(5) Facilities in Castilla (except cabotage facility)

361. The study team has already suggested that cargo handling and repair and maintenance of equipment could be transferred to the Standard Fruits Co. (paragraph 349. of this Chapter). Operation of the berth to be built in future is also better conducted by the company. For the same reasons mentioned in paragraphs 354 to 356 in relation to the Cortes container terminal, berths and handling area should be constructed by ENP, and leased out to the operator.

(6) Cabotage facilities

362. Cabotage terminals are being constructed by ENP in the vicinity of La Ceiba and Coxen Hole in the Roatan, and the team suggests terminals be built at Cortes, Castilla and Puerto Lempira. For La Ceiba, ENP has made up its mind to leave the management to another entity (see paragraph 329 to 335 of this Chapter). For Lempira, since the existing pier is being managed by the Municipality, it may also manage the new pier when the construction is completed. For Cortes and Castilla, without the municipality showing an interest in managing the facilities and due to the public characteristics of the facilities in that they serve for small shipowners carrying goods required for the area's residents, it is inevitable that ENP operate them. For Roatan, with the no desire on the part of the Municipality' to operate the facility, ENP is seeking an appropriate alternative for the operation.

4.5 Issues on Port-related Institutions

Monopoly

363. It has been a subject of argument for a long period of time whether ports of a country should be operated under a single port authority or whether each port should have its own port authority. In developing countries, single authority has long been the norm mainly in accordance with the World Bank's advice. In recent years, however, it has been suggested that port management should be fragmented and decentralized leaving several responsibilities to private sector and/or local government.

364. Theoretical background of criticism to the single port authority is that it tends to restrict competition between ports. The clients cannot receive benefits of cheap and effective port service without a competitive market. Moreover, the monopolistic management brought about by a single port authority presses the client in terms of operation and in particular of tariff by taking advantage of its high bargaining power.

365. While the theory may be rightly construed, if looking into the reality of the Honduran port behavior, ENP's bargaining position is not stronger than those of major exporters. The evidence of ENP's lesser position lies in its huge discount for banana export.

366. As mentioned in 16 of PART I, in Honduras, one port has prevailing scale with several small ports. Small ports do not earn enough revenue for supporting the management, and in this environment, if ENP were divided into a multitude of port authorities, the cost would increase to such an extent that small ports could not bear them. By one authority governing several ports, common administrative cost will be minimized. It is therefore recommended that the single port authority scheme be retained even after localization and privatisation of certain activities. After such fragmentation of its activities, it is still expected that ENP will have large responsibilities for administration, operation and construction.

Policy Making Procedure

367. The supreme organ of ENP is the Board of Directors which consists of seven voting and one non-voting members. Meetings are held more than once a month. To the team's eye, there are too many meetings and this might cause delay of action. It is advisable to reduce the number of meetings by limiting the terms of reference of the Board to really important matters, viz. budget and account, appointment of very high ranking personnel, acquisition and removal of assets over certain amount, important pricing, formulation of master-plan, approval of important rules and regulations and so on. Other matters should be left in the hands of Gerente General so as to make decisions quickly.

368. With a view to improving financial performance, budgetary control in the ENP secretariat should be tightened. The annual budget should be appropriated for a three month term by the Board, and execution of the appropriated budget should be reported. By taking these steps, monetary discipline will be improved and directors can become acquainted with the current financial position.

369. As has been mentioned in paragraph 134 of PART II, ENP is financially contributing to the central government though it is not prescribed by law. This measure is legally inadequate, and from the management point of view quite undesirable, since it presses ENP financially and ENP is placed in a difficult position to formulate even short or intermediate term management program. This practice should be either abolished totally or contribution should be limited to a fixed rate or fixed amount prescribed by a law.

Planning and Coordination

370. A World Bank paper pointed out that for the development of transport infrastructure Honduras lacks systems for formulating plan for investments based on the national economic prospects and strategies and a capability for prioritizing projects within the context of a national development program. SECOPT is required to carry out this task with cooperation of SECPLAN.

371. Above scheme is useful and necessary in view of formulating and executing an investment program really beneficial to the country. However, it is not easy to have SECOPT restructured to meet this end, because required human resources are constrained and salary level of civil service is lower than that of private sector. The paper recommended as a tentative measure to retain long-term consultants to train the professional staff in preparation of pluri-annual investment programs. This may be a sensible proposal if the budgetary climate permits. An alternative is to ask a donor country to provide long-term experts at their expense to advise preparation of transport infrastructure planning and to transfer know-how of this matter.

372. After having completed the steps of privatisation and decentralization recommended in this Chapter, ENP will be transformed from a more business-oriented body to a more planning and coordination-oriented organ. To cope with this transformation, ENP's organizational structure should change expanding department(s) for planning and coordination. However, restricted human resources will make this change difficult. Hiring consultants with managerial knowledge is one solution, but this has yet to be done. It is also recommendable that ENP ask through the government a donor country to provide long-term experts with experience of various fields of port authority's work including coordination of various interests in port and port-related environmental issues.

373. Paragraph 370 of this Section suggests ENP strengthen the capability of budgetary control, and to attain this some financial experts should be recruited or existing personnel be trained to this end.

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PART II

Urgent Improvement Plans

Chapter 1 Items to be Improved

1. Based on the site surveys as well as interviews with various appropriate persons, the Study Team identified the following issues which should be further discussed with ENP. The identified issues will be the basis for an urgent improvement plan at a later stage of this Study.

1.1 Port Facilities

2. The existing port facilities as well as their physical conditions are described in Chapter 2.3, Part I, and several problems with the present port facilities have been already pointed out.

In this Chapter, the "Urgent Improvements" scheme is given. The "Urgent Improvements" scheme of the actual port facilities comprises the following two items:

(1) Improvement plan (upgrading of the facility to strengthen its capacity or function) to increase the efficiency of the port activities.

(2) Repairs plan (rehabilitation to original shape) which should be adopted for some port facilities in order to improve the safety of the port.

3. Concerning point 1 of the scheme, some facts should be mentioned to illustrate the real situation in some ports of Honduras. The pier of the Tela Port was built early in the twentyth century. It is a wooden structure which is already beyond its working life. Actually this pier has been destroyed by a fire. Also, Wharf No. 2 in the port of Cortes is no longer in service due to its subsidence. Both should be replaced or reconstructed. In these cases both point 1 and 2 is applied. This means that besides the improvements aimed at increasing the efficiency of the port activities, the safety factors of the ports should also be improved.

4. Focusing on the investments needed for the reconstruction or replacement of both the Tela pier and Wharf No. 2, it can be said that each project requires a large amount of money as well as a long period of time for realization. However, these aspects are beyond the scope of the "Urgent Improvements" scheme. For other ports, point 1 of the scheme does not apply. Point 2 of the scheme is concerned with the maintenance or repairs done to the port facilities every year. It is important to point out that ENP allocates a budget to maintain safety standards in the ports.

5. The maintenance budget for 1993 in each port is summarized in Table 1.1.1 from

the financial report at the close of the fiscal year.

While the Study Team found by visual inspection that various parts of some ports should be repaired, however, some of the facilities need not be repaired. For instance, the whole wooden pier of the La Ceiba Port is out of order, however, repair is not necessary because a new domestic port is under construction to replace the existing port. Although in Roatan Island, the public pier made of timber is out of service due to deterioration, ENP is building a new concrete jetty in Coxen Hole.

6. At the port of Cortes, the road between Warehouse No.2 and the storage area of Chiquita ,whose length is 0.7 kilo meters, is mainly used for transportation of bananas by containers. Trailers through this road must reduce their speed dramatically because the road is unpaved and has many bumps. Thus, it is necessary for the road to be repaired. If this road is not repaired in the near future, the road condition will be worsened and the efficiency of the transportation will further decline. In addition, cargoes of the trailers are often damaged by the bad condition of the road. It is desirable that this road will be paved in the near future.

7. For Container Yard No.11, the efficiency of the net stacking area is degraded because the storage yard contain ruts and becomes muddy after rainy weather. Therefore, this yard should be paved as soon as possible.

8. Beside the above mentioned, various parts of other ports were observed to require repair, and these are summarized in Table 1-1-2.

Table 1-1-1 Maintenance Budget for Port Facilities in 1993

(Unit: 1000 Lempiras)

Cortes	Tela	La Ceiba	Castilla	San Lorenzo	Total
570.0	5.0	20.0	50.0	25.0	670.0

Source : ESTADOS FINANCIEROS E INFORMACION ADICIONAL (ENP)

Table 1-1-2 List of the Facilities which should be repaired
(January 26, 1994)

Port	Facility	Location	Condition	Remarks
Cortes	Apron	Junction in the middle of Wharf No.3	Damaged and to be repaired	
		Junction of Wharf No.4	Damaged and to be repaired	
		Slab, from the 1,000 feet mark to the end of Wharf No.5	Damaged and to be repaired	
	Road	From warehouse No.2 to Chiquita storage yard	Not paved and badly deteriorated	Should be paved depending on its importance in the future
	Container yard	Container yard No.11	Not paved (Gravel yard)	Should be paved depending on its importance
	Wooden fender	On Wharf No.3	Damaged and to be repaired	
	Rubber fender	On Wharf No.5	Missing and to be installed	
	Steel cover	Several steel covers for water supply pipe valves	Missing and to be installed	
Castilla	Wooden fenders	Half the length of the wooden fender on the wharf	Damaged and to be repaired	
Roatan	Wooden Pier	The whole pier	Deteriorated and out of service	T-type pier is planned in Coxen hole

Source : The study team

1.2 Cargo Handling System including Equipment

9. The basic idea of demarcation of cargo handling in Honduran ports is that ship to quay or quay to ship operation is conducted by a shipping agent and quay to landward operation is borne by ENP. However, there are lots of exceptions. Container operation is one example. Container excluding those of banana are handled by ENP's gantry crane. On the other hand, when sufficient number of trailers are not available in ENP, shipping agents hire the required number of private trailers and cargo transport within the port area is shared between ENP and private companies. Therefore, the evaluation of cargo handling should cover total operation activities by ENP as well as private operators.

10. One of the biggest problems for the port of Cortes is the limited handling area. The port is rectangular in shape; while the total length of the water front line is utilized for port activities, the width is only around 150m. The container yard which normally requires a large area suffers from this limitation. Furthermore, port traffic to/from wharf No.3 and No.4 runs through the container yard which hinders the efficiency of cargo handling. Nevertheless, the cargo handling efficiency at the terminal is thought to be considerably good despite the unfavorable conditions. This may be due to the dedicated efforts of ENP and port related entities.

11. At port of Cortes, the volume of unit cargoes is expected to increase dramatically. Since this would bring severe port congestion and invite inefficiency, ENP together with related entities should not only continue their efforts, but take steps for improvement. Taking into consideration the above aspects, issues which need to be improved are identified in the following paragraphs.

The following items are required to be worked out urgently.

1) Communication of necessary information to operator.
If gantry crane operator has container list and loading/unloading plan, misinformation is less likely to occur and planner will be able to manage more effectively. If straddle carrier operator has container list, the proper information is more easily accessed.(Issue No.12)

2) Designation of trailer stop.
The trailer stop area should be determined. In that way, straddle carrier can take container box from the trailer stop. Container handling at container yard will thus become more efficient.(Issue No.13)

3) Allotment of parking space in the port area.
There is no sufficient space for waiting truck and trailer. Many trucks and trailers

are parked on the road in the port area and outside gate No.11. With the further increase of cargo handling volume, the congestion at these roads would have bad effects on general traffic. As a temporary solution, it may be practical to utilize the reclamation area or the nothern-most part of the Free zone for parking.
(Issue No.14)

4) Enhancement of gate function.
Efficiency would be improved if checking for container was conducted at No.11 gate. This measure will improve the traffic and road condition between No.11 gate and TCC office as well as traffic congestion around No.11 gate.(Issue No.15)

12. Replacement of container handling equipment is behind the pace of progress of container cargo. At the port of Cortes, ENP has purchased two straddle carriers (one more carrier is expected in near future). Next target should be tractor heads. About ten tractor heads should be replaced. Maintenance plan of cargo handling equipment should be prepared.(Issue No.16)

13. Arrangement of traffic at port of Cortes should be conducted. The installation of traffic guide/signs would create a smoother traffic flow and more efficient cargo handling. These measures include a clearly delineated center line of the road, zoning of parking space and stop sign.(Issue No.17)

14. Establishment and observance of basic rules for cargo handling equipment should be conducted. The rule should work in such a way that the more expensive the equipment, the less break time. The gantry crane is the most expensive of the equipment at port of Cortes, thus ENP should try to keep the break time as short as possible. The straddle carrier would come next.(Issue No.18)

15. At the port of Castilla, SFC has a big inventory of cargo handling equipment and weight of ENP equipment is comparatively low. Nevertheless, some cargo handling machines are not in good working condition. Also, according to interviews with ENP personnel at the port, there is a need to handle heavy cargoes from time to time, but there is no crane of large capacity. The port might need a crane with capacity of 75 tons or more depending on the demand of heavy cargoes.
(Issue No.19)

16. Some machines are also not in good working condition in the port of San Lorenzo. There is no facility for container, nor is the yard paved. In future, facilities for container would be needed. Two (2) cranes out of three (3) are not in good condition. Although details of the condition of this equipment have not been clarified, it is necessary to overhaul this equipment without delay and two cranes (15 ton and 30 ton) should be

purchased because ENP is the only organization which handles port cargoes inside the port. The distance is approximately 400m between the warehouse and the berth and containers are carried by prime movers. It may be necessary to increase the number of prime movers to better the service. (Issue No.20)

17. ENP is conducting preventive maintenance. However, ENP sometimes encounters difficulty in replacing equipment parts. It is required to make efficient procurement of some equipment parts which are very vital for operation and/or in need of frequent replacement. Statistical approach based on the past data may be a useful tool to identify such parts. A characteristic example is shown in the case of gantry crane. The working ratio of the gantry crane is not high. Based on the Team's rough calculation, the total operation time of gantry crane was estimated to be, at highest, 2,200 hours in 1992. The gantry crane was purchased in 1978 and it is reaching the end of its service life. According to interviews, in 1992, it broke down four (4) times and each breakdown required five to seven days for repair. Recently, the crane stopped working for about one (1) month as of April 5th, 1993. Frequent breakdowns are one of the reasons for the low container utilization rate. (Issue No.21)

18. Training of operators should be strengthened. The training may consist of theory and practice. Trainees picked from among operators may periodically gather at a place and be given lectures. On-the-job training should be woven into the training curriculum and the progress should be evaluated. Good operators may be qualified as trainers.(Issue No.22)

1.3 Port Operation

19. A shift system has not been introduced in container handling; one gang continues to work until the cargo handling is finished. Sometimes, the work is said to continue a very long time. Some of the workers sleep in the port area because of fatigue. This could result in unsafe work and inefficient cargo handling. Introduction of a shift system is recommended to improve cargo handling productivity of workers and safety of work conditions and health of workers. ENP has started to prepare the introduction of a shift system, which is also mentioned in Chapter 2 of PART IV.(Issue No.23)

20. Warehouses are not classified by cargoes excluding dangerous objects. Common practice currently taken inside the ports is case by case assignment of cargoes. This might hinder efficient cargo handling operation and impede the smooth flow of cargo.(Issue No.24)

21. The most remarkable characteristic of the usage of yards is the prevalence of

containers at almost every point possible. There is no CFS (Container Freight Station) in the port. Stripping or packing of LCL (Less than Container Load) cargo is observed everywhere in the port. This sometimes hinders smooth port operation and transportation as well as port traffic. To establish a CFS, it is necessary to remove containers which are located on the apron.(Issue No.25)

22. There is no control tower for containers. The supervisor under the gantry crane gives instructions to gantry crane operator, prime mover operators and drivers of trailers. As there is no one to observe the total container flow, the supervisor can not give precise instructions, resulting in lower efficiency of cargo handling. If there are persons to observe and grasp the total container flow in the container control tower, they can order the appropriate arrangement of prime movers and trailers. This information would save waiting time and improve cargo handling efficiency. A basic communication system to connect container yard and the control center is necessary.(Issue No.26)

1.4 Port Management

23. ENP does not have a long-term national plan for port development, nor authorized master plan for an individual port. Therefore, there is no guide-line for future port development of ports. This may hamper future investment for port development.(Issue No.27)

24. In some areas, improper personnel deployments are observed. For example, the cargo volume handled in 1992 was 540 thousand ton in the port of Castilla and 130 thousand ton in the port of San Lorenzo. However, the number of personnel is about 70 and 90 respectively. It is a rather difficult task to decide appropriate number of personnel, however, there is a necessity to pursue optimum deployment. One of the indices which might be useful is the ratio between cargo handling volume and number of personnel.(Issue No.28)

25. The responsibility of port operation, in some sections, is concentrated on a few administrative personnel. The cargo handling operation and management of the container terminal should be separated and the responsibilities should be divided.(Issue No.29)

26. At present, ENP records labor accidents concerning ENP's employees and epuipment. ENP is likely to regard itself as a port operator rather than a port administrator. However, ENP should act as a port administrator which aims to upgrade total port activities rather than its own operation. Regardless of number and degree, ENP should record all accidents including those of private companies in the port area as a unified administrative body, and investigate and analyze the causes of those

accidents. These works will make the port of Cortes more attractive by improving the labor environment and preventing accidents.

A system in which it is compulsory to report all accidents to ENP including private companies should be established. By recording accident data such as date, place, cause, degree, ENP can find effective safety measures. And ENP should make an effort to improve the labor environment and call attention to safety. Moreover ENP should hold regular meetings concerning labor accidents with private companies and report and discuss safety measures. This makes all persons concerned with port activities recognize the present situation of labor accidents and also raises consciousness about safety. ENP should create a position that is exclusively concerned with the safety of port activities.(Issue No.30)

27. Some problems are observed in port statistics. There is no data on domestic sea trade. It is necessary to grasp the number of ships and volume of cargoes of domestic trade not only to analyze financial situation but also to evaluate port capacities and make future plans.(Issue No.31)

Chapter 2 Urgent Improvement Plan

2.1 Criteria for Improvement Plan

28. Chapter 1 shows the basic items which require countermeasures to improve port services as well as working conditions. The issues cover a very wide area including facilities, equipment, operational practices and managerial matters. Some issues require a long period of time to improve and others need a large amount of money. These issues are more appropriate in the long term masterplan or strategy. Aside from these issues there are several points which require urgent steps to improve the situation.

29. The identified issues could be categorized into several groups by their natures. These are:

1) Issues concerning the condition of facility. This, mainly, is described in 1.1 of this Part.
2) Issues which mainly derive from the areal limitation, especially in the port of Cortes. The true solution is to rearrange or expand the port area and should be found in the scope of the masterplan.
3) Issues on everyday practices of port operation.
4) Issues which relate to other institutions including municipality where by a solution is only possible in cooperation with the institutions concerned.
5) Others.

30. Taking into consideration the above mentioned matters, the urgent improvement plan should include the following items:

1) Issues which hinder port activities or which are anticipated to become bottle-necks in near future.
2) Facilities and equipment which accompany no large investment and which are easily improved.
3) Port operation and management which require no fundamental change of institution, but only small change of operational procedure or working method.
4) Port development plan of ENP or other relevant entities which contains some questionable points.
5) Easy countermeasures to port activities or facilities which may affect surrounding environment.

2.2 Urgent Improvement Plan

31. Table 2-2-1 shows the list of points of issue which were mentioned in the previous chapter. These issues were identified during the inspections of the Study Team in February, March and June in 1993.

Table 2-2-1 List of Points of Issue

No.	Field	Port	Content of issue	Content of Project	Cost (1000LP)
1	Facility	Cortes	Damage at junction in the middle of wharf No.3.	To be repaired.	
2			Damage at junction of wharf No.4.	To be repaired.	
3			Damage of slab, from the 1000 foot mark to the end of wharf No.5.	To be repaired.	
4			No pavement of road from ware-house No.2 to Chiquita storage yard.	To be paved.	2,000
5			No pavement of Container yard No.11.	To be paved.	2,425
6			Damages of the guard-rail of railroad.	To be repaired.	
7			Damage of fenders on wharves No.3 and No.5.	To be repaired.	
8			Loss of several steelcovers for water supply valves.	To be installed.	
9		La Ceiba	Corrosion of Raykin fenders at persent wharf.	New port is under con-struction.	47,774
10		Castilla	Damage of fenders on the wharf.	To be repaired.	1,842
11		Roatan	Collapse of wooden pier.	New pire is under con-struction.	11,772
12	Cargo handling	Cortes	No transmitssion of the infor-mation for cargo handling to operators of cargo handling equipment.	To give the information to the operaters.	
13			No transfer point between straddle carrier and trailers.	To determin the transfer point.	
14			No parking space for trucks and trailers result in traffic jams	To prepare the parking space in the port area.	159
15			Inefficient gate function at No.11 gate.	Enhancement of gate func-tion at No.11 gate.	

16			No replacement plan of container handling equipment.	To make the maintenance and the replacement plan of cargo handling equipments. To purchase ten tractor heads.	7,000
17			No traffic guide/sings in port area.	To install traffic guide/signs.	
18			Low warking ratio for expensive equipment.	To establish and observe the basick rule on cargo handling.	
19		Castilla	No large capacity crane at Port of Castilla.	To be purchased a large capacity crane.	
20		San Lorenzo	Shortage of large capacity crane and prime mover at the port of San Lorenzo.	To install two large capacity cranes and several prime movers.	
21		All main Honduran ports	Difficulty of replacing parts of some equipment.	To use a statistical approach in replacing the parts.	
22		All main Honduran ports	Necessary to train operaters of cargo handling equipment according to increase of cargo volume	To train the operaters.	
23	Operation	Cortes	No shift system in container handling.	To start investigation on the introduction of a shift system	
24			No. classification of warehouses.	To classify the warehouses by cargo commodity	
25			No CFS at Port of Cortes.	To establish a CFS at Port of Cortes.	25,400
26			No control tower in the container yard.	To establish a control tower for over-all container flow inside the port area.	
27			No long-term national plan for port development.	To make a over-all long-term national plan for Honduran ports and to make master plan for individual port.	
28			Improper personnel development.	To arrange the number of personnel for optimum deployment.	
29			Concentration of responsibility of port operation.	To divide responsibility for the management and operation of container handling among several people.	
30			No countermeasure for all labor accidents in the port area.	To record all accidents including those of private companies. To creat a position responsible for the safety in port area.	
31			No statistics of domestic sea trade.	To compile statistics of domestic sea trade.	

32. According to the above table, the nature of countermeasures No.1, No.2, No.3, No.6, No.7, No.8 and No.10 are maintenance or repair, No.9, No.11 No.14 and No.15 require large investment and they are now under construction, No.28 and No.29 issues require fundamental change of institution and No.20 issue is not urgent because the capacity of cargo handling equipment at Port of San Lorenzo has allowance at present. All these subjects are not appropriate for inclusion in the urgent improvement plan.

33. All remaining subjects require urgent improvement. These are shown in Table 2-2-2.

Table 2-2-2 Project List of the Urgent Improvement Plan

Project number	Issue number	Field	Port	Project Title	Cost (1000LP)
1	4	Facility	Cortes	Paving the road between Warehouse No.2 and Chiquita storage yared.	2,000
2	5			Paving the container yard No.11.	2,425
3	12	Cargo handling	Cortes	Transmitting the container lists and the storage plan to operators of container handling equipment.	
4	13			Determining the transfer point between straddle carrier and trailers.	
5	14			Preparing parking space for trucks and trailers.	159
6	15			Improving the gate function at No.11 Gate.	
7	16			Replacing the container handling equipment.	7,000
8	17			Installation of traffic guide/signs in the port area.	
9	18			Establishment and observance of basic rules for cargo handling equipment.	
10	21			Using a statistical approach for replacing equipment parts.	
11	22			Strengthening training of operators	
12	23	Operation	Cortes	Investigation on the introduction of a shift system.	
13	24			Classification of the warehouses by commodity.	
14	30		All main Honduran Port	Countermeasures of all labour accidents in the port area.	
15	31		All main Honduran Port	Port statistics for domestic trade	

34. Among the 17 projects, two concern pavement, while nine projects relate to cargo handling and four to port operation and management. In these projects, issues number 5, 19 and 23, which are understood as high priority projects by ENP, have been completed or are now under construction.

