9) Plants

All mechanical equipments such as the freezer machinery, the ice making machine and the water reservoir will be installed after the buildings have been completely finished. As the machinery will all be imported from Japan, they will be assembled with a crane and workers under the supervision of a Japanese expert.

10) Utilities

Utilities such as gates, lighting, shelves, sewage pipes, and waste water disposal systems will be constructed according to local methods and based on the specifications in the technical specification book.

(2) Construction Materials, Machinery and Labour

1) Construction Materials

The main construction materials will be filling sand, concrete forming materials, quarried rock, cement and steel reinforcing. All building materials apart from the angling materials and steel plate will be procured from within Ecuador.

The imported materials will first arrive at Guayaquil and will then be taken to the various sites around the country. Most of the imported materials that the local companies deal with come from places such as America, Japan, Brazil, Italy, Germany and Chile. Items such as gasoline, diesel and kerosene are sold by a state run petro-chemicals company. The prices for the various petro-chemicals are standard all over the country. The gabions for holding the rocks can be procured in Guayas.

Table 4-6-1 shows the estimated basic construction material volumes and the various places of procurement.

Table 4-6-1 Availability of Construction Materials

Item	Materials	Unit	Qantity	to be obtained from
Sand	Sand	cu.m	1,027	Manabi
Stone	Crushed stone	cu.m	1,919	Manabi
&	Cement	ton	884	Guayaquil
Cement	Rocks	cu.m	119,253	Manabi
	Concrete Block	cu.m	248	Manabi
Steel	Steel Bar	ton	101	Guayaquil
	Steel Angles	ton	27	Japan
Other	Fuel	kl	669	Manabi
	Timber	cu.m	63	Manabi
	Fender	no	45	Japan

2) Construction Machinery

The standard construction machinery for use on land will be provided by a local private construction company. Other machinery necessary for construction can be rented as the need arises. However as many of the machines are old and/or have been abused or poorly maintained, it will be necessary to carry out detailed checks of the operating condition of the proposed machinery before any construction can begin. The private construction company has dump trucks, bulldozers, concrete mixers and back hoe machines available for use. Maritime use machinery however such as crane barges, pontoons and pump dredges cannot be procured in Manta.

Manta Port Freight Lifting Machinery:
The Manta Port Authority operates four 10 meter berths which are operated under government supervision. The crane in the port at Manta has a maximum lifting capacity of 30 tons and is available for rent. Chart 4-6-3 shows the types of construction machinery and vehicles available for procurement as well as the various procurement sources.

3) Labour

Manta has an abundant labour source--everything from skilled laborers to unskilled laborers can be found within every district of the city. Bulldozer and dump truck drivers can also be found easily but there is a shortage of divers who can carry out riprap grading operations. Because of this, it will be necessary to bring divers from Japan to make up for the shortage.

4) Quality Control

Quality control of construction material will be necessary at the site to ensure the provision of high quality materials. Testing equipment for quality control is available from the national university in Manta.

5) Social Construction Conditions

The financial year in Ecuador begins in January 1 and ends at the end of December. There are 245 working days in the year. Normal working hours are as indicated below.

Monday to Friday
Starting Time: 8:30
Noon Recess: 12:00-15:00
Finishing time 19:00
Weekend: Saturday and Sunday

6) Construction schedule

The construction schedule is shown in table 4-6-4. It is characteristic of this project that all the works are to be implemented by using the construction machines skillfully. So, the construction machines and construction crafts shall be prepared in advance for the construction. Moreover, it is important to make use of the proper construction machines making sure of the security of the construction works. The schedule of the detailed design followd the feasibility study is also shown in Table 4-6-5.

4.6.3 Cost Estimate of the Project

(1) Conditions of Cost Estimate

1) The exchange rate of foreign currency is assumed as the average value in Jan. 1991.

1 US$ = 130 Yen = 910 S/.

2) The construction costs are divided into the foreign portion (indicated as US$) and the local portion (indicated as S/.)

(Breakdown of foreign portion)
- Imported construction equipments, imported materials etc.
- Machineries
- Imported goods produced in the local markets
- Salary allowances and indirect costs for foreign staff members

(Breakdown of local portion)
- Construction equipments and machineries produced locally
- Construction materials and goods produced locally
- Salary allowances and indirect costs for local labor
- Taxes

3) The unit price of each item of the construction work consists of the cost of labor, materials and charges.

4) Major materials are cement, timber, stone for the structures,aggregate for concrete, sand for fill, etc.

5) Taxes on the imported materials and machineries are excluded from the cost estimate.

6) The cost of land acquisition is negligible because the location of the proposed fishing port is within the Manta port area.

7) Miscellaneous expenses are as follows.

Miscellaneous expenses

Facility	Expense rate
1. Fishing port facilities	
1) Landing wharf, revetments	24%
2) Dredging, reclamation	22%
3) Road	20%
2. Buildings	40%
3. Navigation aids	15%

8) Contingency fee corresponds to the 10% of the amount of direct construction cost and engineering fee. This rate is except the market price inflation of the materials and considers the physical error.

9) Engineering fee is estimated 10% of direct construction cost including the design cost and the construction supervising cost. Engineering fee also includes the training fee for Ecuadorian officials concerned to learn the fishing port technology.

10) When the construction are conducted using foreign machineries, economical construction cost affected by the transportation cost. So, it is preferable to check the cost estimate at the implementation stage.

(2) Estimated Construction Cost

The construction cost of the fishing port for the short term development plan is estimated 18,164 thousand US$. (Table 4-6-6) The implementation schedule is shown in Table 4-6-7.

4.7 Administration and Operation of Fishing Port Facilities

There are two broad standpoints from which the administration and operation of a fishing port should be considered comprehensively.

The first standpoint concerns the management of fishery resources as the condition for ensuring sustained growth of the fishing port planned and the other standpoint pertains to the administration and operation of the fishing port facilities themselves.

Fishery resources management refers to optimum control of the type, size and number of fishing boats operating in fishing grounds, method of fishing and other related matters associated with the protection of the resources. In addition, the resources management deals with the control and operation of programs for breeding or increased production of fishes and shellfishes, such as seeding or stocking sea areas with fries.

The administration and operation of the fishing port facilities refer to the functions intended to bring the port facilities into full play in line with the planning concept.

This chapter discusses the administration and operation of the fishing port facilities planned under this project.

Generally, a fishing port consists of the basic facilities and ancillary facilities. The former includes breakwater, anchorage, landing quay, outfitting quay, rest jetty, slipways for craft, handling facilities, ice plant, cold storage facilities, and primary processing plant. The latter includes and administration office, oil supply facilities, power supply system, fishing net6 and gear repair shop, fishing gear warehouse, waste water and refuse treatment plant, and parking area.

The frequency and method of use of the basic and ancillary facilities vary depending on the number of fishing boats using these facilities, the extent of fishing activities, the distribution system for fish catches, and other pertinent factors. This, in turn, defines the character and role of the fishing port.

4.7.1 Administration and Operation of Fishing Port Facilities

In the province of Manabi covered by the proposed project, there exists no port equipped with basic fishing port facilities except Manta Port where part of the commercial port facilities are currently being used to land fish catches from medium and large fishing boats owned by fishing companies and to outfit these vessels.

At present, Manta Port handles container cargo, general cargo and marine products. The administrative and operation function of the Manta Port administration relating to fishery are concerned primarily with the use of the port facilities. The functions include the control of berthing facilities utilization by fishing boats, maintenance of quay decks, fenders and other facilities, and the control of the use of fishery wharf.

The use of water areas of Manta Port is under the control of the CAPITANIA, an organization under the jurisdiction of the Maritime Department (DIGMER) of the Navy. The fishery related administrative functions of CAPITANIA include the screening of applications for registration of fishing boats of 10 gross tons or more, clearing them inward or outward, surveillance in fishing boat operation areas, examination of logbooks of fishing vessels, and issuing instructions regarding anchorage points.

Local fishery offices under the control of the Directorate General of Fishery perform such administrative functions as the examination of export license applications from fishery companies, verification of fish catch statistics compiled by these companies, and giving advice to fishermen.

In the province of Manabi, there are at present 27 fishermen's cooperative associations, which have a weak foundation due to a limited membership and do not carry out modern activities as inadequate consciousness on the part of fishermen of the important role of their cooperative associations and partly to their insecure economic foundations. The low-key activities of the fishermen's cooperative associations may also be attributable to the apparent inadequacy of the national policy of promoting and subsidizing the operations of the cooperatives.

4.7.2 Management of Fishery Port Facilities

(1) Guideline of facility Management

The fundamental concept in the management of the fishing port facilities consists in ensuring that they perform to the full extent their intended functions of facilitating safe entry and departure of fishing boats, smooth and efficient landing, storage, processing and distribution of marine products, and speedy supply of stores and provisions, and repairs. The concept may be boiled down to the following:

1) The basic and ancillary facilities of a fishing port should always be kept in a 100% operating condition.

2) These facilities should always be used in an effective way to bring their functions into full play.

Realization of the basic concept will necessitate a highly capable and empowered administrator with expert knowledge of fishing activities and port facilities, and the relevant administrative organization.

(2) Administrative Organization

For maintaining fishing port facilities in a most desirable condition, it is prerequisite to provide the necessary financial support.

The costs of administration and operation depend on how to look at the management and operation of the fishing port as a whole. One of the key problems in this regard is whether to continue the existing distribution system for marine products. Under the present distribution system, fishes landed by fishermen are not controlled on an overall basis, and the economic foundations of the fishermen are very frail. For these reasons, fishermen especially those operating on a smaller scale, are under the sway of middlemen, producing a serious imbalance in the distribution of wealth in the fishery sector.

The construction of the basic facilities of the proposed fishing port may be financed by the government. however, the costs of their operation and maintenance should preferably be borne by fishermen and middlemen and other traders in the distributive industry.

Generally, there are three entities responsible for the administration of the fishing port: (1) competent agency of the central government, (2) fishermen's cooperative association, and (3) fishery public corporation. In this project, it is considered desirable from the standpoint of economically efficient fishing port operation and promotion of fair distribution of wealth in the fishery industry to establish an integrated system whereby fishermen's cooperative associations will administer and conduct fish production, physical distribution and marketing activities.

(3) Responsibilities of Administrator

The administrator of the fishing port shall lay down and enforce a fishing port administration regulation incorporating a tariff of charges for the use of the port facilities, penal provisions and other appropriate clauses, and service and work rules. The administrator's major responsibilities include the following:

1) Laying down an administrative regulation for the management of the fishing port facilities;

2) Regulating users of the port pursuant to the regulation referred to in 1) above;

3) Maintaining a control register for the facilities, keeping himself posted on their up-to-date conditions, and assuming full responsibility of their maintenance; and

4) Keeping fishery statistics and undertaking studies and researches with a view to contributing toward growth of the fishing port.

4.7.3 Operation of Fishing Port Facilities

(1) Basic Policy for Operation

As already noted, it is considered preferable to introduce an integrated management and operation system in the proposed fishing port whereby fishermen's cooperative associations will administer and carry out fish production, physical distribution and marketing activities. In line with this thinking, the basic policy for the fishing port management is that fishermen themselves will share the port facilities and endeavor to achieve their efficient utilization and fair distribution of wealth derived from their activities.

To this end, it is necessary to reorganize the existing fishermen's cooperative associations into better organized and more active cooperatives having sounder foundations. At the initial stage of the reorganization, it may be necessary for the Directorate General of Fishery to provide the reorganized cooperative with financial aid as well as guidance on the organizational and operational aspects.

(2) Operational Plans

It is proposed to carry out the following specific operational plans in this project according to the stage of development.

1) Short-Range Plan

a) Fish Handling (sorting of species and transportation within the premises of handling area) and sale at auction through fair practice;
b) Ice making for sale to fishermen, traders in the distributive industry, and others;
c) Letting out refrigerators on hire; and
d) Sale of bunker oil to fishing boats.

2) Long-Range Plan

a) Fish Handling and their sale at auction through fair practice;
b) Shipments' control with a view to preventing fluctuations of fish prices due to change in volume of catch;
c) Ice making for sale to fishermen and distributors;
d) leasing out of refrigerators;
e) Sale of bunker oil to fishing boats;
f) Quality inspection of raw and processed fish for exports ;
g) Education and training in fishing techniques, marketing and distributions;

(3) Organization and Activities

1) Organization of Fishing Port

The organization illustrated in Fig. 4-7-1 is considered to the appropriate for the administration and operation of the proposed fishing port.
The Administrative and Operational Committee will be composed of the Governor of the province or other person representing the province, mayor or other person representing the city, a representative of CAPITANIA, president f the fishermen's cooperative association, a representative of the processing industry. The Committee will make decisions on a basic operational policy.
The administrative department will be established consisting of 4 sections; training section, port service section, facility section and marketing section.

2) Responsibility of Each Section

The responsibilities of each section are summarized as follows.

a) Training Section:
Lectures and training on the fishing activities, fishing technology and fishing management.
Promotion of CPAs activities.
Coordination between Government agencies concerned and the fishermen.

b) Port Service Section:
Overall management
Accountancy of charges for fishing port facilities
Statistics of fishing boats, landing volume and facilities usage

c) Facility Section:
Improvement and maintenance of fishing port facilities.
Purchases of equipments and parts.

d) Marketing Section:
Making and sale of ice.
Sale of fuel, water.
Lease of fishing port facilities.
processing, handling and auction of the fish catches.

3) Staffing

The staffing requirements for administrative and organizational purposes under the short-range plan are indicated in Table 4-7-1.

Table 4-7-1 Administrative and Organization Staff of Fishing Port

Section	Nos of Staff Grade A	Grade B	Grade C	Total
Training	2			2
Port Service		3		3
Facility		1		1
Marketing			4	4
Total	2	4	4	10

The staffing requirements for the purpose of the long-range plan will be examined according to development in the role and functions of the fishing port.

4) Operational Plan

The fishermen's cooperative association which will be responsible for the administration and operation of the proposed fishing port will basically be operated on a self-sustaining basis. However, the initial operating cost and excessive maintenance cost will be covered by government subsidies.

In obtaining funds to meet operating costs, it is considered desirable to achieve efficient utilization of the fishing port facilities and to keep the user costs at a lowest practicable level. In keeping with these concepts, the operating plan will be studied on the basis of the following policy.

a) Wharfage will not be charged.
b) Auction commissions will be 3% of the value of fishes landed after 2005.
c) The selling price of ice will be approximately 50 to 70% of the present market price.
d) The rental charge of refrigerators will include depreciation expenses.
e) The selling price of fuel oil will be set at a lower level than the present market price.
f) No charge will be collected for the use of repair shops, primary processing plant, etc.

The normal maintenance costs will include the following:
- Periodic inspection of fenders and curbs and their repairs;
- Periodic inspection of slipway facilities and their repairs;
- Painting of roofs, steel frames and trusses, external mortar walls, fences and other parts of buildings;
- Periodic inspection and cleaning of mechanical and electrical equipment;

4.8 Economic and Financial Analyses

4.8.1 Economic Analysis

(1) Economic Significance of Manta Fishing Port Construction

The proposed fishing port of Manta in the Province of Manabi, Republic of Ecuador will play a main role in the provincial fishing activities. This project, though expected to benefit smaller fishermen in the province directly, will bring about substantial economic benefits to the country as a whole by supplying the people with fish protein and stimulating the fishery activities and related manufacturing and distributive industries of the country. The tangible and intangible benefits derivable from the implementation of the project include the following:

a) Reduction in physical distribution costs resulting from savings in loading and unloading time;
b) Improved freshness of fishery products through increased ice supplies;
c) Increased foreign exchange earnings through the expansion of marine product exports;
d) Stabilization of consumer prices as a result of lower distribution costs for fishery products;
e) Generation of more employment opportunities through the construction of modern processing plants for fishery products;
f) Improved commercial functions of Manta Port resulting from the proposed fishing port construction.

(2) Objective and methodology of Economic Evaluation

The objective of the economic evaluation of the project is to establish its viability from the viewpoint of Ecuador's national economy. The economic evaluation has been undertaken by the common method:

Cost-benefit analysis in which the quantifiable benefits derived from the construction of the Manta fishing port are compared with the project costs and an appropriate economic internal rate of return (EIRR) is calculated to serve as a measure of the viability of the project.

The period covered by the economic evaluation has been taken as 25 years following the completion of the proposed fishery port with due regard to economical service lives of the various fishery port facilities.

(3) Cost

The project cost consists of the costs of construction, replacement, maintenance and operation of the fishing port complex. These respective costs have been established as indicated below.

1) Construction Cost

As Table 4-8-1 shows, the construction cost comprises the costs of construction of the main and functional facilities of the new fishery port, consultant services, and contingencies.

Table 4-8-1 Investment Cost for Construction of Manta Fishery Port

Investment Cost	Year	1992	1993	1994
Foreign Currency portion	Construction cost		3,623	3,667
	(Insurance cost out of above)		-4	-5
Consultancy cost		352	188	187
Contingency			397	397
Total		352	4,204	4,246
Local currency portion	Construction cost		3,735	3,519
Consultancy cost		374	176	175
Total		374	3,911	3,694
Foreign currency	equivalent	361	3,770	3,561
Grand Total		713	7,974	7,807

Note: Standard Conversion Factor (SCF):
0.964 (average value for 1985-1989)

2) Replacement Cost

For those elements of the proposed fishing port facilities having a shorter physical life than the evaluation period of 25 years, allowances are made for their replacement upon expiry of their respective useful lives.
In this project, the physical life is assumed to the 20 years for buildings and 10 years for mechanical equipment.

3) Operation and maintenance Cost

The operation and maintenance cost will be incurred to keep the new fishery port facilities operating in a desired condition. For the purpose of the economic analysis, the operation and maintenance costs for the main facilities, ancillary facilities, buildings and mechanical equipment are assumed as 0.2%, 0.5%,

0.5% and 1%, respectively of their respective estimated construction or acquisition costs. In this analysis, the operation and maintenance costs are shown for the year following the completion of the project facilities and for each succeeding year of the evaluation period.

Table 4-8-2 Operation and Maintenance Cost

Facility	Construction Cost	Operation and Maintenance Cost
Main facilities	10,841	21.7
Ancillary facilities	994	5.0
Buildings	883	4.4
Mechanical equipment	2,475	24.8
	13,510	55.9

Notes: 1) The annual personnel cost is assumed as U.S.$20,000 for the period 1995 to 2004 and U.S.$30,000 for the period 2005to 2019.
2) Physical life of facilities
Basic facilities : 50 years
Buildings : 20 years

(4) Benefits

As noted in paragraph (1) above, the economic benefits derivable from the construction of Manta Fishing Port are multifarious. For the purpose of this analysis, however, the following measurable benefits alone will be taken up on the assumption that if the new fishing port complex is used primarily by small fishing boats after its completion, the catches and the number of fishing boats using the port in the target year of the project will basically remain the same as at the present time.

1) Reduction in loading and unloading time;

When the planned main port facilities and functional facilities come into operation at Manta Fishing Port, there can be expected reductions in the time requirements for outfitting, loading and unloading fishing boats as a result of improved operational efficiency made possible by the new facilities.

The benefit calculations are based on the loading and unloading time, and the time differentials between the "without" case and the "with" case are multiplied by the time-base costs of fish-

ing boat crews to obtain the benefits in money terms. The calculation results are presented in Table 4-8-3.

Table 4-8-3 Calculation of Benefits in Terms of Reductions in Loading/Unloading Time

Fishing Boat	Nos.of boats using new port	Time reduction (min/boat)	Total reduced days	Crew cost ($/day)	Benefit
Small scale longline boat	51,150	10	1,705	24	40.9
Middle scale purse seine boat	220	180	132	45	5.9
Middle scale longline boat	700	90	210	36	7.5
Total	52,070	-	2,047	-	54.3

Notes: 1. Number of fishing boats using new fishery port.

Nos of small longline fishing boat
= 341 x 150 times/boat/year (3 times per week)
= 51,150
Nos of middle scale purse seine fishing boat
= 11 x 20 times/boat/year = 220
Nos of middle scale longline fishing boat
= 14 x 50 times/boat/year = 700

2. Reduction in loading/unloading time

The following values are taken on the basis of the site observations and interviews with persons concerned.

(i) Small fishing boat:
10 min./boat (outfitting 5 min. loading/unloading 5 min.)
(ii) Middle scale purse seine boat:
180 min./boat (outfitting 60 min. loading/unloading 120 min.)
(iii) Middle scale longline boat:
90 min./boat (outfitting 30 min. loading/unloading 60 min.)

3. Costs of crew members
The costs include the food expenses and the personal fee.

(i) Small fishing boat:
(11,000s/. x 1^{person} x $4,000^{s}$ x $2.6^{persons}$)
/910 s/.= $24/day

(ii) Middle scale purse seine boat:
(11,000 x 1 + 5,000 x 2 + 4,000 x 5)/910 = $45/day

(iii) Middle scale longline boat:
(11,000 x 1 + 5,000 x 2 + 4,000 x 3)/910 = $36/day

2) Increased freshness of fishery products due to use of ice;

Attached figure illustrates the relationship between reduced freshness of fishery products and elapsed time where ice is used and where it is not used. In this project, it is assumed that marine products, when landed, will remain without ice for an average of about 7 hours , and that in this case their freshness will be nearly 30% lower than it is when ice is used.

Surveys at markets in the city of Manta revealed that fishes cooled on ice were on sale at prices 30 to 40% higher than those of the same species that were not iced. For the purpose of this analysis, it is assumed that benefits equal to 15% of the average market price of fishes in Manta will accrue in the form of a maintained level of their freshness when they are kept on ice. The benefit calculations involve small longline fishing boats.

Benefit = Landing volume of fish catches x (average fish price- cost of ice usage)x benefit rate
= 8,200ton x 10^3 x (800s/.-20s/.)/910 s/.x 0.15
= 1054.3 thousand US$

3) Reduction of fuel consumption resulting from the shortening of transportation distance;

This benefit means the cost reduction of fuel due to the difference of marine transportation distances between Tarqui beach used for landing place at present and La Poza planned for the new fishing port judging from the navigation track of the fishing boats.

Benefit = Number of fishing boats using the new port x reduction of transporting time per boat x fuel consumption per hour
= 51,150 boats x 5 minutes / boat x $5.8/hour
= 24.7 thousand US$

Fuel Consumption per hour
= Gasoline consumption per boat/(Boating time + fishing time/2) x unit price
= 225 l/boat/ (3.3 + 2.9 hours) x US$0.6/gal
= US$5.8/hour

From the foregoing benefit calculations, the total benefits are as below.
54.3 + 1,054.3 + 24.7 = 1,133.3 thousand US$

(5) Evaluation

From the project costs and benefits calculated as above, the EIRR has worked out at 3.6%, which is lower than the opportunity cost of capital in Ecuador. However, it is considered appropriate to implement the project, since it is an infrastructure project having the high public characteristics and is expected to contribute largely to the promotion of the regional development. From the view point of the economic analysis, that is, the benefit of the project to the nation, this project can be regarded as feasible.

(6) Sensitivity Analysis

1) Assumption of cases

Sensitivity analysis is carried out to evaluate the risks associated with changes in the economic cost and benefit streams. Sensitivity analysis is made for three cases as follows:

Case (1): The construction costs increase by 10%.
Case (2): The forecast fish catch volume decreases by 10%.
Case (3): The costs increase by 10% and the fish catch volume decreases by 10% simultaneously.

2) Results

The EIRR is calculated for each of the three cases. The calculation results are Case (1) 2.8%, Case (2) 2.8% and Case (3) 2.0%. The results of the sensitivity analysis thus prove that each case would be feasible.

4.8.2 Financial Analysis

(1) Purpose of Financial Analysis

The viability of this project must be evaluated by two distinct approaches; economic analysis as treated in 4.8.1 which should be performed from the viewpoint of national economy, and financial analysis dealt with in this section.

The financial analysis is also intended to appraise the financial soundness of the project.

(2) Establishment of Conditions

1) Revenue

Revenues considered for the project include wharfage assessable on the middle scale fishing boats, ice sales to small and middle scale fishing boats, rentals for refrigerating plants, and fuel sales to these boats.

(a) Wharfage

Assessed on middle scale fishing boats:
25 boats (11 purse seine boats and 14 longline boats)

Total number of fishing boats used	Wharfage rate	Annual revenue
920	8,400s/./boat	US$9,000

Total numbers of fishing boats using new port
=920 (Table 4-8-3)
Wharfage rate = 600s/./m x 13.9m/boat= 8,400s/./boat

(b) Amount of ice sales

Tonnage of ice consumed	Unit price	Annual revenue
11,789 tons	20,000s/./ton	US$259,000

Ice consumption

Small longline fishing boat
280 kg/boat/time x 51,150 boats = 8,722 tons

Middle scale purse seine fishing boat
(26.9 tons/boat x 40% x 1/2) x 220 boats= 1,184 tons

Middle scale longline fishing boat (percentage of consumption taken as half of that for middle scale purse seine fishing boats.)
(26.9 tons/boat x 20% x 1/2) x 700 boats = 1,883 tons
Total: 11,655 tons/year

Unit price = 20s/./kg (current market price in Manta)

(c) Rentals for refrigerating plants and cold storage facilities

For replacement cost the applicable depreciation expenses are taken.

Mechanical equipment = Acquisition cost /depreciable years x refrigeration & cold storage ratio
= $2,475,000/10 yr x 90 KWH/191 KWH
= $117,000/yr

Buildings — Same formula as for mechanical equipment adopted
= $830,000/20 yr. x 90 KWH/191 KWH
= $20,000/yr.
Total:137,000 US$

(d) Fuel sales

Fuel Consumption		Unit Price	Annual revenue
Gasoline	11,509 kl	140 s/l	$1,771,000
Heavy oil	2,078 kl	120 s/l	$ 272,000

Total:2,043,000 US$

Computation of fuel Consumption:
Small fishing boat:
225 l/boat/time x 51,150 boats = 11,509 kl
Middle scale fishing boat:
1,150 l/boat/time x 920 = 1,058 kl
Middle scale fishing boat:
1,500 l/boat/time x (1,600 - 920) boats = 1,020 kl

(e) Auction sales commissions
It is assumed that the project owner joining with the local fishermen's cooperative associations will engage in auction sales of fishes about 10 years after the completion of the new fishing port.

At the initial stage the auction sale commission will be 2% (1% for fishermen and 1% for buyers), although it is proposed to raise the commission to 3 or 4% of the transaction amount.

Auction sale commission 10 years after completion of new fishing port (2% of the transaction amount):
8,500 tons x 800s/./kg x 0.02 = $149,000/yr.

2) Operation Cost

(a) Operation and maintenance cost

	Q'ty	Unit Price	Annual Cost
Electricity	1,218,000 KW	44 S/./KW	59,000 US$
Water	1,180 tons	5 S/./gal.	20,000 US$
Gasoline	11,150 tons	110 s/./l	1,391,000 US$
Heavy oil	3,390 tons	40 s/./l	335,000 US$
Personnel	10 persons	150,000s/./Pers/Mon.	20,000 US$
	(15)		(30,000)
Repairs & Maintenance	(1% for mechanical equipment, 0.5% ancillary facilities, 0.5% buildings, 0.1% main facilities)		56,000 US$
		Total	1,751,000 US$

Note: Figures in brackets indicate those for the period 10 years after the completion of the new fishing port.

Computation of operation and maintenance cost:

Electricity	
Ice making:	191 KW x 24 hr x 50% x 280 days ≒ 642,000 KW
Refrigerating and cold storage:	90 KW x 24 hr x 70% x 365 days ≒ 552,000 KW
General:	11 KW x 12 hr x 60% x 300 days ≒ 24,000 KW
Total:	1,218,000 KW
Water	
Ice making:	11,789 tons x (1 + 10%) = 12,970 tons
Small fishing boats:	25 l/boat/time x 51,150 boats = 1,300 tons
Middle scale fishing boats:	50 l/boat/time x 1,600 boats = 80 tons
Total:	14,350 tons
Unit personnel cost	220,000s/./month x 2 pers. +180,000s/./month x 4pers. + 80,000s/./month x 4pers. ≒ 150,000s/./month
Maintenance Cost	10,841 x 0.2% + 994 x 0.5% + 883 x 0.5% + 2,475 x 1% = 55,900 US$

(b) Depreciation

Annual depreciation charges are computed by the straight line method.

Annual depreciation charges:

2,475,000US$/10yr. + 1,877,000US$/20yr.
= 341,000US$

The annual depreciation expenses for the main facilities amount to $217,000 on the basis of an assumed service life of 50 years.

(3) Result

The current account of the balance of payments shows the profits after depreciation at the year 1995. The durable years of the fishing port facilities are long, and from the viewpoint of the financial viability this project is financially feasible for the fishing port management body.

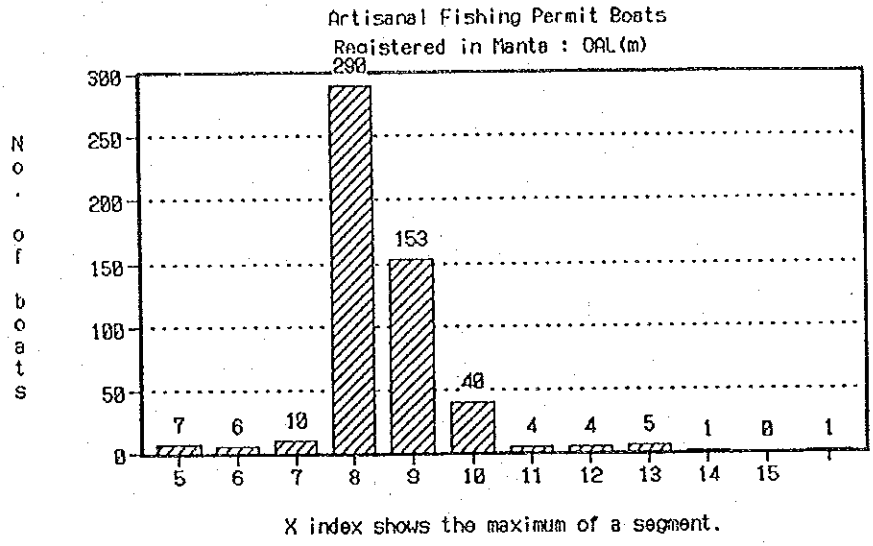
Table 4-8-5 Financial Soundness of APM

(unit:thousand US$)

Items	1995	2005
Revenue	2,448	2,580
Operation & maintenance	1,751	1,761
Depreciation for functional facilities	341	341
Depreciation for main facilities	217	217
Benefits before depreciation	697	819
Benefits after depreciation of main facilities	480	602
Current account profits	139	261

CHAPTER 4 TEXT FIGURES
TEXT TABLES

Fig.4-2-1(1) Histogram for Main Dimensions of Artisanal Fishing Boats



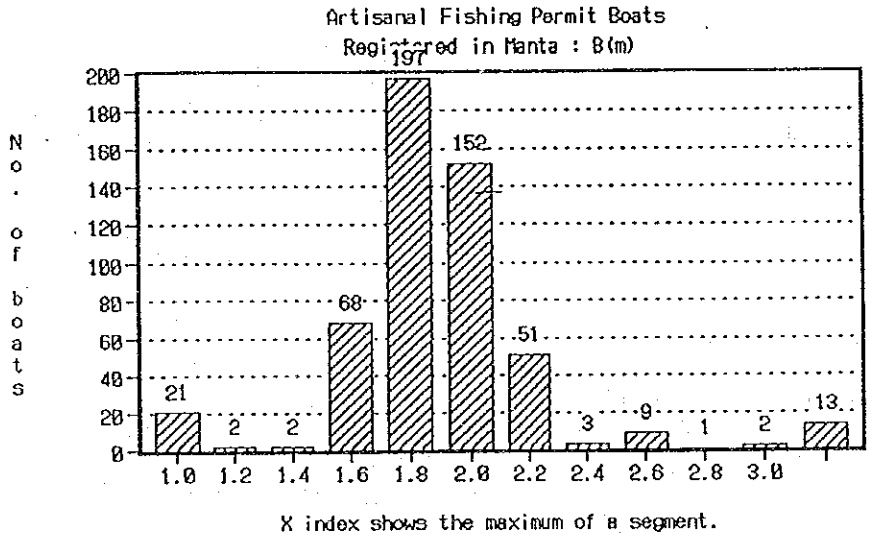
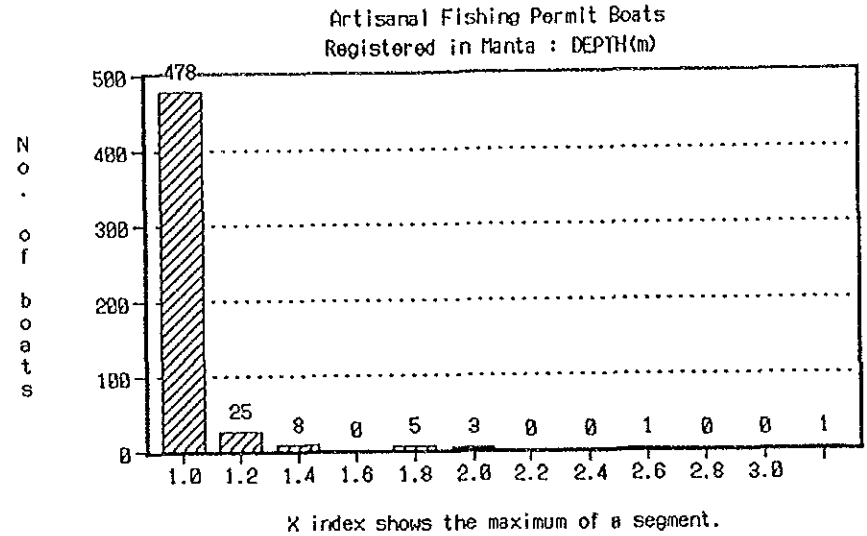


