FISHERIES DEVELOPMENT DEPARTMENT
MINISTRY OF AGRICULTURE AND THE ENVIRONMENT
COMMONWEALTH OF DOMINICA

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR REHABILITATION OF ROSEAU FISHERY FACILITY
IN
THE COMMONWEALTH OF DOMINICA

JANUARY 1999

JAPAN INTERNATIONAL COOPERATION AGENCY

OVERSEAS AGRO-FISHERIES CONSULTANTS CO., LTD.

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PREFACE

In response to a request from the Government of Commonwealth of Dominica, the Government of Japan decided to conduct a basic design study on the Project for Rehabilitation of Roseau Fishery Facility and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Dominica a study team from August 15 to September 23, 1998.

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

January 1999

Kimio Fujita
President,
Japan International Cooperation Agency

January 1999

Letter of Transmittal

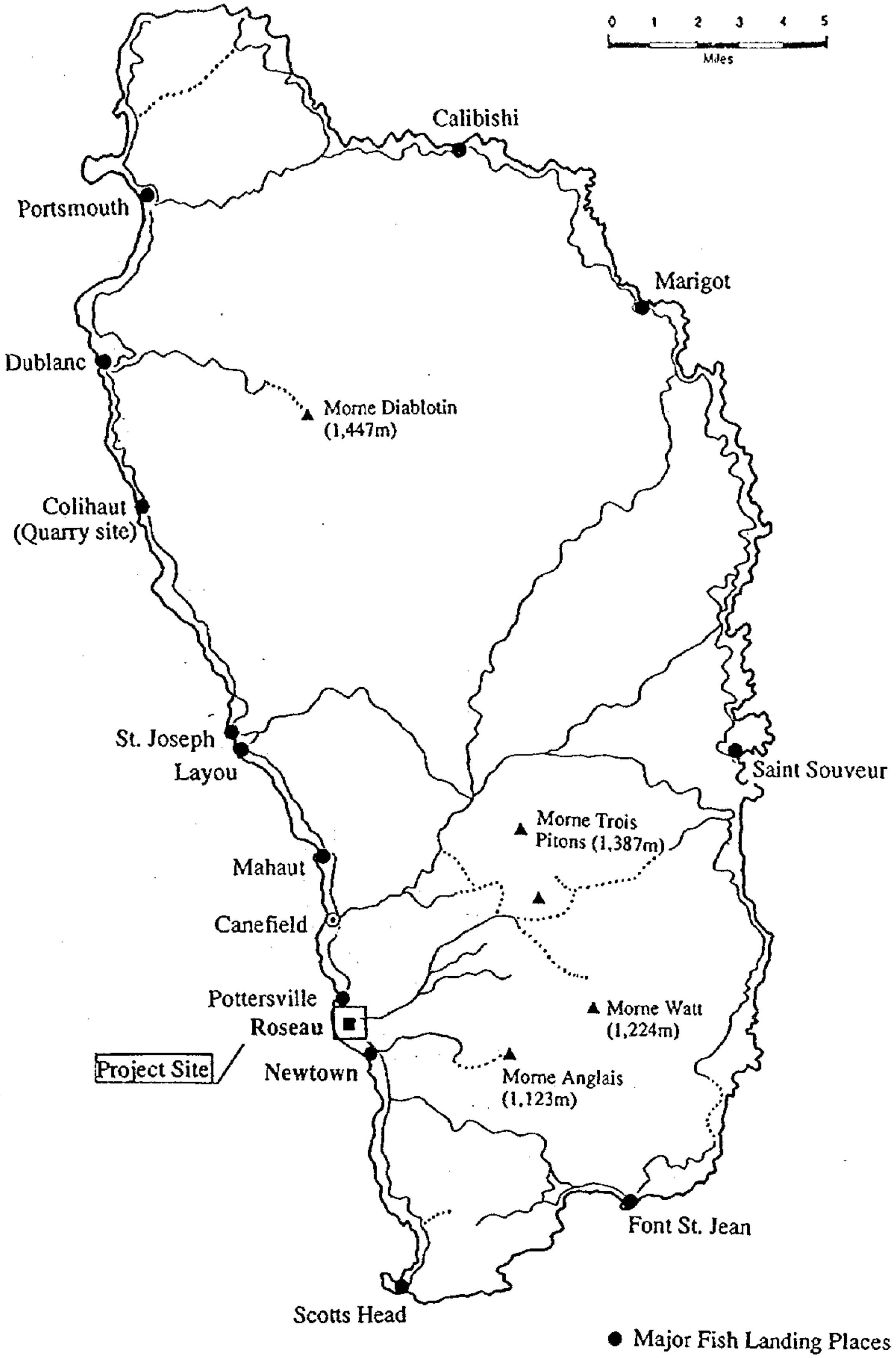
We are pleased to submit to you the basic design study report on the Project for Rehabilitation of Roseau Fishery Facility.

This study was conducted by Overseas Agro-Fisheries Consultants Co., Ltd. under a contract to JICA, during the period from August 5, 1998 to January 15, 1999. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Dominica 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,

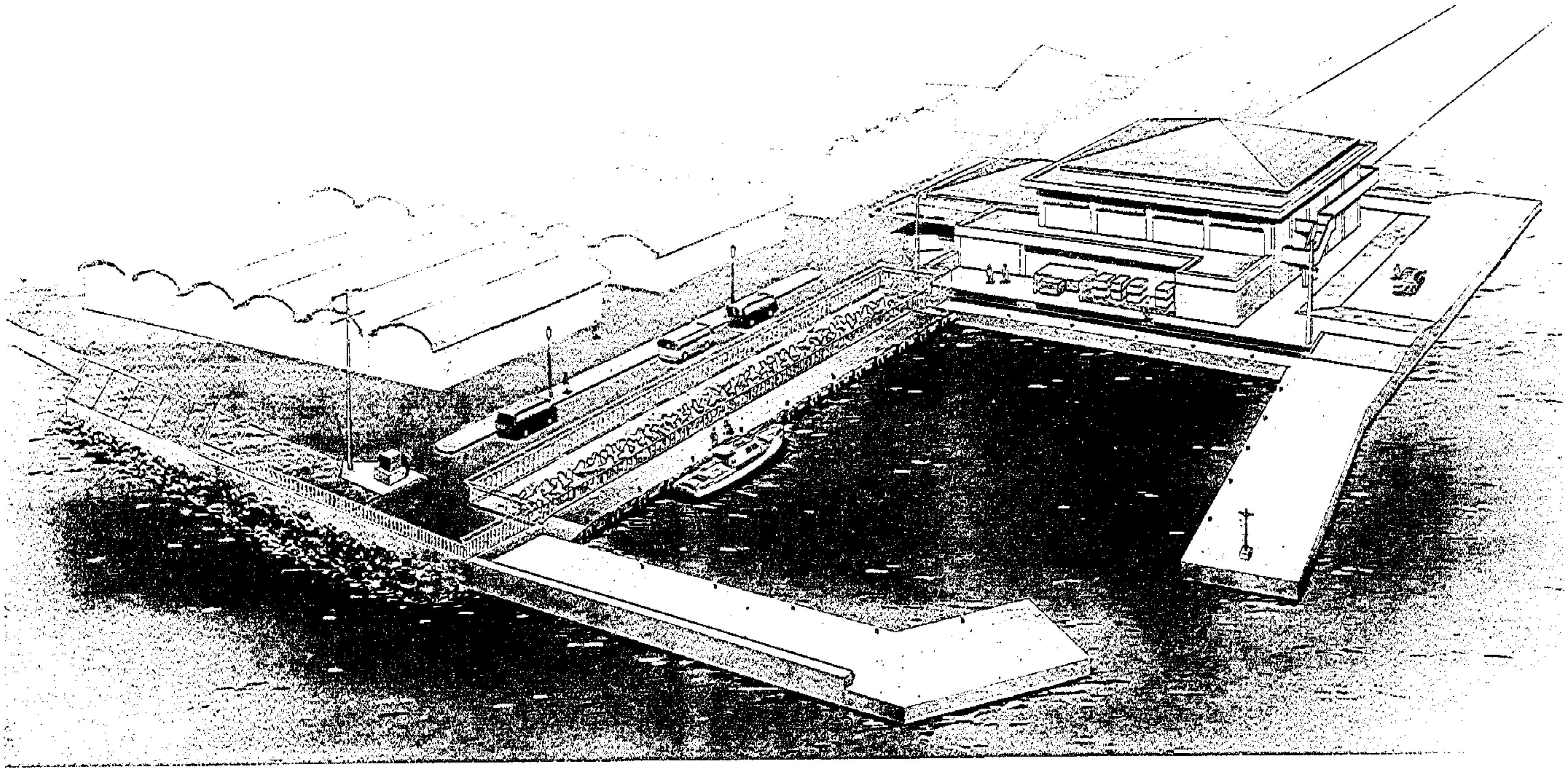
Iida Kazumi
Project Manager,
Basic Design Study Team on
the Project for Rehabilitation of Roseau
Fishery Facility
Overseas Agro-Fisheries Consultants Co., Ltd.



Map of Dominica

Project for Rehabilitation of Roseau Fishery Facility

Commonwealth of Dominica



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CHAPTER 1

BACKGROUND OF THE PROJECT

CHAPTER 1 BACKGROUND OF THE PROJECT

The Commonwealth of Dominica is situated in the Windward Island of the Eastern Caribbean Sea. Dominica is a mountainous volcanic island of approximately 970km^2, most of which is covered with tropical rain forests, having annual rainfall over 4,000mm. The main industry of the country is agriculture, mainly producing banana for export. The recent population is about 71,800 (1991).
The people living in the coastal area are engaged in fishing mainly with traditional wooden canoes and small boats in artisanal level, based on small fishing villages, scattered along the coast of the island. Number of the fishermen is estimated about 2,500, including part-time fishermen, accounting for some 8% of the country's working population. The annual production is estimated about 1,000 ton, which is not enough to meet the domestic demands. Some 300~400 ton of fishery products are, therefore, imported annually.

Being located in the ocean and with population having a taste for fish, the fishery in Dominica has been considered an important sector in supplying foods (animal protein) to the population and creating job opportunities to the people in the coastal areas and it has been required to be promoted. The fisheries, however, have been remained in less developed level and low productivity, due to constraints and problems including insufficient facilities for fishing and marketing.

In these circumstances, aiming at promotion of the fisheries, the government of Commonwealth of Dominica planned a coastal fisheries development project to establish a fisheries complex in Roseau, providing services for fishing, marketing, fisheries administration and enforcement of the department of fisheries. With grant assistance extended by the government of Japan, the complex was constructed in two phases (the first phase 1994: construction of port facilities, the second phase 1995: construction of buildings and procurement of equipment) and re-construction of damaged parts by hurricanes hits during the construction 1995. The complex was completed on March 1997.

The main facilities of the complex are as follows:

Port facilities:

- Landing and Servicing wharves	120m in total	(Sheet pile construction)
- Breakwaters	60m in total	(Sheet pile construction)
- Slip-way/boat lamp	45m x 20m	
- Bus terminal area	Approx. 1,000m^2	

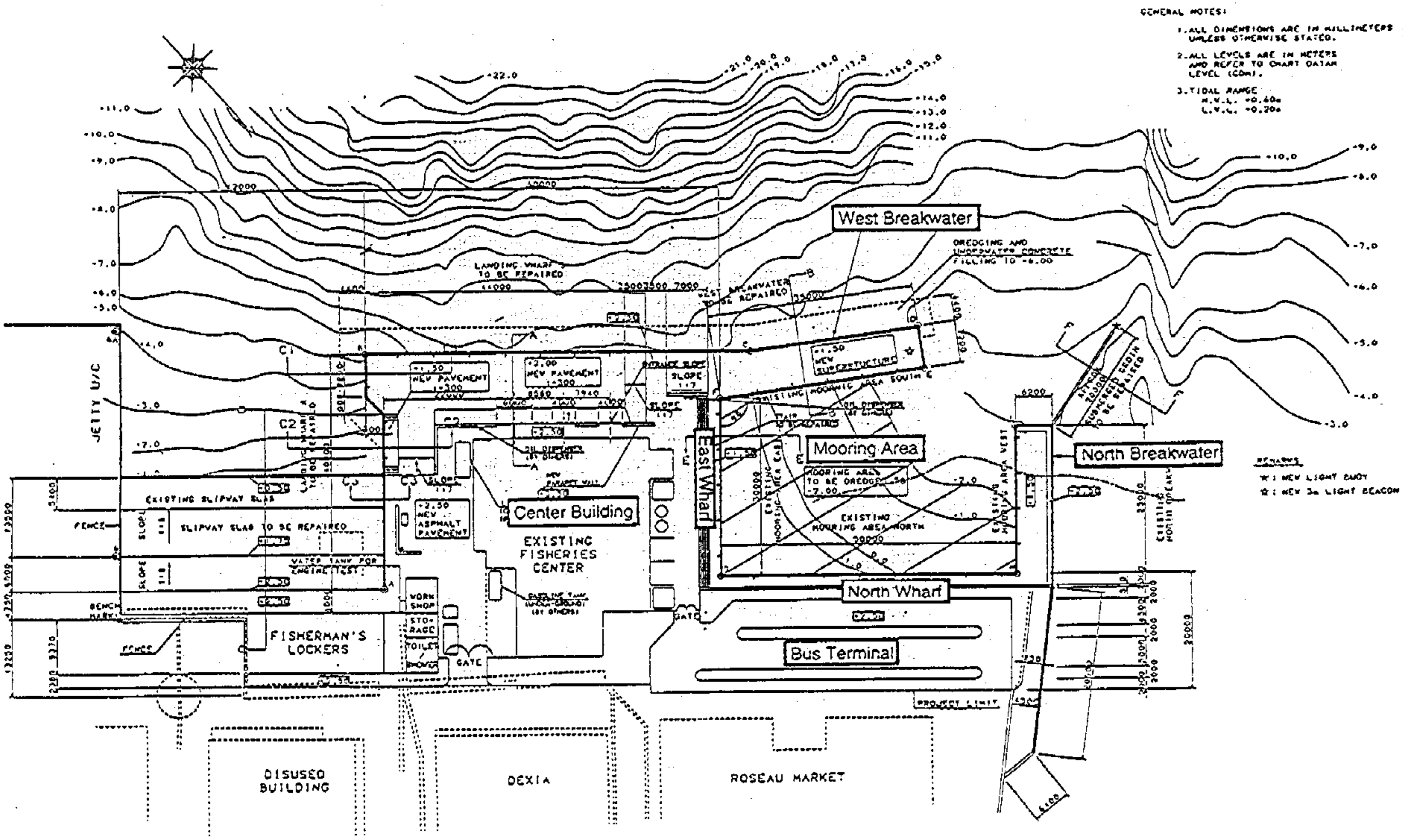
With the landing/servicing wharves and breakwaters, a mooring area, which is the object of this study, is formed with an area, approximately 30m x 50m, beside the center building of the Complex and the bus-terminal area .

Buildings:

- Center building (consisting of area for receiving fish landed, fish-market, refrigerating facilities and administration/ management rooms)
  Reinforced concrete building with two stairs   Area 1,255m^2 in total
- Workshop/ Lavatory/shower rooms
  Reinforced concrete building   Area 50m^2 + 30m^2
- Fishermen's lockers
  Reinforced concrete building   Area 140m^2

After the completion of the complex, disturbance of water in the mooring area has been sometimes observed. Water in the mooring area is sometimes disturbed, even though the sea outside of the mooring area is not very rough. In case of large turbulence, waves get over the wharves and make splashes at the corners of the mooring area, which fall on the bus-terminal area and the equipment outside of the Center building. It is difficult to forecast when the mooring area becomes turbulent.

Due to the disturbance of the water in the mooring area, there are problems in utilization and maintenance of the facilities. It has become difficult for fishing boats to use the mooring area, while the Fisheries Department has made efforts to manage the Complex.
Since Roseau Fisheries Complex is essential facilities for fishing and marketing in promotion of the fisheries sectors, it is necessary to improve the condition of the mooring area and encourage people to utilize the complex more effectively. The government of Commonwealth of Dominica, therefore, made a request for a grant aid to improve the mooring area of the Complex.



General Arrangement of ROSEAU FISHERIES COMPLEX

CHAPTER 2

CONTENTS OF THE PROJECT

CHAPTER 2 CONTENTS OF THE PROJECT

2-1 Objectives of the Project

In Dominica, fishery is recognized as an important sector for supplying food to the population and creating job opportunities to the people in the coastal area and it has been required to promote the fisheries sector. In this respect, Roseau Fisheries Complex plays important roles in its capacity as a fisheries support and service center, providing a base for fish landing and marketing, technical services and guidance to the fishermen. However, of the facilities making up the Complex, the mooring area for landing fish and preparing for fishing trips is faced with the problem of water turbulence, which makes usage of the mooring area difficult and consequently affects operation of the Complex. In order to improve this situation, the Project is to rehabilitate the mooring area with a direct objective to reduce the water turbulence in the mooring area to practically acceptable level. It will contribute to effective operation of the Complex and to promotion of the fisheries in Dominica.

2-2 Basic Concept of the Project

2-2-1 Basic Proposal for Rehabilitation of the Mooring Area

The area of Roseau Fisheries Complex faces directly to open-sea without any shelters such as reeves and islands. Steep and deep seabed is close to the shore. Due to these topographical conditions and the minimum scale of the mooring area facilities, limited by the aforementioned topographical factors, the mooring area is directly affected by weather and sea conditions and its surface tranquillity is placed at a disadvantage. Accordingly, it can not be avoidable that the mooring area becomes turbulent, directly affected by waves and winds when it is rough weather. It has been recognized well by the Dominica side and they do not use the mooring area in such rough weather days.

The problem is that the mooring area sometimes becomes turbulent even when the sea is not rough. In case of large turbulence, the waves get over the wharves and make splashes at the corners of the mooring area, which fall on the bus-terminal area and the equipment outside of the Center building. It has hindered the usage of the mooring area and consequently made problems in utilization and maintenance of the facilities of the Complex.

The request made by the Dominica side is to mitigate the water turbulence in the mooring area when the sea is not rough, by rehabilitation of the mooring area, without reducing its area. The Project is, therefore, to improve the mooring area with a direct objective to mitigate the water turbulence and reduce the splashes in usual days, except rough weather days.

In order to reduce the water turbulence in the mooring area, it is necessary to take the following measures;

(i) to decrease waves entering into the mooring area.

(ii) to reduce energy of waves entered into the mooring area in a short time.

Construction of new breakwater(s) off the mooring area, sheltering the entrance, would be one of the measures to decrease waves entering into the mooring area. This measure would be, however, not feasible because it entails great technical difficulty due to the deep and steep seabed off the mooring area. The rehabilitation plan would, therefore, consist of extension of the existing breakwater(s) to decrease waves entering into the mooring area and modification of the wharf inside of the area to wave-absorbing structures. The plan should be prepared so as to maintain the same area as the existing one because the mooring area is already at a minimum size.

2-2-2 Alternative Measures and Their Comparison

As measures to reduce water turbulence and wave splash inside the mooring area, which is the main objective of the Project, the following methods shall be adopted in accordance with the aforementioned basic measures.

(1) To make the port mouth as narrow as possible, in order to decrease the energy of outer sea waves entering the mooring area. Provided that boats do not pass each other at the port mouth, the width of the port mouth is acceptable to be a half of boat length. Since the mooring area is planned for fishing boat of 14 m long, at the largest, it shall be possible to reduce the port mouth width to 10 m.