2.3 Another Important Matter

2.3.1 Port Road

35. As already mentioned in paragraph 10, the port road which penetrates through the terminal No.5 hinders the cargo handling operation as well as smooth traffic flow. One of the possible solutions is to relocate the road to the edge of the terminal.

36. Fig. 2-3-1 shows the present situation of port traffic and cargo handling movement at the No. 5 terminal. In the figure, white arrows indicate the flow of the general traffic, black arrows unit cargo traffic and thin arrows the movement of straddle carriers.

37. From the figure, it is noted that on the subject road,the traffic congestion is remarkable. There is a basic heavy face-to-face traffic with frequent inter-crossing of straddle carriers. Obstacles at the quay side in the form of remaining wagons, abondoned chassises and other temporary storing materials was another problem observed during the cargo handling operetion. This also curbs the efficiency of the cargo handling operation as well as threatens safety.

38. Fig. 2-3-2 is a proposal for the improvement of the situation. The idea is to relocate the road to the northern tip of the terminal along the rail and to let the general port traffic flow on this route. In this way, the unit cargo terminal is insulated and free and efficient cargo handling operation will be secured.

39. Along with the relocation work, the flow of unit cargo traffic should be regulated. Every trailer should be run counter-clock wise except the eastern-most part of the terminal where traffic goes clock-wise to avoid mingling with the Ro-Ro cargo movement.

40. The relocation of the road results in the loss of 130 slots. The rough estimated cost for the project is around 500 thousands Lps.

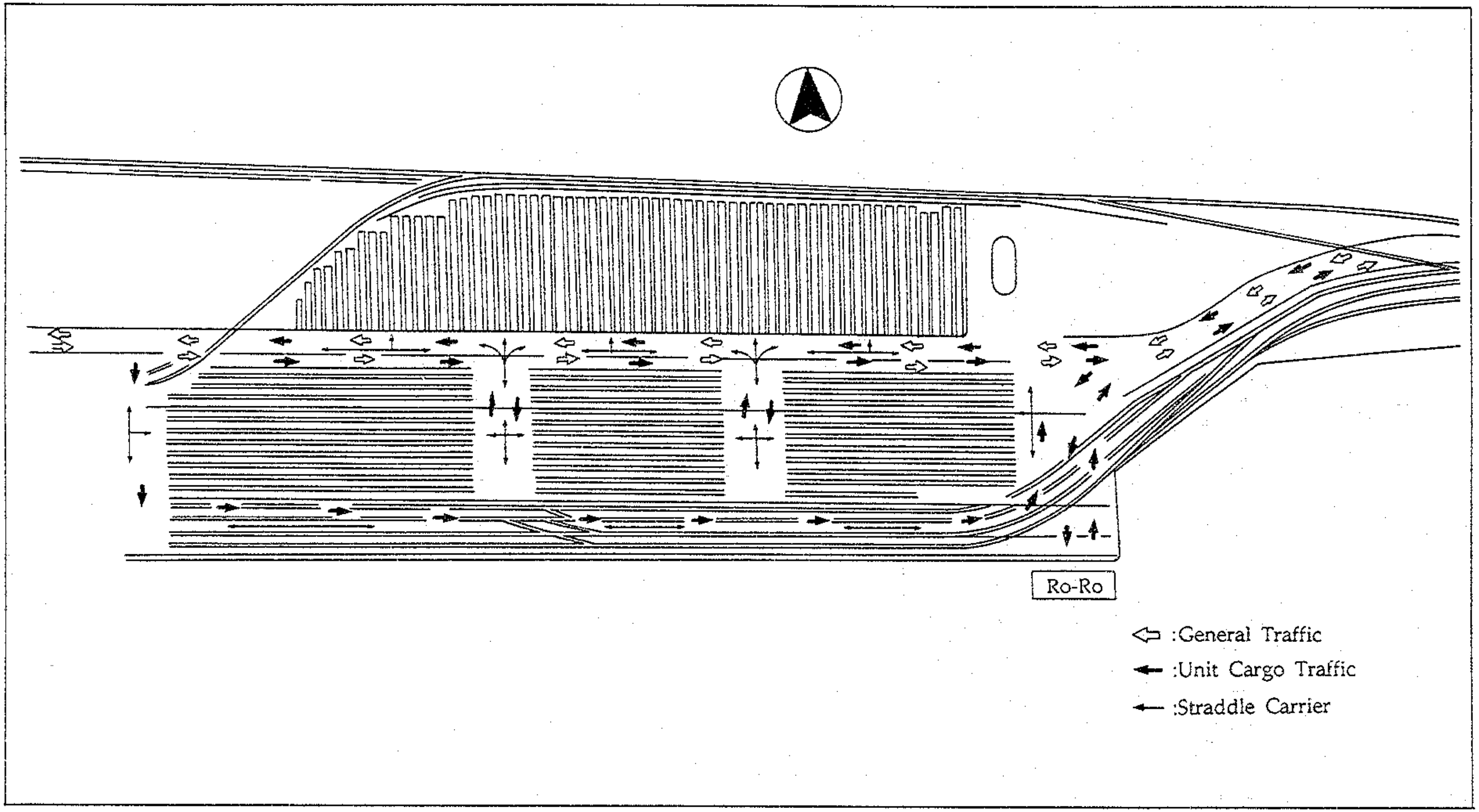


Fig. 2-3-1 Present Traffic Flow in No.5 Terminal

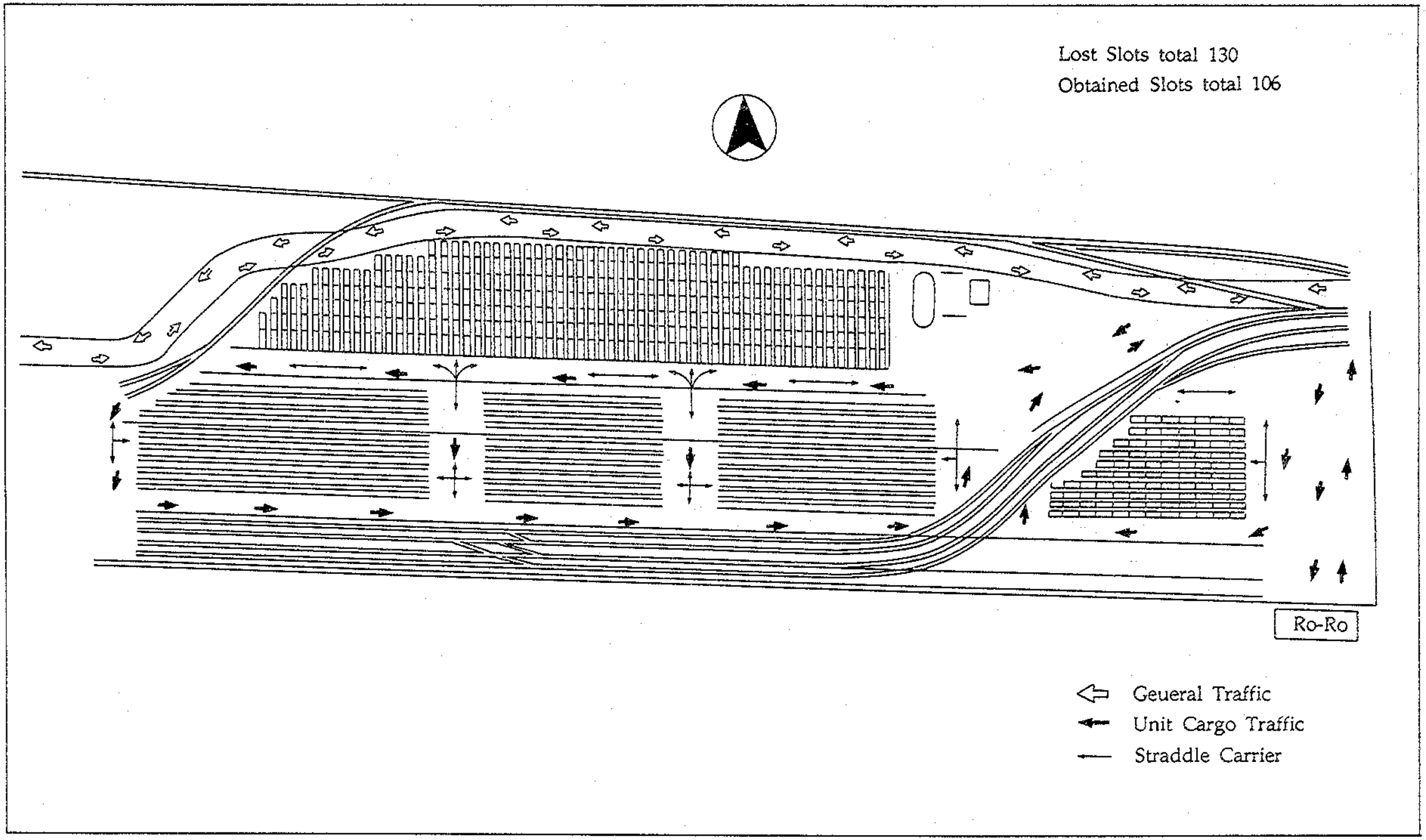


Fig. 2-3-2 Improved Traffic Flow in No.5 Terminal

2.3.2 Asphalt Handling

41. Although the volume of asphalt import has been limited and will not be a major import item at the port of Cortes, this petroleum product is handled at the Wharf No.3 and stored in tanks which are located be behind warehouse No.1 and No.2., and very close to a residential zone.

42. ENP is begining to talk to the municipality, the owner of the tanks, to relocate them to an area far removed from the residential zone. One of the tanks is reported to have gone up in flames and there is no doubt a danger of such kind. From the port as well as city planning point of view, the relocation of the tanks is justified and the ENP's plan is laudable.

43. The new location for the tanks should be close to the liquid cargo terminal, Pier 1 and Pier 1-A, and through this relocation, the people living close to the present tank site can enjoy a better living environment and the port will see its operation improved.

PART III

Masterplan of the Port of Cortes for the Year 2010

Chapter 1 Long Term Plan for the Development of the Port of Cortes

1.1 Basic Procedure for Establishing the Masterplan

1. Masterplan of the port of Cortes is established through the work procedure shown in Fig. 1-1-1.

2. Among the items shown in the Figure, Cargo Volume is given in Chapter 1, PART I. Ship size and necessary port facilities are roughly obtained in Chapter 2, PART I as well as in Chapter 2, PART II.

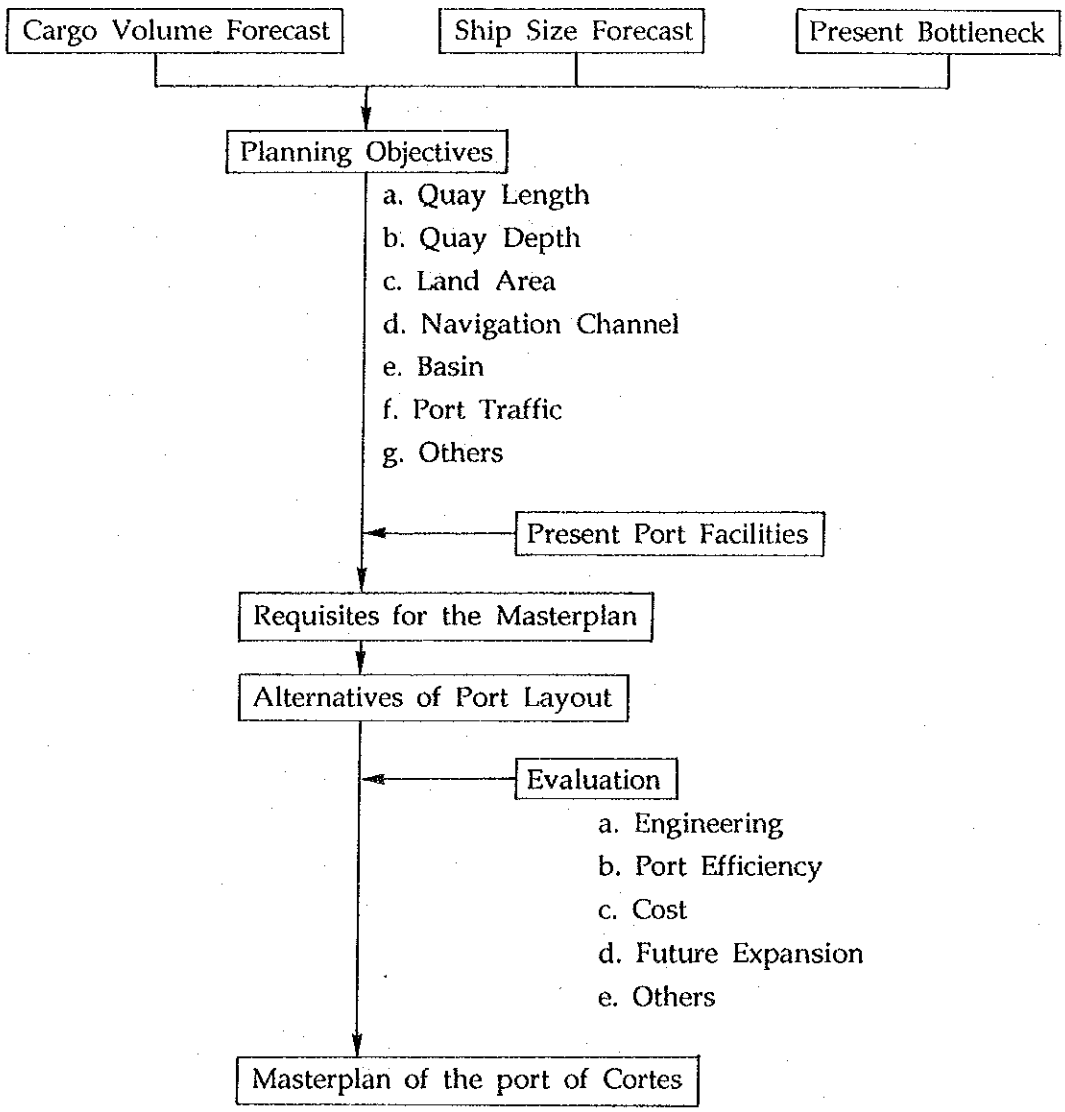


Fig. 1-1-1 Procedure for Masterplan of the Port of Cortes

1.2 Bottleneck in the Present Port Operation

3. When considering the future port, the present conditions of the port should be taken into full consideration. Thus, the present conditions of the port are analyzed and the issues which should be solved in the scope of the masterplan are extracted together with their possible countermeasures.

1.2.1 Characteristics of the Present Port Facilities

4. The present situation of the port is characterized as follows;

1) Unit Cargoes

The port has a modern container terminal with container handling equipment including gantry crane and straddle carriers. However, the terminal has several problems such as;

a. Areal limitation ---> The area behind the quay is narrow and many containers and RO-RO cargoes are obliged to transfer to a distant storage yard.

b. Multiple use -------> The terminal is utilized for general cargo as well as occasional dry bulk cargoes to compensate for the shortage of total quay length. Fruit containers, however, are handled together with general cargo at Quays No.3 and No.4 using ship gear. The terminal is not an exclusive unit cargo terminal, but multi purpose terminal.

c. Port traffic ----------> Port traffic connecting gate 11 and quays No.3 and No.4 goes through the container handling yard which brings safety as well as efficiency problems.

d. Fruit containers----> Fruit containers are handled at quays No.3 and No. 4 by ship gears. All of the containers are go-down containers which means they directly go out to and come from the outside container yard.

2) General Cargoes

General cargoes are handled at quays No.3 and No.4 (sometimes quay No.5). The quays are considered to have sufficient water depths for the moment. Problems related to these terminals are;

a. Fruit container ---> Fruit containers are handled at the quays No.3 and No.4. The cargo necessitates quick cargo handling practice which puts a heavy burden on port traffic.

b. Dry bulk cargo ---> There is no exclusive-use dry bulk terminal in the port. The cargo is handled at quays No. 3, No.4 and No.5. The cargo handling takes long time and occupies a quay for quite a long duration.

3) Dry Bulk Cargoes

As stated above, dry bulk cargo occupies quays for a long period of time. In the port development history, bulk cargoes are usually segregated from general cargoes as the first priority. For the port of Cortes, it is worth considering the construction of an exclusive-use dry bulk terminal. The port already has exclusive liquid cargo terminals.

4) Domestic Cargoes

There is no special quay for domestic cargo vessels. Domestic vessels anchor in a niche among the ocean going vessels and conduct their cargo handling. This accelerates congestion in the port. In future, domestic shipping is expected to increase and segregation of domestic vessels from ocean-going vessels would be crucial for smooth port traffic as well as efficient port activities.

5) Non-utilized Water Front Line

While the port facilities are located along the north coast of the Cortes Bay, there is a non-utilized water front line between Pier 1-A and Quay No.3

6) Areal Limitation

---> port area is long and narrow which forces port traffic to merge into single narrow port road.
Proximity to the town of Puerto Cortes does not allow for expansion of port area in the landward direction.

1.2.2 Other Port Related Matters and their Implications

5. Fruit Companies have their own container storage yards next to the port and some shipping companies have their own van pools around the port. These two factors bring a rather short container staying time inside the port.

6. There are some storage places for dry bulk cargoes around the port.

7. Oil Company has its own oil terminal next to Pier 1-A.

8. Practically, there is only one access road to/from the hinterland and parking space is very limited which causes an occasional mix-up with trailers and trucks around Gate No. 11.

9. Passenger rail cars run across the port area which accelerates the traffic congestion in the port.

1.2.3 Possible Countermeasures

10. The above mentioned bottlenecks will further hinder the operation as well as management of the port. Thus, these bottlenecks should be solved in the scope of the masterplan of the port. Possible countermeasures against them are as follows;

1) Unit cargoes and bulky cargoes are the cargo items which will significantly increase.
   ---> New unit cargo terminal with sufficient storage yard and CFS.
   ---> New terminals for dry bulk cargoes with appropriate cargo handling facilities.

2) Areal limitation (inefficient cargo handling, traffic congestion and safety problem)
   ---> Acquisition of new land area for port operation
   ---> Optimum layout of terminals
   ---> Streamlining of cargo movement

3) Improper access
   ---> New bypass road to/from the port
   ---> Segregation of passenger rail cars

4) Mixture of domestic shipping vessels
   ---> New quay for domestic shipping vessel

1.3 Planning Objectives for the Year 2010

1.3.1 Planning Objectives for 2010

1.3.1.1 Targeted Cargo Volume

11. The future cargo volume at the port of Cortes is forecasted through two methods in Chapter 1, PART II. The macro approach provides two (2) scenarios which set a range of cargo volume by packing type. Micro approach gives the result of cargo-wise forecast which eventually locates between the two scenarios by the macro approach.

12. For the port planning purpose, the rounded number of cargo forecast result obtained by micro approach is adopted. The cargo volume by packing type as planning target is listed in the following table.

13. Among the cargo types, unit cargo shows the largest increase in volume (650 thousand ton ircease by 2000 and 1.2 Million ton by 2010), while dry bulk cargo shows the largest growth rate (200% in 2000 and 280% in 2010 of the volume level of 1992) and unit cargo follows(140% in 2000 and 190% in 2010). General cargo suffers a slight decline up until 2005, then gradually rebounds to the level of 120% in 2010. (Fruit containers are included in the category of unit cargoes. Although the fruit containers currently are handled at the general berth by ship gear, it is foreseen that vessels will pursue the maximum loading capacity and install no ship gear in future. This is why we include fruits containers in that category)

Table 1-3-1 Targeted Cargo Volume by Packing Type

unit:1,000ton

Year	General	Dry Bulk	Unit Cargo	Liquid	Total
1992	509	353	1,301	646	2,809
2000	450	700	1,850	650	3,650
2010	600	1,000	2,500	1,000	5,100

1.3.1.2 Targeted Vessel Size and Cargo Volume per Vessel

a. Maximum Ship Size

14. From paragraphs 201, 202, 203, Chapter 2, PART I increase of ship size has been observed in container vessel, RO-RO vessel and oil carrier.

15. The table below lists the large calling vessel size by type at the Port of Cortes. In the Table, No. means the number of vessels which belong to the vessel class of GRT larger than 15,001 ton (except Lumber Carrier and Reefer Conventional Vessel as these types have no ships belonging to the class of GRT more than 15,001 ton, thus the class of GRT more than 8,001 ton is adopted for these ship types). GRT and LOA are obtained by averaging all vessel sizes and vessel lengths belonging to the classes. The draughts are calculated by using the Team's study result for container vessels and Technical Standard for Port and Harbor Facilities in Japan. From the table, it is noted that current port facility basically provides sufficient water depth except for oil tanker. (Oil company is reported to be extending the oil pier to reach a greater depth)

16. The size of RO-RO vessels has increased in recent years, however, the dimensions are far smaller than container vessel. Vessels other than RO-RO and container show no significant increase of their dimensions and the water depth in front of berth No. 3 (-10.6m) and No. 5 (-11.0m) is thought to be sufficient up until 2010.

17. Thus, maximum vessel size for port planning purpose is given by dimensions of container vessel; 40,000 DWT, 230m LOA and 12m Draught. The current port facility does not provide this depth and is considered to be insufficient. Therefore, quay with the water depth of -12m or more is necessary in future. The following lists the maximum vessel size by type.

Maximum vessel size

	GRT	Length	Draught
Dry bulk	15,000 ton	180m	9.0m
Conventional	20,000 ton	200m	10.0m
Container	**40,000 ton**	**230m**	**12.0m**
RO-RO	20,000 ton	200m	10.0m

Table 1-3-2 Calling Vessel Size at the Port of Cortes (1992)

Ship type	No.	GRT(t)	LOA(m)	Draught(m)
Conventional	3	21,462	185	10.3
Dry Bulk	2	16,522	186	9.5
Oil Tanker	28	23,318	216	12.0
Other Liquid	3	17,654	174	9.0
Lumber Carrier	1	10,946	167	8.3
Reefer (Container)	75	19,595	203	9.5
Reefer (Conventional)	71	9,943	152	8.3
Container	49	27,668	200	11.0
RO-RO	103	15,528	185	(8.5)

b. Trend of vessel size change and number of calls

18. From paragraphs 68,69,72, Chapter 2, PART I and paragraph 201, Chapter 2, PART II, increase of vessel size has been observed in container, RO-RO and oil carrier. On the contrary, the size of dry bulk carrier has shown a tendency to decrease.

19. The table below shows the change, in the past four years, of average vessel size and number of calling ship by type. From the table, it is noted that the average size of RO-RO vessels has increased in the past four years and the average ship size reached almost 10,000 GRT in 1992. Container vessel has steadily increased its number of calls, however, the average ship size maintains almost same size of little less than 10,000 GRT. In 1992, the ship sizes of RO-RO and LO-LO became to the same.

20. For combined port statistics for LO-LO and RO-RO, the combined average vessel size has gradually increased and the number of calls has been increased constantly. This is probably due to the market strategy of shipping companies in response to the possible future increase of unit cargoes at the port.