Fig.4-2-1(2) Histogram for Main Dimensions of Artisanal Fishing Boats



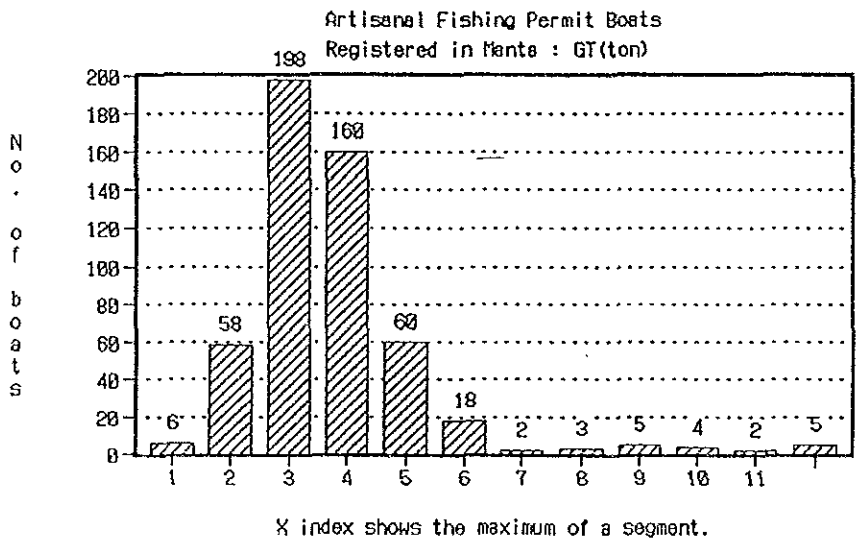


Fig.4-2-2 Histogram for Gross Tonnage by Landing Place

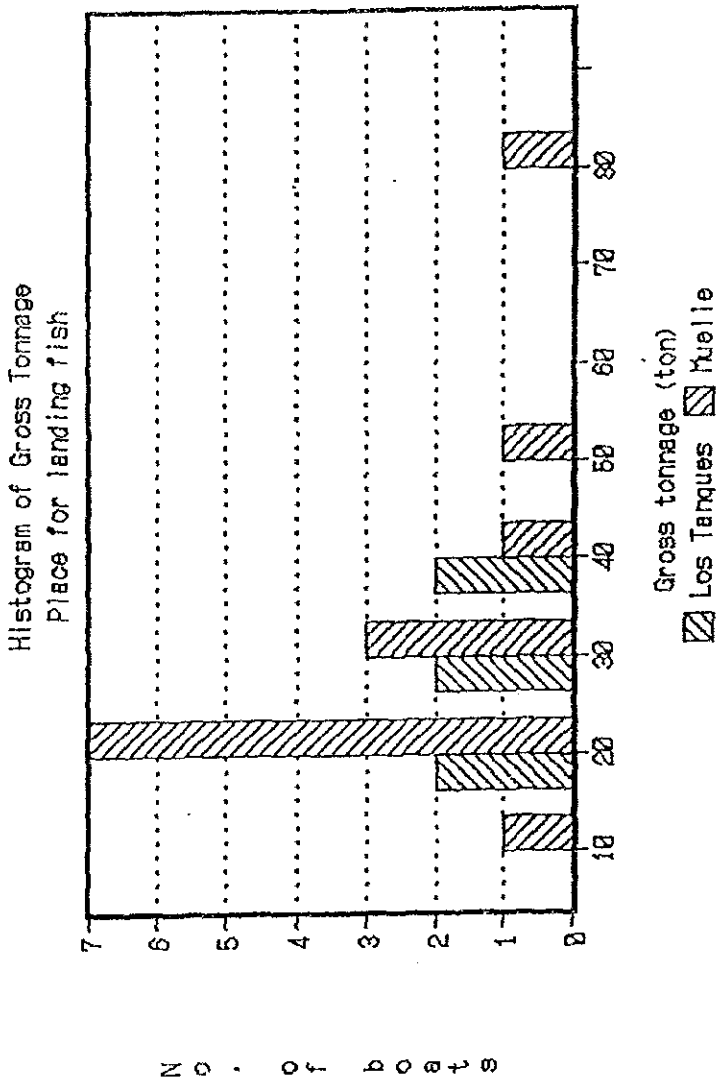
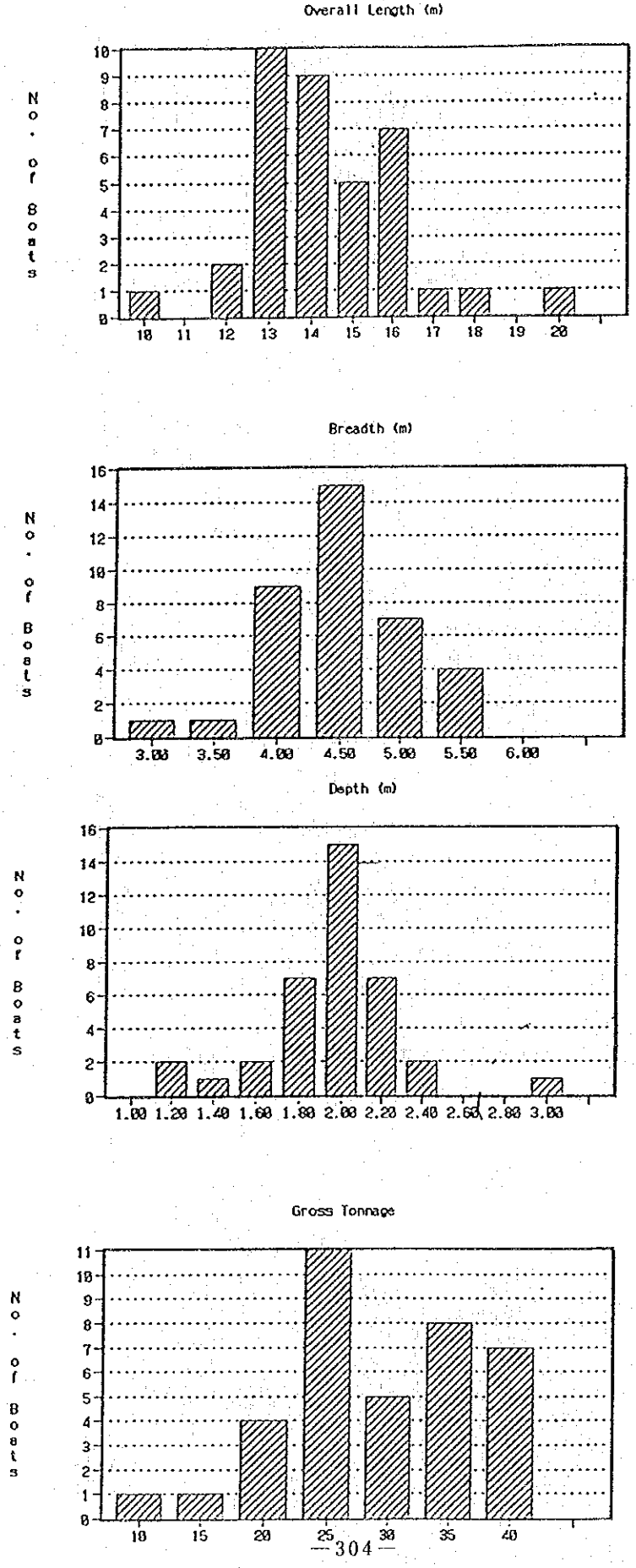


Fig.4-2-3 Histogram for Main Dimensions of Fishing Boats under 40 GT(Manta, Jaramijo)



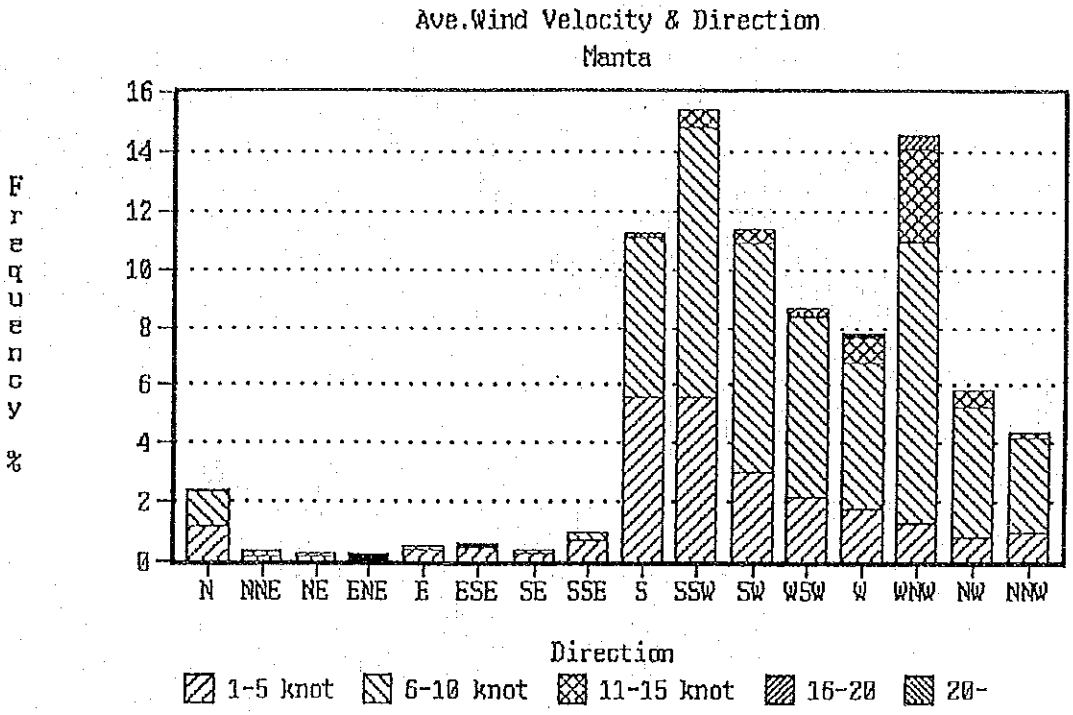


Fig.4-3-1 Average Wind Velocity and Direction(Manta)

Return Period	Probability of nonexceedence	Random Variable	Expectation Precipitation
Rp(year)	P[H<=X]	rv	H(mm)
200	0.9897	7.5937	2027
150	0.9863	6.9641	2029
100	0.9794	6.1005	1784
70	0.9706	5.3652	1576
50	0.9588	4.6939	1386
30	0.9314	3.7196	1111
10	0.7941	1.8407	579

Weibull Distribution
(k=0.75)
H=283*rv+58
Correlation Coefficient r:0.935
Effective Statistical Year K:35
Numbers of Data N:17

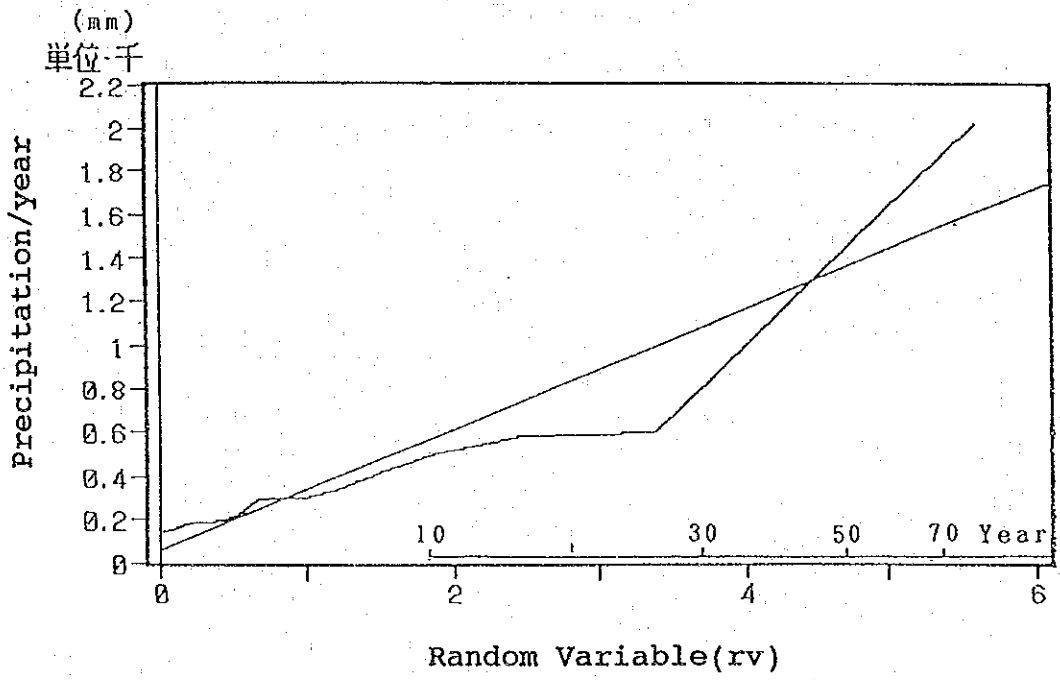
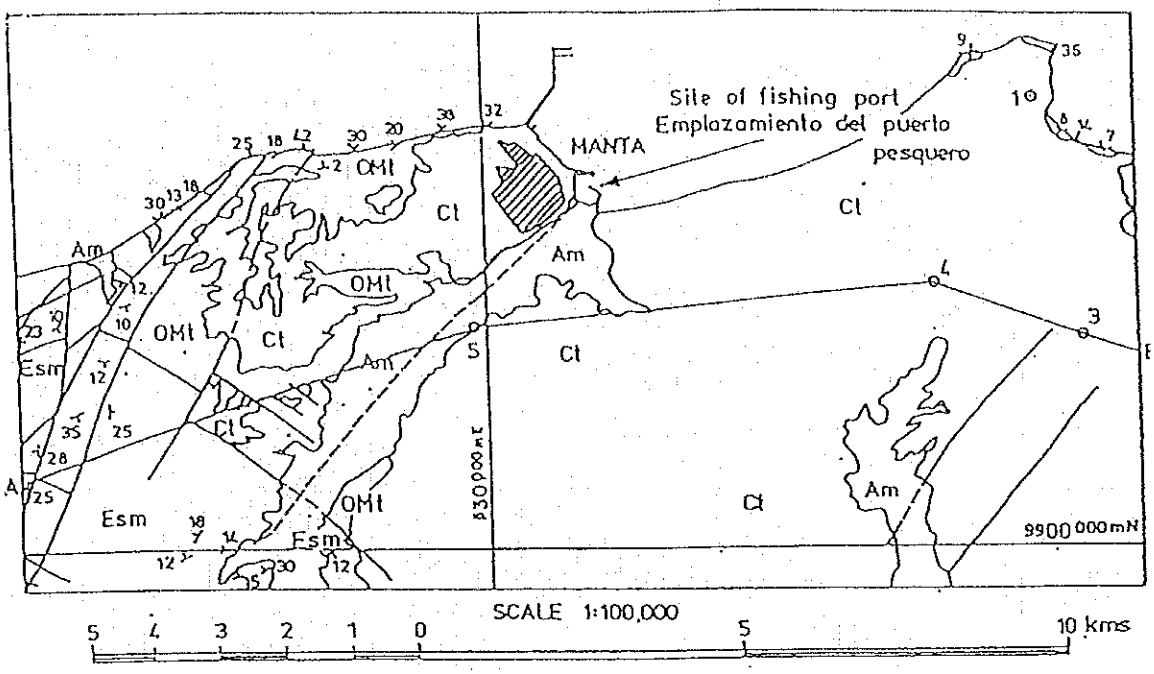


Fig.4-3-2 Probability of Precipitation at Manta



Am	Aluviones modernos
Cl	Tablazo
Omt	Tosagua
Esm	San Mateo

contacto
falla
falla inferida
pozo
estratificación inclinada

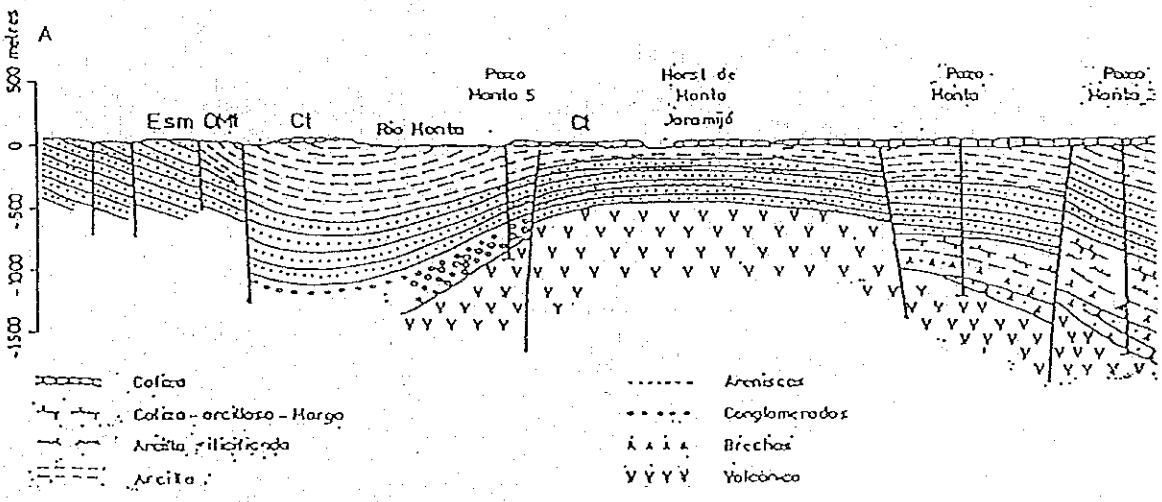


Fig.4-3-3 Geological Map(Manta)

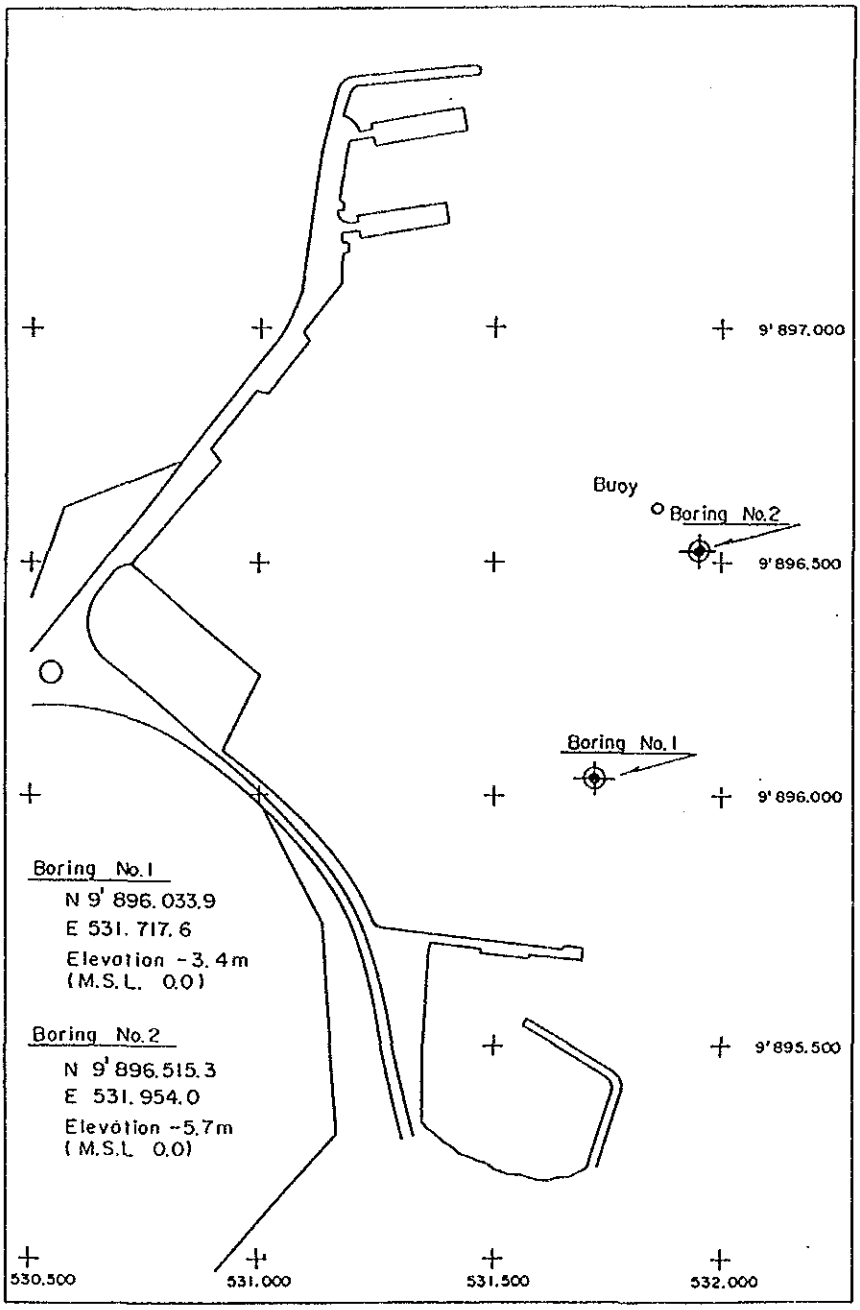


Fig.4-3-4 Location of Boreholes

BORING LOG. I

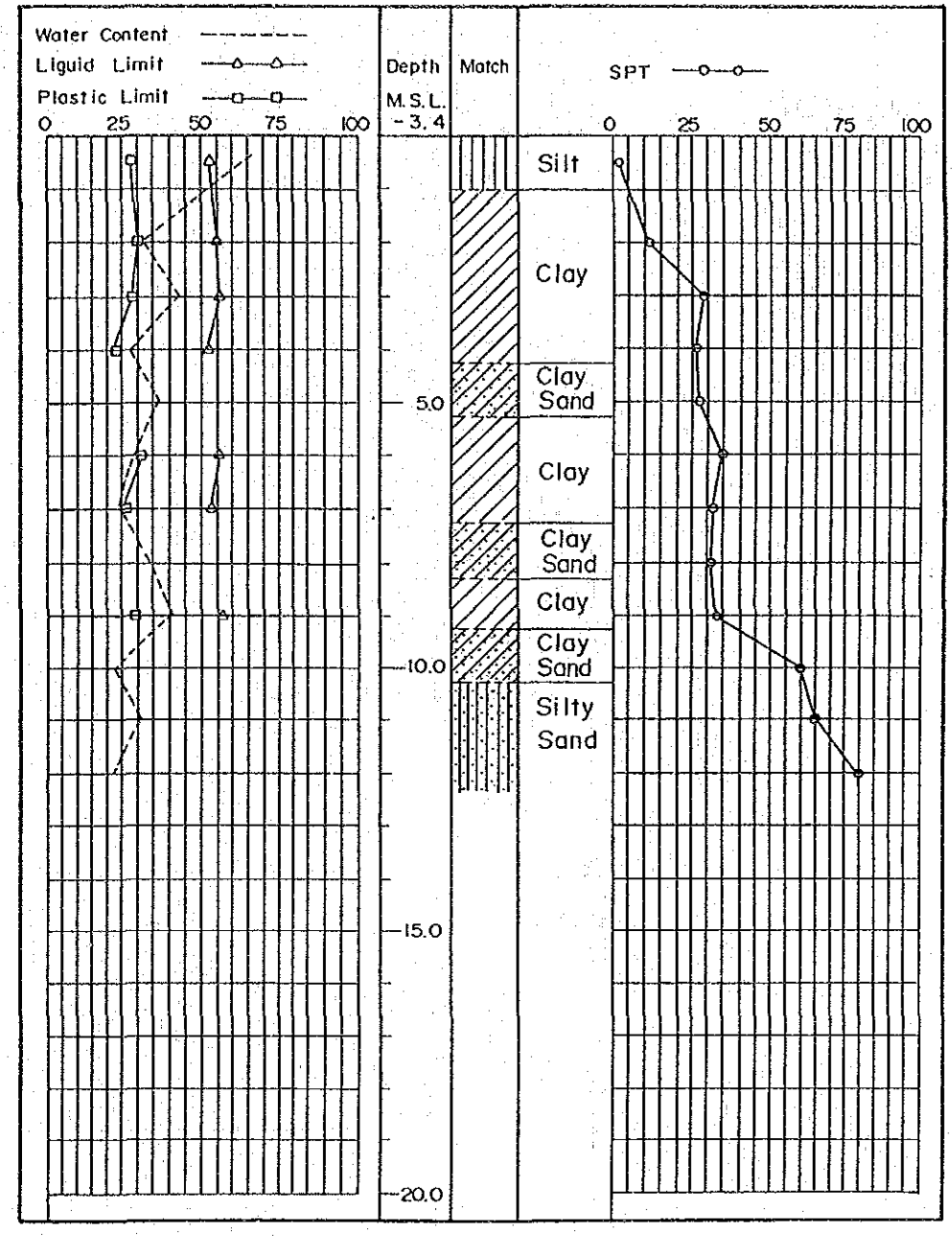


Fig.4-3-5(1) Geological Profile

BORING LOG. 2

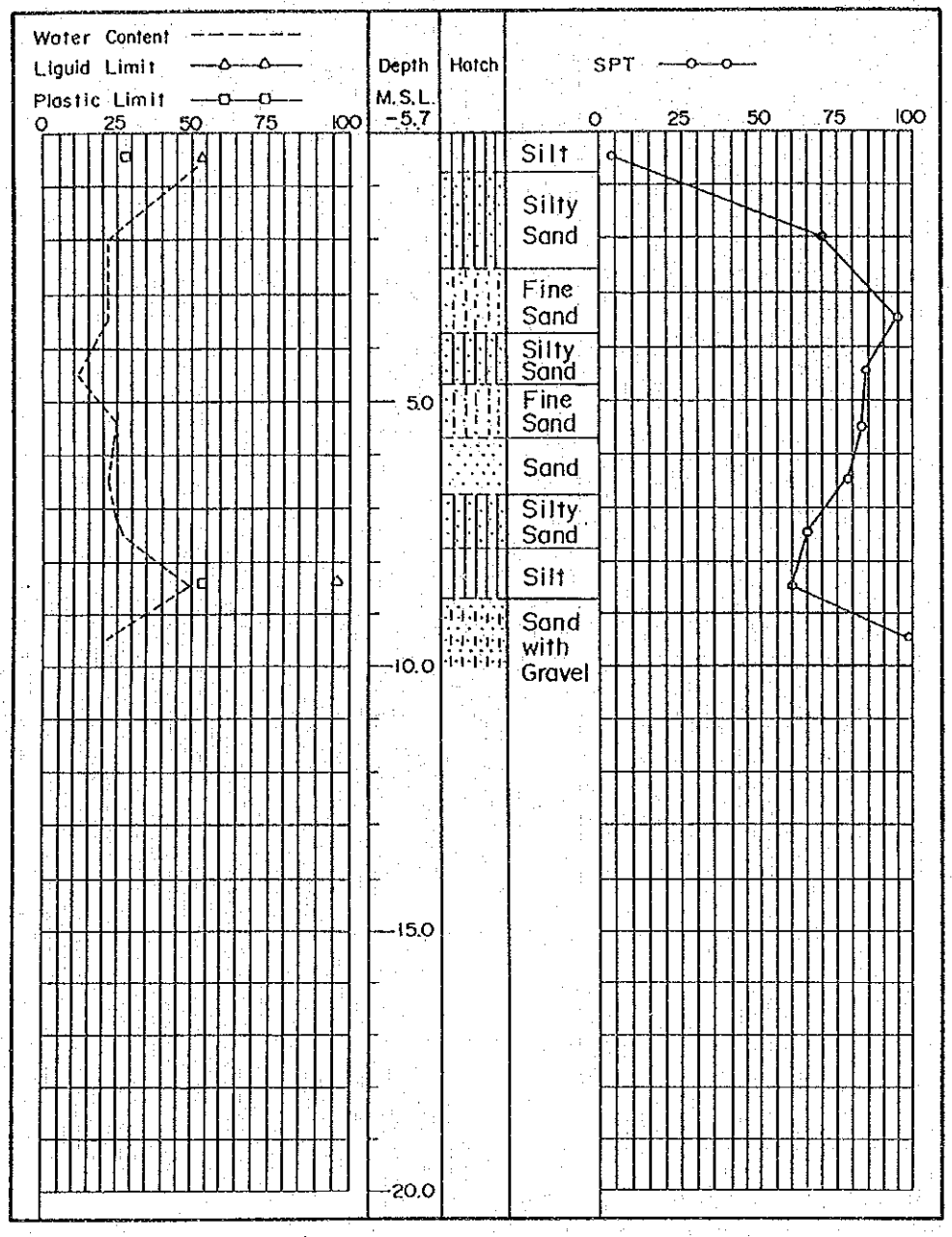


Fig.4-3-5(2) Geological Profile

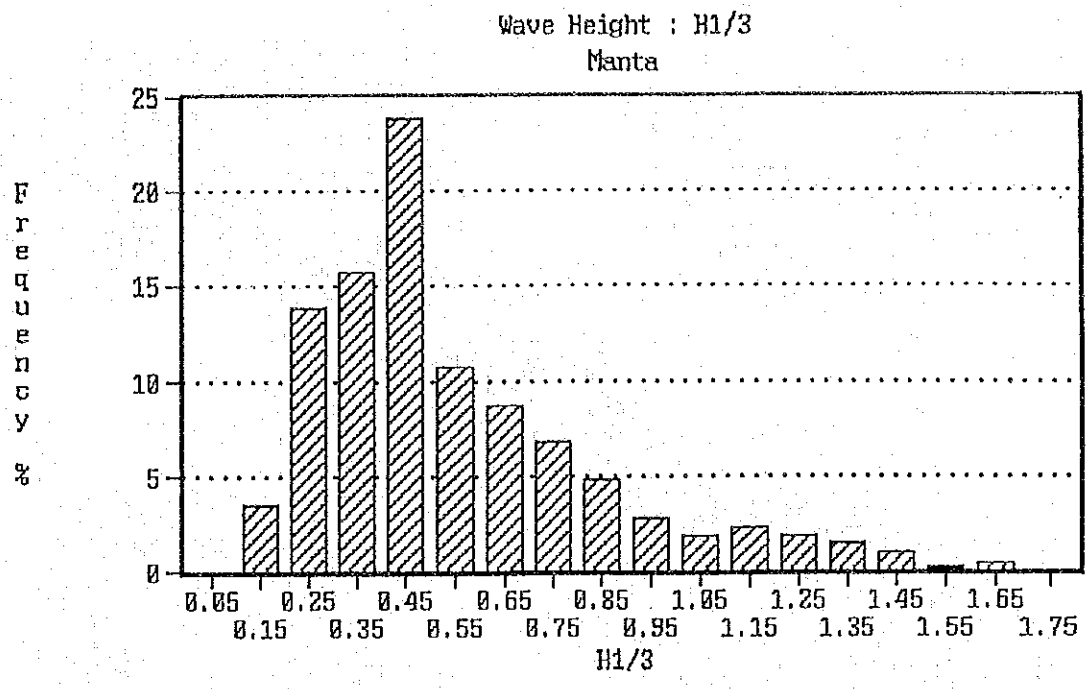


Fig. 4-3-6(1) Wave Heights at Manta

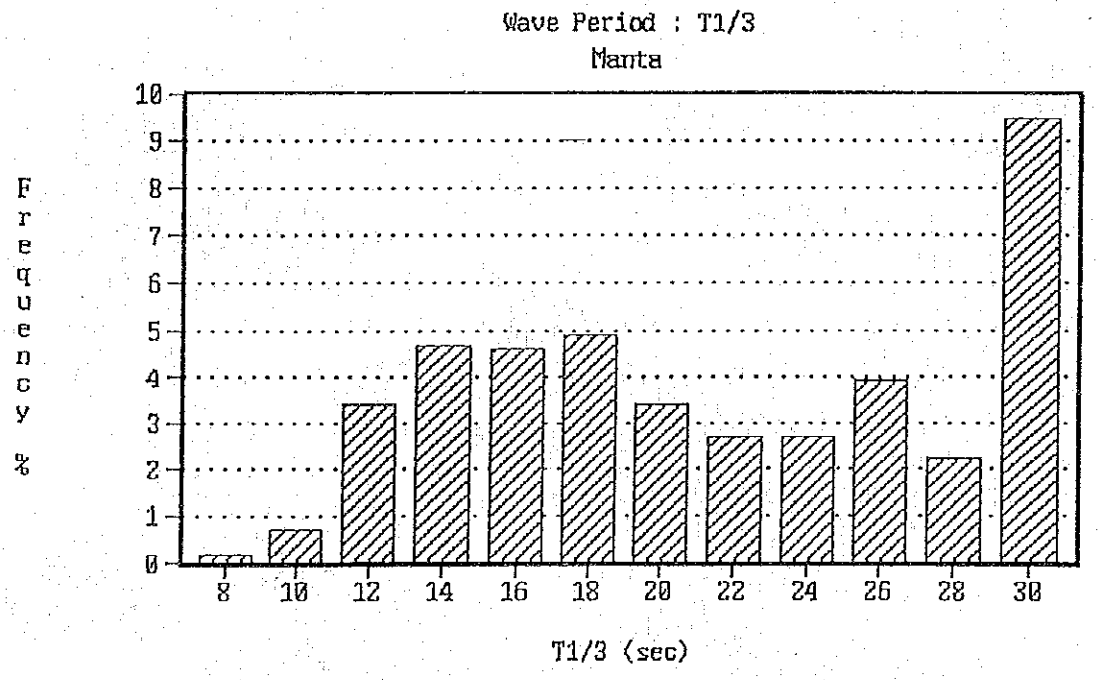
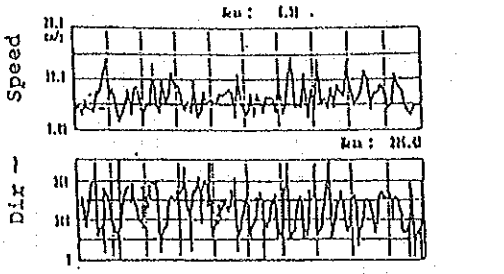
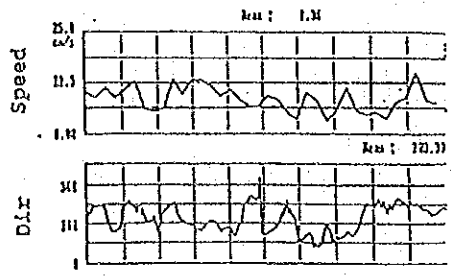


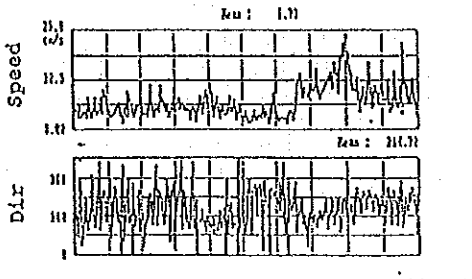
Fig. 4-3-6(2) Wave Period at Manta



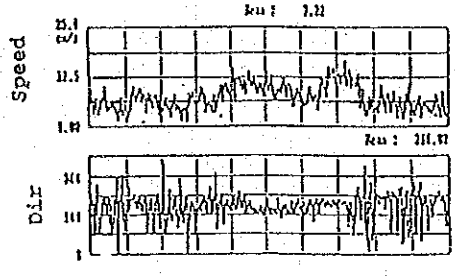
March 18 March 31



July 27 July 31



April 1 April 30



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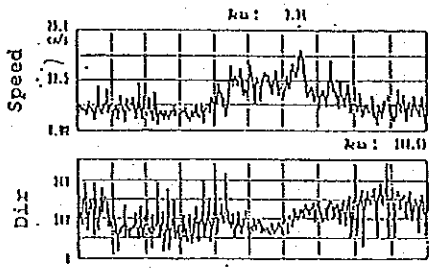

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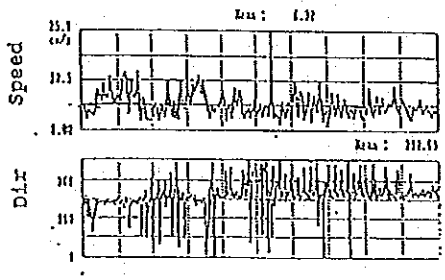
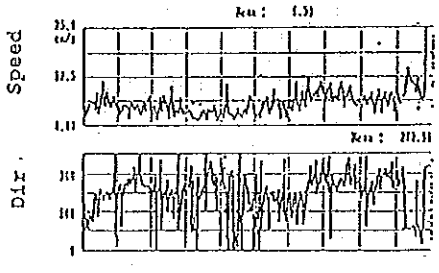
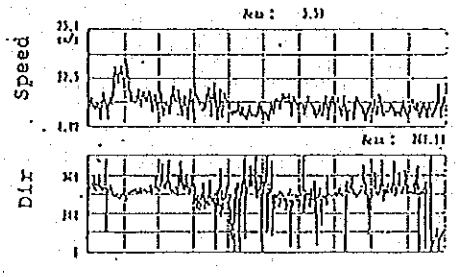


Septem 1 Septem 30

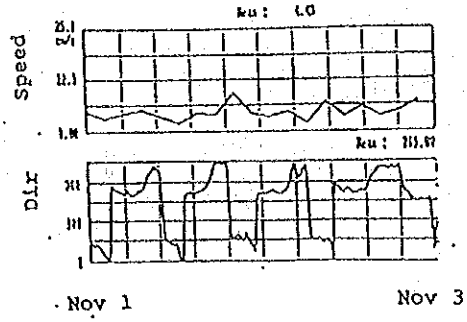


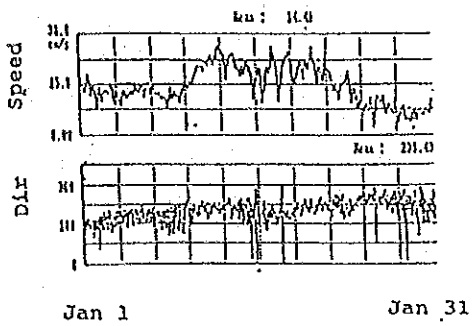
June 1 June 30

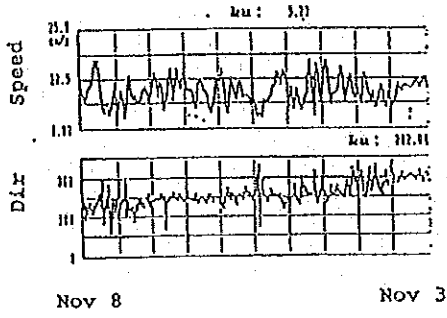


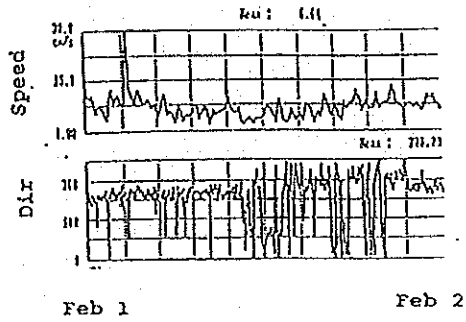
Oct 1 Oct 31

Fig.4-3-7(1) Velocity and Direction of Tidal Current at Manta









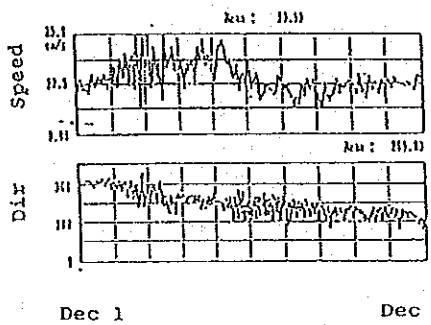


Fig.4-3-7 (2) Velocity and Direction of Tidal Current at Manta.

