Chapter 3 LONG TERM DEVELOPMENT PLAN

A. Precondition of Calculation of Physical Requirement

1) Channel

1. The port of Guayaquil has a long access channel in Estero Salado as shown in Figure I-6-7 in PART I. The design dimensions of the access channel are 9.45 m in depth and 122 m in width. However, due to the progress of siltation/sedimentation the actual depth is likely less than the design depth.

2. The seabed level varies according to different data sources. A sounding survey was conducted along the navigation route from the Boya de Mar to the port area in this study. The result is shown in Figure II-3-1. Through this data is along only one line, the data gives valuable information on the present situation of the channel. It is clear that some parts of the channel are shallower than 9.45 m and that sedimentation is advancing.

3. On the other hand the amplitude of the tide is approximately 2 m at the entrance of the channel and approximately 4 m at the berth. The ships going to the port can use this tidal benefit.

4. The operation under consideration of the tidal benefit is adopted for navigation through the access channel. In case of a ship with draft larger than 32 feet (9.75 m), special permission is required while a ship with more than 34 foot (10.36 m) draft has never entered the port.

5. An entering/leaving ship with draft less than 26 feet (7.92 m) is able to sail in the channel at all times. In case of ships with more than 26 foot (7.92 m) draft, the time when they are able to enter the channel is restricted. According to the Pilot Division the following way of operation is presently adopted.

ship with draft of 32 feet (9.75 m) to 34 feet (10.36 m)
; at the time between H.W. and 1 hour before H.W. at buoy No.5
ship with draft of 29 feet (8.84 m) to 32 feet (9.75 m)
; at the time between H.W. and 2 hours before H.W. at buoy No.5
ship with draft of 26 feet (7.92 m) to 29 feet (8.84 m)
; at the time between H.W. and 4 hours before H.W. at buoy No.5

6. On the basis of the present situation and through review of relative documents, the present design depth of the channel, 9.45 m, is adopted as the depth of the access channel in the Master Plan. The reasons are described below.

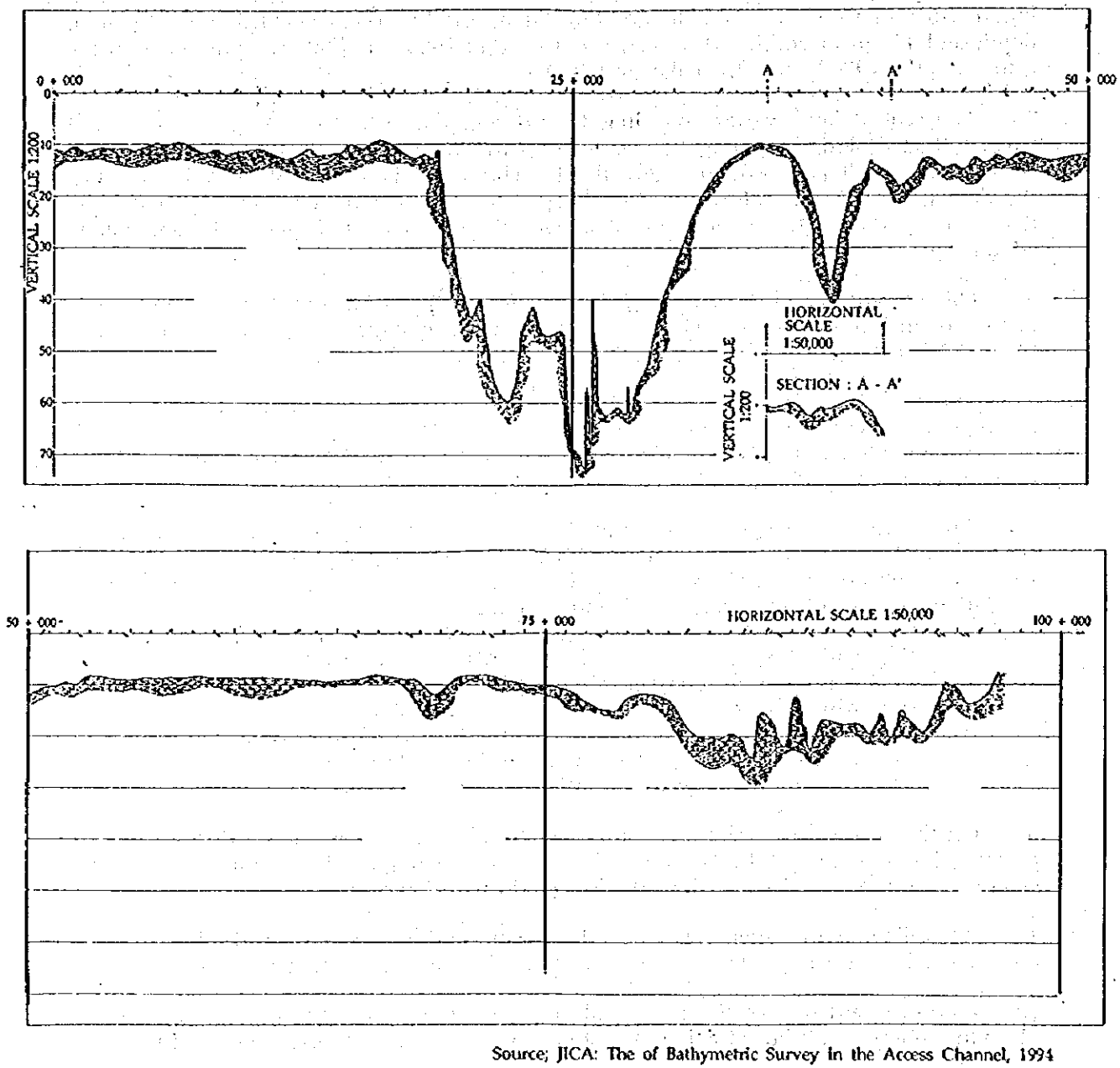
7. According to the interviews with the agents and the personnel of pilot division there have been no requests for a deeper channel except from bulk carriers.