21. Based on the interviews with shipping companies which provide liner services in Honduras, they are likely to increase the calling frequency to cope with the cargo increase in future, rather than enlarge the vessel size. Therefore, the vessel size is not likely to dramatically expand its dimensions.

22. The size of conventional ships has tended to increase while the number of calls has shown fluctuation. In future, cargo volume carried by conventional vessel will decrease for considerable period of time, mainly due to the further progress of containerization, and then rebound in 2005 to a level slightly larger than the present. Thus, dimensions of calling vessel will remain the same in future.

23. Vessel size of dry bulk carrier has decreased in the past four years while the number of calls has fluctuated. In future, dry bulk cargo is the cargo item which is forecasted to show the strong cargo increase. This will probably lead to an increase in vessel size as well as cargo volume per vessel.

Table 1-3-3 Yearly Change of Average Ship Size and No. of Ship Calls

Year		LO-LO	RO-RO	Conventnl	Dry Bulk
1992	GRT	9,681	9,471	5,489	5,451
	No.	499	231	315	40
1991	GRT	9,562	7,709	5,549	5,707
	No.	404	293	333	58
1990	GRT	9,730	5,548	4,444	6,474
	No.	327	268	416	41
1989	GRT	9,809	5,465	4,332	6,701
	No.	314	176	352	55

c. Objective vessel size and cargo volume per vessel

24. When planning berth length, it is reasonable for a continuous berth to adopt the LOA which includes 70% or 80% of vessel callings, rather than the maximum size which is suitable for single berth.

25. The tables below lists the calculation results for the above purpose using 1992 port statistics. The table gives, by vessel type, the number of calls, average cargo volume per vessel, dimensions of the vessel which include 70% and 80% of the total number of calls. The 80% vessel size gives GRT 15,375 ton and LOA 160.67 m for unit cargoes, GRT 9,996 ton and LOA 154.57 m for Conventional cargoes including banana and GRT 6,166 ton and LOA 127.44 m for Dry Bulk vessel.

26. Fig. 1-3-1 shows the combined distribution of vessel sizes for LO-LO, RO-RO and fruit containers. From this figure, it is noted that LO-LO vessels are classified into two groups. The maximum frequency is obtained by the vessel class of GRT 2,001 ton to 10,000 ton and the lower frequency, but important for port planning purposes is obtained by the vessel class of GRT 28,001 to 34,000. For RO-RO vessel, the most frequent vessel calls are obtained at the vessel class of GRT 15,001 -16,000 ton. The vessel size of fruit containers is classified into three types. 9,001-10,000 ton, 13,001-14,000 ton and 19,001-20,000 ton.

27. As for the average cargo volume per vessel, 2,647 MT for Banana LO-LO, 1,433 MT for Container and 1,618 MT for RO-RO are obtained. The average volume for overall unit

cargo is 1,777 MT. Fig. 1-3-2 shows the combined cargo volume distribution of LO-LO, RO-RO and fruit container. The minimum cargo volume is around 200 ton and the maximum cargo volume is 7,000-7,200 ton. The maximum occurence is obtained at the cargo volume of 500-600 ton, and the occurence gradually decreases with the increase of cargo volume. The cargo volume for LO-LO vessel is distributed across a rather wide range while the distribution of RO-RO and fruit container is rather narrow.

28. Fig. 1-3-3 shows the relation between the cargo volume per vessel and vessel size. From this figure, there is no clear relation between the two items.

29. Through the similar calculation with unit cargo, the average cargo volume per vessel of 897 MT for Conventional, 2,114 MT for Banana Reefer and 1,565 MT for combined conventional as well as Banana Reefer is obtained. For Dry Bulk, 6,860 MT is calculated.

Table 1-3-4 Objective Vessel Size and Cargo Volume per Vessel (1992)

	Banana LO-LO	Container	RO-RO	Total
No. of vessel	161	338	231	730
Cargo / vessel	2,647 MT	1,433 MT	1,618 MT	1,777 MT
Top 20% (GRT,LOA)	19,595 MT (203.05m)	8,908 MT (133.84 m)	15,375 MT (160.67 m)	15,375 MT (160.67 m)
Top 30% (GRT,LOA)	19,595 MT (203.05 m)	4,962 MT (133.84 m)	15,375 MT (160.67 m)	15,371 MT (160.67 m)

	Conventional	Banana Reefer	Total	Dry Bulk
No. of Vessel	119	145	264	40
Cargo / Vessel	897 MT	2,114 MT	1,565 MT	6,860 MT
Top 20% (GRT,LOA)	9,400 MT (138.72 m)	9,996 MT (154.57 m)	9,996 MT (154.57 m)	6,166 MT (127.44 m)
Top 30% (GRT,LOA)	7,580 MT (123,48 m)	8,960 MT (146.65 m)	8,960 MT (146.65 m)	5,794 MT (128.05 m)

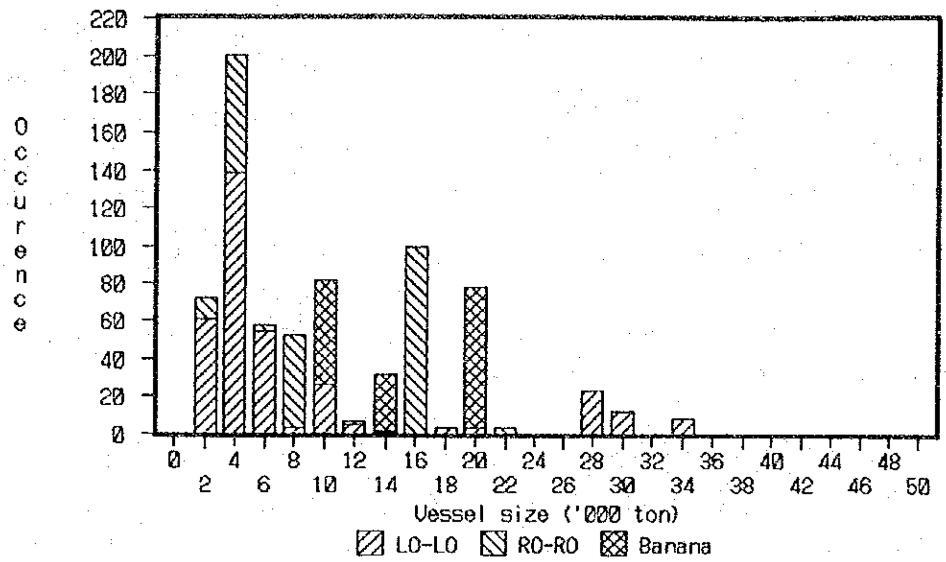


Fig. 1-3-1 Vessel Size of Distribution (Unit Cargo Total)

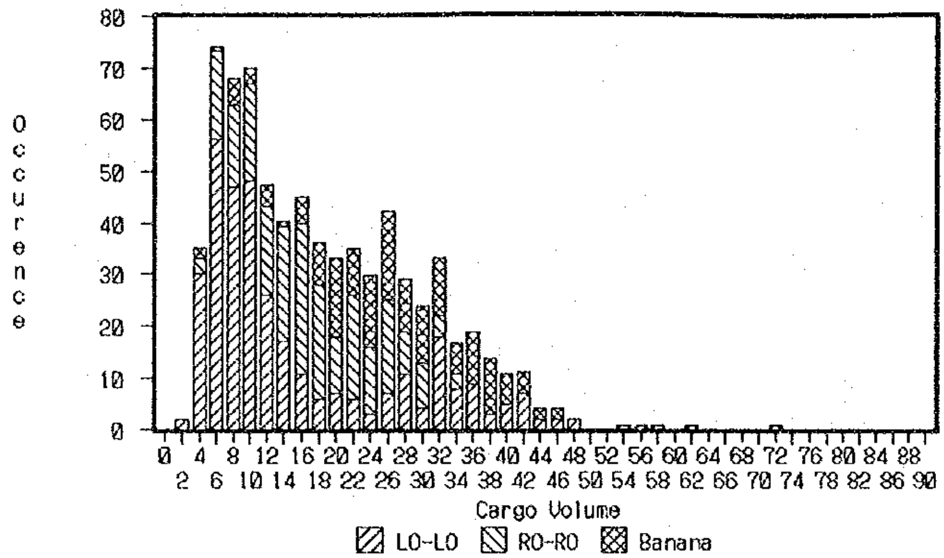


Fig. 1-3-2 Cargo Distribution In, Out (Unit Cargo Total)

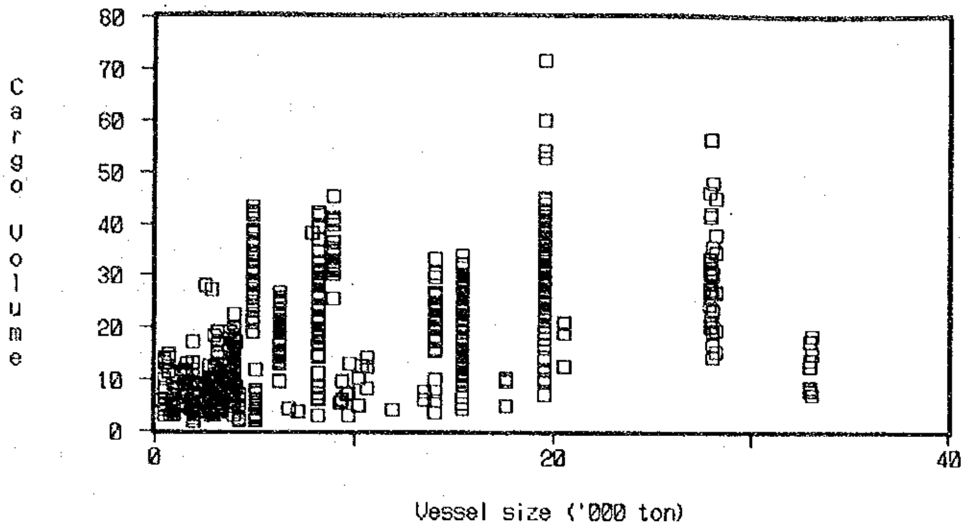


Fig. 1-3-3 Vessel Size - Cargo Volume Relation (Unit Cargo Total)

1.3.2 Future Quay Requirements

1.3.2.1 Quay Requirement in 2010

30. Table 1-3-5 lists vessel size (Top 20%), average cargo volume per vessel, number of calls per year, average waiting time and cargo handling efficiency in 1992.

31. For planning the Masterplan, the vessel sizes are assumed to almost maintain current levels following the interview results with shipping agents. Therefore, for unit cargo vessel, GRT 15,000 MT, LOA 160 m and 25 m for vessel width are adopted where two or more continuous berths are constructed, however, the water depth in front of the quay should be set to accommodate the maximum vessel size, -12 m or more. (The frequency of call of the maximum vessel type is expected to be small. Moreover, for the moment, it is hard to imagine that the maximum vessel makes her call with full load. Therefore, the water depth of -12 m is thought to be enough) For the conventional vessels, the sizes are assumed as GRT 10,000 MT, LOA 155m and 25 m wide, and for dry bulk vessel, GRT 7,000 MT, LOA 128 m and 15 m wide.

32. As for the average cargo volume per vessel, 2,000 MT is assumed for unit cargo vessel because the cargo volume is expected to soon catch up with the vessel's up-scale trend which was described in 1.3.1.2 (b). For conventional vessel and dry bulk carrier, the current cargo volume levels are assumed to be maintained, 1,500 MT and 7,000 MT, respectively.

33. Dividing the total estimated cargo volume in 2010 by the average cargo volume per vessel, number of calls is obtained. They are; 1,250 for unit cargo, 400 for conventional

and 143 for dry bulk.

34. Cargo handling efficiency is assumed to be improved. There is room to improve the productivity of unit cargo handling. In this report, the productivity is assumed to be 150 % of that in 1992, thus 220 MT/hour mainly because of the high productivity of new unit cargo terminals. This implies that the productivity is around 20 TEU per hour which is comparable to the international standard for a gantry crane. The productivity for other types of cargo is assumed to be 110% of that in 1992, thus 40 MT/hour for conventional cargo and 60 MT/hour for dry bulk cargo.

35. Waiting time is also improved. Even now, unit cargo shows considerably low waiting time and the same waiting time is assumed for 2010. For conventional cargo, 24 hours is assumed, which is the waiting time generally observed in world's ports. Dry bulk cargo is usually carried by tramps, for which shippers tend to minimize the waiting time in port and 12 hours is assumed.

36. In-port times per vessel are 13.1 hrs for unit cargo, 61.5 hrs for conventional cargoes and 134.8 hrs for dry bulk cargoes. Accordingly, total berth time per year by vessel type is 11,375 hours, 15,000 hours and 17,560 hours, respectively.

37. Then, necessary number of berths is calculated based on the assumption that every wharf works 24 hours a day, 350 days a year. Then, applying the recommended maximum berth occupancy rate, the required number of berths for each vessel type is obtained; 3 berths for unit cargoes and 6 berths for general cargoes which includes conventional as well as dry bulk cargoes. In this calculation, the number of gantry cranes is assumed to be one crane per berth because calling vessels at the berth include RO-RO vessel which require no land crane and total number of quay at the unit cargo terminal is more than two which makes the use of the cranes flexible and more than two cranes can be allocated to a large vessel or a vessel in need of quick dispatch.

Table 1-3-5 Base Number for Port Planning [1992]

	Unit Cargo	Conventional	Dry Bulk
Vessel size (Top 20%)	15,375 GRT	9,996 GRT	6,166 GRT
Ave. Cargo per Vessel	1,777 ton	1,565 ton	6,860 ton
No. of Calls	730 vessels	264 vessels	40 vessels
Ave. Waiting Time (hr)	4.1 hrs	26.5 hrs	34.0 hrs
Handling Vol.(ton/hr)	144.3 ton/hr	36.2 ton/hr	51.9 ton/hr

Table 1-3-6 Base Number for Port Planning (2010)

	Unit Cargo	Conventional	Dry Bulk
Vessel size (Top 20%)	15,000 GRT	10,000 GRT	7,000 GRT
Vessel Length, Width	160m, 25m	155m, 20m	128m, 15m
Total Cargo Volume	2,500,000 MT	600,000 MT	1,000,000 MT
Ave. Cargo per Vessel	2,000 MT	1,500 MT	7,000 MT
No. of Calls	1,250	400	143
Efficiency (MT/hr)	220	40	57
Handling Time (hr)	9.1	37.5	122.8
Ave. Waiting Time (hr)	4	24	12
In port time(hr)	13.1	61.5	134.8
Total Berth Time(hr)	11,375	15,000	17,560
Berth (24hrs, 350 days)	1.35	1.79	2.09
No. of Berth required	3(2.45)	6(5.54)	

Note: No. of berth required is calculated by adopting recommended maximum berth occupancy (Table 2-4-4, Chapter 2, PART II)

1.3.2.2 Quay Requirement in 2000

38. Table 1-3-7 shows the calculation results for the year 2000. In the table, the vessel sizes are assumed the same as 2010. Productivities of cargo handling are assumed as follows;

Unit Cargoes: 150% of the present level, 220 MT per hour
General Cargoes: same to the present level, 38 MT per hour
Dry Bulk cargo: same to the present level, 55 MT per hour

39. Average waiting time for dry bulk cargoes is assumed to be 24 hours, a little longer than 2010 and average waiting times for unit cargo and general cargo are the same as 2010.

40. After a similar calculation as in table 1-3-6, number of requird berths are obtained as;

2 berths for unit cargoes
5 berths for general cargoes including conventional and dry bulk

Table 1-3-7 Base Number for Port Planning [2000]

	Unit Cargo	Conventional	Dry Bulk
Vessel size (Top 20%)	15,000 GRT	10,000 GRT	7,000 GRT
Vessel Length, Width	160m, 25m	155m, 20m	128m, 15m
Total Cargo Volume	1,850,000 MT	450,000 MT	700,000 MT
Ave. Cargo per Vessel	1,850 MT	1,500 MT	7,000 MT
No. of Calls	1,000	300	100
Efficiency (MT/hr)	220	36.2	51.9
Handling Time (hr)	8.4	41.4	134.9
Ave. Waiting Time (hr)	4	24	24
In port time(hr)	12.4	65.4	158.9
Total Berth Time(hr)	8,400	12,420	13,490
Berth (24hrs, 350 days)	1.0	1.48	1.61
No. of Berth required	2(2.0)	5(4.75)	

1.3.3 Areal Requirements

1.3.3.1 Present Situation

41. One of the biggest problems facing the port of Cortes is areal limitation. Modern port terminal requires large back-up land for cargo handling and cargo storage. Even for general cargo terminal, considerable land is reserved behind the quay for mechanized cargo handling.

42. Container terminal and dry bulk terminal require large areas of land. For example, in Japan, a container terminal with quay length of 250m is usually designed to have 300m wide back-up yard (75,000 sq.m) for container marshalling, container storage and other related activities.

43. The following is yards currently available for container marshalling and storage of unit cargoes and it describes the current situation of the unit cargoes storage yard in the port.

Container yard	: 24,471 sq.m
# 10 Yard	: 14,000 sq.m
# 10 1/2 Yard	: 2,500 sq.m
# 11 Yard	: 48,000 sq.m
Free Zone (North Part)	: 22,000 sq.m
Total	**:110,971 sq.m**

44. At present, the port of Cortes can satisfy areal requirement (this will be verified in 1.3.3.2), however, the yards are scattered and many of these areas are located at distant places from No.5 wharf. Currently, the cargo handling efficiency at the port is observed considerably high in spite of this areal limitation, due to the dedicated effort of management and labor. However, with the increase of cargo volume, problems from the areal limitation might emerge. The efficiency might suffer and possibility of accident might increase.

1.3.3.2 Areal Requirement

45. Unit cargo requires large area for cargo handling and storage. For port planning, areal requirement should be evaluated and woven into port layout. The basic idea for the calculation of areal requirement is to estimate the maximum number of coutainers which should be located in the yard for operation and storage. The factors to be considered include various aspects of container handling practice at the port. The following is to calculate areal requirement for unit cargoes.

a. Rate of empty container

46. Yearly change of the rate of empty container is listed in Table 2-1-3, Chapter 2, Part IV. The rate of empty container has decreased for import container, almost 30% in the past 10 years. For the export container, the rate of empty container has been steady, at around 15-20%. The difference of the rates of empty container comes mainly from the cargo volume imbalance between import and export. Fruits occupy the main portion of export container(reefer container) while consignee of import container varies, as do the contents of the container.

47. In future, import container cargo volume is forecasted to dramatically increase while the increase of export volume is modest. Thus, the volumes of export and import tend to balance, however, fruits including banana have seasonal fluctuation and owners

of containers are different for export and import. Therefore, the rate of empty container would be a little higher than the usual case. In this report, the rate of import container is assumed as 35% in 2000 and 30% in 2010 and the rate of export as 25% in 2000 as well as in 2010.

b. Unit weight per TEU

48. Yearly change of unit weight per TEU is shown in Table 2-1-4, Chapter 2, Part IV. Unit weights of both export and import container tend to decrease while fluctuating considerably. In future, it is forecasted that rather heavy cargo will increase in import containers such as machine parts and electric appliances. However, products from light industry in free zone are expected to increase which results in the decrease of unit weight of container. Thus, 8.5 ton per TEU for import container and 9.0 ton per TEU for export are assumed for 2010 and 8,0 ton and 9.5 ton for 2000.

49. Unit weight does not include tare weight while other statistics on unit cargoes include tare weight. Tare weights are assumed as 2.25 ton per 20 foot container and 4.05 ton per 40 foot container through the calculation.

c. Rate of 40 foot container

50. Currently the rate of 40 foot container reaches 60-65%. Taking into consideration the global trend of prevalence of longer containers including 45 and 48 foot box, the rate is assumed as 65% in 2000 and 70% in 2010.

d. Rate of RO-RO cargo

51. The rate of RO-RO cargo recorded 28% for both import and export in 1992. In future, keeping pace with the progress of containerization, the share of container vessel should tend to prevail. On the contrary, RO-RO vessel would keep its advantage inside the Caribbean Sea. Therefore, the rate is assumed to be 25% for 2000 and 2010.

e. The number of unit cargoes

52. Using the above assumptions, the number of unit cargoes for the years 2000 and 2010 is calculated as follows;

Table 1-3-8 Indices of Unit Cargoes

	ton/	TEU	Empty (%)		40ft	RO-	RO(%)	No.(I/O
	In	Out	In	Out	(%)	In	Out	each)
1992	7.1	9.4	41	24	60	28	28	45,000
2000	8.0	9.5	35	25	65	25	25	62,500
2010	8.5	9.0	30	25	70	25	25	87,100

f. Staying time of unit cargoes

53. Areal requirement depends on staying time of unit cargoes. From the port statistics, the staying time of unit cargoes (including fruit containers) in 1992 is analyzed as follows;

Staying Time of Unit Cargoes (1992)

	In	Out (unit:day)
Loaded:	4	2
Empty:	15	10

54. The above results are considerably influenced by the fact that the go-down cargoes occupies pretty high ratio in unit cargoes. The increase of loaded import cargoes in future will act to prolong the container staying time. Another factor is that ENP intends to have a customs check inside the port area, which currently is conducted on very limited number of containers and this tends to prolong the staying time of loaded container. On the contrary, the staying time of empty container is considerably longer than loaded container and ENP as well as container owners will try to shorten the staying time in order to make as better use of container box as possible. Taking these factors into consideration, the following staying times are assumed for the years of 2000 and 2010.

Staying Time of Unit Cargoes (2000 and 2010)

	In	Out (unit:day)
Loaded:	7	2
Empty:	14	10

g. Areal Requirement

55. Areal requirement is calculated as follows;

A = (L x S) / (H x d)

A:Areal requirement
L:No. of Container in storage yard, TEU --->(see the equation below)
S:Unit area per TEU --->22.7 sq.m
H:Average layers --->2.5 (for container)
1.0 (for RO-RO)
d:(Storage area)/(Storage area + Road area) --->50%

L = (M x Ds / Dy +Mi) x p

M: No. of container handled per year (TEU)
Mi:Average number of import containers per vessel --->see the table below
Ds:Staying time
Dy:Operational days per year --->350days
p: Peak ratio --->1.3

Average number of import containers per vessel (Mi)

Year	1992	2000	2010
per vessel	1,777 ton	1,850 ton	2,000 ton
Import	889 ton	925 ton	1,000 ton
TEU	99 TEU	103 TEU	118 TEU

Table 1-3-9 Areal Requirement for Unit Cargoes at Peak Time

Year	1992	2000	2010
Areal requirement (sq.m)	105,366	150,408	211,697
Container in the yard(TEU)	3,561	5,425	7,886

(Actual storage area at present: 110,971sq.m)

note: Number of container in the yard includes RO-RO cargoes which are regarded to have the same size as 40 foot container. The stacking layers are assumed 2.5 for containers which includes reefers and 1.0 for RO-RO cargoes.

56. The calculation results indicates that the current storage area is almost equal to the areal requirement at peak period. (Storage area at present includes the northern part of free zone of 22,000 sq.m which is currently in temporary use for RO-RO storage) In future, the areal shortage will dramatically increase and an additional 45,000 sq.m in 2000 and 100,000 sq.m in 2010 are required.

1.3.4 Port Road and Access to/from Hinterland

57. Another planning objective is port road and access to/from hinterland. The port traffic inside the port area is not regulated due to the areal limitation, sometimes resulting in inefficient flow of port traffic as well as cargo handling operation. With the increase of port cargo, the situation will worsen unless effective countermeasures are taken. Access to/from hinterland is another issue. Even now, traffic congestion is observed at the port gate.

58. In 2010, besides the port traffic, the general traffic outside the port is expected to increase remarkably. Thus, heavy traffic congestion on the access road to/from the port will undoubtedly occur.