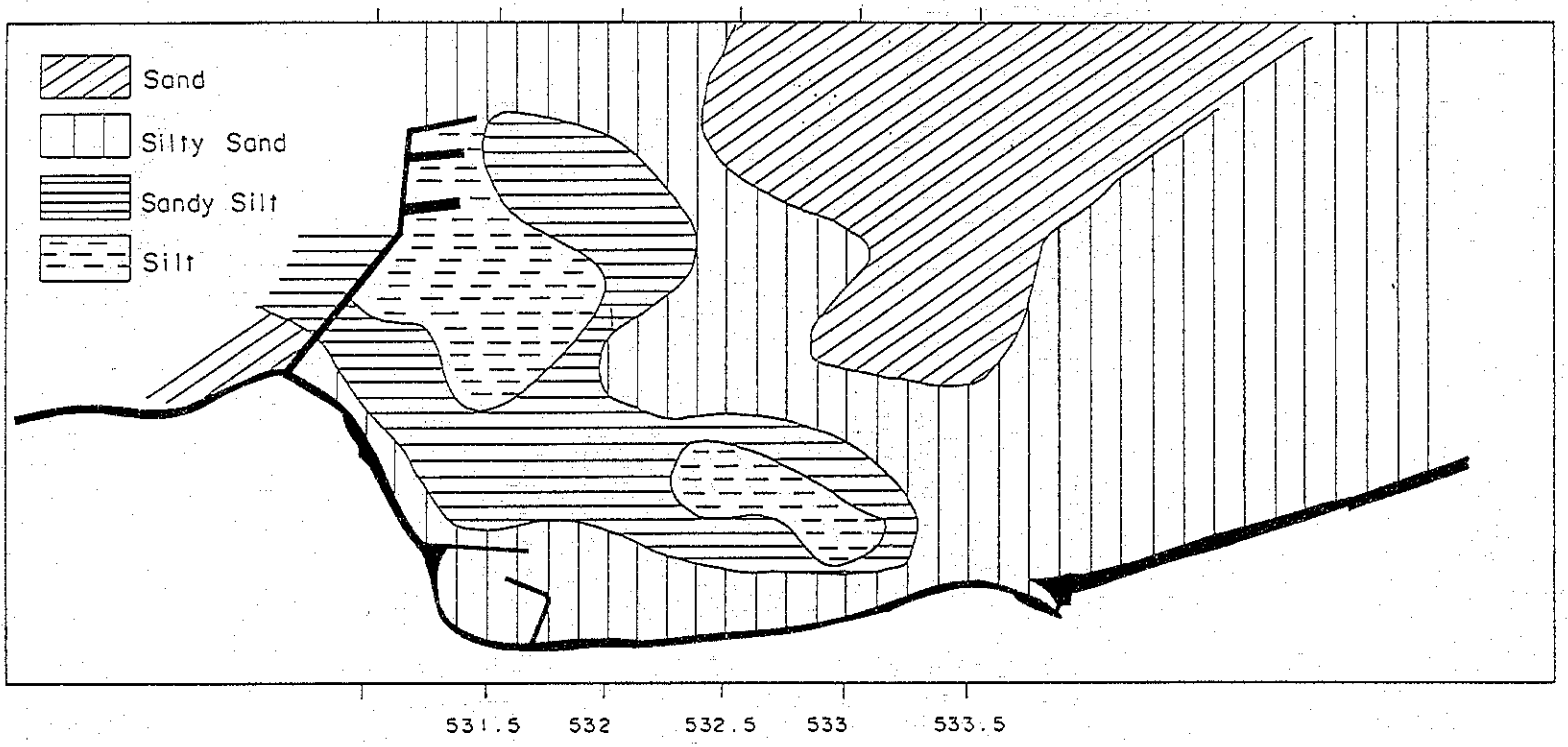


Fig.4-3-8(1) Distribution of Seabed Material at Manta Coast

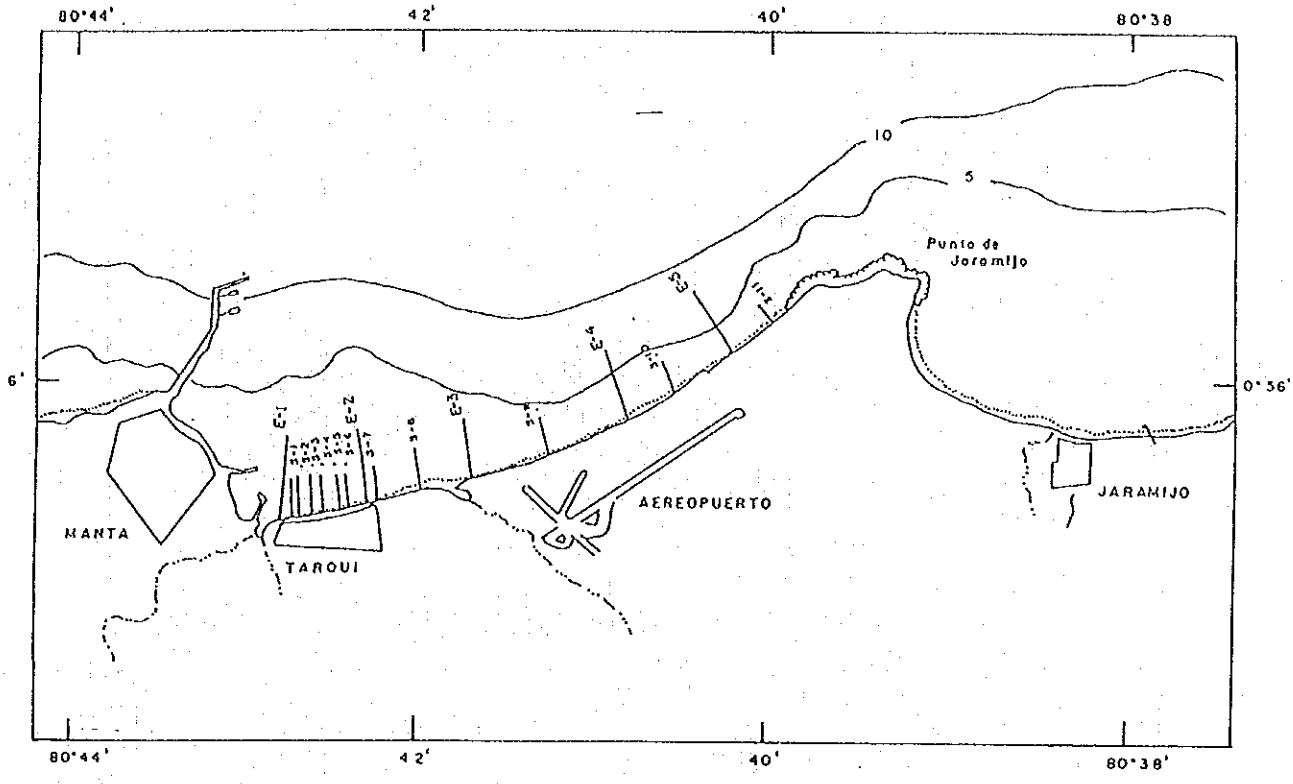


Fig.4-3-8(2) Measuring Line of Seabed Material

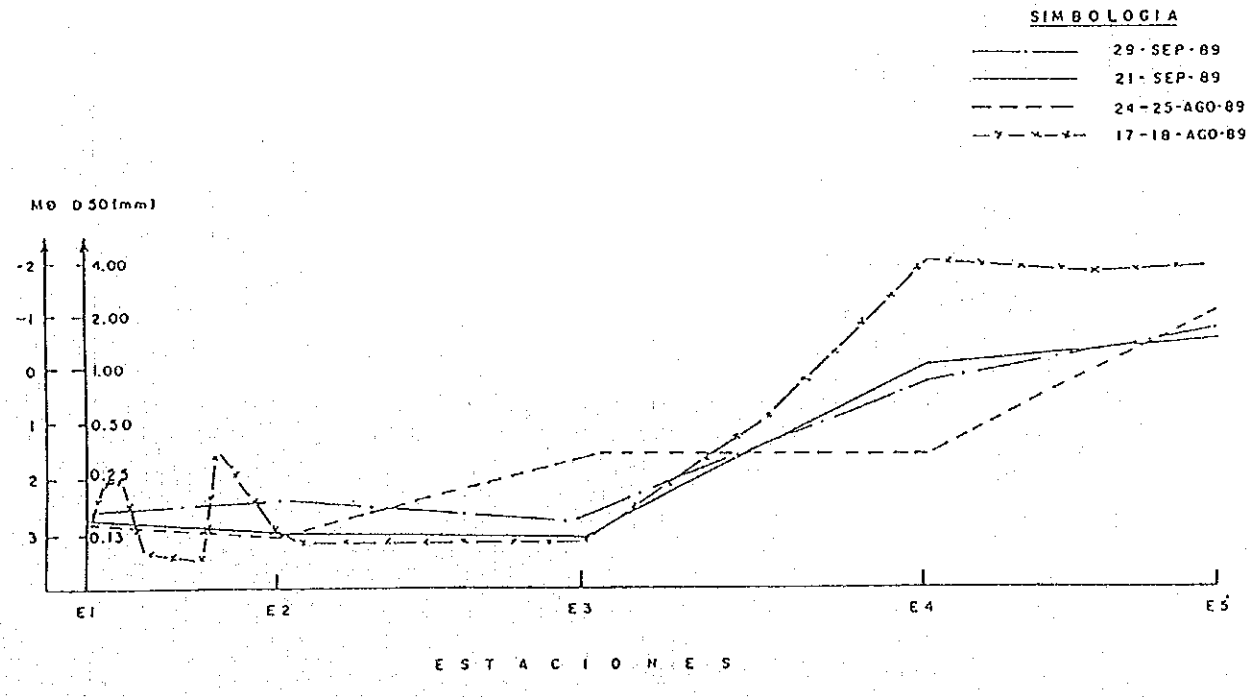


Fig.4-3-8(3) Distribution of Seabed Material at Manta Coast

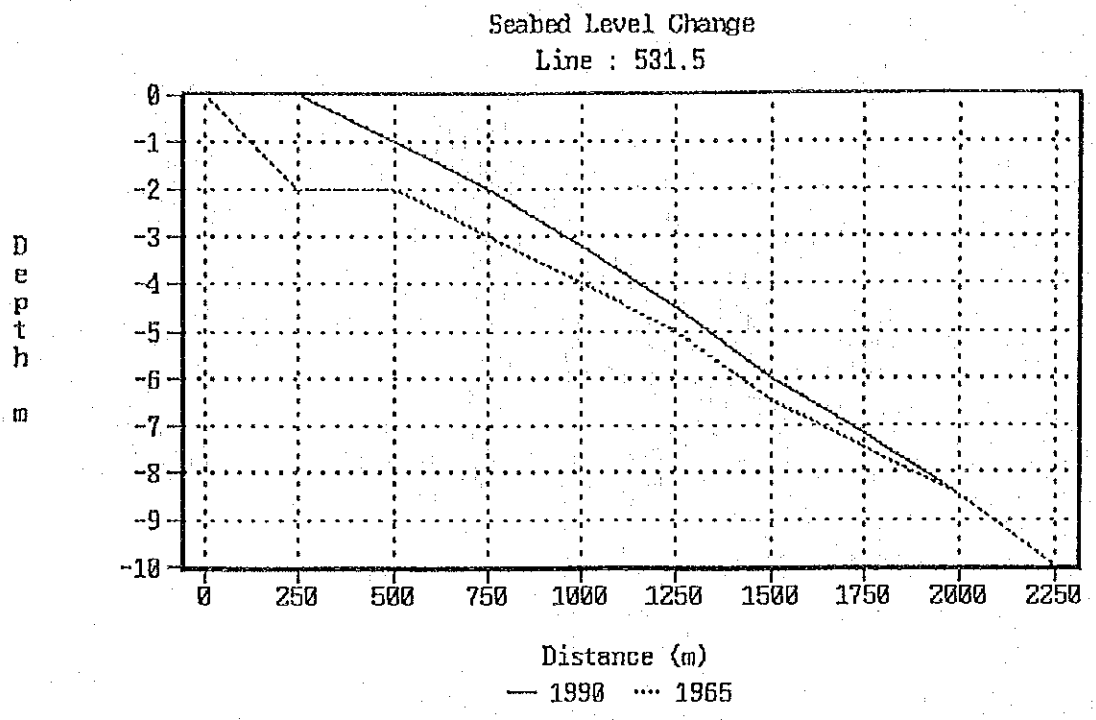


Fig.4-3-9(1) Seabed Level Change at Manta

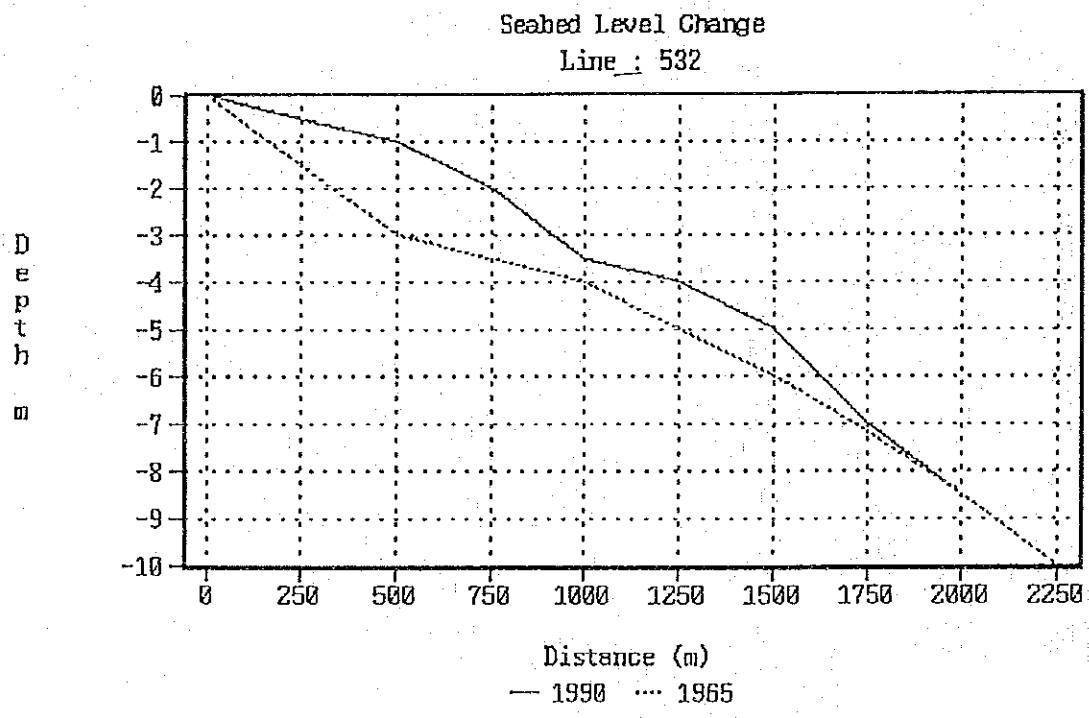


Fig.4-3-9(2) Seabed Level Change at Manta

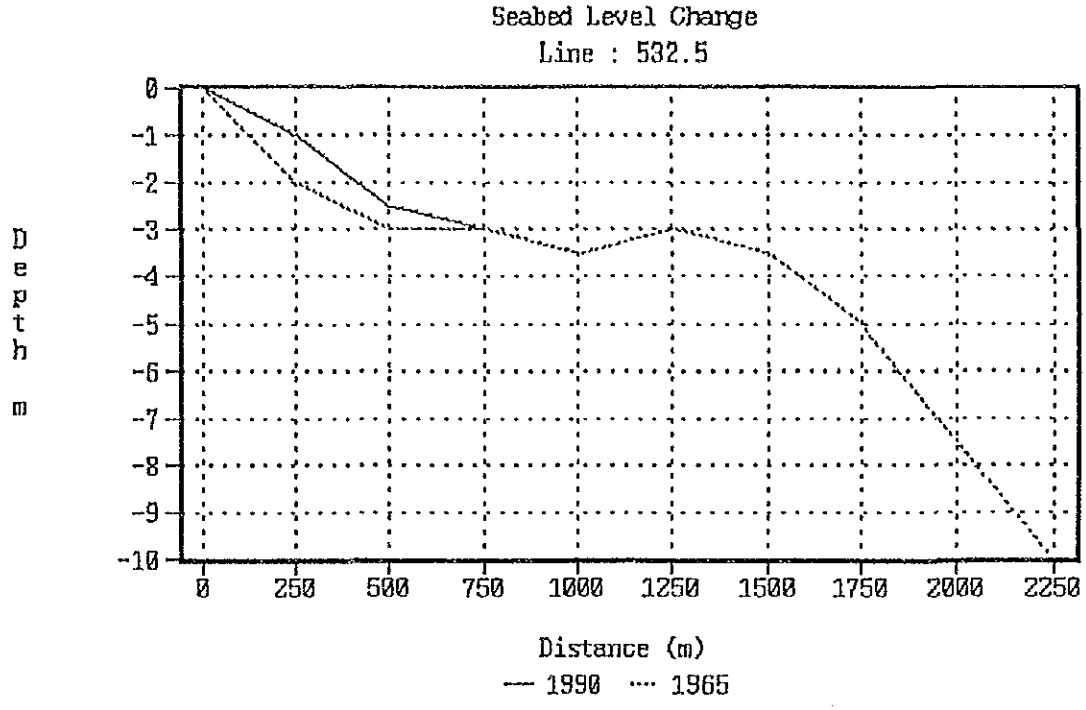


Fig.4-3-9(3) Seabed Level Change at Manta

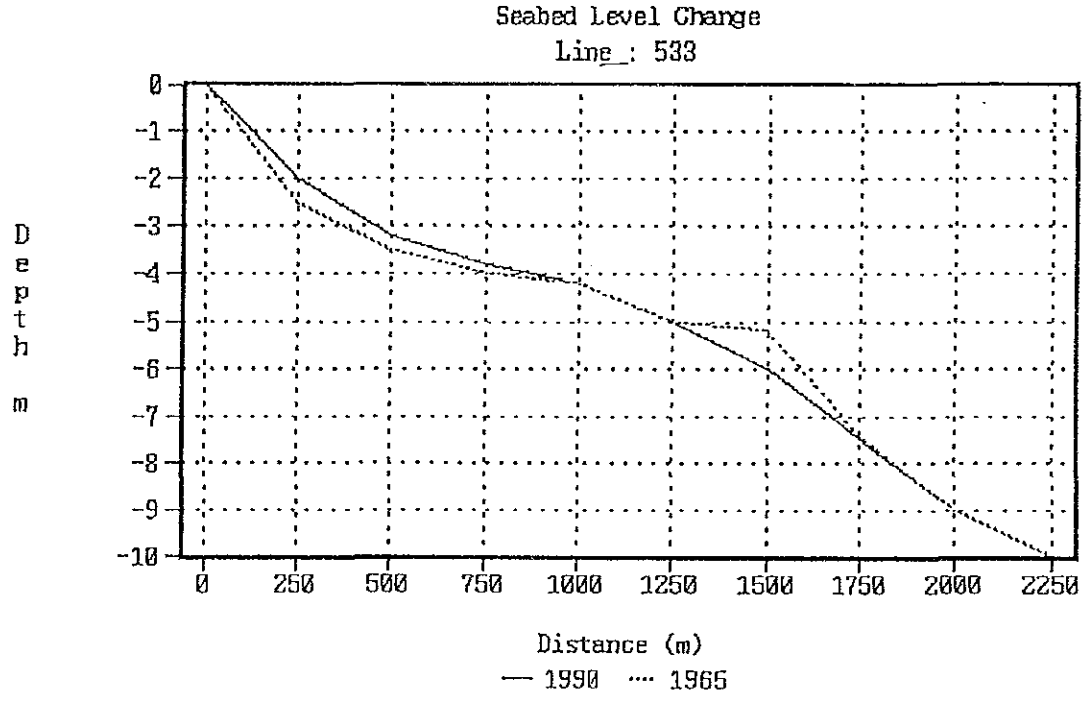


Fig.4-3-9(4) Seabed Level Change at Manta

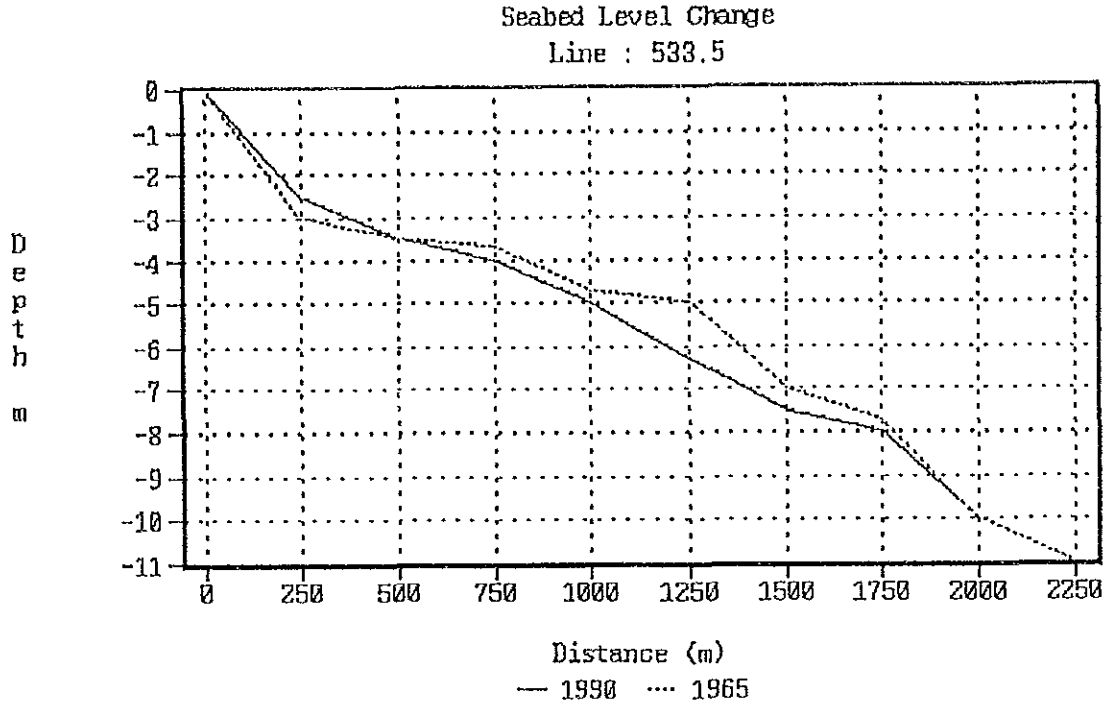


Fig.4-3-9(5) Seabed Level Change at Manta

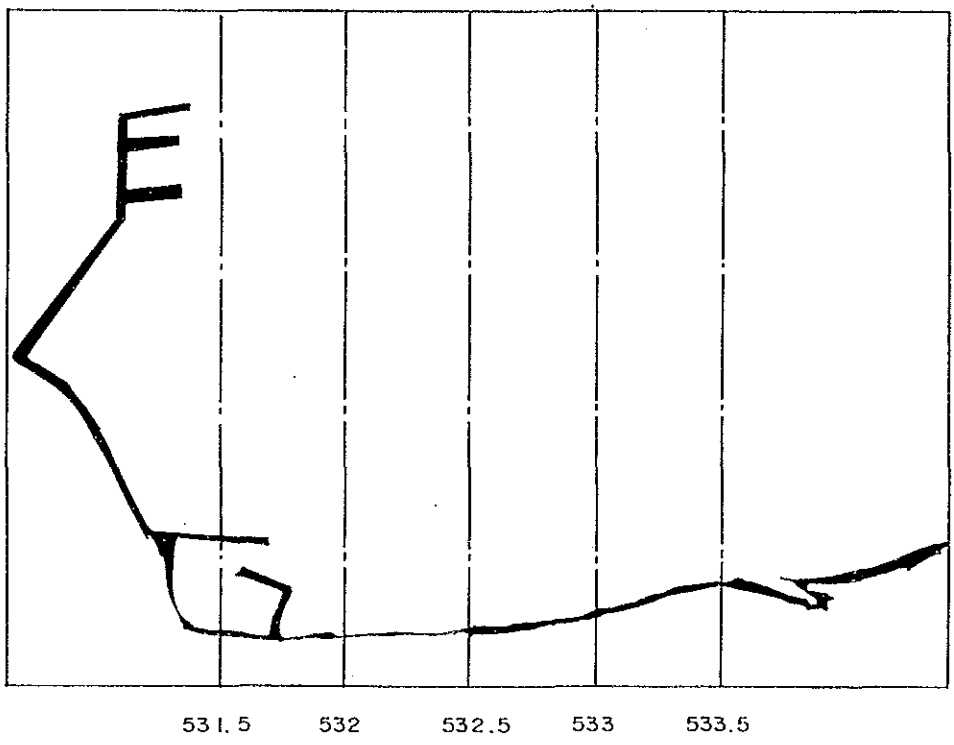


Fig.4-3-9(6) Measurung Line of Seabed Level Change

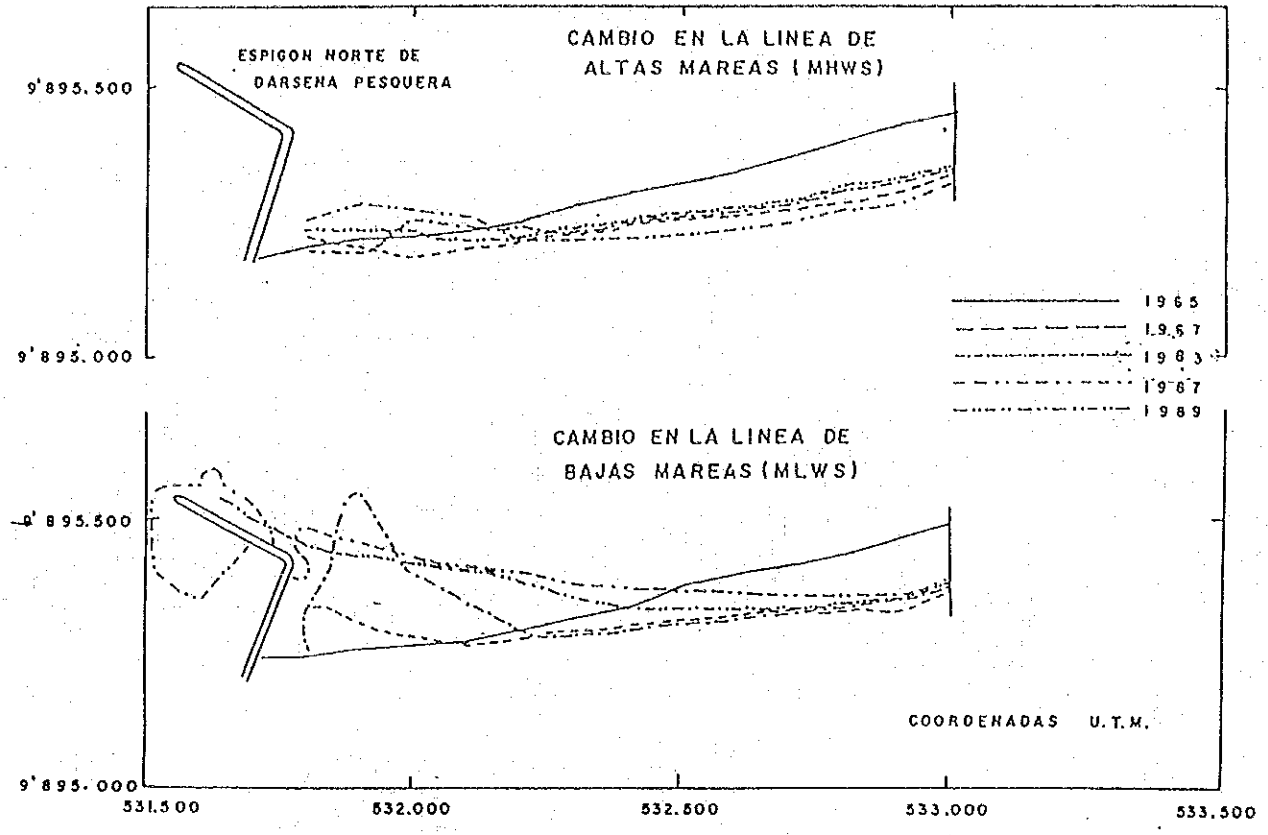


Fig.4-3-9(7) Shoreline Change at Manta

Fig.4-4-1 Work Schedule Pattern for Middle Scale Boats.

Pattern A

Group	No.	Sun.	Mon.	Tue.	Wed.	Thu.	Fri.	Sat.	Sun.	Mon.	Tue.	Wed.	Thr.	Fri.	Sat.
No.1	12			Fishing				Idling			Fishing				Idling
No.2	12	Idling			Fishing				Idling			Fishing			
No.3	13		Idling			Fishing				Idling			Fishing		
No.4	13			Idling			Fishing				Idling			Fishing	
No. of idling boats		37	38	26	13	0	12	24	37	38	26	13	0	12	24

Pattern B

Group	No.	Sun.	Mon.	Tue.	Wed.	Thu.	Fri.	Sat.	Sun.	Mon.	Tue.	Wed.	Thr.	Fri.	Sat.
No.1	12			Fishing				Idling			Fishing				Idling
No.2	12	Idling			Fishing				Idling			Fishing			
No.3	13		Idling			Fishing				Idling			Fishing		
No.4	13			Idling			Fishing				Idling			Fishing	
No. of idling boats		24	25	26	13	0	0	12	24	25	26	13	0	0	12

