MINISTRY OF AGRICULTURE, LANDS,
FORESTRY AND FISHERIES
GRENADA

BASIC DESIGN STUDY REPORT
ON
THE PROJECT
FOR
CONSTRUCTION OF
MELVILLE STREET FISH MARKET
IN
GRENADA

JANUARY 1999

JAPAN INTERNATIONAL COOPERATION AGENCY
CRC OVERSEAS COOPERATION Inc.
PACIFIC CONSULTANTS INTERNATIONAL

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PREFACE

In response to a request from the Government of Grenada the Government of Japan decided to conduct a basic design study on The Project for Construction of Melville Street Fish Market in Grenada and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Grenada a study team from August 11, 1998 to September 14, 1998.

The team held discussions with the officials concerned of the Government of Grenada, 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 Grenada 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 Grenada for their close cooperation extended to the teams.

January, 1999

Kimio Fujita
President
Japan International Cooperation Agency

January, 1999

LETTER OF TRANSMITTAL

We are pleased to submit to you the basic design study report on The Project for Construction of Melville Street Fish Market in Grenada.

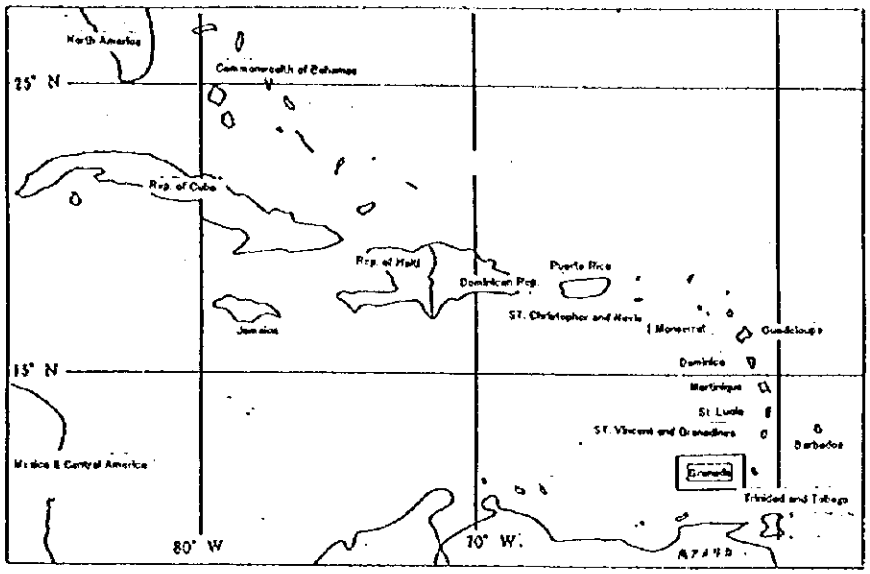
This study was conducted by the joint venture of CRC Overseas Cooperation Inc. and Pacific Consultants International under a contract to JICA, during the period from August 3, 1998 to January 20, 1999. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Grenada 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,

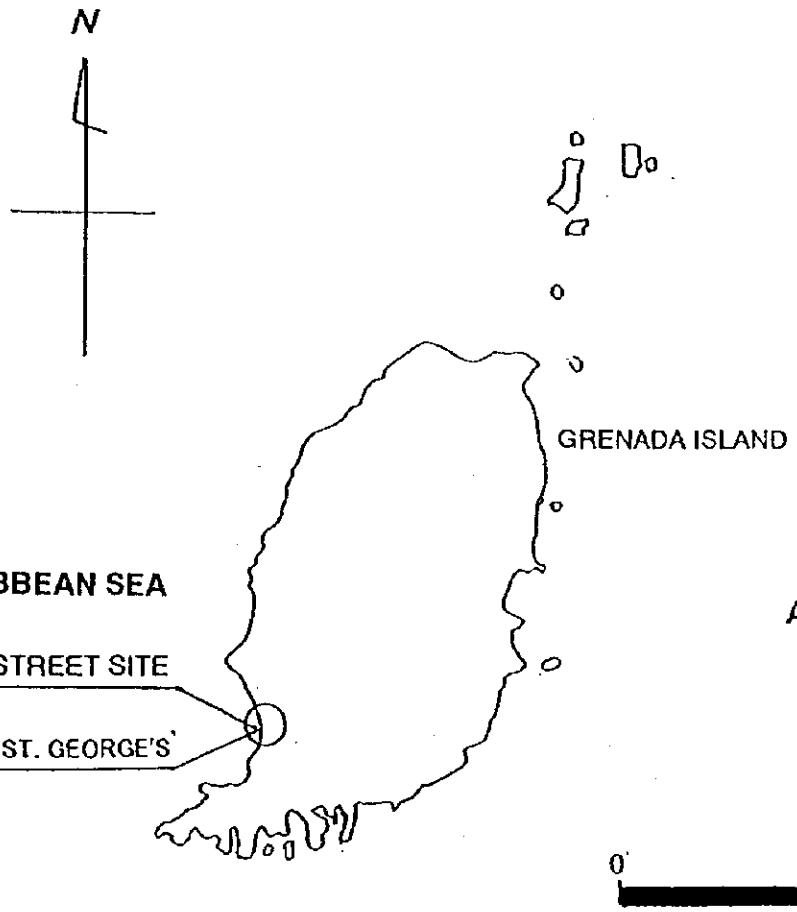
Mamoru Kondo
Project manager
Basic design study team on
The Project for Construction of Melville Street
Fish Market in Grenada
Joint venture of
CRC Overseas Cooperation Inc.
and Pacific Consultants International

LOCATION MAP OF GRENADA

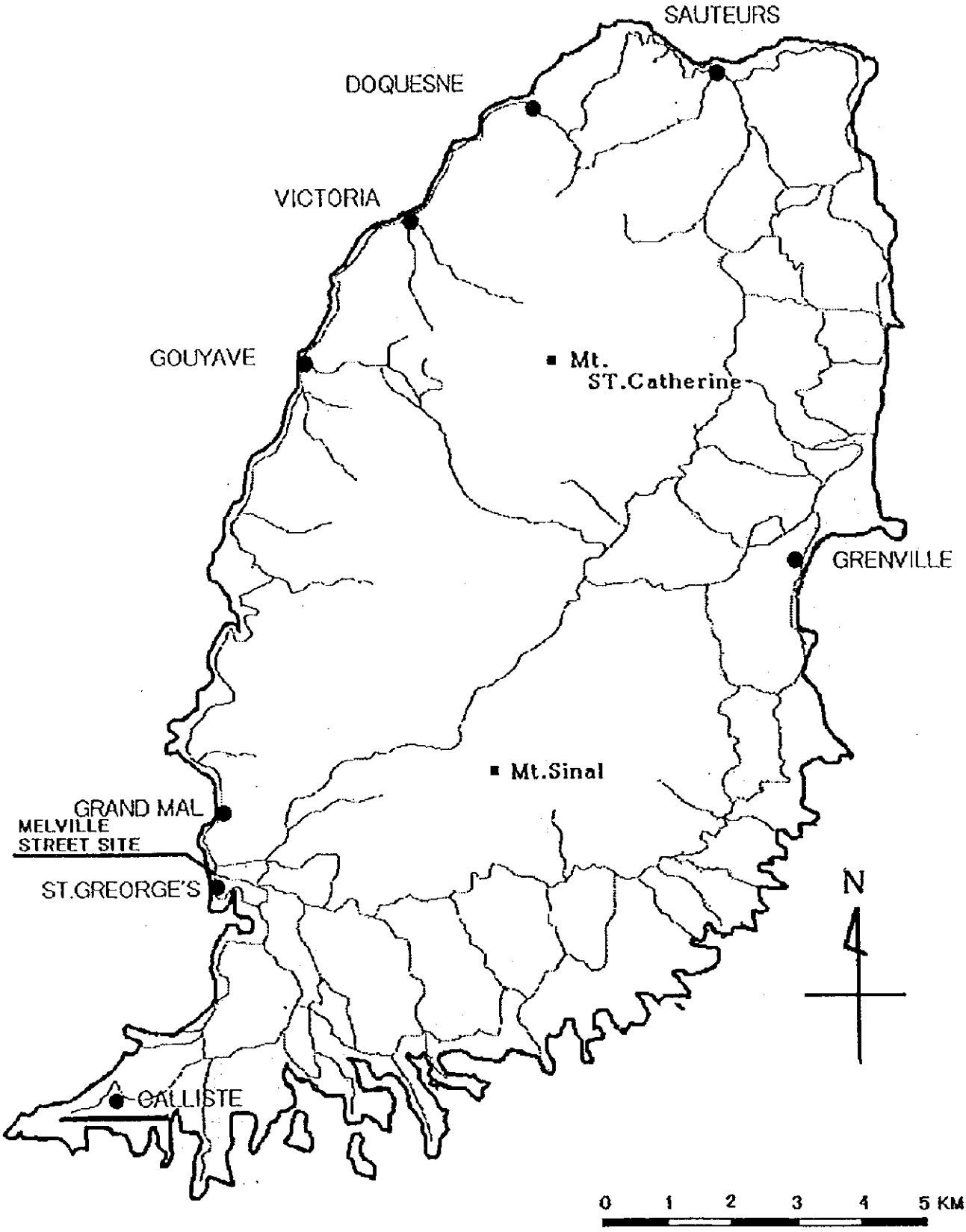


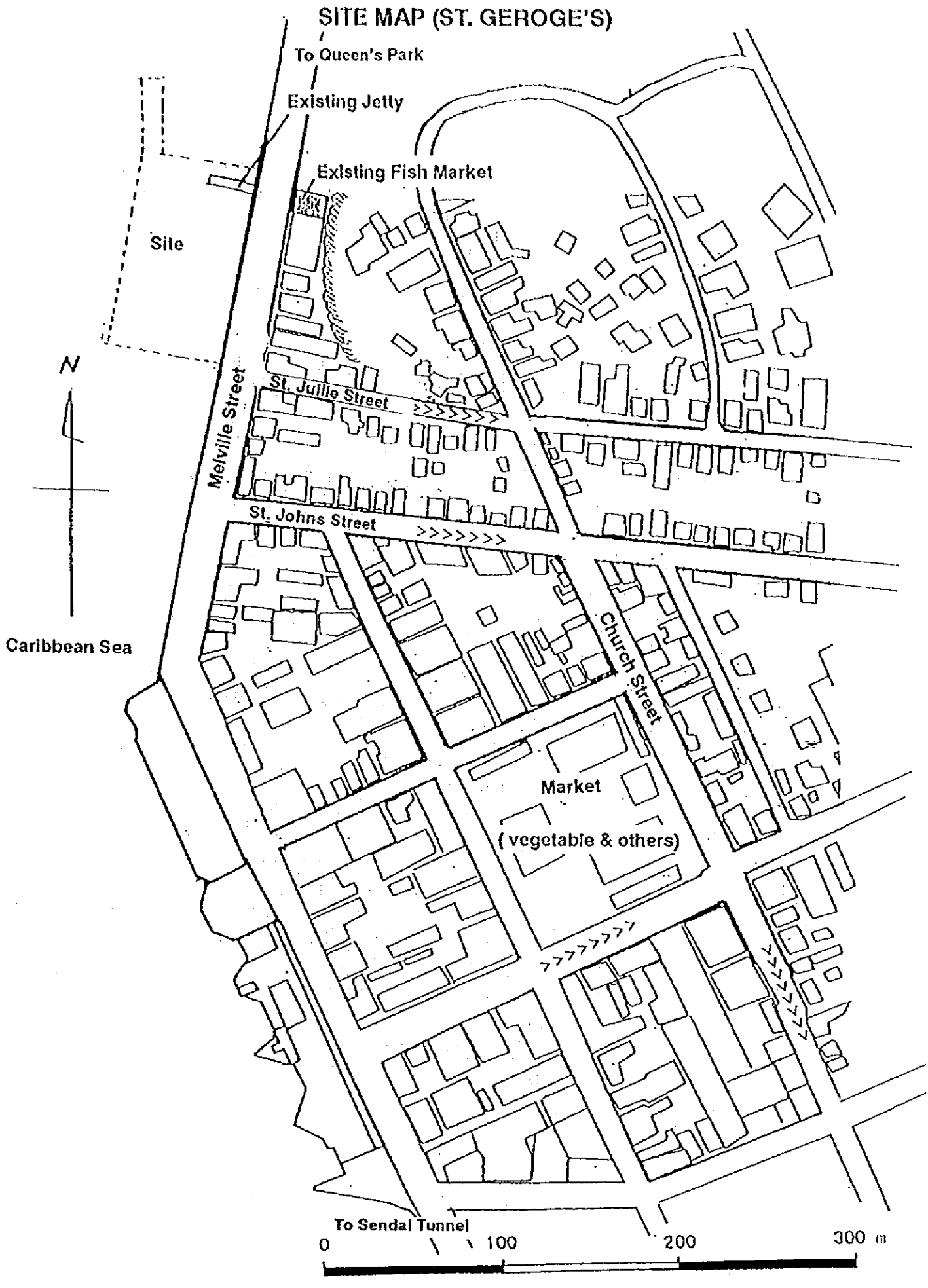
PETITE MARTINIQUE ISLAND

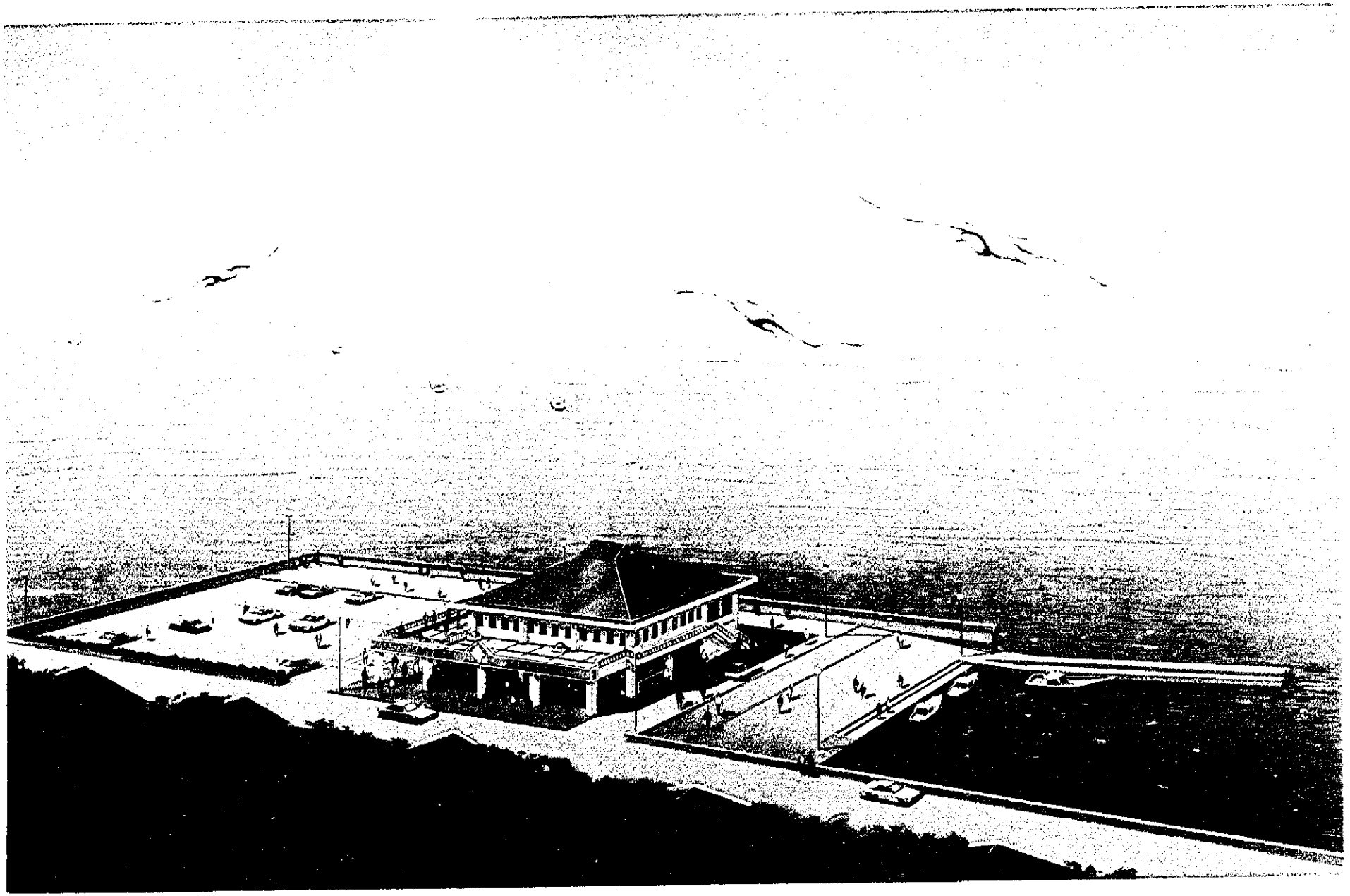
CARRIACOU ISLAND



MAP OF GRENADA ISLAND




SITE MAP (ST. GEROGE'S)
To Queen's Park
Existing Jetty
Existing Fish Market
Site
N
Caribbean Sea
Melville Street
St. Julie Street
St. Johns Street
Church Street
Market
(vegetable & others)
To Sendal Tunnel
0
100
200
300 m