8. From the situation of the ports and shipping route along the Pacific Ocean coast of South America, full introduction of large draft ships cannot be expected for sometime.

9. Concerning maintenance dreading, APG makes efforts to maintain the design depth of the channel but the channel cannot be maintained perfectly. From the engineering aspect, siltation will progress more rapidly if the channel is deepened, and require more effort and money to maintain the planning depth.

10. In addition, necessity of the continuous dumping of dredged materials will be a problem from the viewpoint of the environment, especially in connection with the shrimp industry, as the volume of dumping will increase in case of the deeper channel.

11. The Master Plan should be prepared under the idea that the depth of the access channel to the port of Guayaquil has been decided as 9.45 m.



Source; JICA: The of Bathymetric Survey in the Access Channel, 1994

Figure II-3-1 Depth along the Navigation Route in Estero Salado

2) Standard Ship Dimensions in Planning

12. The standard ship dimensions in the Master Plan are decided on the basis of the result of the forecast of calling ships and the physical conditions such as channel dimensions.

13. The depth of navigation channel consists of the draft of ships and allowance which includes various kinds of elements concerned. In general, however ten percent of the draft is required.

14. It means that the channel depth of 9.45 m corresponds to the channel for ships of 8.6 m draft. However ship navigating in the access channel can use the tidal benefit. The tidal amplitude is about 2 m at the entrance of the access channel and 4 m at the berth. Presently ships with over 26 foot (7.92 m) draft enter the channel at high tide under the controls described earlier and the depth of existing berth is designed as 10.5 m under MLWS. Under the assumption that the same operational system should be adopted the standard ship dimension is decided as 9.5 m of draft in the Master Plan.

15. According to the technical note of the Port and Harbor Research Institute in Japan, the dimensions of ships with 9.5 m draft are as in Table II-3-1.

Table II-3-1 Standard Ship Dimensions

Ship Type	DWT	Length	Breadth
Container Ship	19,000	180 m	26 m
Conventional Type Ship	17,000	155 m	22 m
Bulk Carrier	20,000	160 m	23 m

16. More than 9.5 m draft ships can go through the channel during high tide. This factor should be considered in planning the dimensions of facilities at the port area.

3) Ships by Cargo Type

17. At present each berth is used by various types of ships. However at the stage of the Master Plan, the utilization of each terminal will be specialized according to ship type. Namely, a container terminal will be used by container ships and a bulk terminal by grain bulk carriers. Other berths will be used by conventional type ships so these berths and their backyard area is reffered to as a multi-purpose terminal in the Master Plan.