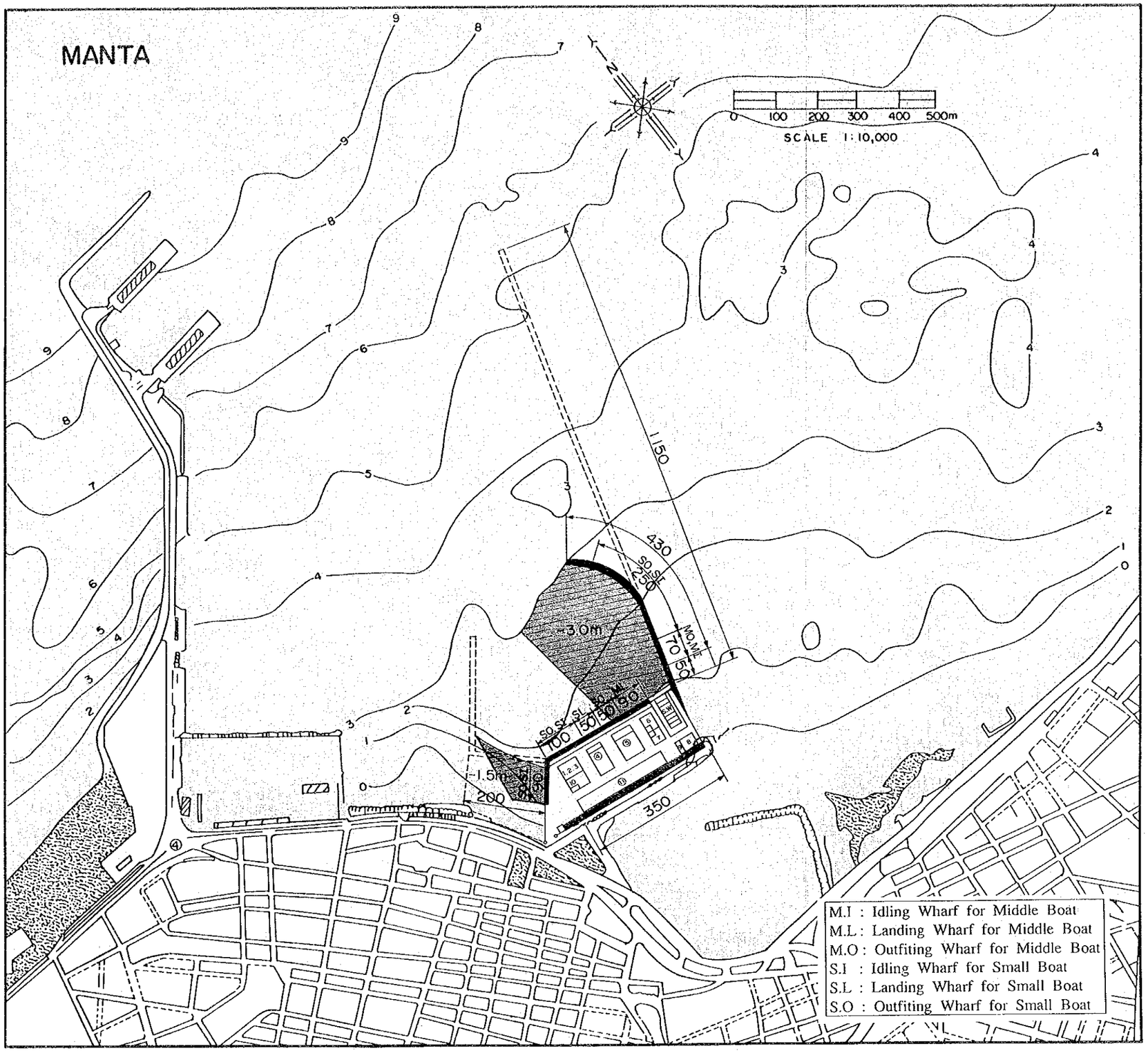


Fig.4-5-1 Short-Term Development Plan Alternative-1 for Manta

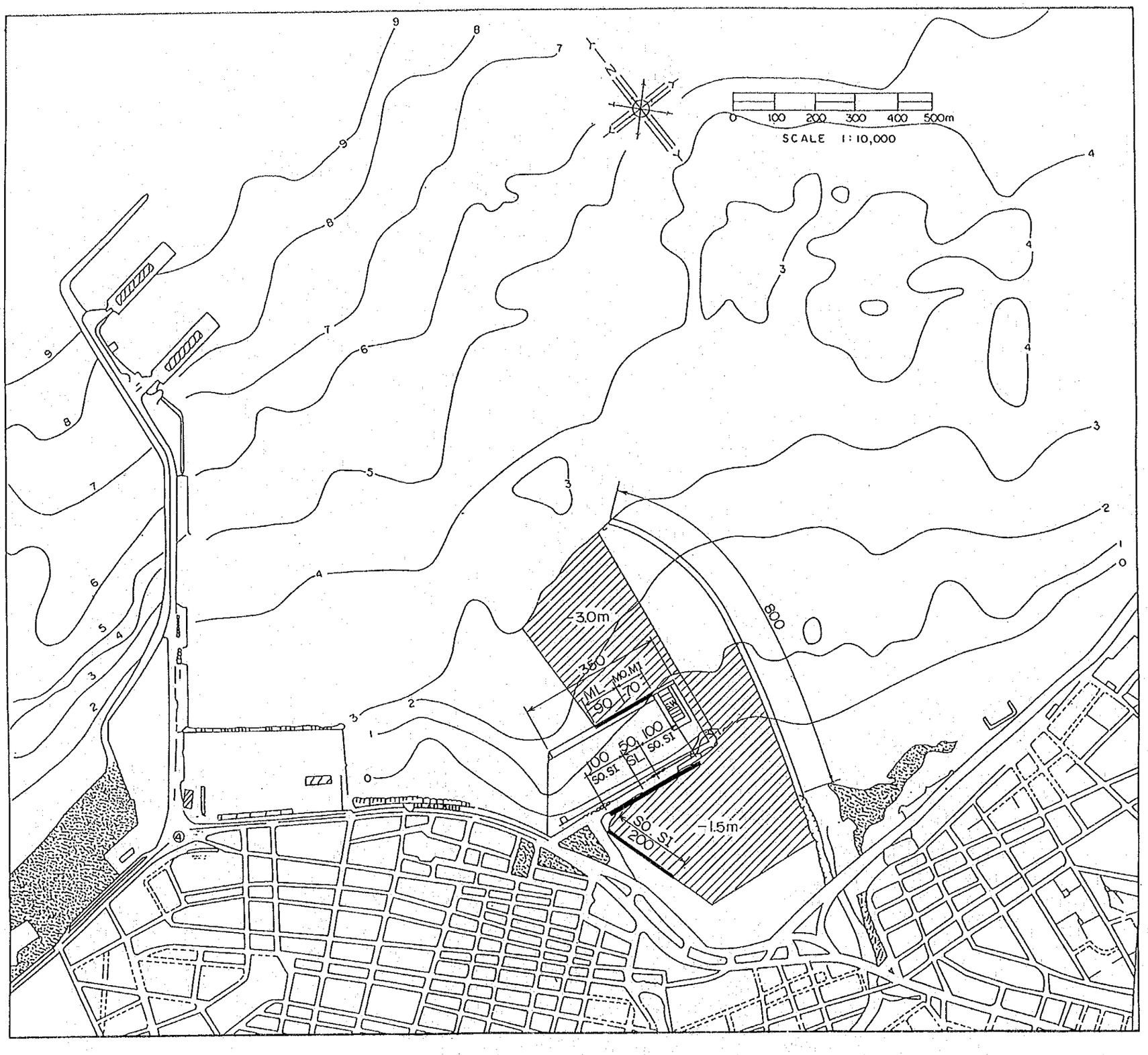
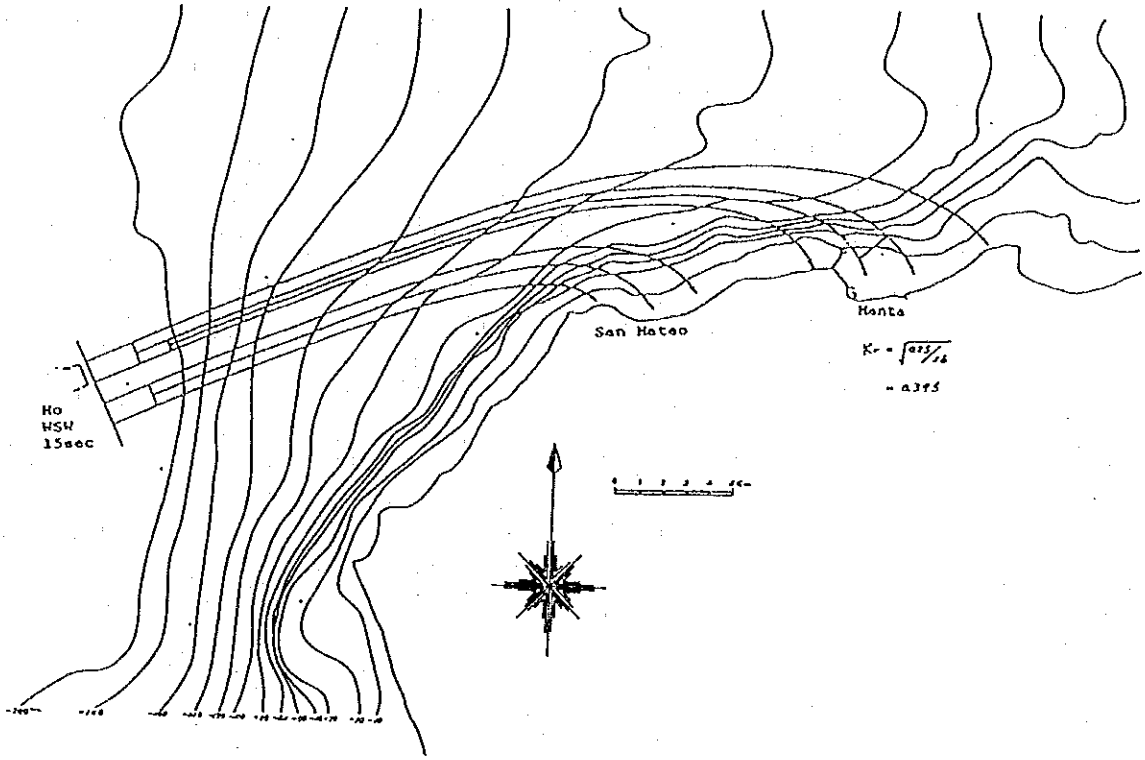


Fig.4-5-2 Short-Term Development Plan Alternative-3 for Manta



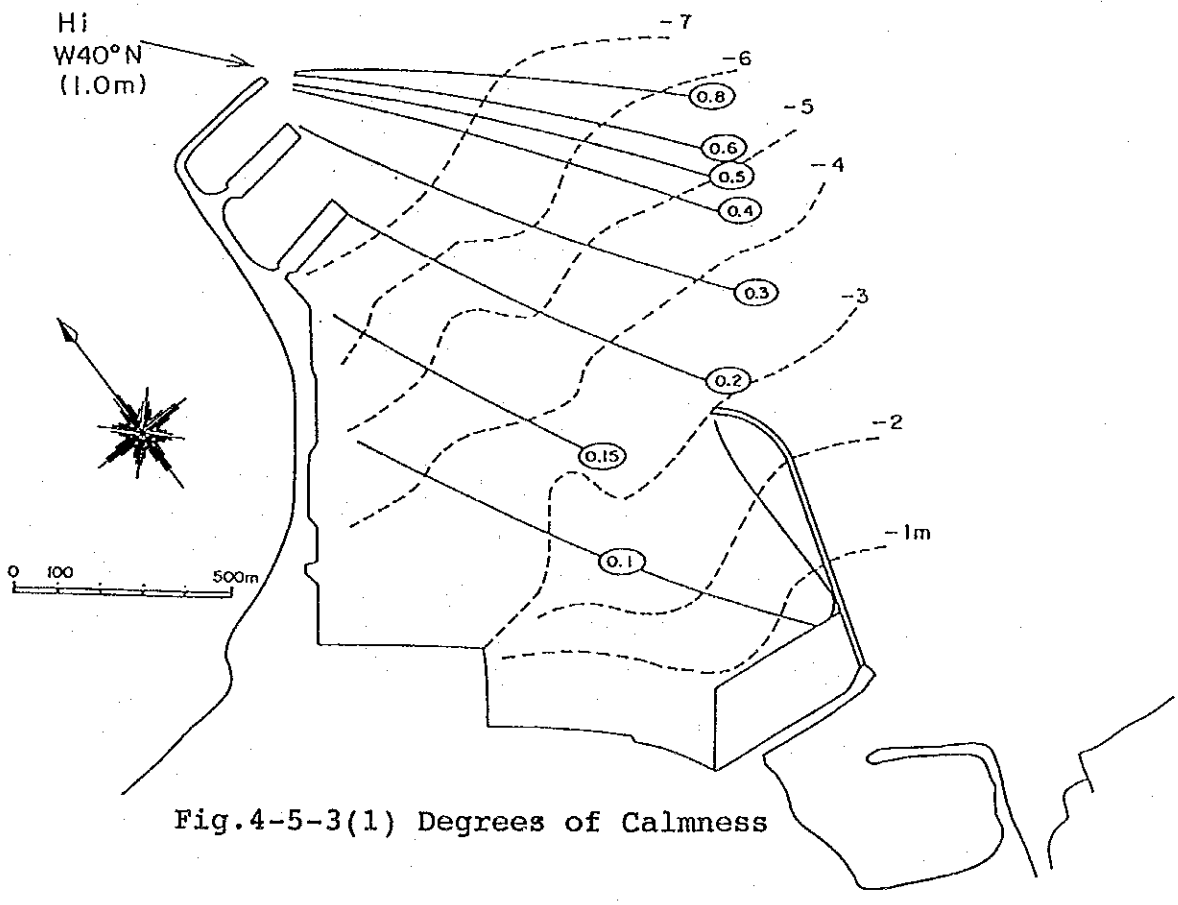
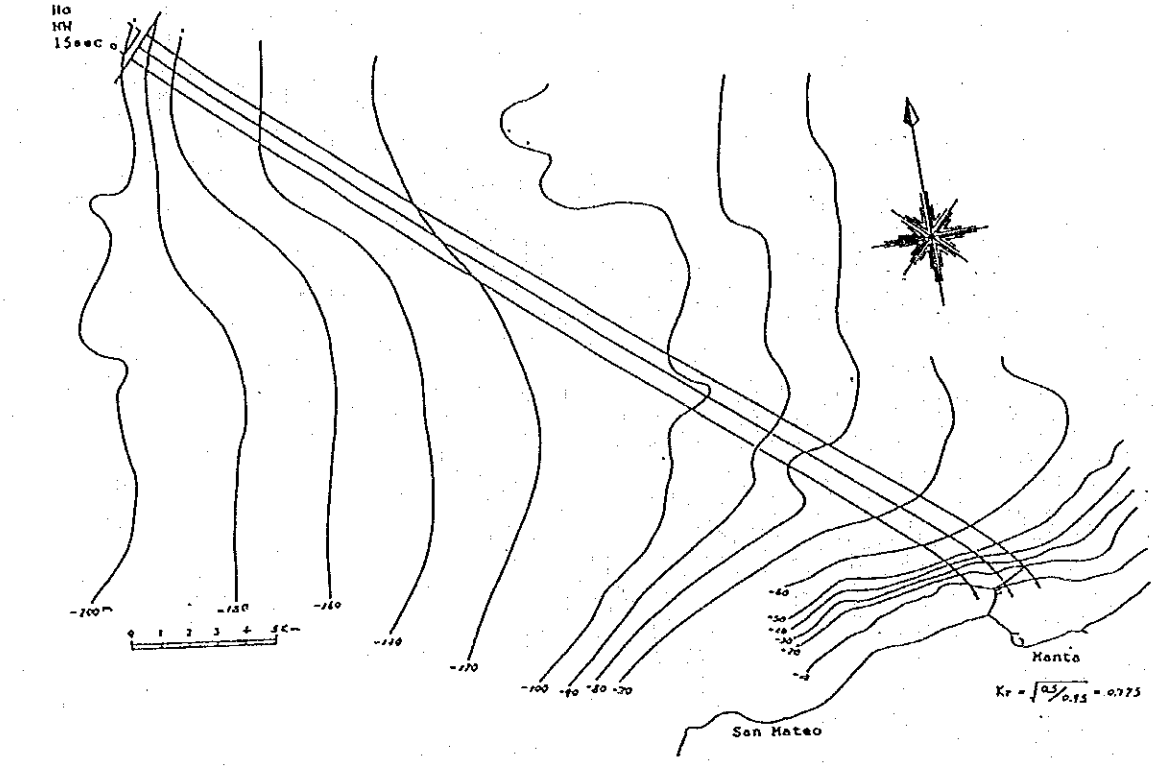


Fig.4-5-3(1) Degrees of Calmness



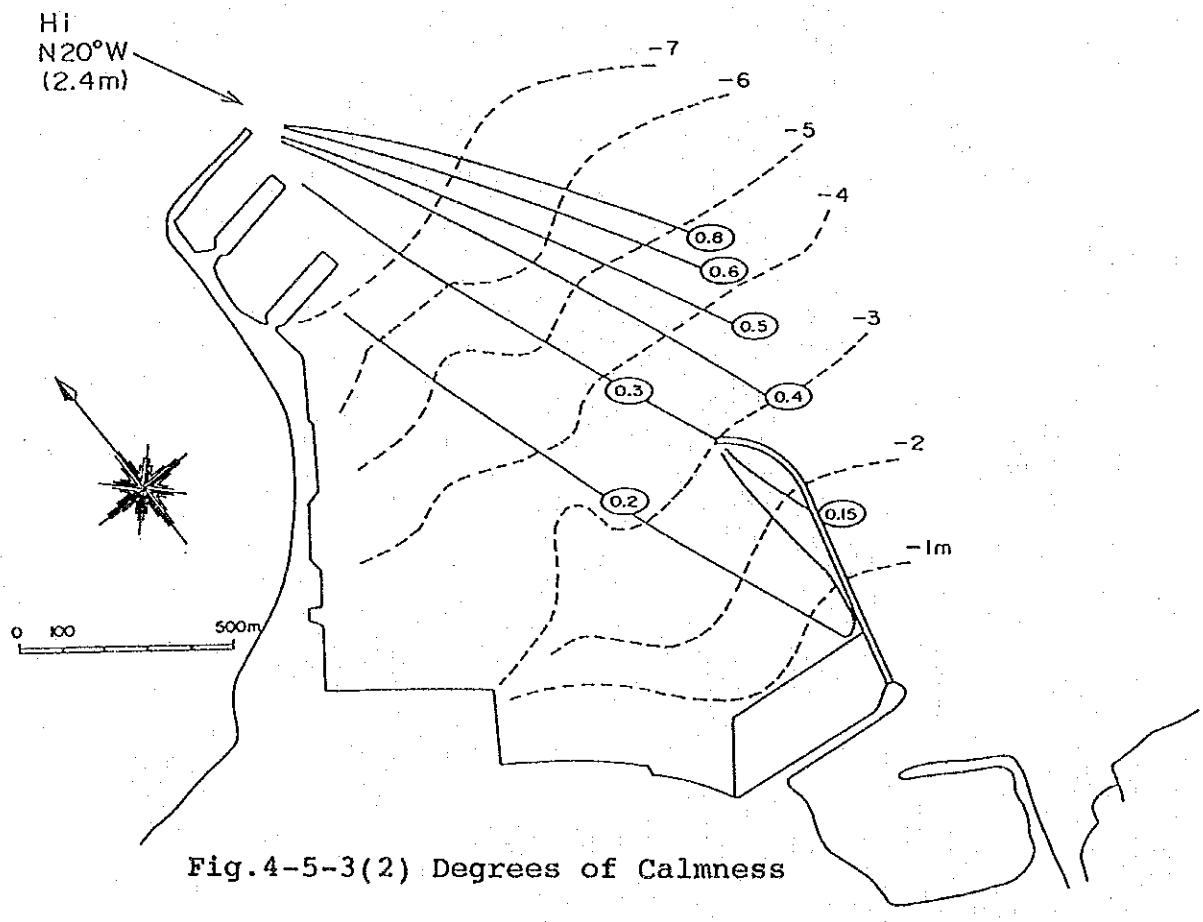


Fig.4-5-3(2) Degrees of Calmness

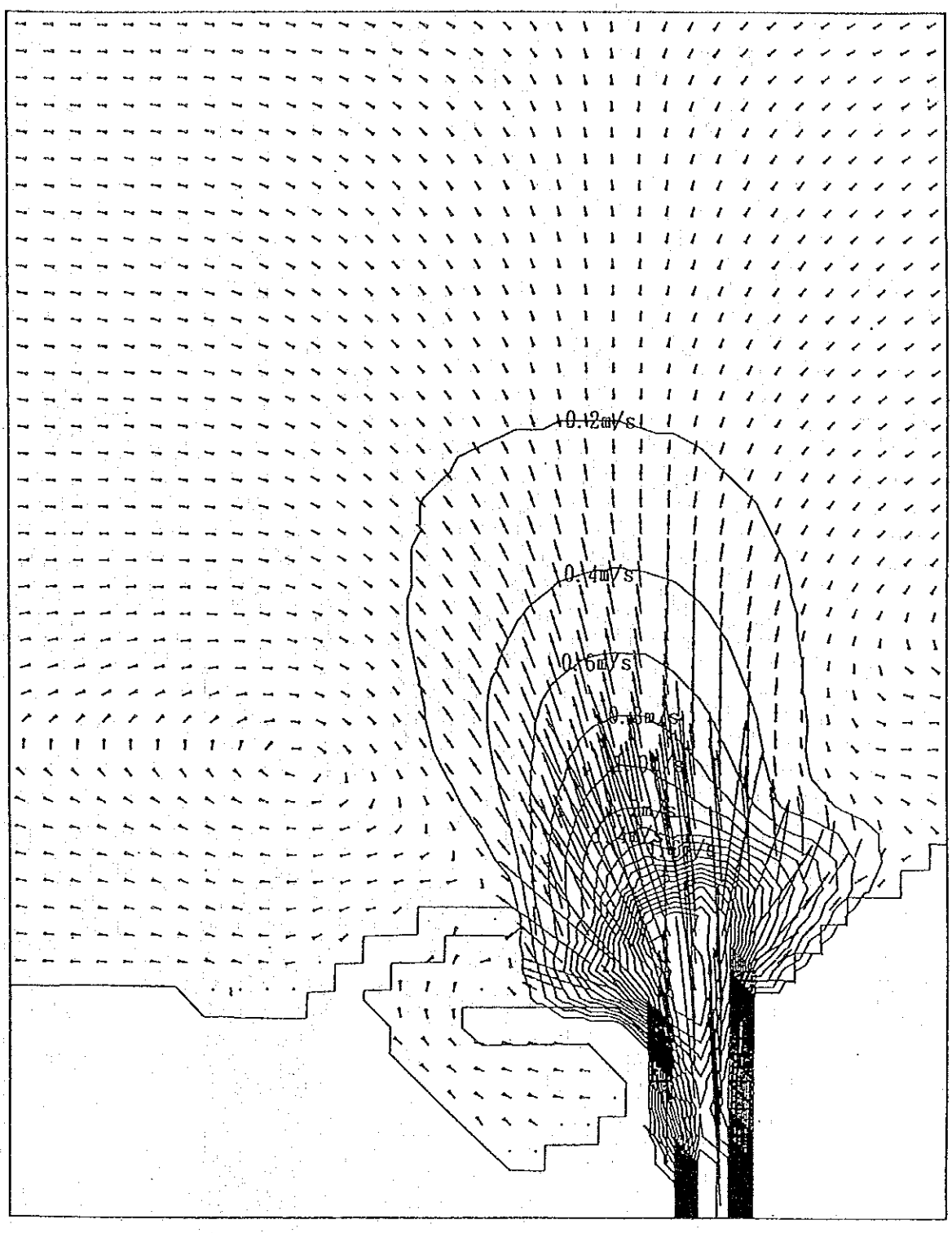


Fig.4-5-4(1) Current Vector

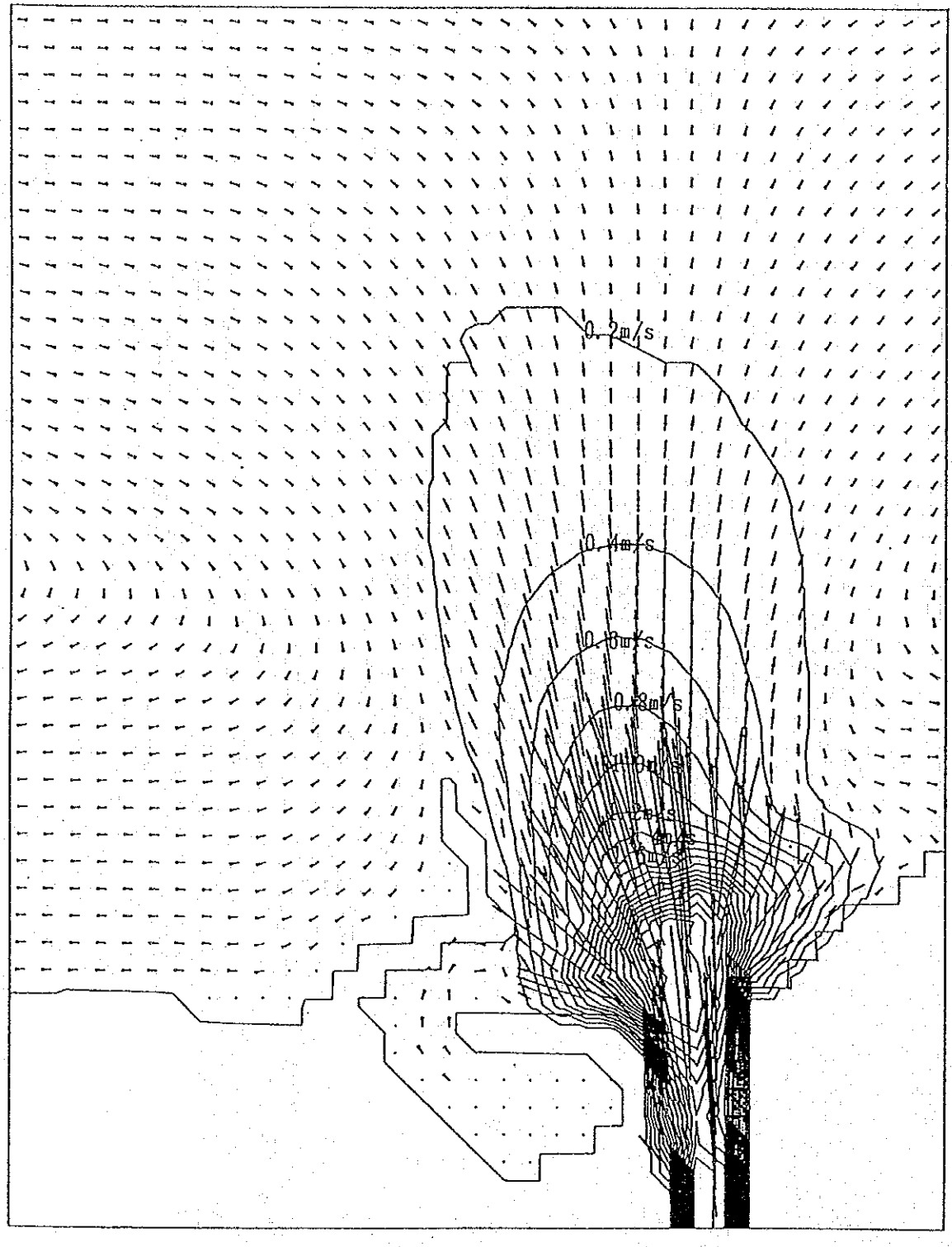


Fig.4-5-4(2) Current Vector

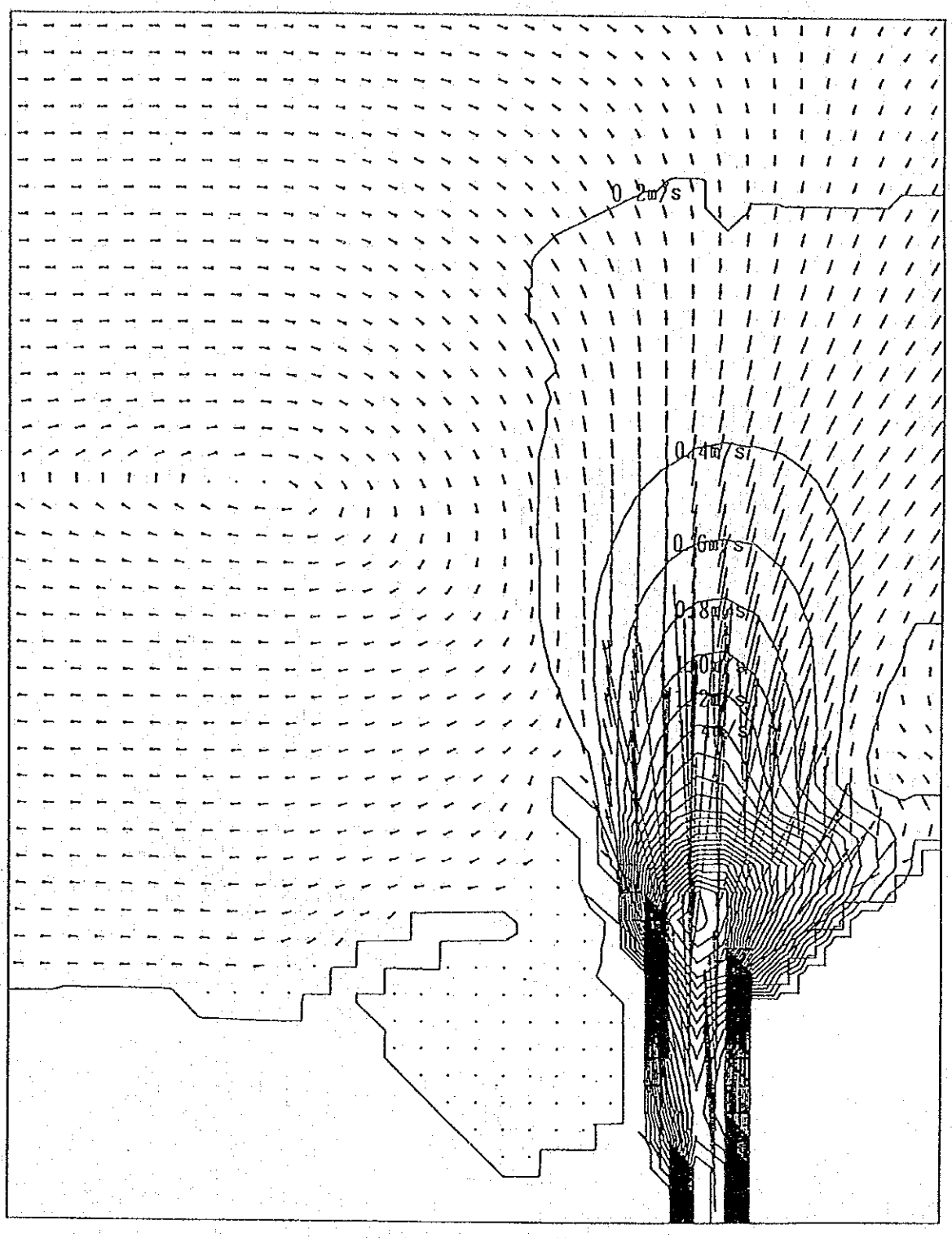


Fig.4-5-4(3) Current Vector

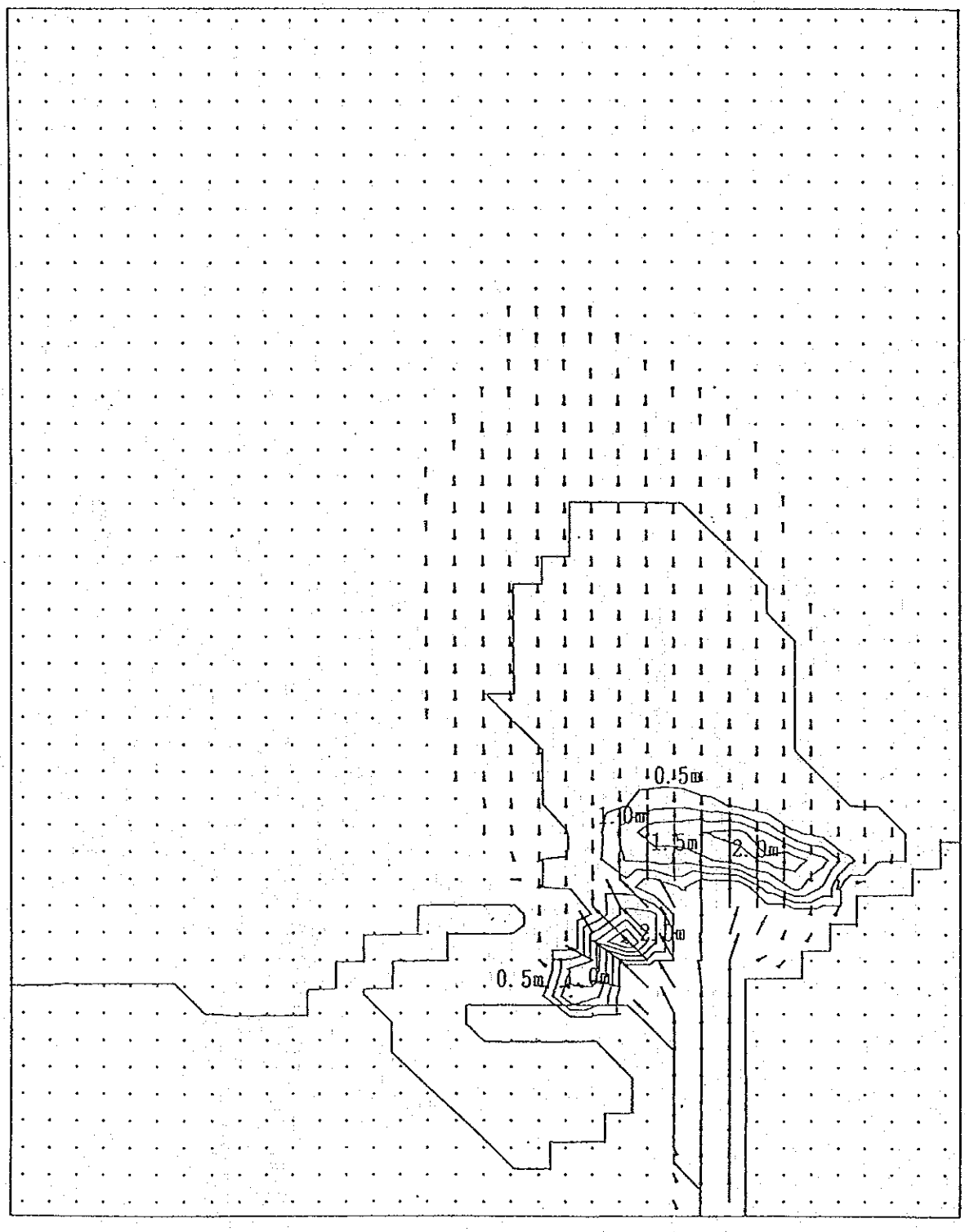


Fig.4-5-5(1) Seabed Topography Change

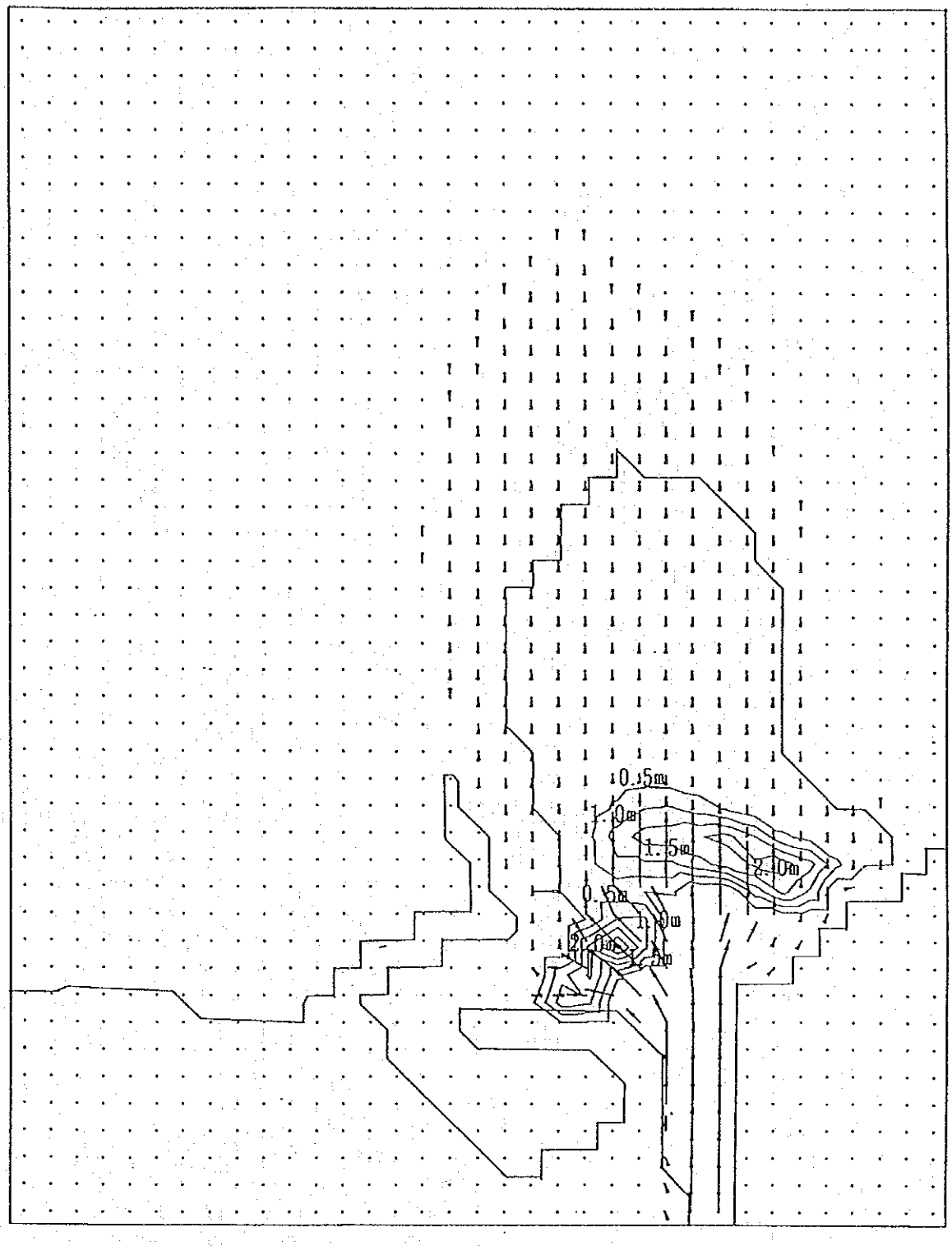


Fig.4-5-5(2) Seabed Topography Change

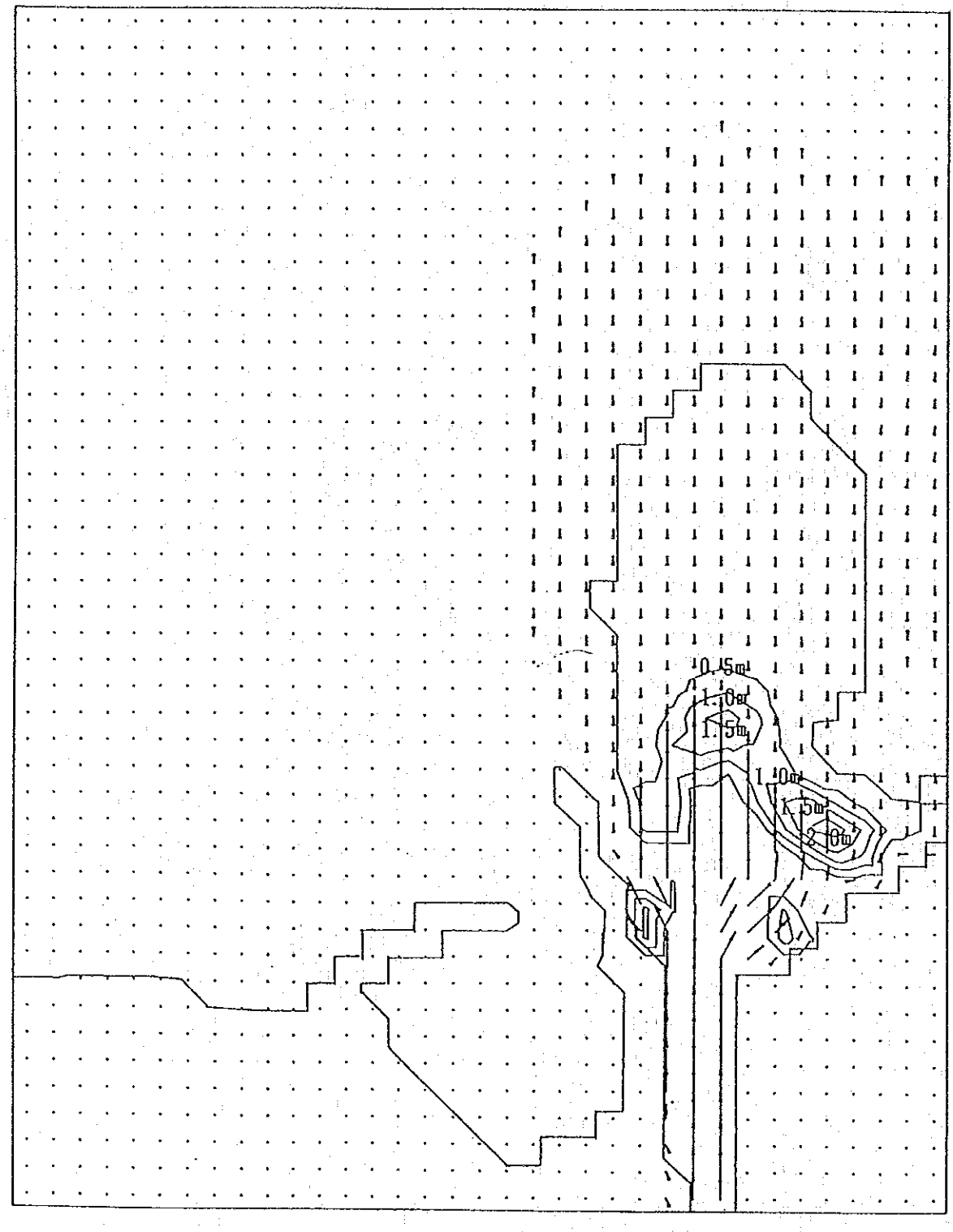
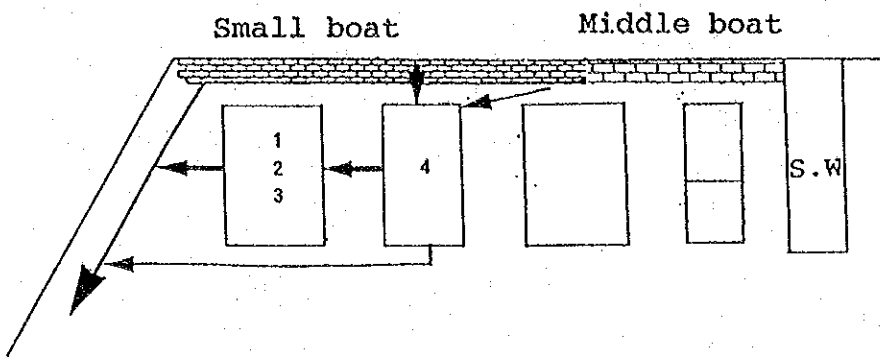