ABBREVIATIONS

ABBREVIATIONS	FORMAL NAME
GCFL	Grenada Commercial Fisheries Limited
CARIB CODE	Caribbean Building Code
CARICOM	Caribbean Community
CIDA	Canadian International Development Agency
CPUE	Catch Per Unit Effort
FAO	Food and Agriculture Organization
JICA	Japan International Cooperation Agency
OECS	Organization of Eastern Caribbean States
UBC	Uniform Building Code
UNCHS	United Nations Center for Human Settlement
IFAD	International Fund for Agricultural Development
AFDP	Artisanal Fisheries Development Project
KEAED	Kuwait Fund for Arab Economic Development
OPEC	Organization of Petroleum Exporting Countries
SMB	Sverdrap, Munk and Bretschneider (Wave analysis)

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【Appendices】

Chapter 1

Background of the Project

Chapter 1. BACKGROUND OF THE PROJECT

1-1 Background

In Grenada (with a population of 95,000), the economy largely depends on traditional agriculture/fishery and tourism which are dominant industries in the country. The per capita GDP was US$2,985 (1996), and the annual economic growth rate for the previous ten years (1986-1995) was 4.0% on the average, boosted by foreign aids and increasing exports of major agricultural products such as nutmeg, mace (a spice made of dried skin of nutmeg seeds), and etc. However, a sharp decrease in aids from the U.S.A. and other countries since 1990, and stagnant agricultural production resulted in the fall of growth rate to below 2%. The Government of Grenada carried out a three-year structural adjustment plan in 1992. Although it proved partial success in reducing the number of government officials and government debts, the effects on the recovery of economic growth rate is not sufficient, leaving high unemployment rate and high prices. The prices of food and fuel in 1996 marked a 4.5% and a 7.6% increase respectively from the year-ago level, adding strains on the family budgets and the economic situation has not been improving.

In these circumstances, the Government of Grenada drafted the First Medium-term Economic Strategy Plan (1994-1996) designed for economic recovery. Currently, the Second Medium-term Strategy Plan (1996-1998) is being carried out, which is focused on construction of roads and development of water supply facilities, aiming at increase of public investment, improvement of international competitiveness, reduction of unemployment rate, improvement of social welfare and environmental protection, etc. Fishery infrastructure development, modernization of farmland usage and extermination of harmful insects are among the development policies for the agriculture/fishery industry.

The fishery sector's present contribution to the GDP is some 1.7%, but the fishery products accounts for about 15% of the total exports. It is, therefore, placed importance in the above policies as a promising economic sector of the nation which is not abundant in resources.

As the aid projects for the fishery sector from the foreign countries proved obvious success, the Government of Grenada is positive in introducing fishery development projects in league with other countries and international organizations.

The area of continental shelves around Grenada is as large as 3,100 km², while in St. Vincent it is more than 1,800 km², with resources of various demersal fish species. Grenada's surrounding waters includes the migration route for tuna in the South Equatorial Current, forming an abundant fishing ground for pelagic species during January and June every year.

The number of fishermen in the nation is some 1,700 (1,500 in Grenada Island, and the rest in Carriacou Island), of which 80% is full-time fishermen. There are 39 landing beaches (29 in Grenada Island) in the country. The total number of fishing boats is 541 (434 in Grenada Island), of which 3 to 10-meter-long wooden boats with outboard motor share more than half, 471 (367 in Grenada Island), and over 10-meter-long boats are 24 (all in Grenada Island) and the others are beach-seine fishing boats for small pelagic fishing on the coast (43 in Grenada Island). The nation's average annual catches for the past seven years is some 1,700 tons (about 1,600 tons in Grenada Island).

Because of the national predilection for fish the annual per capita fish consumption is estimated at around 20 kg. The difference in catch amounts between the high and low seasons is large, causing chronic shortage of fresh fish supply for general public due to growing demands from tourist industry. As a result, as much as 750 tons of fishery products (salted codfish and other salted/dried fish and canned/processed fish) are imported annually to fill the domestic demands, while about 450 tons of highly valued quality fish, tuna and shellfish are exported annually.

In order to obtain foreign currency through fish exports and effectively utilize the fish resources the Government of Grenada has positively introduced projects for fishery development with aids from foreign countries and international organizations. However, the resources of coastal bottom fish and conch-shellfish, which has long supported artisanal fishing is suffering depletion. The fish catches are declining in both size and quantity. In these circumstances, switch to sustainable and effective utilization of offshore fishery resources (tuna and other

large pelagic fish, bottom fish at the slopes of continental shelves) is necessary, which is expected to have room for development. For that purpose, a system should be established to manage depleting coastal marine resources and promote education for fishery development aimed at exploitation of undeveloped resources.

The distribution system for exporting marine products and frozen fish has been largely improved since the completion of the facilities of Grenada Commercial Fisheries Ltd. (GCFL) in March, 1997. However, most of the fishery facilities in the country are old and decrepit, and insufficient in number. In particular, belated development of urbanward distribution facilities causes considerable post harvest loss of fish catches, wasting important resources and leaving the volume of fish handling quite small. As a part of efforts for effective fishery development, it is important to establish a sanitary market to activate fish distribution in the island, and to make the fish resources effectively used by reducing post harvest loss. Particularly, the fish market at Melville Street in densely populated St. George's (with a population of 30,000) handles as much as 150 tons of fish annually, exceeding the capacity of the market. Much of the fish is sold on the road outside the market. It is not sanitary and quality preservation of fresh fish is quite difficult. It is also a big obstacle to the traffic. For such reasons, development of Melville Street fish market is given top priority in the fish market development plans for Grenada Island.

Under the circumstances, the Government of Grenada formulated "The Project for Construction of Melville Street Fish Market in Grenada" which is focused on the foundation of an educational base for fishery development and construction of the fish market, and requested Japan for Grant Aid cooperation.

In response to the request, the Government of Japan sent a Preliminary Study Team (April, 1998) to confirm the fishery's situation and the distribution system of Grenada, as well as the appropriateness of the Project site and the necessity for a Japan's Grant Aid. And the Government of Japan has concluded that the requested project, "The Project for Construction of Melville Street Fish Market in Grenada" is adequate and has higher priority for implementation under Japan's Grant Aid, and decided to carry out the Basic Design Study.

1-2 Outline of the Request and the Main Component

1-2-1 Outline of the Request

The main objectives of the Project are upgrading of existing old fish market, jetty and attached facilities including parking lot which are on Melville Street in St. George's. They are effective to develop sanitary market environment, expand domestic fish distribution, cut post harvest loss, alleviate traffic congestion in front of the Melville Street fish market, develop the waterfront, which will promote implementation of Grenada's fishery development policies and contribute to the redevelopment of St. George's.

To strengthen fish resources management and activate fishing through promotion of offshore fish resources utilization, the function of the local fishery centers throughout the country should be centralized while constructing central facility. Then the facility will function as the base for education for artisanal fishery development in Grenada .

1-2-2 Major Component of the Request

The main facilities and equipment of the requested Project are given below. The component was modified at Preliminary Study and Basic Design Study as shown in Chapter 2, sub-paragraph 2-2-1.

Table 1-2-1 Major Component of the Request

Facilities & Equipment	Size & Quantity	Remarks
Fish landing wharf	1 set	Note: In addition to the fish market facilities, installation of fishery development center facilities and supply of equipment were requested at the Preliminary Study in April, 1998.
Breakwater	1 set	
Fish market facilities	1 set (40m x 20m)	
Ice-making/storage plant	1 unit	
Retailing counter	1 unit	
Administration office	1 unit	
Cold/chilled storage	1 unit (10 tons x 2)	
Dry store	1 unit (5 tons x 1)	
Toilet, shower	1 unit	
Workshop	1 unit	
Fishing gear locker	1 unit	
Parking lot	1 unit	
Access road & pavement in the premises	1 unit	
Fence and guard post	1 unit	
Lighting	1 unit	
Septic tank	1 unit	

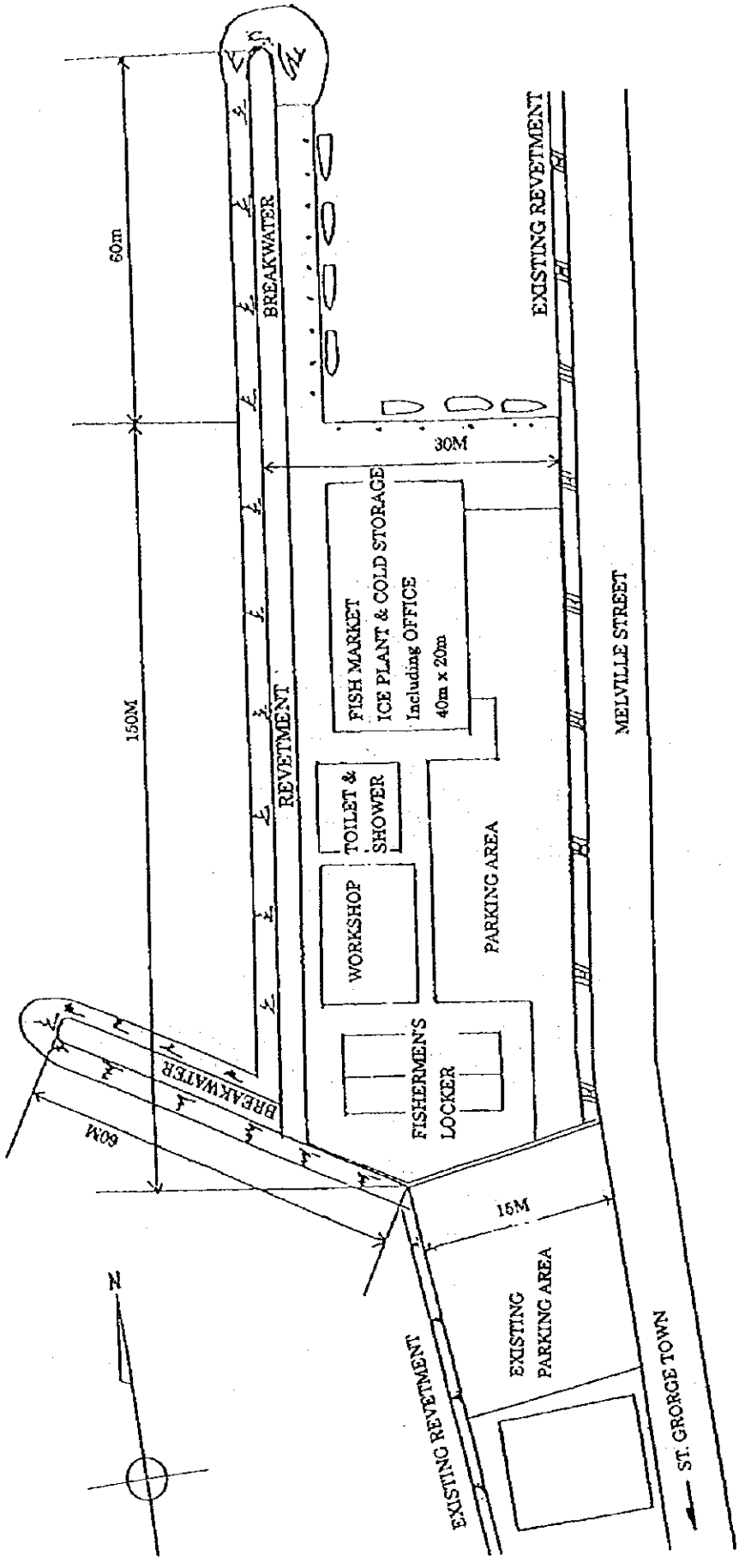


Figure 1-2-1 Project Site Layout Plan in the Original Request

Chapter 2

Contents of the Project

Chapter 2. CONTENTS OF THE PROJECT

2-1 Objectives of the Project

Melville Street fish market that is the target of the Project is brisk as the only public market in the capital of Grenada, St. George's, and plays quite an important role for both people associated with fishery such as fishermen and fish retailers, and inhabitants in the metropolitan area.

However, the fish distribution facilities in the metropolitan area including existing old Melville Street fish market are not in good condition, causing deterioration of freshness/quality of the catches and quite big post harvest loss, and valuable resources are not be utilized effectively and as a result fishing efforts of fishermen are wasted.

Further, the existing jetty of Melville Street which is used for landing the catches of coastal small fishing boats is of bare concrete structure without side protection materials and bollards, etc. and addition it has become quite old with some portions where the surface mortar comes off and the steel reinforcement is exposed. In addition concrete blocks are disorderly thrown in the sea at the tip of the jetty, making it difficult to secure necessary water depth and keeping away fishing boats bigger than medium-size from the jetty.

The existing fish market facilities are constructed on a narrow land along Melville Street, and cannot supply the ice necessary for fish market business because of no land available for expanding the facilities, and is narrow for fish transaction of fish retailers partly because of insufficient ice storage and water supply/drainage facilities, etc. The existing fish market was constructed in around 1950 with the content shown in Table 2-1-1. In comparison with 1950, now the number of retailers has increased to 42 and population of the hinterland has reached 30 thousand.

Table 2-1-1 Existing Melville Street Fish Market Capacity

Item	No. of fish retailers n (persons)	Unit area of retail counter d (m^2)	Area of passages, etc. * g (m^2)	Necessary area of fish market $A = n \times d + g$	Popul'n of Hinterland (St.George's)	Annual catches (tons)
Capacity of the Existing Melville Street Fish Market (Planned at 1950 around)	13	2.5	65	97 (=13×2.5+65)	20,000	50

Note: * Passage area, etc. $g = 2 \times n \times d$

Further as sunlight directly gets into the fish retail counter in the afternoon, and the displayed fishes become severely deteriorated and unsanitary, the retailers are forced to move to the opposite side of the road and make open-air sales of fish under temporal sunshade. However, it is dangerous to cross the road in heavy traffic in the daytime and to move the wooden tables piled with fish. And the fish sales on exhaust gas-polluted bustling road edge makes the quality of commodity extremely deteriorated. Addition, the fish retailers who are not able to be accommodated in the fish market carries out selling fish on road all day long. In this way the selling fish on the road is unsanitary and causes traffic jam at the same time.

The Project site on Melville Street belongs to the central part of the capital St. George's where the fish retail market, meat market, fruit and vegetable market, bus terminal, and so on are concentrated. The street faces seashore and it is daily utilized by the people of the island including retailers, shoppers, and passengers of the bus. The urban area is formed on the steep slope extending to the beach in hugging shape. The narrow space is well developed but the traffic in the city has reached almost its limitation with recent sharp increase in the number of vehicles. Therefore, Melville Street fish market and its vicinity are more complicated in terms of traffic lines of people, commodities and vehicles due to fish retailers on road, forcing people to do inefficient and inconvenient shopping.