(2) To dissipate the energy of waves, having entered into the mooring area, by means of wave absorber. Wave absorber can be either sloping wave absorber or upright wave absorber. The former has higher wave breaking efficiency, however, a large area is required to form the wave breaking slope. Since the current size of the mooring area needs to be maintained, wave breaking structures cannot be constructed in front of the existing wharf lines, and because the bus-terminal area at the back of the mooring area is also highly restrained,

there is not enough space to build a wave breaking slope. Therefore, upright wave absorber, which requires smaller area than the former, shall be adopted.

There are some types of upright wave absorber, as follows;

(a) Upright wave-absorbing caisson quay

This is an upright quay constructed with concrete caissons, of which the front wall has vertical, horizontal or circular holes. Ratio of total holes area against total front wall area of the caissons, that is, the void ratio is generally 15 ~ 30%. The reflection coefficient becomes less than 0.5 when width of the caisson is 10 ~ 20% of wave length. It means that effective wave period depends on width of the caisson. Therefore, it is unsuitable for the Roseau mooring area where waves of periods of wide range from 3 sec. to 10 several sec. should be taken in consideration.

(b) Upright quay filled with deformed concrete blocks

It is a structure in which deformed concrete blocks are filled between a wave-permeable front wall and a impermeable rear wall. In this type of wave absorber, the distance between the front and rear walls regulates upper limit of wave period, on which the absorbing structure works effectively. The longer the distance between the front and rear walls is, the larger the upper limit of the wave period becomes. Therefore, if the distance is long enough, the absorber is effective for waves of wide range periods.

Bottom structure is not necessary for this wave absorbing structure and crown structure is not required either, if it is not used as a mooring quay.

Rubble stones can be considered to use in stead of the deformed concrete blocks. But rubble stones are inferior to deformed concrete blocks in efficiency of wave absorption and stability against wave action.

A wave absorber constructed with concrete caissons filled with deformed concrete blocks is a kind of this type, but it is not used except special cases because construction of the caissons requires much time and large cost.

(c) Pier type wave-adsorbing quay

This is a pier under which there is a slope covered with rubble stones or deformed concrete blocks. In case of a prier of large scale for large ships, waves of large periods are effectively absorbed, because the wave-absorbing slope can be made long enough to work on waves with large periods. In case of the Roseau mooring area, this type can not be adopted because the mooring area is too small to build this type of absorber.

From the abovementioned consideration, a wave absorber combined with (b) and (c) mentioned above is suitable for Roseau mooring area. The absorber is composed with a front steel pipe pile pier, sheet pile rear wall and deformed concrete blocks filled between the pile pier and the rear wall.

Because of the following restraints, it is difficult to reconstruct the east wharf with wave absorber.

- Since there is the center building adjoining to the east wharf, it is practically impossible to reconstruct the east wharf with wave absorber, landward from the existing wharf line.
- Construction of the absorber seaward from the existing wharf line is contrary to the requirement to keep the existing area for mooring. The mooring area should not be reduced since it is the minimum scale.

As a result of simulation of water turbulence inside the mooring area made in a case that both the north wharf and the east wharf are absorbers and in a case that only the north wharf is absorber, there is not such a significant difference between the two cases as worth to cope with the abovementioned restraints. It is, therefore, planned to reconstruct only the north wharf with wave absorber, leaving the east wharf as it is.

Taking these points into consideration, the alternative improvement measures indicated in Figure 2-2-1 can be arrived at consideration. The difference between each alternative lies in the method adopted to reduce the port mouth width, as indicated below.

Case 1: Extension of both breakwaters by 6 m each (port mouth width 10 m).
Case 2: Extension of the west breakwater by 15 m.
Case 3: Extension of the north breakwater by 10 m.
Case 4: Addition of 15 m long breakwater at the tip of north breakwater, with right angle.
Case 5: Addition of 10 m long breakwater at the tip of the north breakwater toward the west breakwater (the port mouth width is to be 10 m).

Comparison of these alternative measures is given in Table 2-2-1. The comparison is made from the four viewpoints, that is, stop distance (the sailing distance available to boats entering the mooring area before stopping), water surface area available for moorage, tranquillity of the mooring area, and invasion of sand/gravel from Roseau River. In the overall evaluation, Case 1 and Case 5 are considered to be the most advantageous for adoption among the options.

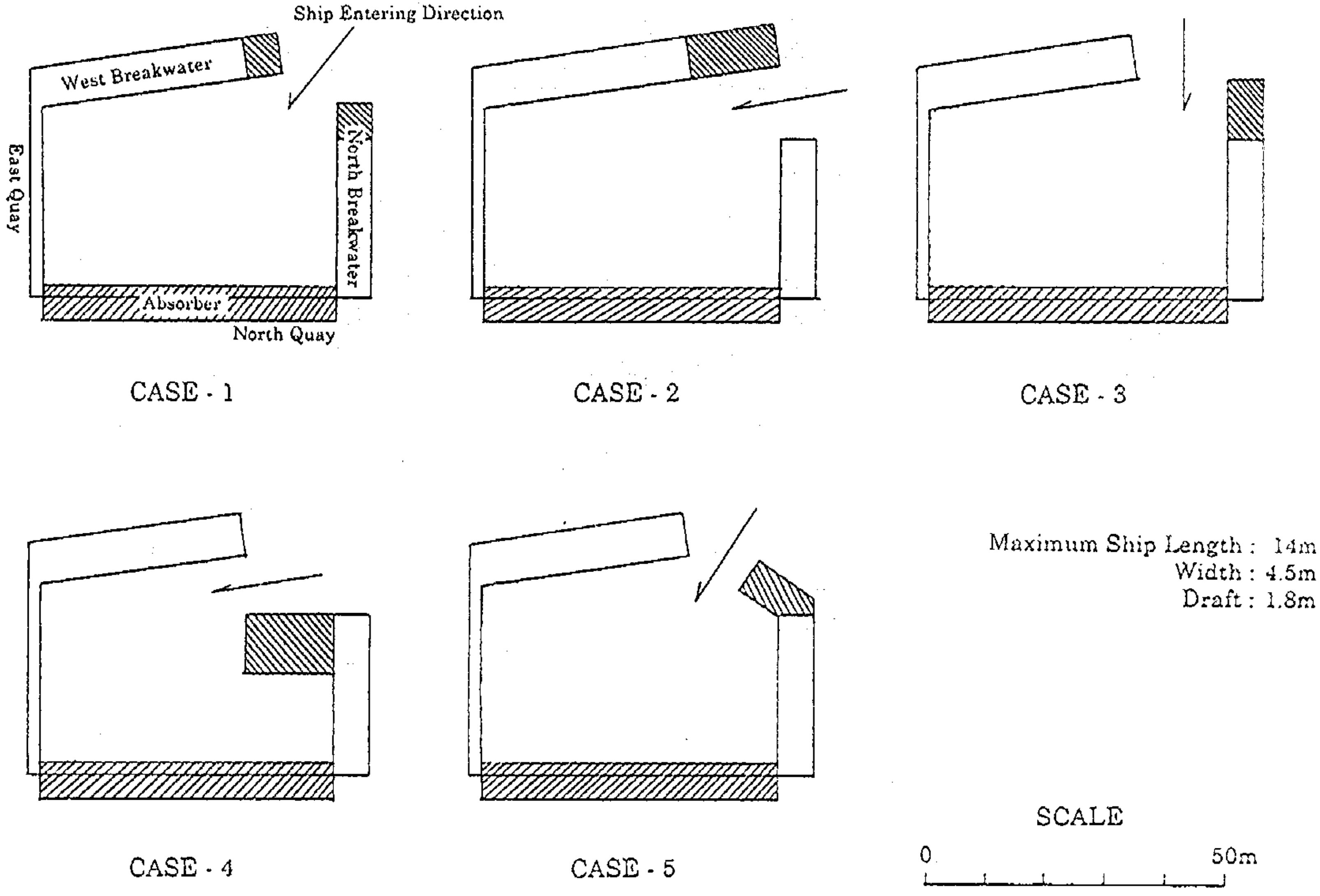


Fig.2-2-1 Plans of alternative measures

Table 2-2-1 Comparison of Alternatives

Alternative	Easiness of going in and out	Usable mooring area	Tranquillity inside the area	Accumulation of sand/ gravel from the river	Overall Evaluation
Case 1	The stop distance for incoming boats is the longest. Visibility from inside and outside the port is good.	Widest area	Good	Small	Good
Case 2	Since the mouth faces the river, there is a risk that shoal of the river can be an obstruction on boat's passing.	Relatively wide	Good	There is a risk that the west breakwater will lead the river flow into the mooring area.	
Case 3	There is a risk that the north breakwater will become an obstruction.	Relatively wide	Poor ... because waves from the south will directly enter the inside of the north breakwater, which does not have wave absorber.	Since extension of the north breakwater is long, the river flow is difficult to go into the mooring area.	
Case 4	The stop distance is short.	Narrow	Extremely tranquil with respect to waves from the south.	Small	
Case 5	The stop distance is shorter than in Case 1.	Narrower than in Case 1	Better than in Case 1	Smaller than in Case 1, because the port mouth is further from the river mouth.	Good

2-2-3 Simulation of Water Turbulence Inside the Mooring Area

(1) Simulation Techniques and Conditions

In this simulation, stationary state solution of the gentle gradient equation using the finite element method was used. The calculation conditions are as follows.

Calculation area : Semi-circle of 80 m radius incorporating the mooring area (see Figure 2-2-2)

Element division : Triangles of side length 1.5 m

Water depth : 2.5 m over the whole area

Reflection coefficient : 0.9 for the wharf without a wave absorber. As for the north wharf which possesses wave absorber, 0.35 when the wave period is 3 seconds, 0.5 when the wave period is 6 seconds, and, using linear change between this two period, 0.5 for all wave periods larger than 6 seconds.

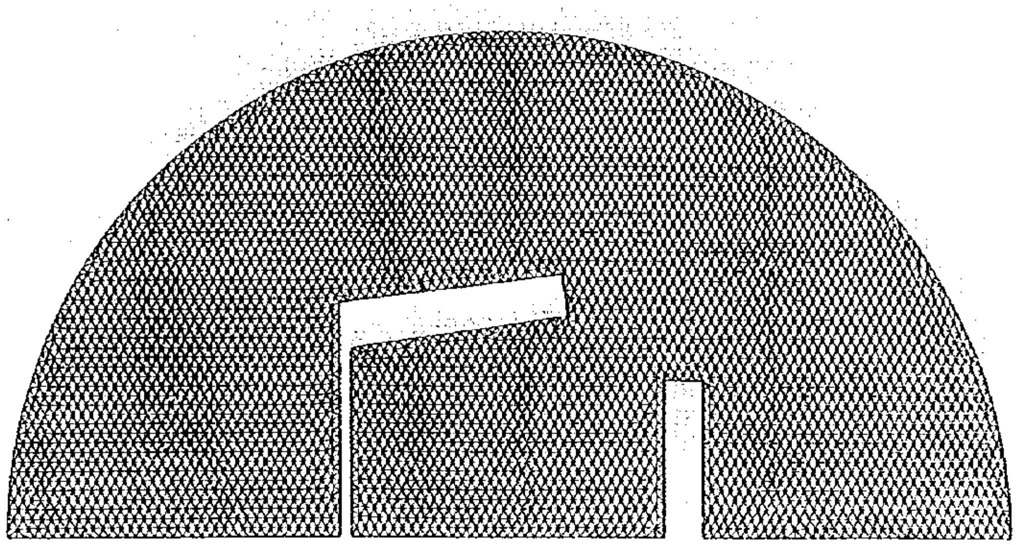


Fig. 2-2-2 Area of simulation analysis is on the water surface agitation

(2) Comparison of Simulation Results

Figure 2-2-3 shows wave height ratios against the offshore wave heights when the wave period is 4, 8 and 12 seconds. Wave direction is at right angle to the port mouth, the direction which wave energy most easily enters the mooring area. The smaller wave period become, the more nodes and antinodes of standing waves appear inside the mooring area. The same simulations were made in each of the following cases of Figure 2-2-1, using wave period in interval of 0.2 seconds from 3 to 15 seconds.

a. Present state case
b. Present state case with a wave absorber given to the north quay
c. Case 1
d. Case 4
e. Case 5

Figure 2-2-4 shows the largest wave height ratio along the east and north wharves, for each wave period. The following is clear from this figure.

A. In the present state case, the wave height ratio is greater as the wave period is shorter, and the maximum values appear more than in other cases. In particular, a wave height ratio of 3.5 or more appears at around wave periods of 3, 4, 7 and 8 seconds and roughly 3 is seem around wave periods of 10 and 12 seconds. Wave height ratios such as these are the cause of wave splash.

B. In the present state case with the addition of wave absorber, the wave height ratio reduces to between 40-60% of the present case without it.

C. In Case 5, wave height ratio when the wave period is 7 seconds or below is roughly 1.1, which shows hardly any difference with the wave height ratio in Cases 1 and 4, but, when the wave period becomes longer than this, the wave height ratio falls to 1 or 0.8 and is smaller than in the other cases.

Judging from the above mentioned and the results of local observations, in which the amplification coefficient of waves of 7 seconds or more is greater than that of waves with a wave period of less than 7 seconds, Case 5 can be adapted as the optimum alternative for reducing water turbulence in the mooring area. In Figure 2-2-5, which shows the wave height ratio distribution in Case 5, the level of tranquillity is far better than in Figure 2-2-3 of the present state.

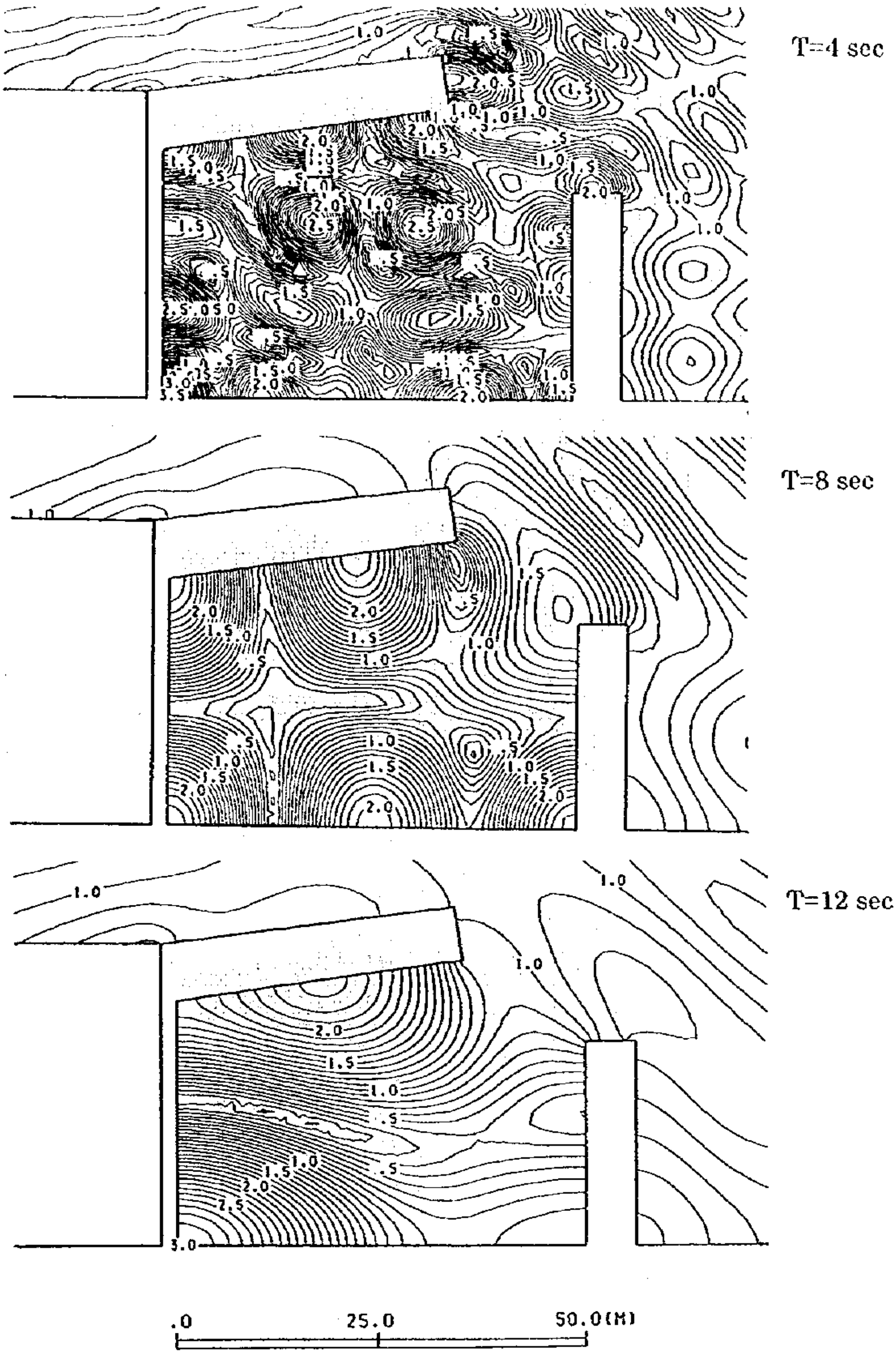


Fig.2-2-3 Wave height ratio distribution in Case of Present state
(Wave direction = Direct to the port mouth)