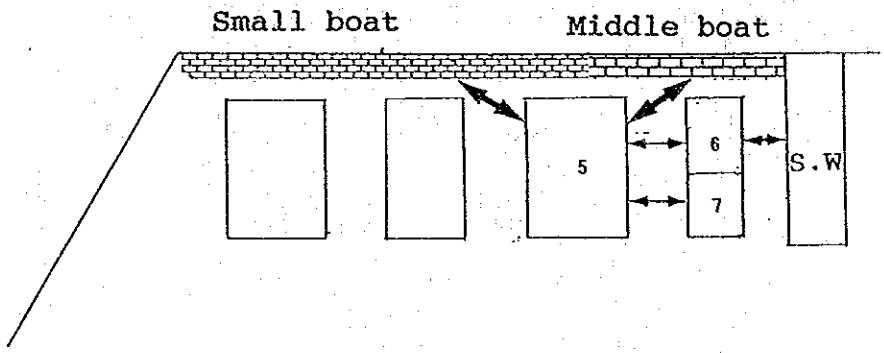
Fig.4-5-5(3) Seabed Topography Change



Fish Catches

1. Cold Storage
2. Ice Making Plant
3. Ice Storage
4. Fish Handling Space

Flowchart of Fish Catches

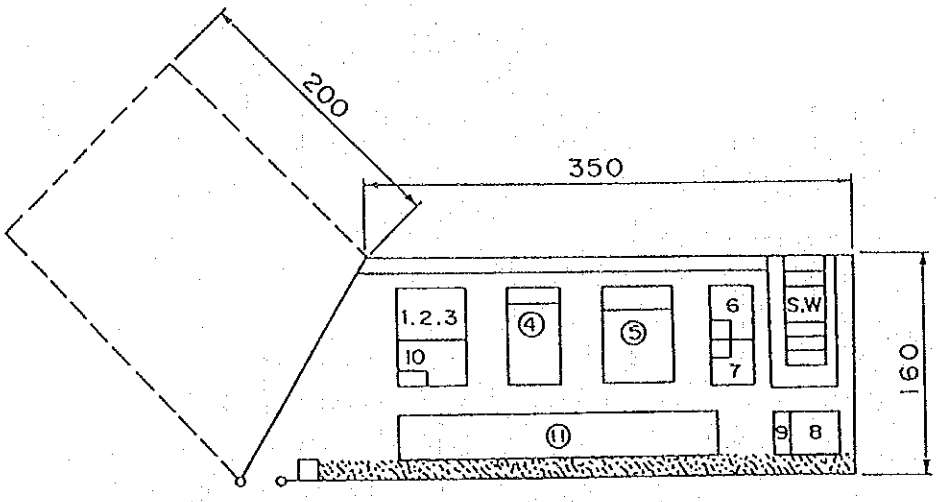


Instruments

5. Fishing Gear Repairing Space
6. Workshop
7. Warehouse
S.W Slipway

Flowchart of Instruments

Fig.4-5-6(1) Flowchart of Fish Catches



Manta

1. Cold Storage
2. Ice Making Plant
3. Ice Storage
4. Fish Handling Space
5. Fishing Gear Repairing Spa
6. Workshop
7. Warehouse
8. Fuel Oil Tank
9. Freshwater Tank
10. Administration Bldg
11. Parking Area

S.W Slipway

Greenbelt

Fig.4-5-6(2) Layout Plan for Functional Facilities(Manta)

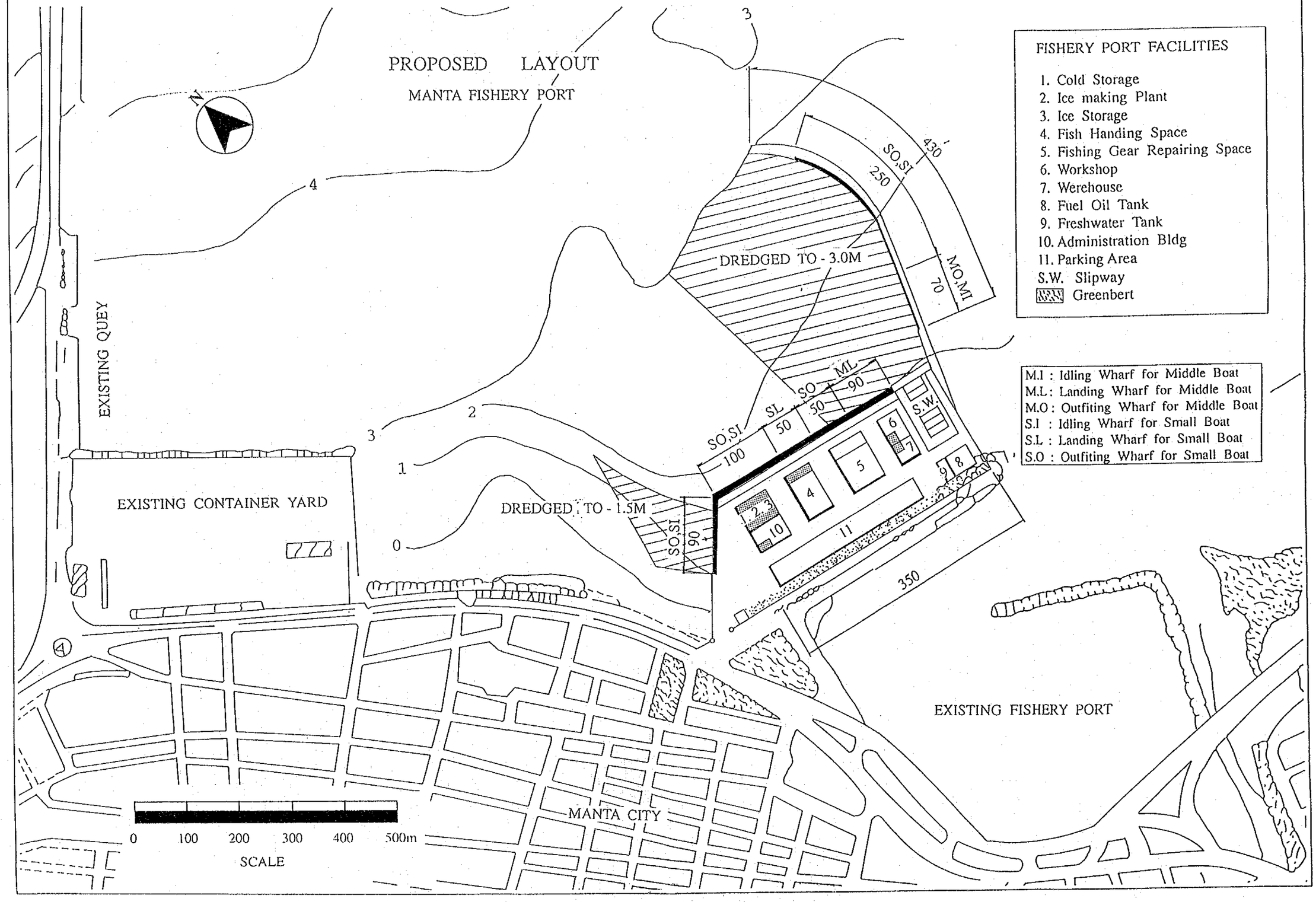


Fig.4-5-7 Layout Plan of Manta Fishing Port

Fig.4-6-1(1) Typical Cross Section of Slope Type Quay
for Fish Landing of Small Boat

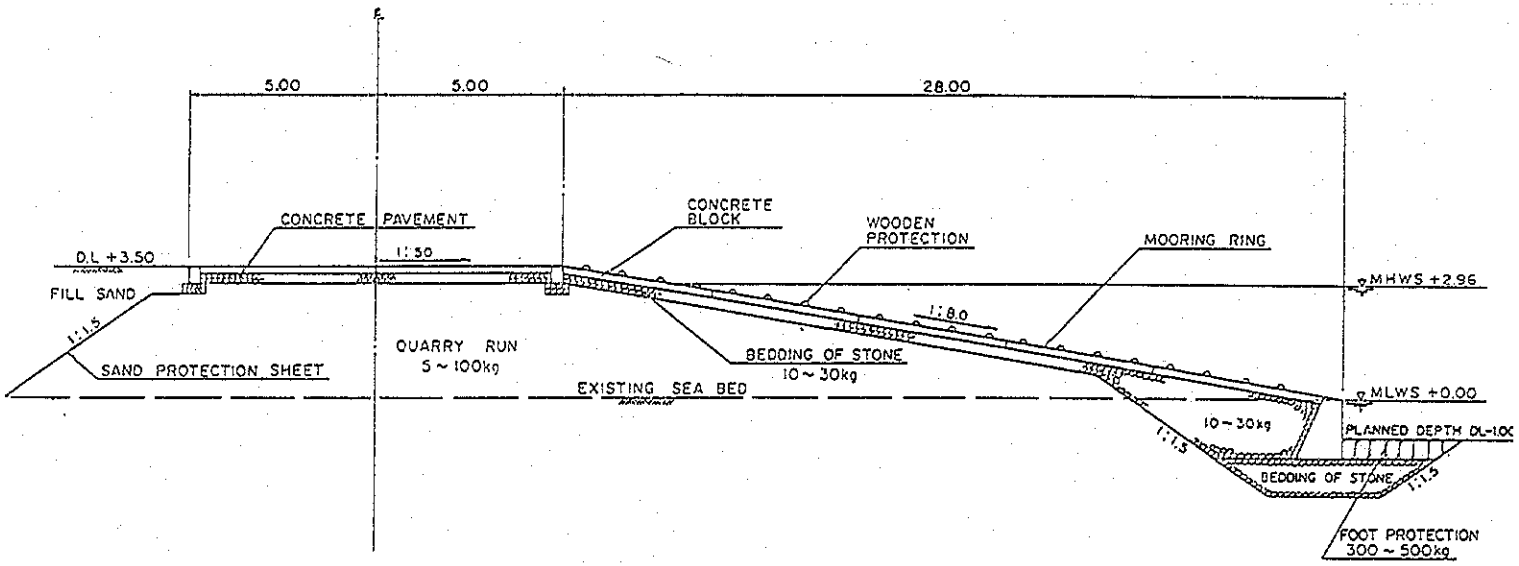


Fig.4-6-1(2) Side View of Slope Type Quay

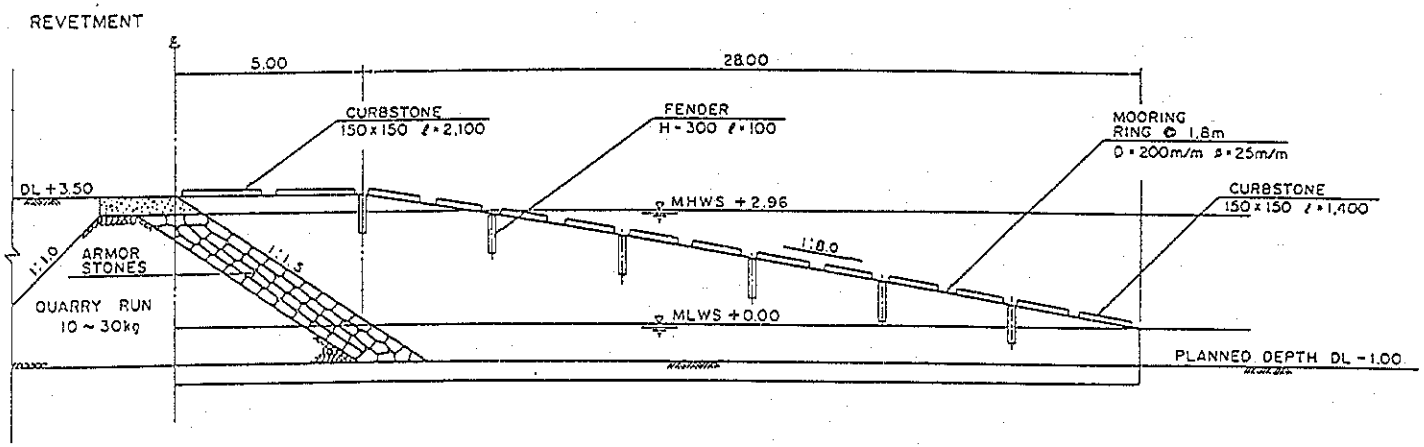


Fig.4-6-2 Typical Cross Section of Gravity Type Quay
for Fish Landing of Middle Boat

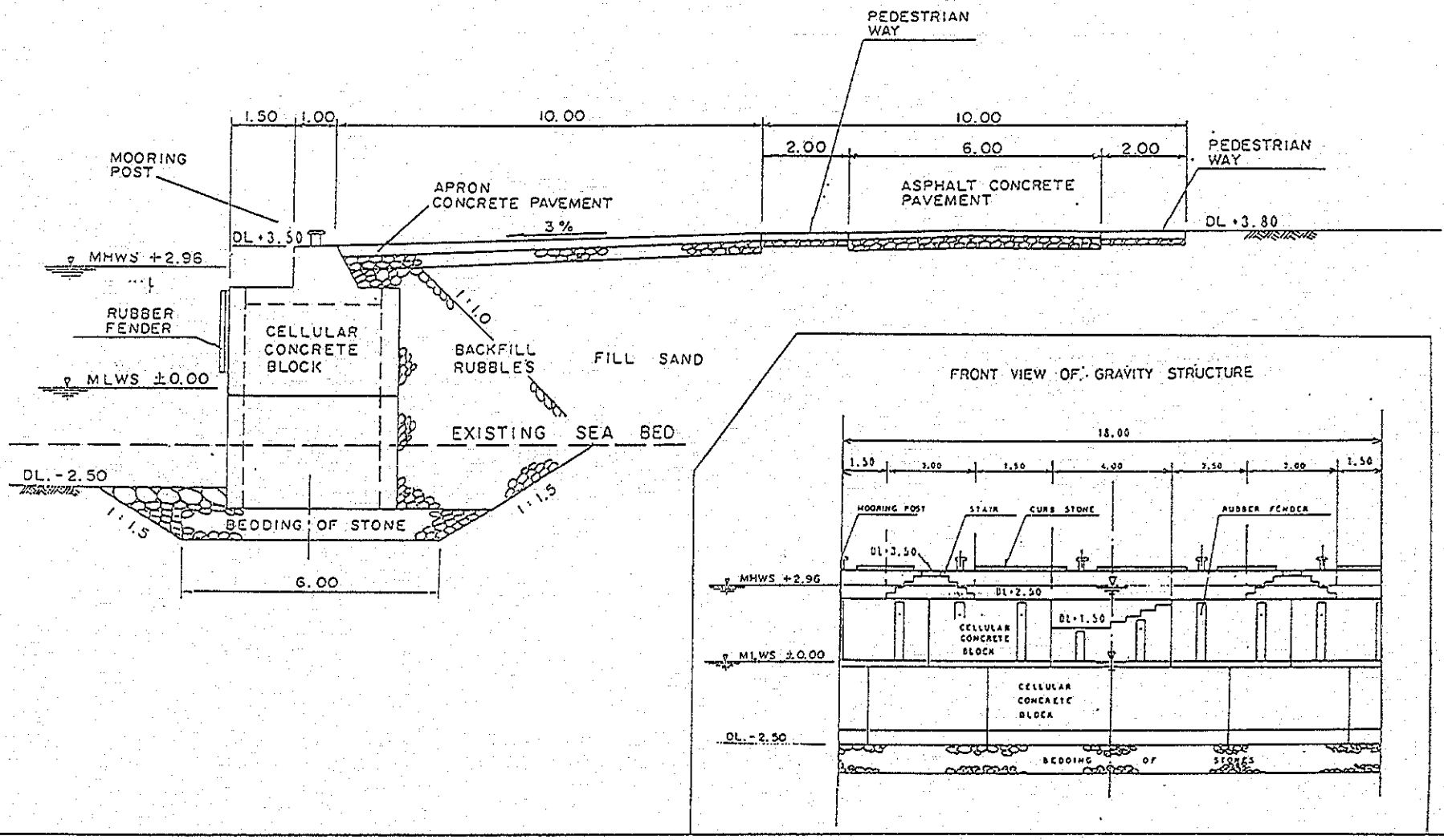


Fig.4-6-3 Typical Cross Section of Open Type Quay for Outfitting of Middle Boat

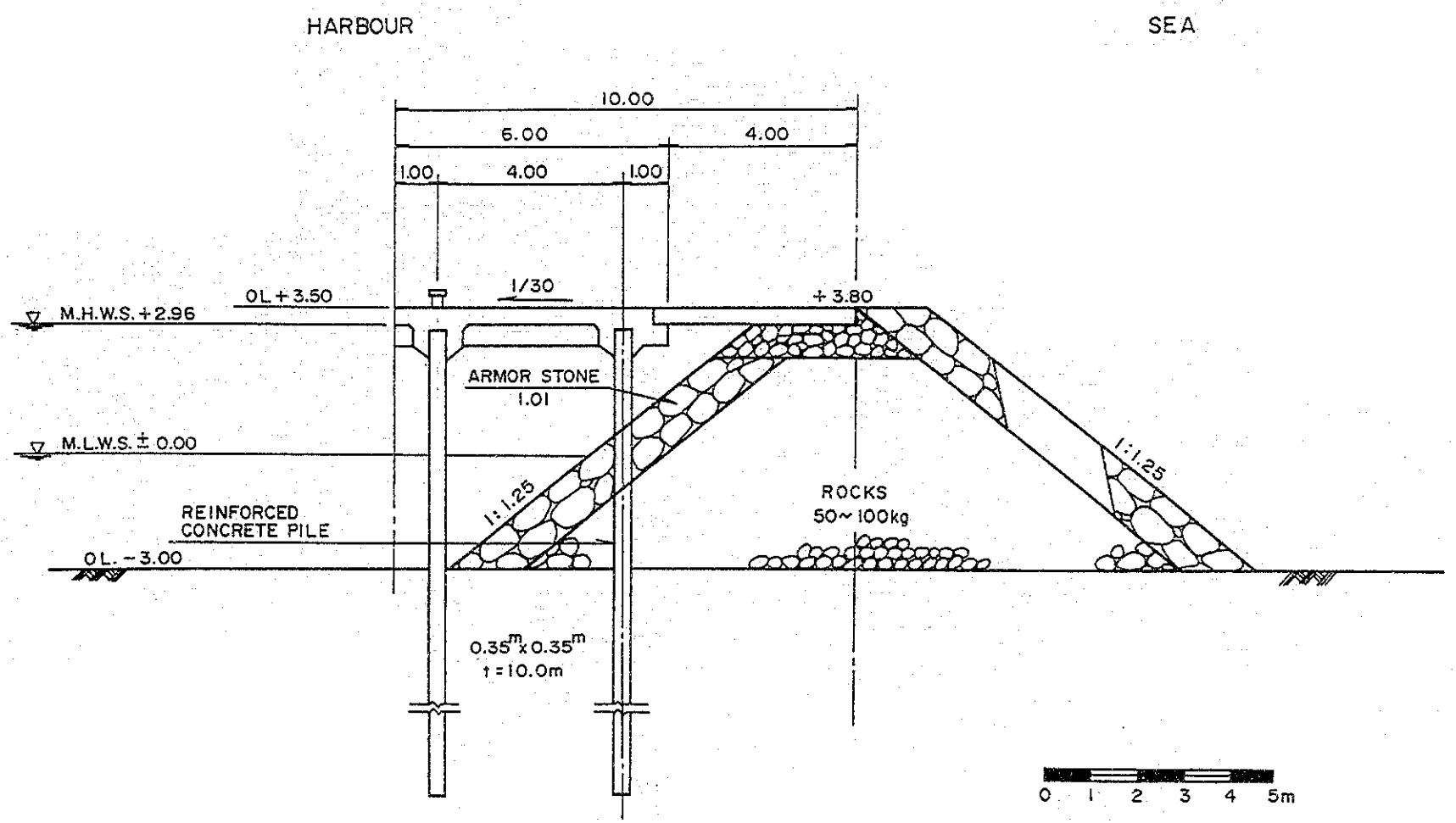


Fig.4-6-4 Typical Cross Section of Slip Way

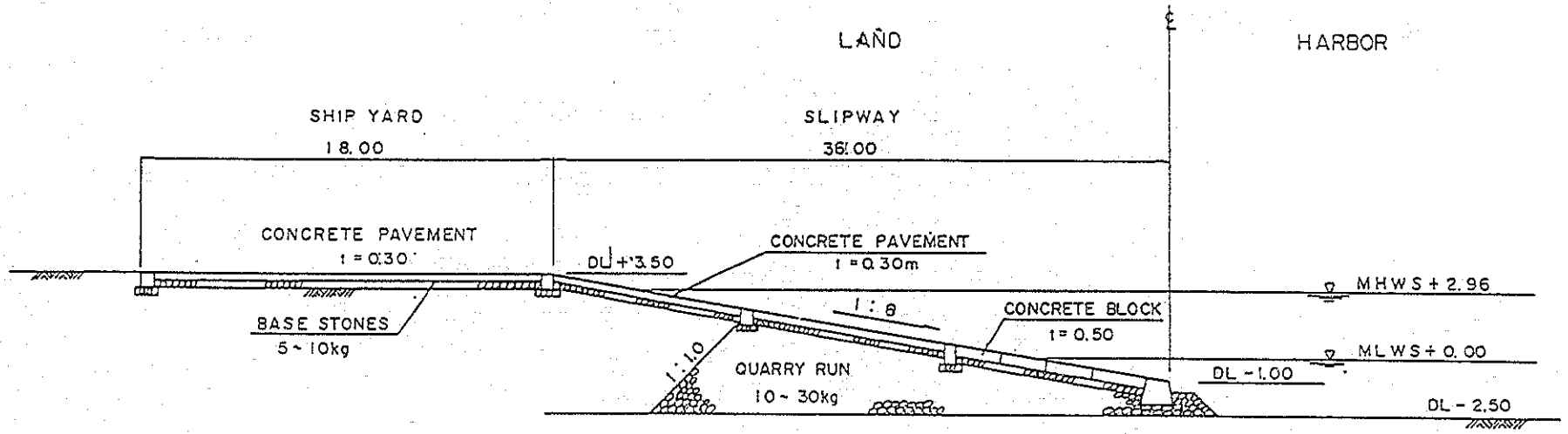


Fig.4-6-5 Typical Cross Section of Revetment

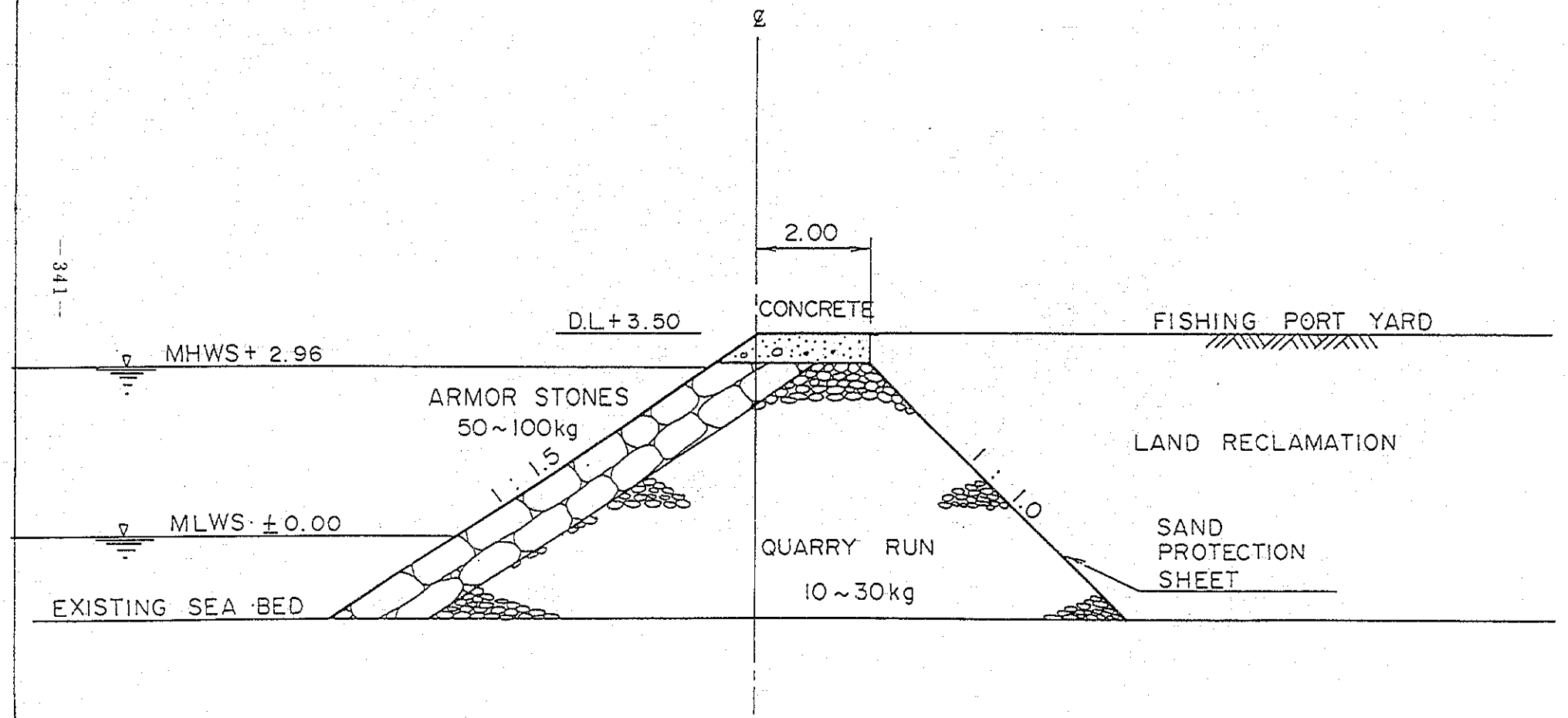


Fig.4-6-6 Floor Plan of Cold Storage, Ice Making Plant and Ice Storage

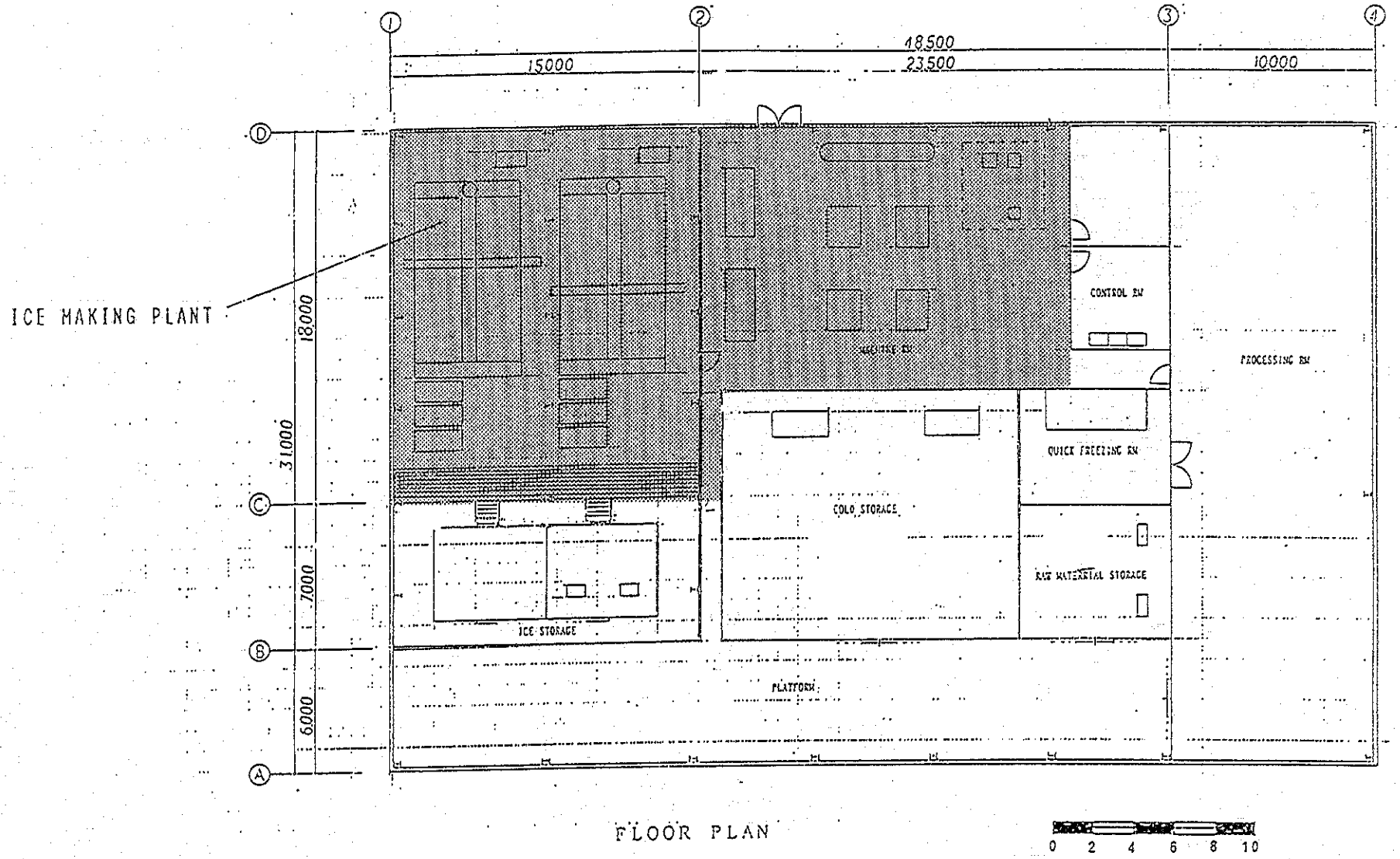
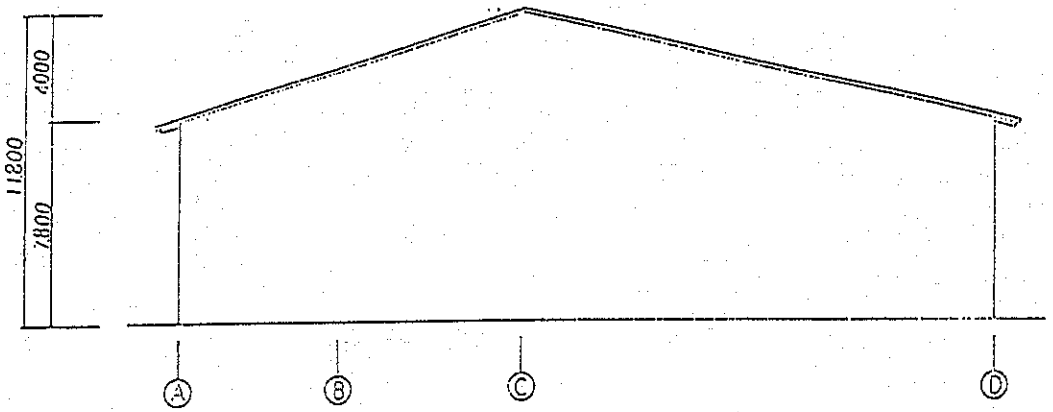
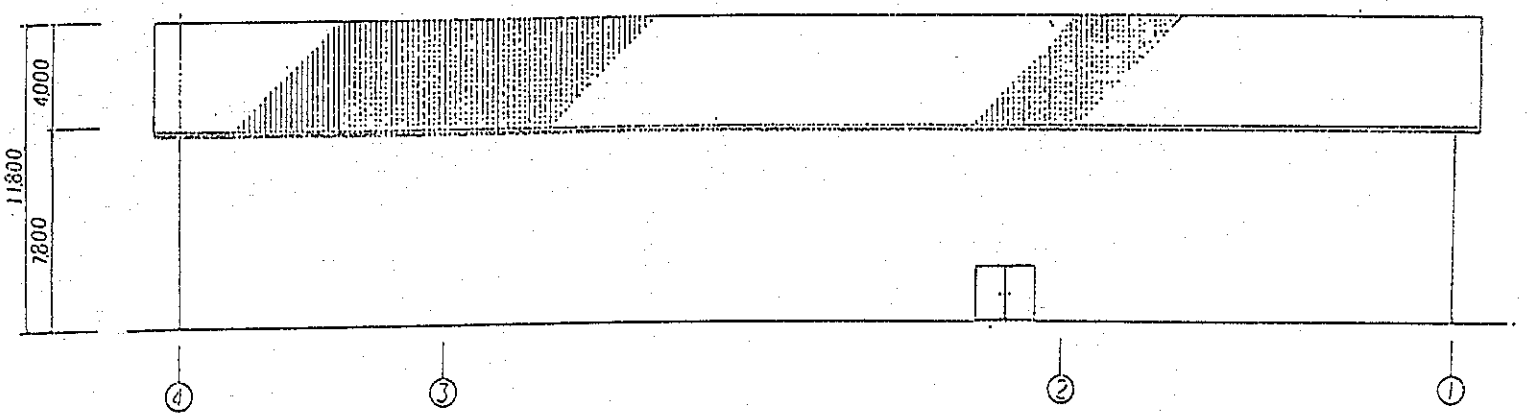


Fig.4-6-7 Elevation of Cold Storage, Ice Making Plant and Ice Storage



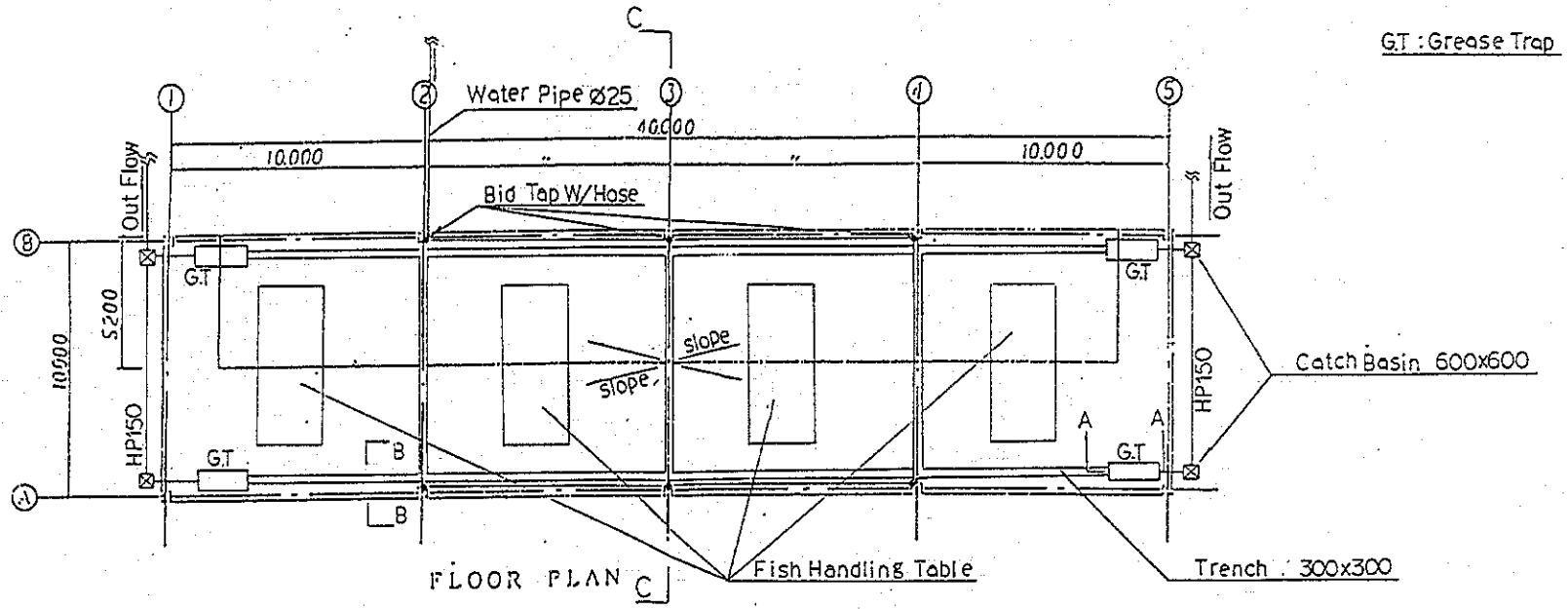
ELEVATION 1.