In the meantime coastal bottom fish (groupers, etc.), lobster, and conch shell, etc. tend to decline, and such problems as miniaturization of fish and decrease of catch has occurred. As shown in the following table the closed season of lobster was

increased to 5 months per year with addition of 1 month against the previous year, and also that of 5 months was laid down to conch shell to cope with the problem. The situation is still quite severe for fishermen as the catches of lobster and conch shell decreased to about 13 tons and 1 ton respectively in 1997 while they were about 30 tons and 7 tons respectively in 1996. Likewise as to the catch of typical coastal bottom fish of groupers that have much demand from hotel and restaurant, etc., the monthly catch in 1996 exceeded 500kg only in December, while there were as many as 3 months that did not reach 50kg. In 1997 the catches barely attained the order of 2 tons per year with the self control by laying down a closed season of 2 months.

Table 2-1-2 Recent Catches of Typical Coastal Fish Resources

(Unit : kg)

Robster	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1996	5,176	5,486	3,131	6,125	0	0	0	0	1,827	2,642	3,603	1,025	29,015
1997	5,134	776	2,140	2,601	0	0	0	0	0	1,211	581	789	13,232

(Unit : kg)

Conch	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1996	0	17	465	1,563	0	0	0	0	87	561	802	3,449	6,944
1997	39	0	149	34	0	87	0	0	0	42	461	100	912

(Unit : kg)

Rock Cod	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1996	135	162	8	11	43	122	162	136	262	234	193	705	2,173
1997	713	87	239	43	77	514	551	0	0	437	13	41	2,715

Remarks: [ ] means no landings

From the above-mentioned matter a quick correspondence is necessary for the protection and management of coastal fish resources. At the same time the conversion to offshore fishery that has still much room for development is also necessary in future. To this end adequate implementation and promotion of fishery development policy is necessary. And it is important to strengthen education and extensional activity toward effective and sustainable utilization of fish resources by establishing quickly an organization of national fishery development center and a

functional system.

The objective of Project is to reconstruct the existing old fish market, jetty and attached facilities including parking lot on Melville Street, to realize easing of the congestion of the fish market, promotion of sanitary sales of fish, decrease of the post harvest loss, and then to improve the distribution of fish catches in Grenada, based on the Grenada's fishery development plans and policy. At the same time the Project aims at implementing and promoting the protection of coastal fish resources of Grenada and the development of offshore fishery by integrating the functions of fishery centers (fish markets) located throughout the country and improving the facilities that will become a development and educational base for coastal artisanal fishery of Grenada. In addition the Project is expected to contribute to reconstruction of the urban environment of the capital St. George's.

2-2 Basic Policy of the Project

2-2-1 Contents of Request and Results of Discussions

Transition of contents of the requests of Grenada is shown in the following Table 2-2-1(1/2) and (2/2) as "Contents of Original Request", "Results of the Discussions at the Preliminary Study" of April, 1998, and "Results of Discussions at the Basic Design Study" of August, 1998.

Table 2-2-1 Contents of Request and Results of Discussions (1/2)

Contents of Original Request (January, 1997)	Results of Discussions at Preliminary Study (April, 1998)	Results of Discussions at Basic Design Study (August, 1998)	Remarks
Implementing Agency ・Ministry of Agriculture, Land, Forestry and Fisheries	・Ministry of Agriculture, Land, Forestry and Fisheries	・Ministry of Agriculture, Land, Forestry and Fisheries	No Change
Project site ・Melville Street	・Melville Street	・Melville Street	No Change
Project Managem't ・Ministry of Agriculture, Land, Forestry and Fisheries ・Fisheries Division	・Ministry of Agriculture, Land, Forestry and Fisheries ・Fisheries Division	・Ministry of Agriculture, Land, Forestry and Fisheries ・Fisheries Division	No Change

Table 2-2-1 Contents of Request and Results of Discussions (2/2)

Contents of Original Request (January, 1997)	Results of Discussions at Preliminary Study (April, 1998)	Results of Discussions at Basic Design Study (August, 1998)	Remarks
Facilities and equipment requested			
1. Facilities			
Fish Market (40m x 20m)	Fish Market	Fish Market	
Ice making / storage plant	Ice making / storage plant	Ice making / storage plant	
Retailing counter	Retailing counter	Retailing counter	
Cold /chilled storage (10tons x 2)	Cold / chilled storage	Cold / chilled storage	
Dry store (5tons x 1)	Dry store		Dry store is deleted.
Toilet, Shower	Toilet, Shower	Toilet, Shower	
	Lockers for fish retailers	Lockers for fish retailers	Fish handling space, market management office, lockers for fish retailers and materials store are added as inevitable.
		Fish handling space	
		Market management office	
		Materials store	
Administration office	Fishery Development Center Administration office Conference room Seminar rooms	Fishery Development Center Administration office Conference room Seminar room	Necessary compartment as the facilities for Fishery Development Center is arranged.
Toilet	Toilet	Toilet	
	Quality control room		Quality control room is deleted.
Fish landing wharf	Fish landing wharf	Fish landing wharf	
Breakwater			Deleted breakwater.

Parking Lot	Parking Lot (approx. 30 cars)	Parking Lot (approx. 30 cars)	
Workshop Fishing gear locker	Workshop Fishing gear locker		Workshop and fishing gear locker are deleted.
	Access spaces on the premises	Access spaces on the premises	Access spaces on the premises is added.
Fence and guard post	Fence guard post		Fence and guard post is deleted.
Lighting	Lighting facilities	Lighting facilities	
Septic tank	Septic tank		Septic tank is deleted. (City sewer system is available.)
2. Equipment			
		Sea water pump Pushcart Insulated box Fish box Scale (retail scale and platform scale) Radio sets	Equipment of minimum necessity is added.

2-2-2 Examination on the Conditions of Project Sites

There is no land available for construction of the project facilities on the seashore along the Melville Street requested by the Fishery Division of the Government of Grenada, and it is necessary to create land by such methods as reclamation and/or piling platform. Because this work requires not only expenses but also long time for careful examination, an alternative plan of construction site of the fish market was discussed at the preliminary study in April 1998. The result of the field survey and the situation of each candidate-site is shown as follows.

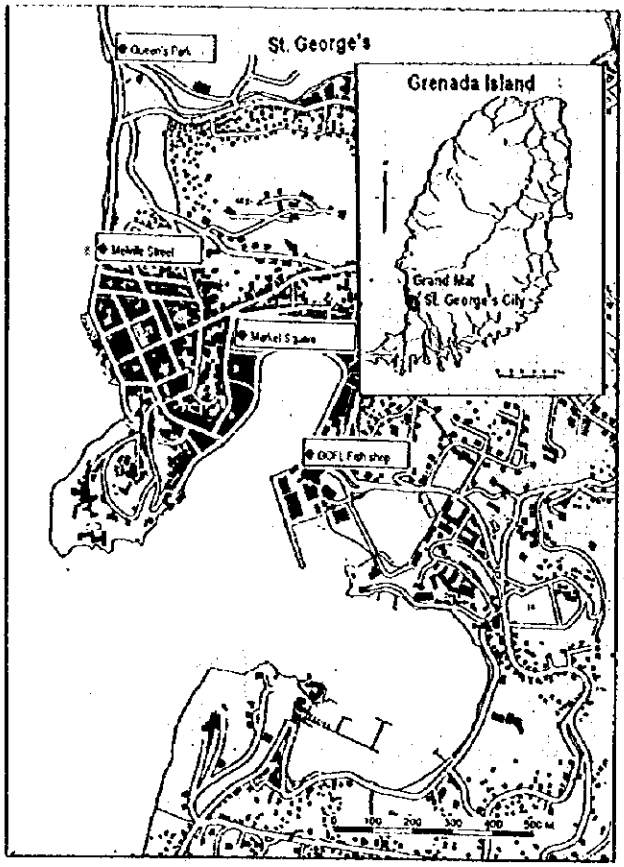


Figure 2-2-1 Locations of Candidate-Project Sites

(1) Melville Street

This is the site planned and requested by the Government of Grenada. This is the most convenient location for shopping citizens because it is located near to the center of St. George's as well as bus terminal, fruit and vegetable market, etc.

As it faces seashore and is near to a landing jetty, it is also the most suitable location for fish trading from the viewpoint of fish retailers. This was also shown by the results of a questionnaire survey for fishermen and brokers conducted at various fishing villages. The result showed that majority hoped the construction of a new fish market on this site.

(2) GCFL Frozen Fish Shop in St. George's (Carenage)

At present the land was returned to the Port Authority, and there is no land

available for the Fishery Division. GCFL is selling frozen fish at the fish shop in a remaining land of about 40 ㎡, and GCFL is requested to leave this land. If it is possible to expropriate the land again, there would be little prospect for attracting shoppers and visitors, because the land is a little bit far from the center of the city.

(3) Grand Mal

Grand Mal has little prospect for attracting shoppers and visitors because it is as far as 5km from the center of St. George's, and the traffic convenience is bad. At Grand Mal, Grenada Commercial Fisheries Ltd. (GCFL) possesses refrigerator, ice making plant, etc., but if a fish market is constructed here and operated by the Fishery Division, there is a possibility that a problem will occur because of duplicated management by GCFL and Fishery Division.

(4) Market Square (Vegetable Market)

Here on a site of about 8,000 ㎡, more than 100 permanent and temporary shops are carrying on business, and there is also a bus terminal here on which about 50 mini buses are parking at all times. There is no room to construct a new fish market on the Market Square, and it is impossible to construct new market and improve the present shops because no substitute land is available.

(5) Queen's Park

This site is located at about 500m of north of Melville Street. On this land a sports stadium is under construction, and no other construction of new facilities is possible.

From the above-mentioned situation Market Square and Queen's Park are physically impossible as the Project. The remaining 3 sites of Melville Street, St. George's (Carenage), and Grand Mal were compared and studied in more details. As shown in Table 2-2-2 on next page, it became clear from this study that Melville Street was the best as the Project site. In addition, the existing fish market is very difficult to be expanded, because it has not enough space and there is also a rocky cliff at the back. Further the meat market adjacent to the fish market is scheduled to continue operation in future, too, and it cannot be absorbed in the Project. Therefore, it was decided that if a new fish market is constructed on Melville Street,

a reclaimed land will be constructed along the seashore.

Table 2-2-2 Selection of Project Site

Plans / Items	Plan-A New Construction on Melville Street	Plan-B Improvement of existing GCFL fish shop in St. George's (Carenage)	Plan-C Expansion of Grand Mal GCFL fishery facility
Present situation	There are existing fish market and jetty.	There is GCFL frozen fish shop.	There are jetty, ice plant, freezer and chilled, cold storage facilities.
Securing of land	It is necessary to reclaim land or to create platform because no land is available.	Port Authority has issued a request of leaving, and there is no land available.	There is an adjacent land, but land creation is necessary for constructing facilities.
Traffic access	It is located in the city and 100m from bus terminal. Traffic is very convenient.	It is located about 1.5km from the center, and traffic convenience is slightly bad.	It is located about 5km from the center, and traffic convenience is considerably bad.
Landing function	Good because of the location along the seashore	Far from landing facilities	There is a landing quay.
Managem't system	Fishery Division will manage.	GCFL will manage.	GCFL will manage.
Necessity of changing fish distribution system	There will be no change of fish distribution style, and increase of fish distribution will be expected.	As the existing GCFL fish shop is dealing frozen fish only, change of distribution style will be necessary to newly deal fresh fish.	The Grand Mal facility is dealing export fish and frozen fish, and change of distribution style will be necessary to newly deal fresh fish.
Necessary component and construct'n cost	Construction cost is high because of necessity of reclamation.	Construction cost is low because reclamation is unnecessary, but construction is actually impossible.	Construction cost is low because cold/chilled storage, ice making plant, etc. are unnecessary.
Intention of Grenada governm'nt	There is a very strong demand to construct a new market on Melville Street.	Most of the site was returned to Port Authority. It is said impossible to expropriate the land again.	It is too far as a fish market in metropolitan area, and agreement of the government of Grenada cannot be obtained.
Total evaluation	○ The most suitable site	× No land available	× Too far from urban center

2-2-3 Basic Policy of the Project

(1) Outline of the Project

Based on the above-mentioned contents of the request and results of the discussions, the following facilities and equipment will be the object of the study as component of the Project.

1) Facilities Component

① Reclamation

② Revetment

③ Landing Wharf

④ Breakwater

⑤ Fish Market Facilities

Ice making/storage plant, Fish retailing counters, Cold storage, Materials store, Fish handling space, Fish cutting room, Market management office, Sanitary room (Toilet, Shower), Lockers for fish retailers, Machinery room, Rainwater reservoir tank

⑥ Fishery Development Center

⑦ External Facilities

Parking lot, Access spaces on the premises, Lighting equipment

2) Component of Equipment

⑧ Equipment

Sea water pump, Pushcart, Insulated box, Fish box, Weighing scale, Radio sets

(2) Basic Policy of the Project

The necessity and basic policy of each component of the Project are shown as follows.

① Reclamation

As mentioned in sub-paragraph 2-2-2, suitable land for construction of fish market was not available in urban area and vicinity of St. George's, and it is impossible to expand Melville Street fish market that is located under a cliff of steep slope. Therefore, it is most appropriate to reclaim the seashore opposite to the existing fish market in view of convenience of landing and sales of fish, etc. The shape of reclamation will be rectangular, and the longer side of the rectangle shall be along the existing revetment.

② Revetment

As western side of the reclaimed land faces the ocean, concrete revetment will be constructed on the western and southern sides of the reclaimed land with a view to preventing disasters caused by hurricanes, etc. Further, parapet (wave protector) will be put on the top of revetment to decrease overflowing wave.

③ Landing Wharf

In order to supply fresh seafood to consumers as swiftly as possible, it is necessary to add the function capable of landing directly the fresh seafood caught by local fishermen as a fish market. In addition it is necessary to consider restoration of the existing jetty that will be demolished for reclamation. As on the southern side of reclaimed land "St. George's new port (tourism/commercial port) Development Plan" and "Urban Area Development Plan" are scheduled, fish landing function will be constructed at the wharf on the northern side of reclaimed land.

④ Breakwater

As the fishing boats that utilize the landing wharf are small in size, it is necessary to secure calmness by constructing a breakwater jetty against the wave coming from northwest. To this end a breakwater will be constructed on the extension of the west revetment from the north corner of the reclaimed land.

⑤ Fish market facilities

The size of fish market will be studied based on the recent annual fish handling quantity by taking in the number of retailers now selling on the street, too. The facilities shall be arranged on the first floor of the building to be constructed on the reclaimed land in view of profitability and include the following equipment.

(a) Ice making/storage plant

Use of ice is inevitable for distribution of fresh fish and reduction of post harvest loss. Ice plant is a fundamental facility of fish market. Then the size will be decided corresponding to fish handling quantity of the fish market.

(b) Fish retail counters

Retailing counter will be designed in order that fishes are displayed cooled with ice and they can be sold in sanitary condition. The underside compartment of fish retail counters will be of a structure that can contain weighing scales, etc.

(c) Cold storage

It is necessary at a minimum to secure and keep the commodity for the following business day in order to implement a stable supply of fish at market everyday. To this end cold storage will be planned and arranged. For keeping the fish bought by each retailer, fish boxes will be used for stowing so that each retailer can easily identify his fish.

(d) Materials store

A stowage space to sort out and keep the equipment and materials necessary for operation and management of the fish market will be provided.

(e) Fish handling space

A fish handling space will be provided for the necessity of such work as

reception, keeping, delivery to retailers, quality control by inspection of freshness, and weighing of the catches landed at the site and the catches transported by land from other landing places.

(f) Fish processing room

A space to carry out cut processing of such big fish as tuna and marlins from among the fishes for retail that finished quality inspection and weighing.

(g) Market management office

Total 5 market staffs including the supervisor who is responsible for the market facilities are stationed, and they conduct operation and management of the market. An office space will be provided for these staffs.

(h) Sanitary compartment

Compartments of toilets and showers are provided for fish retailers and market staffs.

(i) Lockers for fish retailers

Locker space for fish retailers is provided at entrance of the sanitary compartment.

(j) Machinery room

It is planned to install an emergency generator in this project, and a compartment will be arranged to install the generator set and main switchboard, etc.

(k) Rainwater reservoir tank

It is planned to utilize rainwater as low-quality water for cleaning floor, etc.