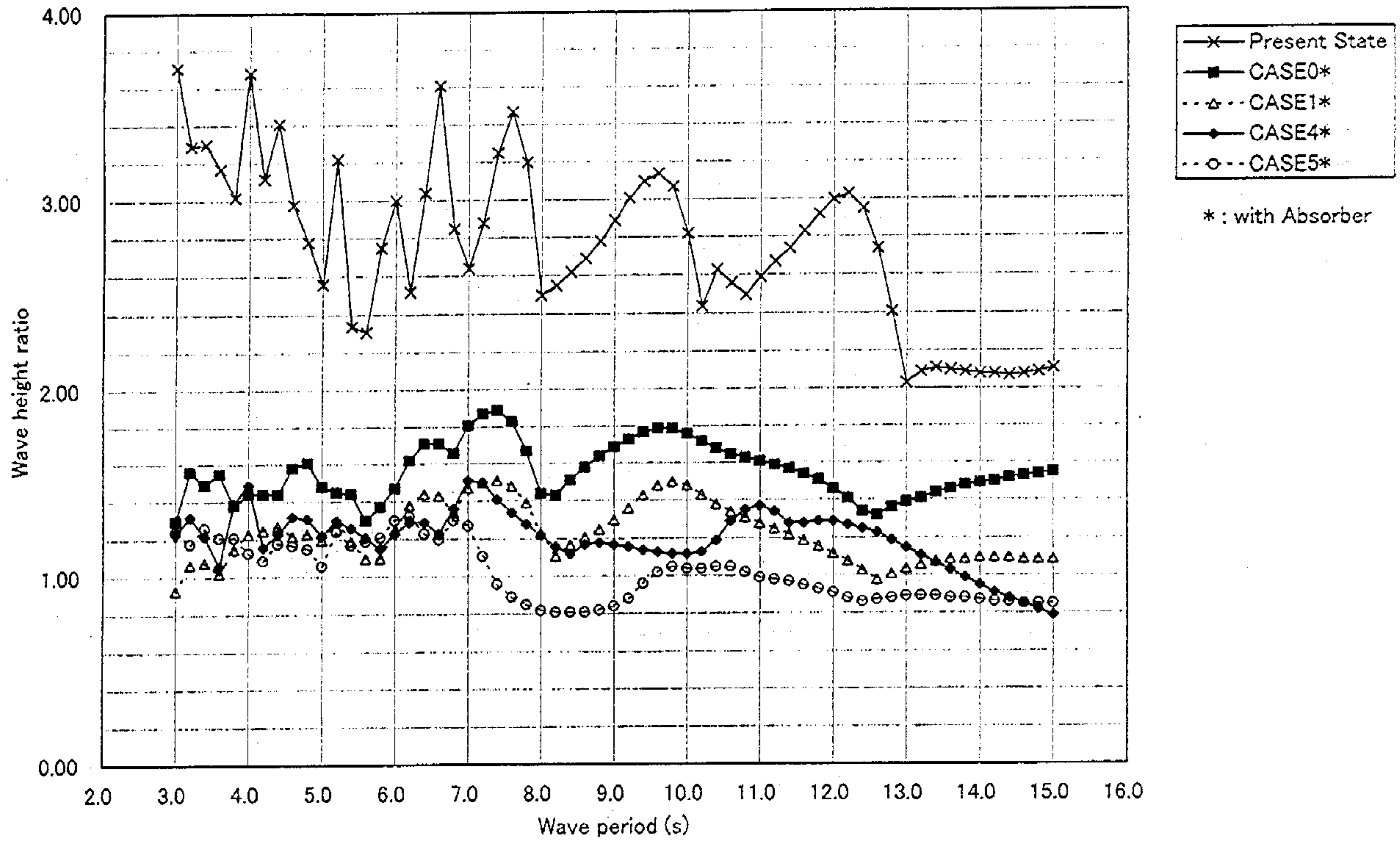


Fig.2-2-4 Comparison of maximum wave height ratio along the wharf

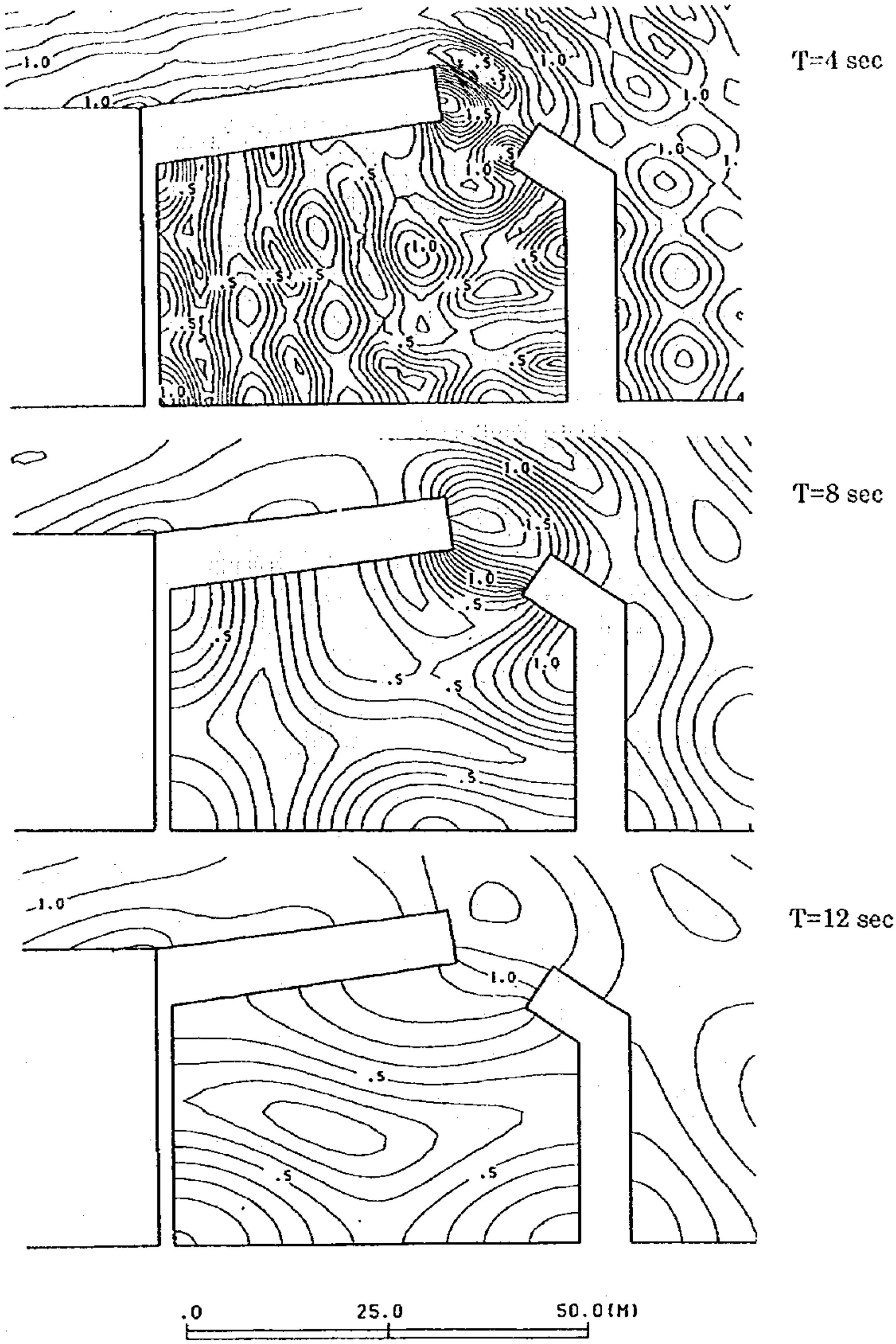


Fig.2-2-5 Wave height ratio distribution in Case 5
(Wave direction = Direct to the port mouth)

(3) Effect of the Submerged Groin

In order to investigate the effect of the submerged groin, simulation was carried out on the two cases of Case 5 with the submerged groin and Case 5 without it. Figures 2-2-8 and 2-2-9 show the results of the wave direction of SW, which is the direction for reflected waves from the submerged groin to be easy to enter the mooring area. The reflection coefficient from the submerged groin was set at 0.4. Comparing the case with the submerged groin to the case without the submerged groin, the wave height ratio is the same when the wave period is 4 seconds, slightly higher when the period is 8 seconds, and slightly lower when the period is 12 seconds. In other words, there is hardly any difference between the two cases. However, waves around the port mouth become higher in the case with the submerged groin. A similar trend was also observed with other wave directions.

(4) Simulation of Case 5 with Present Topography

The simulation described until now has assumed a constant water depth of 2.5 m, however, the water depth obtained from the sounding survey conducted in August 1998 shall be used here. Figure 2-2-8 shows equi-depth lines based on these recent observations. The water depth for the calculation has been added MHWL +0.6 m to it. Moreover, as shown in Figure 2-2-9, the port mouth width of 10 m is taken to be the distance between fenders attached to the crown concrete of the west and north breakwaters, therefore the width for wave passage becomes 11.3 m. In the present state case, however, since there are no fenders, the width for wave passage is the interval between the positions at 0.5 m backward from each breakwater tip. This width is 18.5 m. In the following calculations, this shape shall be applied to Case 5 and the present state case, respectively.

Furthermore, concerning the wave reflection coefficient on the north wharf with a wave absorber, since the wave period that is generally likely to occur is 12 seconds or less, it is desirable for the reflection coefficient regarding these wave periods to be 0.5 or less. Figure 2-2-6 has been obtained on base of many experiments on absorbers in front of breakwater and sea wall. If the crown level is higher than the still water level, the reflection coefficient K_R depends on the ratio $B_e/L_{1/3}$ of the width of the absorber at the still water level against wave length and the ratio $H_{1/3}/h$ of wave height against the water depth, bearing no relation to the crown level.
Then, taking the water depth has 2.5 m, reflection coefficient K_R is shown in Figure 2-2-7 for cases that wave height is 0.5 and 1 m on the base of Figure 2-2-6. From the figure reflection coefficients against each wave period are obtained as shown in Table 2-2-2 and 2-2-3.

Table 2-2-2 Reflection coefficient K_R for the width B_e= 6m

Period (sec.)	Wave length (m)	$B_e/L_{1/3}$	K_R	
			$H_{1/3}$=0.5m	$H_{1/3}$=1.0m
3	12.09	0.496	less than 0.32	less than 0.32
6	28.31	0.212	less than 0.32	less than 0.32
9	43.62	0.138	0.34	0.31
12	58.4	0.102	0.51	0.43
15	73.3	0.082	0.65	0.53

Note : If Be is 7 m, K_R is 0.55 against wave period 15 sec.

Table 2-2-3 Reflection coefficient K_R for the width B_e= 5m

Period (sec.)	Wave length (m)	$B_e/L_{1/3}$	K_R	
			$H_{1/3}$=0.5m	$H_{1/3}$=1.0m
3	12.09	0.403	less than 0.32	less than 0.32
6	28.31	0.177	less than 0.32	less than 0.32
9	43.62	0.114	0.44	0.34
12	58.4	0.086	0.63	0.53
15	73.3	0.068	0.75	0.63

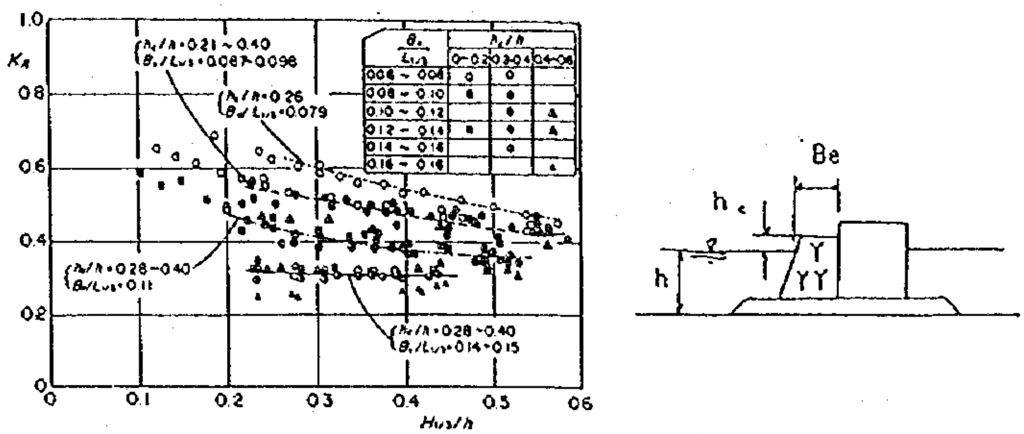


Fig. 2-2-6 Reflection coefficient K_R of composite breakwaters with absorbers
(Tanimoto and others, 1987)
(From Gregory: Handbook of port and harbour engineering, 1995)

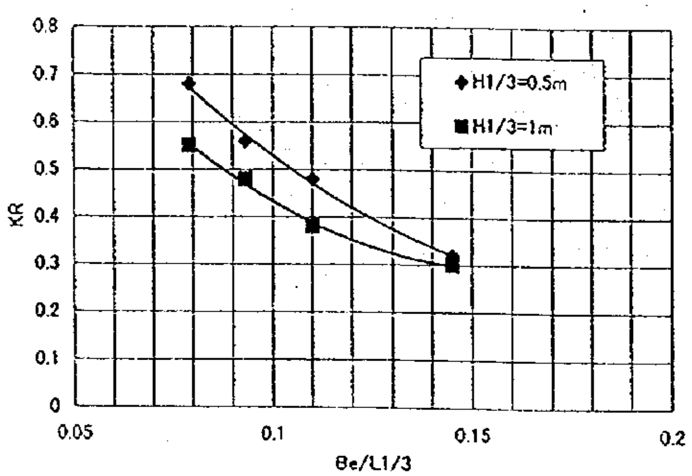


Fig. 2-2-7 Reflection coefficient K_R of North wharf

As indicated above (Table 2-2-2 and 2-2-3), the longer the period is and the smaller the wave height is, the larger the reflection coefficient becomes. Wave height in Roseau is usually less than 50 centimeters. Assuming that the effective width of wave absorber is 6 m and the wave height is 0.5 m, the reflection coefficient is approximately 0.5 for the waves of 12 second in period, according to the Table 2-2-2. In the case of the width of wave absorber is 5m in the same condition, the reflection coefficient increses 0.63 according to the Table 2-2-3. Therefore, the width of wave absorber is required 6m at least. In the following simulation, based on this table, the reflection coefficient has been set as 0.35 for wave period of 3 to 10 seconds, and increased by straight line progression from 0.35 at 10 seconds to 0.65 at 15 seconds.

Figure 2-2-12 shows the largest wave height ratio along the wharf against the offshore wave in the case of WSW direction, which approach the port mouth at almost right angles. The figures of 8 m, 9 m, 10 m, 11 m and 12 m in Case 5 are widths between fenders at the port mouth, and, as was described above, the width of wave passage is 1.3 m wider than these distances. The difference in wave height ratio is small when compared among the port mouth widths of 8 m, 9 m and 10 m, but it becomes larger when compared between 10 m and 11 m. Accordingly, a port mouth width of 10 m is considered to be appropriate.

In the present state, sharp peaks of 3.5 or more can be seen in the wave height ratio for wave periods of 4.2, 7.2, 9.2 and 11.8 seconds, but no such peaks appear in Case 5. In Case 5, when the port mouth width is 10 m, after demonstrating a peak of 1.36 around a wave period of 6.4 seconds, the wave height ratio increases gently to 1.65 as the wave period rises until 15 seconds. Figures 2-2-13 and 2-2-14 respectively show the wave height ratio distribution in the present state case and Case 5 (port mouth width 10 m) at the wave periods of 4, 8 and 12 seconds. It can be seen that, at times when the wave period is 12 seconds or less, the level of tranquillity in the port is greatly improved in Case 5, compared to the present state case.

However, when the wave period is 15 seconds, whereas the wave height ratio is 3.5 in the present state case, it is 1.58 in Case 5. Moreover, as indicated in the Table 2-2-2, because the reflection coefficient increases rapidly when the wave period becomes larger than 12 seconds, it is clear that wave splash made by waves of such large period will also occur in Case 5. Generally speaking, the energy density of wave components of a period of more than 12 seconds is small, so that this should not prove to be a major problem. It is assumed that wave splash only becomes a major problem in Case 5 in several times a year when hurricanes pass through or around the Caribbean Sea.

2-2-4 Calculation of the Mooring Area Operating Rate

The following two types of observation data were used in calculating the operating rate of the mooring area.

A. Values of offshore waves visually observed daily basis by Dominica Coastal monitoring Programme from the coast in front of Roseau market (Dominica Coastal monitoring Program, Section 1 ; Observation period : From September 1987 to May 1988 and from September 1988 to April 1989).

B. Values observed during this study using a wave recorder every two hours at 10m deep offshore-ward of the tip of the north breakwater (Observation period: From July 16 to October 29, 1998).

Figures 2-2-15 and 2-2-16 show the results of simulation of the largest wave height ratio along the wharf within the mooring area in the present state case and Case 5, for each wave direction and wave period. Multiplying the above observed values by this wave height ratio, wave height inside the mooring area was calculated. The results of this are shown in Table 2-2-4. Excepting the time when waves are coming from directions between WNW and SSE, the sea condition was regarded to be tranquil.

Table 2-2-4 Mooring Area Operating Rate

Data	Operating Threshold Wave Height 30 cm		Operating Threshold Wave Height 50 cm	
	Present State	Case 5	Present State	Case 5
A	43%	89%	73%	97%
B	52%	83%	65%	95%

Generally speaking, the threshold wave height for operation by small fishing boats is 30 cm. In this case, the operating rate in the present state case and Case 5 is 43% and 89% respectively when using Data A, and 52% and 83% respectively when using Data B. This disparity arises from the fact that the wave periods in Data A are longer than those in Data B because Data A was obtained from visual observations. Taking into consideration that Data A does not contain a part of data during the calm season and Data B was taken only during the hurricane season, the yearly operating rate would be considered about 90 % in Case 5.

The operating rate would be, therefore, improved to around 90% in Case 5 from 50% at the present one. Then, the days of operation through a year will be roughly estimated to be around 320 days in Case 5 against about 180 days in the present state.
Since the above estimate of the rate is based on the wave observation conducted in a rather short period, the actual operating ratio has a possibility to be changed by weather condition.

2-2-5 Conclusion of simulation

The request from the Dominica side seeks to eliminate wave splash that occurs in the mooring area at normal days, except rough days and when hurricanes strike, without reducing the usable space of the mooring area. From the results of the above-mentioned simulation of water surface turbulence in the mooring area in each alternative measure indicated in Figure 2-2-1, Case 5 indicates the highest wave splash reduction effect among the alternatives. In this case, it is estimated that wave splash that currently occurs in normal days, except rough days and the days having waves with long periods more than 12 seconds, can be mostly eliminated.
In conclusion, the Case 5 shall be taken as an practically appropriate measure to improve the mooring area for the Project.