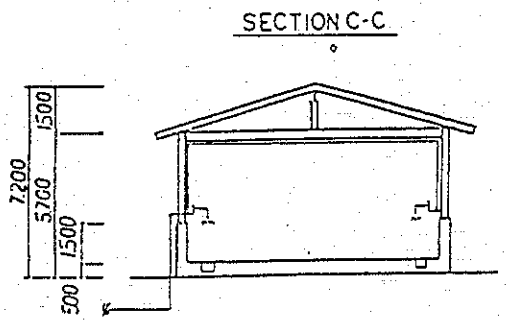


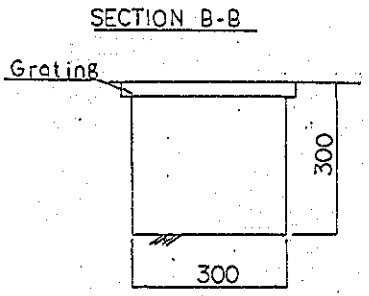
ELEVATION 2.

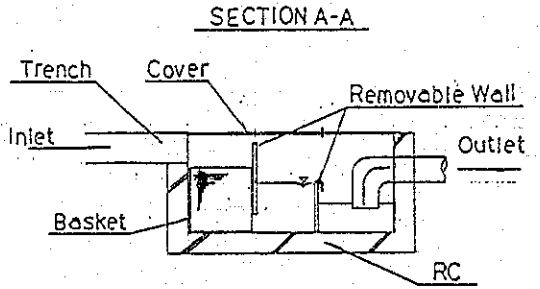
0 2 4 6 8 10

Fig.4-6-8 Floor Plan of Fish Handling Space and Elevations









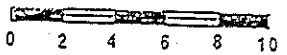
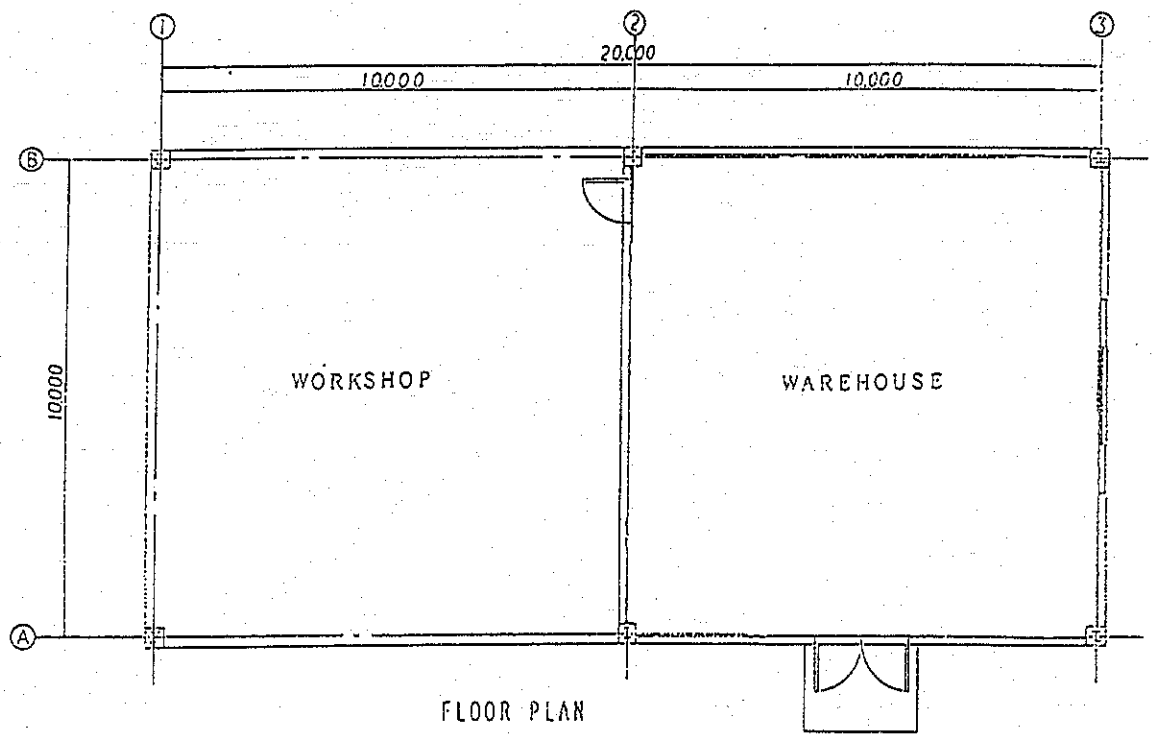
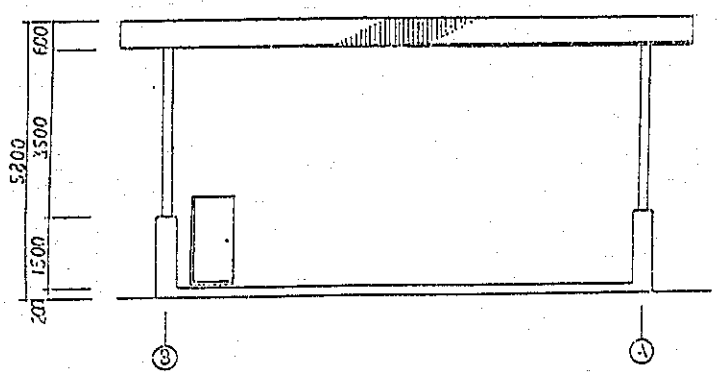


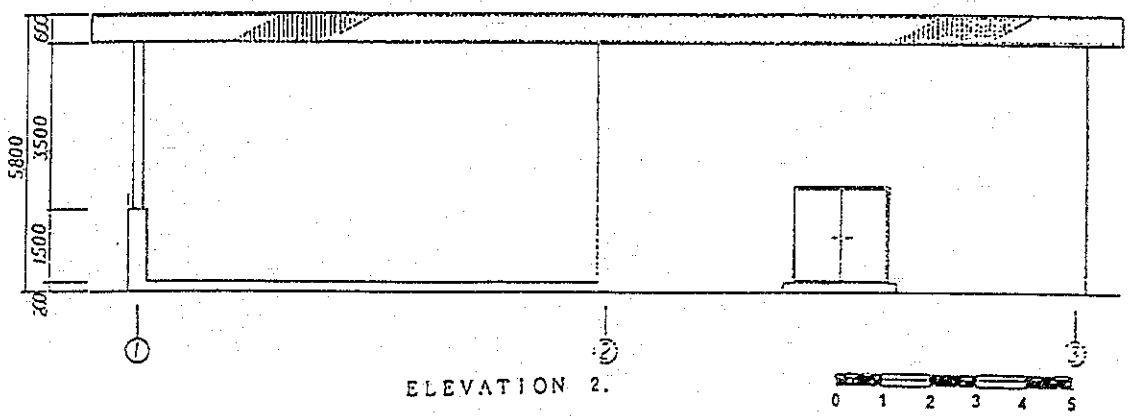
Fig.4-6-9 Floor Plan of Warehouse, Workshop and Elevations



FLOOR PLAN

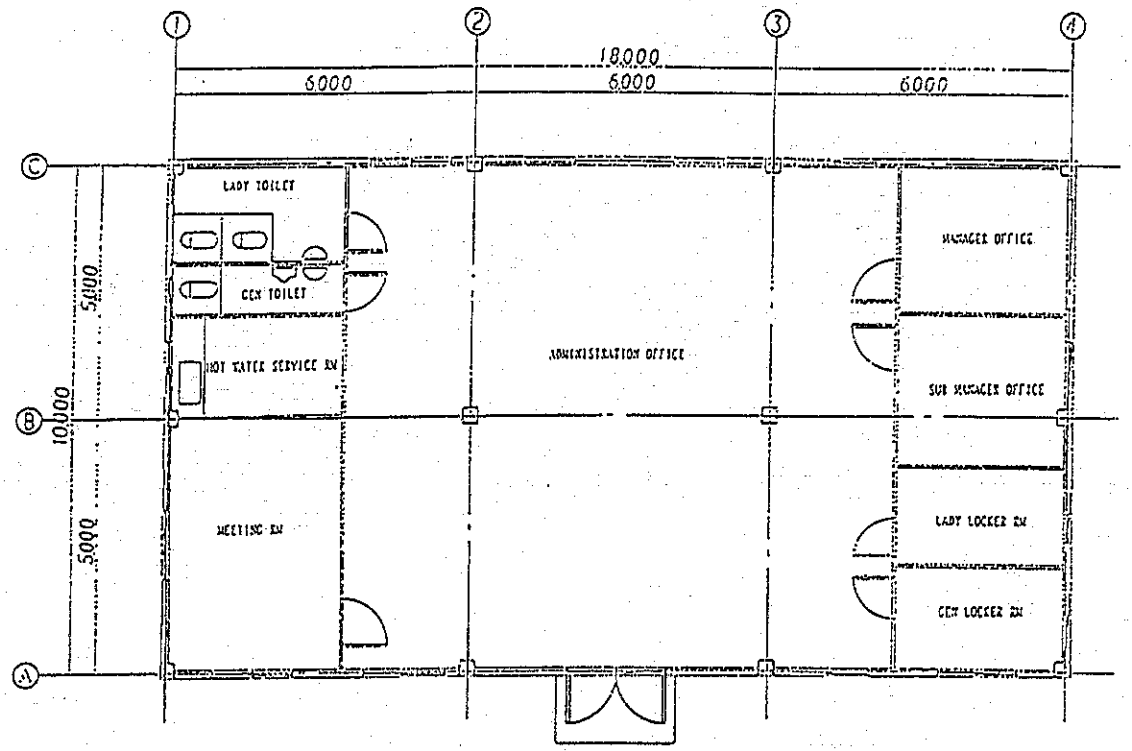


ELEVATION 1.



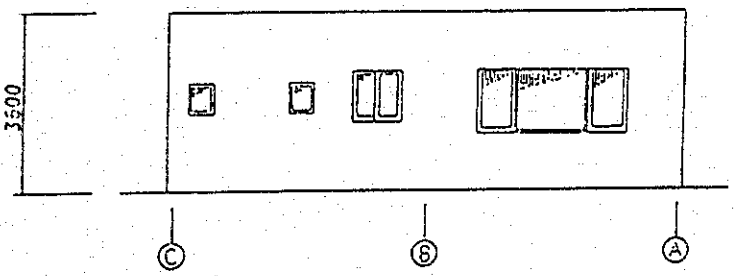
ELEVATION 2.

Fig.4-6-10 Floor Plan of Administration Bldg.and Elevations

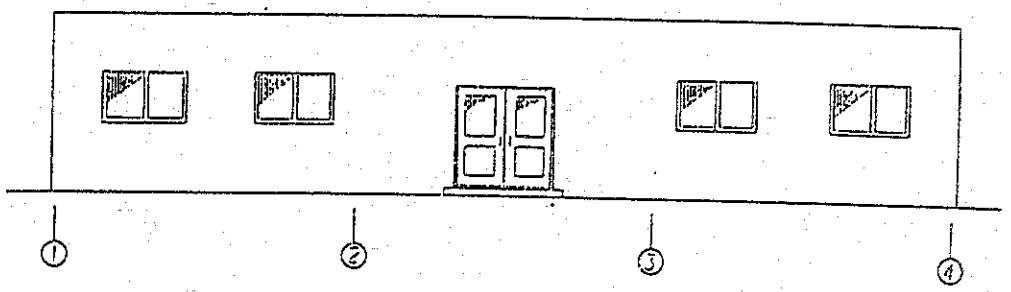


FLOOR PLAN

0 1 2 3 4 5

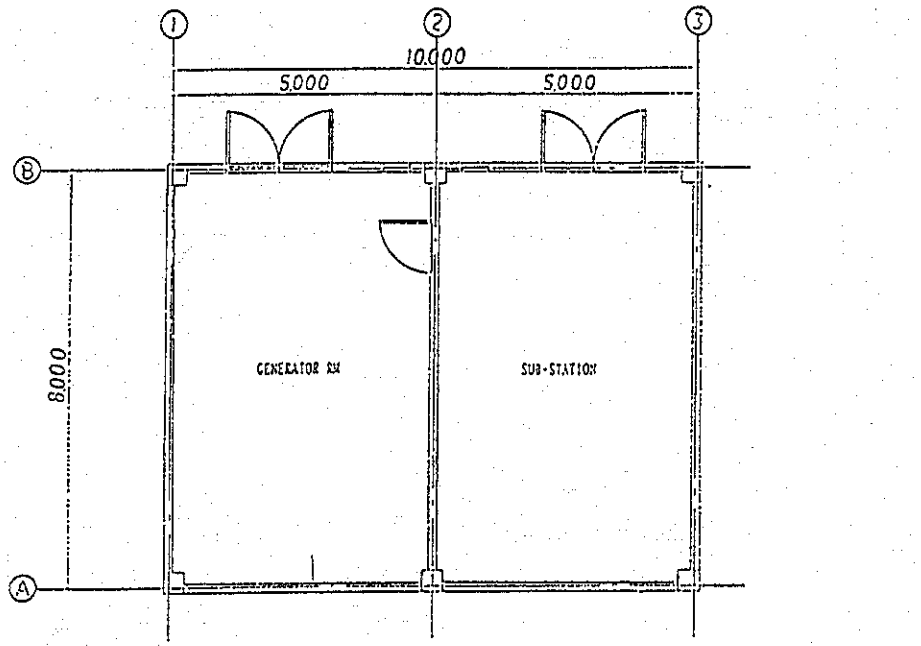


ELEVATION 1.



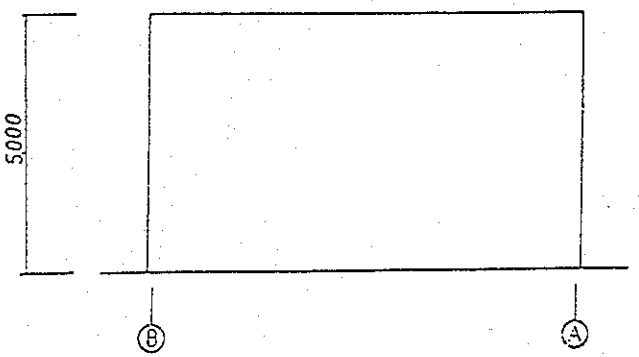
ELEVATION 2.

Fig.4-6-11 Floor Plan of Sub-Station and Elevations

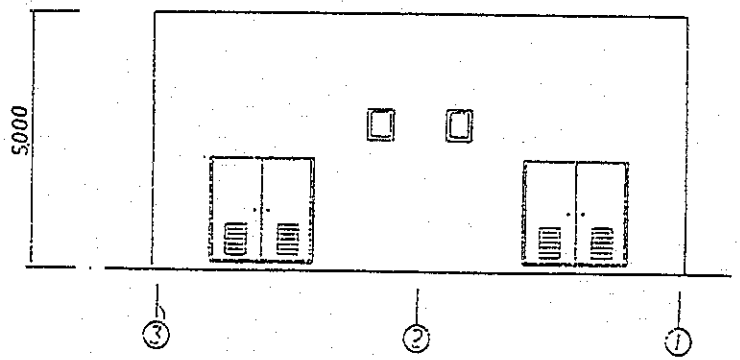


FLOOR PLAN

0 1 2 3 4 5

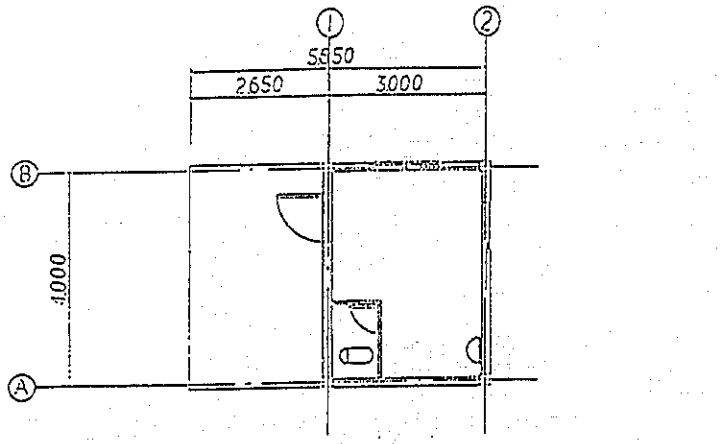


ELEVATION 1.



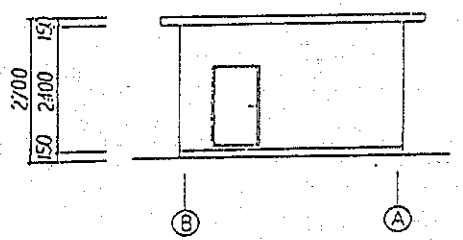
ELEVATION 2.

Fig.4-6-12 Floor Plan of Guard House and Elevations

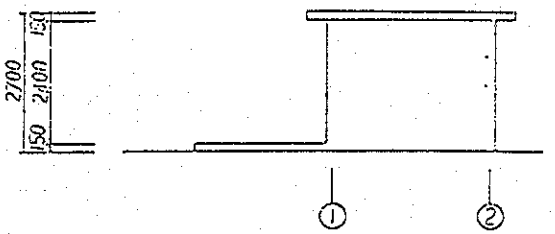


FLOOR PLAN

0 1 2 3 4 5



ELEVATION 1.



ELEVATION 2.

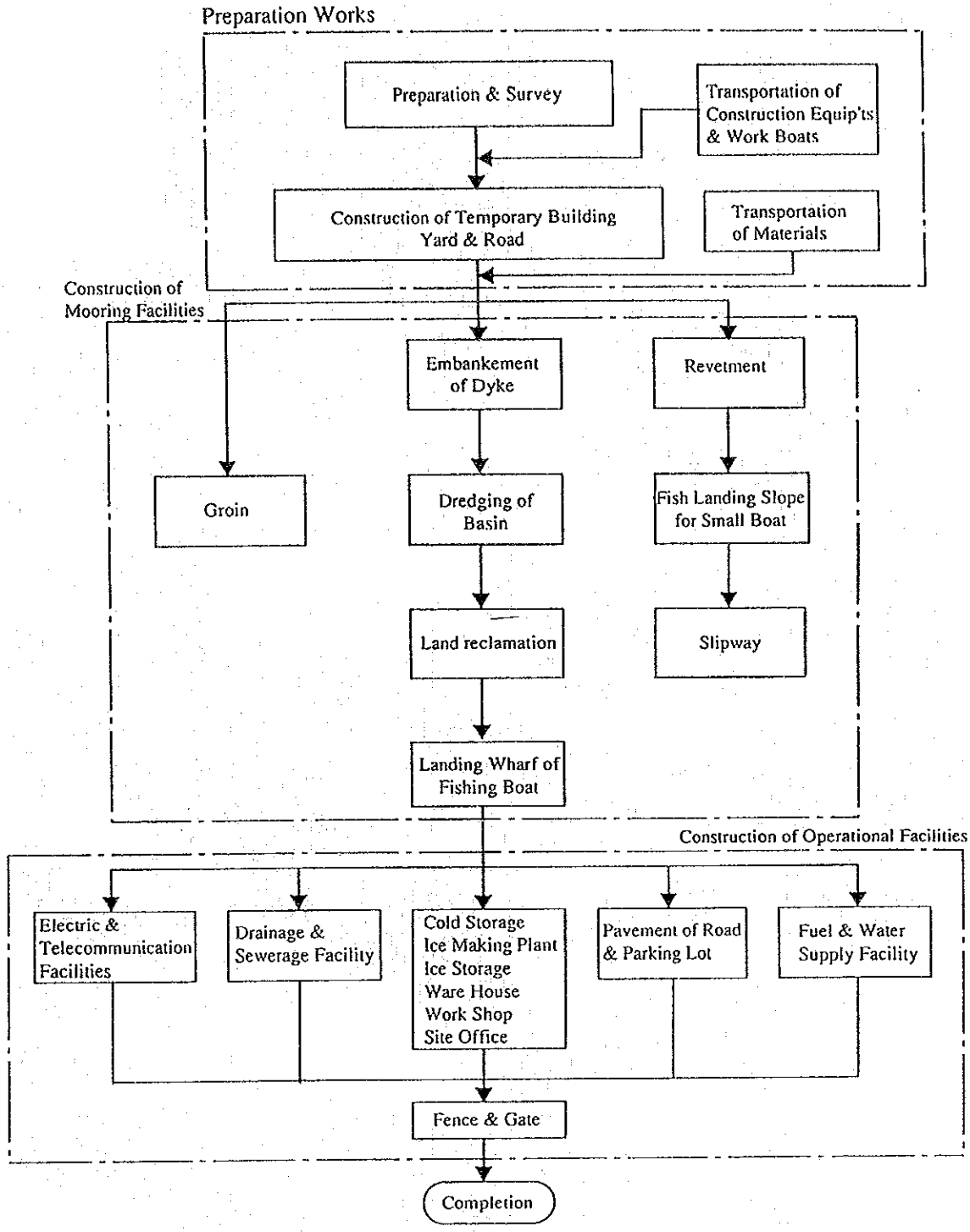


Fig.4-6-13 Flow Chart of Construction

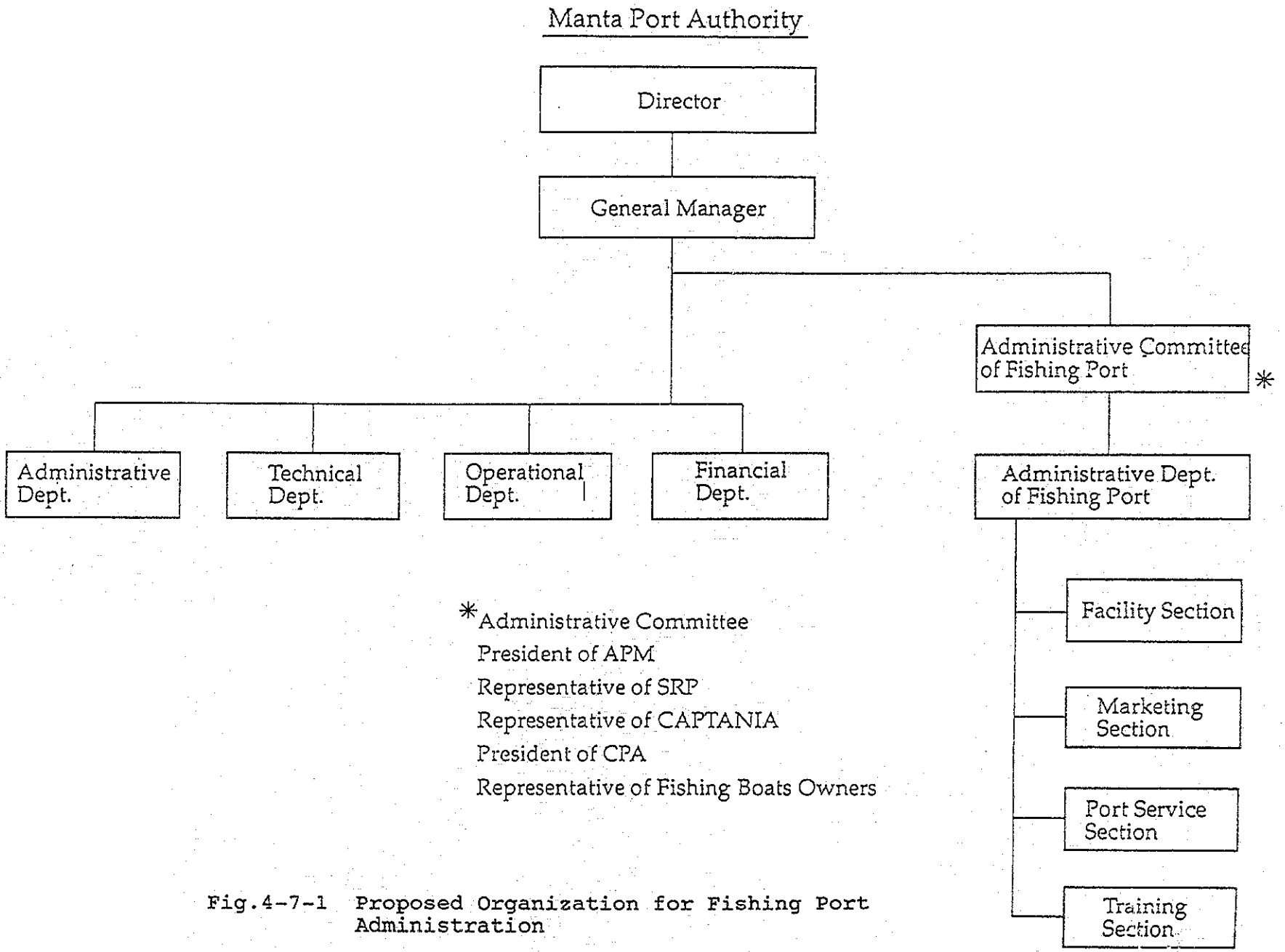


Fig.4-7-1 Proposed Organization for Fishing Port Administration

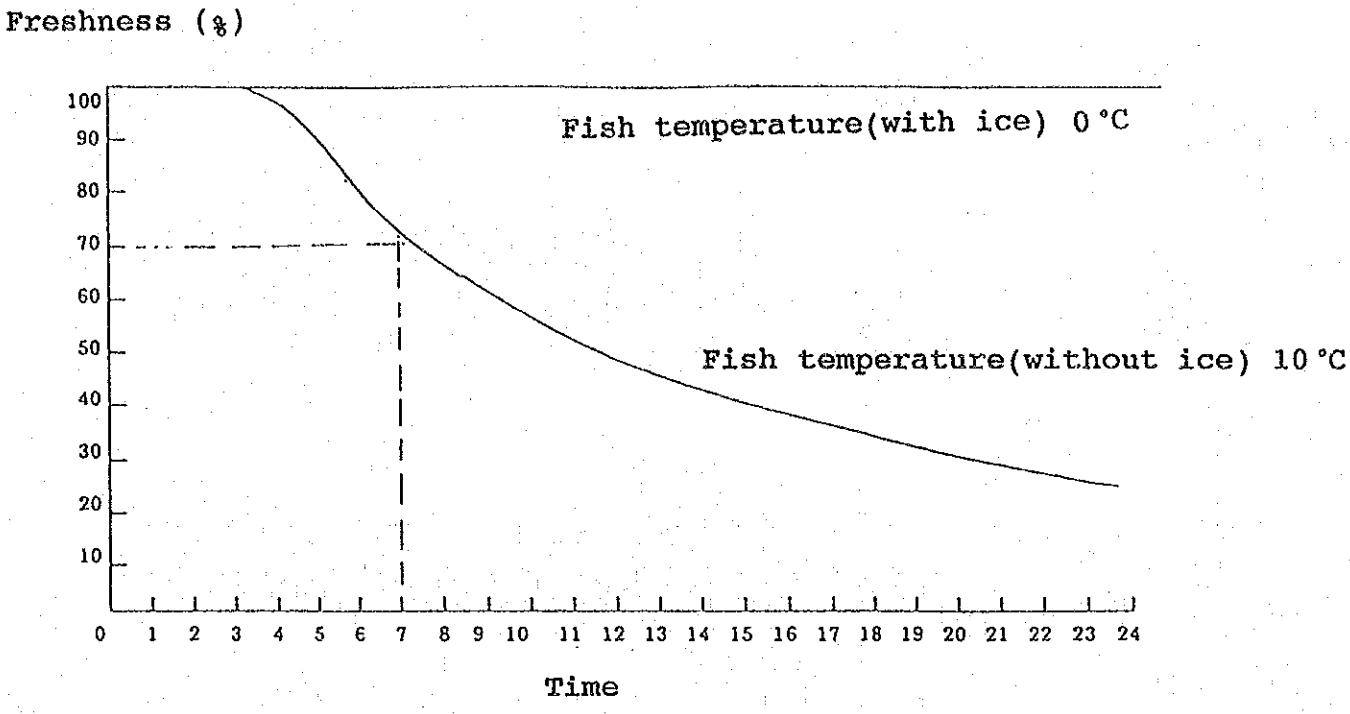


Fig.4-7-2 Relation between the Freshness and the Time

Table 4-2-3 Study on the Fishing Boats of Industrial Permit by Individual Management Body

STUDY ON THE FISHING BOATS OF INDUSTRIAL PERMIT BY INDIVIDUAL MANAGEMENT BODY
JUNE 26 TO JULY 2, 1991, MANTA

Name	Matricula #	OAL(m)	TB(ton)	Landing	Preparation	Remarks
Brisas d'Mar	105	14.45	23.49	Crucita	Muelle	purse seine
Granadier	Tramitte	11.88	20.69	Crucita	Yacht club	purse seine
Solismar	263	12.53	20.52	Los Tanques	Yacht club	long line
Marathon	Tramitte	15.90	17.36	Los Tanques	Muelle	long line
Mariuxita	Tramitte	10.00	?	Los Tanques	Muelle	long line
Maria Elisa	Tramitte	9.50	15.00	Los Tanques	La Poza	long line
Palomo I	272	13.97	34.02	Los Tanques	Muelle	long line
Jose Jose	270	19.38	36.00	Los Tanques	Muelle	long line
Don Enrique	309	14.00	26.59	Los Tanques	Muelle	long line
Isla de Plata	AI-class	10.00	?	Los Tanques	Yacht club	Vela, long line
Escorpion	154	12.43	21.73	Muelle	Muelle	purse seine
Don Casi	289	13.97	23.38	Muelle	Muelle	long line
Nino Dios	101	11.89	15.82	Muelle	Muelle	long line
Lunes	294	14.15	36.00	Muelle	Muelle	long line
Karla	256	13.01	19.25	Muelle	Muelle	long line
San Luis	295	12.40	19.68	Muelle	Muelle	purse seine
Crusando el Mar	Tramitte	12.00	13.00	Muelle	Muelle	long line
Eagle	297	12.37	21.98	Muelle	Muelle	long line
N.A.	N.A.	13.00	?	Muelle	Muelle	long line
Don Alfred 2	300	15.04	44.16	Muelle	Muelle	long line
Adnay I	258	11.20	16.33	Muelle	Muelle	long line
Ecuador Primero	82	20.92	77.25	Muelle	Muelle	purse seine
Sta. Marianita	Tramitte	12.00	19.95	Muelle	Muelle	long line
Martes	306	11.20	19.25	Muelle	Muelle	long line
Albatros	AI-class	8.60	2.99	Muelle	Muelle	long line

Total: 25

Table 4-2-4 Dimensions of Middle Boats smaller than 40 GT

Manta & Vicinity, Less Than 40 GT, B/P, Max. Range of "Individual"

Remarks:

Total No. 37
IPM 9
IPM/Total(%) 24

(1) "Libro de Registro" and Other Sources

Matricula	Owner	IPM	Name	TB	OAL	B	Depth	PS	Artes	Intv.
13	Manta		Don Felix	33.11	15.15	5.10	2.10	230		
18	Manta		Jose Jose	35.07	13.64	4.62	1.73	50		
27	Manta		Kary 1	12.07	9.63	3.07	1.22	36		
47	Jaramijo		Marisol	35.24	15.94	4.85	2.07	165		
52	Manta		Puchy	4.95	13.30	2.90	1.05	60		
105	Jaramijo		Brisas	23.49	14.45	3.95	1.88	38	P	*
110	Jaramijo		Sonia Patricia	27.07	13.83	4.05	1.67	165		
113	Manta		Santa Aurita	35.02	15.62	4.45	1.93	165		
120	Manta		Don Augusto	31.11	16.10	4.45	1.11	165		
152	Pto.viejo		Carlos Enrique	22.58	14.40	4.42	2.07	165		
154	Manta	78	Scorpion	21.73	12.43	4.00	2.00	165	P/L	*
192	Jaramijo		Don Ramon	35.48	15.36	4.73	2.16	165		
208	Manta		Adonay 2	39.18	14.33	5.40	2.27	165		
233	Manta		Maria Fernanda	31.00	12.52	3.96	2.26	156		
235	Manta	22	Cathy	20.99	12.81	4.19	1.52	220	L	
240	Jaramijo		General Alfaro	38.85	15.89	4.65	1.87	80		
250	Jaramijo		Yole	30.84	15.04	4.61	2.00	82		
256	Manta	94	Karla	19.25	13.01	3.93	1.58	134	L	*
257	Jaramijo		Gaviota	30.60	14.57	4.68	1.99	110		
258	Manta		Adonay 1	16.33	11.20	3.60	1.62	110	L	*
263	Jaramijo	30	Solismar	20.52	12.53	3.67	1.95	165	P	*
266	Manta	42	San Ramon A	21.10	12.80	4.28	2.02	125	P	
268	Jaramijo		Tiburon 2	32.50	17.35	5.30	2.10	230		
276	Manta		Adonay 3	38.20	19.38	5.30	2.98	220		
282	Manta		Maria Narcisa	29.73	13.10	4.20	2.00	100		
284	Manta		Pajaro Asul	23.52	12.42	4.30	1.78	135		
286	Manta		Principe Azul 2	19.00	11.88	3.72	1.61	80		
287	Manta		Don Hector	24.62	13.49	4.30	1.82	110		
288	Manta		Adonay 4	29.66	13.74	4.50	2.00	110		
289	Manta	109	Don Casi	23.38	13.97	4.40	1.80	165	L	*
290	Jaramijo		Fliper	29.69	12.90	4.10	2.00	115		
291	Manta		Rag Lango 1	28.12	13.50	4.00	2.00	165		
295	Manta	88	San Luis	19.68	12.40	4.10	1.83	165	P	*
296	Manta	102	Maraton	34.87	15.80	4.90	2.05	175	L	*
297	Manta	95	Eagle	21.98	12.37	4.12	1.86	150	L	*
299	Manta		San Eduardo 2	33.90	14.55	4.47	1.98	125		
301	Manta		Mary d'Rocio	20.44	12.40	3.90	1.75	?		
			Average:	26.89	13.89	4.30	1.88	138		