59. The maximum number of vessels berthing simultaneously will be almost doubled, which indicates that the traffic burden of the port caused by port activities will also be doubled and the traffic congestion will be much worsened.

60. Traffic volume is calculated as follows;

$$n = V \times a/W \times b/12 \times r/30 \times (1+d)/e \times f$$

- n : Number of traffic per hour
- V : Annual cargo turnover (ton/year)
- a : Share of truck (%)
- W : Average cargo weight per loaded truck
- b : Monthly fluctuation rate
- r : Daily fluctuation rate
- d : Rate of other port related traffic
- e : Rate of number of loaded truck vs number of total truck
- f : Hourly fluctuation rate

61. From the Japanese experience, it is assumed that b=1.2, r=1.5, d=0.5, e=0.5, f=0.15 and from port statistic W equals 12 for container and W equals 8 for other cargoes. As for share of truck (a), 0.9 is for general cargo, 0.95 is for dry bulk cargoes and 1 is for unit cargoes. After calculations, the results are obtained as in the table 1-3-10.

62. As shown in the table, the traffic volume generated from the port will be doubled. This necessitates a bypass road to trunk line or widening of the present road. The most critical traffic congestion would occur at gate 11 and thus some countermeasures should be taken here.

Table 1-3-10 Traffic Volume by Packing Type (number / hour, ton/year)

Year	General	Dry Bulk	Unit Cargo	Total
1992	127(509)	95(353)	195(1,301)	417
2000	113(450)	189(700)	278(1,850)	580
2010	150(600)	270(1,000)	375(2,500)	795

1.3.5 Others

63. The port of Cortes is located on the north coast of the Cortes bay. The Bay provides the port with sufficient water area which is calm year round thanks to the shelter of the Punta Caballos. Until 2010, the Bay provides a sufficient water area for anchoring. However, the water depth in front of the reclaimed land area which will be utilized as new terminal is not deep enough to accommodate deep draught vessels. Therefore, dredging work will be required for new terminal as well as ship manoeuvering basin.

1.4 Requisites for the Masterplan

From the analyses above, the requisites for the masterplan should be as follows;

1.4.1 Unit Cargo Terminal

64. Quay requirement for unit cargo is three berths and areal requirement is about 100,000 sq.m. The only practical solution for the realization of the new terminals is the reclaimed area. The area can provide sufficient area for efficient cargo handling.

65. Wharf No.5 which furnishes installments for container handling and accepts unit cargoes would gradually change its function to a multi purpose terminal, as the shortage of general cargo quay will prevail. The major part of unit cargoes should be handled at the new terminal, which could realize a better efficiency.

1.4.2 Dry Bulk Cargoes Terminal

66. There is no dry bulk terminal in the port (as of July 1993), however, private initiatives have already begun to examine the feasibility of an exclusive-use dry bulk terminal. Among these private initiatives, fertilizer and grains seem to be the first items for which the exclusive-use dry bulk terminal should be realized. For fertilizer, oil company and fertilizer company is very active to have exclusive-use dry bulk terminal. Their effort includes a joint study on the feasibility of oil pier modification project. Grains are the cargo item which is forcasted to show the largest volume among the dry bulk cargoes. Another possibility is a reopening of the construction of cement terminal. Cement company is seeking the timing and conditions to resume the suspended cement terminal project at quay No.2.

67. Dry bulk terminal contributes in decreasing the quay length requirement for general cargo quay. For example, import volume of grains in 2010 is forecasted as 320 thousand ton which is considered to be large enough to occupy the full length of a general cargo quay. When the cargo volume reaches this level, it is obvious that the construction of an exclusive-use quay is justified.

Table 1-4-1 Break-down of Dry Bulk Cargoes

Unit:1,000 ton

	Total	Fertilizer	Grains	Cement	Others
1992	353	89	150	29	85
2000	700	140	250	170	140
2010	1000	200	320	300	180

1.4.3 General Cargo

a. The year 2010

68. As already stated in 1.3.1.1, general cargo will increase moderately. The quay requirement for general cargo, however, comes not only from the volume of general cargo but also from dry bulk cargoes which are handled at the general cargo terminal. In all, quay requirement for general cargo terminal will be considerably large.
From the table 1-3-6, it is noted that three berths are required for unit cargoes and six berths are required for conventional as well as dry bulk cargoes, unless a dry bulk terminal is realized. The Port of Cortes currently has five berths, three for general use and two for unit cargoes. ENP is planning to expand 124m of No. 5 mainly for handling refrigerated cargoes.

69. Table 1-4-2 shows berth requirement for general cargo in relation to dry bulk cargoes. For example, if no dry bulk terminal is realized by 2010(case-1), six berths are required to handle both general cargoes and dry bulk cargoes. Total berth requirement will be nine when combining the berth requirement for unit cargoes and this is far greater than the number of present berths(5). Table 1-4-3 gires similar velation for the year 2000.

Table 1-4-2 Berth Requirement in Relation to Dry Bulk Cargoes (2010)

	Dry Bulk Terminal	Cargo Vol.	No. of Call	Berth No.	General B.
1	Non	1,000,000t	143	2.09	6
2	Fertilizer	800,000t	114	1.67	*6
3	Fertilizer+Grains	480,000t	69	1.01	5
4	Fertilizer+Grains+Cemet	180,000t	26	0.38	4

Note: For the case 2, the berth requirement falls on the border between 5 berths (70%) and 6 berths(65%), which means that if we adopt 5 berths, they will be running a little over their optimum occupancy level.

Table 1-4-3 Berth Requirement in Relation to Dry Bulk Cargoes (2000)

	Dry Bulk Terminal	Cargo Vol.	No. of Call	Berth No.	General B.
1	Non	700,000t	100	1.61	5
2	Fertilizer	560,000t	80	1.28	5
3	Fertilizer+Grains	310,000t	45	0.72	4
4	Fertilizer+Grains+Cement	140,000t	20	0.32	*3

Note: For the case 4, number of berths falls on the border between 3 and 4. That means three berths are running a little more than the level of their optimum occupancy rate.

1.4.4 Areal Requirement for Unit Cargoes

70. Areal requirements for unit cargoes in 2000 and 2010 are shown in table 1-4-4. In the calculation of the areal limitation, the northern part of the free zone which currently is utilized for temporary RO-RO storage area is counted as storage area.

71. Some additional area would be required for parking place. Moreover, the increase of container other than fruit container prevails in future. This implies that the number of unit cargoes handled and stored inside port will be larger than the calculated results which are obtained by average number of fruits and others.

72. Even when additional berth is constructed in the years 2000 and 2010, future cargo volume demands large areas for cargo handling as well cargo storage.

Table 1-4-4 Areal Shortage for Unit Cargoes in 2000 and 2010

Year	2000	2010
Areal requirement (sq.m)	45,042	106,331

(Actual storage area at present: 110,971 sq.m)

1.4.5 Domestic Cargo Terminal

73. Features of domestic cargo vessels are shown as follows;

	No. of ships	Cargo volume	No. of mooring ship
1992	396	47,520	2-3
2000	579	69,494	3-5
2010	913	109,600	4-7

Average ship size: 120 GRT

74. Although number of mooring ship is expected as above, some other water area should be reserved as some of vessels engaging in domestic trade would use the basin as their mother port. In 2010, 15-20 vessels would stay in the basin.

75. There are some other small crafts which are suitable to be accommodated in the basin for domestic shipping. As of summer, 1993, there are two tug boats and one ENP vessel and ENP is purchasing two more tug boats. Therefore, 10 vessels should be assumed to moor at the domestic quay.

76. In total, quay length of about 200m and water area which can accommodate 25 vessels are required.

1.4.6 Access to/from Hinterland

77. As already calculated in 1.3, the traffic volume generated from the port will almost be doubled in 2010 and there will be big traffic congestion. There are two countermeasures against this; construction of a new by-pass road and widening of the present road.

78. It is not practical to plan a widening of the access road because the road is contained at the both sides by private residents and the free zone and there is practically no possibility to widen the road. The practical solution to the access problem would be to construct a new by-pass to major road. The possible location of this road will be the sea side rim of the free zone.

79. Another problem concerning traffic will be the congestion around gate No.11. Possible solution is to prepare another gate for unit cargoes which are handled at the new terminal. Parking space for waiting trucks may be required around the gate.

1.5 Alternatives of Port Layout

1.5.1 Screening for Alternatives

80. As stated in 1.4.2, PART III, there are some private initiatives on dry bulk terminal. Here, following four cases are examined;

Case 1: No dry bulk terminal is realized.
Case 2: Fertilizer terminal is realized.
Case 3: In addition to case 2, grain terminal is realized.
Case 4: Three terminals for fertilizer, cement and grain are realized.

81. The estimation results in 1.4 give a picture of berth requirement for the years 2000 and 2010. Table 1-5-1 summarizes the estimation results. Unless bulk cargo terminal is realized, the shortage of berth sums up to two terminals for the year 2000 and four berths for the year 2010, respectively (case-1).

82. Even if fertilizer terminal is realized (case-2), berth requirement is unchanged both in 2010 (four berths), and in 2000 (two berths).

83. When grain terminal is realized in addition to fertilizer(case-3), berth requirement decreases to three from four in 2010, and to one berth from two in 2000.

84. When fertilizer, cement and grain terminals are realized (case-4), berth requirement is nil in 2000 and two in 2010.

Table 1-5-1 Berth Requirement for Each Case

	Case 1	Case 2	Case 3	Case 4
2000	2UT+5GT	2UT+5GT+1DBT	2UT+4GT+2DBT	2UT+3GT+3DBT
2010	3UT+6GT	3UT+6GT+1DBT	3UT+5GT+2DBT	3UT+4GT+3DBT

Note: In this table, UT means unit cargo terminal, GT means general cargo terminal and DBT means exclusive-use dry bulk terminal.

1.5.2 Alternatives for Port Layout

85. In this section, major items for future port planning are presented. Those are;

a. Number of terminals by type
b. The location of new terminals

c. Quantities of dredging and reclamation

d. Location of by-pass road

86. The possibility of the realization of bulk terminals should be carefully evaluated, taking into consideration various factors including the cargo volume and the cost, however, the shortage of berth is clear in future and it should be recommended to encourage private entities to accelerate the construction of dry bulk terminals.

87. ENP fully recognizes the necessity of dry bulk terminal. Their priority remains on fertilizer and grain. For fertilizer, a fertilizer company has already initiated their action. Lots of talks are required among the company, ENP and other relevant entities, however, fertilizer seems to be the first item to be realized. Grain is the biggest single cargo item in dry bulk cargoes and continues to be the biggest cargo item.

88. From Table 1-5-1, the following four options (two for each 2000 and 2010) are drawn, in which No.5 berths are converted to general cargo berth from the unit cargo berth and for the year 2010, the quay in front of the cold storage is assumed to be constructed and utilized as general cargo berth.

[2000]

(Option 1) **Two unit cargo berths without DBT**

(Option 2) **Two unit cargo berth and 1 DBT for fertilizer**

[2010]

(Option 1) **Three unit cargo berths and 1 DBT for fertilizer**

(Option 2) **Three unit cargo berths and 2 DBTs for fertilizer and grain**

89. Basing upon the above sketch, the following four alternatives for the masterplan of the Port of Cortes in 2010 are proposed.

a. Alternative 1-1 (Fig. 1.5.1 and Fig. 1.5.3)

90. Three unit cargo terminals of total quay length 555m with a container yard of 160,000 sq.m and one dry bulk terminal for fertilizer is constructed. Domestic wharf is located at the right side of the river mouth of Rio Medina. Three lane by-pass road (one lane is for temporary car parking or for outrun) is constructed along the sea-side of the free zone.

b. Alternative 1-2 (Fig. 1.5.1 and Fig. 1.5.4)

91. Three unit cargo terminals of total quay length 555m with a container yard of 240,000 sq.m (pier head line of the third terminal is re-oriented to the south from the southeast) and one dry bulk terminal for fertilizer is constructed. Domestic wharf is located at the right side of the river mouth of Rio Medina. Three lane by-pass road (one lane is for temporary car parking) is constructed along the sea-side of the free zone.

92. This alternative tries to acquire deeper water depth and lessen the dredging volume.

c. Alternative 1-3 (Fig. 1.5.1 and Fig. 1.5.5)

93. Three unit cargo terminals of quay length 555m with a container yard of 120,000 sq.m and one dry bulk terminal for fertilizer are constructed. Domestic wharf is located at the right side of the river mouth of Rio Medina. Three lane by-pass road (one lane is for temporary car parking) is constructed along the sea-side of the free zone.

94. This alternative tries to make the future port as compact as possible, thus minimizing the project cost.

d. Alternative 2 (Fig. 1.5.2 and Fig. 1.5.6)

95. Two unit cargo terminals of quay length 370m with a container yard of 120,000 sq.m and two dry bulk terminals for fertilizer and grain are constructed. The terminal(s) for fertilizer and grains are constructed at wharf No.2. Domestic wharf is located at the right side of the river mouth of Rio Medina. Three lane by-pass road (one lane is for temporary car parking) is constructed along the sea-side of the free zone.

1.5.3 Priority of the Projects

96. The basic philosophy for prioritization of the projects is to minimize the total port cost including ship cost. Toward this end, the optimum berth occupancy rate is proposed by UNCTAD and is listed in this report. The method to obtain the optimum berth occupancy is the so called queuing theory.

97. The basic idea of the theory can be a useful tool in understanding the phenomenon of port-vessel inter-relation. Let's assume a very simple example in which a bank offers two services: paying out and receiving money. It is sometimes observed that all the windows are occupied which obliges customers to form a long line. If the line is too long, customers may go to another bank. On the contrary, if there is a great number

of windows, customers can get services any time, which in turn compensate the bank for its huge investment in the windows. The question is how many windows are optimum. The bank tends to minimize the number of windows, thus minimizing the expenditure for clerks as well as the investment for windows. However, there is a danger that potential customers will be lost and that the business of the bank will never expand. The optimum number of windows is calculated by using a mathematical method; the queuing theory. The optimum number of berths proposed by UNCTAD is calculated along the same lines.

98. Another aspect of the above hypothetical bank story is whether the windows should be separated according to the type of service. Under the assumption in which every window offers both services, constomers are free to choose any window. But it should be borne in mind that under this situation, transactions take time because tellers have to handle two different types of work. In this context, separation of windows according to the type of service may emerge as an important issue for improvement of transaction time.

99. The above two paragraphs depict the relationship between ports and ships. Simply substitute the number of berths for the number of windows and the allocation construction of an exclusive use terminal for the separation of windows.

100. The port of Cortes has five berths excluding liquid terminals. The rule of berth allocation observed in the port is basically "first come, first service". Although the No.5 berth is installed with gantry crane, the berth handles break bulk cargoes as well as dry bulk cargoes. No.4 berth also handles containers, break bulk cargoes and dry break bulk cargoes. In this regard, all the present berths at the port can be regarded as multi purpose in nature.

101. When there are five berths, the optimum berth occupancy rate is 65%. While each berth is assumed to operate 24 hours, 350 days a year (8,400 hours a year), the optimum berth time in total gives 27,300 hours. With the construction of two new berths, it is assumed that there will be seven berths, then optimum berth time in total gives 41,160 hours (8,400×7×70%).

102. By applying the queuing theory, priority of each project is clarified. Several projects are needed for the port of Cores by 2010. The question is in what order these projects should be realized and in what manner the Master plan should be established.

103. Consideration should be given from the view point of the effects on decreasing port congestion, the possibility of realization of the project and so on. The following lists the candidate projects;

1)Unit cargo terminal
2)By-pass road
3)Domestic terminal
4)Dry bulk terminal (fertilizer, grain and cement)
5)Cold storage terminal

104. Among the projects above, prioritization of unit cargo terminal, dry bulk terminal and cold storage terminal is crucial for establishing the Masterplan of the port of Cortes (Cold storage with its supplement work is already authorized and is ready for implementation. Therefore, the remaining work for the cold storage is the construction of quay in front of the cold storage).

105. For the port of Cortes, basic direction of the port development is to realize efficient cargo handling, especially of unit cargoes and of dry bulk cargoes. In this context, new unit cargo terminals and dry bulk terminals are to be proposed in the masterplan. And these terminals are expected to be operated exclusively by cargo types. General cargo and dry bulk cargoes which are not shifted to the exclusive terminal will be handled only at the general cargo terminal.

106. An important factor in determining the Masterplan is that when the capacity of the general cargo terminals becomes smaller than the cargo demand, unit cargo terminals should be constructed rather than new general cargo terminals and No.5 berth should be converted to a general cargo berth. In this way, the port of Cortes can acquire new unit cargo terminals with sufficient container yard and achieve improved efficiency.

107. Attention should be paid to how the various of terminals interact with one another. Construction of a dry bulk terminal directly affects the cargo volume handled at the general cargo terminal and construction of a unit cargo terminal may push No.5 berth out to the general cargo terminal group from the unit cargo terminal group.

108. Table 1-5-1 lists the effects of the construction of either unit cargo terminal or dry bulk terminal on port congestion. The number is expressed in total berth time for the years starting from 1992 up to 2010. In calculation, cargo handling efficiency is assumed the same as the present except for the new unit cargo terminal where the efficiency is assumed to be 150% of the present.

Table 1-5-2 Sensitivity of Dry Bulk Terminal & Unit Terminal

Unit: berth time (hour)

Year	As it is	Case-1		Case-2		Case-3		Case-4	
	Qys 3-5	Qys 3-5	DBT	Qys 3-5	DBT	Qys 3-5	UT	Qys 3-5	UT
1992	29,963	27,694	2,269	25,714	4,248	25,055	3,213	20,929	5,913
1993	30,447	27,861	2,586	25,689	4,758	25,488	3,246	20,413	6,568
1994	31,459	28,378	3,081	25,928	5,532	26,267	3,399	21,057	6,809
1995	32,512	28,935	3,577	26,420	6,093	27,076	3,558	21,728	7,059
1996	33,602	29,529	4,073	26,844	6,758	27,913	3,724	22,427	7,314
1997	34,728	30,163	4,565	27,043	7,685	28,779	3,894	23,156	7,574
1998	35,894	30,839	5,054	27,809	8,084	29,676	4,070	23,920	7,837
1999	37,093	31,556	5,537	28,340	8,753	30,600	4,250	24,715	8,102
2000	38,328	32,317	6,011	29,484	8,845	31,552	4,436	25,542	8,369
2001	39,597	33,122	6,475	26,495	13,103	32,538	4,621	26,394	8,642
2002	40,900	33,974	6,926	31,093	9,807	33,549	4,812	27,275	8,918
2003	42,236	34,875	7,361	31,195	11,041	34,583	5,009	28,181	9,200
2004	43,603	35,827	7,776	32,015	11,588	35,638	5,214	29,109	9,487
2005	45,002	36,833	8,169	32,884	12,117	36,711	5,427	30,056	9,783
2006	46,430	37,894	8,535	33,805	12,624	37,799	5,649	31,018	10,088
2007	47,886	39,015	8,871	34,781	13,105	38,899	5,882	31,992	10,404
2008	49,369	40,199	9,171	35,814	13,555	40,010	6,126	32,974	10,732
2009	50,878	41,448	9,430	36,908	13,970	41,128	6,382	33,960	11,074
2010	52,411	42,767	9,644	38,067	14,344	42,249	6,651	34,947	11,431

109. The second column shows the total berth time for the case of no additional berth. Total berth time in 1992 is almost 30,000 hours and the port currently is running a little over the optimum occupancy rate (optimum berth occupancy rate is 27,300 hours per year). The total berth time will increase by about 8,500 hours in 2000 and 22,500 hours in 2010. Maximum berth time for five berths is 42,000 hours (24hours x 350 days x 5 berths), thus from 2003 onward, total berth time needed to accommodate all the calling ships will far exceed the maximum capacity (100% occupancy) of the port and there will be a long queue of waiting ships, or the port will lose a considerable number of potential ship calls. (Practical maximum port occupancy rate at which ships are tolerant to wait for berthing is far below the maximum capacity and ships will choose another port.)

110. In analyzing the priority of berth construction, the following four cases are assumed and berth time is calculated based on the future cargo demand and cargo handling efficiency;

Case-1 : Construction of both fertilizer and grain terminals. Wharves No.3-No.5 handle all the other cargoes including unit cargoes.

Case-2 : Construction of three dry bulk terminals for fertilizer, cement and grains. Wharves No.3-No.5 handle the rest of the cargoes (general, dry bulk and unit cargoes).

Case-3 : Construction of two unit cargo terminals for handling all the unit cargoes excluding fruit companies' containers. Wharves No.3-No.5 handle all the rest of the cargoes (general, dry bulk and fruit companies' containers).

Case-4 : Construction of two unit cargo terminals for handling all the unit cargoes including fruit companies' containers. Wharves No.3-No.5 handles all the rest of the cargoes (general and dry bulk).

111. From the table, it is noted that in Case-1, the total berth time at the Nos. 3-5 wharves increases by 2,500 hours in 2000 and 13,000 hours in 2010, compared with the present total berth time. In Case-2, total berth time in 2000 is almost the same as that at present and in 2010 it increases by about 8,000 hours.

112. One of the problems accompanying Case-1 and Case-2 is access to the terminal. The terminals are to be constructed between the Pier 1-A and No.3 wharf. When traffic to these terminals uses the No.1 gate, the burden to the in-port road and the gate No.11 is lessened, however, this traffic goes through the main part of the city of Puerto Cortes and the traffic concentrates on the main access road between the free zone and the lake. Another problem is that construction of dry bulk terminals do not bring any solution to areal limitation of the unit cargo handling.

113. In Case-3, total berth time increase a little, by 1,500 hours in 2000 and 12,000 hours in 2010. In Case-4, total berth time decreases by 4,500 hours in 2000 and in 2010 it increses by 5,000 hours compared with 1992. Cases-3 and 4 assume the construction of a new by-pass road along the coastal side of the free zone and can avoid the access problem. Also, the construction of new unit cargo terminals solves the areal limitation and enables more effective cargo handling.

114. In short, Case-4 gives the smallest total berth time for No.3-No.5 wharves, however, total berth time still increases by 5,000 hours compared with the present situation. On the contrary, construction of dry bulk terminals only (Case-1 and Case-2) do not give sufficient effect to lessen the burden on No.3-No.5 wharves. Thus, construction of new unit cargo terminal accompanied with the transfer of fruit containers to the new terminal is most effective countermeasure against the port congestion.

115. From the analyses above, **the priority should be given to the construction of new unit cargo terminal together with the by-pass road.**

116. At the same time, it is noted, from the table, that even in case-4, total berth time for wharves No.3-No.5 is larger than the optimum time after 2003. Thus, two dry bulk terminals are justified for the Masterplan. The total berth time for unit cargo berth also exceeds the optimum time (8,400 hours)and another unit cargo terminal is justified as well. In short, as the Master plan of the port, three unit cargo terminals together with the domestic terminal is justified, among which two unit cargo terminals with domestic terminal should be given the first priority. Two dry bulk terminals are included in the Master plan with the second priority.

117. However, dry bulk terminals are possibly constructed by the private sector, thus ENP should encourage private participation no matter what the priority is.

1.5.4 Evaluation of Alternatives

118. Through the evaluation stated hereunder, only three projects are included. These are, unit cargo terminal, domestic terminal and by-pass road. Dry bulk terminal and cold storage terminal are excluded because they will possibly be constructed by the private sector. Table 1-5-3 extracts from 1.6 and 1.7; the major items which are important to compare each alternative. From the table, it is noted that alternative 1-1 has the lowest project cost among the 1-1, 1-2 and 1-3 alternative group. The volume of dredging (Fig. 1-5-3) is a little larger than the volume of reclamation (if we take the extra volume of dredging into account, the difference will be much larger).