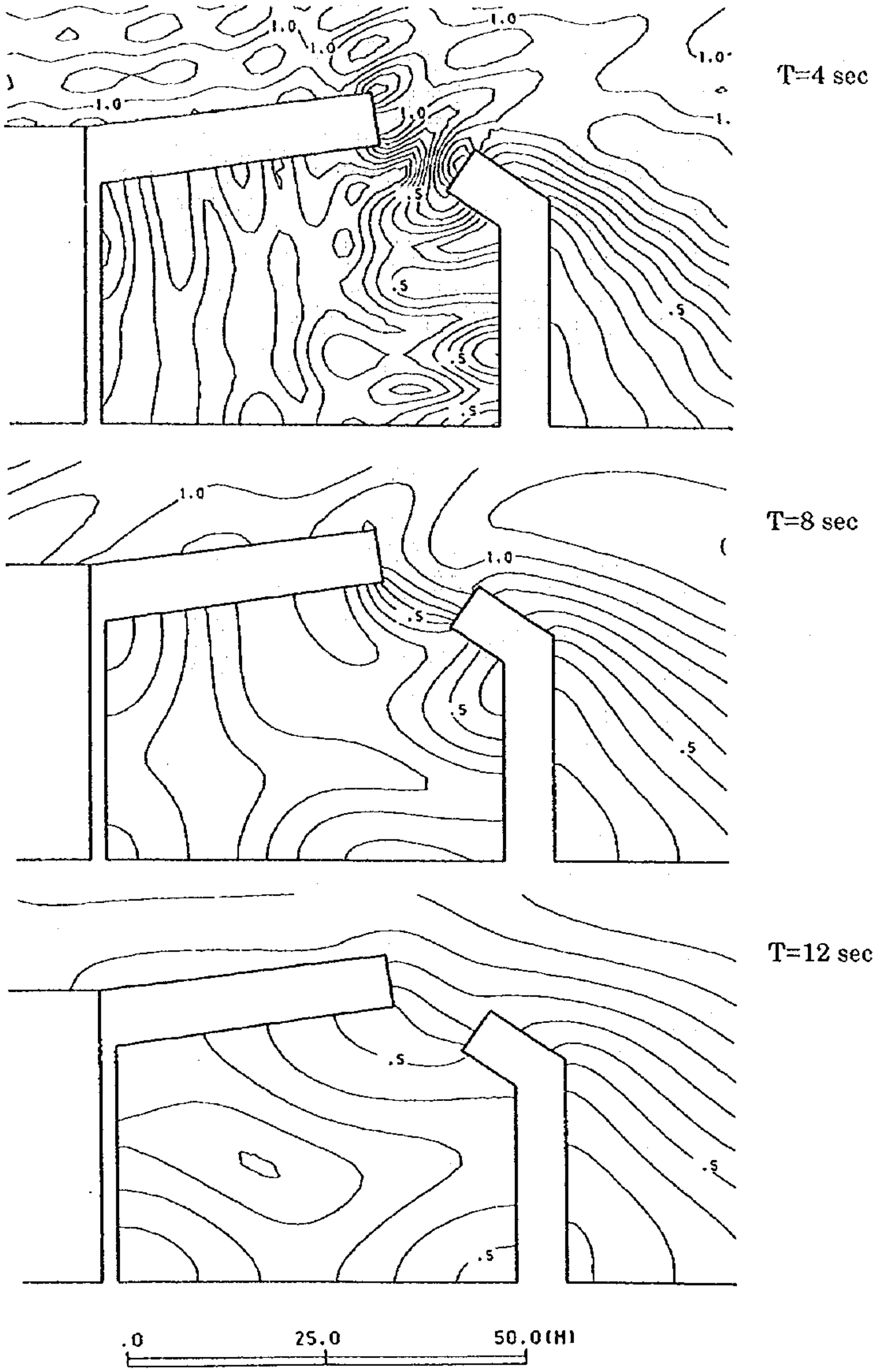


Fig. 2-2-8 Case 5 without Submerged groin (Wave direction = SW)

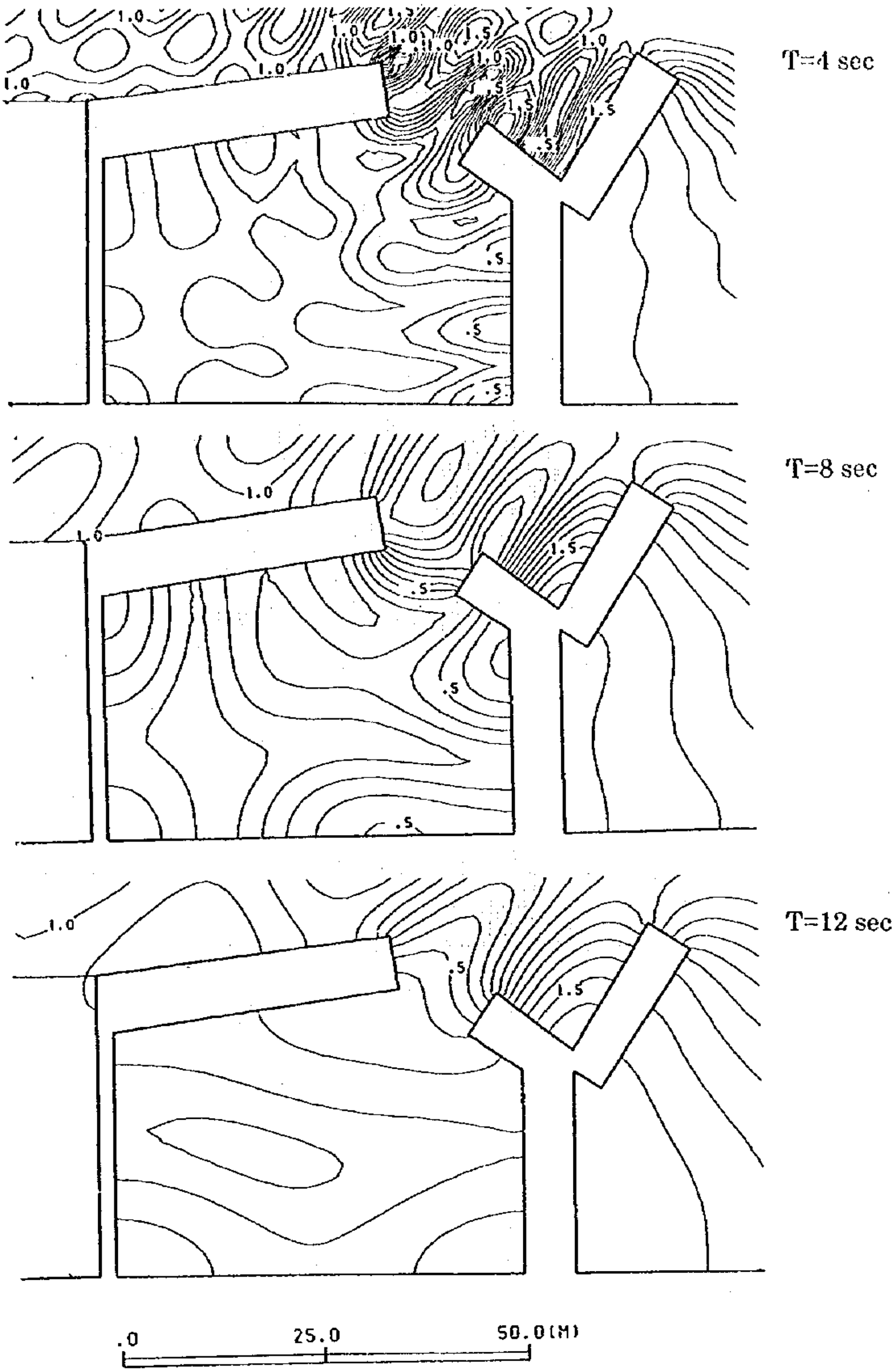


Fig. 2-2-9 Case 5 with Submerged groin (Wave direction = SW)

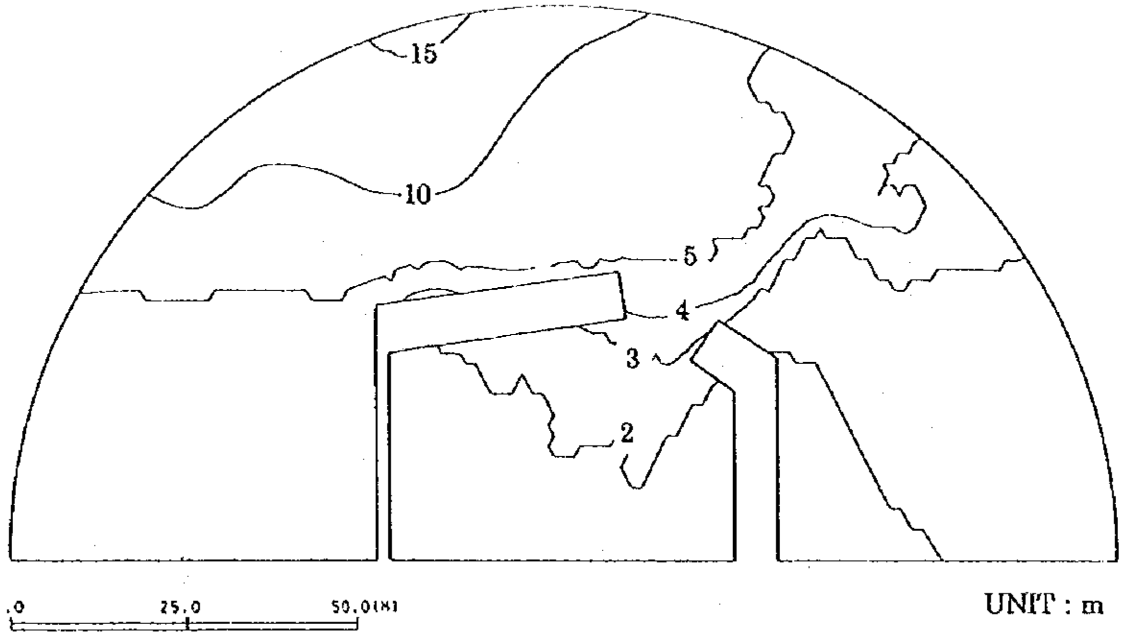


Fig. 2-2-10 Water depth of present topography

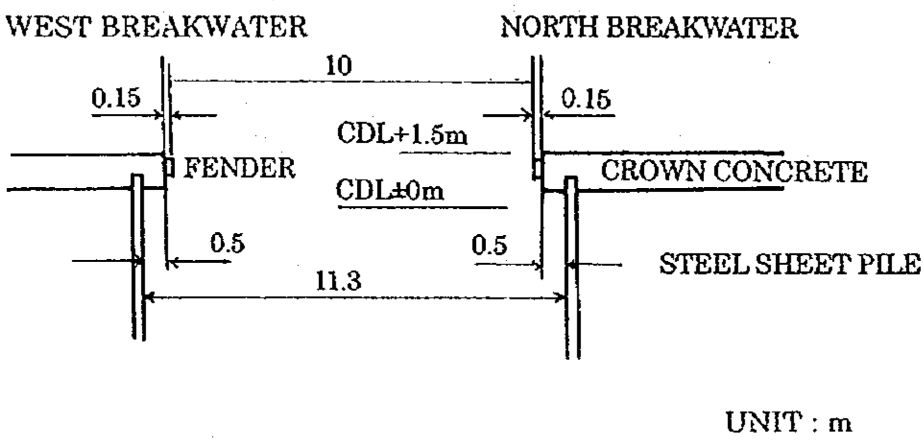


Fig. 2-2-11 Port mouth width of Case 5

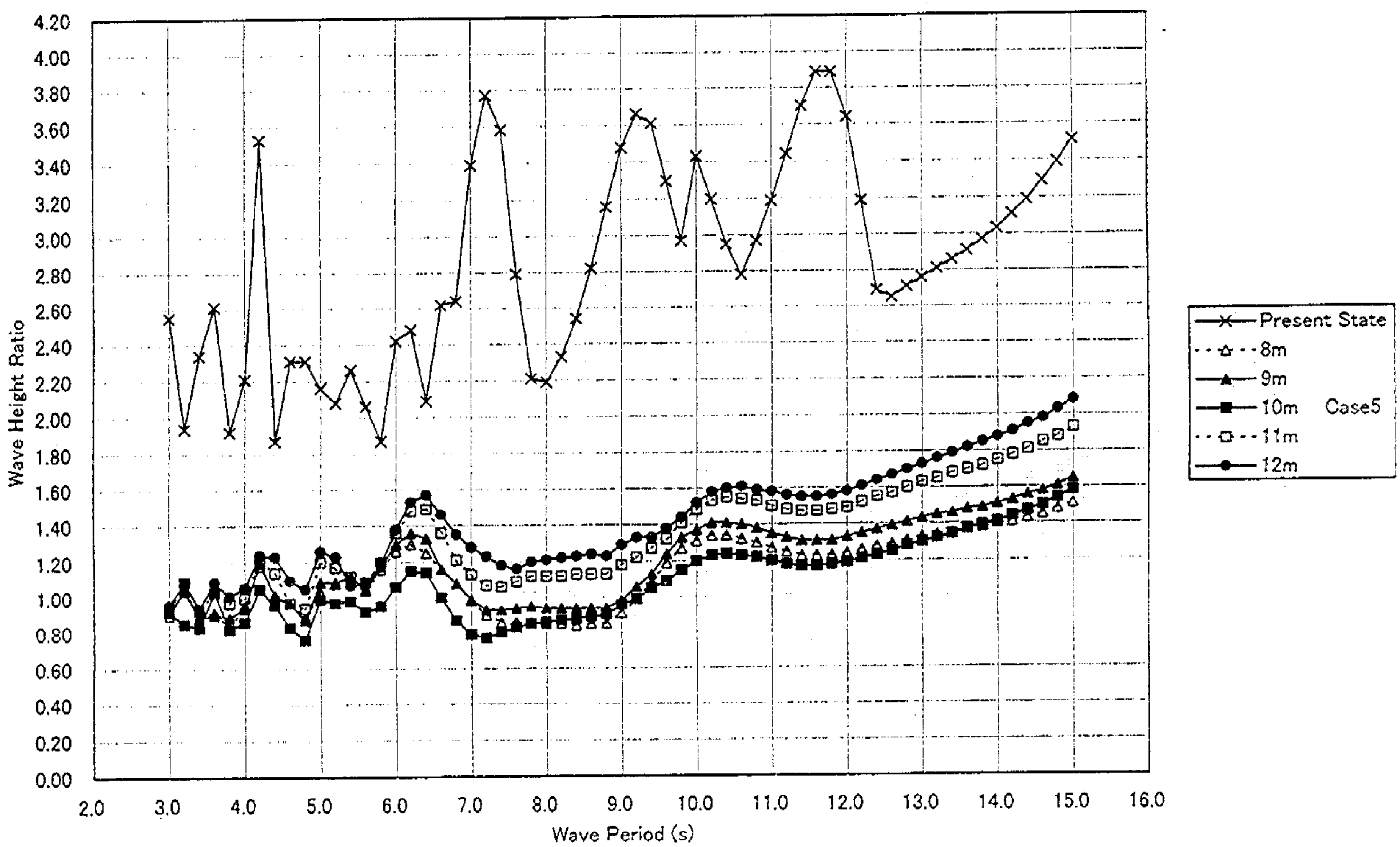
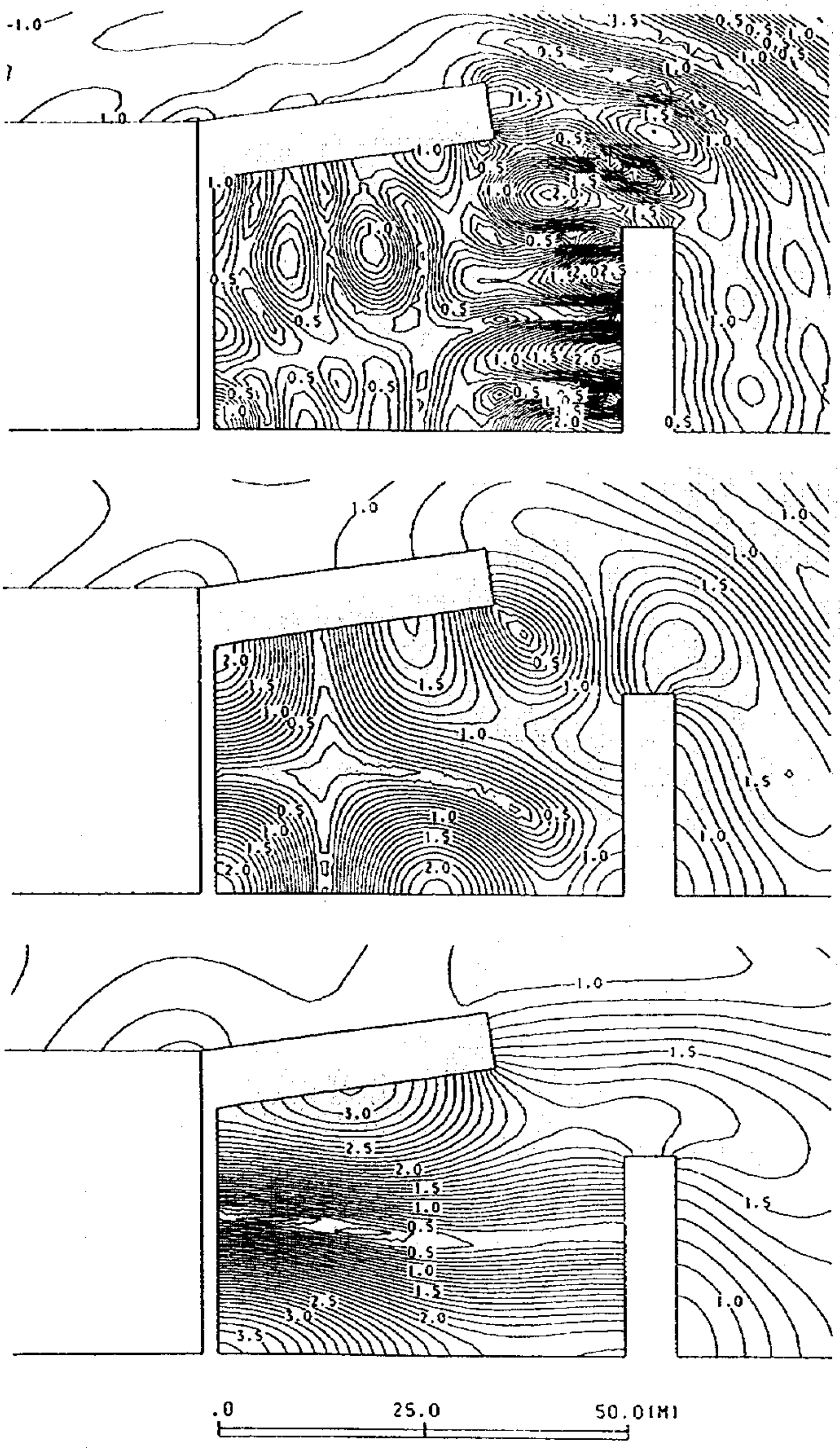


Fig. 2-2-12 Wave height ratio in Case of Present state and Case 5 with different port mouth width at the present topography