⑥ Fishery Development Center

Following compartments that have minimum necessity as function of fishery development center are planned, and will be arranged on the second floor of the fish market building.

(a) Administration offices

Fishery development center aims at providing assistance and supporting services to fishermen and those associated with fishery, at each stage of resources management, fish production, fish distribution and consumption, as a base of fishery development and education in Grenada. Office spaces are provided to manage these business activities.

(b) Office of business department

Office and data room are provided for each department of fishing technology extension, fishery statistics, fish resources management that are major service activities of the fishery development center.

(c) Conference room

As a space is necessary for fishery people to have a conference together at a time for fishing technology extension for fishermen, fishery executives, and fishery successors, and a conference room is provided for this purpose as well as for multi-purpose meetings.

(d) Sanitary compartment

Toilet, pantry and locker for the Fishery Development Center are provided.

⑦ External Facilities

(a) Parking lot and access spaces on the premises

Parking lot and access spaces on the premises are constructed as a public fish market to facilitate users such as shoppers. Pavement shall be basically asphalt, but concrete pavement will be provided for the space between landing quay and fish market as well as the space between parking lot and apron.

(b) Lighting

Lighting lamps are provided for vehicles coming in and going out after sunset and/or before sunrise as well as for security during night time.

⑧ Equipment and Materials

(a) Seawater pump

Seawater pump is used for easy cleaning near the landing wharf and for the works of taking off fish scales (scaling works).

(b) Pushcart

Pushcarts are used for transportation of ice and fish catches at the fish landing wharf, fish retailing counters, fish handling space, etc.

(c) Insulated box and fish box

Insulated box: Used for temporary stowage of fresh big fish with ice.

Fish box: Used for fresh stowage in the cold storage in the market.

(d) Weighing scale

Two kinds of weighing scales are used for fish retailing and fish handling work in the market.

(e) Radio set

VHF radio set is provided for securing safety of short distance fishing boats and transmitting information on situation of catches, etc. Further SSB radio set that can conduct long distance communication is also provided in order to enable communication with foreign ships sailing outside of the Caribbean Sea in an emergency such as marine disaster.

2-3 Basic Design

2-3-1 Design Concept

The basic design concept of the Project is divided into five (5) items, namely, management plan, layout plan, facility plan, implementation plan and consideration on local conditions, and the basic design will be carried out based on the following policy.

(1) Management plan

In formulating a management plan of the Project, enough consideration shall be given to promote activities of fish production, fish distribution and marketing and so on by utilizing effectively the Fishery Division's long experiences, performances and organization available in the operation and management of local fishery centers (fish markets).

In the management activities of the Project, at first the function of central fish market in the metropolitan area that is the largest consumption market of Grenada will be enriched to encourage activation of domestic fish distribution. Next, the function of fishery development center that will become the base of fishery development such as offshore fishery development will be improved and expanded. Through these activities of the Project, "Establishment and enhancement of efficiency of a system for stable fish supply", "Resources management", and "Improvement of fishing skills" will be plotted.

The Project facilities will be managed and operated under the control of Fishery Division similarly to the other five fishery centers in Grenada Island (Gouyave, Victoria, Duquesne, Sauteurs, and Grenville) by taking necessary budgetary measures. Accordingly, as to the system for collection of facilities utilization fee (fish retailing booths, fish landing wharf, parking lot), sales of ice, cold storage of fish, and other profitable business-items, the existing management system will be followed as much as possible.

(2) Layout Plan

The Project site is on the seashore street of St. George's urban area. Steep cliff is reaching the back of the existing fish market building and an additional land space is not obtainable on shore. Then, land space necessary for construction of the facilities will be created by reclaiming seashore part, and on this site the facilities will be arranged. The southern end of the reclaimed land will border on St. Juillee Street by request of the Government of Grenada related to "St. George's New Port (Tourism/Commercial Port) Development Plan and Urban Development Plan".

The basic concept is that the site should be effectively laid out with market facilities to make them fully function as the central fish market in the metropolitan area. Concretely, the fish market building will be laid out close to the fish landing wharf, with an access road for land transport between the wharf and they will make a system to receive fish catches transported both by sea and by land. The traffic line shall be separated from that of general shoppers. The western side, which faces the open sea, a 10m-wide high wave buffer zone will be established from the revetment (west-revetment) and the building will be laid out toward Melville Street's side. The buffer zone is designed to serve as an esplanade where people usually stroll about. On southern side of the building, a parking lot for shoppers of the fish market will be arranged.

(3) Facility Plan

As the main facilities of the Project, not only facilities and buildings of fish market and fishery development center, but also fish landing wharf for fishing boats, and a parking lot for shoppers will be constructed. In addition, as various shops border on Melville Street, a commercial space such as small shopping block is not newly provided in the Project site. Common spaces to be used as pedestrians' path will be paved with materials that will allow easy repair, maintenance as well as continued amenity. Therefore, parking lot and roads on the premises will be paved with either asphalt or concrete in view of durability.

(4) Implementation Plan

For drafting the implementation plan full cooperation with the Grenada side is necessary. Close communication with the Government of Grenada will be

established so that particularly such measures as the reclamation site preparation, securing of temporal stockyard for construction works, removal of existing facilities such as jetty (including securing of substitute land for fish landing jetty as safety measures and fishermen's convenience during construction), securing of alternative traffic route during the construction period and measures for existing fish market users are conducted without problem.

As the project is quite large scale civil engineering and building works implemented at the site adjacent to the urban area, cleaning and safety will be fully controlled at the construction site and nearby access roads. Civil engineering and building work will be implemented at different timing. As a measure for land subsidence, building work will start with an interval of about 3 months after reclamation work is finished. Also concerning the earth for reclamation, materials of good quality and good uniformity will be used after enough investigation of quarry. Further, close consultation with Grenada side will be conducted on grasp of entire progress of work and content of work during the preliminary period so that a big delay in the progress of work due to rainy season may not occur.

(5) Consideration on the Local Conditions

1) Natural conditions

① The weather conditions are high temperature and high humidity. Each facility should be designed by taking ventilation and lighting into full account (consideration for ventilation and lighting in the building as well as sun shields against daytime sunshine, etc.).

②Grenada Island has a mountain range of 600-700m high. The annual precipitation in the mountains is more than 4,000 mm, while in the coastal area as little as 550mm in dry season. (It is 1,150mm in rainy season, twice as much as that in dry season). Taking that into account, rainwater should be collected and used for miscellaneous purposes. Seawater will also be used effectively to wash

fish landing wharf and other places where salt-corrosion is not expected.

③The Project site faces the ocean and is affected by sea breeze. Accordingly salt-proof building materials and equipment will be used.

④The reclaimed land level shall be high enough allowing easy drainage, and correspond to the submergence and the highest wave caused by cyclone, etc.

⑤The project site front faces the ocean, but the ocean area is relatively calm. Public sewer system will be utilized so that fish wastes and waste water, etc. may not pollute the seashore. In addition, with regard to existing meat market that drains to the Project site, Grenada side will be responsible for taking measures to drain to the public sewer lines. (The measures to connect to the public sewer line is necessary by the National Water and Sewerage Authority, Sewerage Regulation 1993.)

2) Social Environment

①The Project site adjoins the fish landing jetty for coastal fishermen, fish market, meat market (including a slaughterhouse), various shops (restaurants, shoe shops, boutique, gas station, grocery, etc.), road-edge general parking lot / standby place for bus and taxi. The layout plan shall keep the function of these existing facilities around the Project site and shall suit the St. George's Development Plan by the Government of Grenada.

②General view of the building will be designed to agree with the environment, e.g., suitable material, color, shape, etc. St. George's is a city on a slope and faces seashore, but there is no place where citizens can stand on water front except the existing landing jetty of the fish market. As the existing jetty disappears by reclamation, the Project shall consider that function of the planned landing wharf is expanded as a space to commune with water as much as possible. Further, easy maintenance is technically the first condition as the building facilities that face the seashore, but the surrounding scenery will be taken into full consideration as

public facilities in the urban center.

3) Construction Condition

① The UK and the USA regulations and standards are mainly adopted for the design of building and civil engineering structures. In addition to them CARIB CODE (Caribbean Building Standards) is also adopted. In the construction of the Project facilities, the design will be made by referring to these regulations, based on Japanese Building Standards and Japanese Civil Engineering Design Standards. Further as to the environment standards for drainage of dirty water, etc. local standards will be adopted according to the results of the discussions with the Government of Grenada. In addition public sewer system has been constructed in St. George's. The Project site is included in the restricted area, and also the Project facilities will be designed in conformity to the Sewerage Regulations 1993.

② As to chlorofluorocarbon refrigerant there is no regulation for its use now in Grenada. Because it is thought that the use of the substitute chlorofluorocarbon or ammonia is questionable in terms of maintenance/operation of the plant from the viewpoint of the local technological level. R22 that is permitted to use internationally till 2020 will be used as refrigerant.

③ Skilled engineers are not many in construction and marine engineering businesses in Grenada. As the past cases show, they were recruited from neighboring countries whenever needed. This is a construction situation common in the West Indies.

④ Materials such as sand, aggregate, and earth are available in the country, but steel materials (for building and civil engineering), pipes, and other construction materials are dependent on import, and are not always sufficient in quantity. Locally procured materials will be used as much as possible, and those difficult to be procured locally shall be imported from Japan or the third countries, after comparison and examination of the procurement cost, etc. are conducted.

⑤ Utilization of local contractor, materials and equipment

The local construction companies in Grenada have much experience in public works, etc. Their utilization as sub-contractor as well as positive employment of local workers will be considered.

2-3-2 Design Conditions

(1) Fish Market Building and Fishery Development Center

1) Fish market facilities

Fish market facilities consist of fish retailing counters to sell fresh fish, and ice making/storage plant, cold storage, fish handling space, market management office, materials store, sanitary rooms, lockers for fish retailers, and so on as the backup facilities to support the fish retailing activity. Among them the base for setting up the size of fish retailing counters, ice making/storage plant, cold storage, and fish handling space that will be changed according to handling quantity of fish is shown as follows.

The fish market will operate 300 days except on Sundays and holidays. The annual handling amount of fishes at the Melville Street fish market is estimated as 150 tons per year which is the average of recent years and the expected saved amount by reduction of post harvest loss. Post harvest loss will be reduced for the following reasons:

(a) Efficient landing

Existing fish landing jetty is not adapted to sufficient water depth, and restricts fishing boats to enter. The fish catches on medium-sized boats and by-catches of tuna long-liners are landed at Grand Mal or other fish landing places, then distributed for the Melville Street fish market consuming much time and freshness in a marketing and distributing process. With the development of fish landing wharf at the Project site, aritisanal fishermen's catches will be landed directly and swiftly to the market which has rather big consuming demand for fresh fish.

(b) With the environmental development of the market, fisheries will be sold in sanitary condition to increase shoppers. As a result, fish consumption is expected to rise while volume of fish which have been unsold and wasted will fall.

(c) Ice making and cold storage plant

As the existing fish market has no ice-making equipment, it has been brought from GCFL in Grand Mal, 5km to the north of the site. But sufficient ice is not secured for the fish amount. Although they have a cold storage, fishes are piled in bags and/or in bulk as the market space is very small and limited, forcing it take time to have fishes in or out of the storage, which is inefficient in terms of freshness/quality preservation.

It is difficult to estimate the amount of post harvest loss which will be saved by the Project. As explained in the field survey, more than 300 tons of fish catches are wasted annually in Grenada, but 10-20% of the loss will be improved; exactly, 50 tons will be saved.

Based on the above, the handling amount at the new Melville Street fish market is estimated at 200 tons (150+50 tons).

① Fish retailing counter

The service space for customers of the fish retailing counters in the existing fish market is of U-shape of width of 3m, depth of 4m, and extension of 11m (=3+4+4m), divided into total 13 booths consisted of 8 booths (with 4 booths on each side) and 3 booths on the back straight line portion and 2 booths on the corner. Two (2) booths on the corner are inconvenient because of restricted service space, but almost all of the space is used everyday. An exclusive space for one fish retailing counter is about 1m by 1m, a cutting board of 30cm wide with the same length, and a sink for washing on the rear part of the both sides, and then the storage space for fish, etc. that are not displayed on a retailing counter and the space for retailer to stand are less than 1m. Therefore, the area per one fish retailer is 2.0 ~2.5 ㎡ under the present situation, and this figure will be also used in the Project. Further the rear space behind retailers needs to be kept for passage to enable constant bringing in/out of fresh fish commodities by pushcart.

The total number of fish retailers in the Melville Street fish market is 42. The breakdown is 15 permanent venders doing business roughly everyday, 20 jacks venders handling beach seine catches, 3 conch venders selling shell fish, and 4

vehicle venders coming for sale by car from Gouyave and other fish landing places. Beach seine is operated not everyday but roughly once every two days. Conch venders are not selling now inside the existing market due to quality problem, but need to be included in the Project because the quality is being improved gradually. Vehicle venders are supplying more quantity of fishes directly to hotel and restaurant, etc. as broker rather than fish retailer. It is not necessary to prepare any retailing booth for the vehicle vendors. In the Project a fish retailing counter shall be provided to each of permanent venders, and 15 counters shall be prepared to jacks venders and conch venders. Accordingly, the total number of retailing booths shall be 30 as follows.

Table 2-3-1 Number of Fish Retailing Booth

Classification Of Fish Retailers	Number of Fish Retailing Booth (plan)	Remarks (Fulfillment Rate to the number of fish retailers at the existing Melville Street Fish Market)
Permanent Vender	15	100%
Jacks Vender and Conch Vender	15	65%
Total	30	79%

② Ice Making/Storage Plant

(a) Volume of ice

The fish handling quantity in the Melville Street fish market is estimated at about 200 tons per year. The landing quantity at the Project site is about 100 tons per year. Other than these, the fish stored temporarily by insulated boxes in the market facilities is 90 tons. (Temporary storage will be carried out by 2 insulated boxes each of which has 750 litters capacity; 0.15 tons / day/box × 2 boxes = 0.3 tons / day, 0.3 tons / day × 300 days / year = 90 tons / year.) The quantity of these fishes is total 390 tons. As ice is required in each step, this 390 tons of fish is to be used to determine the volume of ice required. The necessary volume of ice for this quantity of fish is 390 tons from the calculation by setting the ratio

between fish and ice as 1:1 based on the FAO standard is 390 tons, too. Moreover the necessary volume of ice is total 465 tons per year, when 75 tons of ice as the general demand (5kgs/person × 50 persons = 250kgs/ day, 0.25 ton / day × 300 days / year = 75 tons / year) is included.

Usage	Quantity of fish (ton)	Volume of Ice (ton)
Fishing (solely fishing boats on the site)	100	100
Fish market (for retailers)	200	200
Fishing market (for backup section)	90	90
General Demand	—	75
Total		465

(b) Capacity of Ice Making Plant

Necessary volume of ice per day is 1.55 tons. (465 tons / 300 days = 1.55 tons / day) From this result the capacity of ice making plant shall be about 2 tons per day. As the range of fluctuation of catch throughout year by fishing season is big in Grenada, it is planned to provide 2 units of ice making plant of 1.0 ton / day capacity in view of maintenance in order that it is possible to supply ice even at the time of maintenance, inspection, and repair.

(c) Capacity of Ice Storage Bin

The proper capacity of ice storage bin is 2~4 days portion of daily ice making capacity by FAO standard, etc. In the Project the size of ice storage shall be 6 tons equivalent to 3 days portion of daily capacity of ice making plant.

Table 2-3-2 Particulars of Ice Making/Storage Plant

Item	Content	Remarks
1. Required Volume of Ice	about 465 tons per year	Note : Owing to a big fluctuation of fish catches through year and consideration for maintenance, plural number of the plant shall be provided.
2. Capacity of Ice Making Plant	about 2.0 tons per day	
3. Capacity of Ice Storage	6.0 tons	

③ Cold Storage

The purpose of cold storage in the fish market of the Project is to secure and store the fresh fish commodities for sales on the following day prior to the day of sales. It is required to store about 0.67 tons (=200tons / 300days) on average per day from the handling quantity of about 200 tons per year of the fish market. However, as the fish handling quantity of the market in high season is 2 times (1.37 tons) of the annual average because of big monthly fluctuation throughout year, the storage capacity of the cold storage shall be 1.50 tons.

