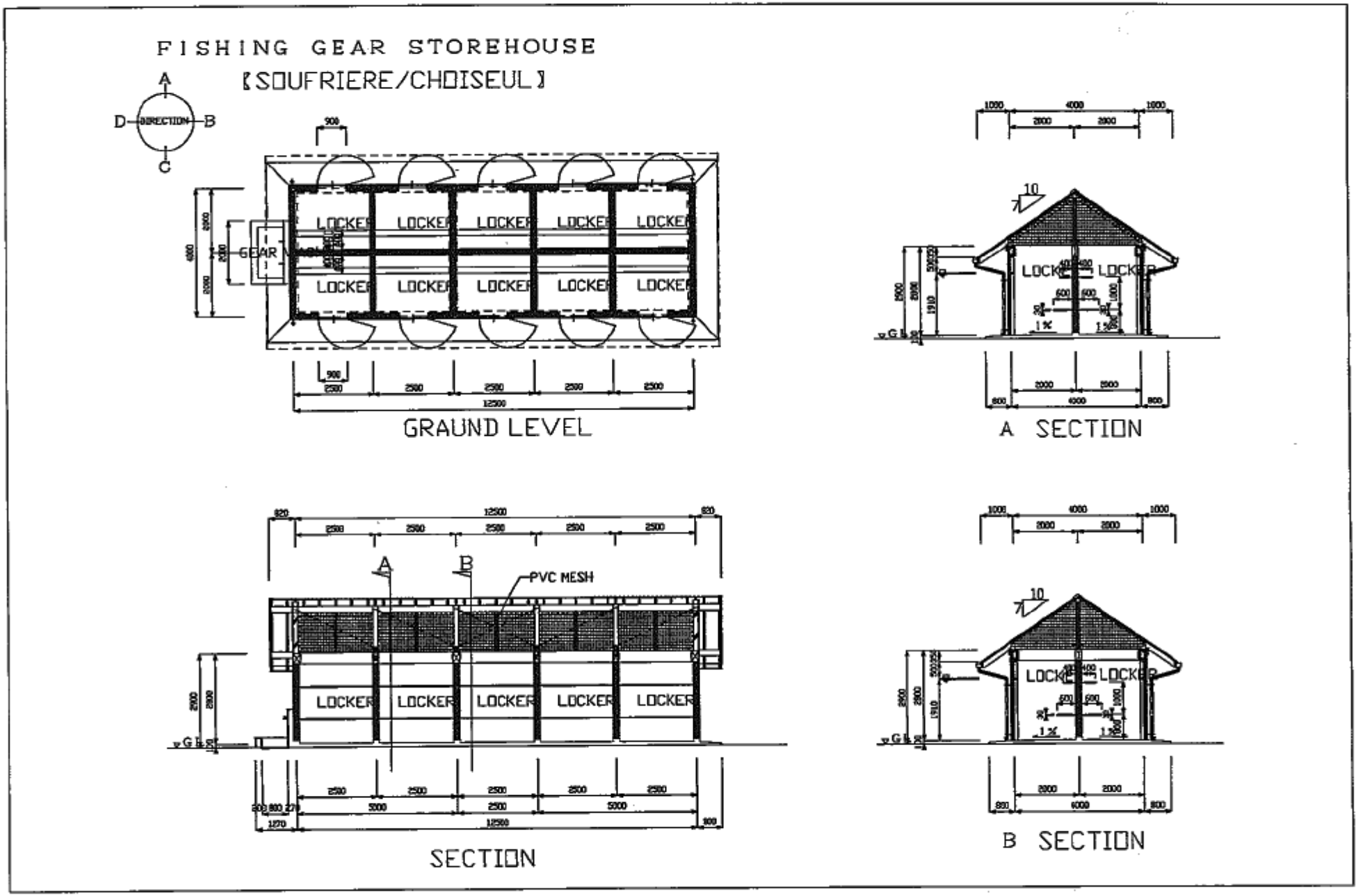


Figure 2.3-14 Plan and Section of Fishing Gear Storehouse at Soufriere/Choiseul

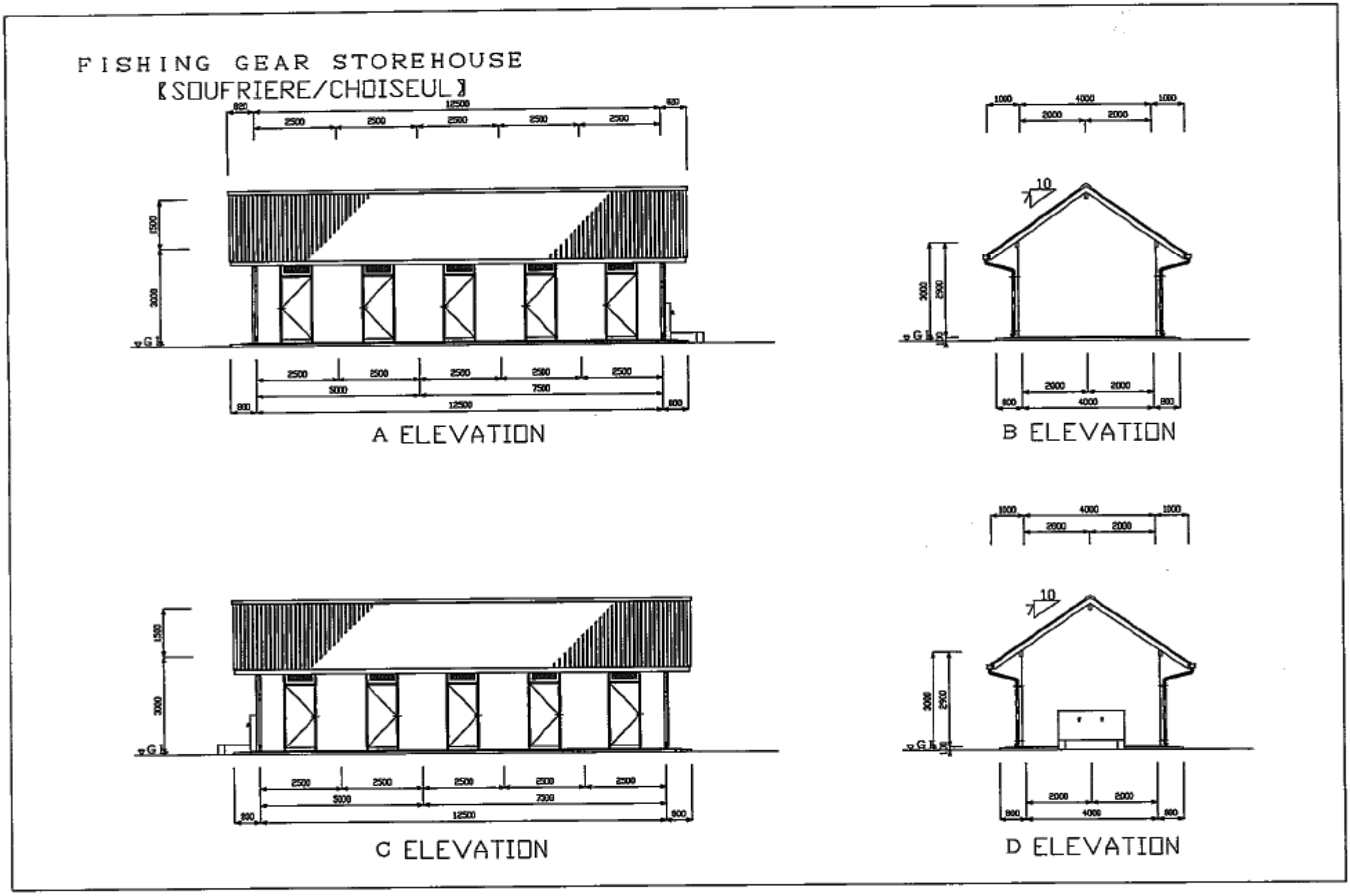


Figure 2.3-15 Elevation of Fishing Gear Storehouse at Soufriere/Choiseul

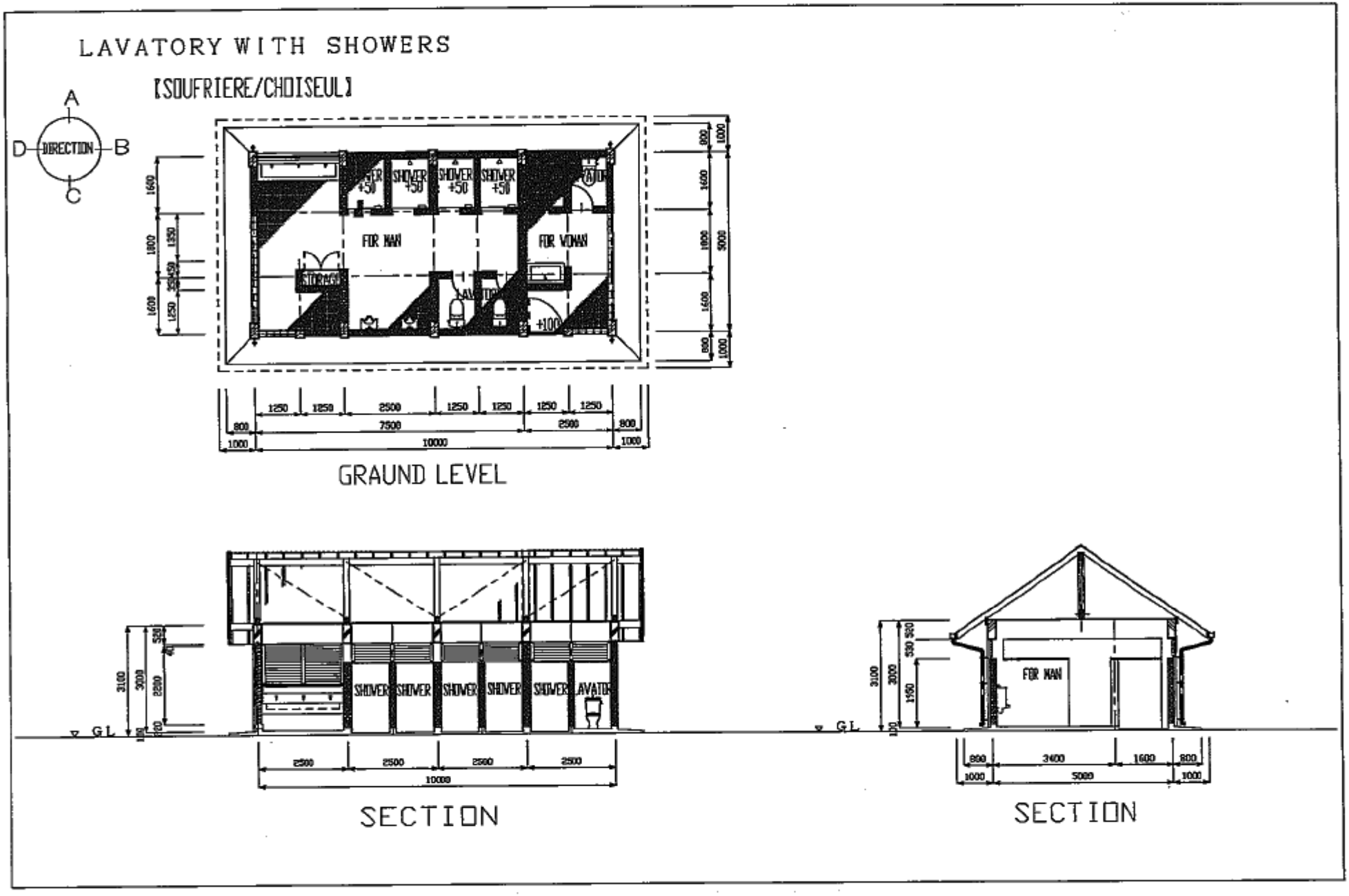


Figure 2.3-16 Plan and Section of Lavatory with Showers at Soufriere/Choiseul

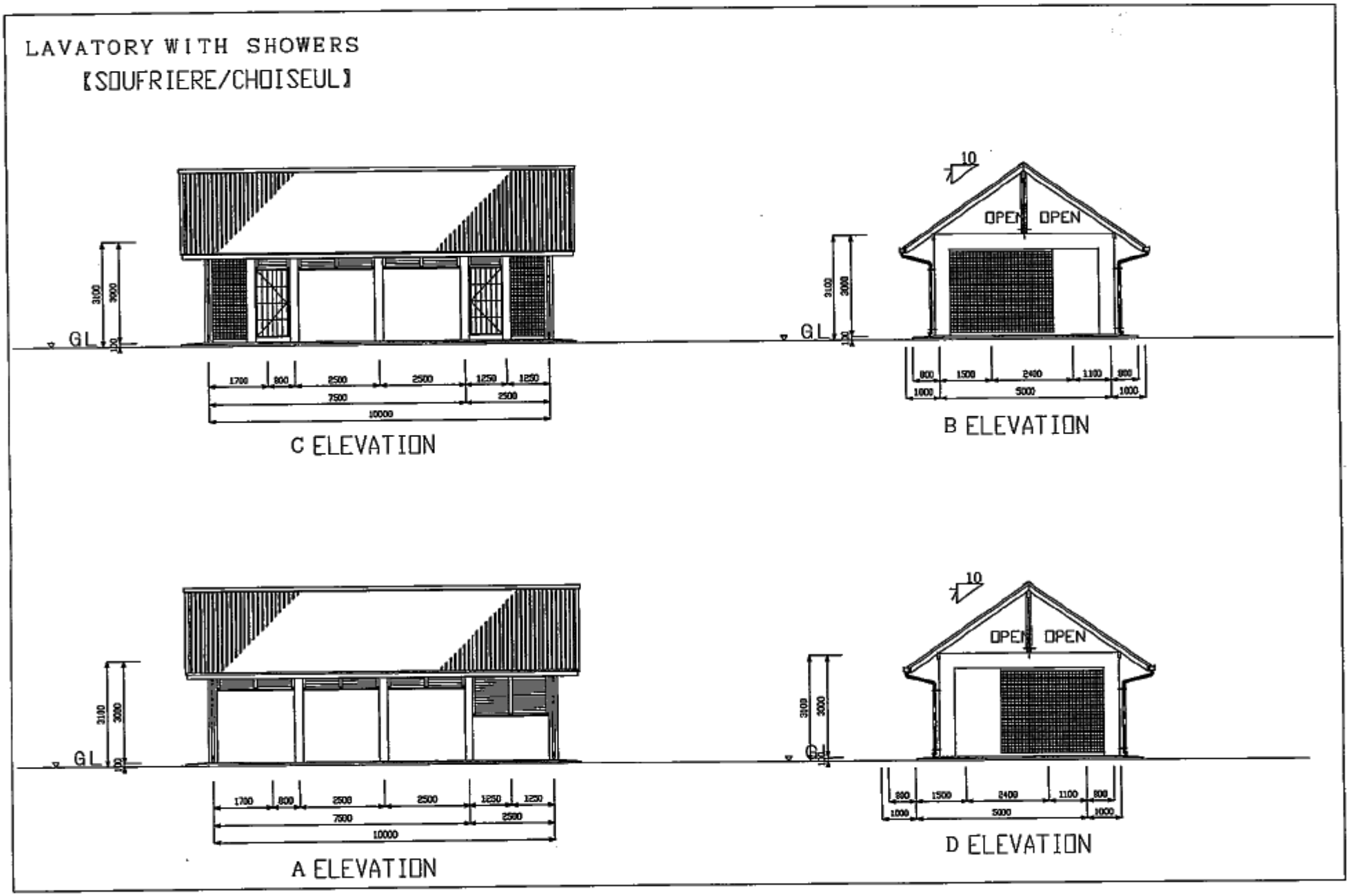


Figure 2.3-17 Elevation of Lavatory with Showers at Soufriere/Choiseul

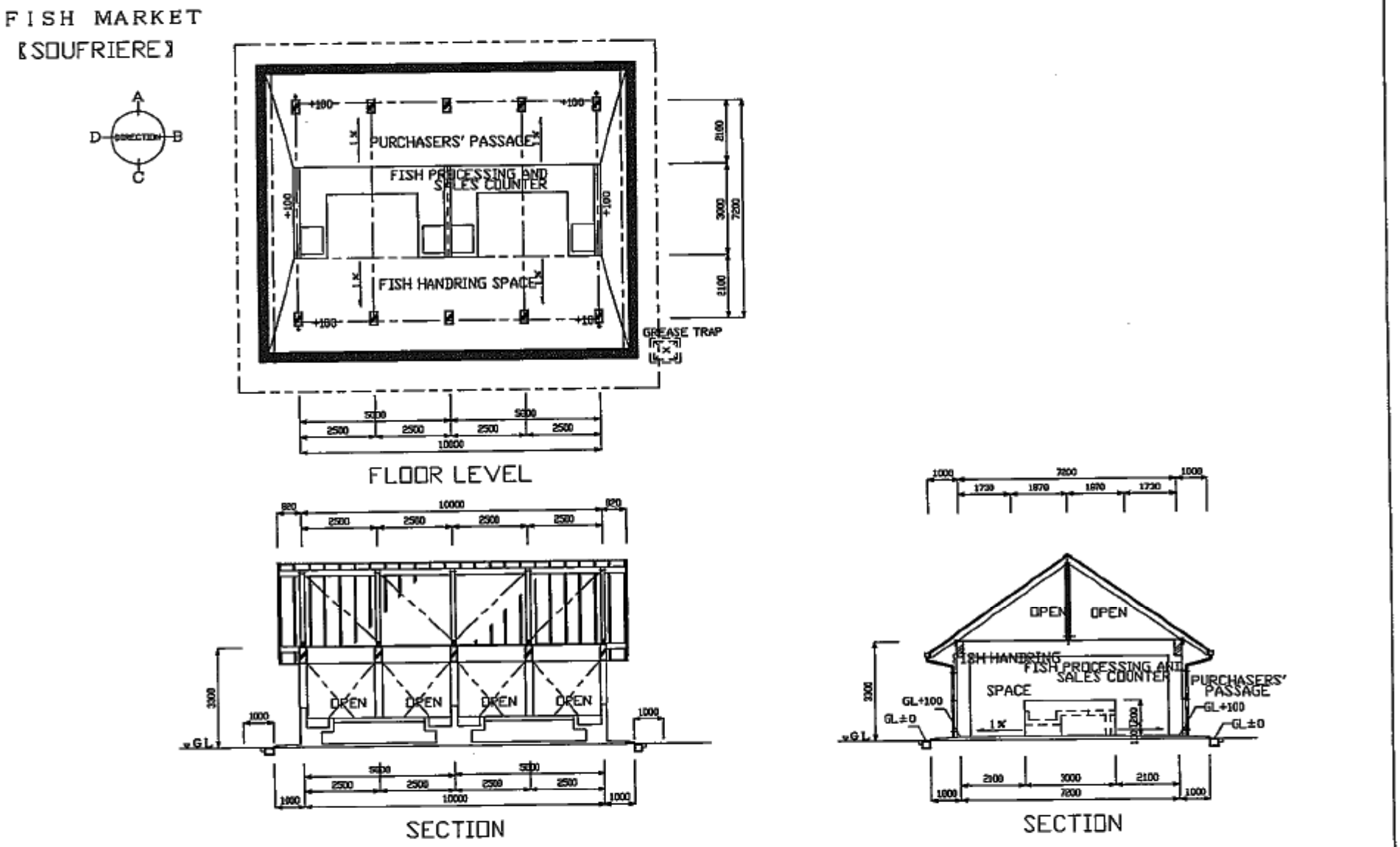


Figure 2.3-18 Plan and Section of Fish Market at Soufriere

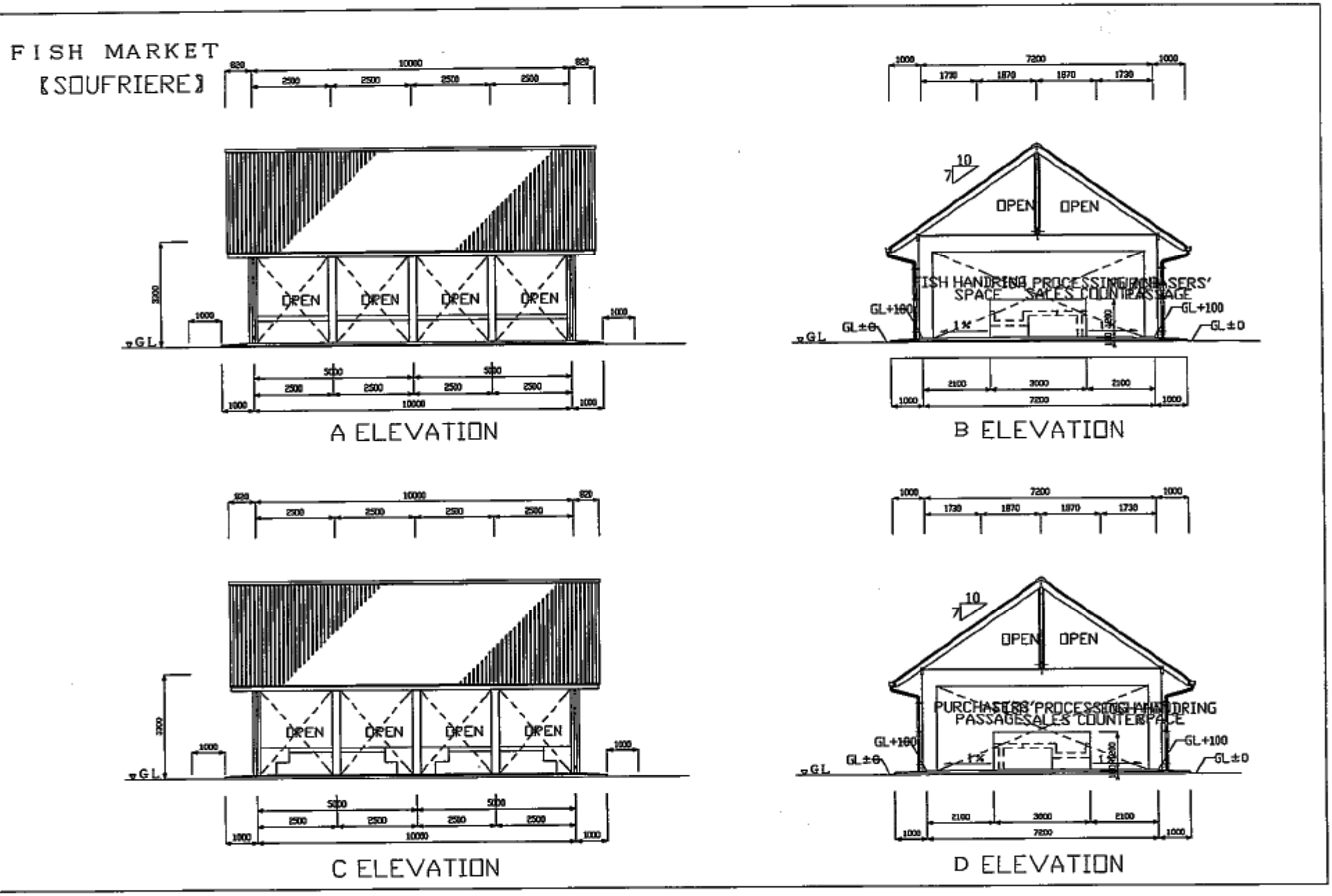


Figure 2.3-19 Elevation of Fish Market at Soufriere