119. Alternative 1-2 has the largest project cost among the alternatives. The volume of reclamation is larger than the volume of dredging (Fig. 1-5-4) and other reclamation material should be obtained from another place.

120. Alternative 1-3 has almost the same project cost as Alternative 1-1. However, the volume of dredging is far larger than the volume of reclamation (Fig. 1-5-5) and this makes it difficult to dispose of the excess amount of dredged material. Furthermore, this alternative has a certain limitation for future expansion of the port and after 2010 when the cargo volume is expected to increase further, the project cost will be much higher than the rest.

121. Alternative 2 has the lowest project cost among the four alternatives because of the limited scale of the project. The volumes of dredging as well as reclamation are small compared to the other three alternatives.

122. Alternative 2 should be thought as part of alternative 1-1 and could also be regarded as the stage plan. The adoption of an alternative depends on the realization of dry bulk terminals. Therefore, the base of the masterplan should be alternative 1-1 and

in this report, the alternative will be treated as such.

Table 1-5-3 Brief Comparison of Each Alternative

Alternative	Dredging (cu.m)	Reclamation (cu.m)	Revetment(m)	Project cost ('000Lps)
1-1	746,760	637,580	480 (-5.3m)	273,123.0
1-2	887,774	1,133,278	725 (-7.0m)	351,843.3
1-3	1,058,455	244,302	200 (-6.4m)	274,709.0
2	437,354	255,638	400 (-5.0m)	212,560.1

Note: 1) Dredging volume is obtained from the dredging plan and does not include dredging for depth allowance.

2) Reclamation volume includes the volume required for by-pass road.

3) Revetment is to protect the reclamation slope of the new terminal.

4) Project cost means the construction costs of major port facilities such as wharves, jetty, by-pass road as well as dredging, reclamation including compaction and revetment, and pavement.

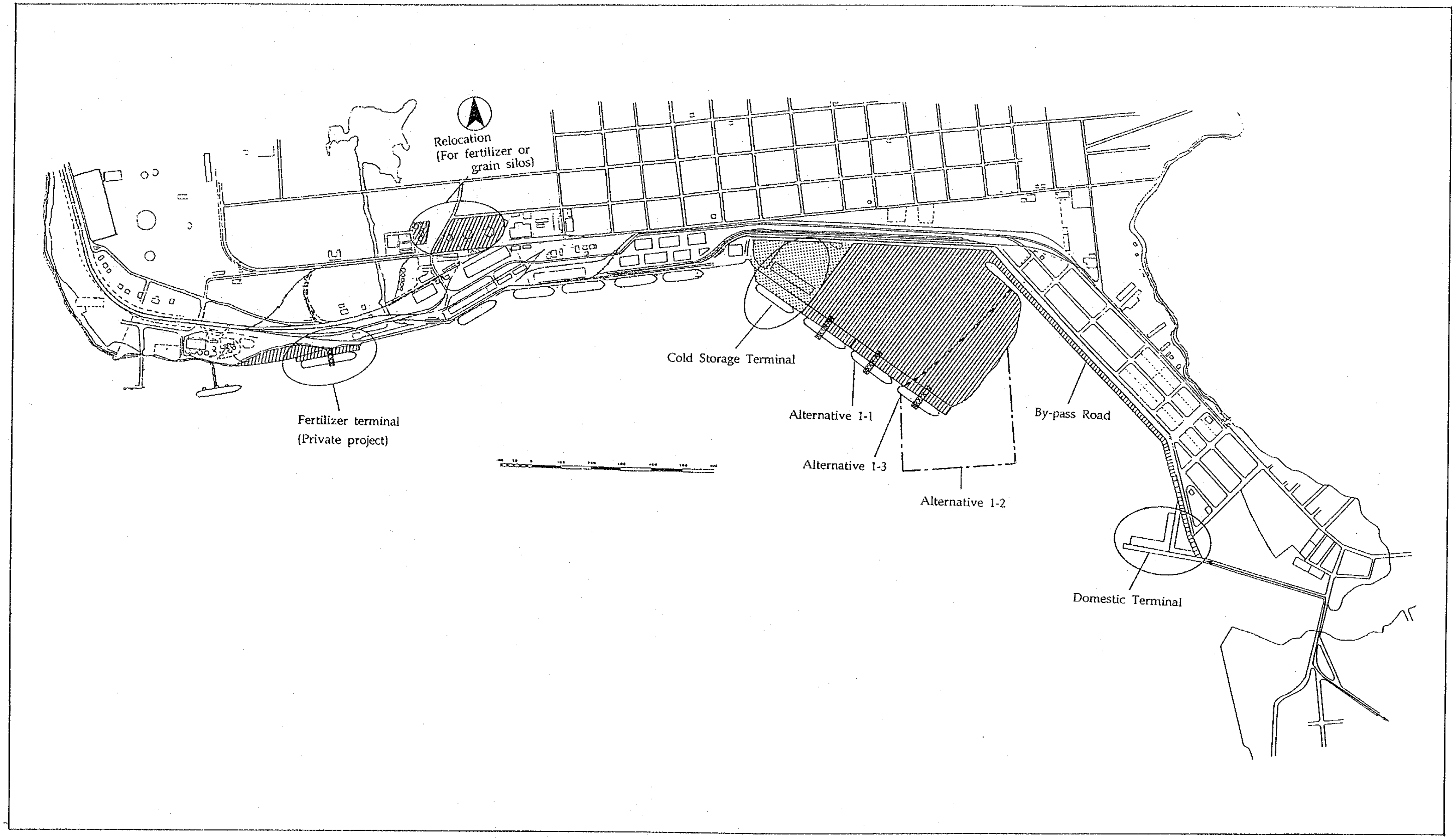


Fig. 1-5-1 Alternatives 1-1, 1-2, 1-3
for Masterplan (2010)

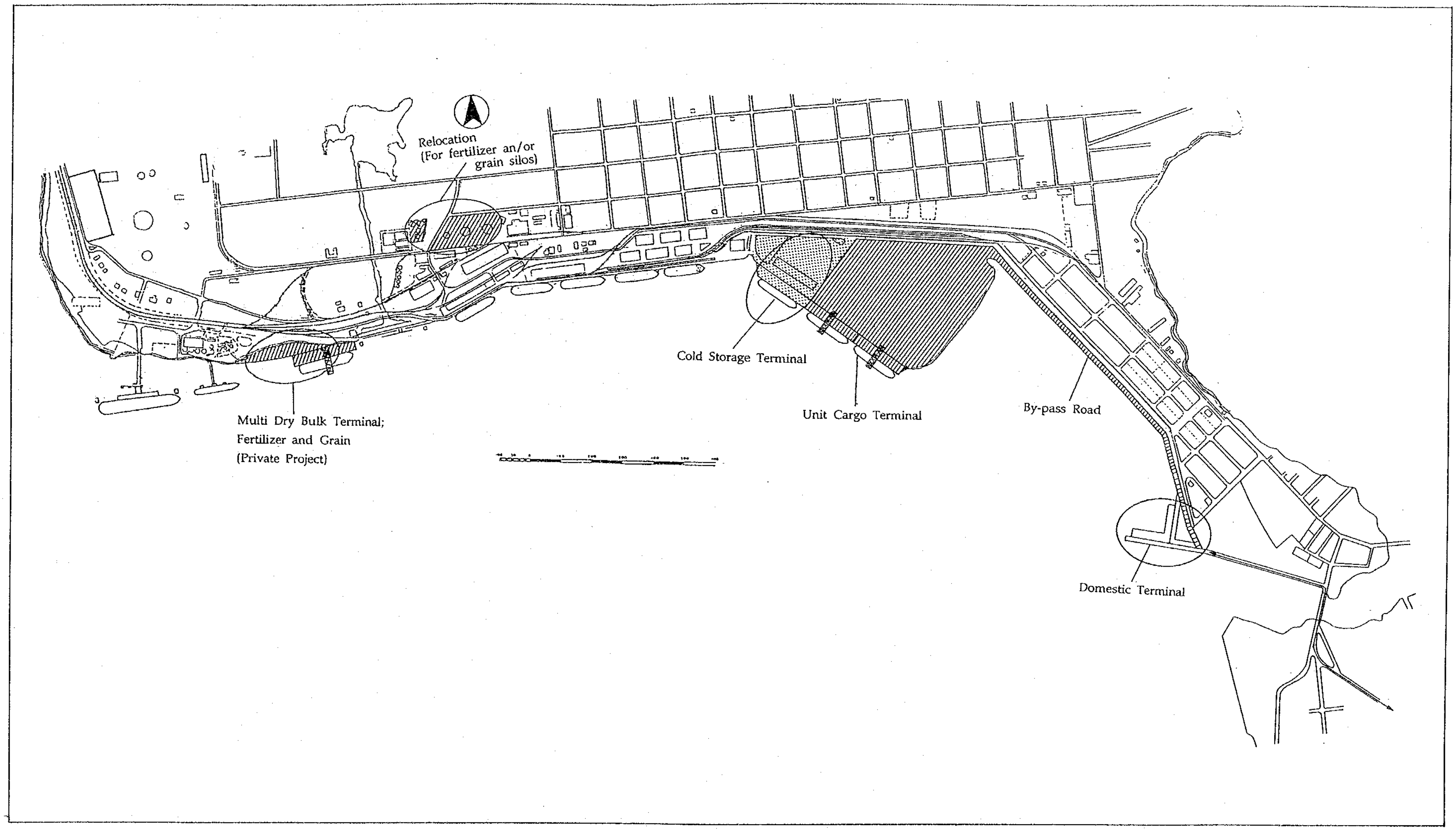


Fig. 1-5-2 Alternative 2 for Masterplan (2010)

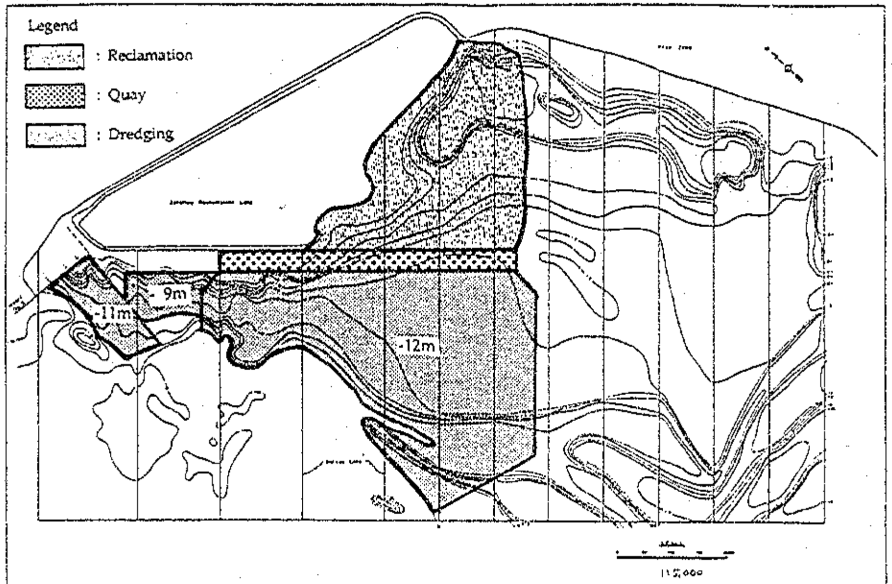


Fig. 1-5-3 Alternative 1-1

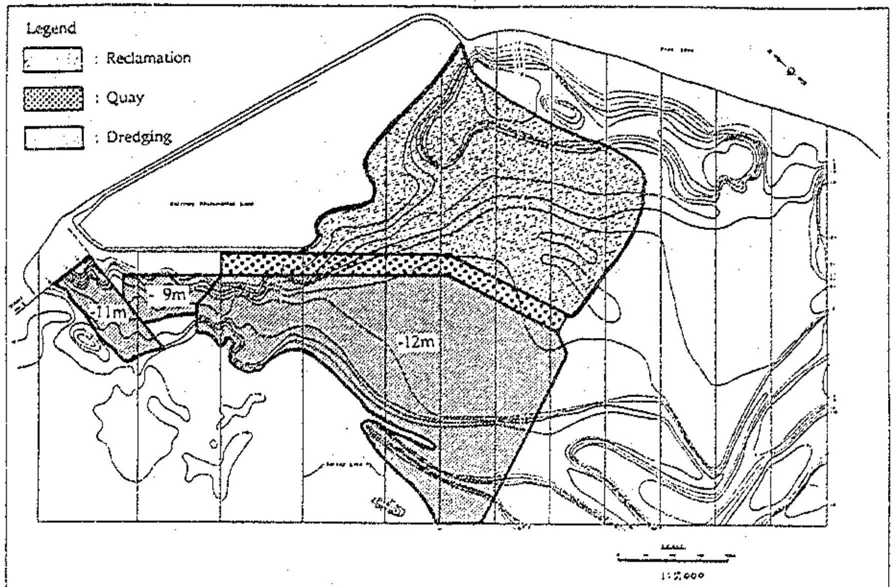


Fig. 1-5-4 Alternative 1-2

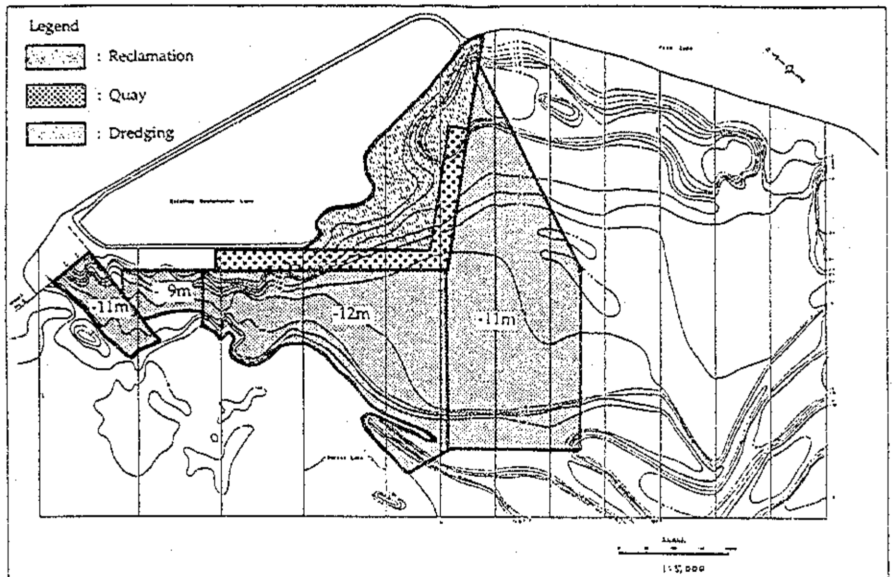


Fig. 1-5-5 Alternative 1-3

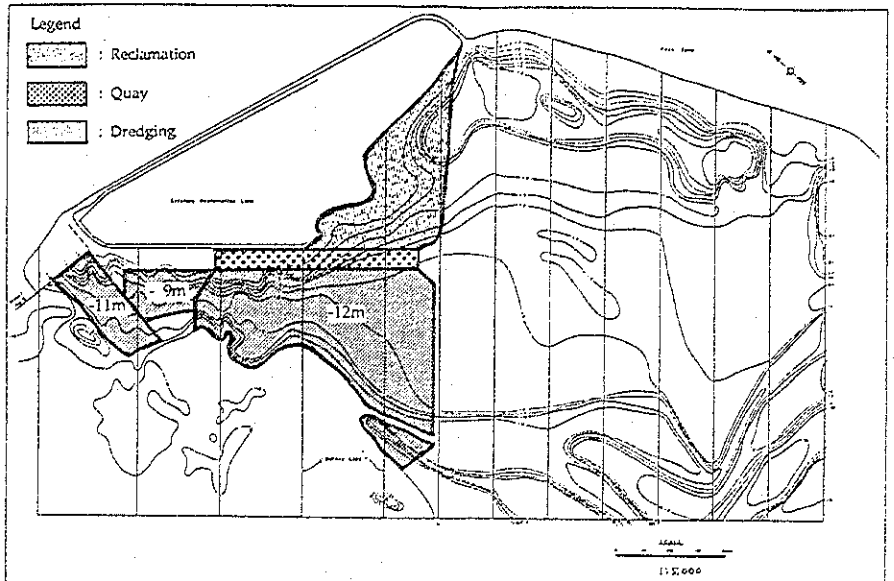


Fig. 1-5-6 Alternative 2

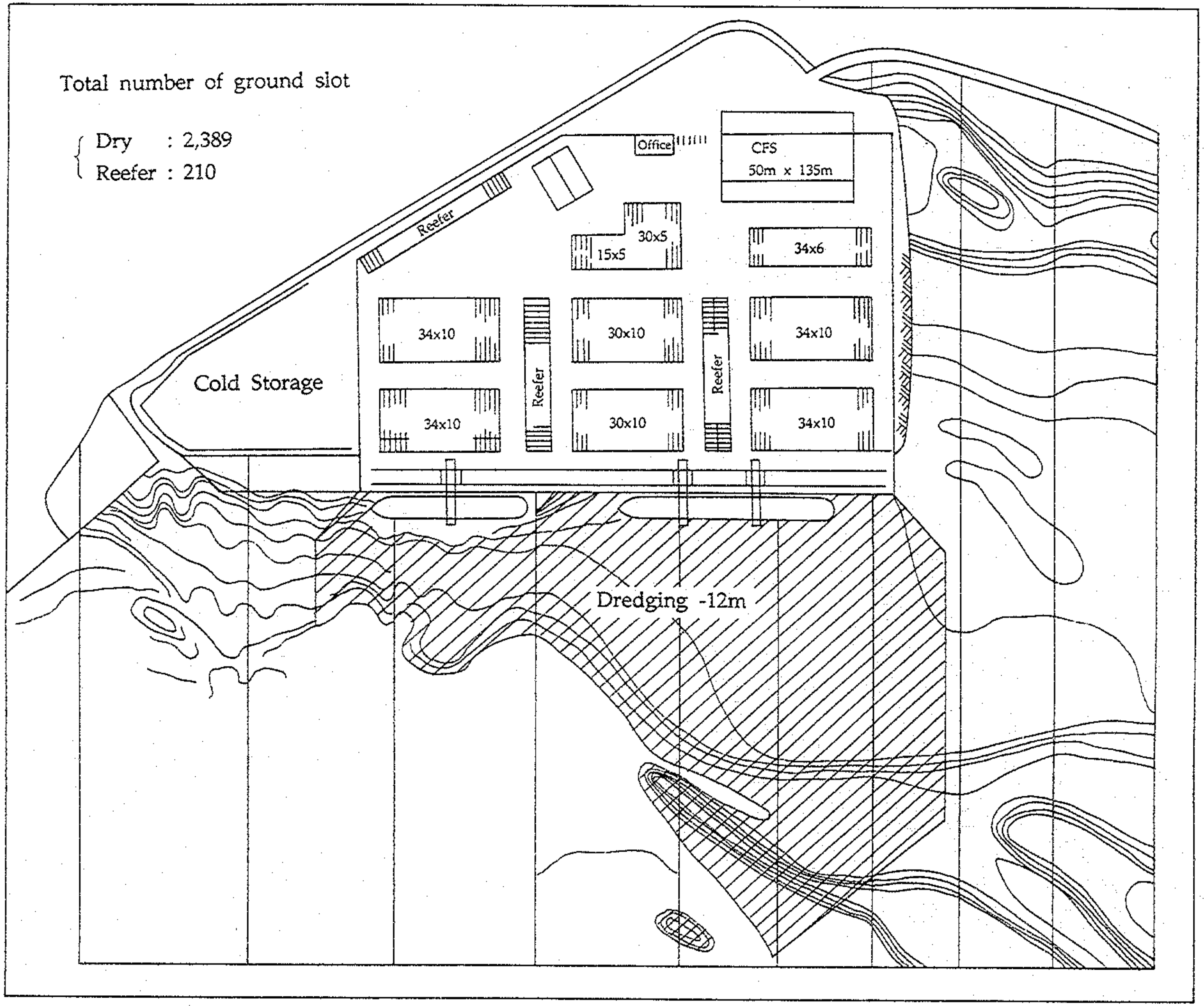


Fig. 1-5-7 Lay-out Plan of Alterative 1-1

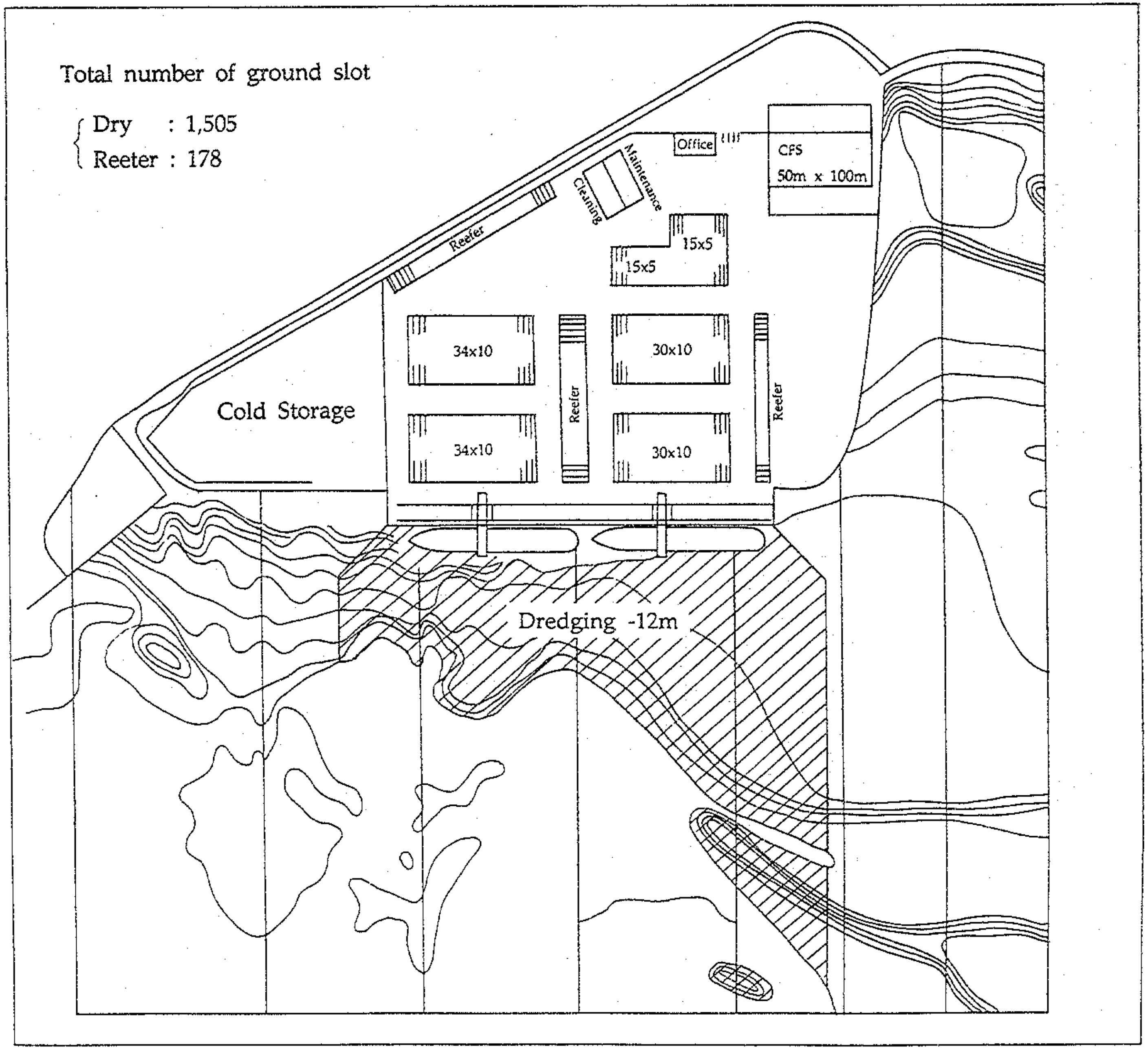


Fig. 1-5-8 Layout plan of Alternative

1.5.5 Other Items Necessary for Port Planning

1.5.5.1 Container Freight Station (CFS)

123. Currently, there is no CFS in the port of Cortes. The Study Team observed some containers were being stripped in the container yard mainly by manpower. This practice might cause several problems such as cargo damage by rain/sun-shine and inefficient cargo handling. With the increase of unit cargo volume, the port needs a Container Freight Station (CFS).

a. Optimum System of CFS

124. There are two types of CFS flooring, high (platform style) and low (ground style). High floors are generally the same height as a container on top of a chassis, or of a truck's loading bed. Low floors are set at about the same height as the surrounding pavement. The following table shows merits and demerits of the two systems.