18. In case of container cargo some are transported by full container ships and others by conventional type ships. The relation between the volume of conventional type cargo and that of container cargo transported with conventional type cargo is assumed to remain the same as present. Under this assumption the share of container cargo transported by full container ships.

19. The relation between cargo and ship type is assumed as shown is Table II-3-2. Liquid bulk cargo is handled using the existing equipment for liquid cargo at bulk terminal.

Table II-3-2 Relation between Cargo and Ship Type

Cargo Type \ Ship Type	Container excluding banana	Banana	Other Cargo
Full Container Ship	a part of container cargo	all of container cargo	-
Conventional Type Ship	a part of container cargo	box and pallet type cargo	cargo besides below
Bulk Carrier	-	-	grain and liquid bulk

4) Berth Dimensions

20. Berth dimensions are decided on the basis of the standard ship dimensions. In general the length and depth of the berth are required to exceed the standard ship dimension to provide some allowance.

21. In the Master Plan the depth of the berth is planned to be the same as existing facilities in case of expansion of berth next to the existing berth. But in case of developing a new berth at the western expansion area, the depth is planned as 11 m for larger than standard ships going the channel at high tide.

22. Container terminal berth length is planned as 220 m in reference to the recent data of other development plans. In case of a multi-purpose terminal it is planned as 185 m to coincide with the existing berth dimension which is enough for standard ship dimensions of the Master Plan.

23. Bulk carriers enter the port with the draft corresponding to the depth of channel at the calling time. Therefore bulk berth dimension will remain the same as at present.

B. Efficiency of Cargo Handling

1) Present Situation

24. The efficiency of cargo handling is reflected in the productivity of the port. One of the most simple port productivity indexes is the annual cargo throughput per berth. This figure is obtained from data of APG. However while berths in the port are designated as conventional berth, container berth and bulk berth, in reality, all berths are used by various types of vessels. Therefore the figure 370,075 tons per berth obtained by dividing annual cargo volume (3,330,675 ton) by the number of berths (9) means the productivity of the port as a whole.

25. Cargo volume divided by berthing times at each berth also reveals the productivity of the port. The figures are obtained from statistics of APG. The figure in 1993 on the whole is calculated as 58.51 tons per hour.

26. The ratio of the time occupied by vessels to the total operation time shows the situation of port activities. The ratio for each berth is calculated on the basis of data in statistics of APG as follows. The 1993 figure is calculated as 0.72 (56923/78840).

27. The cargo handling efficiency is different depending on cargo handling method and types of cargo. The figures above give the productivity of the port of Guayaquil as a whole.

28. At this time the cargo handling efficiency is estimated by analyzing the cargo handling capacity by each cargo type and berthing time without cargo handling.

29. The sufficient data has not be found for activities of the port of Guayaquil. But there is some helpful information for estimation of the cargo handling efficiency.

30. On the relation between actual cargo handling time and berthing time at the Port of Guayaquil, the result of the investigation by APG staff from September 5 - 11 in 1994 can be used for estimation. According to the data, no cargo handling is conducted for about 30% of berthing time. This figure rises to 40% in the case of banana ships. The daily distribution of time without cargo handling during berthing from the result of the investigation by APG is shown in Figure II-3-2.

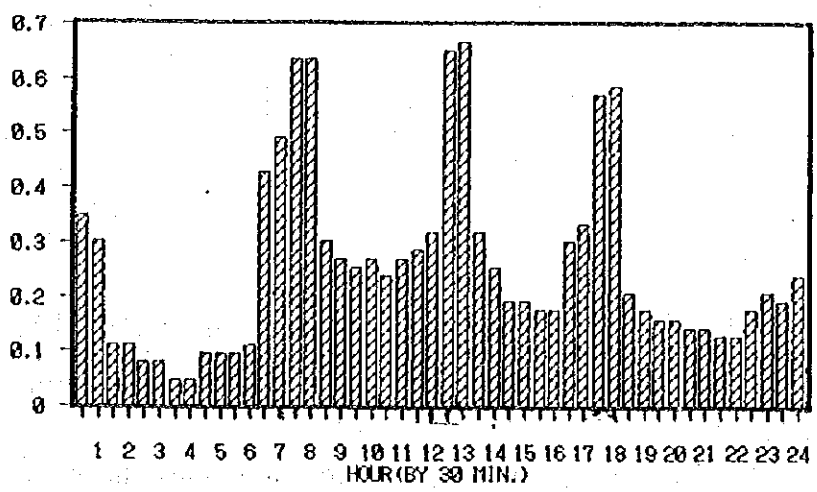


Figure II-3-2 Daily Distribution of Time without Cargo Handling during Berthing
Source; APG's investigation in 1994

31. According to the above, the shares of time without cargo handling during berthing are assumed as 40% for banana ships and 25% for other ships.