T = 4.0 sec

T = 8.0 sec

T = 12.0 sec

Fig. 2-2-13 Wave height ratio distribution in Case of Present state

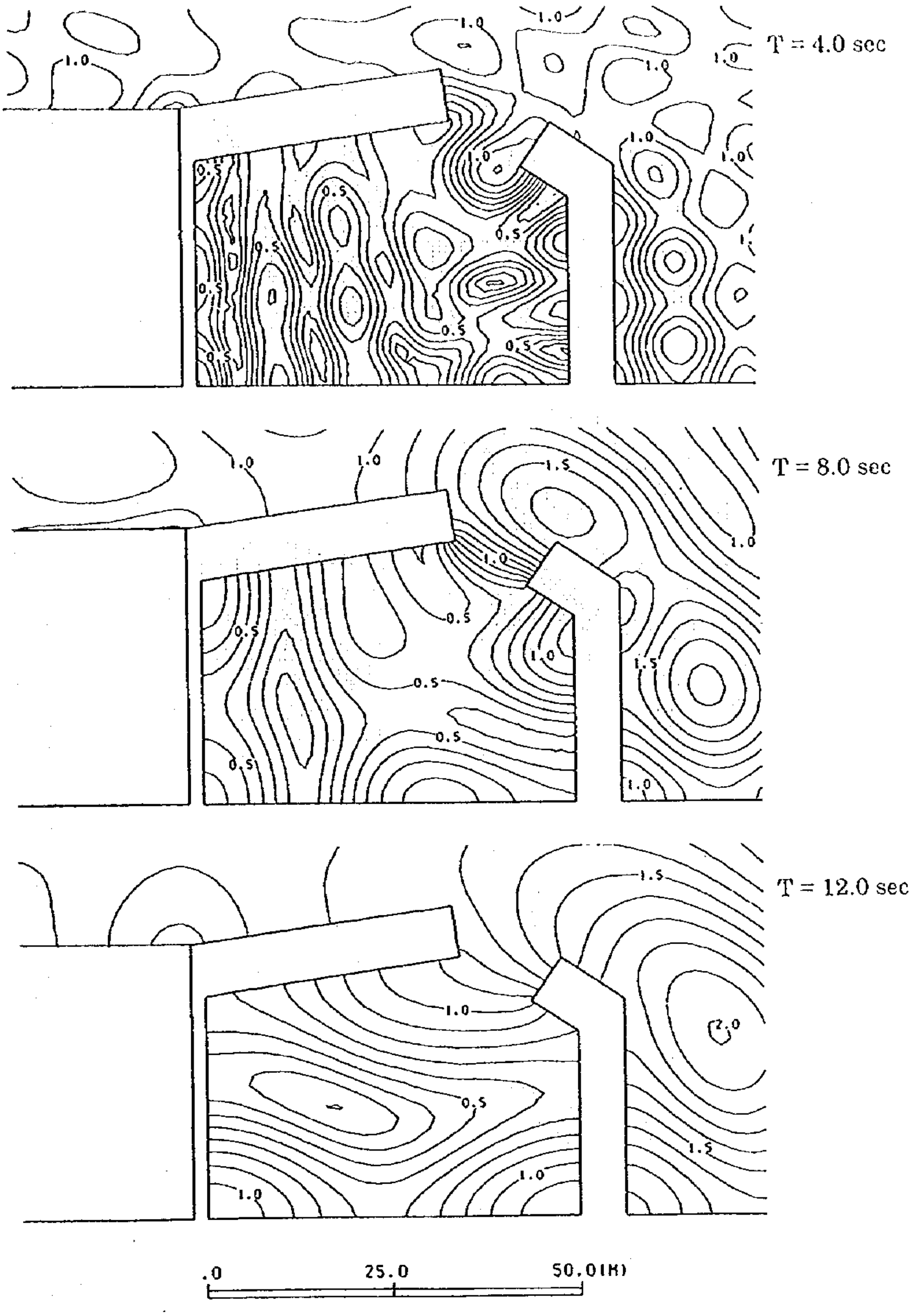


Fig. 2-2-14 Wave height ratio distribution in Case 5 at the present topography

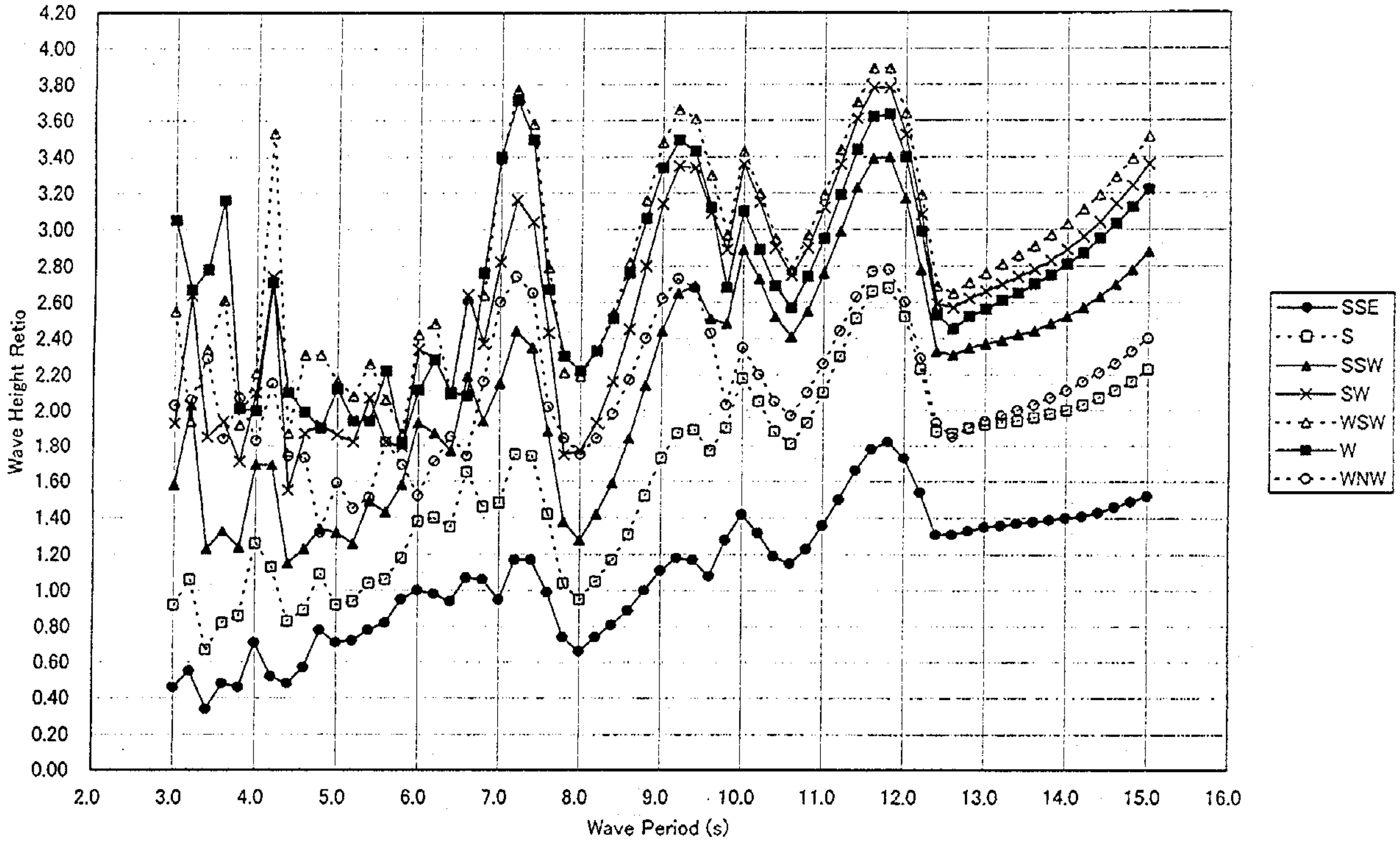


Fig. 2-2-15 Wave height ratio for different wave directions in Case of Present state

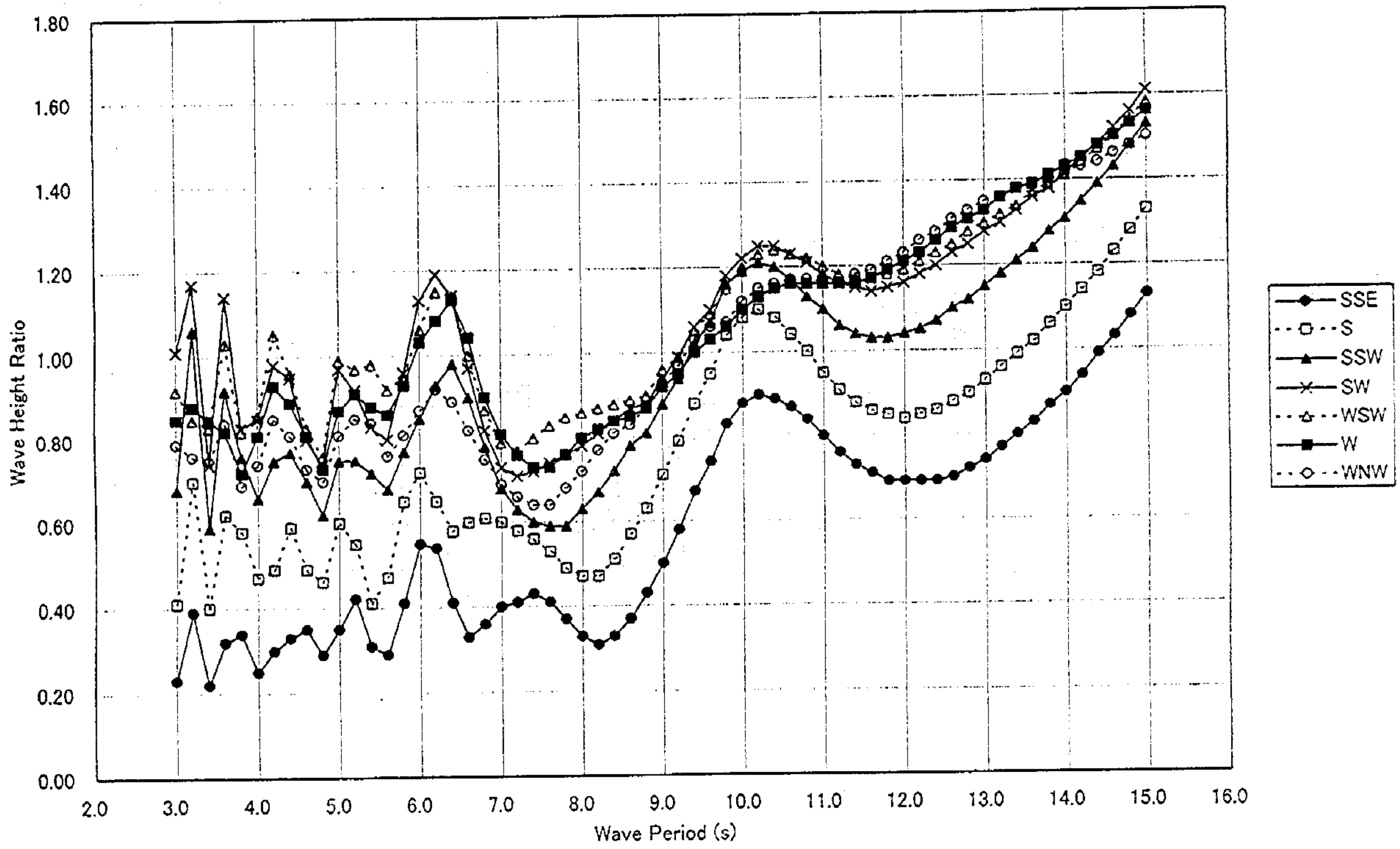


Fig. 2-2-16 Wave height ratio for different wave directions in Case 5

2-3 Basic Design

2-3-1 Design Direction

With consideration given to the current situation in Dominica and the natural conditions in particular waves and environment to the rear of the Project site, this Project, which is to be implemented within the bounds of the Grant Aid Scheme of the Government of Japan, shall be implemented through designing improvements of the port facilities that are required to eliminate wave splash, which currently occurs at normal days in the mooring area of Roseau Fisheries Complex.

(1) Direction with regard to Natural Conditions

Waves outside of Roseau mooring area are in general extremely tranquil, except the times when a hurricane approaches or low pressure is influential. However, the design of facilities must take into account waves that are caused by hurricanes. According to the Actualization Examination Report on the Coastal Fisheries Development Plan of Dominica (March 1996), the design conditions of the port taking hurricanes into account are as indicated in Table 2-3-1.

Table 2-3-1 Design Conditions

	Item		Design Value	Remarks
Climate and Sea Conditions	Maximum wind velocity		53.8 m/sec.	During approach of hurricanes
	Maximum wave height (significant)		H = 8.0m	30 year probability offing waves, Ho = 7.0 m, To = 10.5 sec.
	Water level	Tide level (high tide)	MHWL = CDL +0.6m	
		Suction height	Maximum +0.6 m	During approach of hurricanes
	Maximum flow velocity		0.5 m/sec.	
	Seismic coefficient		0.1	Recommended value: 0.20
	Bottom sediment		Crushed sand mixed with gravel (gravel pieces of 20-30 cm diameter in places)	
	Rainfall		2,073 mm/year	
	Temperature	Annual variation	Maximum temperature 35 °C	Maximum 34.0 °C
		Daily difference	11.6°C	Maximum daily difference
	Humidity		80%	
	Water temperature		Fresh water temperature 32 °C	
Soil Conditions			Surface	Foundation Bed
	Wet density		1.75~1.90ton/m³	Ditto
	Moisture content		19%wt	11-14%wt
	Soil type/Particle size		Sand (0.07-2.0 mm) 80%	Sand 45-65%, rest is gravel
	N value		3~26	26 minimum
	Layer thickness		3m~5m	Seabed surface and below

CDL: chart datum level (±0.000 m in the Project)

The wave height in front of the port facilities is determined as Table 2-3-2 with consideration given to the above 30 year probable wave and its shallow water deformation.

Table 2-3-2 Frontal Wave Heights at the Project Site
(calculation using 30 year probable waves)

		Wharf and Breakwater	Submerged Groin Area
Main offshore wave direction		W	W
Offshore wave height H_0 (m)		7.0	7.0
Offshore wave period T_0 (m)		10.5	10.5
Offshore wave length L_0 (m)		172	172
Converted offshore wave height H'_0 (m)		6.65	6.65
H'_0/L_0		0.03867	0.03867
Shallow sea wave direction		W	W
Peak wave height (wave before breakwater)	Seabed ground height (m)	7.1	4.1
	Water depth (m)	7.7	4.6
	h/H'_0	1.15	0.69
	H/H'_0	1.19	0.82
	Wave height H (m)	7.91 (≒8.0m)	5.45 (≒5.5m)

Note) Seabed gradient: i = 1/10, tide level: HWL +0.60 m

(2) Direction regarding to Design Wave of Target Facilities

The facilities targeted for improvement are the north breakwater and north wharf. Concerning extension of the north breakwater, a design wave height of 8 m indicated in Table 1-3-2 shall be adopted for the breakwater.

Concerning facilities for modifying the north wharf to a wave breaking structure, the design wave height is calculated in the following manner based on transmitted waves from the west breakwater (see Appendices A-1). First, the maximum wave height (H_{max}) at the front of the west breakwater is as follows:

According to Table 2-3-2, the characteristics of design wave in front of the west breakwater have been determined as follows:

Offshore wave length L_0 = 172 m

Equivalent deepwater wave height H'_0 = 6.65 m

H'_0/L_0 = 0.03867

Water depth h = 7.7 m

Relative depth h/H'_0 = 1.15

From Figure 2-3-1,

$H_{1/3}/H'_0 = 1.0$

$H_{max}/H'_0 = 1.5$

Therefore $H_{1/3} = 6.65 \times 1.0 = 6.65$ m

$H_{max} = 6.65 \times 1.5 = 9.97$ m

Wave height H_T transmitted by the west breakwater is obtained from Figure 2-3-2 as follows;

On $H_{1/3}$; $K_T = 0.33$ is obtained from the figure using:

$h_c/H = 0.9/6.65 = 0.13$ and $d/h = 5.6/7.7 = 0.72$

Therefore $H_T = 6.65 \times 0.33 = 2.2$ m

On H_{max}; $K_T = 0.35$ is obtained from the figure using:

$h_c/H = 0.9/9.97 = 0.1$ and $d/h = 0.72$.

Therefore $H_T = 9.97 \times 0.35 = 3.5$ m

Based on the above, the designing wave height is set 3.5m for the pier of the north breakwater and 2.5m for the deformed concrete blocks as wave absorber.

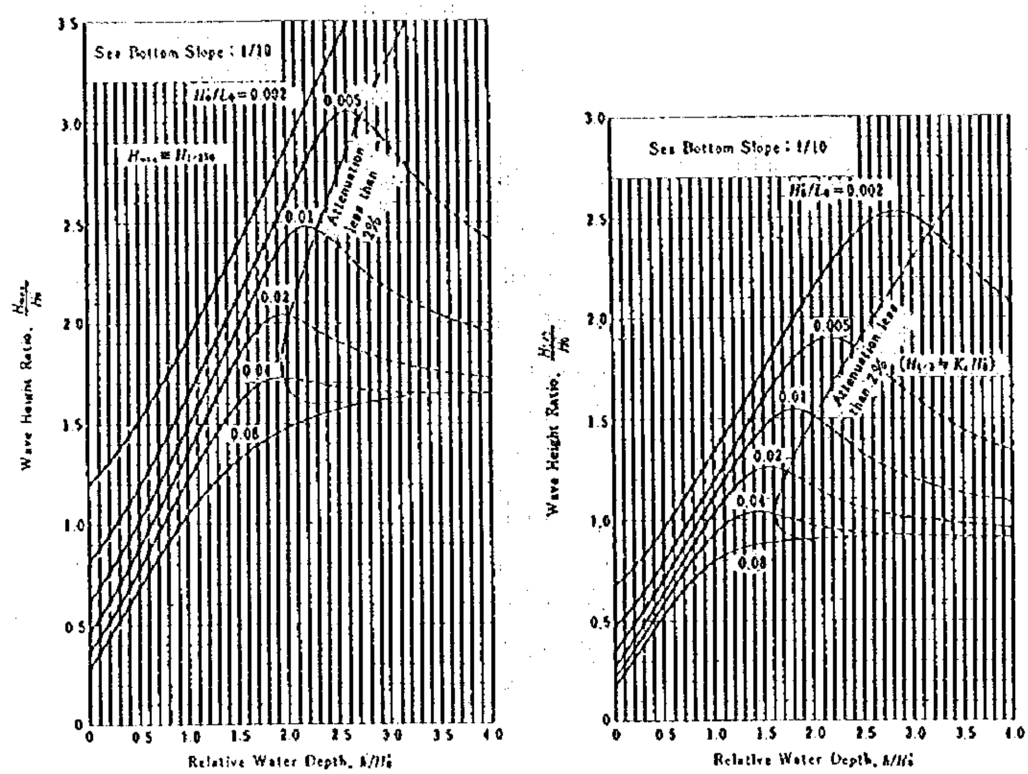


Fig. 2-3-1　Diagrams for the estimation of wave height in the surf zone (Goda, 1975)
(From Goda :　Random sea and design of maritime structure 1985)

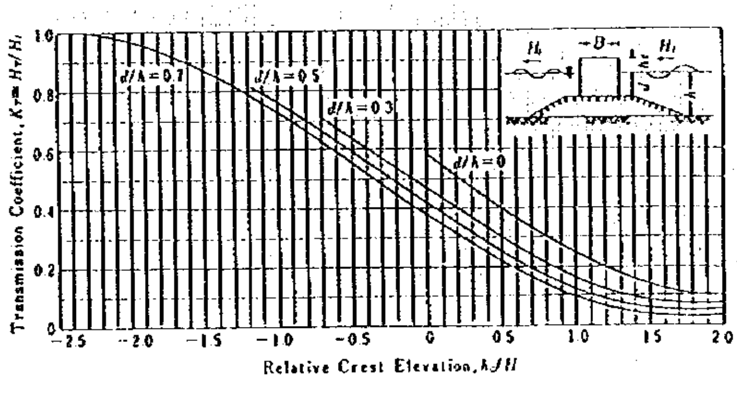


Fig. 2-3-2　Wave transmission coefficient for a vertical breakwater (Goda, 1969)
(From Goda :　Random sea and design of maritime structure 1985)

(3) Direction for Measures for Reducing Wave Splash

1) Improvement of the North Wharf to a Wave Breaking Structure

The land in the rear of this wharf is currently used as a parking area and bus terminal for vehicles entering and leaving the fisheries complex and market. Therefore, a structure which entails minimum protrusion to the rear should be adopted. Accordingly, as was mentioned earlier, it is appropriate to adopt upright rather than sloping wave absorber. Regarding the effective width of the wave absorber, the effective width (Be) shall be set at 6 m, bearing in mind that at least 6 m is required as mentioned in 2-2-3 (4).

For this reason, the existing north wharf with a width of 2 m shall be reformed into a pier type using steel pipe piles; moreover, wave absorber with an effective width 6 m shall be constructed and the retaining sheet piles shall be put in place at the land side. The crest of this pier shall be higher so that normal waves can easily pass underneath. A parapet shall be attached on the crown of the retaining sheet piles.

2) Narrowing the entrance by extension of the north breakwater

According to the Basic Design Study Report on the Coastal Fisheries Development Project in Dominica (October 1993), fishing boats planed are as follows:

Large fishing boats	Total length:	14.0 m
	Width:	4.5 m
	Draft:	1.8 m

Provided that boats do not pass each other in a port mouth, width of the port mouth is usually set as at least a half of boat length or about three times of boat breadth. In Case 5, adopted as the appropriate measure in the previous section 2-2, the port mouth width is 10m. This satisfies the above criteria in terms of boat length, but not in terms of boat width. However, since the mooring area is used only when sea condition is tranquil, the port mouth width can be set at 10m as indicated in Case 5.

(4) Direction for Re-arrangement of Area behind the North Wharf

In order to implement the aforementioned wave absorbing structural improvement to the north wharf, the retaining sheet pile must be moved about 7 m backward in the land area. Since an sewage pipe (PVC, 100 mm in diameter) and emergency discharge pipe (PVC, 100 mm in diameter) are installed underground in this area, they need to be re-arranged.

Moreover, since the said improvement of the north wharf will reduce the existing parking area, a parking area shall be newly prepared in order to compensate the reduction.