125. For simultaneous handling of containers, the ground system is disadvantageous from the viewpoint of land utilization, since each bay needs 15 meters' space for the container and forklift, while 3.5-4.0m is needed for the platform system. Further, in this type, containers must be lifted up and down each time and a large top-lifter or a straddle carrier must stand by.

126. For the port of Cortes, the above two demerits exceed those of the platform system, which requires investment for the chassis. Thus, the platform system should be adopted.

Table 1-5-4 Merits and Demerits of two CFS systems

Platform system	Ground system
1. Many trailers are needed.	1. Can be handled with fewer trailers.
2. Containers need not be lifted and grounded.	2. Containers must be lifted and grounded.
3. Passage between the bays can be narrow.	3. Passage has to be wide, unless a straddle carrier is used.

b. Size of CFS

127. Then, CFS size should be determined. From experience in many ports, it is well known that a CFS with a length of 40-50m is effective for efficient cargo handling.

128. The length comprises the following;

* Cargo yards on the container side and truck side (5 to 6m each)
* A work space on each side for forklifts, roller-conveyors, etc. and passageways (6 to 10m each)
* A cargo yard and a sorting space in the center (10 to 15m)
* Other space (to cope with daily fluctuations in the work load), a space for work related to customs clearance, and spaces for long-term storage of import cargoes

129. The width of CFS is determined from the required area of CFS which is obtained through the following calculation;

$$S = C \times D / w / r / k$$

where,

S:	Required area of CFS (sq.m)	
C:	Cargo volume of total containers via CFS (ton)	
D:	Dwelling time in CFS (days)	
w:	Unit weight of cargoes in CFS (tons/sq.m)	->1.3
r:	Effective area ratio of CFS	->0.5
k:	Working days per year	->350

130. From Fig. 2-5-12, in Chapter 2, PART V, the rates of container cargo volume which go through CFS are given as follows;

import: 11.7%
export: 7.7%

131. There are some inland depots in Honduras which result in rather moderate rates of container cargo volume going through the CFS. In future, the trend will continue and almost the same rates are assumed for the calculation, 12% for import and 8% for export. (See Fig. 1-5-9)

132. Although the average dwelling time of unit cargoes is 7 days for import and 2 days for export, these numbers include all unit cargoes. All fruit containers which are

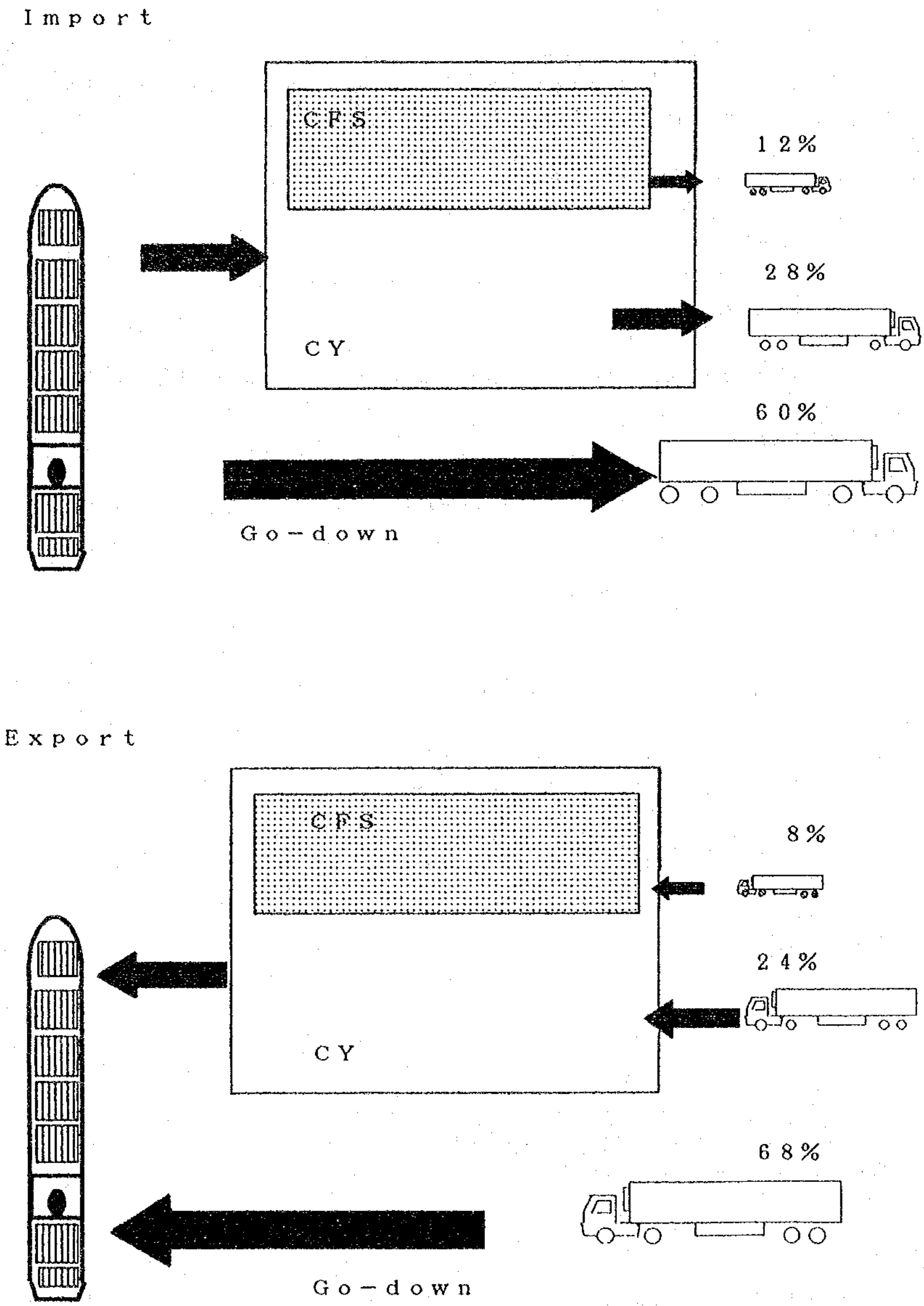


Fig. 1-5-9 Shares of Cargoes which go through CFS

counted as go-down cargoes are excluded from the calculation of CFS. Thus, the dwelling times of cargoes in CFS are assumed as 7 days for both import and export.

133. After calculations, the sizes of CFS required in 2000 and 2010 are obtained as follows;

	1992	2000	2010
Size of CFS (sq.m)	3,502	4,867	6,762
Width(m)	70	100	135

Note: The length of CFS is assumed as 50m.

134. Together with the CFS itself, there is some other space necessary for CFS operation; namely 25m at container side, 15-25m at truck side and 10-15m at the remaining two sides.

1.5.5.2 Other Facilities in Unit Cargo Terminal

a. Terminal Gates

135. Usually, two lanes with truck scales for "in" container (export) and another two lanes for "out" container (import) are required for a terminal of 300m length. For the port of Cortes, some factors which should be taken into consideration are; the unit length of a terminal is 185m, and containers of fruit companies might be treated in different way.

136. Here, in the subsequent calculation, all the containers handled at the unit cargo terminal are assumed to pass through and be checked at the gates. Number of terminal gates is calculated for both imports and exports, Basic idea is to install necessary number of gates to handle smoothly the maximum number of containers. Therefore, the maximum number of containers which pass through the gates should obtained.

137. The maximum number of import containers is obtained during the unloading operation of the container vessel, while the export containers are brought in continuously and the maximum number is obtained at the peak of the time series of container in-flow.

138. The average time to handle one container at the gates is usually four minutes for export containers and three minutes for import containers.

After calculations, the number of gates are obtained as follows;

	Import	Export
2000	3	4
2010	4	5

b. Maintenance Shop and Cleaning House

The sizes of the maintenance shop and cleaning house depend on such factors as the rates of container damage, the type and number of cargo-handling vehicles and machines to be used in the terminal. Considering other examples, following dimensions are assumed for each building;

Area : 1,000 m^2 (40 m x 25 m)
Height : 10 m
Width of the space in front of the maintenance shop : more than 10 m

c. Terminal Office Building

The area of the terminal office is decided from the number of persons working in the terminal. It is assumed that around 50 persons work at one terminal and required floor area for one person is usually set as 10 sq.m. Accordingly, required floor area is 1,000 m^2. In case that half of the office is two stories and some space is reserved for future expansion, necessary area of terminal office is 1,000 sq.m. It is located next to the terminal gate.

1.5.6 Dry Bulk Terminal

1.5.6.1 Basic Plan of Dry Bulk Terminal

139. As already stated, dry bulk cargo is the cargo item which is forecasted to show the highest increase rate. Therefore, construction of a dry bulk terminal is thought to be effective in easing the congestion of the general cargo berths. Furthermore, if a yard conveyer system is introduced to the backward transportation, congestion in port traffic will be alleviated.

140. Among the dry bulk cargo items, grain(import) is forecasted to show the largest cargo volume, followed by cement(export) and fertilizer(import). From the economic point of view, dry bulk terminal for multiple items is worth considering. Cargo items which can be handled at a terminal are grain and fertilizer. Cement is the cargo item which should be handled separately. Thus, grain and fertilizer are selected as targeted dry bulk cargoes.

141. Dry bulk terminal is one of the suitable port facilities in which private investment should be encouraged. The direct merit of the terminal will go to the limited number of enterprenuers, and this invites the attention of the private sector. Detailed discussions should take place among the various interests including ENP and consignees because there will be quite a few variations in private participation. The following is a trial for a dry bulk terminal at which grain and fertilizer are handled.

a. Cargo Volumes for Grain and Fertilizer

142. Cargo volumes of grain and fertilizer for the years of 2000 and 2010 are forecasted and listed as follows.

unit:'000 MT

Year	2000	2010
Grain	250	320
Fertilizer	140	200
Total	390	520

b. Average Cargo Volume Handled per Ship

143. One of the major objectives for constructing a dry bulk terminal is to pursue the scale merit. The basic idea is that the greater the volume handled per ship, the cheaper the cost of transportation. The optimum volume carried per ship varies by cargo items as well as the distribution system in the hinterland, however, the construction of a dry bulk terminal contributes to enlarge the cargo volume carried per ship and eventually the size of the ships calling at the port.

144. Average cargo volumes per ship indicated in Table 1-3-6 and Table 1-3-7 are forecasted based on the assumption that dry bulk cargoes are handled at the general cargo berth. By the use of an exclusive terminal for dry bulk cargoes, the volume carried per ship will be increased (in this report, we assume the volume will increase to 10,000 tons).

c. Objective Vessel

145. From the port statistics, it is noted that the size of dry bulk carriers is rather small. In 1992, the number of ships greater than 15,000 GRT counts only 2 out of 40. However, for port planning purposes, the maximum ship size should be adopted as the

target ship size. The maximum ship size will be enlarged in future (to 20,000 GRT in this report).

Expected maximum vessel size: 20,000 GRT, Draught 10.0m, LOA 185m
(1992 port statistics: 16,522 GRT, Draught 9.5m, LOA 186m)

d. Location

146. There are several candidates for the location of the dry bulk terminal. The waterfronts available for the terminal are: Wharf No.2 and its vicinity, the reclaimed land in front of the free zone and the north shore outside the port. Among these possible locations, the north shore requires a larger amount of investment for the construction of breakwater as well as the pier to reach the sufficient water depth and to ensure the calmness of water area. The reclaimed land is reserved for the new unit cargo terminal and the usage of the area is already given in this report. Therefore, the location for the dry bulk terminal should be wharf No.2 or its vicinity.

147. The soil condition at the bottom in front of wharf No.2 is said to be very soft and may require lots of engineering work as well as civil works. The western vicinity of wharf No.2 is reported to have no such problem, although a small reclamation work is required. At any rate, the exact location should be decided by ENP based on the detailed soil examination as well as other relevant considerations.

e. Wharf Dimensions

148. Taking into consideration the objective ship size, wharf dimensions should be as follows;

Depth in front of the wharf	: -11.0m
Length of the wharf	: 220m
Apron width	: 30m

149. In front of wharf No.2, where the dry bulk terminal will possibly be constructed, water depth is sufficient to accommodate the objective ship size and there is no dredging work required.

f. Others

Terminal Type :	Marginal
Structure Type :	Concrete piles with concrete slab on top with supportive civil works

1.5.6.2 Cargo Handling Equipment

150. The cargo volume listed in the afore-mentioned table can be handled by one terminal if the terminal is equipped with appropriate cargo handling facilities. There are basically two possible cargo handling systems; batch system and continuous system. As for unloading, batch system adopts crane and continuous system includes pnuematic unloader as well as other mechanical continuous unloaders. There are also two systems for transportation after unloading; trucks (batch system) and conveyer (continuous system).

151. A pnuematic unloader can be operated even during rain which gives a certain advantage to this system. This system has long prevailed in the new installment list of granular cargo handling in Japan, however, mechanical unloader has recently gained popularity. There are several mechanical unloaders such as bucket elevator type continuous unloader, belt conveyor type continuous unloader, chain conveyor type continuous unloader and screw conveyor type continuous unloader. The following is a comparison of the pnuematic unloader and the mechanical unloader.

a. Mechanical unloader has better efficiency and stability than pnuematic.
b. Mechanical unloader has difficulty in unloading cargoes at the final stage. A combination of small bulldozer and pnuematic unloader may be required to complete the operation.
c. Mechanical unloader requires 5-20% higher of initial investment, however, operation cost is 20-35% less, compared with pnuematic unloader (cost in Japan).
d. Pnuematic unloader makes 10-20 dB more noise than mechanical unloader. There is no significant difference in producing dust and spill.
e. Adoptability for cargo types of mechanical unloader is broader than that of pnuematic unloader. Crushing during the operation is less by mechanical unloader.
f. Weight of mechanical unloader is around 300 tons, 10-20% heavier than pnuematic unloader.

152. As shown above, there are significant differences between pnuematic unloader and mechanical unloader. When deciding the type of unloader, a detailed study on total cost including initial investment as well as operation cost should be conducted. However, it should be borne in mind that there is no pnuematic unloader in the port and mechanical unloader has a disadvantage in completing ship hold. Even if a mechanical unloader is adopted, pnuematic unloader may be needed for this purpose. A derick crane should also be installed to lay a small bulldozer down to the ships hold, which is used to gather scattered remaining cargoes.

153. On the contrary, crane system has an advantage in flexibility of usage; (the system could be applied even to general cargo). The system needs no derick crane to lay down a small bulldozer to the ship hold. There are two typical cranes; gantry type crane and level luffing crane. Level luffing crane is suitable for rather small vessels of 60 thousand DWT or less, while gantry type crane has an advantage in handling larger vessels. As for the unloading capacity, level luffing crane is more economical than gantry type crane, handling up to 900 tons per hour.

154. At any rate, ENP should conduct a further study to decide which system is more suitable to the terminal. The basic idea is that if the terminal handles only a single cargo item, then one of the continuous unloading systems is suitable. Crane system is appropriate for a terminal at which more than two cargo items are handled, including break bulk cargo because it can be applied to a wide selection of cargo by just changing the attachment.

155. As for transportaion system, the continuous system usually has an advantage in terms of cost as well as of easing traffic congestion, although batch system has the advantage of creating new job opportunities for truck drivers.

1.5.6.3 Model Terminal

156. In this section, a model dry bulk terminal is planned. Assumptions are made as follows;

a. Cargo items handled at the terminal
   Fertilizer, Grains and occasionally break bulk cargo

b. Unloading system
   1. Level luffing crane (schematic figure is shown as Fig. 1-5-10)
   2. Pnuematic Unloader (see Fig 1-5-11)

c. Transportation system
   Belt conveyor system

[Unloader]

157. The capacity of unloader necessary for handling the forecasted cargo volume is calculated very roughly as below.

158. Total berth time per annum is about 5,040 hours (24hours x 350 days x 60%; berth occupancy rate is assumed to be as 60%). When average cargo volume per ship is assumed as 10,000 tons, then total ship call per year will be 39 in 2000 and 52 in 2010.

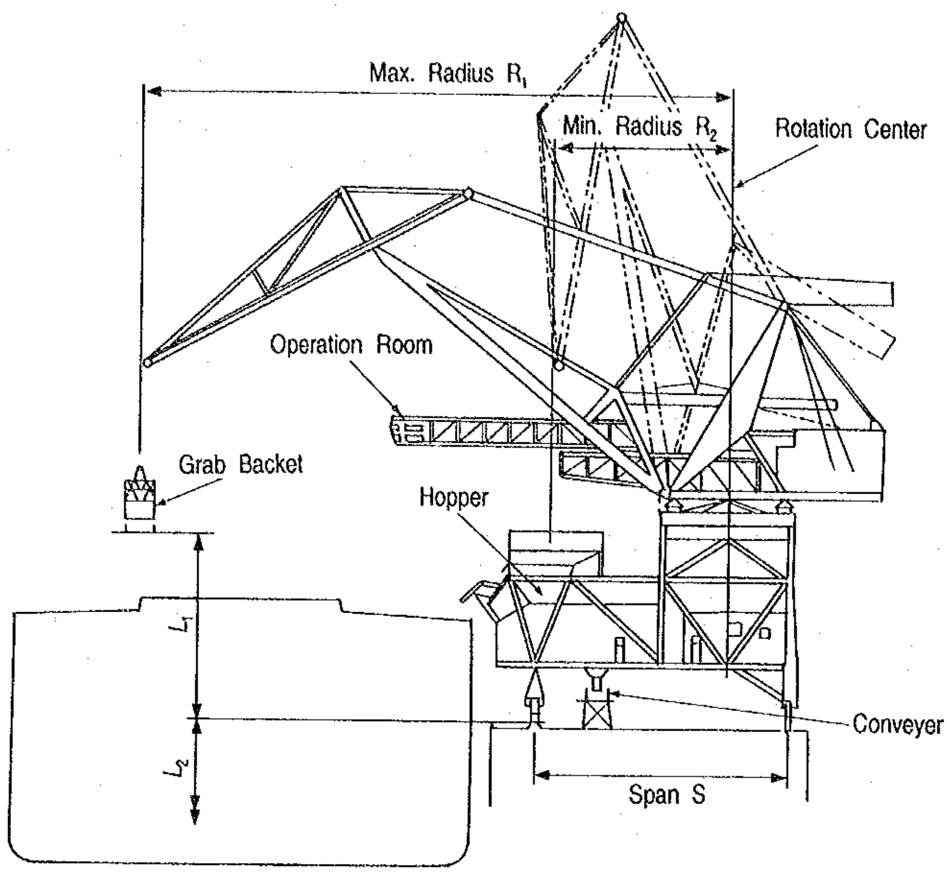


Fig. 1-5-10 Level Luffing Unloader

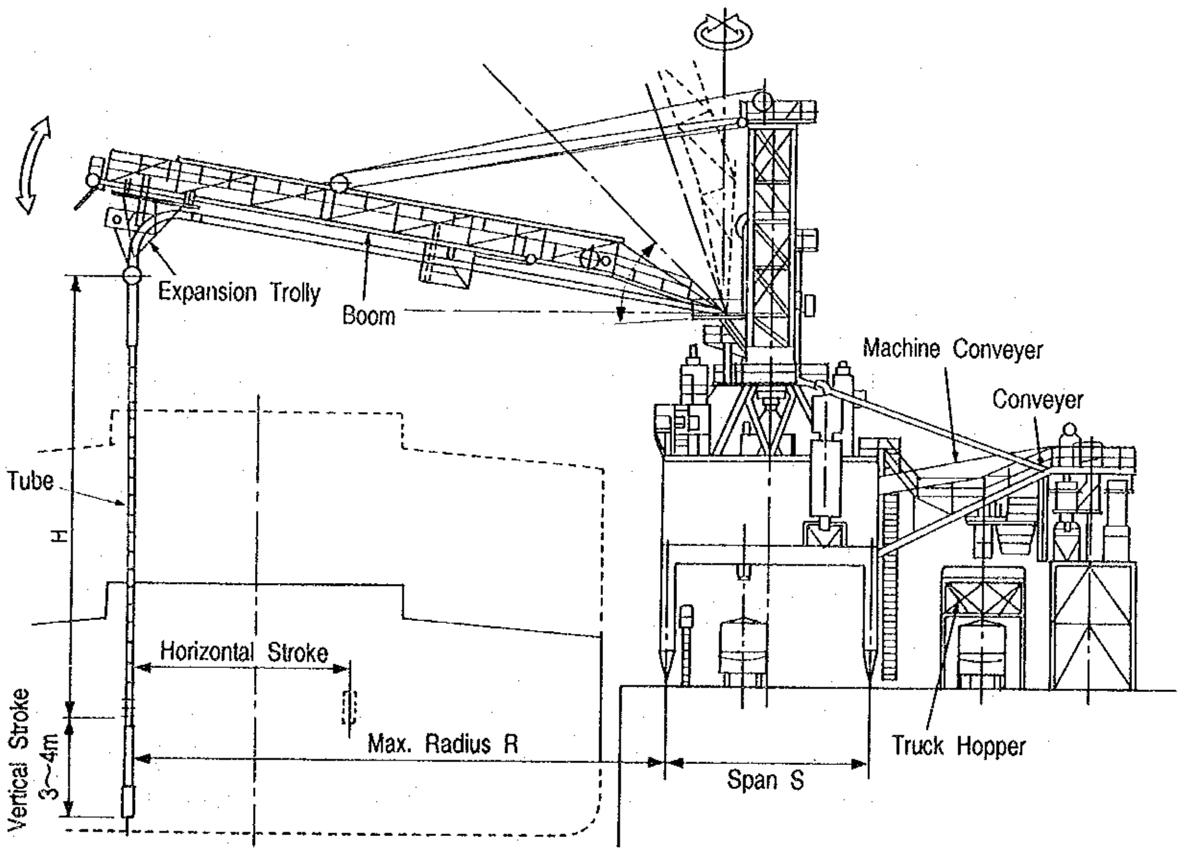


Fig. 1-5-11 Pneumatic Typ Unloader

159. The time for mooring and leaving is assumed to be 5 hours per ship and workable hours per day is 20 hours per day, then total time available for cargo handling is obtained as follows;

in 2000: (5,040 - 5 x 39) x 20/24 = 4,037 hours
in 2010: (5,040 - 5 x 52) x 20/24 = 3,983 hours

160. Then cargo handling volume per hour is as follows;

in 2000: 390,000 / 4,037 = 97 ton
in 2010: 520,000 / 3,983 = 131 ton

161. Cargo handling efficiency is thought to be around 0.6, then the capacity of cargo handling equipment should be 219 ton/hour (131/0.6). Adding a little excess, the capacity of the unloader should be, at minimum, **250 ton/hour.**

162. The average berth time per ship is a little over two days (10,000/250/0.6 + 5 = 72 hours). This, in turn, indicates that total berth time will be around 160 days per year in 2010 and the terminal has little spare capacity from the practical point of view. Another unloader is required soon.