Table 4-2-11 Exports of Fishery Products from Manabi

By Air

(unit:MT)

	US	Brazil	Colom-bia	Chile	Puerto Rico	Other Latin	Spain	Other Europe	Japan	Thai-land	Other Asia	Total
Fresh	4711					19					83	4813
Tuna	3											3
Others	4708					19					83	4811
Frozen	149								0		13	162
Fish	35											35
Shrimp	114								0		13	127
Canned	126		77									203
Tuna	40											40
Sardine	86		77									163
Total	4986		77			19			0		96	5178
Fish	4872		77			19					83	5051
Shrimp	114								0		13	127

By Ship

(unit:MT)

	US	Brazil	Colom-bia	Chile	Puerto Rico	Other Latin	Spain	Other Europe	Japan	Thai-land	Other Asia	Total
Fresh	241				521		1288				0	2050
Tuna					182							182
Others	241				339		1288				0	1868
Frozen	7131			30	2558		10172	137	965	1975	856	23823
Fish	587			13	2558		8417		859	1975	453	14862
Tuna	164			13	432		19					628
Sardine	19											19
Others	405				2126		8398		859	1975	453	14215
Shrimp	6544			17			1755	137	106		403	8961
Canned	9728	1828	588	1320	1953	367	4190	169	101		3285	23528
Tuna	5128	1828		1129	1929	294	4063	146			2613	17129
Sardine	3369		588	191	24	73	69	24	101		672	5109
Others	1231						58					1289
Total	17101	1828	588	1349	5032	367	15649	306	1066	1975	4140	49401
Fish	10557	1828	588	1333	5032	367	13894	169	960	1975	3738	40440
Shrimp	6544			17			1755	137	106		403	8961

By Land

(unit:MT)

	US	Brazil	Colom-bia	Chile	Puerto Rico	Other Latin	Spain	Other Europe	Japan	Thai-land	Other Asia	Total
Frozen	17											17
Canned	4461		2862								25	7348
Tuna	283		1123									1406
Sardine	4178		1739								25	5942
Total	4478		2862								25	7365
Fish	4461		2862								25	7348
Shrimp	17											17

* Raw Fish Weight

Source:Invoice

Table 4-2-12 Exports of Fishery Products from Manta Port

(unit:MT)

	1989	1990
All Commodity	58,793,901	64,958,353
Fishery Products	23,568,066	26,012,928
Atun Congerado	18,237,499	18,489,608
Atun Enlatado	1,019,415	2,485,322
Picudo Congelado	98,050	348,424
Sardinas Enlatados	464,622	694,861
Pez Espada	795	360
Filete de Dorado y Marlin	117,868	41,466
Filete de Pescado	457	
Tiburon	44,240	51,235
Aletas de Tiburon	6,816	2,270
Buches de Corvina	1,620	
Buches de Pescado	1,620	
Desperdicios de Pescado	41,000	
Huevos de Pescado	3,440	
Camarones	3,155,501	3,763,630
Langostinos	372,115	133,430
Langosta	3,008	2,322
Ratio of Fishery Products	40.1%	40.0%

* Raw Fish Weight

Sourse : APM

Table 4-3-1 Average Wind Velocity and Direction

ANOS:1981-1988

(%)

Dirección	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Velocidad (Nudos)																
1- 5	1.2	0.2	0.2	0.1	0.4	0.5	0.3	0.7	5.6	5.6	3.0	2.2	1.8	1.3	0.8	1.0
6-10	1.2	0.2	0.1	0.1	0.1	0.1	0.1	0.3	5.5	9.2	7.9	6.2	5.0	9.7	4.4	3.2
11-15	—	—	—	—	—	—	—	—	0.2	0.6	0.5	0.3	0.9	3.1	0.6	0.2
16-20	—	—	—	—	—	—	—	—	—	—	—	—	0.1	0.4	—	—
-20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	2.4	0.4	0.3	0.2	0.5	0.6	0.4	1.0	11.3	15.4	11.4	8.7	7.8	14.5	5.8	4.4

Viento Media : WNW/ 6.2 Nudos total de calmas 14.6%

Table 4-3-2(1) Distribution of Monthly Wind Direction at Manta (1986-1987)

ESTACION MANTA | PROVINCIA MANABI | ANO 1979-1980

MESES	NUM/OBS	N	NE	E	SE	S	SW	W	NW	C
MARZO	93	4	1	2	3	14	26	24	6	13
ABRIL	90	0	1	0	9	13	30	19	5	13
MAYO	93	0	0	1	5	35	26	19	1	6
JUNIO	90	0	1	0	5	50	22	11	1	0
JULIO	93	0	0	0	5	48	28	8	2	2
AGOSTO	93	0	0	0	6	47	25	15	0	0
SEPTIEMBRE	90	0	0	0	1	51	22	15	1	0
OCTUBRE	93	0	0	0	4	43	35	9	0	2
NOVIEMBRE	90	0	0	1	4	40	32	12	0	1
DICIEMBRE	93	0	0	0	0	57	20	13	1	2
ENERO	93	1	0	3	5	19	25	27	4	9
FEBRERO	84	3	1	4	2	15	15	16	13	15
TOTAL	1095	8	4	11	49	432	306	188	34	63

TOT.OBS	FRECUENCIA								
1095.00	0.73%	0.37%	1.00%	1.17%	39.45%	27.95%	17.17%	3.11%	5.75%

Table 4-3-2(2) Distribution of Monthly Wind Velocity at Manta (1986-1987)

ESTACION MANTA | PROVINCIA MANABI

MESES	VELOCIDADES(m/s) 7:00	13:00	19:00
MARZO	1.52	5.03	3.42
ABRIL	1.63	5.17	3.63
MAYO	2.61	5.74	5.00
JUNIO	3.90	5.83	5.37
JULIO	4.00	5.90	5.74
AGOSTO	3.71	6.23	6.35
SEPTIEMBRE	3.83	7.23	6.40
OCTUBRE	3.45	6.39	5.65
NOVIEMBRE	4.27	5.83	6.17
DICIEMBRE	3.74	6.26	6.23
ENERO	2.26	5.29	4.74
FEBRERO	1.43	3.68	4.07
	VELOCIDAD MEDIA(m/s)		
	3.03	5.72	5.23

Source: INOCAR

Table 4-3-3(1) Distribution of Monthly Wind Direction at Manta (1979-1980)

ESTACION MANTA | PROVINCIA MANABI | ANO 1979-1980

MESES	NUM/OBS	N	NE	E	SE	S	SW	W	NW	C
ENERO	93	1	0	2	3	35	8	28	5	11
FEBRERO	87	0	0	0	1	13	3	42	5	23
MARZO	93	9	2	2	4	6	1	37	2	30
ABRIL	90	2	1	0	1	10	0	46	3	27
MAYO	93	1	0	2	1	12	15	41	4	17
JUNIO	90	0	0	1	1	11	50	22	5	0
JULIO	93	0	0	0	0	17	53	21	2	0
AGOSTO	93	2	0	1	6	29	17	29	0	9
SEPTIEMBRE	90	0	1	0	6	25	24	27	0	7
OCTUBRE	93	1	0	0	0	10	48	31	2	1
NOVIEMBRE	90	0	0	0	0	4	38	40	2	6
DICIEMBRE	93	0	0	0	0	7	46	33	4	3
TOTAL	1098	16	4	8	23	179	303	397	34	134

TOT.OBS	FRECUENCIA								
1098.00	1.46%	0.36%	0.73%	2.09%	16.30%	27.60%	36.16%	3.10%	12.20%

Table 4-3-3(2) Distribution of Monthly Wind Velocity at Manta (1979-1980)

ESTACION MANTA | PROVINCIA MANABI

MESES	VELOCIDADES(m/s) 7:00	13:00	19:00
ENERO	2.03	5.06	4.55
FEBRERO	0.57	5.29	3.52
MARZO	0.48	4.74	3.06
ABRIL	0.53	8.19	5.79
MAYO	1.81	8.26	6.97
JUNIO	4.53	8.73	8.23
JULIO	5.16	8.74	8.32
AGOSTO	3.29	7.29	7.55
SEPTIEMBRE	3.00	7.53	7.27
OCTUBRE	4.74	9.68	7.90
NOVIEMBRE	4.33	9.37	7.40
DICIEMBRE	4.68	8.42	7.74
VELOCIDAD MEDIA(m/s)	2.93	7.61	6.53

Source: Direccion de Aviacion Civil

Table 4-3-4 Precipitation at Manta

:mm

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANUAL
1965	6.2	32.9	138.9	107.3	1.0	13.3	0.0	0.0	0.0	0.3	0.5	0.6	301.0
1966	31.8	59.8	58.4	34.1	5.5	0.9	0.0	1.0	–	3.3	0.4	0.0	195.2
1967	42.6	232.3	9.5	8.8	–	–	–	–	0.0	0.0	–	0.0	293.2
1968	49.0	33.0	–	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	82.0
1969	–	–	–	–	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.2
1970	0.0	0.0	2.0	15.0	0.0	0.0	0.0	0.0	0.0	–	0.0	0.0	36.0
1971	13.0	34.0	283.0	5.0	0.0	3.0	0.0	0.0	–	–	0.0	0.0	338.0
1972	0.2	–	161.9	120.0	0.0	19.5	0.0	–	–	–	–	–	301.6
1973	0.0	–	–	25.1	1.0	–	0.0	0.0	9.7	0.0	0.1	1.0	36.9
1974	11.4	63.9	30.9	15.6	2.5	0.3	0.0	0.0	9.7	0.0	4.0	9.0	147.3
1975	122.2	201.8	244.1	6.5	0.0	5.8	0.0	0.2	0.0	0.1	0.3	1.0	582.0
1976	125.7	127.1	58.2	178.9	16.6	1.3	1.0	0.0	0.1	0.0	0.3	2.3	511.5
1977	35.4	47.6	45.1	44.4	0.0	0.6	0.0	0.4	3.9	0.0	0.0	0.0	177.4
1978	46.3	43.5	62.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	152.5
1979	52.0	53.9	4.9	0.0	0.0	0.4	0.0	0.0	0.9	0.3	0.0	0.0	112.4
1980	23.4	18.9	13.7	23.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	79.5
1981	55.6	105.5	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	165.6
1982	0.0	0.0	0.0	2.4	0.0	0.0	0.0	0.0	2.8	1.0	18.9	62.6	87.7
1983	377.4	173.4	163.8	428.8	424.5	117.0	218.6	15.4	20.7	0.0	0.8	22.1	2022.5
1984	0.0	109.5	39.7	8.9	0.0	0.4	0.0	0.0	0.0	0.4	0.0	23.9	182.5
1985	5.6	55.0	33.9	0.0	42.3	0.0	0.0	0.0	0.0	0.0	0.0	50.1	186.9
1986	162.0	5.1	0.0	44.7	0.6	0.0	0.0	0.0	0.0	1.6	0.0	2.3	216.3
1987	29.2	374.7	133.7	58.8	0.0	0.0	0.0	3.7	0.0	0.5	2.5	0.6	603.7
1988	66.1	22.0	2.0	9.0	8.3	0.0	0.0	0.0	3.5	0.0	1.5	0.0	112.4
1989	92.6	153.3	146.2	33.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	425.6
Mean	56.2	88.5	74.4	48.8	21.7	9.7	9.1	0.9	2.3	0.3	1.3	7.3	320.6

Table 4-6-2 Required Materials for Facilities

No.	Material	Unit	Revetment	Groin/Inner Breakwater	Landing Wharf of F. Boat	Landing Slope of S.F. Boat	Dredging of Channel & Basin	Land reclamation	Buildings	Total
1	Sand	Cu.m	262	0	312	436	0	0	17	1,027
2	Crushed Stone	Cu.m	483	0	576	828	0	0	32	1,919
3	Cement	ton	193	0	269	406	0	0	16	884
4	Rocks	Cu.m	24,881	76,408	7,357	9,338	0	0	1,269	119,253
5	Concrete Block	Cu.m	0	0	0	0	0	0	248	248
6	Steel Bar	ton	0	0	45	27	0	0	29	101
7	Steel Angles	ton	0	0	0	0	0	0	27	27
8	Fuel	kl	83	181	78	62	39	208	18	669
9	Timber	Cu.m	0	0	0	55	0	0	8	63
10	Fender	no	0	0	45	0	0	0	0	45

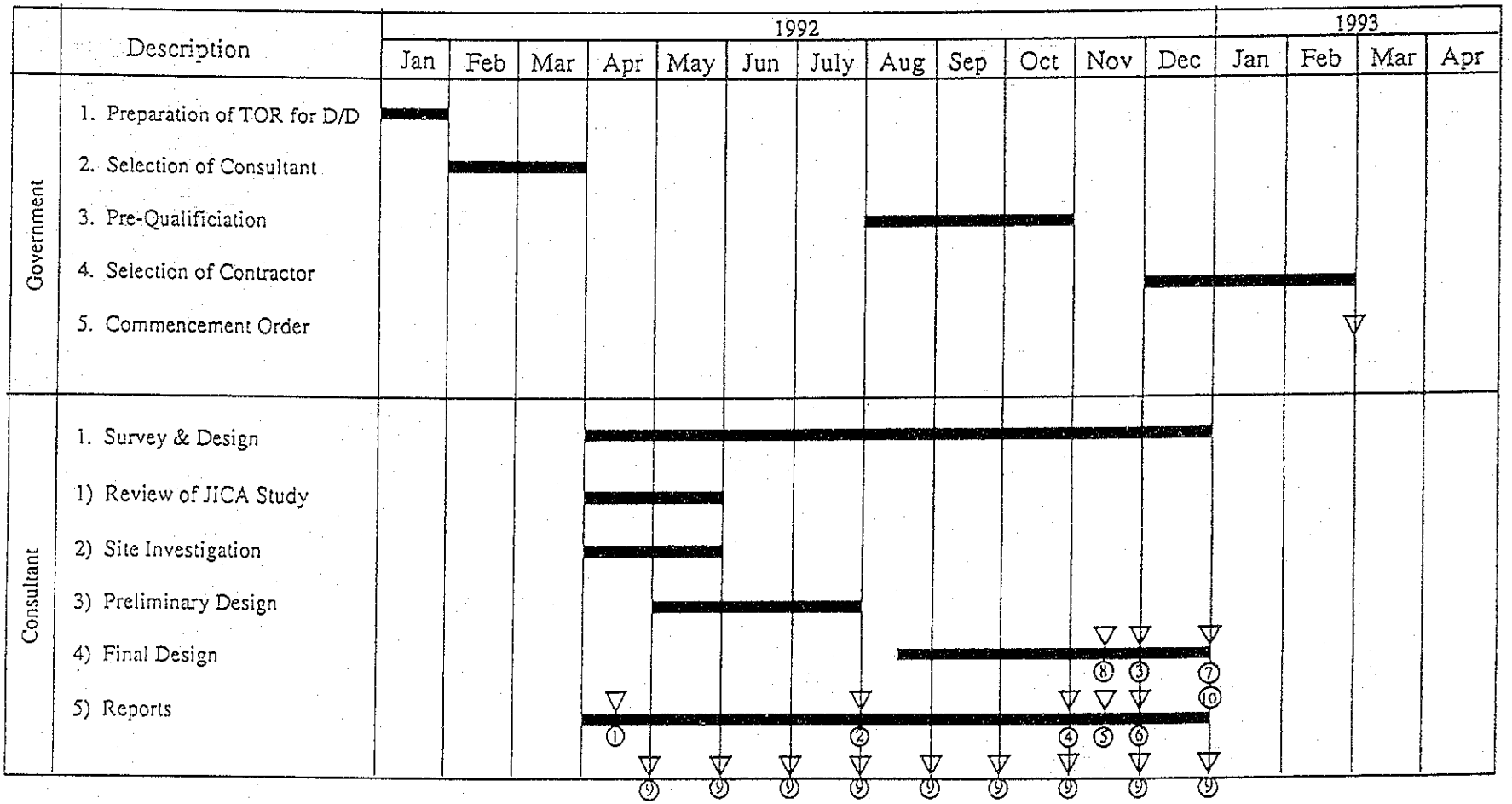
Table 4-6-3 Required Construction Machine

No	Name of Equipment	Specification & Capacity	Quantity	Purpose	Availability in Local
1	Cutter Suction Dredger	600ps	1	Dredging & Reclamation	No
2	Anchor Boat	60ps 3t lift	2	ditto	No
3	Tug Boat	D200ps	1	ditto	No
4	Tug Boat	D700ps	1	ditto	No
5	Pon toon	120t	2	Wharf	No
6	Pon toon	20t	2	ditto	No
7	Diver Boat	3t 30ps	12	Groin,Wharf	Limited
8	Grab Dredger	320ps 3m^3	1	Wharf	No
9	Dump Berge	120m^3	2	ditto	No
10	Crane Berge	50t lift	1	Wharf	No
11	Platform Truck	6t	2	Building,etc	Yes
12	Trailer	20t	1	Whart	Yes
13	Concrete Plant	0.75m^3/B 60ps	1	ditto	Yes
14	Bulldozer	11t	1	Reclamation, Groin	Yes
15	Truck Crane	10-30t lift	1	Groin,Buidg etc	Yes
16	Crawler Crane	25t lift	1	Wharf,Groin	Yes
17	Dump Truck	8t	16	Groin, Revetment etc	Yes
18	Tire Roller	8-20t	1	Road	Yes
19	Grader	3m	1	ditto	Yes
20	Macadum Roller	10-12t	1	ditto	Yes
21	Asphalt Finisher	2.4 - 4.5m	1	Ravement & Road	Yes
22	Concrete Vibrator	26ps	5	Wharf	Yes
23	Welder	G300A	1	Wharf	Yes

Table 4-6-4 Construction Schedule for the Short-term Development Plan

No.		Description	Unit	Qty.	First Year 1992 JFM	AMJ	JAS	OND	Second Year 1993 JFM	AMJ	JAS	OND	Third Year 1994 JFM	AMJ	JAS	OND	Fouth Year 1995 JFM	AMJ	JAS	OND
CIVIL WORKS	1	Landing Slope for Small Boat	m	50													(6)			
	2	Landing Wharf for Middle Boat	m	90													(9)			
	3	Outfitting Wharf for Middle Boat	m	18													(3)			
	4	Slipway	lum	1													(3)			
	5	Revetment	m	552								(12)								
	6	Groin	m	430								(12)					(12)			
	7	Dredging of Basin	Cu.m	100,600							(3)									
	8	Land Reclamation	Cu.m	190,400								(6)								
	9	Backfilling of Breakwater	m	350						(2)										
	10	Road	m2	21,030								(3)		(3)						
	11	Pavement	m2	42,570								(3)		(3)						
BUILDING	1	Freezing Storage	m2	417												(6)				
	2	Block Ice Making	m2	900												(6)				
	3	Ice Storage	m2	195												(6)				
	4	Fish Handling Space	m2	400												(6)				
	5	Fishing Gear Repairing Space	m2	1,000												(4)				
	6	Warehouse	m2	100												(3)				
	7	Workshop	m2	100													(6)			
	8	Control Office	m2	180																
	9	Electric Supply	m2	80											(6)					
	10	Guard House	m2	23													(3)			
PLANT	1	Air Blast Freezer	Set	1													(3)			
	2	Cold Storage Facility	Set	1													(3)			
	3	Freezing Facilities	Set	2													(3)			
	4	Ice Making Facility	Set	1													(3)			
	5	Emergency Power Supply Facility	Set	1													(3)			
UTTY	1	Utility	L.S	1								(3)					(12)			
D/D・C/V	1	Survey & Design	L.S	1					(9)											
	2	Construction Supervision	L.S	1								(12)					(12)			

Table 4-6-5 Design Schedule



① Inception Report
② Preliminary Design Report
③ Draft Final Design Report
④ Bill of Quantities
⑤ Condition of Contract
⑥ Cost Estimate
⑦ Final Design Report
⑧ Tender Document
⑨ Monthly Progress Report
⑩ Drawings

Table 4-6-6 Construction Cost

No	Name of Facility	Unit	Quantity	Construction Cost (x 1,000 US$)				
				F.C	L.S	Sub-total	Tax	Total
I	CIVIL WORKs							
1	Landing Slope for Small Boat	m	50	250	627	877	0	877
2	Landing Wharf for Middle Boat	m	90	670	641	1,311	31	1,342
3	Outfitting Wharf for Middle Boat	m	18	134	128	262	6	268
4	Slipway	lum	1	60	150	210	0	210
5	Revetment	m	552	176	1,511	1,687	0	1,687
6	Groin	m	430	120	2,341	2,461	0	2,461
7	Dredging of Basin	cu,m	100,600	788	177	965	11	976
8	Land Reclamation	cu,m	190,400	1,480	369	1,849	9	1,858
9	Backfilling of Breakwater	m	350	5	42	47	0	47
10	Road	s.m	21,030	298	71	369	0	369
11	Pavement	s.m	42,570	596	150	746	0	746
	Sub-Total			4,577	6,207	10,784	57	10,841
II	BUILDING							
1	Freezing Storage	s.m	417	56	102	158	0	158
2	Block Ice Making	s.m	900	120	222	342	0	342
3	Ice Storage	s.m	195	26	48	74	0	74
4	Fish Handling Space	s.m	400	19	35	54	0	54
5	Fishing Gear Repairing Space	s.m	1,000	40	75	115	0	115
6	Warehouse	s.m	100	8	15	23	0	23
7	Workshop	s.m	100	4	8	12	0	12
8	Control Office	s.m	180	26	47	73	0	73
9	Electric Supply	s.m	80	7	12	19	0	19
10	Guard House	s.m	23	5	8	13	0	13
	Sub-Total			311	572	883	0	883
III	PLANT							0
1	Air Blast Freezer	set	1	273	0	273	82	355
2	Cold Storage Facilities	set	1	489	0	489	147	636
3	Freezing Facilities	set	2	783	0	783	235	1,018
4	Ice Making Facility & Storage	set	1	232	0	232	70	302
5	Emergency Power Supply Facility	set	1	126	0	126	38	164
	Sub-Total			1,903	0	1,903	572	2,475
				6,791	6,779	13,570	629	14,199
IV	UTILITY							0
	(I+II+III)x7%	L.S.	1	475	475	950	44	994
	Sub-Total			475	475	950	44	994
	Total(Direct Cost)			7,266	7,254	14,520	673	15,193
V	ENGINEERING SERVICE	L.S	1	727	725	1,452	0	1,452
VI	CONTINGENCY	L.S	1	794	725	1,519	0	1,519
	Total(Indirect Cost)			1,521	1,450	2,971	0	2,971
	Grand Total			8,787	8,704	17,491	673	18,164

Table 4-6-7 Construction Cost by Year

Item	Description	Unit	Quantity	Total Amount			First Year			Secound Year			Third Year		
				F.C	L.C	Total	F.C	L.C	Total	F.C	L.C	Total	F.C	L.C	Total
CIVIL WORKS	Landing Slope for Small Fishing Boat	m	50	250	627	877	0	0	0	0	0	0	250	627	877
	Landing Wharf for Middle Boat	m	90	701	641	1,342	0	0	0	0	0	0	701	641	1,342
	Outfitting Wharf for Middle Boat	m	18	140	128	268	0	0	0	0	0	0	140	128	268
	Slipway	lum	1	60	150	210	0	0	0	0	0	0	60	150	210
	Revetment	m	552	176	1,511	1,687	0	0	0	176	1,511	1,687	0	0	0
	Groin	m	430	120	2,341	2,461	0	0	0	60	1,171	1,231	60	1,170	1,230
	Dredging of Basin	cu,m	100,600	799	177	976	0	0	0	799	177	976	0	0	0
	Land Reclamation	cu,m	190,400	1,489	369	1,858	0	0	0	1,489	369	1,858	0	0	0
	Backfilling of Breakwater	m	350	5	42	47	0	0	0	5	42	47	0	0	0
	Road	m2	21,030	298	71	369	0	0	0	298	71	369	0	0	0
	Pavement	m2	42,570	596	150	746	0	0	0	596	150	746	0	0	0
	Sub-Total			4,634	6,207	10,841	0	0	0	3,423	3,491	6,914	1,211	2,716	3,927
BUILD-ING	Freezing Storage	m2	417	56	102	158	0			0	0	0	56	102	158
	Block Ice Making	m2	900	120	222	342	0			0	0	0	120	222	342
	Ice Storage	m2	195	26	48	74	0	0	0	0	0	0	26	48	74
	Fish Handling Space	m2	400	19	35	54	0	0	0	0	0	0	19	35	54
	Fishing Gear Repairing Space	m2	1,000	40	75	115	0	0	0	0	0	0	40	75	115
	Warehouse	m2	100	8	15	23	0	0	0	0	0	0	8	15	23
	Workshop	m2	100	4	8	12	0	0	0	0	0	0	4	8	12
	Control Office	m2	180	26	47	73	0	0	0	0	0	0	26	47	73
	Electric Supply	m2	80	7	12	19	0	0	0	0	0	0	7	12	19
	Guard House	m2	23	5	8	13							5	8	13
	Sub-Total			311	572	883	0	0	0	0	0	0	311	572	883
PLANT	Air Blast Freezer	set	1	355	0	355	0	0	0	0	0	0	355	0	355
	Cold Storage Facilities	set	1	636	0	636	0	0	0	0	0	0	636	0	636
	Freezing Facilities	set	1	1,018	0	1,018	0	0	0	0	0	0	1,018	0	1,018
	Ice Making Facility & Storage	set	2	302	0	302	0	0	0	0	0	0	302	0	302
	Emergency Power Supply Facility	set	1	164	0	164	0	0	0	0	0	0	164	0	164
	Sub-Total		1	2,475	0	2,475	0	0	0	0	0	0	2,475	0	2,475
	Utility	L.S.	1	519	475	994	0	0	0	240	244	484	279	231	510
	Total (Direct Cost)			7,939	7,254	15,193	0	0	0	3,663	3,735	7,398	4,276	3,519	7,795
	ENGINEERING SERVICE	L.S	1	727	725	1,452	352	374	726	188	176	364	187	175	362
	CONTINGENCY	L.S	1	794	725	1,519	0	0	0	397	363	760	397	362	759
	Total(Indirect Cost)			1,521	1,450	2,971	352	374	726	585	539	1,124	584	537	1,121
	Grand Total			9,460	8,704	18,164	352	374	726	4,248	4,274	8,522	4,860	4,056	8,916

Table 4-8-4 Economic Internal Rate of Return

Manta
IRR (3.6%)

(unit:*10^3 US$)

year	No.	bene-fits	costs				bi-ci	(bi-ci)/(1+r)^i
			facili-ties	renewal	mainte-nance	total		
1992	1	0	713	0	0	713	-713	-713
1993	2	0	7,974	0	0	7,974	-7,974	-7,697
1994	3	0	7,807	0	0	7,807	-7,807	-7,274
1995	4	1,133	0	0	76	76	1,057	951
1996	5	1,133	0	0	76	76	1,057	918
1997	6	1,133	0	0	76	76	1,057	886
1998	7	1,133	0	0	76	76	1,057	855
1999	8	1,133	0	0	76	76	1,057	825
2000	9	1,133	0	0	76	76	1,057	797
2001	10	1,133	0	0	76	76	1,057	769
2002	11	1,133	0	0	76	76	1,057	742
2003	12	1,133	0	0	76	76	1,057	716
2004	13	1,133	0	2,475	76	2,551	-1,418	-928
2005	14	1,133	0	0	86	86	1,047	661
2006	15	1,133	0	0	86	86	1,047	638
2007	16	1,133	0	0	86	86	1,047	616
2008	17	1,133	0	0	86	86	1,047	595
2009	18	1,133	0	0	86	86	1,047	574
2010	19	1,133	0	0	86	86	1,047	554
2011	20	1,133	0	0	86	86	1,047	535
2012	21	1,133	0	0	86	86	1,047	516
2013	22	1,133	0	0	86	86	1,047	498
2014	23	1,133	0	3,358	86	3,444	-2,311	-1,061
2015	24	1,133	0	0	86	86	1,047	464
2016	25	1,133	0	0	86	86	1,047	448
2017	26	1,133	0	0	86	86	1,047	432
2018	27	1,133	0	0	86	86	1,047	417
2019	28	1,133	-7,220	0	86	-7,134	8,267	3,182
total		28,325	9,274	5,833	2,050	17,157	11,168	-85

APPENDICES

Appendiz 3.2

Comparison of the Construction Costs for the Fishing Ports at the Study Area

(1) Design Condition

Following assumptions are adopted for the comparison of the construction costs of the fishing ports.

Dimensions of Structures;

Berth Depth:
- -3m (Middle scale boats)
- -1m (Small scale boats)

Berth Length:
- Each berth length corresponds to the Nos of planned fishing boats at 2005.
- Landing berth : alongside
- Outfitting berth : fore and aft
- Breakwaters are used as idling berth. In the cases of Liguique, San Lorenzo and Santa Rosa, breakwaters are also used as landing berth and outfitting berth.

Breakwater:
- Main breakwater is extended over the surf zone.
- Sub-breakwater is planned over 100m.

(2) Design Constants;

Design constants are adopted as follows.

Design Constants

	Jaramijo	Manta	San Mateo	St.Marianita	Liguique	San Lorenzo
i	1/150	1/100	1/100	1/90	1/100	1/50
Kr	0.395	0.395	0.395	0.456	0.456	0.516
Ho'	1.19	1.19	1.19	1.37	1.37	1.55
Ho'/Lo	0.0034	0.0034	0.0034	0.0039	0.0039	0.0044
hb/Ho'	2.5	2.5	2.5	2.4	2.4	2.3
Hb/Ho'	1.93	1.93	1.93	1.85	1.85	1.80
hb(m)	3.0	3.0	3.0	3.3	3.3	2.8
Hb(m)	2.3	2.3	2.3	2.5	2.5	2.4

	St.Rosa	Pto.Cayo	Machalilla	Pto.Lopez
i	1/150	1/100	1/50	1/50
Kr	0.516	0.577	0.707	0.707
Ho'	1.55	1.73	2.12	2.12
Ho'/Lo	0.0044	0.0049	0.0060	0.0060
hb/Ho'	2.3	2.25	2.15	2.15
Hb/Ho'	1.80	1.74	1.65	1.65
hb(m)	2.8	3.9	4.6	4.6
Hb(m)	2.4	3.0	3.5	3.5

(3) Conceptual Plan:

Conceptual plan of the fishing port is shown below.

(4) Planned Fishing Boats:

Planned fishing boats are defined as follows.

Planned Fishing Boats

	Jaramijo	Manta	San Mateo	St.Marianita	Liguique
Small boat(Panga)	140	341	183	50	6
Middle boat(Barco)	20	30	40	-	-
"PEN"*	44	67	89	-	-
Total	184	408	272	50	6

	San Lorenzo	St.Rosa	Pto.Cayo	Machalilla	Pto.Lopez
Small boat(Panga)	15	12	50	53	71
Middle boat(Barco)	-	-	-	45	45
"PEN"*	-	-	-	100	100
Total	15	12	50	153	153

* "PEN" means Panga equivalent numbers of fishing boats.

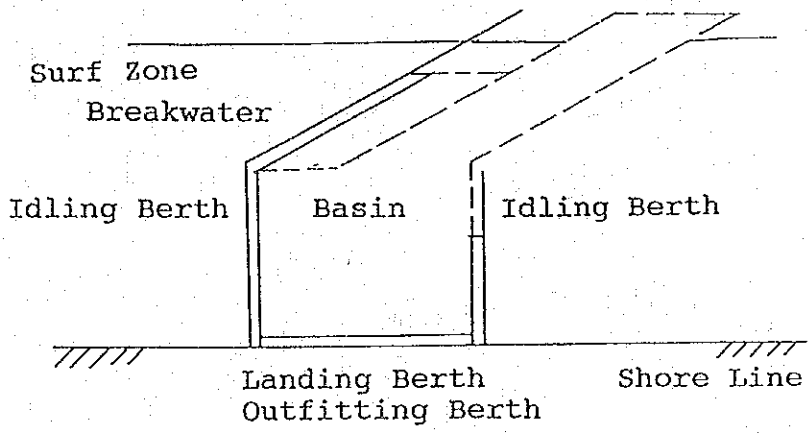
(5) Comparison of the Construction Costs

Construction costs at each fishing port are as follows.