(5) Direction for Partial Raising of Existing Submerged Groin

The existing submerged groin is buried up to almost top of its concrete blocks with sand/gravel, transported by the Roseau River. Sand/gravel, therefore, are flowed over the submerged groin when water flow of the river increases, and accumulate around the tip of the north breakwater.
At present, the deposit of sand/gravel has not hindered fishing boats passing the mouth of the mooring area. However, by reduction of the mouth width for improvement of the tranquillity of the mooring area, there would be a possibility that the deposit becomes obstruction in future.
Therefore, in order to reduce sand/gravel flowing over the submerged groin, steel sheet piles shall be driven along the groin (river side of its concrete blocks) in about 15m long from the north breakwater. Height of the sheet piles will be CDL±0m.

In order to check the influence of the partial raising of the submerged groin on the calmness of the basin, the calculation of wave height distribution in the mooring area was conducted for Case 5 with the present submerged groin and for Case 5 with the submerged groin which is raised up to CDL±0m in crown height at the part of 5m long near to the north breakwater. The wave direction is set SW. The reflection coefficient of submerged groin was taken as 0.6 for the raised part and 0.4 for the other part.

The results are shown in Figures 2-3-3 and 2-3-4.
The wave height ratio against the offshore wave height is slightly higher in the case with partially raised groin than in the case of the present groin around the intersection area of the submerged groin and north breakwater, but the calmness in the mooring area is almost the same in the both cases.

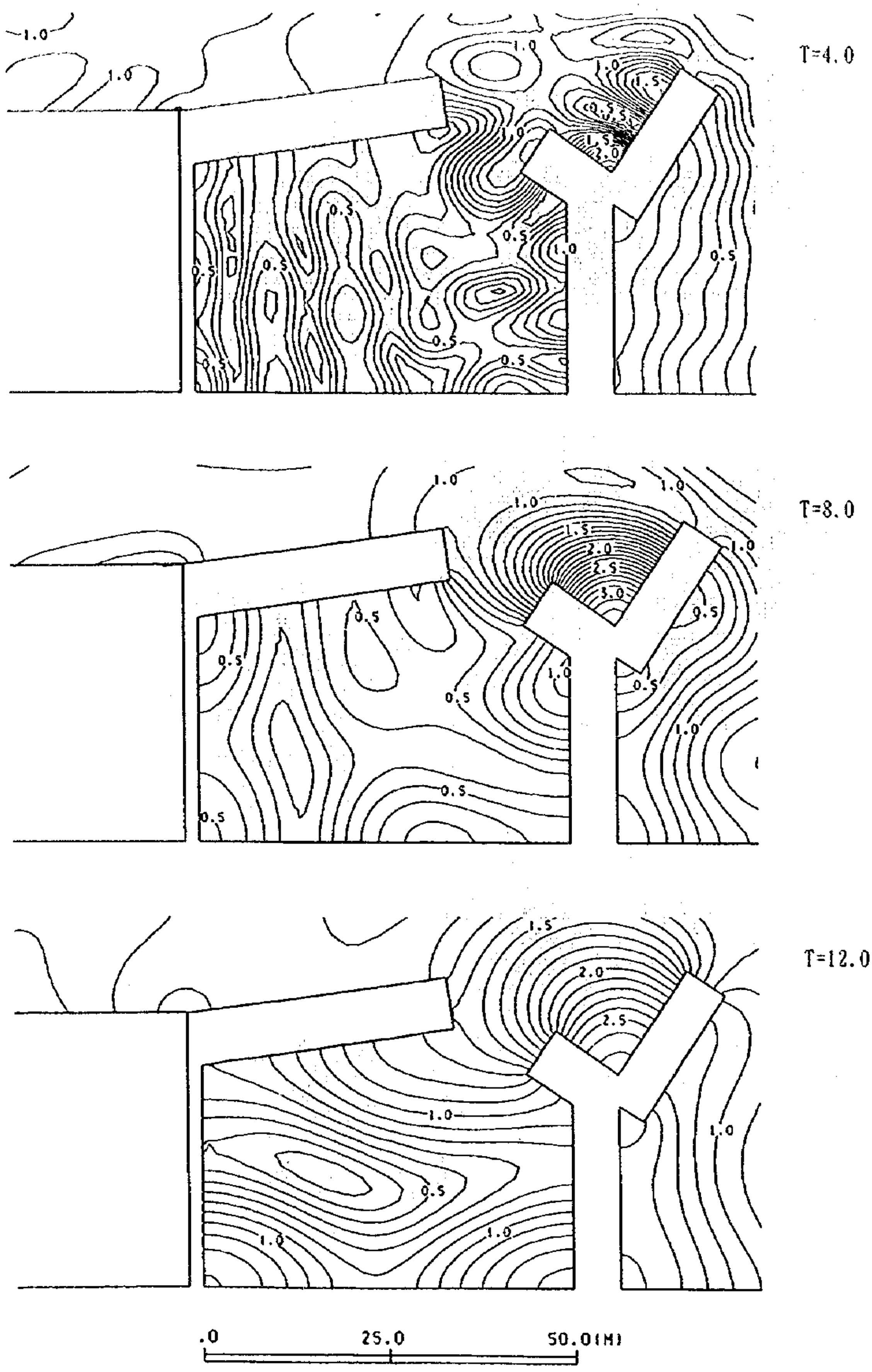


Fig. 2-3-3 Wave height ratio distribution for Case 5 with the present submerged groin (Wave direction = SW)

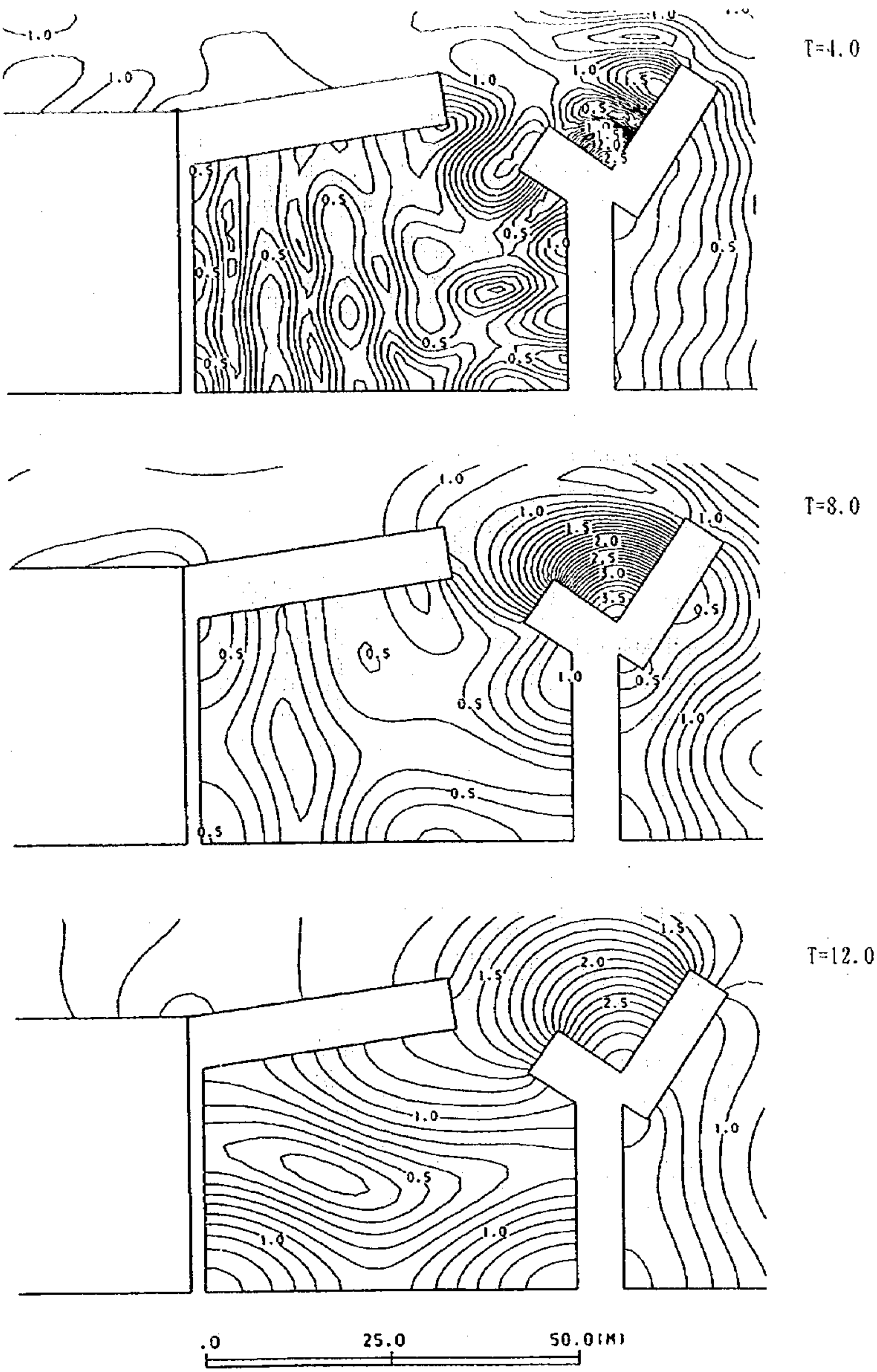


Fig. 2-3-4 Wave height ratio distribution for Case 5
with the partially raised submerged breakwater (Wave direction = SW)

(6) Direction regarding Construction Conditions

Design of the Project facilities shall basically be carried out based on Japanese technical standards and in compliance with British and American construction-related legislation and standards and the CUBIC CODE stipulated by Caribbean nations (Caribbean Unified Construction Standard). Concerning environmental criteria, Japanese criteria shall be applied.

With respect to construction materials, sufficiently durable items shall be selected and locally procurable materials (including imports) shall be utilized as much as possible. Other materials shall be imported from Japan, the United States and other nearby countries.

(7) Direction regarding Utilization of Local Contractors and Equipment/ Materials

The Project work can basically be handled by local contractors. However, concerning special works such as placement of sheet pile and underwater work, etc., consideration shall be given to employing foreign technicians. Moreover, as for the sheet pile driving machines and other special construction machinery, these shall be procured from nearby countries including the United States.

(8) Direction regarding Operation and Maintenance Capacity of the Implementing Agency

It appears that operation and maintenance of the port facilities (including dredging of the mooring area) will be carried out as necessary with cooperation provided by the Ministry of Works.

(9) Direction regarding Setting of the Scope and Grade, etc. of Facilities, Equipment and Materials

Mooring area facilities shall be improved with a view to eliminating wave splash inside the mooring area at normal times, except for splash caused by rough weather, hurricanes and by long period waves. Moreover, the improved facilities shall be given structures that have sufficient resistance against hurricane waves.

(10) Direction regarding Work Period

The construction shall be finished within the period for implementation of Japan's grant aid. The work shall be carried out firmly with sufficient preparation of necessary equipment and material in advance and measures to minimize influence of hurricanes.

(11) Designing Criteria of Structures

1) Design Standards

Since Dominica does not possess its own technical standards, international technical standards are applied. In Dominica, BS and ASTM standards are generally applied to concrete material and steel. In this plan, the following standards, which either meet or exceed the aforementioned standards, are applied.

Port Structures Standard Design Method:	Japan Fishing Port Association
Road Paving Manual:	Japan Road Association
Soil Testing Methods:	Japan Society of Soil Mechanics and Foundation Engineering
Concrete Standard Specifications:	Japan Society of Civil Engineers
Japan Industrial Standards (JIS):	Japanese Standards Association
British Standard (BS)	
American Society for Testing and Materials (ASTM)	

2) Design Loads

Of the design loads, the dead loads of materials have been determined in the manner shown in Table 2-3-3 based on the Actualization Examination Report on the Coastal Fisheries Development Plan of Dominica (March 1996).

Table 2-3-3 Material Loads

	Type	Density (ton/m^3)		Internal Angle of Friction	Remarks
		In Air	In Water		
Load	Seabed sediment (after dredging and compacting)	1.90	1.00	35°	In case of sand only 1.6/0.85ton/m^3
	Reclaiming sediment (filling sand)	1.80	1.00	35°	
	Back filling sediment (maximum 70mm)	2.10 (1.80)	1.24 (1.00)	35°	
	Stones	2.80			
	Plain concrete	2.30			
	Reinforced concrete	2.45			
Live load		1 ton/m^2 (pier, wharf)			

2-3-2 Basic Design

(1) Overall Plan

The scope of this improvement project is indicated in the plane view shown in Figure 2-3-5.

1) Extension of the North Breakwater

The north breakwater shall be extended toward the tip of the west breakwater. Regarding the distance between the tips of both breakwaters, the port mouth width of 10 m shall be secured between the fenders that are placed on the crown concrete of each breakwater. The extended breakwater shall be double steel sheet pile structure with crown height of CDL +1.5 m (same as the existing breakwater structure). The tips of the extended portion and the existing west breakwater shall be furnished with fenders. A parapet shall not be constructed on the extended portion, same as the existing west breakwater.

2) Re-construction of the North Wharf to Wave Absorbing Structure

The existing north wharf shall be removed and, in its place, a steel pipe pile pier with crown height CDL +2.0 m and width 2 m shall be constructed at the side of the mooring area in the same position as the existing structure. At the position of approximately 7 m back from the central line of the front steel pipe piles, a steel sheet pile-type revetment of crest height CDL +2.5 m shall be constructed. A parapet of 0.75 m in height shall be placed on the crown of this revetment, and a penetrable fence of 1.8 m in height shall be placed on the parapet.

In the area between the steel pipe piles on the mooring area side and the steel sheet pile revetment, wave absorber shall be formed by filling with artificial deformed concrete blocks on the rubble mound foundation. Since it is difficult to place artificial concrete blocks up to the HWL in the area of 2 m in width underneath the pier, it is thought that the effective width for wave absorber in this part is reduced by half to 1 m. By adding 5 m of the remaining width of the wave absorber, the total effective width of the wave absorber becomes 6 m, which is consistent with the design direction described in 2-3-1.

The interval between steel pipe piles on the mooring area side shall be set so that the artificial concrete blocks are not able to become extricated in the direction of the mooring area. Moreover, to ensure that normal waves are able to easily pass beneath the pier, hanging concrete shall not be placed at the front of the pier. In order to prevent bending of the steel pipe piles caused by means of collision and abrasion by the artificial concrete blocks, the piles shall be given sufficient thickness and concrete shall be filled in the part above the foundation ground height.

With this re-construction, the crown height of the new north wharf shall be 0.5m higher than the existing one and front concrete curtain shall not be provided for the wharf. Therefore, when the fishermen use this north wharf, more attention and care will be required for safety work.

3) Re-arrangement of Land Behind the North Wharf

Two existing lighting poles and an emergency discharge pipe line (PVC, 100 mm diameter) shall be transferred to the land side of the above-mentioned steel sheet pile-type revetment, and a sewage pipe line (PVC, 100 mm diameter) shall be temporarily moved behind the revetment during ground improvement works and returned to its original position after the completion of works.

In order to compensate the reduction of the parking area, caused by the wave breaking structural improvement of the north wharf, the following measures shall be taken:

A. Make the width of the footpath alongside the revetment as 1.0 m.

B. Remove the existing central dividing strip.

C. Pave a part of the grass area seaward from the existing power transformer and reclaim about 5m wide and 20m long from the end of the grass area along the Roseau River for additional parking area. The retaining wall of the additional parking area shall be constructed with steel sheet piles and concrete. The sheet piles extracted form the existing north wharf shall be utilized for this work

Taking these measures, the total area for parking will become same as the present status and it will be possible to keep the present parking capacity or increase some more, as follows;

Comparison of Bus Terminal Area

	Parking	Pavement/strip	
Total			
Present status :	660 m²	298 m²	958 m²
Remodeling :			
Decrease by Improved Mooring Area	(-) 196 m²	(-) 50 m²	
By removal of the divider strip	(+) 84 m²	(-) 84 m²	
Rearrange a part of the green area	(+) 12 m²	-	
Newly reclaimed area	(+) 100 m²		
Total	0 m²	(-) 134 m²	
Area after the Re-arrangement :	660 m²	164 m²	824 m²

Comparison of Parking Capacity

Present status :

Park Style = Train style along the pavement of north wharf and divider strip

Parking Capacity = Mini Bus (length 4.5m x width 2m)

Beside the pavement of north wharf	7
Beside the divider strip	6
Total	13

After R-arrangement :

Parking Style = Aslant style (See Fig.2-3-10)

Parking Capacity = Mini Bus (length 4.5m x width 2m)

Beside the pavement of north wharf	13
Newly reclaimed area	5
Total	18

4) Partial Raising of Existing Submerged Groin

By driving steel sheet piles, a sheet pile wall shall be made in about 15m long from the side wall of the north breakwater, along the concrete block line (rive side) of the existing submerged groin. Height of the sheet piles shall be CDL±0m, except the end (about 1m) of the sheet pile wall, which is CDL-0.25m. Thus, the raising part with height CDL±0m will be 5m long when the submerged groin is seen from the sea side. The sheet piles extracted form the existing north wharf shall be utilized for this work.

(2) Basic Design Drawings

1) Plane View of the North Breakwater and North Wharf Improvements

Figure 2-3-6 shows the plane view of the extended portion of the north breakwater and improvement of the north wharf. In order to avoid up-pressure of waves, FRP grating shall be placed on the crown of the north wharf pier.

2) Improvement Structure of the North Wharf

Figure 2-3-7 shows front and section views of the improvement to north wharf.

3) Structure of the North Breakwater Extension

Figure 2-3-8 shows section views of the north breakwater extension, while Figure 1-3-5 shows the front view of the tip of the north breakwater.

4) Remodeling of the Parking Area Behind the North Wharf

Figure 2-3-10 shows a direction view of small vehicles parked in the parking area following restructuring of the north wharf.

5) Partial Raising of Submerged Groin

Figure 2-3-12 shows a plane view and a section view of the partial raising of the submerged groin.