163. Two unloading lines are required for handling fertilizer and grain while a crane is commonly utilized.

164. Cost for an unloader is roughly estimated as 30 million Lps. If other supplemental installments are included, the total cost should be doubled.

[Other installments]
165. There are other facilities required to streamline the cargo handling efficiency. The storage as well as processing plant should be located near the quay. These facilities should be constructed and operated by private companies. These facilities include;

a. Silos
b. Packing facility
c. Fumigation Plant
d. Others

166. According to interviews at the fertilizer company, the areal requirement for packing and storage of fertilizer counts around 10,000 sq.m each. This areal requirement could be fulfilled at the post-relocation lot of asphalt tanks (total area of about 20,000 sq.m is obtained after relocation). Another possibility for the area is the reclaimed land of about 10,000 - 15,000 sq.m just behind the wharf. Anyhow, the exact location of silos as well

as packing facilities should be examined in detail.

167. Fig. 1-5-12 shows the conceptual plan of the dry bulk terminal and its back-up facilities including packing and storage. From the figure, total length of conveyor system is obtained as follows;

a. The place right behind the quay side: 200m
b. The asphalt tank area: 1,500m

168. Table 1-5-5 shows examples of crane type unloader. The objective cargoes vary from terminal to terminal, however, they are all rather heavy materials. Objective ship size varies from 3,000 DWT to 20,000 DWT. Unloading capacity also varies considerably, from 210 tons per hour to 700 tons per hour and lifting capacity is scattered from 62 kN to 167 kN.

Table 1-5-5 Some Examples of Crane Type Unloader

	Terminal A	Terminal B	Terminal C
Unloading Capacity(t/h)	210	300	700
Objective cargoes	Copper Nickel	Pilite Lime stone	Silicon
Objective ship size	20,000 DWT	3,000 DWT	15,000DWT
Lifting Capacity (kN)	62	71	167
Bucket Capacity (cu.m)	2.4	1.8	5.3
R1 (m)	30	22	46.5
R2 (m)	9	6.5	13
L1 (m)	10	11	13
L2 (m)	15	6.8	12
S (m)	5	9	15.95
Rolling-up Speed (m/min)	100	100	100
Level Luffing Speed (m/min)	80	80	100
Rotation Speed (rpm)	1.0	1.25	0.8
Travelling Speed (m/min)	32	20	20

R1, R2, L1, L2 and S are given in Fig. 1-5-10.

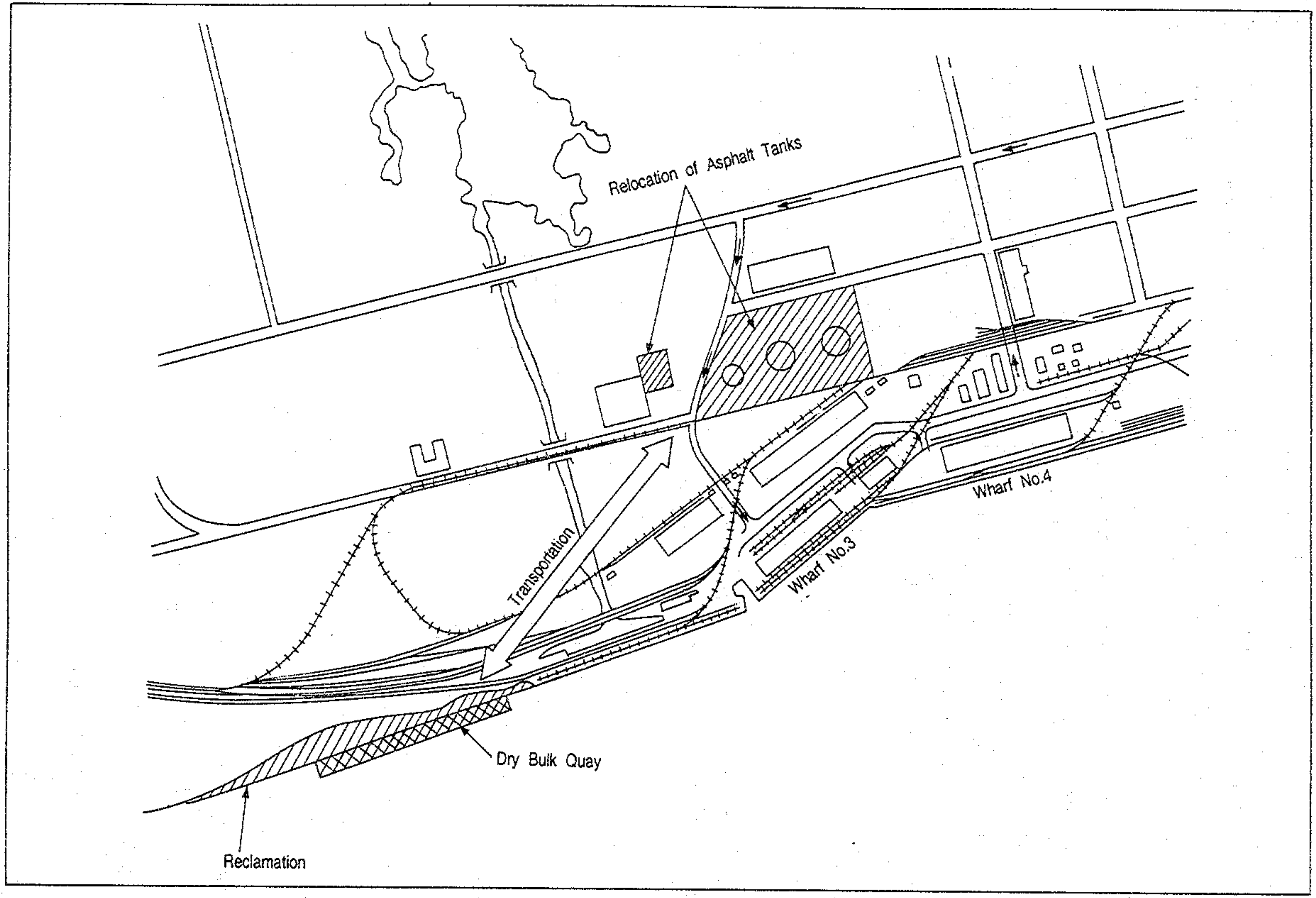


Fig. 1-5-12 Location of Dry Bulk Terminal

169. Table 1-5-6 gives some examples of pnuematic type terminal. Objective cargo is grain, objective ship sizes are 60,000 DWT and unloading capacities are in the range of 400 to 600 tons per hour.

Table 1-5-6 Examples of Pnuematic Type Terminal

	Terminal A	Terminal B	Terminal C
Unloading Capacity (t/h)	400	500	600
Objective ship size	60,000 DWT	60,000 DWT	60,000 DWT
Objective Cargo	Grain	Grain	Grain
S (m)	10	9	9
R (m)	27	26	26
H (m)	23	27	26
Conveyer Speed (m/min)	150	55	50
Swing (m/min)	15	12	12
Travelling Speed (m/min)	10	13.8	15
Number of Nozzle	2	2	2

S, R and H are given in Fig. 1-5-11.

1.5.7 Important Items for the Masterplan

170. As stated in 1.5.3, alternative 1-1 is adopted as the masterplan of the Port of Cortes in the year 2010. In this section, items which are important for the realization of the masterplan are summarized.

1.5.7.1 Dry Bulk Terminal

171. As the volume of port cargoes increases and port activities progress, dry bulk cargoes tend to be handled separately to pursue higher efficiency. In the port of Cortes, dry bulk cargoes are expected to show the largest growth rate. Thus, the move toward the exclusive dry bulk terminal will be strengthened.

172. Usually, a terminal handles a limited number of cargo item(s) to maximize the terminal efficiency and the benefit of the terminal goes to a limited number of entities. This tempts private entreprenuers, thus, in this report, dry bulk terminal is assumed to be funded by the private sector although the exact form of private participation is to be considered in future.

173. At the same time, the quay requirement for the Port of Cortes is quite large and it is thought to be difficult for ENP to meet the entire demand without private participation. Some private talks have already been initiated concerning dry bulk terminals and ENP should thoroughly consider these offers.

174. Attention should be paid to another item. A private company is planning to modify the oil terminal to handle fertilizer as well as oil. There are not many examples of handling dry bulk cargo at a liquid terminal. The terminal should be planned taking into account operational as well as managerial consideration. ENP, as the port management body, should also keep eye on this project from the view point of operation and management of the entire port.

1.5.7.2 Unit Cargo Terminal

175. When planning the masterplan, fruit containers are included in the cargo items, although fruit containers are currently handled at the general berth by ship gear. The reason is that as the volume of cargo increases and terminal efficiency is improved, fruit containers are expectd to be handled by gantry crane(s) to pursue higher efficiency.

176. Eighty per cent of the accumulated LOA distribution is adopted as the unit length of a terminal (185m), on the assumption that more than two terminals are constructed and the maximum vessel (GRT 40,000 ton, LOA 230m) will thus be accommodated.

177. The number of gantry cranes is assumed as one per berth, taking into account the characteristics of the calling vessel; a considerably large number of RO-RO vessels and small vessels will call. For large vessel, two gantry cranes may be allocated. In this way, flexible container handling practice is realized and the investment can be minimized.

1.5.7.3 Dredging Area

178. It is assumed that all the calling vessels have a tug service. The dredging area is decided as such. If vessels are to manouever themselves, far larger dredging work is required.

1.5.7.4 Port Road

179. From the view point of port operation, the port road running through the back of the wharf No.5 is the most troublesome part in the port. Heavy port traffic goes back and forth while the container handling operation takes place. This is detrimental to safety as well as the cargo handling operation. This is the reason that in this report relocation of the port road is mentioned as an item for urgent improvement plan.

1.5.8 Initial Environmental Examination

180. Any new project affects the surrounding environment to some extent.The relationship between Environmental Impact Element (EIE) and Constituent of Environment (CE) is shown in Table 2-9-1 of 2.9, PART II. In this section, the degree of effect to the environment is briefly examined for each project stage and the CEs which require special attention are selected. Deeper analyses on these selected CEs are conducted in a latter stage of this study.

1.5.8.1 Construction

181. Environmental effect by construction works is the first item encountered in the course of project implementation. The CEs which are possibly affected by the construction works are; air quality, water quality and water bottom material quality, noise and vibration, offensive odor, animals and plants and cultural assets.

182. Among these items, water quality and water bottom material quality are the items which should carefully be checked because the construction work includes dredging as well as reclamation. Dredging and reclamation works will generate turbidity which may affect various sea activities such as fishing and sea recreation. Another effect, by the works, is a possibility of deterioration of the eco-system. Dredging work will sweep away and reclamation work bury all the benthos.

183. Other items to be considered are noise and vibration caused by heavy machines for construction work and vehicles for transportation of construction materials.

1.5.8.2 Emergence of Sites

184. In the masterplan, several new terminals are proposed. Among these new terminals, the emergence of several new land areas is the most important in terms of environmental effect, because these new lands have impacts on the surrounding water flow. The new land will change the pattern of water flow to a considerable degree. The proposed unit cargo terminal requires a land area of some 100 thousand sq.m. This is the area where environmental impact analysis should be conducted.

1.5.8.3 Utilization

185. With the increase of cargo volume, volume of sea and land traffic increases. Especially prevalent are increases in dry bulk cargoes and unit cargoes, which bring an increase in large equipment such as heavy trucks and container trailers. This results in the generation of noise and vibration.

186. Direct concern should be paid to terminal operation. Dry bulk terminals handle a large amount of dry bulk cargoes. There is a fear that cargo spills or leakages in the sea as well as onto the neighboring land area may deteriorate the water quality as well as air quality of the surrounding area.

1.5.8.4 Selected Environmental Constituents

187. In total, the following items are selected for further examination;

Construction	--->	· water quality and sea bottom material quality · noise and vibration
Emergence of sites	--->	· water and current around the new unit cargo terminal
Utilization	--->	· noise and vibration · water quality · air quality

1.6 Stage Plan of the Projects

188. The projects shown below are candidates for the Masterplan of the port of Cortes in 2010.

1) Unit cargo terminal
2) By-pass road
3) Domestic terminal
4) Dry bulk terminal (fertilizer,cement and grain)
5) Cold storage terminal

189. An important factor in determining the Master plan is that even now the capacity of general cargo terminals is smaller than the cargo demand. Another factor is that the present unit cargo terminal (No.5 berths) has constraints in terms of area and cargo movement (As for the cargo movement, a countermeasure is proposed in Paragraph 13 PART II). Combining these two phenomena, the Study Team reached the conclution that the terminal to be constructed is a unit cargo terminal, not a general cargo terminal; No.5 berth should be converted to a general cargo berth. As shown in the previous section, the construction of unit cargo terminals turns out to be the most effective tool to ease the port congestion. In this way, the port of Cortes can acquire new unit cargo terminals with sufficient container yard and achieve improved efficiency.

190. Among the projects above, unit cargo terminal with by-pass road has the first priority. The construction timing of domestic terminal should be similar to the construction of unit terminal because, as mentioned in 1.4.5, domestic cargo is forecasted to grow considerably and thus increasingly inconvernience large international vessels. For a more efficient port operation, domestic vessels should be separately berthed. In this way, the efficiency of the unit terminal is realized and the efficiency of general cargo terminal will be improved. Therefore, unit cargo terminal, by-pass road and domestic terminal are the items which should be constructed in the early stage of the project period.

191. As already mentioned in 1.5.3, the terminals interact with one another. Construction of a dry bulk terminal directly affects the cargo volume handled at the general cargo terminal and construction of unit cargo terminal push No.5 berth out to the general cargo terminal group from the unit cargo terminal group. Therefore, the stage plan of the Master plan should be established based on the evaluation of future port capacity not only of unit cargo terminal alone but also general cargo terminal as well.

192. Fig. 1-6-1 and Fig. 1-6-2 show the yearly change of berth time and the optimum berth time. Both figures assume the completion of two unit cargo terminals by 2000. In

Fig. 1-6-1, it is assumed that all berths are for all cargoes, in other words, vessels calling at the port can berth at any berth available. The present berth allocation practice is similar to this. The thick lines with the shade thereunder indicate the optimum berth time and the thick continuous line indicates the yearly change of total berth time. The calculation of berth time is made on the basis of cargo handling efficiencies. The efficiency for each cargo item is assumed as follows;

General cargo :	36 tons per hour (same to the present)
Dry bulk cargo :	52 tons per hour (same to the present)
Unit cargo :	144 tons per hour (till 2000: at wharf No.5)
	220 tons per hour (after 2000: at wharf No.6)

193. The optimum berth time are given as follows;
Till 2000: 8,400 hours x 5 berths x 65% = 27,300 hours
After 2000: 8,400 hours x 7 berths x 70% = 41,160 hours

194. From the figure, it is noted that the total berth time has exceeded the optimum berth time since around 1985 and is forecasted to keep exceeding the optimum. Currently, the berth occupancy rate is a little over 70%. In 2000, the occupancy rate will increase to 93% if no contermeasure is taken. (Actually, ENP has already initiated some project/plan. The completion of a 124m expansion of wharf No.5 is an example.) With the construction of two new terminals in 2000, the port can meet the demand. The berth occupancy rate in 2000 is around 65%. Then the rate gradually increases and in 2003 surpass the optimum, 70%. In 2010, the total berth time reaches the level of 90% and a long line of waiting vessels is expected.

195. Fig. 1-6-2 is drawn using similar assumptions as in Fig. 1-6-1 except two items. The first difference is that the berths are separated into two categories and each vessel is allocated to one of the berth groups to which the vessel belongs. This is to secure higher terminal efficiency by specializing the terminals by cargo groups. Until 2000, when the new unit cargo terminal is realized, Nos.3-4 berths are belong to the general cargo group and No.5 berth belongs to the unit cargo group. After 2000, with the construction of the new unit cargo terminals, No.5 berth will be converted to a general cargo terminal. The second difference is that fruit companies' containers are transferred to the unit cargo group from the general cargo group after 2000.

196. The optimum berth times till 2000 are given as follows;

General cargo terminal:	8,400 hours x 3 berths x 55% = 13,860 hours
Unit cargo terminal :	8,400 hours x 2 berths x 50% = 8,400 hours

Similarly, after 2000, they are calculated as follows;

General cargo terminal: 8,400 hours x 5 berths x 65% = 27,300 hours
Unit cargo terminal : 8,400 hours x 2 berths x 50% = 8,400 hours

197. The figure shows that the total berth time in 1992 (25,000 hours per year) for the general cargo group already far exceeds the optimum berth time (13,860 hours per year) and almost touches the maximum capacity of the three berth terminal (25,200 hours per year). On the contrary, total berth time for unit cargoes is far below the optimum berth time and the port has been utilizing this spare time for the general cargo group. In 2000, without any new terminal, the total berth time for the general cargo group is about 31,500 hours per year and far exceeds the maximum berth time. As for the total berth time of unit cargoes, the terminal continues to hold excess capacity compared with the optimum berth time. After 2000, with the construction of new unit cargo terminals and the transfer of two No.5 berths to the general cargo group from the unit cargo group, total berth times are a little below the optimum berth times for both general cargo group and unit cargo group. The total berth time will catch up to the optimum berth time by the year 2003, and after that continue to exceed it. Therefore, another unit cargo terminal should be constructed and new terminal(s) for dry bulk cargo as well as refrigerated cargo should be constructed to ease the congestion at the general cargo terminal.

198. The real situation falls between the two figures. That is, till 2000, all the terminals are used as multi-purpose terminals and after that terminals are divided into two groups. Anyhow, with the construction of two unit cargo terminals in 2000, the port provides sufficient capacity to both unit cargo and general cargoes. After 2004, the demands exceed the optimum occupancies, however, for the unit cargo terminals, considerble share of Ro-Ro vessels would work to alleviate the congestion. This is because this type of vessel occupies a small portion of the quay for berthing and it is commonly observed that No.5 wharf accommodates two vessels while berthing a Ro-Ro vessel. Therefore, even if the berth occupancy rate is calculated considerably high, the port still can provide sufficient services to vessels, under the condition that the cargo handling operation is conducted smoothly with sufficient cargo handling equipment as well as competent workers in the well planned container yard. (Assuming 65% for optimum occupancy ratio, then optimum berth time will be about 11,000 tons a year.)

199. Fig. 1-6-3, Fig. 1-6-4 and Fig. 1-6-5 are drawn to show the same situation in terms of cargo volume. In Fig. 1-6-3 and Fig. 1-6-4, cargo volumes are converted into general cargo terms. The volume of dry bulk cargo is converted by multiplying 2/3 which is the inverse number of the proportion of cargo handling efficiency of dry bulk cargo (52

ton/hr) against general cargo (36 ton/hr). Based on the same idea, volume of fruit containers (144 ton/hr) is converted by 1/4. The results are the same as in the previous figures.

In short, Projects should be realized in following order:

i By 2000, two unit cargo terminals, by-pass road and domestic terminal should be completed. All unit cargoes in cluding fruit container should be handled at the new unit terminal.

ii By 2004, dry bulk terminals for fertilizer and grains should be completed.

iii By 2009, another unit cargo ferminal should be completed.