Construction Cost (unit: million US$)

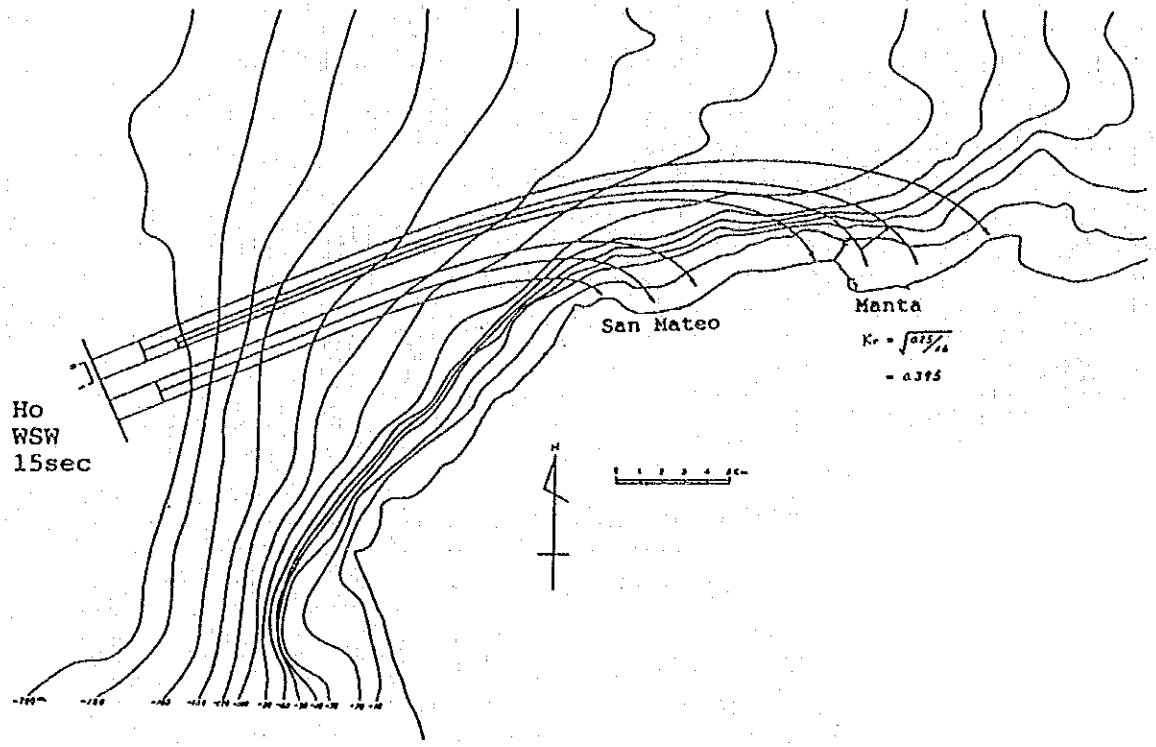
	Jaramijo	Manta	San Mateo	St.Marianita	Liguique
Breakwater(m)	520	1,430	650	300	330
Berth(m)	200	410	300	60	20
Construction Cost	9.0	27.4	11.2	3.5	3.3
Construction cost /Fishing Boat	0.048	0.067	0.042	0.071	0.550

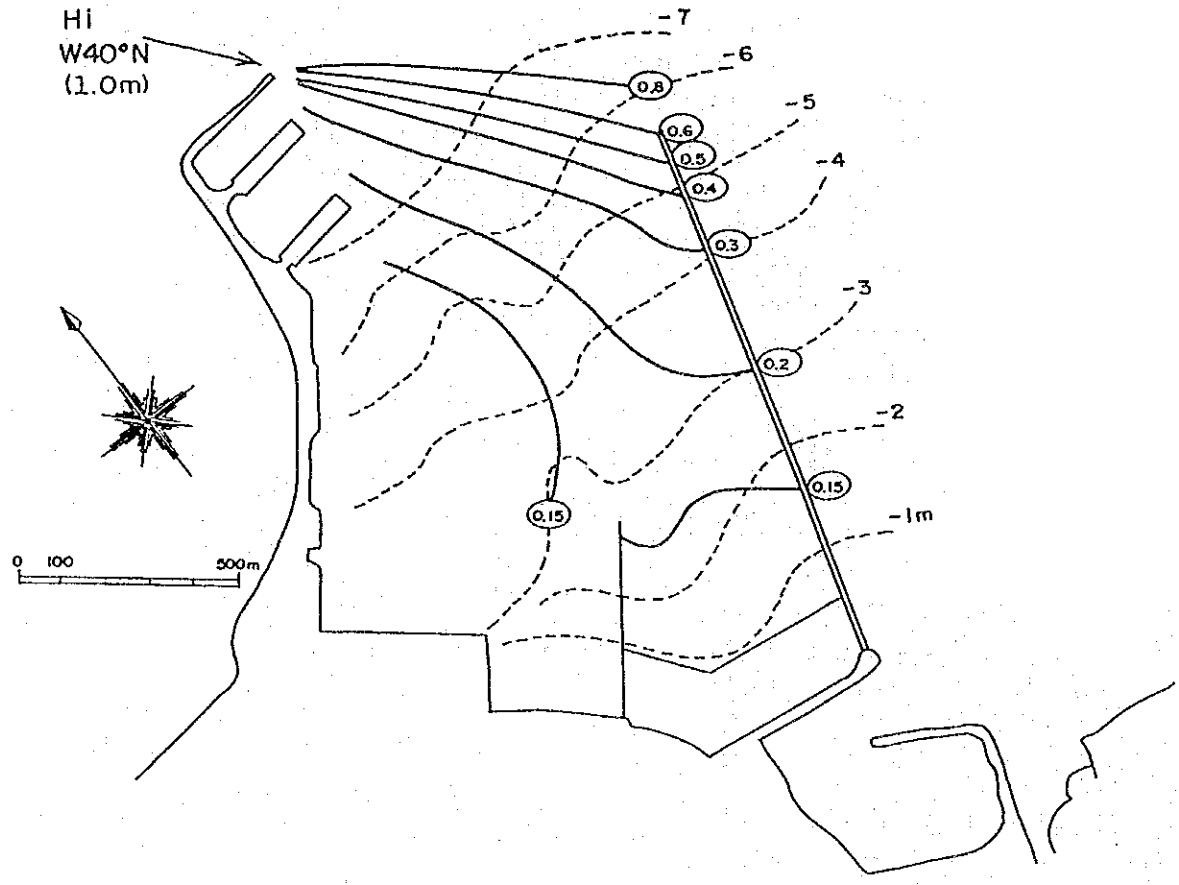
	San Lorenzo	St.Rosa	Pto.Cayo	Machalilla	Pto.Lopez
Breakwater(m)	15	12	50	53	71
Berth(m)	-	-	-	45	45
Construction Cost	1.4	4.2	5.8	11.6	12.4
Construction Cost /Fishing Boats	0.093	0.350	0.116	0.075	0.072



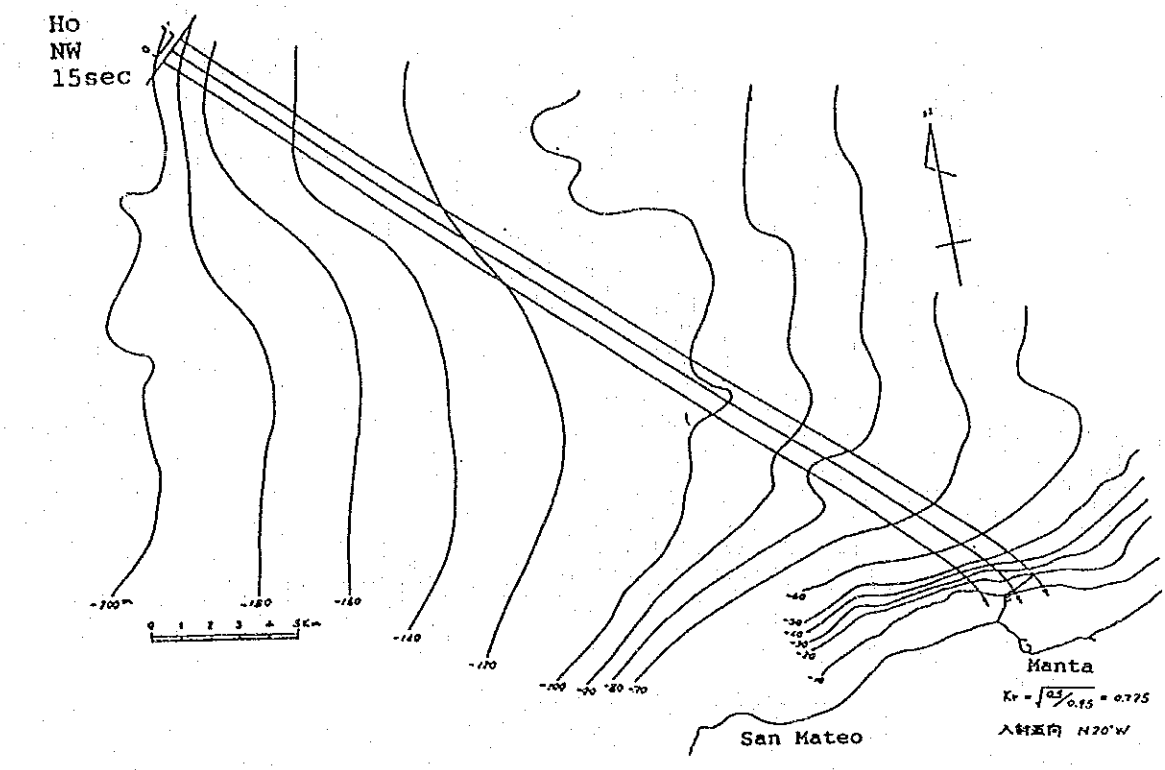
Conceptual Plan for Site Selection

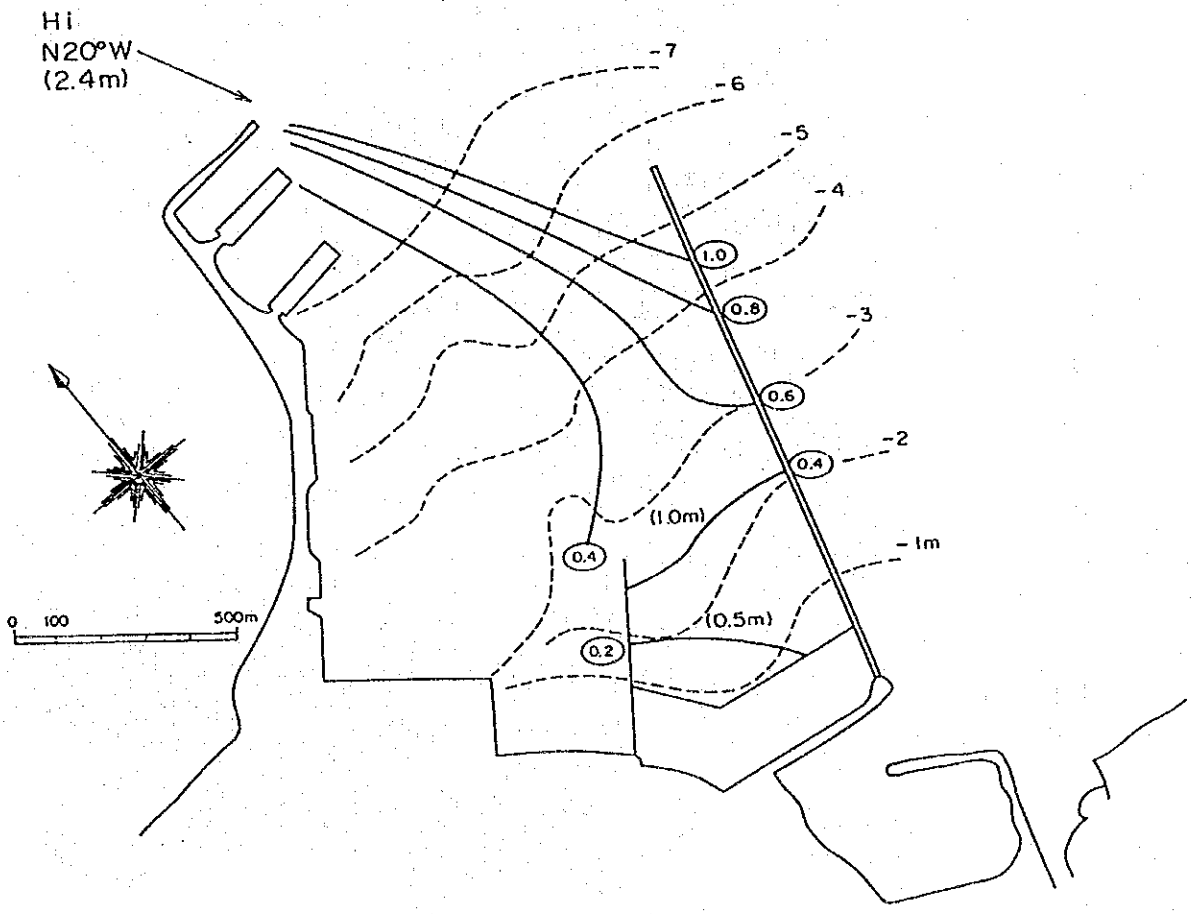
Appendix 3.5.1(1) Degrees of Calmness





Normal condition



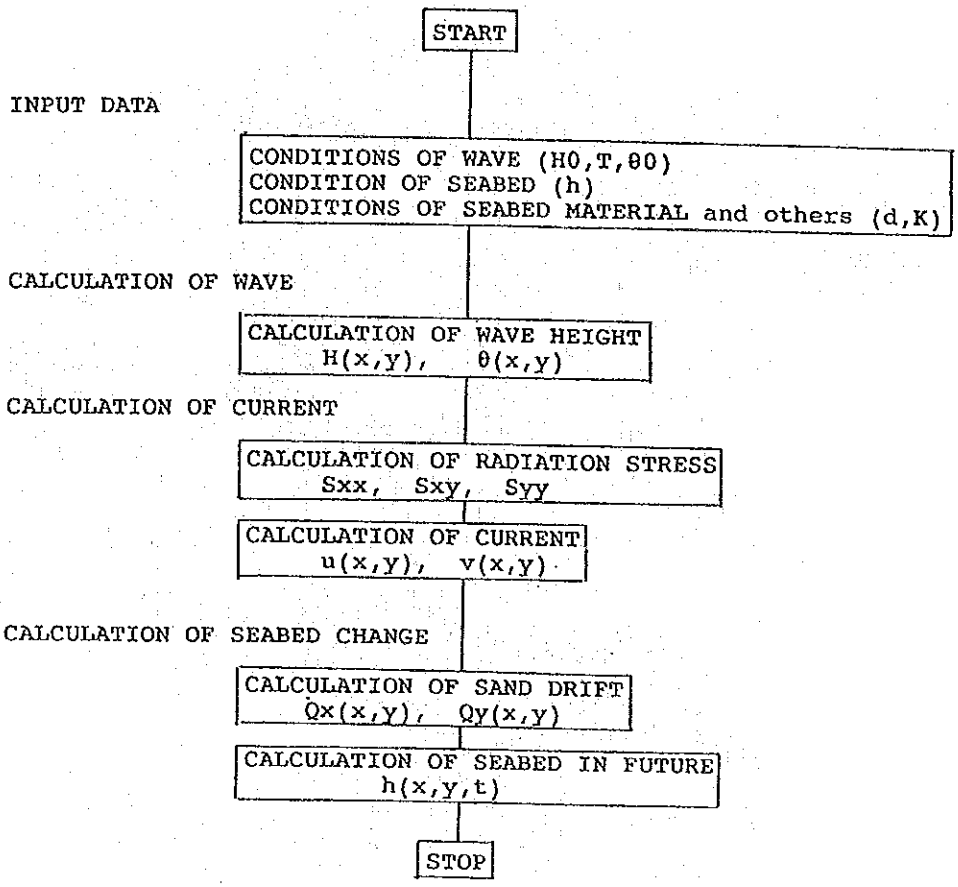


Stormy condition

Appendix 3.5.1(2)

Computer Simulation for Beach Evolution

(1) Flowchart of Simulation



(2) Basic Equations

The mild slope equation presented by Berhhoff for a stationary wave field is given by

$$\Delta \cdot (C C_g \Delta \phi) + \sigma^2 \frac{C_g}{C} \phi = 0$$

where,

ϕ : amplitude of the velocity potential
C, Cg : phase velocity, the waves group velocity
σ : angular frequency

The equation of motion is written as (1), and the continuity equation is written as (2):

$$\left.\begin{aligned} u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} + Fx + Mx + Lx + g\frac{\partial \eta}{\partial x} = 0 \\ u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y} + Fy + My + Ly + g\frac{\partial \eta}{\partial y} = 0 \end{aligned}\right\} \quad (1)$$

$$\frac{\partial u\,(h+\eta)}{\partial x} + \frac{\partial V\,(h+\eta)}{\partial y} = 0 \quad (2)$$

where,

Rx, Ry : radiation stress terms
Fx, Fy : bottom friction terms
Mx, My : lateral mixing terms
U, V : corresponding velocity components of the nearshore current
η : water surface elevation
h : still water depth

The change in local bottom elevation can readily be computed, once the spatial distribution of sediment transport rate is given, by solving the conservation equation for sediment mass:

$$(1-\varepsilon)\frac{\partial \eta}{\partial t} + \frac{\partial q_x}{\partial x} + \frac{\partial q_y}{\partial y} = 0$$

where,

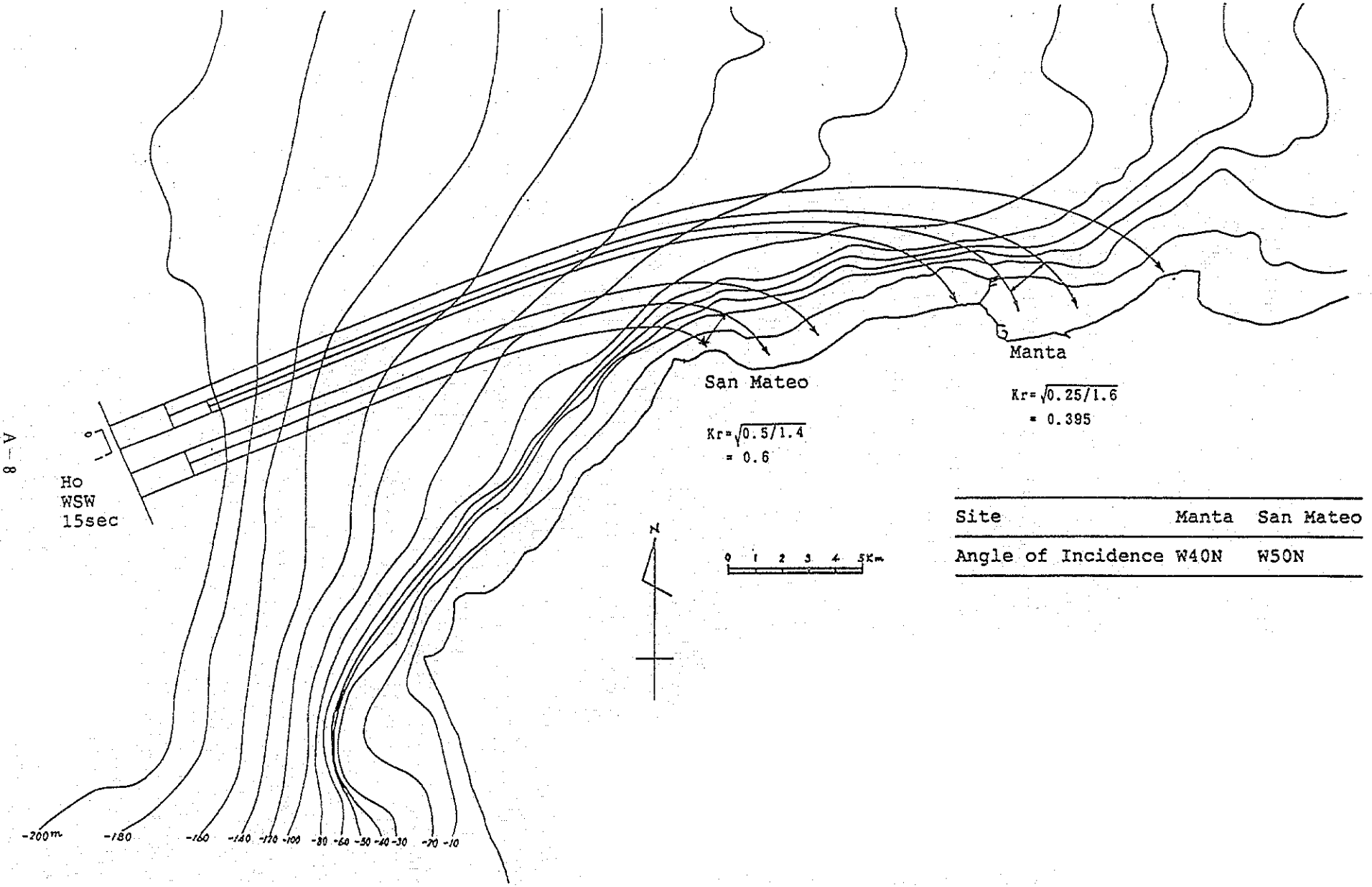
η : water surface elevation
ε : void for sediment particles comprising the bottom
qx, qy : components of the sediment transport rate per unit width in the x- and y-directions

The sediment transport rate is calculated using the formula by Brown.

$Q = 0 \quad (\phi \leqq \phi_c)$
$Q = 40*w*d*\phi^3 \quad (\phi \geqq \phi_c)$

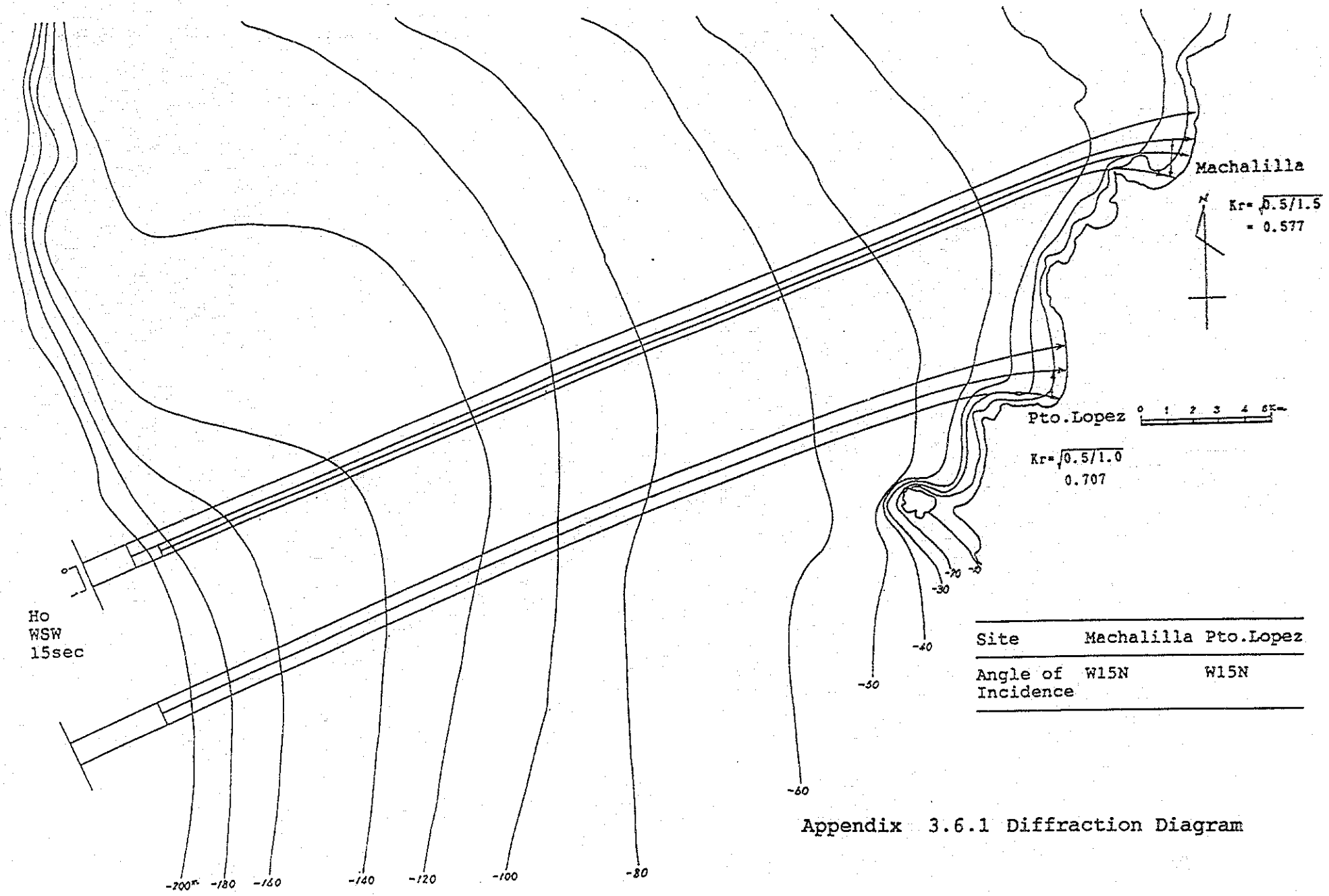
where,

d : grain size
w : fall velocity of sediment particles



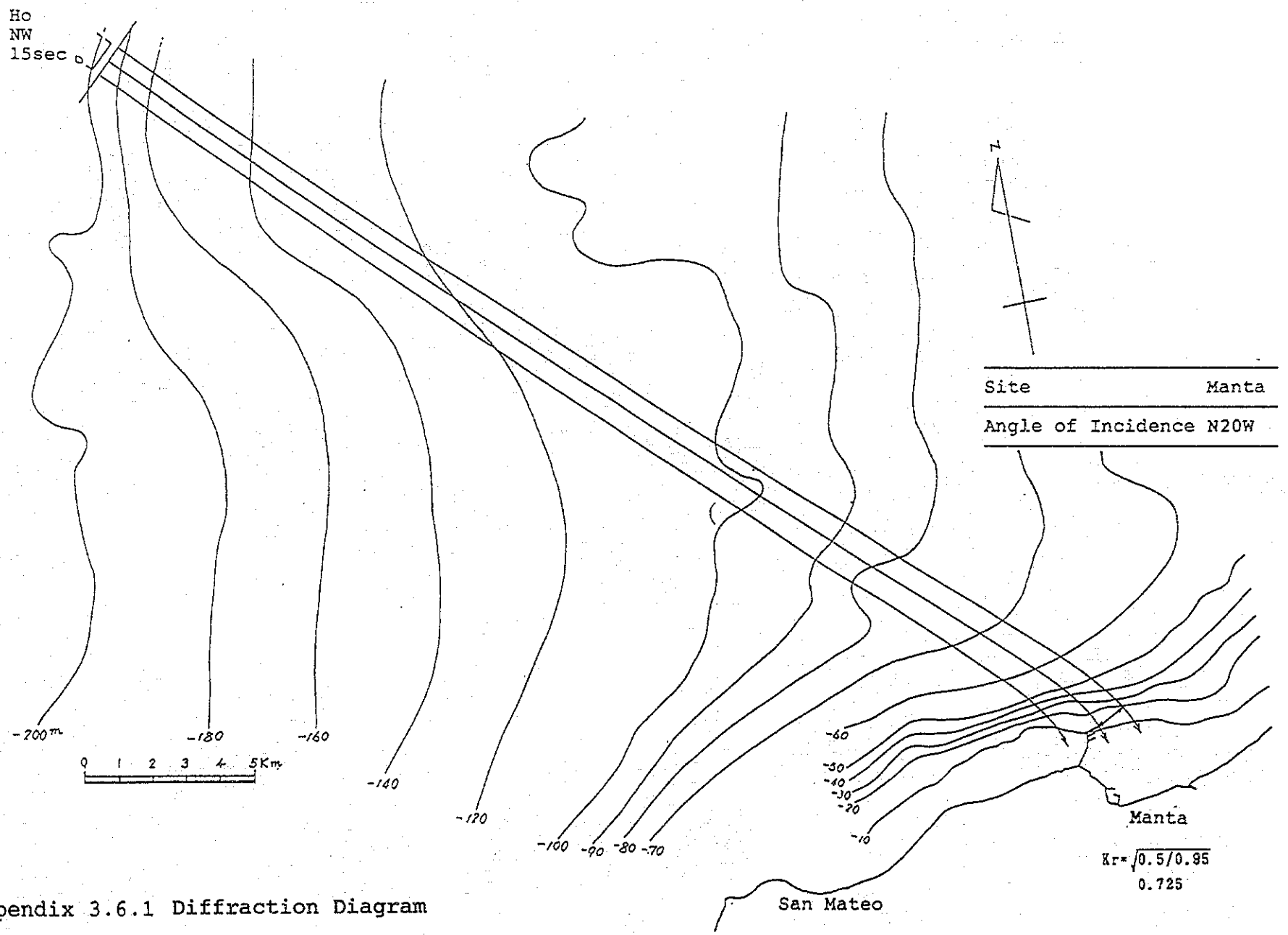
Site	Manta	San Mateo
Angle of Incidence	W40N	W50N

Appendix 3.6.1 Diffraction Diagram

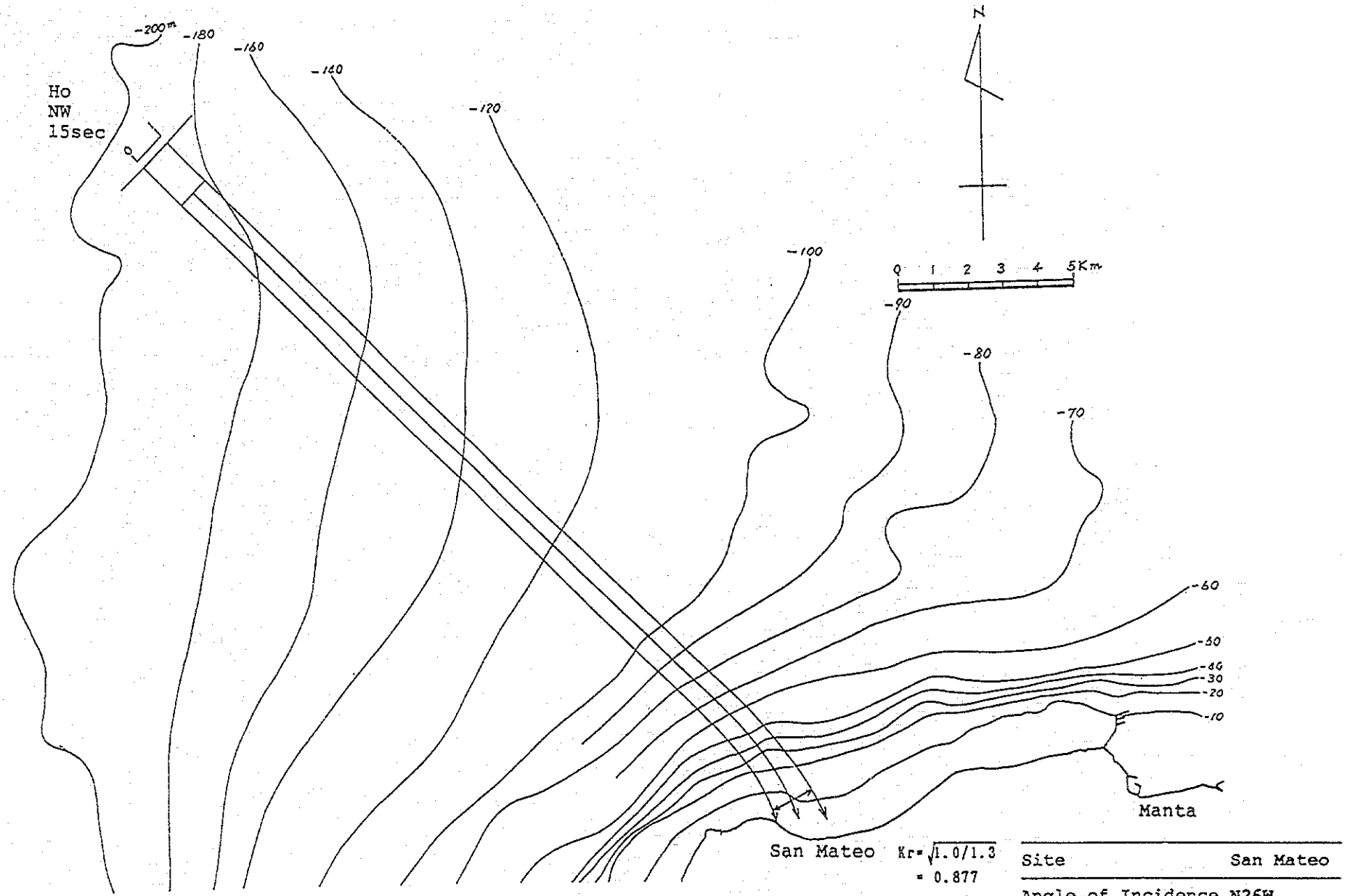


Site	Machalilla	Pto.Lopez
Angle of Incidence	W15N	W15N

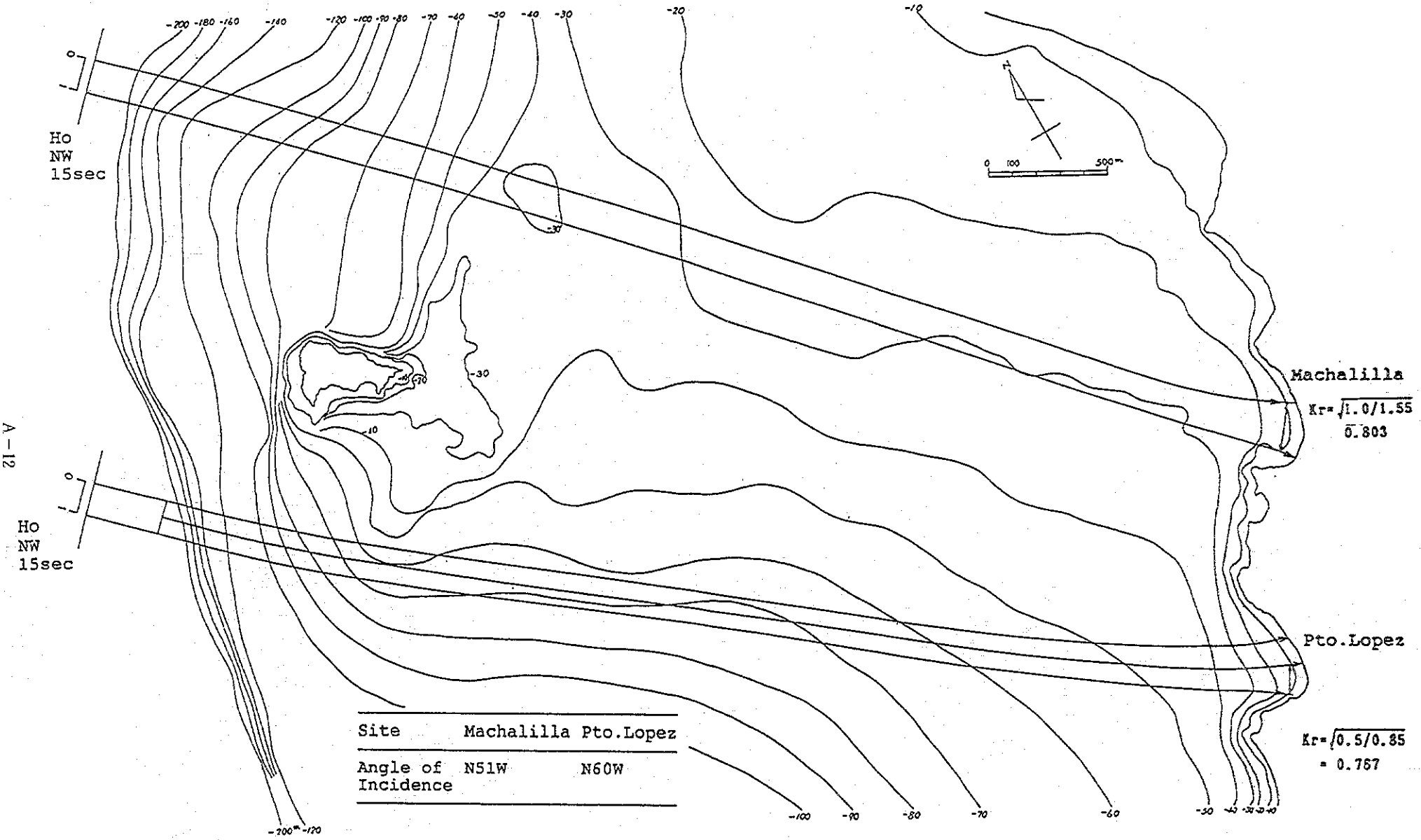
Appendix 3.6.1 Diffraction Diagram



Appendix 3.6.1 Diffraction Diagram



Appendix 3.6.1 Diffraction Diagram



Appendix 3.6.1 Diffraction Diagram

Appendix 4.3(1)

Soil Survey Results at Manta

BORING LOG 1

Depth	Sketch	Sample No.	SPT	w	LL	IP	GRADATION					Soil Description and Identification
				%	%	%	#4	#10	#20	#40	#200	
		1	1	66.9	52.9	23.6		100	99.6	99.5	98.2	Very loose grey silt with fine sand (MH)
		2	11	32.0	54.6	25.0	100	99.6	98.5	97.6	85.6	Stiff green clay of high plasticity with shells (CH)
		3	28	43.6	56.4	27.9			100	99.4	95.4	Very stiff tan clay of high
		4	26	27.3	52.8	23.7		100	99.5	98.6	91.7	plasticity (CH) Very stiff tan clay of high plasticity with fine sand (CH)
5.0		5	27	37.7	N.	P.	100	99.8	98.9	96.5	27.8	Medium density grey clayed sand (SC)
		6	35	28.3	56.2	25.5		100	98.7	97.7	89.4	Hard grey clay of high plasticity with fine sand (CH)
		7	32	24.2	54.5	28.9		100	99.2	98.9	85.9	Hard grey clay of high plasticity with fine sand (CH).
		8	31	34.4	N.	P.	100	99.3	97.7	90.3	15.9	Dense grey clayed sand with shells (SC)
		9	34	41.1	56.2	26.4	100	99.8	98.5	97.3	90.7	Hard grayed clay of high plasticity with fine sand (CH)
10.0		10	58	23.9	N.	P.	100	99.0	98.3	97.6	38.1	Very dense yellowish clayed sand (SC)
		11	65	31.3	N.	P	100	95.5	93.4	92.4	35.8	Very dense fine grey silty sand (SM)
		12	80	22.9	N.	P.	100	99.3	98.0	96.2	30.9	Very dense fine brown silty sand (SM).
15.0												
20.0												

Casing: ϕ 4", 5 m. drived