32. There is not sufficient information on cargo handling capacity. Therefore the handling capacity for each cargo and/or ship type is compelled to be estimated with limited data. The folowing assumptions were made;

Container Ships
Banana : on the result of ship call of banana container in 1994
General : on total berthing time of full container ships in statistics data by APG
Conventional Ships
Container : estimation on the observation at the port and APG's new rule / 8 box/hour
Banana : average capacity among three types of cargo handling system such as cage, pallet and elevator system / 90.24=(69.12+43.2+23.04)/3×2
Conventional : estimation with total berthing time and berthing time of other ship type
Bulk Carrier
Grain : actual handling capacity by interview
Liquid Bulk : actual handling capacity by interview

33. The result of estimation with parameters is shown in Table II-3-3.

Table II-3-3 Estimation of Present Situation of Cargo Handling by Each Cargo Type

	<Container terminal>		<Multi-Purpose Terminal>			<Bulk Terminal>		
Parameter \ Cargo	Banana	General	Container	Conventional	Banana	Grain	Liquid	Total
Cargo Volume ton(box)/year*	28,103	36,547	564,288	761,313	1,060,931	287,400	13,435	
Handling Capacity ton(box)/Hr	46	10	90	52	90	110	90	
Working Time /Berthing Time	0.75		0.75		0.60	0.75		
Cargo Volume /Berthing Time	35	8	68	39	54	82	68	
Required Berthing Time / Year	815	4,873	8,360	19,521	19,647	3,484	199	56,899
Corresponding Number of Berth	0.13	0.77	1.33	3.10	3.11	0.55	0.03	9.0

Note(*): ton; for Multi-Purpose terminal, Bulk Terminal
box; for Container Terminal

2) Future Improvement

34. It is assumed that the cargo handling efficiency will be improved by the increase of handling volume per hour and shortage of the berthing time without cargo handling. The former is related to cargo handling machine and system and the latter is related to operational management.

35. It is supposed that three hours are used for three meal breaks for each shift. Therefore, at least three hours are not used for cargo handling. In 2010, the berthing

time without cargo handling (except meal time) is expected to be cut in half.

36. The handling capacity for each methods and/types is estimated as in Table II-3-4. The following assumptions are made for the estimation;

Container Ships
- Banana : most efficient situation of handling based on interview
- General : container handling capacity in general

Conventional Ships
- Container : 1.25 times of present situation
- Banana : average handling capacity of cage and pallet system (without elevator system)
- Others : same as container cargo

Bulk Carriers
- Grain : 80% of design capacity
- Liquid Bulk : 80% of design capacity

37. Because the modernization program by APG is now on-going, it is better to prepare some cases in which cargo handling efficiency is improved. Therefore, another case in which cargo handling efficiency increases by half is shown in Table II-3-5. The improvement described in Table II-3-4 is reffered to as High Level and Table II-3-5 as Medium Level in the report.

38. It should be not that the figures in Table II-3-3, 4, 5 are prepared for estimation of improvement of cargo handling efficiency in future under some assumption with insufficient data.

Table II-3-4 Cargo Handling Efficiency in 2010 (High Level)

	<Container terminal>		<Multi-Purpose Terminal>			<Bulk Terminal>	
Parameter \ Cargo	Banana	General	Container	Conventional	Banana	Grain	Liquid
Handling Capacity ton(box)/Hr*	50	20	112.50	65.00	137.87	160.00	160.00
(Ratio-2010/1993)	(1.09)	(2.00)	(1.25)	(1.25)	(1.53)	(1.45)	(1.78)
Working Time /Berthing Time	0.81		0.81		0.74	0.81	
Cargo Volume /Berthing Time	41	16	91	53	102	130	130
(Ratio-2010/1993)	(1.18)	(2.17)	(1.35)	(1.35)	(1.88)	(1.58)	(1.93)