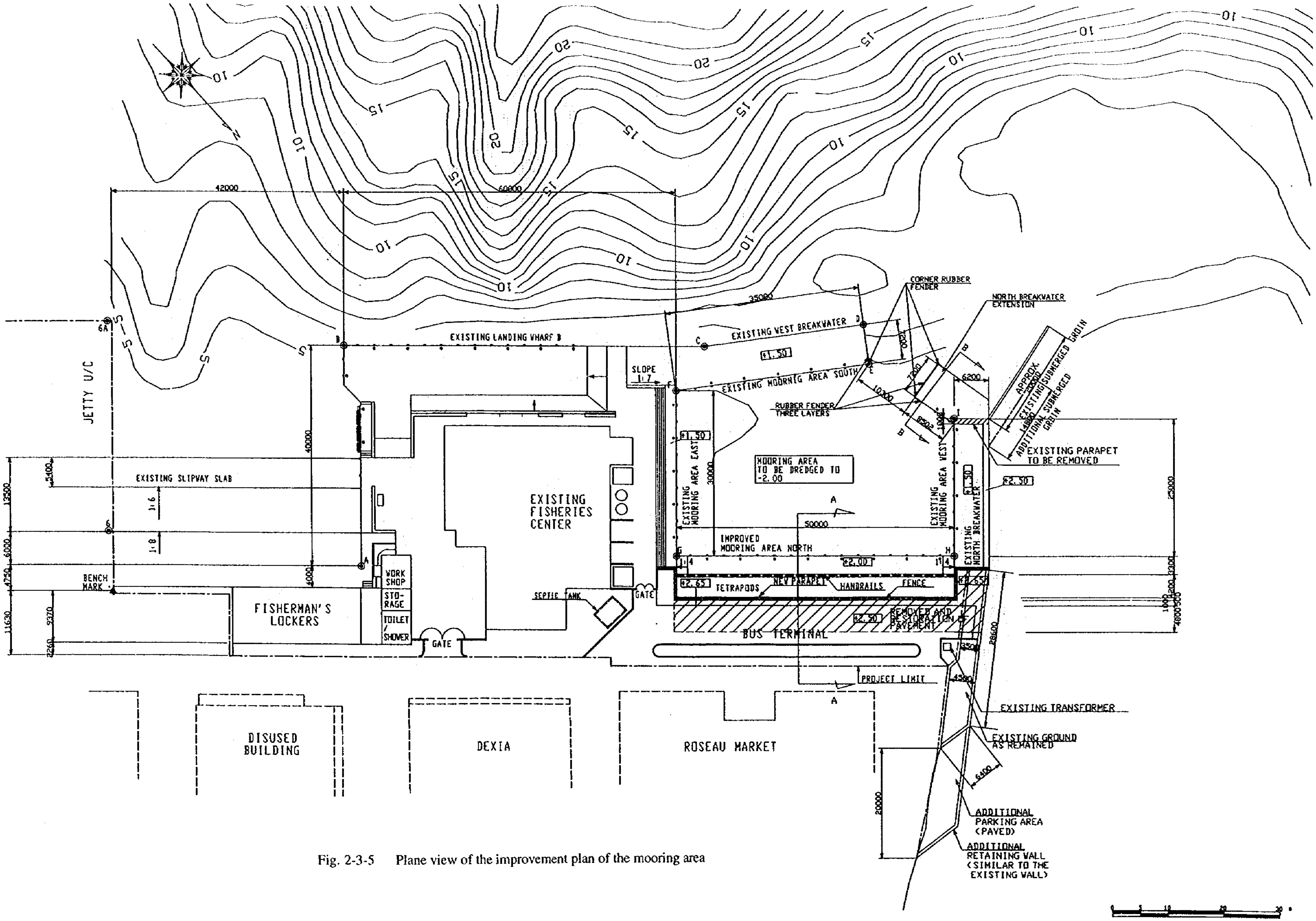


Fig. 2-3-5 Plane view of the improvement plan of the mooring area

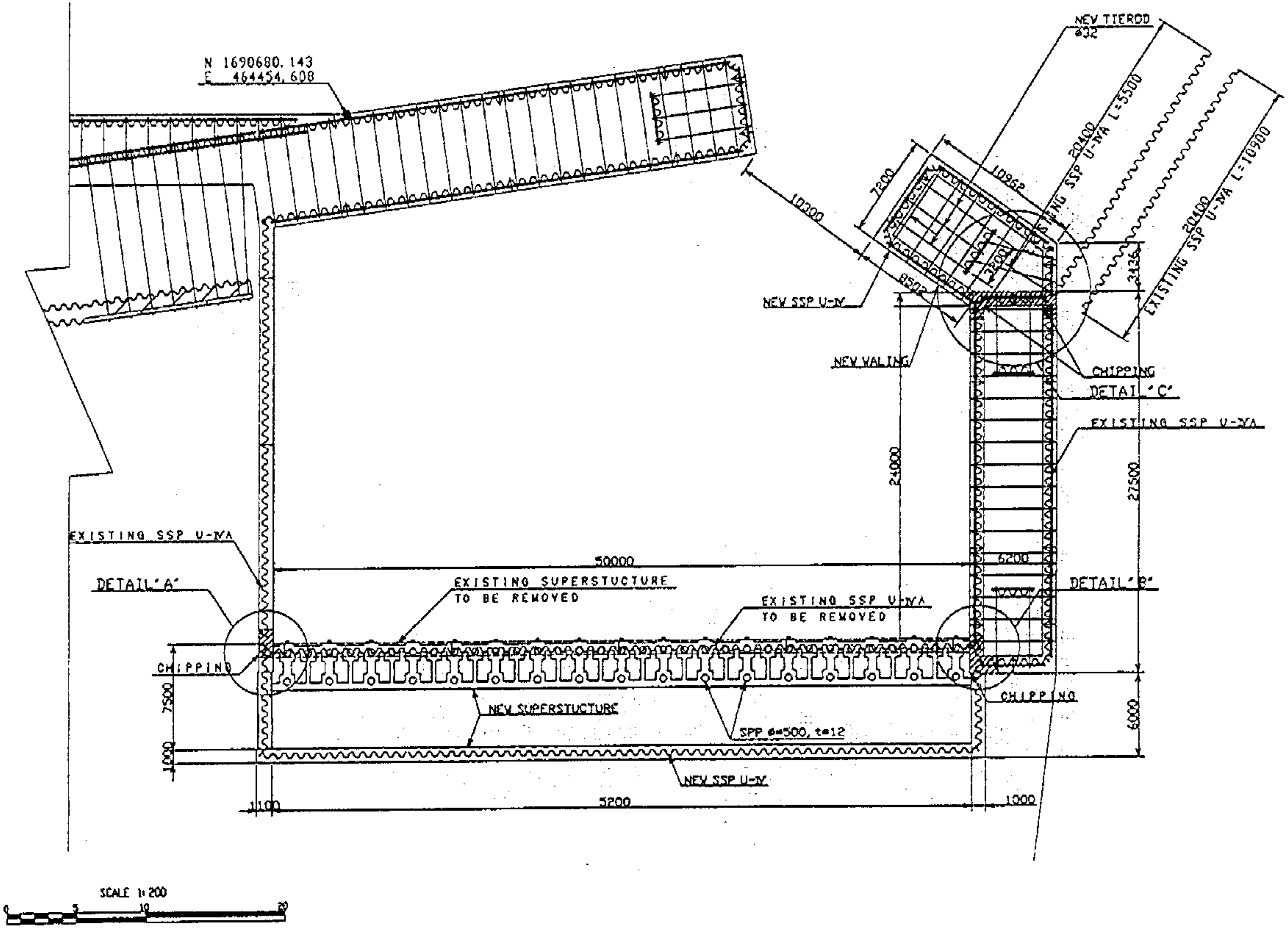


Fig. 2-3-6 Plane view of the extension of North Breakwater
and the improvement of North Wharf with wave absorber