Further as the purpose of the cold storage is for retailing, the stowage in the cold storage shall be in principle by fish boxes to facilitate delivery of fish, and an appropriate working space in the cold storage shall be secured. Similar to the above-mentioned ice making plant, the cold storage shall be divided into 2 compartments, because of a big fluctuation of fish handling quantity throughout year as well as consideration for enabling the operation of the remaining one compartment even in case of the suspension of operation of one compartment for repair/inspection in terms of maintenance of the equipment. Further, freezer is judged unnecessary for the fish market facilities of the Project, because the production and sales of frozen fish are carried out by Grenada Commercial Fishery Ltd. (GCFL). However, if frozen fish is released by GCFL for domestic distribution and sold by the retailers of Melville Street fish market, the cold storage shall be possible to have a temperature of − 15 degrees C for frozen fishes.

④ Fish Handling Space

The backup section of the fish market implements those works such as reception, storage, delivery to retailers, quality control inspection and measurements of the catches from fishermen landed at the site as well as the catches from other landing places transported by land. This fish market handles various kinds of fish ranging from small coastal pelagic and demersal fishes to big offshore highly migratory fishes. The size of the fish handling space is set up by using the average figures during 10 days among January and February in 1995 when the biggest fish landing on the Project site was recorded for the past 3 years. The handling quantity at the fish handling space shall be 0.93 tons /day from the

following table.

Table 2-3-3 Biggest Fish Landing Records in the Past
(Two Consecutive Months)

Unit: KG

1995			1995		
Day	Jan	Feb	Day	Jan	Feb
1	0	249	16	727	249
2	0	688	17	792	143
3	359	496	18	616	0
4	632	0	19	492	0
5	537	0	20	516	469
6	849	868	21	158	577
7	137	0	22	214	627
8	72	678	23	1005	265
9	261	427	24	625	506
10	1641	936	25	878	311
11	847	440	26	778	0
12	370	0	27	467	0
13	634	304	28	77	0
14	134	314	29	70	
15	0	164	30	305	
			31	580	
TOTAL				14773	8711

Highest 10	Unit:KG
①	1,641
②	1,005
③	936
④	878
⑤	868
⑥	849
⑦	847
⑧	792
⑨	778
⑩	727
Total	9,321 kg
Average	932 kg

2) Fisheries Development Center

The office space necessary for the activities of fisheries development center includes Center's Director room, space for General Affairs Department (Reception/Secretary room, Office of General Affairs/Accounting, Office Store), space for business departments (Fishing Technology Extension Dept., Fishery Statistics Dept., Fish Resources Management Dept., Data room), Conference room, Sanitary room (Toilet, Pantry, Locker, etc.).

The number of staffs is total 14 based on the following breakdown as mentioned below. The conference room shall be of such size as accommodating about 35 persons to secure the space enabling the participation at time in technical courses for fishing of 10% of about 350 full-time fishermen in St. George's parish.

Name of Department	Number of Staffs
Center's Director Room	1
General Affairs Department	4
(1 for Receptionist/Secretary, 3 for General Affairs/Accounting)	
Business Department	9
(3 each for each Department)	

3) Parking lot

In the Project about 30 cars corresponding to the parking space on the road shoulder in front of the Project site that will disappear by the construction of the new fish market will be accommodated on the parking lot for visitors inside the reclaimed land.

Parking capacity

Number of cars	: 30
Dimension of one parking	: 3m × 6m

(2) Fish Landing Wharf

1) Particulars of fishing boats

The number of fishing boat in the St. George's area (St. G) is ninety seven (97). Among them, fifty nine (59) fishing boats are allocated in the Project area. The number of fishing boats which utilizes the new fish landing wharf at the project area is determined as fifty eight (58), excluding one (1) seine boat. The particulars of fishing boats are summarized in the following table.

Table 2-3-4 Particulars of Fishing Boats

Boat type	No. of Boats	Main dimension		
		Length (m)	Breadth (m)	Draft (m)
OBM: Small sized outboard motor boat	17	6.0	1.5	0.7
OBM: Middle sized outboard motor boat	29	9.0	2.1	1.2
IBE: Middle sized inboard engine boat	12	9.0 to 12.0	2.1 to 2.4	1.2 to 1.8
Total	58	-	-	-

2) Wharf length

The functions for the wharf are, in general, landing, preparation, resting and refuge. In this project, the necessary function of the proposed wharf is exclusively landing of fish catches among the above functions. This is because that the existing jetty, at present, is used exclusively for fish landing and most of the fishing boats goes back to their home beach soon after finishing the landing of their catches. All of twelve (12) number of middle sized inboard engine boat shown in the Table 2-3-4 are tuna long line fishing boats, and its landing at Melville Street fish market is by-catches (which are not target species of their fishing) only and irregularly. Therefore, it is not necessary for the new wharf to take into consideration for the landings from long line fishing boats.

The required wharf length, therefore, is totally 35m for 46 fishing boats, which consists of 10m for 17 small sized outboard motor boats and 25m for 29 middle sized outboard motor boats as shown in the following table.

For determination of the wharf length, the rotation of the fishing boat for landing fish catches at the wharf is assumed as 15 minutes and the working time is set as 3 hours, which is two (2) hours in the morning and one (1) hour in the afternoon from the result of hearing survey at the high fishing season. Then, the number of rotation is obtained as follows.

Number of rotation r = 3 hours / (0.25 hour/time) = 12 times

Table 2-3-5 Required Wharf Length

Boat size	Require length(m) $L_r = N/r \times L$	Requirement		
		Berth length (m) $L=1.15 \times l$	Average number of boats per day (number)	Rotation of berth (times/day) r
OBM: Small sized outboard motor boat	10	6.9	17	12
OBM: Middle sized outboard motor boat	25	10.4	29	12
Total	35	-	46	-

2-3-3 Basic Design

(1) Civil Structure Plan

1) Design condition for civil structure

The design condition for civil structure is as follows.

① Design standard

Design standard for the structures in Grenada is fundamentally based on the Caribbean Uniform Building Code (CARIB CODE). For the civil structures, the available code of CARIB CODE is applied as practical as possible, and the Japan's Design Standards, which are commonly applied for the past projects, shown below are also considered for design of civil structures.

a. Design Standards for Fishing Port Facilities in Japan :
Japan Fishing Ports Association
b. Technical Standards for Concrete : Japan Society of Civil Engineers
c. Technical Standards for Port and Harbor Facilities in Japan :
Japan Ports and Harbors Association
d. Technical Standard for Soil Test :
Japan Society of Soil Mechanics and Foundation Engineering

① Water level

Based on the result of investigation, design water level is as follows.

MHWL	CD+0.50 m	
MWL	CD+0.34m	
MLWL	CD+0.12m	
CD*	CD+0.00m	(*CD: Chart Datum)

The elevation of existing jetty is +1.0m and the average height of the Melville Street is +3.0m.

② Wave

In general, the wave condition at the site is calm except the time of hurricane and N to W monsoon season in November to February. For design of the structure of the site, wave of hurricane is applied comparing the wave force of N to W monsoon wave. NW waves were observed during the basic design study at the site, and it was found

the incoming wave from NW direction would generate propagating wave along wharf and make difficult to berth along the wharf for small sized fishing boat due to propagating wave. The study for preventing propagating wave along wharf should be studied for NW waves.

a. Hurricane wave

For the selection of hurricane wave, hurricane data, which passed near or around Grenada during latest 30 years, was collected to examine the wave, among which waves attacked at the site are analyzed.

The significant offshore wave for each direction was estimated by determining the effective fetch distance, applying the Wilson Method. Computer is used for the estimation. The relation among wave height and period was determined by analyzing the significant formula among these factors. The wave condition for each recurring period was estimated by formula of distribution of probability. The recurring period of the design wave was determined as for 30 years considering the life and type of the structure, economical point view and similar coastal structures in the Caribbean area. Design wave condition is applied from the study and calculation of wave transformation in shallow water area for hurricane waves considering the boundary condition and the transformation of approaching wave in front of construction site by a numerical model. The applied model is the one based on the Conservation Equation of Energy Flux Method by Karlsson (1969), that calculates the transformation (refraction, diffraction and shoaling), of multi-spectrum irregular wave. The wave condition such as direction and height of deep water waves and equivalent deep water waves for 30 years recurring wave are as shown in the following table.

Table 2-3-6 Estimation of Characteristic of Wave

Offshore Wave Direction		Wind wave						Swell	
		WSW	W	WNW	NW	NNW	N	NNW	N
Deep water waves	$H_{1/3}$	2.4m	2.6m	2.7m	2.8m	2.9m	2.9m	2.9m	2.9m
	$T_{1/3}$	6.0s	6.3s	6.5s	6.6s	6.7s	6.8s	11.4s	9.9s
Equivalent deep water waves (H_0')	$H_{1/3}$	2.0m	2.4m	2.5m	2.4m	1.8m	1.2m	1.2m	0.9m
	Wave dir.	268°	274°	289°	299°	306°	309	298°	303°

Wave from NNW to N direction is coming into the site, but the angle of incoming to the site is almost parallel with the water depth line. Consequently the equivalent deepwater wave become small due to the refraction. The maximum equivalent deepwater waves is, hence, from WNW direction and its height is 2.5m and the period is 6.5 sec. The wave against the structure is estimated considering the changing wave height according to the change of depth of sea. The coefficient of wave height at the location of structure against equivalent deepwater wave is 1.1. The design wave height (H) in front of the structure is 2.8m (H = 1.1 x Ho' = 1.1 x 2.5m = 2.8 m). The period of wave is 6.5 sec., which is same as that of equivalent deepwater waves.

a. Wave from NW direction

Wave, which comes into the site by NW monsoon wave, is considered as waves which is generating by the monsoon wind of 7 m/sec, fetch of 45 km and duration of 6 hours. In this wind condition, the wave height and period are estimated as follows by SMB (Sverdrup, Munk and Bretschneider) method.

Wave height H = 0.7 m

Wave period T = 3.3 sec.

This wave is applied for the study of calmness at the landing wharf against the breakwater. The date of the frequency of wind, including NW direction, is not found in the country. Therefore, according to the available wind observation date around Caribbean sea, the frequency of wind from S to N is estimated as follows.

Table 2-3-7 Wind data (Unit: Frequency)

Velocity (Kt) / Direction	0~4	4~7	7~11	11~17	17~22	22~28	28~31	31~41	Total	Ratio
S	11	31	31	28	11	7	0	0	119	38.6%
SW	7	11	7	7	3	0	0	0	35	11.4%
W	4	7	7	0	0	0	0	0	18	5.8%
NW	4	7	7	7	7	0	0	0	32	10.4%
N	11	15	15	28	28	4	0	3	104	33.8%
Total	37	71	67	70	49	11	0	3	308	100.0%
Ratio	12.0%	23.1%	21.8%	22.7%	15.9%	3.6%	0.0%	1.0%	100.0%	

Source: Sailing Directions for the North Atlantic Ocean by Defense Mapping Agency of United States of America. Third Edition 1988.

The frequency of wind which is applied for the study of breakwater is very high as 22.7%. It should be studied the allocation of breakwater against this wave at the landing wharf.

④ Soil

The soil condition at the sea bed of the site is sandy soil which includes good coral material. The settlement of the sea bed by the filling or reclamation is not expected. The soil condition is determined from the result of soil investigation as follows.

Average depth from sea bottom	0～1m	1～3m	>4m
Average N-value	5	10	>20

⑤ Seismic Force

Load (load which is shown in the Part 2 of the Section 3 of the Caribbean Uniform Building Code; CARIB CODE, is seismic force due to earthquake) is for the standard seismic load which is applied for determining the seismic force (H) to the building structure. However, the standard is considered for this Project because the standard is applicable for both building and civil structure. This standard is modified seismic method which considered the independent seismic period of structure and the force is applied against its own weight (W), considering the site condition as follows.

$$H = K' \times W = (Z \cdot C \cdot I \cdot S \cdot K) \times W$$

Where,

Z : Numerical coefficient related to the seismicity of a region. 0.5 is applied for Grenada.

C : Numerical coefficient natural period of structure as specified $1/(15\sqrt{T})$. 0.12 is applied.

I : Occupancy importance coefficient. Hospital(1.5), meeting facility(1.2), others(1.0). 1.0 is applied.

S : Numerical coefficient for site-structure resonance of sub soil. Max. C x S $\leqq$ 1.4 is applied.

K : Numerical coefficient related to structural type. 0.8 to 2.0 in general. 2.0 is applied for gravity type structure.

Then, $K' = Z \cdot C \cdot I \cdot K \cdot S = 0.14$

⑥ Operational condition

a. Size of boat (Particular dimensions)

Symbol	Boat type	Length(m)	Breadth(m)	Draft(m)
OBMs	: Small size outboard motor boat	6.0	1.5	0.7
OBMm	: Middle size outboard motor boat	9.0	2.1	1.2
IBE	: Middle size inboard engine boat	9.0~12.0	2.1~2.4	1.2~1.8

b. Berthing speed : 0.5 m/sec.

c. Traction of fishing boat : 1.0 ton

d. Load factor (Normal) : 1.0 ton/m^2

e. Load factor (Earthquake) : 0.5 ton/m^2

f. Load factor (Hurricane) : 0.0 ton/m^2

⑦ Characteristic of construction material

Material	Unit weight (ton/m^3)	Angle of internal friction (degree)	Remark
Structural steel	7.85		
Reinforced concrete	2.45		
Plain concrete	2.30		
Cement mortal	2.20		
Timber	0.80		
Sand and aggregate	1.8 (above water level)	35	Backfilling material
	1.0 (below water level)	35	Backfilling material
Gravel	1.8 (above water level)	30	Backfilling material
	1.0 (below water level)	30	Backfilling material

⑧ Constants of steel

- Young's modulus : 2.1 x 10^5 kg/cm^2
- Shearing modulus : 8.1 x 10^5 kg/cm^2
- Poisson's ratio : 0.30
- Coefficient of thermal expansion : 12 x 10^{-6} / ℃

⑨ Allowable stress

The allowable stress for the design of the structure is as follow based on the Design Standards for Fishing Port Facilities in Japan.

a. Reinforcing bar

Kind of reinforcing bar	: SD295 (JIS)
Allowable tensile stress in general (kg/cm^2)	: 1,800 kg/cm^2

b. Reinforcing concrete

Standard design strength	: 210 kg/cm^2
Allowable bending compressive stress	: 70 kg/cm^2
Allowable bond stress	: 14 kg/cm^2

In case of earthquake is considered, the allowable stress can be increased by 1.50.

2) Study on the Type of Civil Structures

① Reclamation (land filling) method

Based on the bathymetric data, the average depth at the proposed reclamation area is about 2m. And from the available soil data of the geographic condition of the sea bottom where is 200m off from the shoreline and water depth of −10m, the surface material about 18 to 20m thickness from sea bottom is medium to coarse coral sand layer and under this layer, there is coral layer, which is considered as the firm foundation layer.

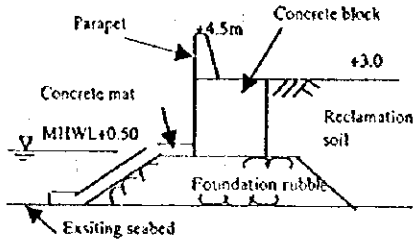
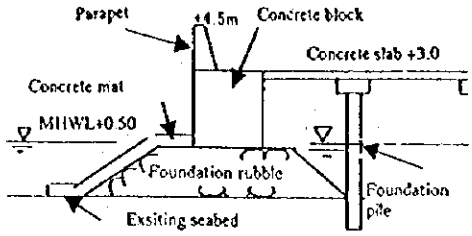
Judging from the sub soil condition, two reclamation methods are proposed as follows.

Plan-A: Reclamation (filling) with sandy material: Revetment is built around the reclamation area and filling inside with sandy material

Plan-B: Platform with pile foundation: Revetment is built around the reclamation area, same as above, and concrete platform is made on the foundation piles.