Note(*): ton; for Multi-Purpose terminal, Bulk Terminal
box; for Container Terminal

Table II-3-5 Cargo Handling Efficiency in 2010 (Medium Level)

	<Container terminal>		<Multi-Purpose Terminal>			<Bulk Terminal>	
Parameter \ Cargo	Banana	General	Container	Conventional	Banana	Grain	Liquid
Handling Capacity ton(box)/Hr*	48	15	101.25	58.50	113.94	135.00	125.00
(Ratio-2010/1993)	(1.04)	(1.50)	(1.13)	(1.13)	(1.27)	(1.23)	(1.39)
Working Time /Berthing Time	0.81		0.81		0.74	0.81	
Cargo Volume /Berthing Time	39	12	82	48	84	100	102
(Ratio-2010/1993)	(1.13)	(1.63)	(1.22)	(1.22)	(1.56)	(1.33)	(1.50)

Note(*): ton; for Multi-Purpose terminal, Bulk Terminal
box; for Container Terminal

C. Physical Requirement

1) Method of Calculation

39. The physical requirements are calculated on the basis of cargo volume in future. Two cases have been prepared for cargo volumes in 2010. Therefore physical requirements are calculated for each case.

40. On cargo handling efficiency, the target in 2010 was se up under some assumptions with limited data because there are not sufficient information on cargo handling efficiency. Because improvement of cargo handling efficiency is largely affected by progress of modernization program by APG, the case with the progress of improvement remain at half level of the target to be set up is also examined.

41. Namely four cases are thought and named as Table II-3-6. The index of 1/2 in the name shows the difference of cargo volume and A/B the difference of cargo handling efficiency. The required number of berth is calculated in Case 1A and 1B to identify difference between high and medium cargo handling efficiencies and in Case 2B for maximum required number of berth. The requirement of other facilities basically depends on cargo throughput, therefore the requirement in Case 1A is equal to Case 1B and Case 2A to Case 2B.

Table II-3-6 Cases of Calculation

	small cargo volume	large cargo volume
high efficiency	Case 1A	Case 2A
medium efficiency	Case 1B	Case 2B

2) Number of Berth for Case 1A and 1B

42. Required number of berths is determined based on cargo volume and handling capacity. The required number of berth is calculated by the following formula.

$$N = Nc \ / \ Ch \ / \ (Dy \times Hd) \ / \ Ro$$

N : Required number of berth
Nc : Cargo throughput per year
Ch : Cargo volume per berthing time
Dy : Annual operation days
Hd : Working hours per day
Ro : Planning berth occupancy ratio

43. On cargo handling efficiency, cargo volume per berthing time for Case 1A is from Table II-3-4 and for Case 1B from Table II-3-5. It is assumed that the port opens all year and that planning occupancy ratio is 0.6 for container terminal and 0.7 for other terminals in reference to other port planning examples.

44. The calculation procedure and result are summarized in Table II-3-7 for case 1A and Table II-3-8 for Case 1B. The required number of berths for each terminal in 2010 is calculated as follows;

Case 1A

Container Terminal	3
Multi-Purpose Terminal	9
Bulk Terminal	1

Case 1B

Container terminal	3
Multi-Purpose terminal	10
Bulk Terminal	1

45. The productivity of port shown by the annual cargo volume per berth is 505,538 ton/year for Case 1A and 469,429 ton/year for Case 1B. These figures are equal to as 1.52 and 1.41 times as that of in 1993.

Table II-3-7 Required Number of Berth in 2010 for Case 1A

Case 1A	<Container terminal>		<Multi-Purpose Terminal>			<Bulk Terminal>		
Parameter \ cargo	Banana	General	Container	Conventional	Banana	Grain	Liquid	Total
Cargo Volume ton(box)/year	105,000	141,665	860,563	1,446,000	1,333,000	390,000	30,000	
Cargo Volume /Berthing Time	41	16	91	53	102	130	130	
Required Berthing Time (hour)	2,585	8,718	9,415	27,380	13,110	3,000	231	64,439
Calculated Number of Berth	0.49	1.66	1.54	4.47	2.14	0.49	0.04	
Required Number of Berth	3 (2.15)		9 (8.14)			1 (0.53)		13