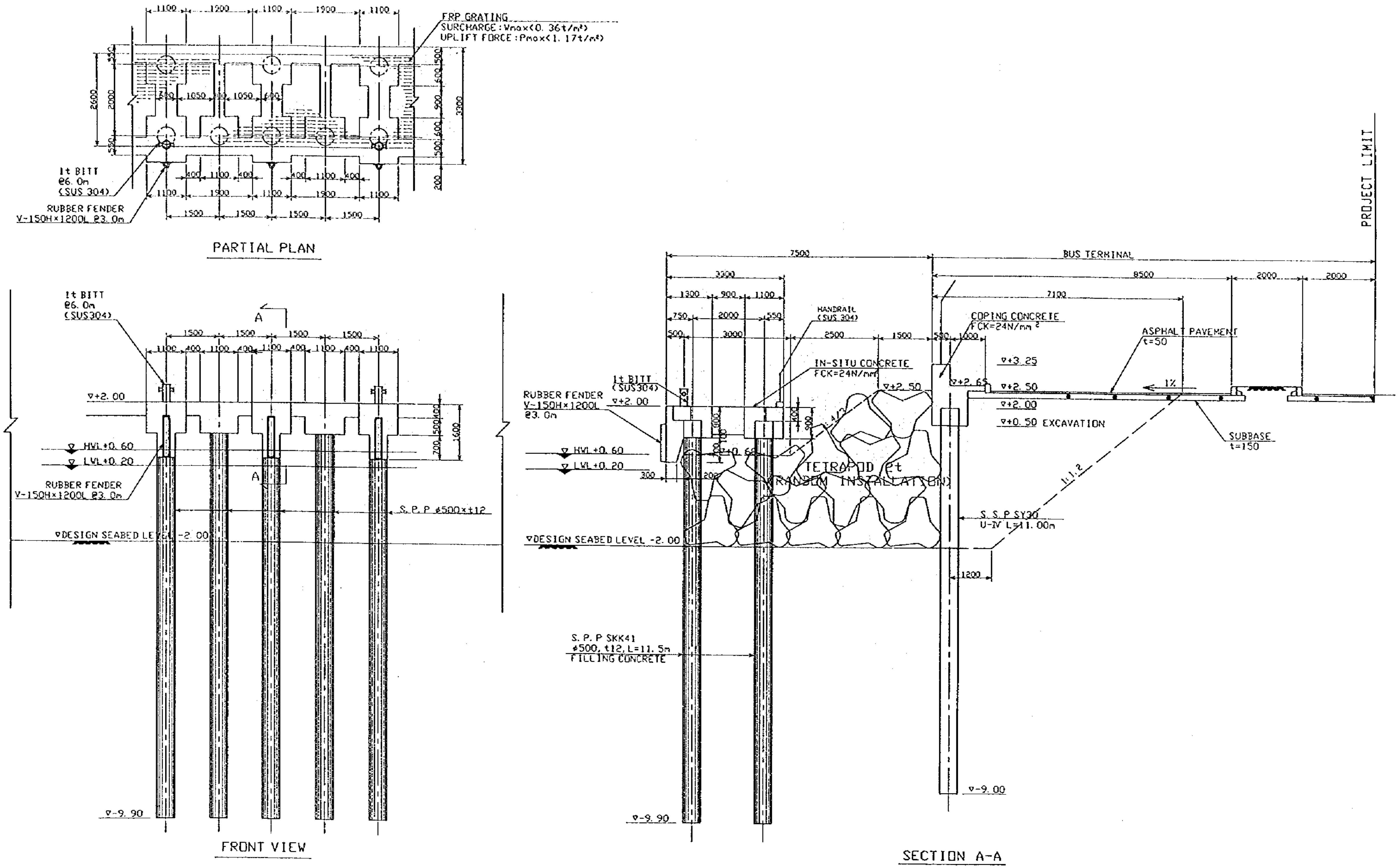


Fig. 2-3-7 Front, Section and Plane views of the improvement of North Wharf

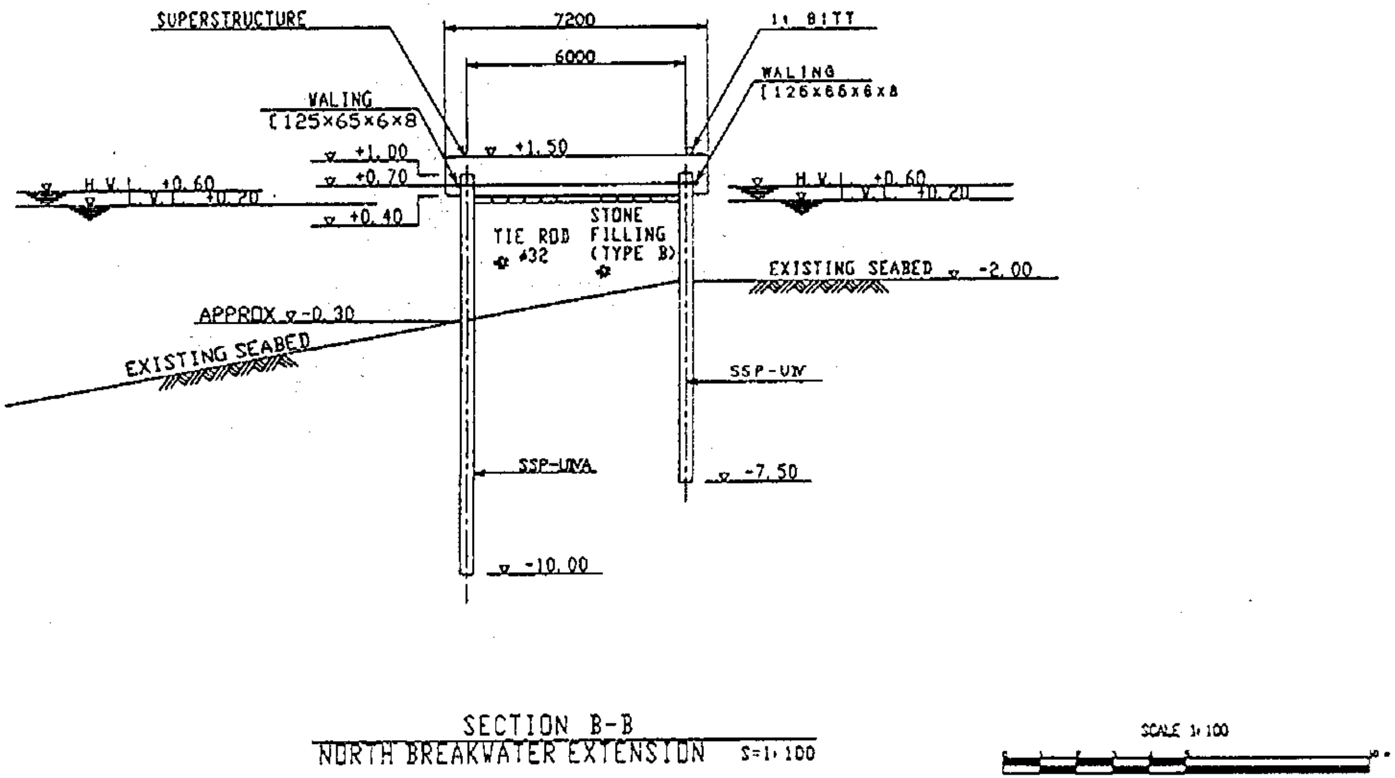


Fig. 2-3-8 Section view of the extension of North Breakwater

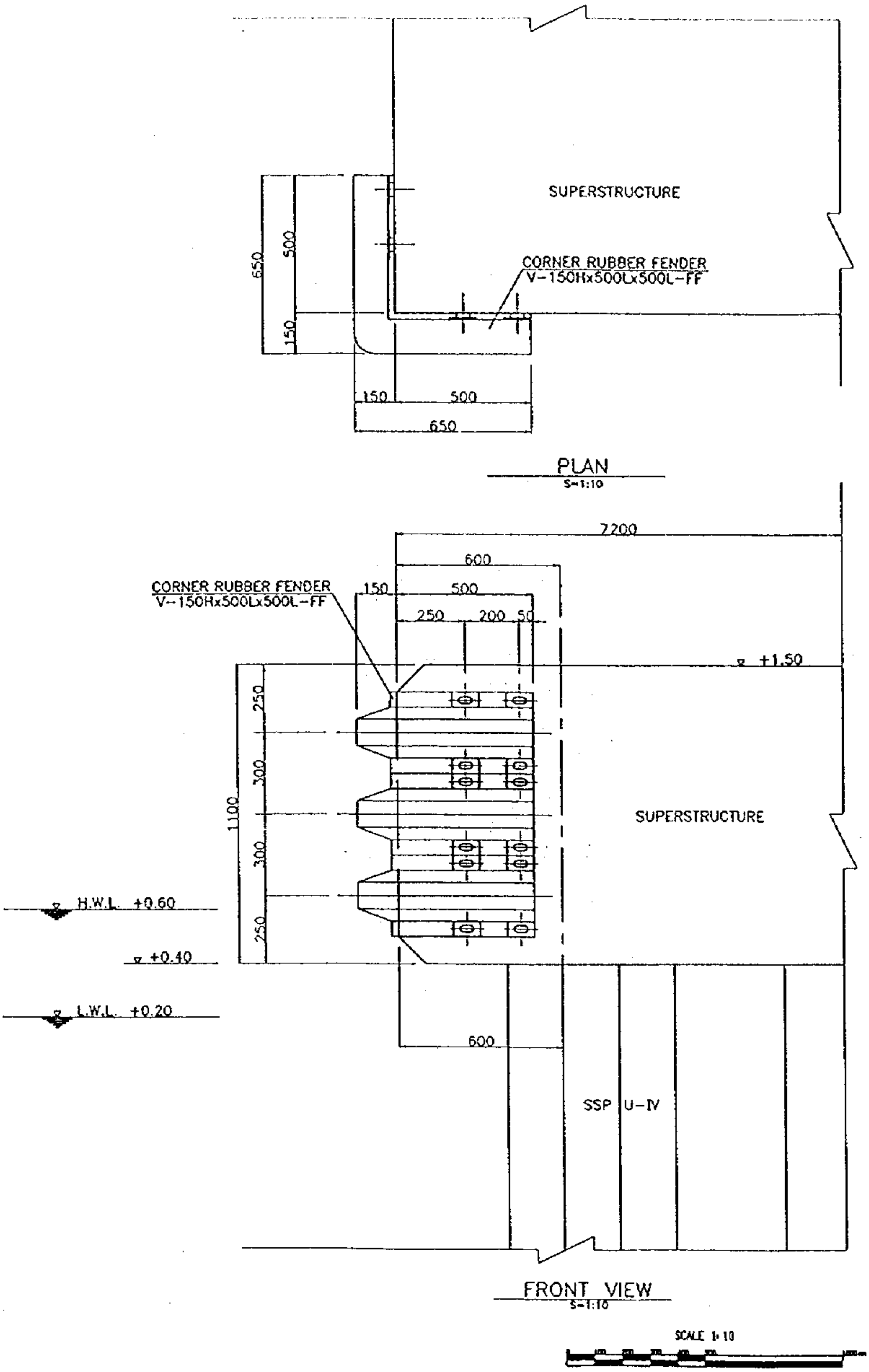


Fig. 2-3-9 Plane and Front views of the tip of North Breakwater

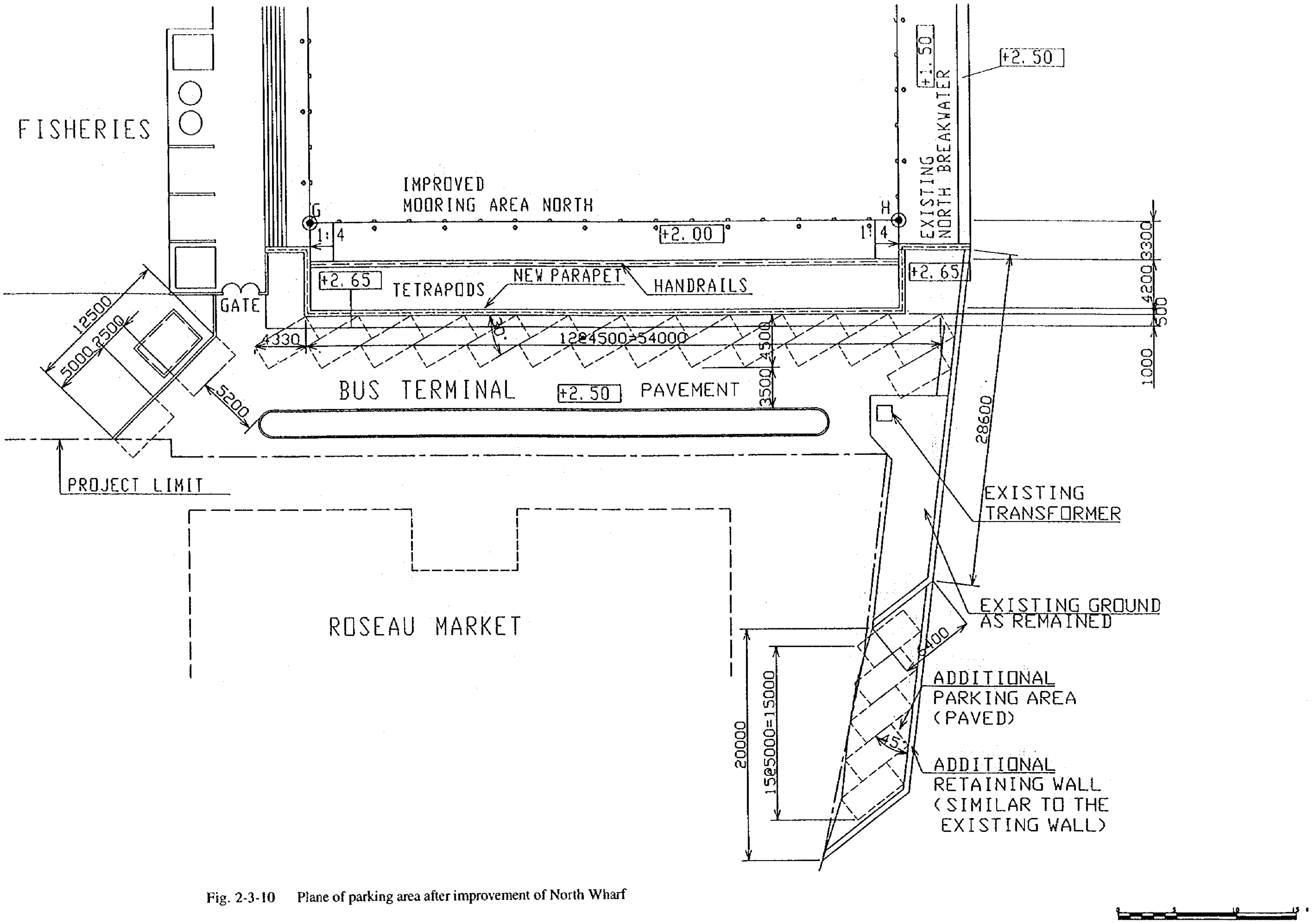


Fig. 2-3-10 Plane of parking area after improvement of North Wharf

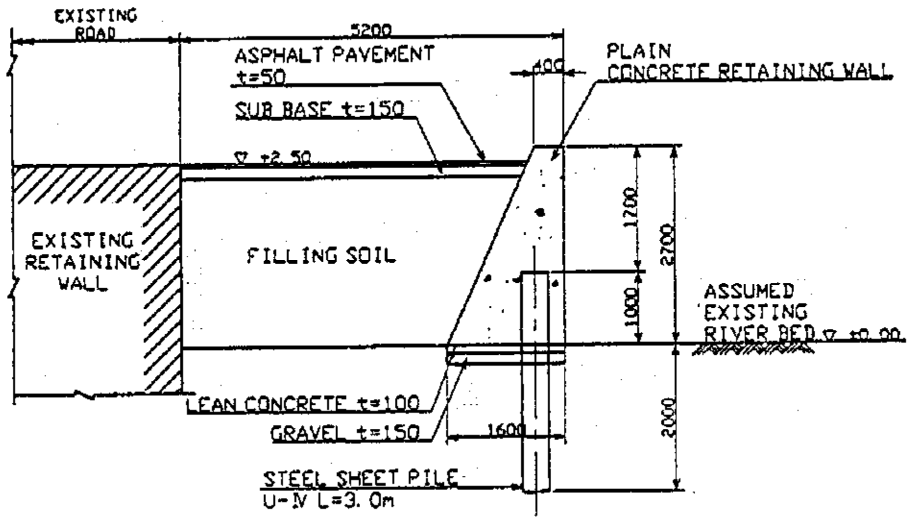


Fig. 2-3-11 Section view of Retaining wall for new parking area

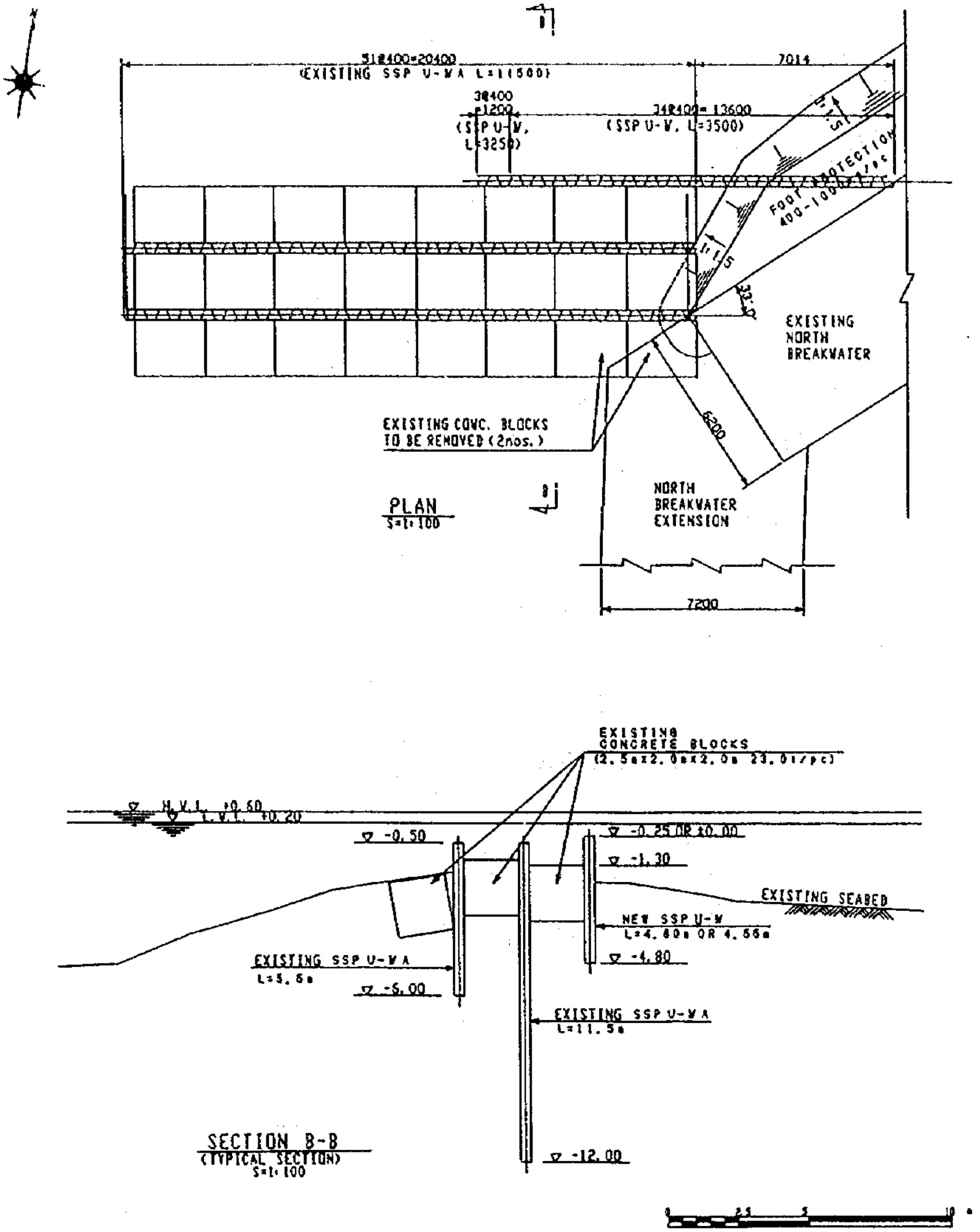


Fig. 2-3-12 Partial raise of Submerged groin

CHAPTER 3

IMPLEMENTATION PLAN

CHAPTER 3 IMPLEMENTATION PLAN

3-1 Implementation Plan

3-1-1 Implementation Concept

(1) Basic Direction

The Project improvement works shall be implemented in accordance with the following basic policies.

1) Local manpower and local equipment and materials shall be utilized as much as possible, however, concerning areas of marine civil engineering that require expert technology and experience, since there are no local contractors or engineers that possess such technology and experience in Dominica, procurement from nearby countries shall also be considered.

2) Attention shall be paid to protecting the surrounding environment and preventing disruption of traffic and market activities around the construction site.

3) Close communications shall be maintained with the Dominica side to ensure smooth implementation of the Project.

4) Care shall be taken to ensure that operation of the other facilities of Roseau Fisheries Complex (center building, workshop, fishermen's lockers, slipway) is not hindered during the construction period.

5) Considering the construction site is limited due to the close proximity of the road and central market, efficient construction methods shall be adopted so as to conduct the work smoothly.

6) Culture and traditions of Dominica shall be respected.

(2) Components of Work

The Project work shall consist of the following components.

1) Securing of the Project site

2) Work for the wave absorbing structural improvement of the north wharf.

3) North breakwater extension work

4) Re-arrangement of the bus terminal area and incidental works entailed by the wave breaking structural improvement of the north wharf.

5) Partial raising of the existing submerged groin with steel sheet piles

6) Provision of services for implementation and supervision of the above works

7) Procedural work necessary for implementation of the Project

3-1-2 Implementation Conditions

The construction site is cramped and adjoined by the central market and roads. To ensure that traffic and market activities are not hindered and secure safety for people and vehicles around the Project site, the construction area shall be fenced off and safety measures shall be taken for transportation of construction material. Consideration shall be given to secure water, power supply and sewerage for the other facilities in Roseau Fisheries Complex (the center building, workshop, fishermen's lockers, slipway) to maintain their operation as much as practicable.

Efforts shall be made to obtain hurricane information in advance, and measures shall be taken to protect the facilities as much as possible during and after the works. Consideration shall also be given to the construction methods to minimize effect of hurricanes.

3-1-3 Scope of Work

The scope of works to be borne by both countries in implementation of the Project is as follows.

<Work to be borne by the Dominica side>

1) To secure the construction site and surrounding area.

2) To regulate and control traffic around the Roseau market and the Project site during the construction period for safety traffic and smooth execution of the construction work.

3) To provide temporary construction yards and quarries for obtaining stones and earth and their disposing.

<Work to be Borne by the Japan side>

1) Procurement of all equipment, materials and manpower required in the Project improvement work

2) Marine and land transportation of equipment and materials necessary for the Project improvement works and insurance for their transportation to the Project site.

3) Assistance and consultant supervision of the detailed design and tender

3-1-4 Consultant Supervision

Following conclusion of the contract for consulting service with the government of Dominica, the consultant shall conduct a site survey and hold consultations with the government for preparation of the detailed drawings, tender documents with specifications of the works, etc. in Japan and prepare the tender to select contractors in accordance with the implementation procedure stipulated under the Grant Aid Scheme.

Following conclusion of the contract for construction, the consultant shall check the shop drawings prepared by the contractor, supervise the construction work.

The consultant shall dispatch a supervisory engineer to Dominica during the construction to provide guidance to and supervise the contractor, ensuring that the works are executed on time and in accordance with the specifications given in the tender documents. The consultant shall also conduct inspections of the works and attend quality control testing, witness progress inspections and prepare the consultant supervision report.

3-1-5 Procurement Plan

The construction equipment and materials required for the Project improvement works, and their procurement sources, are as indicated below.

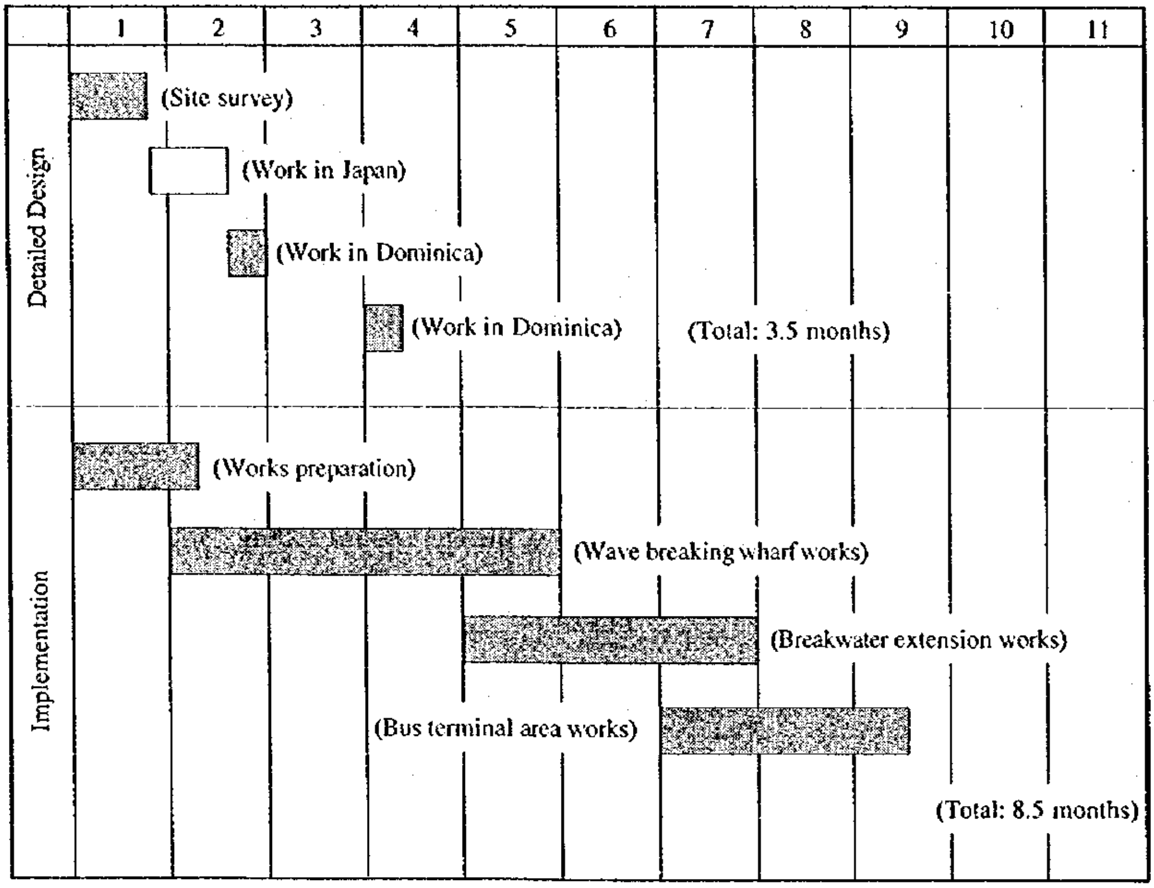
Local procurement: Sand, stone, reinforcing steel, cement, wood, general construction machinery, etc.

Procurement from Japan or third countries : Steel frame, steel piles, steel sheet pile, underwater concrete, fenders, steel molds, special construction machinery (steel pipe pile and sheet pile driving machines, etc.)

3-1-6 Implementation Schedule

It is scheduled for the Project detailed design to last 3.5 months and the work period to last 8.5 months. The implementation schedule is shown in Table 3-1-6.

Table 3-1-6 Work Implementation Schedule



3-1-7 Measures to be taken by Dominica side

The following necessary measures should be taken by the Government of the Commonwealth of Dominica on condition that the Grant Aid by the Government of Japan is extended to the Project.

1) to secure a lot of land necessary for the Project;

2) to clear and level the site for the Project prior to the commencement of the construction;

3) to provide a proper access road to the site;

4) to provide facilities for distribution of electricity, water supply, telephone trunk line, drainage and other incidental facilities outside the site;

5) to undertake incidental outdoor works, such as gardening, fencing, exterior lightning, and other incidental facilities in and around the site, if necessary;

6) to ensure prompt unloading and customs clearance of the products purchased under the Japan's Grant Aid at ports of disembarkation in the Commonwealth of Dominica;

7) to exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the Commonwealth of Dominica with respect to the supply of the products and services under the verified contracts;

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

9) to bear commissions, namely advising commissions of the Authorization to Pay (A/P) and payment commissions, to the Japanese bank for its banking services based upon the Banking Arrangement (B/A);

10) to provide necessary permissions, licenses and other authorization for implementing the Project, if necessary;

11) to ensure that the facilities constructed and equipment purchased under the Japan's Grant Aid be maintained and used properly and effectively for the Project; and

12) to bear all the expenses, other than those covered by the Japan's Grant Aid, necessary for the Project.

3-2 Operation and Maintenance Plan

It is forecast that sand/gravel will accumulate around the port mouth and in the mooring area, though it would be mitigated by extension of the north breakwater and narrowing of the port mouth. It is, therefore, necessary for the Fisheries Development Division to carry out maintenance dredging with cooperation from the Ministry of Communications, Works and Housing.

CHAPTER 4

PROJECT EVALUATION AND RECOMMENDATIONS

CHAPTER 4 PROJECT EVALUATION AND RECOMMENDATIONS

4-1 Project Effect

The request made by the Dominica side is to reduce the water turbulence in the mooring area in usual days, excepting rough weather days, by rehabilitation of the mooring area, without reducing its area. Faced with sever topographical conditions surrounding the mooring area and a number of restraints such as not to change the size of the mooring area and to avoid modification of other facilities as much as practicable, the rehabilitation plan described in the previous chapter was prepared as the feasible measure practically available.

With this rehabilitation, it is expected that the wave splashes can be mostly eliminated in usual days except rough days and the days having waves with long periods over 12 seconds. In specific terms, as the results of simulation of water surface turbulence in the mooring area, it is anticipated that rate of significant waves less than 30 cm high in the mooring area will be increased from about 50% at present to around 90% by the rehabilitation work. With the extension of the north breakwater, there could be an advantage in reducing river sediment flowing into the mooring area.

For promotion of the fisheries sector under the development policies for diversifying the primary industry, Roseau Fisheries Complex has important roles as a core facility for contributing to priority issues of enhancing fish landing, marketing and supporting fishing activities. Implementation of the project will improve the level of tranquillity of the mooring area and make it easier to unload fish and prepare for fishing. With this effect, it is anticipated that the Project will contribute to operations at Roseau Fisheries Complex, and promotion of fisheries in Dominica.

Implementation of the Project under the Grant Aid Scheme of Japan is also considered to be appropriate when viewed from the following viewpoints.

(1) The direct beneficiaries of Roseau Fisheries Complex, including the mooring area, are the fishermen and people working in fisheries. The Project benefit is not only limited to people living close by to the Complex, but all fishermen in Dominica will benefit through operations of the Complex such as collecting and marketing fish from regional fishing villages

(2) Roseau Fisheries Complex is not a profit-making facility, but a public service facility, since it is utilized by fishermen, fish-venders and consumers in general.

(3) The Project facilities will not make any impacts or affects on the surrounding natural and social environment.

4-2 Recommendation

By reducing water turbulence and eliminating wave splash inside the mooring area, implementation of the Project will make it easier to utilize the mooring area and result in the aforementioned effects. In order to realize the effects, it is necessary for consideration to be given to the following points in addition to the implementing the Project.

(1) Risk Prevention During Rough Weather

It is impossible to deal with the effects of hurricane or rough weather conditions and waves of long period. It is necessary to take steps to avoid danger in such conditions by suspending use of the mooring area, evacuating fishing boats to other places and so on.

(2) Necessity of Maintenance Dredging

It is forecast that gravel will enter and accumulate around the port mouth and in the mooring area. Although this will be mitigated somewhat by extension of the north breakwater and narrowing of the port mouth, it will still be necessary for the Fisheries Development Department to conduct maintenance dredging around the port mouth with assistance of the Ministry of Communications, Works and Housing.

(3) Necessity of Maintenance Management

Even though tranquillity inside the mooring area will be improved and normally occurring wave splash will be almostly eliminated in usual days, this does not mean that maintenance and repair of facilities and equipment at the Complex will be no longer necessary. Since the Complex facilities are in sea wind, it is essential that the building facilities and equipment such as bits on wharves and pumps, the incinerator, fish-waste disposal unit and pipes/cable-supports, etc. be maintained with necessary measures such as rust removal and painting etc.