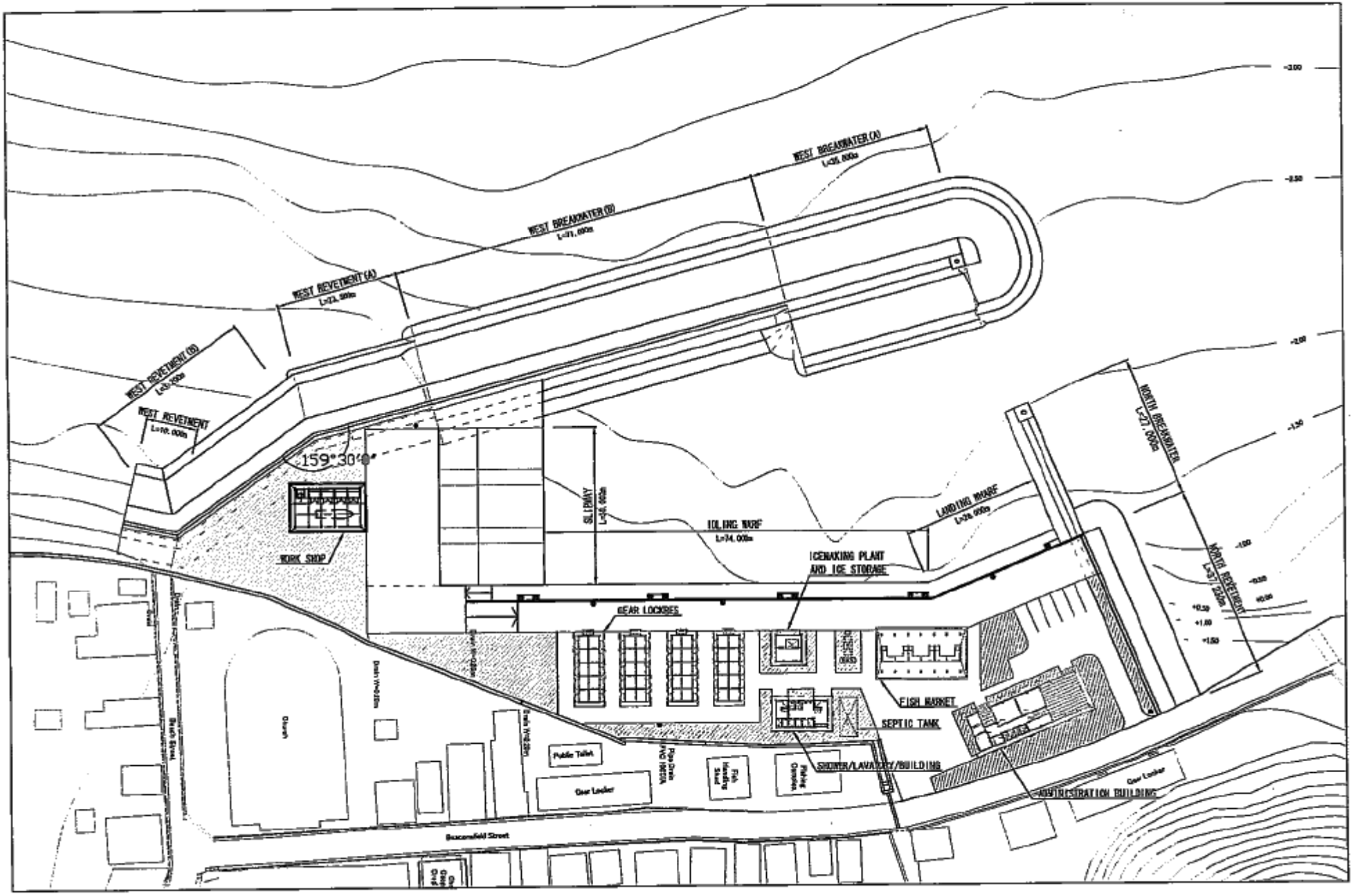


Figure 2.3-20 General Layout Plan at Choiseul

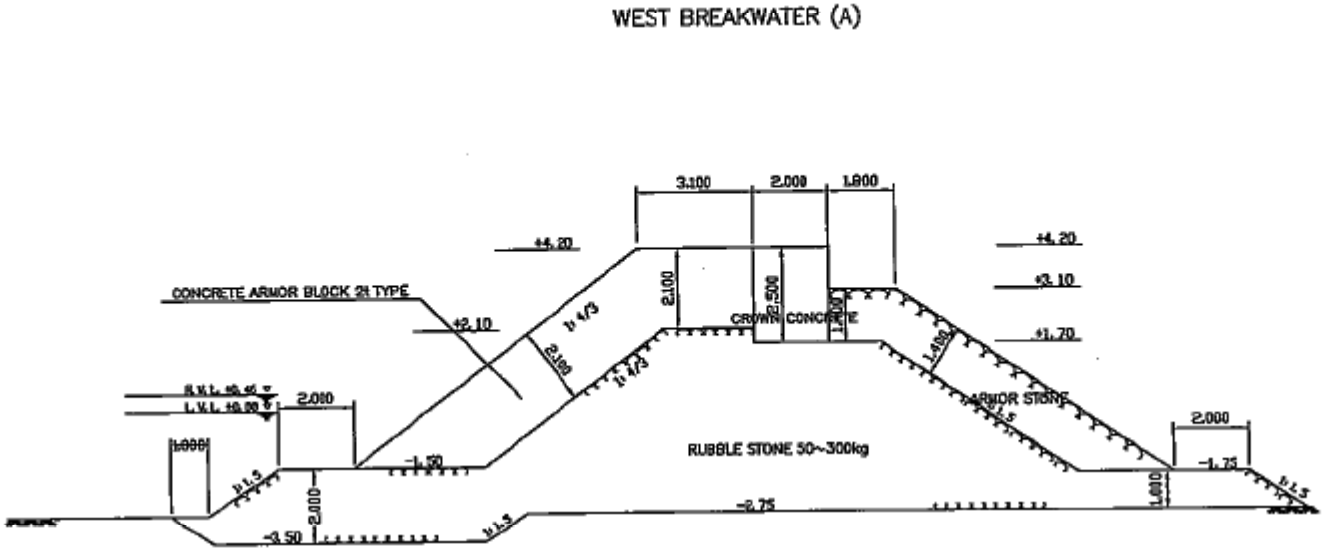


Figure 2.3-21 Section of West Breakwater (A) at Choiseul

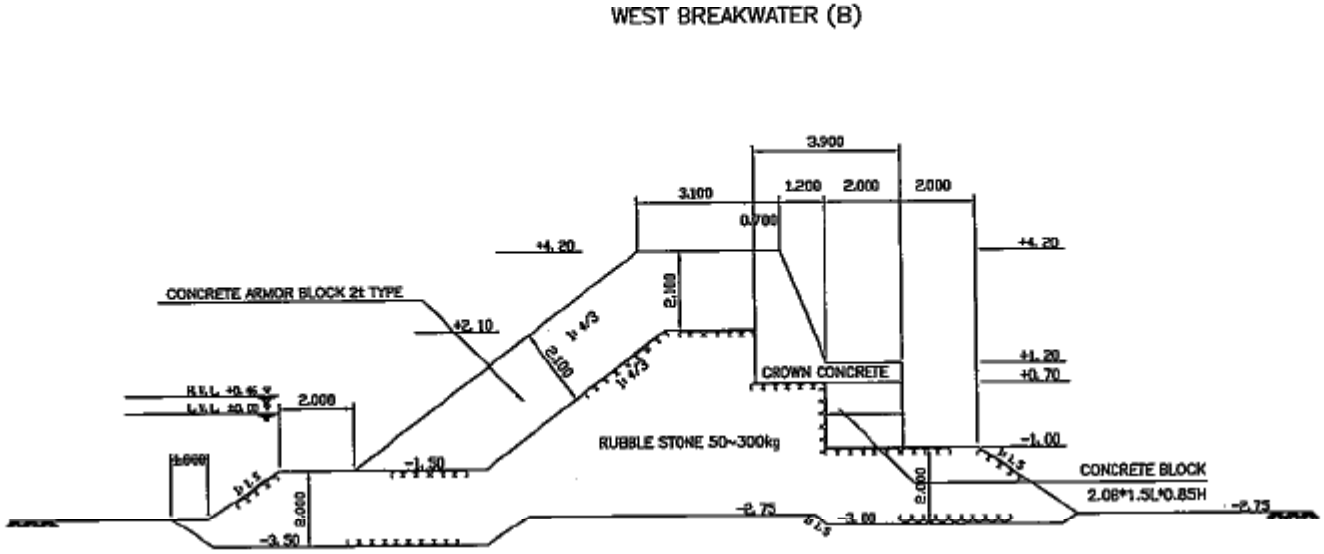


Figure 2.3-22 Section of West Breakwater (B) at Choiseul

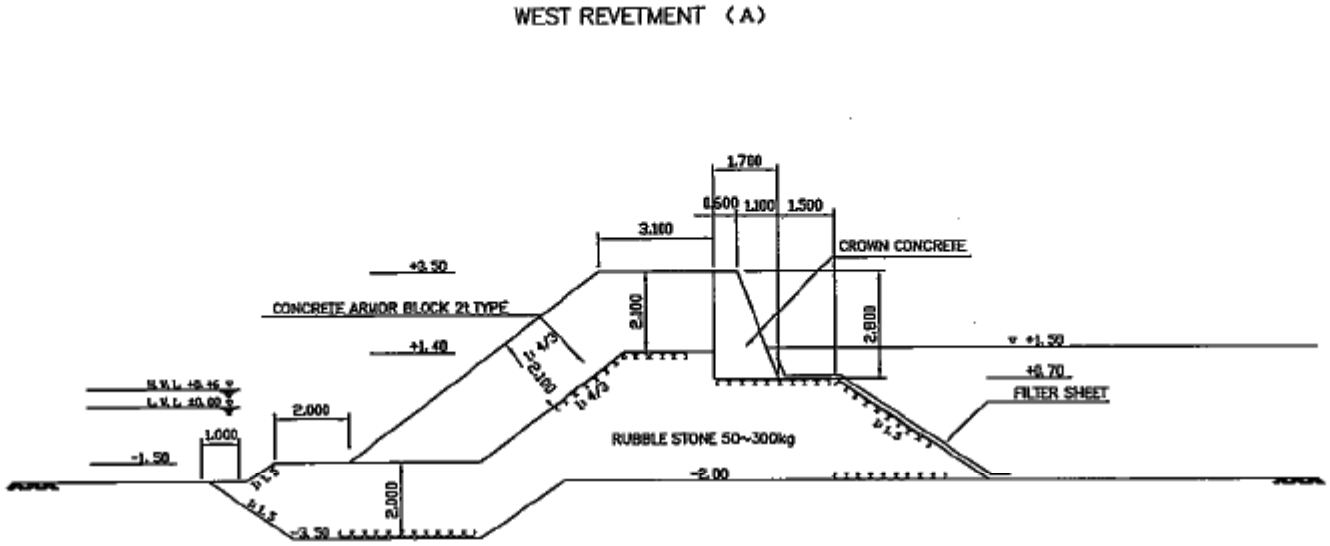


Figure 2.3-23 Section of West Revetment (A) at Choiseul

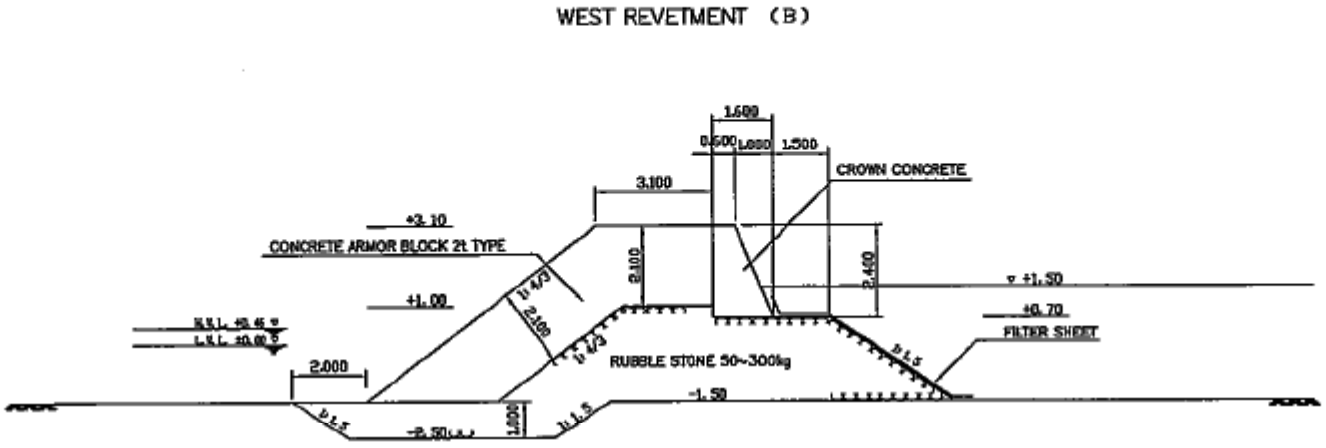


Figure 2.3-24 Section of West Revetment (B) at Choiseul

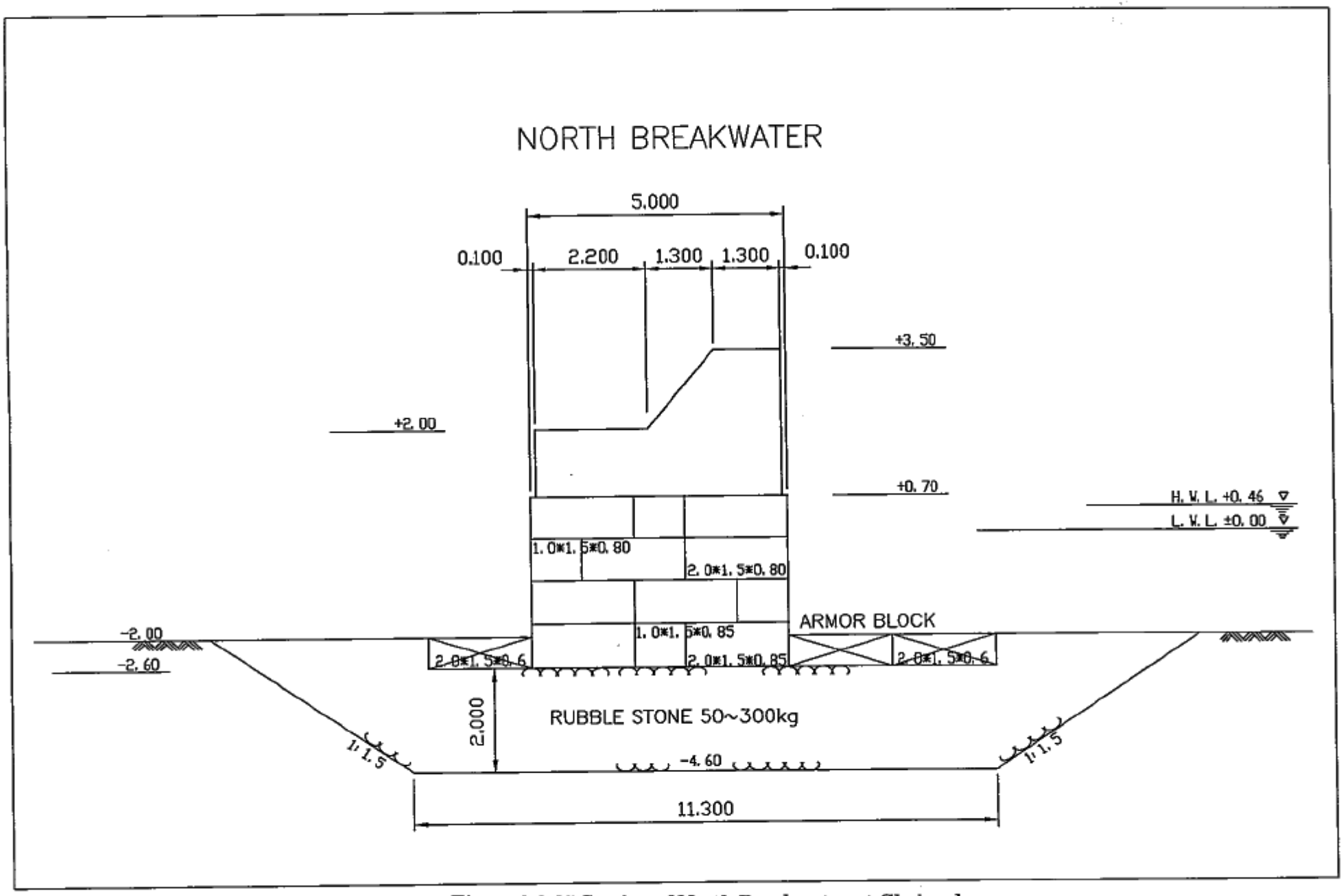


Figure 2.3-25 Section of North Breakwater at Choiseul

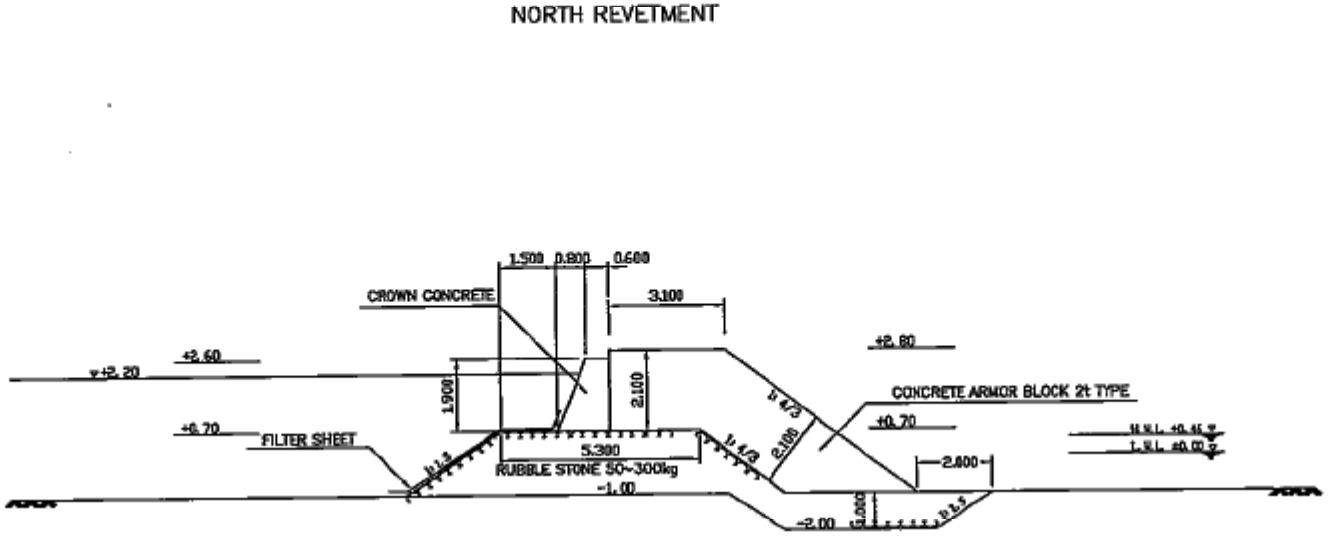