Table II-3-8 Required Number of Berth in 2010 for Case 1B

Case 1B	<Container terminal>		<Multi-Purpose Terminal>			<Bulk Terminal>		
Parameter \ cargo	Banana	General	Container	Conventional	Banana	Grain	Liquid	Total
Cargo Volume ton(box)/year	105,000	141,665	860,563	1,446,000	1,333,000	390,000	30,000	
Cargo Volume /Berthing Time	39	12	82	48	84	110	102	
Required Berthing Time (hour)	2,692	11,624	10,461	30,422	15,864	3,556	295	74,914
Calculated Number of Berth	0.51	2.21	1.71	4.96	2.59	0.58	0.05	
Required Number of Berth	3 (2.72)		10 (9.25)			1 (0.63)		14

3) Container Terminal

46. The number of container cargo which is handled through the container terminal is 246,665 boxes. The required number of berth is calculated as 3. The requirement of other facilities in a container terminal are calculated based on the number of container boxes, TEU or tonnage.

(a) Container Yard

47. Required storage number of container and number of slots are calculated by the following formulas respectively.

$$Ml = (My \times Dw \times p) / Dy$$

Ml : Required storage number of container (TEU)
My : Annual container throughput (TEU)
Dw : Average dwelling days (days)
Dy : Operating days per year (days)
p : Peak ratio

$$Sl = Ml / L$$

Sl : Required number of ground slots
Ml : Required storage number of container
L : Stacking height of container

48. The peak ratio and operating days are assumed as 1.3 and 365 days. The dwelling days are assumed for each kind of container cargo as listed in Table II-3-9. The stacking height is assumed as 3 but in case of banana container assumed as 2.

49. Area per slot depends on container handling system and shapes of yard. According to some examples the area of container yards is approximately 35 m^2.

50. The total required number of ground slots in TEU is calculated as 10596. The total area of the yard including roads and others was set up based on the average yard area per slot. Thus, 93030 m^2 is required as the yard.

Table II-3-9 Required Area of Container Yard for Case 1A and 1B

Parameter \ Cargo	Import	Export	Banana	Empty	Transit	Total
Throughput(TEU)	69,191	57,363	140,000	146,878	2,100	415,532
Dwelling Days	4	3	1.5	10	3	-
Peak Ratio	1.3					-
Operating Days	365					-
Required Number	986	612	748	5,321	22	7,577
Stacking Height	3	3	2	3	3	-
Required slots	329	204	374	1,744	7	2,658

(b) Container Freight Station

51. Required area for CFS is calculated by the following formula.

$$A = (Mc \times Dw \times p) / (w \times r \times Dy)$$

A : Required area of CFS (m^2)
Mc : Annual handling volume of container cargo through CFS (ton)
Dw : Dwelling days at CFS (days)
p : Peak ratio
w : Volume of cargo per unit area (ton/m^2)
r : Utilization ratio of CFS
Dy : Operating days per year (days)

52. The ratio of LCL (less than container load cargo) cargo at the port of Guayaquil is 5% for import cargo and 40% for export cargo at present. In the calculation the ratio of LCL cargo in 2010 is assumed to be 10% for import and to remain the same for export.

53. The calculation procedure with assumed parameters is shown in Table II-3-10. As a result, required area of CFS is 7427 m^2.

Table II-3-10 Required Area of CFS for Case 1A and 1B

Parameter \ Cargo	Import	Export	Total
Annual Handling Volume (ton)	668,254	577,183	1,245,437
Ratio of Storage in Port	0.95	0.97	-
Ratio of LCL	0.1	0.4	-
Annual Volume of LCL (ton)	63,484	223,947	287,431
Dwelling Day at CFS	7	5	-
Peak Ratio	1.3		-
Volume of cargo per Unit Area (ton/m^2)	1.5		-
Utilization Ratio of CFS	0.5		-
Operating Days per Year	365		-
Required Area of CFS (m^2)	2,110	5,317	7,427

(c) Maintenance Shop

54. Required area for maintenance shop depends on factors such as rate of damaged container, type and number of cargo handling vehicles and machines to be used in the terminal. Generally, size of maintenance shop is 800 to 1000 m^2 per berth. The maintenance shops require an area of 3000 m^2.

(d) Terminal Office

55. Terminal office is planned next to the terminal gate for management and operation of container terminal. Generally, the area of a terminal office is 1,200 to 1,500 m^2 per berth. 4,000 m^2 office is planned in the terminal.