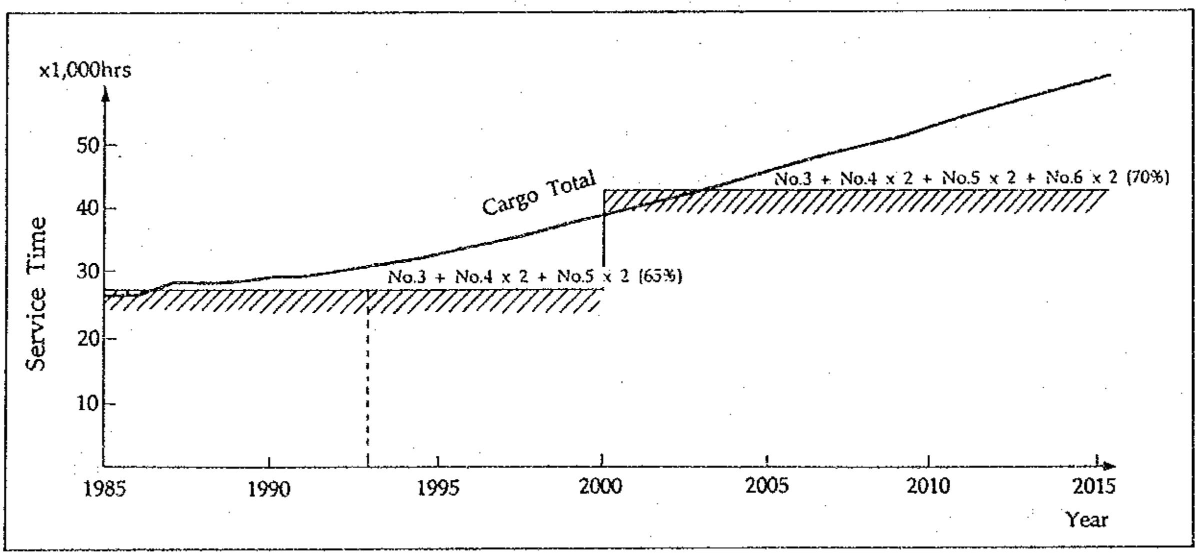


Fig. 1-6-1 Cargo Volume - Terminal Capacity Relation in all

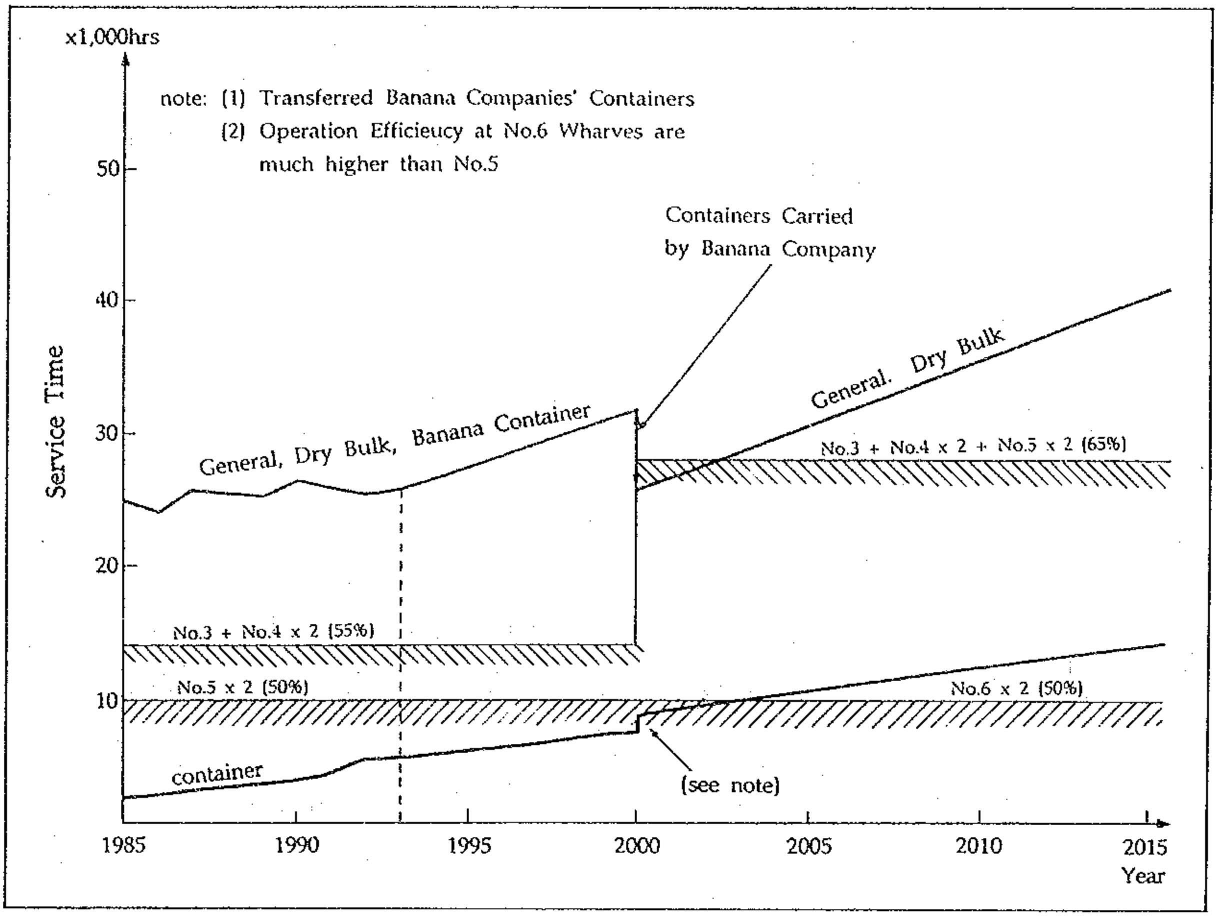


Fig. 1-6-2 Cargo Volume - Terminal Capacity Relation by Terminal Type

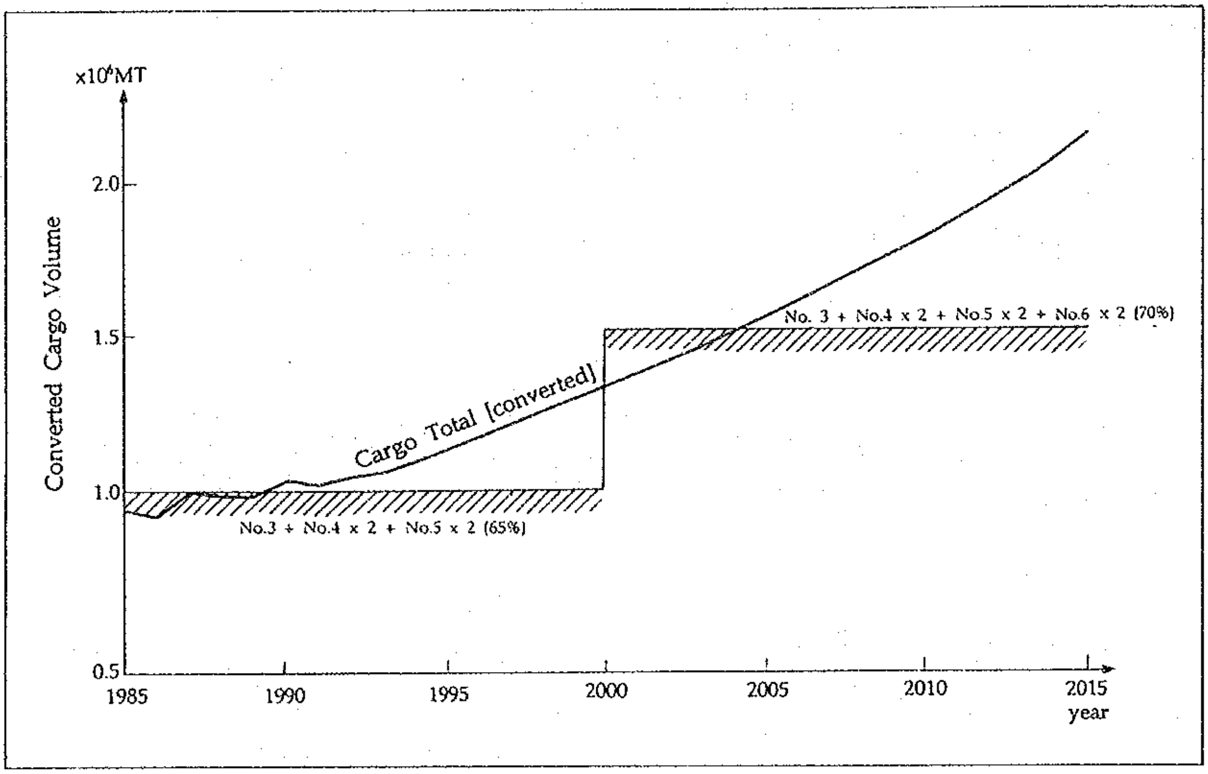


Fig. 1-6-3 Cargo Volume - Terminal Capacity Relation (in volume term)

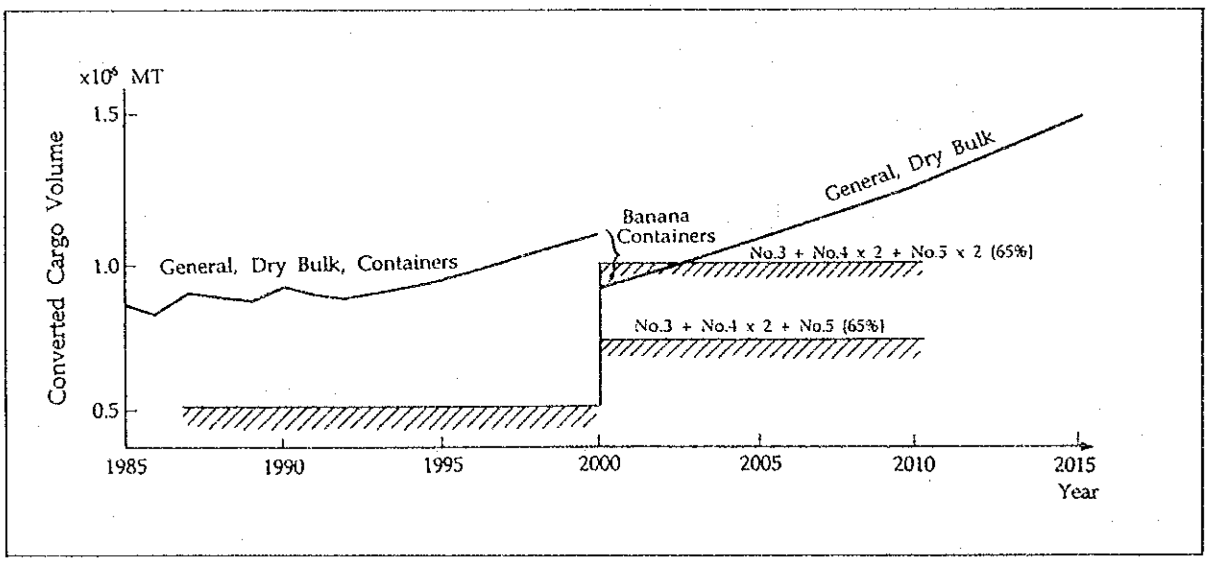


Fig. 1-6-4 Cargo Volume - Terminal Capacity Relation
(General Cargo Group in Cargo Volume Term)

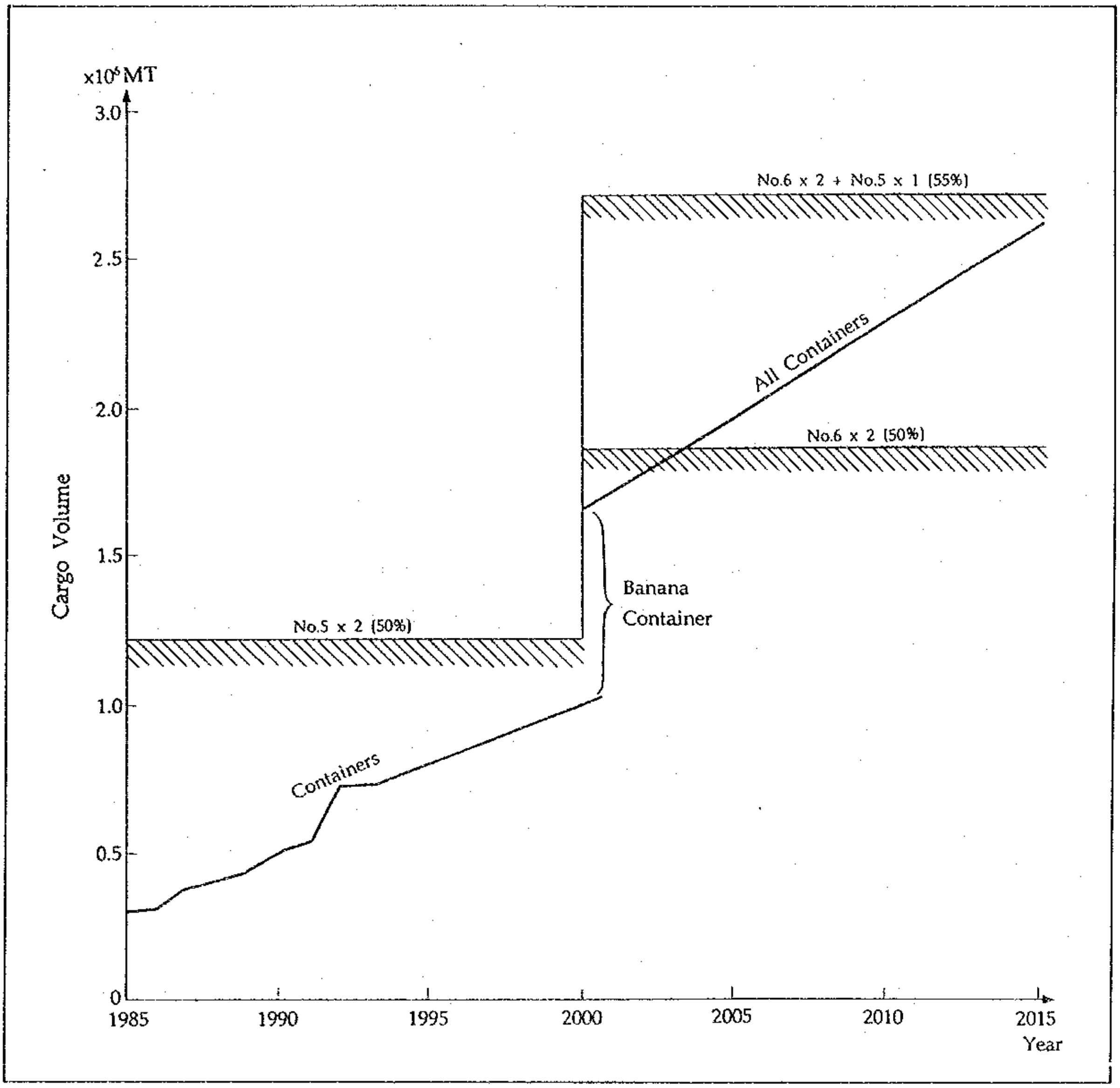


Fig. 1-6-5 Cargo Volume - Terminal Capacity (Container, in Cargo Volume Term)

1.7 Rough Design of Port Facilities

200. In the Master Plan of the Port of Cortes for the year 2010,the port facilities and their layout alternatives are mentioned in section 1.5,and the new facilities to be designed here are summarized as below:

	Water Depth	Length
(A)Unit Cargo Berth	-12.0m	185m
(B)Multi Purpose Berth	-10.0m	Dolphin Type
(C)Domestic Cargo Berth	-4.5m	200m
(D)Bypass	--	approx.1,380m
(E)Fertilizer Terminal		
(F)Cement Terminal		

201. The facilities except Fertilizer Terminal and Cement Terminal,which are to be constructed by an agency other than ENP, have been designed in this section.
As the aim of design is to get quantities of the materials for a preliminary cost estimation required in Port of Cortes by 2010, only the major structural components are determined.

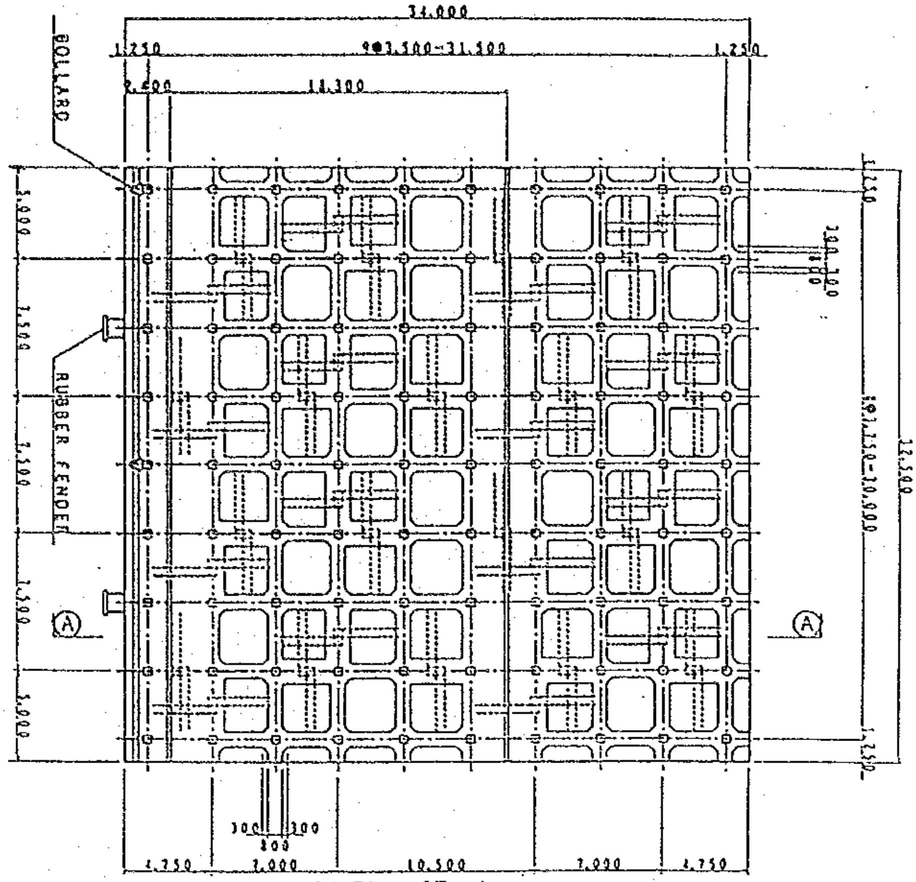
202. Types of the port facilities are tentatively the same as that of the existing wharves in the Port of Cortes--Open Deck Type on Concrete Piles,which is popular in Honduras. The typical cross sections of the main facilities are shown in figures as below:

(A)Unit Cargo Berth -- Fig.1-7-1
(B)Multi Purpose Berth -------------------------------------- Fig.1-7-2
(C)Domestic Cargo Berth and Trainning Wall ------- Fig.1-7-3

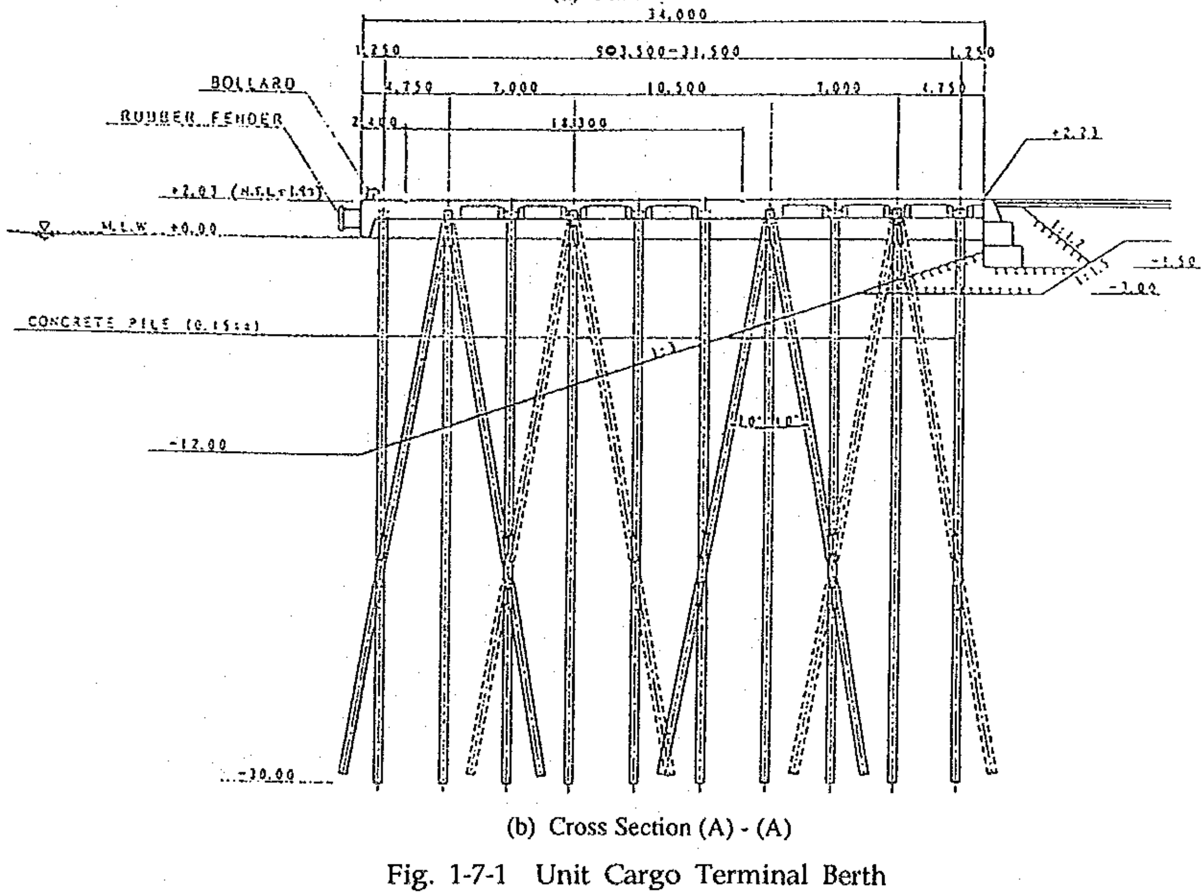
[References]

1. Technical Standards for Port and Harbour Facilities in Japan

2. American Standard Testing Material

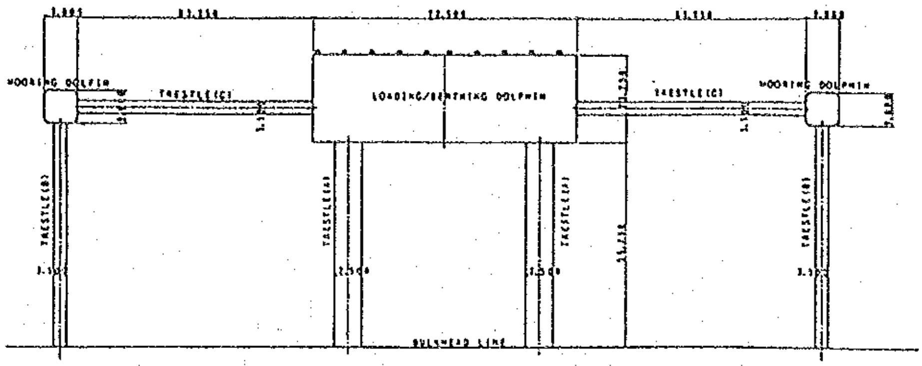


(a) Plan of Berth

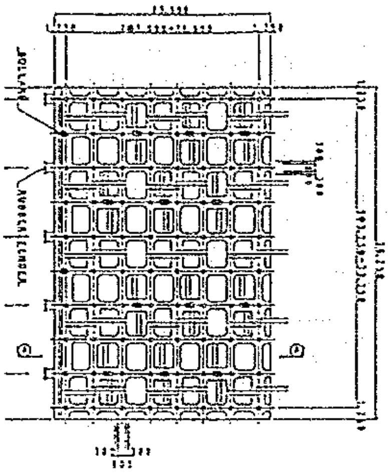


(b) Cross Section (A) - (A)

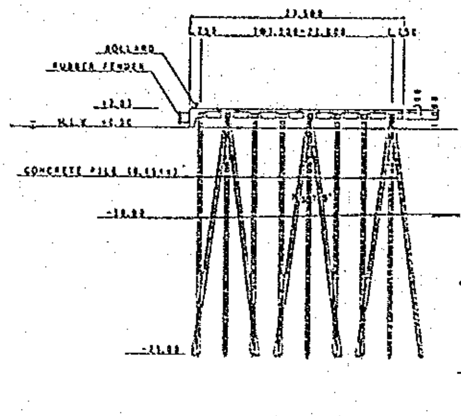
Fig. 1-7-1 Unit Cargo Terminal Berth



(a) Location of Grain Terminal

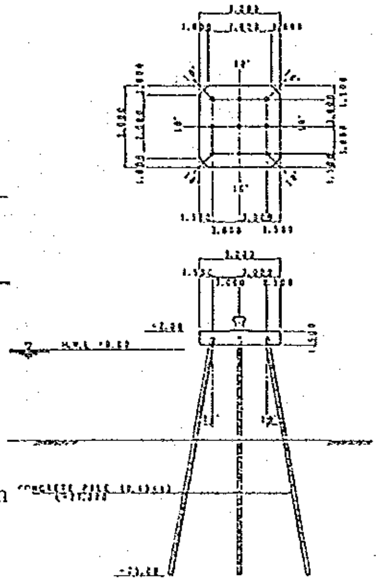


(b) Plan of Loading Dolphin

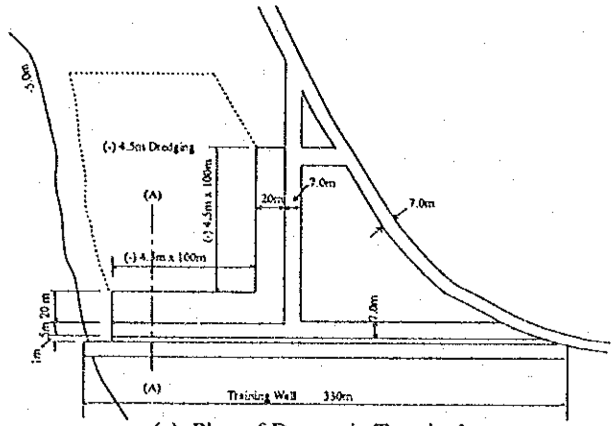


(c) Cross Section of Loading Dolphin

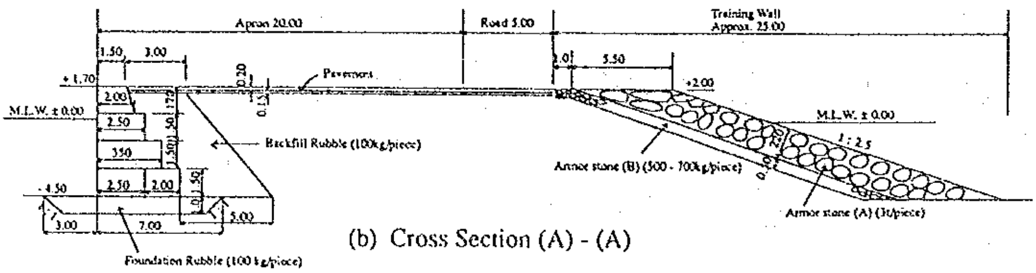
Fig. 1-7-2 Grain Terminal Berth



(d) Mooring Dolphin



(a) Plan of Domestic Terminal



(b) Cross Section (A) - (A)

Fig. 1-7-3 Domestic Terminal Berth and Training Wall