As the above two plans are compared from the function, design, construction method and economical point of view as shown in the following table, Plan-A (the reclamation with sandy material) is recommended.

Table 2-3-8 Comparison of reclamation method

Description	Plan-A : Reclamation with sandy material	Plan-B : Platform with pile foundation
Section		
Basic Concept	Revetment is build. The inside is filled with sandy material	Revetment is built. Concrete slab is placed on the foundation piles.
Suitability For geological condition	The depth of the area is shallow and sea bed material is suited for the reclamation.	It is hard to drive piles due to boulders and hard layer under the sea bottom.
Material availability	There is quarry for filling material near the site. Material is available in large quantity. Cost of material is low.	Foundation pile and cement are not available in the country and must be imported. The prevention for corrosion is necessary.
Construction method	It is very simple construction method to transport and compact. No special equipment is needed. The preparation time for the construction is short. Access to the site is difficult due to the narrow road. The construction activity may be limited due to the traffic condition.	The heavy equipment is required to import. The work is complicated and needs good experience. Most of the work is carried out on the sea. The preparation for the pile driving needs longer period. Large temporary stockyard is required.

Building construction	It is easy for the building work to excavate and make underground facilities on filling material. It is easy to arrange the drainage system	It is difficult for the building work on the concrete surface. It is hard to take anti pollution and decomposition for water enclosed under the platform.
Wave force	No special attention is need because no wave comes into the filling material.	Heavy consideration is required for the wave uplift force for incoming waves. In order to reduce the wave uplift force, structures such as breakwater is required.
Construction cost	○ Lower cost	△ Higher cost
Construction period	○ Shorter period	△ Longer period
Evaluation	○ Recommend	× Not recommendable

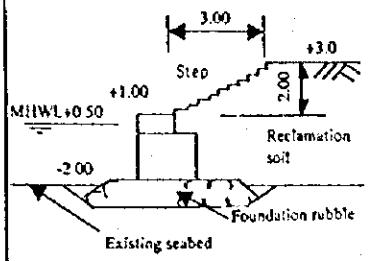
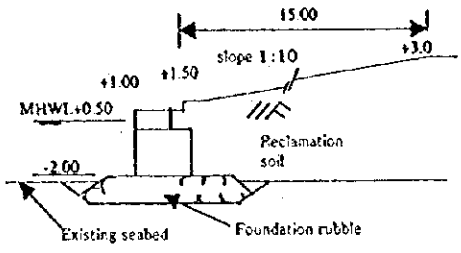
② Landing wharf and apron layout

A part of the north revetment and the inner side of the breakwater are to be used as landing wharf for the fishing boats. The height of the wharf is determined as +1.0m, which is as same as that of existing jetty. It is desirable to arrange the height of the landing wharf as low as possible considering the present conditions of the small fishing boat. On the other hand, the height of the reclaimed land, where the market facility is going to be built, is as +3.0m which is as same height of Melville Street for easy access of customers and vehicles to the market.

In order to lift up 2 m height and carry the fish catches to the fish market, at present, fishermen use narrow steps and, then, across the heavy traffic road. For planning the transportation of fish catches, following two alternatives are studied, these are Plan A: Steps, which is same as present, and Plan B: Slope, which connects between wharf and market with gentle slope apron.

Two alternatives are compared from technically and economical points of view as shown in following table, and Plan-B of slope type is recommended.

Table 2-3-9 Comparison of Apron

Description		Plan-A : Step type	Plan-B : Slope type
Technical Consideration	Section		
	Structural concept	10 steps of 20cm height are provided to connect the quay and market area. The steps are provided whole part along the quay.	The area between quay and fish market is connected with gentle slope. The concrete apron is provided whole part behind quay area.
	Advantages & Improvement	The width of the step area is short. The less reclamation area is required. The short horizontal movement. The cargo handling is quick (if special handling devices are provided).	The handling is easy and quick by employing simple transportation devices such as handcart. (At present, heavy sized fish catch cause big problem for handling). Significant spaces between quay and building area could avoid pollution for the building by seawater.
	Disadvantage	It is very hard to lift up fish product by hand. It is desirable to provide handling devices (davit etc.). Cost for maintenance and management is essential for such devices. Controlling is also required for devices.	The more reclamation area is required. Amount of filling material is more than (a) type. Apron must be paved.

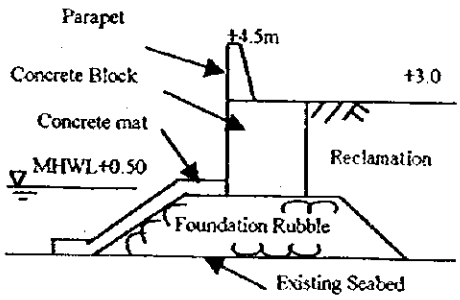
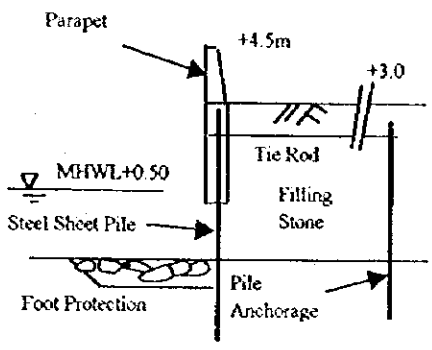
Construction cost	The water front structure is combination of low wharf and high revetment. Construction cost is high.	The water front structure is low wharf and connected to market with apron. Construction cost is low.
Evaluation	× Not recommend	○ Recommend

③ Revetment

For the reclamation at offshore of Melville Street beach, revetments on north, west and south sides at the reclamation are constructed. The water depth is about 3 m at the west revetment.

Two structural types are compared, which are suitable for subsoil condition at the project site as shown below. These are Plan-A: Gravity type (Concrete Block on rubble mound) and Plan-B: Steel Sheet Pile type.

Table 2-3-10 Comparison of Structural Type of Revetment

Description	Plan-A: Gravity type (Concrete Block on Mound)	Plan-B: Steel Sheet Pile Type
Section		
Basic concept	Precast concrete block on the Foundation Rubble	Steel sheet pile in front and pile anchorage at the back are driven and tied with tie rod. Filling stone is placed between.
Suitability for geological condition	It is suitable for the sub soil condition to make gravity type structure.	It is hard to drive piles due to boulders and hard layer under the sea bottom.

Material availability	There is quarry near the site. Large quantity of material is available.	It is not available at site for steel sheet pile, anchorage pile, tie rod and steel attachment. Material should be imported and expensive and take time. It is necessary to take anti corrosion for steel material.
Construction Method	Any special equipment is required for transportation, placing of mound material. The works are simple and easy to execute. The preparation time is short.	The construction equipment should be transported from abroad. It should be kept stabile for steel sheet pile against wave force. It is hard to drive pile at shallow water area by barge. The work, including pile driving, backfilling, fixing steel attachment and tie rod, is complicated and hard. The large temporary work yard is required. The building construction is complicated because the anchorage pile is under the building.
Construction Cost	○ Lower cost	△ High cost
Construction Period	○ Short period	△ Longer period
Evaluation	○ Recommend	× Not recommend

As the result of comparison, the structural type is determined as Plan-A: Concrete block on foundation rubble mound which is built on existing sea bed. The material of rubble mound is available in the Grenada Island and it is recommended to utilized the local material as much as possible. The structural analysis is based on the hurricane waves. At the back of the west revetment, buffer zone is provided for wave over topping when hurricane is attacked.

④ Fish landing wharf

Landing wharf is constructed at the north side of reclamation where the water depth is 1.0m to 2.0m. The water depth at the wharf is shallow and the height of the wharf is low for easy mooring for small boats. Since the soil condition is good, the structural type of wharf is concrete block placed on rubble mound is adopted which is as same as revetment structure. The foundation rubble mound is constructed on the existing sea bed. The wharf depth is determined considering the 0.3m allowance than the maximum draft of the fishing boat. The water depths at the wharf are 1.0m for the small sized outboard motor boat (OBMs) and 1.5m for middle sized outboard motor boat (OBMm) as shown below. As for the middle size inboard engine boat (IBE) of which draft is 1.5m to 2.0m, it is able to berth at the wharf of 2.0m depth without trouble at the normal sea condition.

Boat type		Draft(m)	Allowance(m)	Required depth(m)
OBMs	: Small size outboard motor boat	0.7	0.3	1.0
OBMm	: Middle size outboard motor boat	1.2	0.3	1.5
IBE	: Middle size inboard engine boat	1.2 to 1.8	0.3	1.5 to 2.1

The auxiliary facilities at the landing wharf is as follows from the type of fishing boat and its operational condition.

Fender	:2.5 m interval
Mooring ring	:2.5 m interval
Curb	: install at the quay

⑤ Breakwater

In order to keep the calmness for smooth operation in the ordinary sea condition at the landing wharf, breakwater is planned to construct at the extension of west revetment to the north side. In general procedure, the limit of wave height for the small fishing boat to operate in front of the landing wharf is 0.3m as shown in the Design Standard for Fishing Port in Japan. Therefore, the required length of breakwater is decided to decrease the wave height into 0.3m in front of the fish landing wharf against NW wave of 0.7m height as determined in the wave condition. The wave height in front of the wharf is become small according to the length of the breakwater. As shown in following Figure 2-3-1, in order to get the wave height ratio of 0.42 (which is equivalent to 0.3m / 0.7m), the required length of breakwater is determined as 35m.

On the other hand, the inner side of breakwater is also available for berthing fishing

boat after reducing the wave height due to the diffraction of wave by breakwater. According to the study, wave at the area of breakwater beyond 18m from tip of the breakwater is reduced less than 0.3m and fishing boat is able to berth. Auxiliary berthing facilities will be provided at this area for fishing boat. Slope will be provided to connected between the wharf apron and breakwater for easy approach of pushcart to transport fish catches.

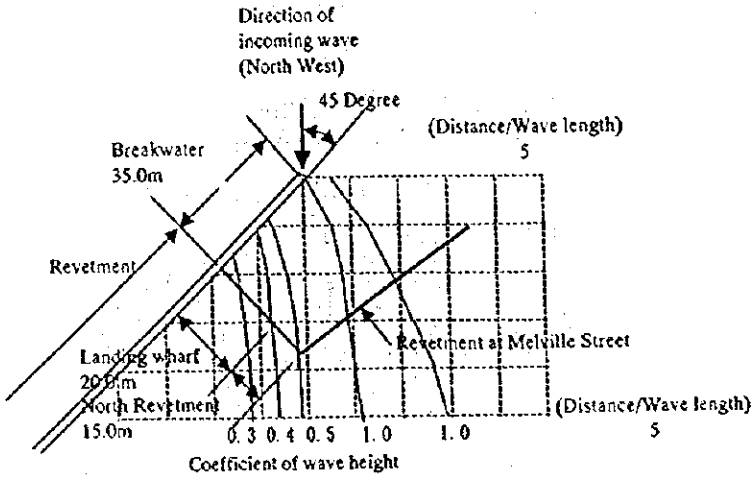


Figure 2-3-1 Required Length of Breakwater

As to resist against the hurricane, the breakwater is not economical to keep the calmness in front of fish landing wharf because the higher and wider breakwater is required against the wave of hurricane. Therefore, at time of hurricane and monsoon season during November to February, when the offshore wave height is more than 0.7m, waves will cross over the breakwater, which height is low, and the wave in front of the wharf and inside of the port is become too high to utilize the port. The port facilities, including fish landing wharf, is not available against these sea conditions such as hurricane and monsoon waves.

However, for the stability analysis of the breakwater, hurricane wave is applied so that the structure is stable against the hurricane wave. The structural type of breakwater is concrete block placed on the rubble mound at the sea bed. The structural type is as same as revetment and wharf. The high mound breakwater is not recommendable because the quantity of rubble is too much, longer construction

period and the fishing boat will not be able to berth along the inside of the breakwater.

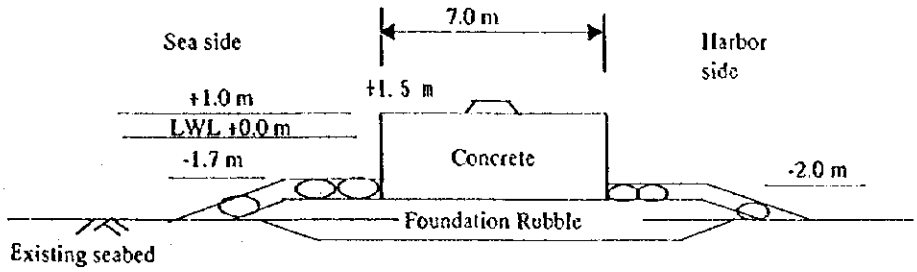


Figure 2-3-2 Breakwater on low rubble mound

⑥ Structure of Fish Market Building Foundation

The sub soil condition at the site is sandy material with coral debris (N-value of sub soil is more than 50 at 9m below the sea bed). Therefore, it is negligible for future settlement after land reclamation with suitable filling material which is available near the site. The filling material is from Queen's Park quarry site, which is the same quarry for the reclamation of the St. George's Port expansion project. The filling material from this quarry is sandy material and has suitable grade according to the laboratory test result. Filling material at the reclamation area will be compacted during the construction period to prevent the future settlement.

Judging from the filling material and construction method the future settlement will not happen at the reclamation area. As for the structural type of building facility, flat type foundation is recommended from its high structural rigidity and good construction activity with due consideration of bearing capacity of the area and structural load of building.

(a) Bearing capacity for foundation at the reclamation area

The soil condition of the material at the reclamation area is sandy and top layer of 3m thickness from surface has N-value of 5 to 10 and, then, the layer of 2m thickness below the top layer has N-value of 5. Then, the allowable bearing

capacity at the reclamation (Qa) is calculated as 6.06 tons/m² as shown below and the bearing capacity is, therefore, determined as 5 tons/ m².

$Qa=(\alpha CNc+\beta \gamma 1BNr+\gamma 2DfNq)/(3.0)$

$=6.06$ tons/m²

(Source: Building Standard Law, Architectural Institute of Japan)

(b) Structural type of building foundation

The design vertical load of the column for the fish market building, which has 4.5m height of the first story and 3.5m height of the second story, is estimated as 210tons.

The dimensional area of foundation is assumed as 38m² for independent type foundation and 42m² for flat type foundation, then the bearing capacity is calculated as 5.5 tons/m² and 5.0 tons/m² respectively as shown in the following table.

Therefore, the flat type foundation, which has within the following table. Therefore, the flat type foundation, which has the allowable bearing capacity of 5 tons/m², is applied.

Table 2-3-11 Comparison of type of building foundation

Foundation type	Vertical load (fp ton/column)	Foundation size (A m² = L×B)	Bearing capacity (fb ton/m² = fp/A)
(a) Independent type	210	38=6.16×6.16	5.5(=210/38)≧5.0 (× : Beyond allowance)
(b) Flat type		42=6.48×6.48	5.0(=210/42)≦5.0 (○ : Within allowance)

As for the construction material and cost for these two foundation types, amount of concrete and reinforcing bar of flat type foundation is more than the independent type foundation.

However, the amount of form of flat type foundation is less than the independent type foundation.

The construction materials are, therefore, almost same between these two types of foundations as shown below.

Table 2-3-12 Comparison of Materials by type of foundation

(Per one column)

Foundation type	Concrete Q'ty:Vc (Unit price)	Reinforcement bar Q'ty:w (Unit price)	Mold frame Q'ty:a (Unit price)	Remarks
(a) Independent type	Vc=11m³	w=65kg/m³×Vc =65×11 =715	a=3 m²/m³×Vc =3×11 =33	Slight difference between two types.
(b) Flat type	Vc=12.6m³	w=60kg/m³×Vc =60×12.6 =756	a=2 m²/m³×Vc =2×12.6 =25.2	

(2) Architectural Plan

1) Layout plan and Section plan

Concerning the layout plan of the fish market, half portion of the market on the street side shall be provided for fish retailing space and service space for shoppers. The street side (east) and north and south sides of the fish market shall not have walls but made to be used as compartment of open space but covered with a roof. Half of the seaside area shall be reserved for the backup section such as reception and storage of fish commodities, and ice making, and shall be clearly separated from viewpoint of sanitary control.