Figure 2.3-26 Section of North Revetment at Choiseul

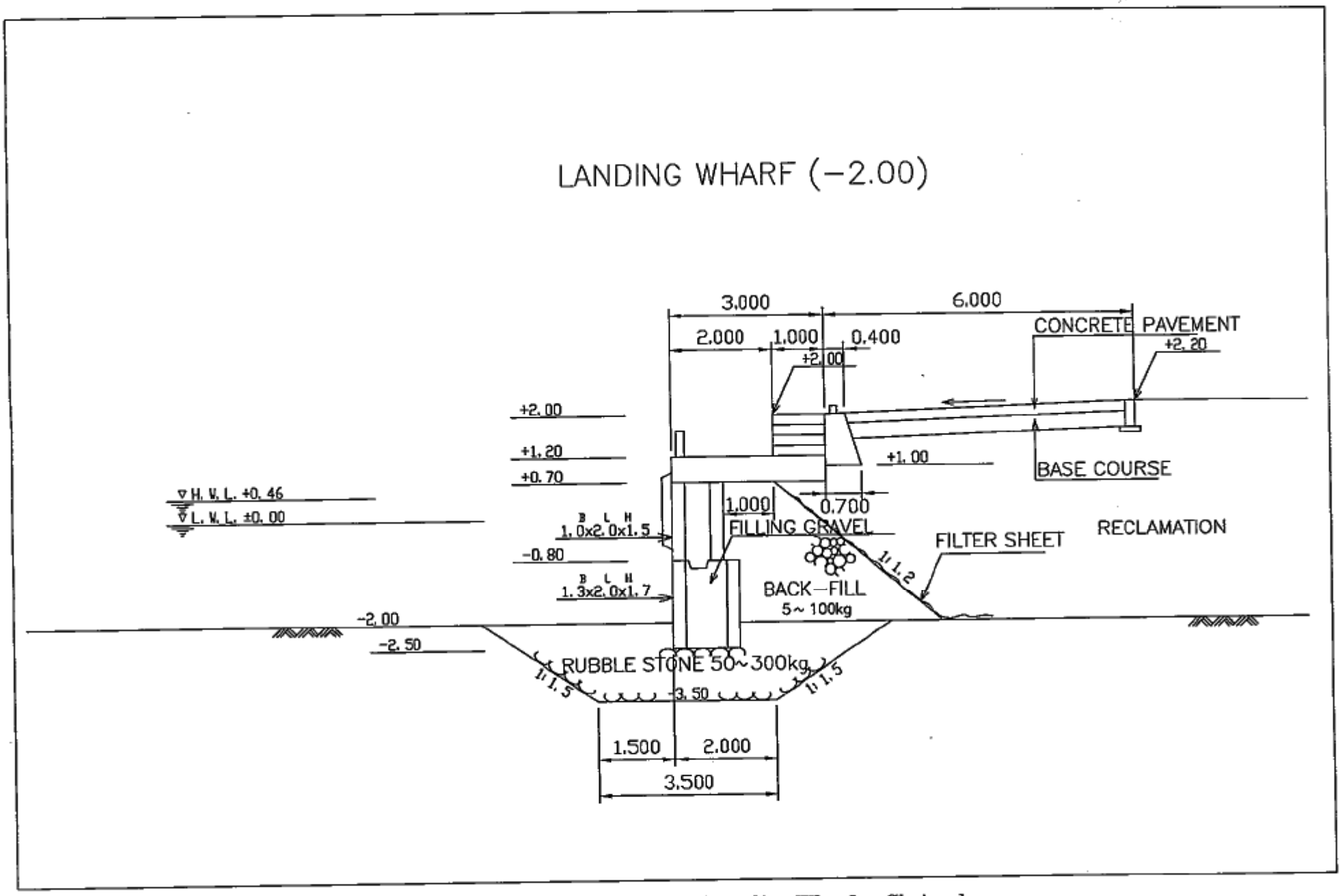


Figure 2.3-27 Section of Landing Wharf at Choiseul

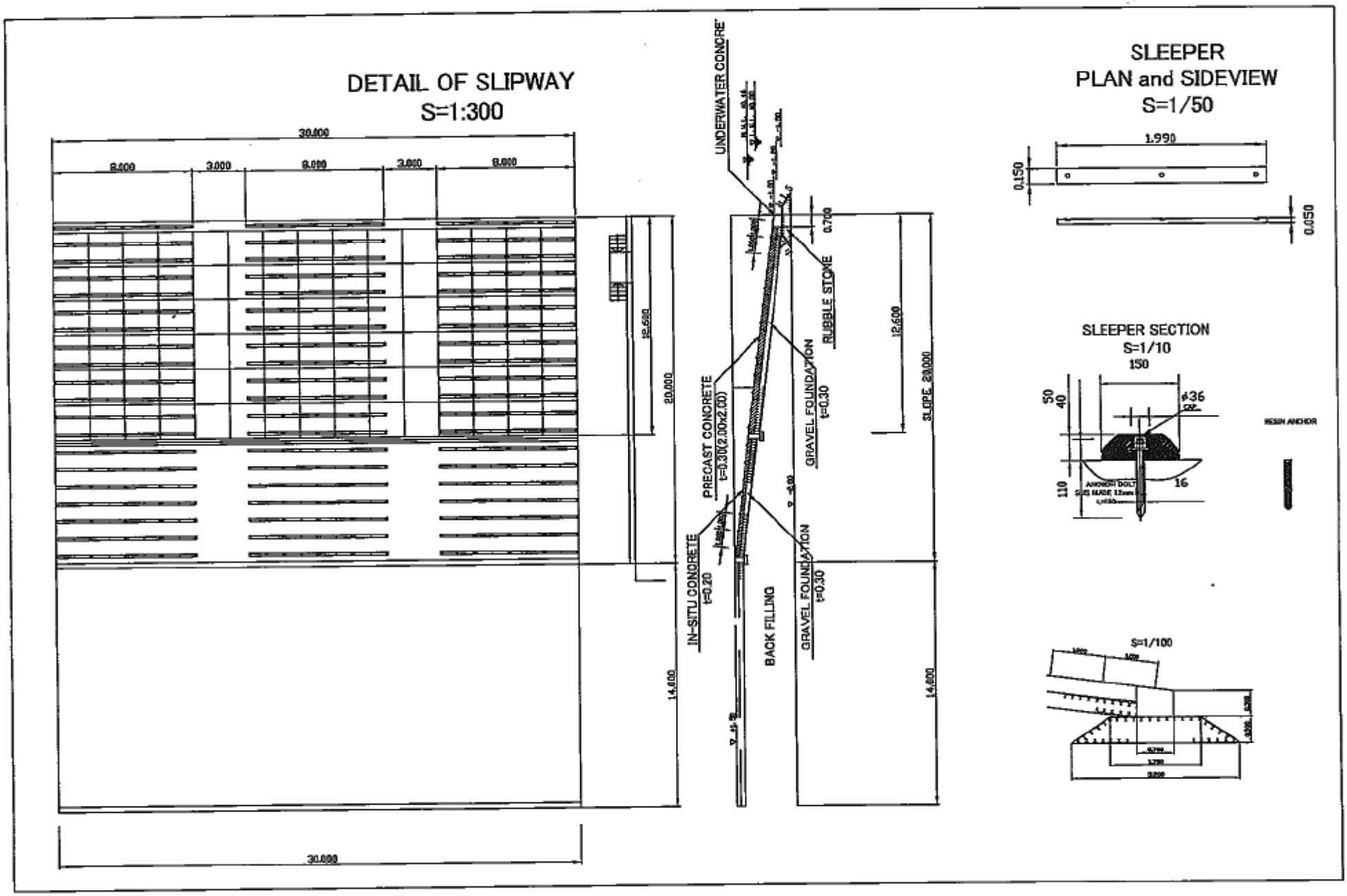


Figure 2.3-28 Plan and Section of Slipway at Choiseul

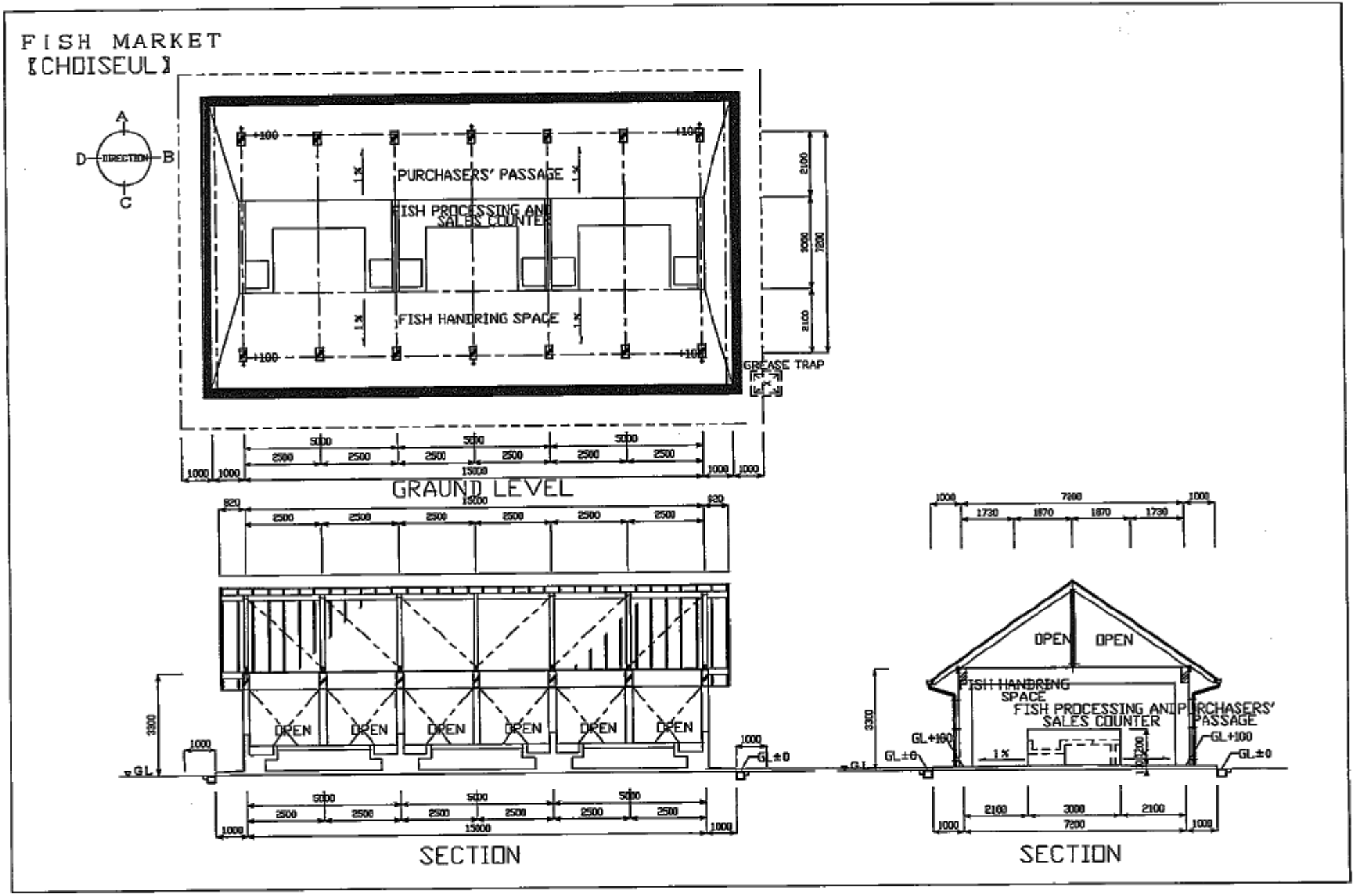


Figure 2.3-29 Plan and Section of Fish Market at Choiseul

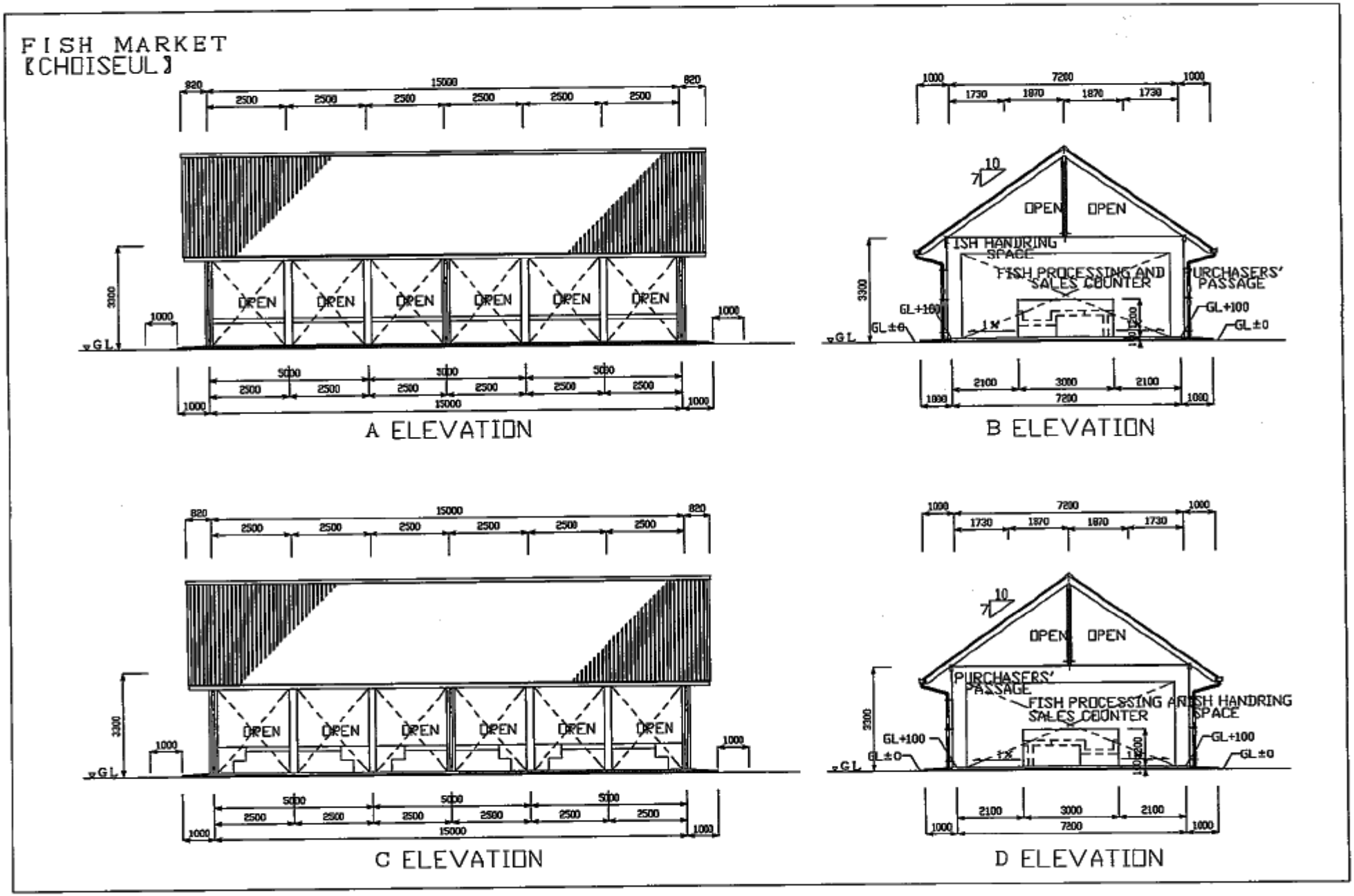


Figure 2.3-30 Elevation of Fish Market at Choiseul

2.4 Environmental Effects

(1) Soufriere

In St. Lucia environmental degradation has become conspicuous in recent years, which includes water pollution, forest destruction, contamination by insecticides and tourism development. The government enacted the environment preservation act for Soufriere in 1994 and subsequently designated the preservation area of marine resources, called Soufriere Marine Management Area (SMMA) which is divided into the following 5 areas.

(a) Marine preservation area: No fishing is allowed in this area, which has been established for tourists who enjoy diving to watch underwater sceneries and aquatic animals and plants. The boundary is established at a point of 75m deep.
(b) Fishing area: Beach seines are permitted, but scuba diving and gill net fishing are prohibited.
(c) Multi-purpose area: Both fishermen and tourists can use permitted gear. Gill net is not allowed to use.
(d) Yacht mooring area: Around 3,500 yachts come to Soufriere annually.
(e) Recreation area: In this area it is allowed to build hotels, restaurants and rest-houses.

The project site has been selected close to the fishing area for convenience. It is anticipated that construction work of fishery infrastructures may give some impact to the marine ecology in the project sites.

(a) Construction work of jetties, slipways, revetment
Construction work may cause turbid water affecting coral reefs. It is necessary to use a silt protector to prevent turbid water from spreading.
(b) Fishing port facilities
Infrastructures built in the water may deform the waves and the topography of the beach area. Piles will be used for building jetties and slipways in order that effects of waves to the beach may be minimized.

Fishing activities may also give some negative impact to environment.

(a) Fishermen may discard or drain contaminated objects in the fishing port. It will be necessary for the port manager to control misconduct of fishermen in this respect and generate awareness of fishermen of environment preservation.

(2) Choiseul

It has been identified that there are no sea grass beds, coral reefs, and mangroves within 400m from the shore lines. The main impact to environment may occur as a result of:①Reclamation carried out to build the construction site for fishery infrastructures; ② Dredging in front of the wharf.

The water near the site is likely to become turbid. Whilst there are no living areas of aquatic animals nearby, a silt protector will be used during the construction period to prevent the outflow of turbid water.

Effects of breakwaters to the shore lines

(a) The new structures may change the shore lines as well as the topography of the beach. Wave dissipating concrete blocks will be built in front of the breakwaters to eliminate the effects caused by reflection waves.
According to the analytical studies (shoreline modeling and calculation on topographic changes by 2nd dimension modeling) regarding the change of shore lines, the sand may be deposited around 10cm deep near the port and 10cm of erosion may take place on the beach. However, there would not be large scale changes on the seabed topography. It has thus been concluded that there will hardly be any effects to the waves and topography caused by the construction of breakwaters.

As in the case of Soufriere, it is important to create awareness of fishermen to preserve the environment in the fishing port. Since the port is protected by the breakwaters, special caution should be given to fishermen in particular reference to the effects of breakwaters.