The fishery development center is separable, too, in terms of function from the fish market on the first floor. It is placed on the second floor in view of efficient use of reclaimed project site and is approached directly by outer stairs. Further, the layout plan was formulated by the study based on the fish handling quantity of the Melville Street fish market and that of the necessary area of each facilities. The calculation was made according to the Japanese Standards used for Fishing Port Design, in taking the results of the field study into account.

①Fish Market Facilities

(i) Fish retailing counter

Fish retailing counters are U-shaped in order to secure a wide service space for customers, and it will be tried to enhance convenience in respect of hygiene and utilization by providing at key points of the wash basin (for 6 sinks) for processing and washing. Further, convenience for customers will be considered by providing a processing table (for 6 booths) for scaling in a corner of fish retailing compartment. As mentioned in Table 2-3-1, it was designed that the retailing counter contains 30 booths (2.5 ㎡ per 1 booth). Then the necessary area is as follows.

$$A = n \times d + g = 42 \times 2.5 + (2.0 \sim 2.5) \times 42 \times 2.5 = 315 \sim 367(㎡)$$

A: Required fish market area (㎡)

n: Number of fish retailing booths, etc.

(30 retailing booths+ 6 sinks+ 6 scale booths)

d: Required area per booth (2.5 ㎡)

g: Passage spaces for shoppers g = (2.0~2.5) x n x d

The fish market layout plan was studied based on the result of above-mentioned calculation. As a result the total area will be 338 ㎡, calculating from 154 ㎡ for fish retailing, 13 ㎡ for processing (removal of scale), and 171 ㎡ for passage spaces for shoppers, as shown on the following table.

Table 2-3-13 Floor Area of Fish Retailing Compartment

Name of Quarter(Object)	(No. of persons)	Required area (m^2)
Fish Retailing Compartment	30 fish retailers	154
Fish retailing booth	30 booths	(80)
Sink	6 sinks	(12)
Carrying space	North and south	(62)
Processing booth (removal of scale)	6	13
Passage spaces for shoppers	--	171
Total		338

(ii) Backup section of the fish market

Fish handling space for fish reception and measurement is placed on the northern side adjoining an entrance for commodities bringing in. Surrounding this fish handling space, management office, ice making/storage plant, cold storage, materials store, fish processing room, lockers for fish retailers, sanitary rooms (toilet, shower) will be arranged.

The required area was calculated as follows; for (a) fish handling space, (b) ice making/storage plant, (c) cold storage, (d) market management office that are

the center of the backup section in the fish market.

(a) Fish handling space

The necessary space for fish handling is about 86 ㎡, total about 98 ㎡ including passages, etc.

$S = N/(R \times \alpha \times P)$

$= 0.93/(0.012 \times 0.6 \times 1.5)$

$= 86.11$ (㎡)

S: Required space for fish handling(㎡)

N: Maximum handling quantity per day (0.93 tons/day by Table 2-3-11)

R: Handling quantity per unit area (0.012 tons) *See note below.

α: Rate of occupation (0.6)

P: Number of rotation of fish handling

(1.5: Referring to daily fish reception.)

* Note: The base of handling quantity per unit area (R = 0.012 tons/㎡)

Corresponding to about 63 small reef fishes (length 18cm × height 7cm × weight 200g/fish, area ration 80%)

(reference: Miscellaneous fish handling standards in Shizuoka prefecture 0.010 tons/㎡)

Nf = 0.8/(0.18 × 0.07) = 63.4 fishes

(b) Ice making/storage plant

The capacity was examined and decided as mentioned in sub-paragraph 2-3-2, with plate ice of 2 tons/ day and ice storage capacity of 6 tons. The necessary area for accommodating this ice making/storage plant is about 42 ㎡ from the standard dimensions of the plant.

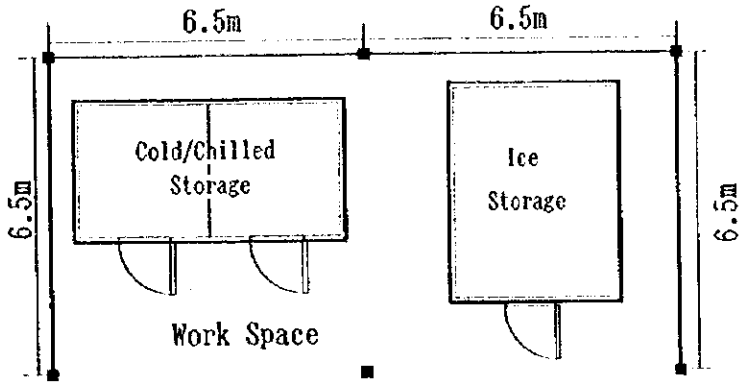


Figure 2-3-3 Layout of Ice Making Plant and Cold Storage

(c) Cold storage

As mentioned in the sub-paragraph 2-3-2, the stowage quantity of the cold storage shall be 1.5 tons by the fish handling quantity in high season at the Melville Street fish market, and the cold storage is divided into 2 compartments.

Though cold storage is installed in the existing fish market, it is necessary to improve it because stowage method is in bulk, which takes time in stowing and delivery, and temperature control is quite difficult.

Therefore, in the Project this situation will be improved by looking carefully at retail purpose, and by realizing fish boxes stowage easier and more efficient.

The size of the fish box used generally in Grenada has the outer dimension of 760 mm × 480 mm × 200 mm (capacity of about 0.070 cubic meter = 70 liters), and it can store the maximum of about 25kg of fish in together with the same quantity of ice.

In this case 60 boxes are necessary on the assumption of 1,500 kg per day. The dimensions of the cold storage are set up as follows from the above-mentioned condition. The floor area will be about 42 ㎡ for installation of cold storage, and working spaces for stowing and delivery, and so on.

Necessary floor area:

Width; 5.4 m (= 2 compartments × 2.7 m), Depth; 2.7 m (Height about 2.2 m)

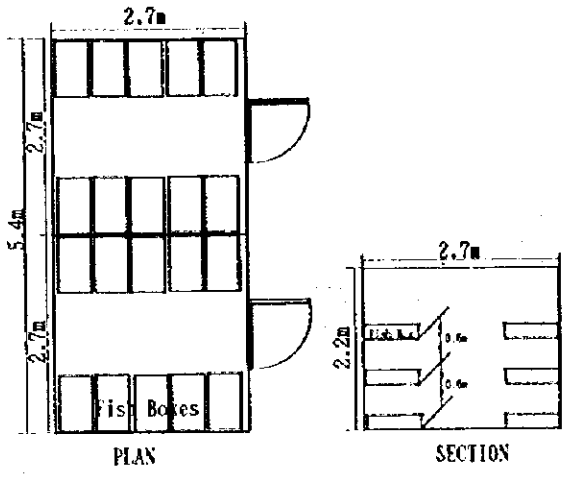


Figure 2-3-4 Dimension of Cold Storage and Shelves Arrangement

(d) Market management office room

There are total 5 staffs consisting of 1 market supervisor and other 4 market staffs in the market. An exclusive office is provided for market supervisor who is responsible for all the activities in the Melville Street fish market. Other staffs use one general office arranged next to the market supervisor's office.

Job Content	Calculation Base	No. of Person	Space
Market Supervisor	9.0~20 ㎡/person	1	10 ㎡< (9~20 ㎡)
Market Staffs	4.5~7.0 ㎡/person	4	14 ㎡< (18<28 ㎡)

(Calculation base: Architectural Institute of Japan, Building Design Data Book 4)

The layout plan was studied on the basis of the above-mentioned calculation. As a result the area of the backup section of the fish market will be designed with 338 ㎡ as shown in the following table.

Table 2-3-14 Fish Market's Backup Section Area

Name of Quarter (Object)	(No. of persons, etc.)	Required area (㎡)
Ice making/storage plant		42
Cold stoorage		42
Fish handling space		98
Materials store		23
Fish processing room		9
Market management office	5	24
Market supervisor's office	(1)	(10)
Staffs' office	(4)	(14)
Sanitary room		47
Toilet, Shower	(30 + 5) persons	(35)
Locker for fish retailers	(30 sets)	(12)
Other compartments		53
Emergency generator room		(23)
Switchboard room		(20)
Outer store		(10)
Total		338

② Fishery Development Center

The compartment of the fishery development center will be arranged on the second floor in a lump. The access to the fishery development center shall be on the route to the entrance through upstairs open terrace by providing an external stairs on the parking lot side.

As to the internal layout, a water tapped sanitary rooms (toilet, pantry) is placed in the center surrounded by each room, and lighting and ventilation of the surrounding rooms will be considered. The rooms are the fishery development center's Director room, Reception/secretary room, Office of general affairs/accounting, Office store, and each one Office room for 3 business departments (Fishery technology extension, Fishery statistics, and Fish resources management), Data room, Conference room, above-mentioned Sanitary room, and so on. Further, the northern side exit is equipped with a balcony of about 1.0m wide and external stairs that are used as an emergency evacuation route.

The area calculated by the standard office floor area based on the number of personnel; and the detailed organization and contents of the service activities of the fishery development center are given below.

Job Content	Calculation Base	No. of Persons	Floor area
Center's Director	15.0~25.0 ㎡	1	15.0~25.0 ㎡
General Affairs Department	6.0~9.0 ㎡	4	24.0~36.0 ㎡
Business department- 1	9.0~20.0 ㎡	3	27.0~60.0 ㎡
Business department- 2	9.0~20.0 ㎡	3	27.0~60.0 ㎡
Business department- 3	9.0~20.0 ㎡	3	27.0~60.0 ㎡

(Calculation base: Architectural Institute of Japan, Building Design Data Book 4)

The layout plan was studied based on the above-mentioned calculation results, and it will be planned with the total area of 338 ㎡ including the offices and conference room of the fishery development center.

Table 2-3-15 Area of Fisheries Development Center

Name of Quarter (Object)	No. of Person	Required Area (㎡)
Center's Director Room	1	36
General Affairs Department	Total 4	
Reception/Secretary Sect.	(1)	9
General Affairs/Accounting Sect.	(3)	23
Office Store	-	12
Business Department	Total 9	
Fishing Technology Extension Dept.	(3)	33
Fishery Statistics Dept.	(3)	29
Fish Resources Management Dept.	(3)	33
Data Room	-	25
Conference Room	(for 35 persons)	63
Sanitary Room, Passage, etc.		
Toilet, Pantry, Locker, etc.		23
Entrance/Exit, Corridor, etc.		52
Total		338

2) Structural Plan

① Standards for structure design

British Standards (BS) and USA Regulations are mainly used concerning the building and structure designs. There is also CARIB CODE (Caribbean Design Standards) stipulated by Caribbean countries.

In construction of the building of the Project, the design will be conducted by applying the Building Standards of Japan and the BS, CARIB CODE, etc. will be referred to.

②Outline of Structures

As the fish market building will be constructed on a reclaimed land facing the sea, the structure of its skeleton shall be reinforced concrete. This method of construction is possible by obtaining materials locally, which is utilized generally in Grenada. Further, the Sub-structure shall be foundation of bearing power of soil that is effective in prevention of unequal subsidence, because the construction site is a reclaimed land, and it shall adopt raft foundation that has higher rigidity and easiness of construction from the results of comparative study of raft foundation and independent foundation as mentioned in Table 2-3-11.

Building	Super-structure	Sub-structure
Fish Market Building	Reinforced concrete structure, 2 Floors	Concrete floor with foundation of bearing power of soil (Raft foundation)

③ Design Load

a. Fixed Load

Weight of structural materials, finishing materials, and machinery and equipment will be calculated respectively. Unit weight of each major structural material is based on the following figures.

Concrete	2.3 tons/m^3
Reinforced concrete	2.4 tons/m^3

Concrete mortar 2.0 tons/m^3

Concrete block (19 x 19 x 39cm) 300kg/m^3

(Including filling concrete, joint mortar, and reinforcing bar)

(Source: "Building Standard Law of Japan")

b. Live Load (Unit: kg/m^2)

Portion	Slab, Small Beam	Column, Large Beam for Foundation	Seismic Force
Roof	30	10	0
Office Rooms, etc.	300	180	80

c. Wind Load

By taking into consideration of the local situation of hurricane, wind load is designed as wind velocity of 60m/second (225kg/m^2).

(Source: " Building Standard Law of Japan")

d. Seismic Load

Since Grenada Island stands on the West Indies volcanic zone (Older or Outer volcanic arc) of the Caribbean Sea, every building must be designed for full earthquake resistance. The base shearing of about C0=0.2 that is more than equal to the design condition of civil engineering facilities shown on page 2-44 as well as satisfies Building Design Standards of Japan will be considered.

(Source: "Building Standard Law of Japan")

e. Major Materials and Allowable Stress

Material	Standard	Long-term Allowable Stress (kg/ cm^2)			Short-term Allowable Stress (kg/ cm^2)		
		Compres-sion	Tension	Shearing	Compres-sion	Tension	Shearing
Ordinary Concrete	Fc=210 kg/c m	70	—	7	140	—	10.5
Reinforcing Bar	SD295 (JIS)	2,000	2,000	—	3,000	3,000	—

The aggregates for concrete shall be washed by fresh water and salt density shall be less than the allowable value (equivalent to JASS 5-11 class, because

the local made aggregates will be used and salt damage to the reinforcing bar is expected. Attention must be also paid to mixing of concrete and design of concrete structure member.

3) Facility Plan

① Water Supply Facility

Water is supplied by branch piping connected to city water main line of 4 inches in diameter laid under Melville Street. As a result of comparing and examining two water supply systems of "Direct connection to city water" and "Head water tank", the direct connected system is adopted for the following reasons.

a. As the site is on the coast, city water supply pressure is high and its fluctuation is little.

b. The site is located in the central urban area of the capital St. George's, and suspension of city water supply occurs rarely, because the site area has an improved infrastructure in the capital city.

Further, utilization of rain water collected from the building roof will be planned as low-quality water for cleaning the market, etc. For that purpose a rainwater tank is installed. Seawater is supplied by pump to the vicinity of the processing compartment for scaling, and will be used for miscellaneous purposes except where salt damage is expected.

② Water Drainage Facility

Because public sewer pipe of about 7 inches in diameter is laid under the Melville Street, drainage of filthy and low-quality water is connected to it.

As to the drainage of fish processing water, separated inlet is placed at key points, and fish piece, scale, etc. are prevented from flowing into sewer pipe by installing washable strainer in these inlets.

Rainwater will be drained by providing drain ditch, drain inlet, and drain outlet put at the seashore.

③ Electric Facility

Electricity is supplied through a drop wire electric pole installed inside the site, to switchboard in electric room on the ground floor of the building.

a. Electric lamp, outlet-plug

Lighting shall be planned based on the utmost utilization of natural light. As source of light, fluorescent lamp and mercury-vapor lamp are used in view of durability and efficiency. Outlet is placed at proper points for supplying electricity to equipment and machinery.

b. Telephone

Telephones are placed at 2 points of the backup section of the fish market, and at about 10 points of Fisheries Development Center on the first floor respectively.

c. Calling up bell at the entrance of fish reception

A calling up bell is provided at the entrance of fish reception.

④ External Construction

a. Pavement

The eastern front side of the fish market building, access road for business trucks from Melville Street on the northern side, buffer zone on the western revetment side, and peripheral spaces of the fish market building shall be paved with concrete for easy maintenance due to high durability, and necessary corking is made after pavement. Parking lot on the southern side of the building shall be paved with asphalt that is locally procurable and good in execution.

b. External lighting

Eight (8) units of lighting lamps will be provided for the use at night of the site facilities such as landing wharf and parking lot as well as for security.

c. Drainage plan

Waste water is drained through penetration pipes to the sea, providing with a gradient toward the revetments on the southern and western sides in the site. Further rainwater from the building is drained through the ditches and pits which are connected to the drainage exit to the sea.

⑤ Security of the fish market building

Grid type partitions and sliding doors with the same design are to be provided on the outer surroundings of the fish retailing space as a crime prevention measures during the closing time.

⑥ Building Materials Plan

Procurement of building materials is planned by fully examining the possibility of both importation and local procurement, and by paying attention to the following points.

- The construction site faces beach, and salt damage is anticipated.
- High temperature caused by tropical sunshine, etc. and high humidity throughout year
- It is necessary to choose sanitary materials that is difficult to become dirty and easy to clean, because perishable fish food (fresh fish and shell fish) is handled in the market.

The main finishing of the building is as follows.

a. Exterior Finishing

- Roof: Slab of reinforced concrete, weather proof material integrated with insulation material
- Outer wall: Reinforced concrete with paint finishing

b. Interior Finishing

- Floor of general rooms : Vinyl tile covering
- Floor of the fish market : Epoxy paint finish on concrete
  (Fish retailing counter top is finished with ceramic tiles.)
- Wall of general rooms : Plasterboard with paint finish
- Other rooms : Paint finish on mortar with concrete block
- Roof : Plasterboard with paint finish
- Doors, sash, etc.: Rust proof is considered to exterior surface, and steel door shall be made of bonded steel plate and finished with paint. Windows of outer wall are attached with lattice for crime prevention.

⑦ Ventilation and air conditioning

Ventilation and/or air conditioning equipment are provided for the office space of the fisheries development center, market management office, and a part of processing compartment.

4) Special Equipment Plan

① Design Condition

The design condition for ice making plant, cold room, etc. is as follows.

(a) Ambient temperature : 32℃

(b) Humidity: less than 75%

(c) Raw water temperature: 28℃

(d) Power source: AC 400V, 50Hz, 3 phase
AC 230V, 50Hz, single-phase

(e) Other conditions

As the Project site faces sea, has condition of high temperature and humidity, and is much effected by sea breeze (briny air), the materials having superior salt-proof character shall be used for machinery and equipment with consideration of protecting them from direct blow of sea breeze by arranging machinery and equipment inside rooms as much as possible. Moreover the inside of rooms shall be also well ventilated, and the equipment that is manufactured with consideration for condensation of salty air on its surface shall be adopted. Concerning the condenser and its attached air duct, etc. of the refrigerating equipment, it will be considered to use the fin and tube with salt-proof character, and to use the air duct made of stainless steel.

② Ice making/storage plant

The size was set up with the capacity of ice making plant of 2 tons per day, and the capacity of ice storage bin of 6 tons equivalent to 3 days portion of ice making capacity .

As to the kind of ice, two (2) kinds of flake ice and plate ice are used locally. As the project site is located in tropical area, ice of bigger size can be effectively utilized. Therefore, the plate ice is planned. This plate ice will be supplied to the fishing boats landing at the site as well as to the retailers at the fish market. Accordingly, it will be planned to accommodate the plant on the minimum floor area as much as possible by considering the working spaces including the access to the ice storage bin. The ice making plant itself shall be put on the top of the ice storage bin, and to this end steel frame will be assembled. Moreover, as ice is very important to this fish market and the management, the idea of double safety will be introduced, and it will be planned to provide two (2) units of ice making plant with the capacity of 1 ton per day corresponding to the planned capacity of 2 tons per day so that the production of ice may not completely stop due to repair, maintenance, etc. of the units.

From these conditions the specification of ice making/storage plant is designed as follows.

a. Frame structure

Structure: Steel frame structure

Frame size: Approximately 5.1m(L) x 4.2m(W) x 3.1m(H)

b. Ice making plant

Quantity : 2 units

Designed ambient temperature : 32℃

Kind of raw water : Fresh water

Designed temperature of raw water: 28℃

Power source : 3 phase, 400V, 50Hz

Ice making volume : 2.0 tons/day (1 ton/day x 2 units)

Kind of ice : Plate ice (thickness 12～15 ㎜)

Place of installation: On top of the ice storage bin with steel frame

Compressor : Approximately 5.5 kW

Refrigerant : R-22

Condenser : Air-cooled, salt-proof (fin and tube)

Accessories : Exhaust duct for condenser (made of stainless steel)

c. Ice storage bin

Quantity : 1 unit

Ice storage capacity : 6 tons

Designed ambient temperature : 32℃

Ice storage temperature : 0～－15℃

Power source : 3 phase, 400V, 50Hz

Dimension : Approximately 4.5m(L) x 3.6m(W) x 2.2m(H)

Compressor : Approximately 1.5 kw

Refrigerant : R-22

Condenser : Air-cooled, salt-proof (fin and tube)

Starter : Variable voltage starter

Material of insulation panel: Colored steel plate, insulation board of thickness of more than 100mm

Accessories: Exhaust duct for condenser (made of stainless steel), thermometer, door heater, drainage piping, wooden grating, insertion board, etc.

③ Cold storage

It is planned to store fish box by providing shelves in the cold storage, and two (2) units of compartment (each unit has a storage capacity of 0.75 tons) will be provided in view of the local situation that storage volume fluctuates depending on high and low fishing seasons. The temperature condition shall be 0～－15℃ in order that the bin can store frozen fish for a short period before retailing. The cold room shall be salt-proof, because the Project site is situated along seashore.

Quantity : 1 system (2 units)

Designed ambient temperature : 32℃

Temperature inside the cold room: 0～－15℃

Power source : 3 phase, 400V, 50Hz

Dimension : 2 units x { approximately 2.7m(L) x 2.7m(W) x 2.2m(H)}

Compressor : Approximately 3.0kw

Refrigerant : R-22

Condenser : Air-cooled, salt-proof (fin and tube)

Door : Approximately 1100mm(W) x 1700mm(H)

Material : Colored steel plate, insulation board 100mm thick or more

Equipment : Wooden shelves (3 shelves and floor), Exhaust duct for condenser (made of stainless steel), wooden grating, door heater, relief valve, thermometer, drainage piping

④ Generator

Emergency generator of 30KVA will be provided for the backup of the cold storage and lighting of security lamps in case of power failure. It shall be diesel engine driven generator with automatic start and switch device.

Quantity : 1 unit

Output : 30KVA

Output voltage : 3 phase, 400V, 50Hz

Engine : Diesel engine

Control device : Attached with automatic start and stop device in case of power failure

Fuel tank : about 120 liter

⑤ Spare Parts

In Grenada refrigerating equipment provided by Japanese Grant Aid has been effectively utilized, but it is difficult and takes time to procure spare parts. Accordingly, the Project will include the following spare parts as advance stocks for the ice making/storage plant, cold storage refrigerating plant and for the emergency generator set; and the number of spare parts are intended for two (2) years usage.

a. For Ice making plant and cold/chilled storage bin

Main contents: Refrigerant, Ref-oil, Tool set for installation and repair/maintenance work, Spare parts for compressor of ice making plant and cold storage, Spare parts for control panel

b. Generator

Main contents : Packing for engine overhaul, Ignition plug, Oil filter, Fuel filter, etc.

5) Equipment and Materials

① Basic Concept

In view of the content of the Project, the equipment plan shall be formulated by taking the followings into consideration.

a. In order that the purpose and function of the project will be fully satisfied, the equipment and materials that suit the usage, necessity and the level of the local technology will be selected.

b. It shall be considered to set up an appropriate quantity of expendables, and replacement parts, etc. in taking their procurement situation into consideration so that there will be no hindrance.

c. Equipment such as fish box, insulated box, etc. will be decided by giving priority to easiness of the local procurement.

② Machinery and Implements for the Fish Market

a. Seawater Pump

Grenada Island is mountainous, and is relatively favored with precipitation as a whole. However, the coastal area has less precipitation than the mountains, and rainwater is one of the precious natural resources. In the Project rainwater tank shall be provided to make an effective use of rainwater for cleaning, etc. in the fish market. Seawater is also used for easy washing of catches nearby landing wharf and at a corner of scale removing and cutting services. For this purpose one unit of sea water pump will be provided. The pump shall be a standard type with about 15m head and 1 inch in diameter.

b. Pushcart

Pushcart is used inside the market facility (fish landing wharf, fish retailing counters, fish handling space, etc.) for transportation of ice and fish. The specification will be the loading capacity of about 300kg and the dimension of about 900mm × 1200mm, if the size is selected to transport 4 nos. of fish boxes (fish 25kg + ice 25kg = 50kg/ box). The number of pushcart shall be planned as total 5 nos., 3 for fish handling space/fish landing wharf and 2 for retailing counters.

Quantity: 5 nos.

Loading capacity: 300kg, maximum 500kg

Dimension of loading platform: 120cm (L) x 75~90cm (W)

Material: (body) stainless steel, (caster) stainless steel

Spare Parts: Caster wheel, 1 for front wheel, 1 for rear wheel

c. Insulated Box

The insulated box is used for temporary stowage (stowage by ice) of big fresh fish. The thickness shall be about 30mm and an insulated lid of the same thickness shall be provided. The capacity shall be 750 liter assuming that it will store about 150kg of fish at a time. Given storage of 300kg of fish per day, 2 insulated boxes are necessary. They will be placed in one corner of fish handling space in the backup section of the market.

Quantity : 2 sets

Inner Volume : about 750 liter

Outer Dimension: width about 1,100cm x 1,200cm, height about 100cm

Material : (outside) polyethylene, (insulation material) polyurethane

Others : Insulated lid

d. Fish Box

Fish box is used for stowage and transportation of fresh fish in the market. It shall have a outer dimension of 720mm x 480mm x 250mm that is popular now in Grenada, shall be of polyethylene made, and shall be of the type that enables the pile in cold storage. The number of fish boxes shall be 60 from the handling volume per day of 1500 kg, and this is equivalent to 2 boxes per each fish retailer.

Quantity : 60 sets

Net Volume : 60 liter

Outer Dimension : width about 720mm x 480mm, depth about 200mm

Material : polyethylene

Accessories : attached with handle made of stainless steel

e. Weighing Scale

Weighing scale shall be two kinds, for retailing and for backup section of the fish market. The scale for retailing shall be desk top balance type with the capacity

for 20 pounds. Another scale for backup section in the fish market shall be platform type and the 200 pounds type will be selected. The number of the scales is total 33 consisting of 30 for retailing corresponding to the same number of retailing booths and 3 for spare. The number of the scale (platform scale) for backup section in the fish market shall be two (2), each for weighing at the time of arrival and bringing in/out of commodities.

- Desktop scale

  Quantity: 33 nos.

  Weighing Scope: 0～20 pounds

  Weighing Method: balance type

  Material: Steel

  Outer Dimension: width about 35cm x 20cm, height about 30cm

  Painting: Rust proof painting

- Platform scale

  Quantity: 2 units

  Weighing Scope: 0～more than 200 pounds

  Weighing Method: balance type, floor put type

  Material: Steel

  Outer Dimension: width about 75cm x 85cm, height about 110cm

  Painting: rust proof painting

f. Radio Set

Most of medium-sized fishing boats are equipped with VHF radio set. Small fishing boats also use handy radio set although the number of such boats is small. Radio set is indispensable for fishing operation in securing safety of fishing boats at sea and transmitting the information on catches' landing situation. In addition, there are many requirements for radio set from the fishermen whose boats yet to carry it. The specification of radio set shall be marine band VHF, of 10 watts installed type, and shall include one set of antenna with wiring.

Moreover SSB radio set that enables long distance communication will also be provided so that it may be possible to communicate with foreign ships in the Caribbean Sea in such an emergency event as marine disaster.

• VHF Radio Set

Quantity : 1 set

Specification: VHF International Marine Band and American Marine Band

Output : 10w attached with output fading switch

Power Source: 230V, 50hz, single phase

Accessory: microphone attached with hand switch, antenna, antenna cable (about 50m), connecting terminal, metal fittings for fixing whip antenna, vinyl tape (50m) for installation work, water-proof tape 20m, Antenna rod and its installation work is included in construction work.

• SSB Radio Set

Quantity : 1 set

Specification : SSB International Marine Band

Output : 150W

Power Source : 230V, 50hz, single phase

Accessories: microphone attached with hand switch, antenna, antenna cable (about 50m), insulator through wall, connecting terminal, metal fittings for fixing whip antenna, vinyl tape (50m) for installation work, waterproof tape 20m, Antenna rod and its installation work is included in construction work.

(3) Reclaimed Land plan

The size of the reclaimed land shall be 42m wide and extended 90.6m from the following plot plan, in considering the fish market, parking lot, the size of such supplementary facilities as landing wharf and the buffer zone against overflowing wave.

① North - South direction

Western revetment	Distance (m)
Parapet of revetment	2
General parking lot	30
Parking space	6
Fish market	26
Access to parking space	7
Apron to quay	16.5
Total	90.5

② East - West direction

North revetment(wharf)	Distance (m)
(North revetment)	
Access revetment	15
Quay (-1m)	9
Quay (-2m)	11
Low height breakwater	7
Total	42

Fish market	Distance (m)
Front road	3
Depth of market	2 7
Esplanade	10
Parapet (revetment)	2
Total	42

(4) Summary of Basic Design

The results of the basic design study in the Project is as follows.

Table 2-3-16 Summary of Basic Design

Name	Content	Remark
1. Facilities		
1-1 Fish market facilities	Fish market building: the first floor is about 676 ㎡.	
(1) Ice making/storage plant	42 ㎡, Ice making capacity is about 2.0 tons/day. Ice storage capacity is 6 tons.	Ice storage for 3 days
(2) Fish retailing counters	338 ㎡, Retailing booth × 30, Sink × 6, processing table × 6	For 30 fish retailers
(3) Cold room	42 ㎡, about 1.5 tons (divided into 2 compartments)	
(4) Materials store	23 ㎡	
(5) Fish handling space	98 ㎡	
(6) Fish processing room	9 ㎡	
(7)Market management office	24 ㎡, Supervisor's × 1, Staffs × 1	
(8) Sanitary rooms	35 ㎡, Shower, Toilet	
(9) Lockers for fish retailers	12 ㎡ for 30 persons	
(10)Machinery room	53 ㎡, Emergency generator of 30 KVA	
(11)Rainwater tank	Outdoors (2 ㎡), 2 tons type	
1-2 Fishery development center	The 2nd floor of fish market building, about 338 ㎡.	
(1) Administration office, etc.	80 ㎡ for Center director's room, Reception/Secretary section, General affairs/Accounting department, and Office store,	
(2) Conference room	63 ㎡, used for conference and training course, etc. for 35 persons	
(3) Office of business department	120 ㎡ for 3 business departments of fish resources management, fishing technology extension, fishery statistics, data room, etc.	
(4) Sanitary rooms	75 ㎡ for toilet, pantry, locker	

1-3 Fish landing quay (1) Revetment (2) Fish landing wharf (3) Breakwater (4) Reclamation	 Extension: South 42m,West 90.5m, concrete block structure 1 berth for small-sized boat, 2 births for medium-sized boats Total length 35m, concrete block structure Parallel with beach 90.5m Right angle to beach 42m Revetment+4.2m on average	 Parapet height: +4.5m Approach revetment is 15m.
1-4 External facilities (1) Parking lot and access spaces on the premises (2) Lighting	 Parking capacity 30cars, asphalt pavement, partly concrete pavement 8- lamps of 40W	
2. Equipment		
2-1 Seawater Pump	Head 15m, Diameter 1 inch , 1set	
2-2 Pushcart	Loading capacity: 300kg, Dimension of loading platform is 1.20m×0.90m, 5 nos.	
2-3 Insulated Box	750 liter type, lid (attached with handle) : 2 nos.	For cold/chilled storage
2-4 Fish box	Outer dimension 720mm×480mm×200mm Material: Polyethylene, 60 nos.	Fish box of stackable type
2-5 Weighing Scale	For retailing: Desktop balance type, 0~20lbs, 33sets Platform scale: Floor put type, 0~200lbs, 2sets	30 sets plus 3 sets (10%)
2-6 Radio Set	1 unit of marine band VHF 3watts/10watts switching type, attached with wiring material and antenna equipment 1 unit of marine band SSB 150W, attached with wiring material and antenna equipment	

(5) Basic Design Plan

Plan of Civil Engineering Facilities

- Civil Utilities Layout Plan
- Civil Utilities Standard Section –1
- Civil Utilities Standard Section –2

Plan of Building Facilities

- Plot Plan of Building
- Floor Plan of Building
- Roof Plan and Section Plan
- Elevation of Building