(e) Terminal Gate

56. Required number of truck lanes is calculated by the following formula.

$$N = (Mc \times p \times s) / (Dy \times H \times 60)$$

N	: Required number of truck lanes
Mc	: Annual containers throughput (boxes)
p	: Peak ratio
s	: Necessary procedure time per truck)
Dy	: Operating days per year
H	: Operating hours per day

57. The peak ratio and necessary procedure time per truck are respectively assumed as 1.5 and 3.0 minutes in reference to other similar cases. And the gate open everyday and 8 hours in a day. The number of truck for LCL cargo is assumed to be equivalent to number of container boxes in calculation.

58. Required number of truck lanes is calculated as 6.33. Thus a 7-lane gate will be prepared for the terminal.

(f) Requirement of Container Terminal

59. Based on the requirements of each of the above elements, the container terminal is planned as follows. These figures are prepared under assumption that the container yard, CFS, maintenance shop and other facilities are located behind each berth.

Number of Berth	; 3 (220 m in length)
Apron	; 40 m x 660 m
Container Yard	; 930,300 m^2
Attached Area for Other Facilities	; 7,000 m^2
Lane of gate	; 7 lanes
gantry crane	; 3 (two of them has been installed or decided to be installed outside of the Study)

4) Multi-Purpose Terminal

60. The cargo transported by conventional type ships including container cargo are handled through this terminal. The required number of berth is calculated as 9 for Case 1A and 10 for Case 1B.

(a) Apron

61. The apron is the quay surface between the front line of the berth and the transit shed or open storage area where cargoes and vehicles used for cargo handling are placed temporarily.

62. The width of the apron must be adequate to ensure safe and smooth cargo handling. It is determined considering the way the berth is utilized, the types of transit sheds and warehouse, the cargo handling equipment and the type of connecting land transportation. In the Master Plan a width of 30 meters has been adopted.

(b) Transit Shed and Sorting Area

63. Transit shed and sorting yard are planned in this terminal area. Transit shed and sorting yard should be used for tentative storage. Required area of storage facilities is calculated by the following formula.

$$Ab = (Mb \times p) / (Rt \times w \times r)$$

where
- Ab : Required area (m^2)
- Mb : Annual cargo volume (ton/year)
- p : Peak ratio
- Rt : Turnover ratio (times/year)
- w : Volume of cargo per unit area (ton/m^2)
- r : Utilization ratio of storage facilities

64. Because there are no statistics on present utilization of transit sheds, the requirement is calculated under the condition in general. The parameters used in calculation are shown in Table II-3-10.

65. The situation of banana cargo is different from other cargo and turnover ratio is assumed as 365 because banana cargo stay within one day before loading. It is assumed that all of banana cargo use the transit shed in future for high efficiency of cargo handling.

66. The container cargo is assumed to be conveyed to open yard immediately.

67. Cargo through transit shed or sorting area is assumed to increase for efficient cargo handling. Required areas of tentative storage facilities is calculated by above formula and parameters are approximately 22000 m^2 as shown in Table II-3-11. This figures are divided into 17482 m^2 and 4566 m^2 for the area of the transit shed and the sorting yard by cargo type.

Table II-3-11 Required Area of Transit Shed and Sorting Area for Case 1A and 1B

Parameter \ Cargo	Banana	Solid Bulk	Other Cargo
Annual Handling Volume (ton)	1,333,000	683,000	763,000
Ratio of Transit Shed	1.0	0.9	0.9
Volume through Transit Shed (ton)	1,333,000	614,000	686,700
Peak Ratio		1.3	
Turnover Ratio	365		50
Volume per Unit Area (ton/m^2)		2.5	
Utilization Ratio		0.7	
Required Area (m^2)	2,713	9,132	10,202

(c) Warehouse and Open Shed

68. Warehouse and open yard are planned in the terminal area. The warehouse and open yard should be used for long term storage. Required area of storage facilities is calculated by the same formula as transit shed. It is assumed that half of cargo through the terminal is storage in the port area and that half of solid bulk cargo is storage in open shed.

69. Banana cargo does not use warehouses. Container cargo is stored in the open yard, the area at which must be 30 m^2 per container slot.

70. The required area is calculated as 8131 m^2 for open shed and 26300 m^2 for warehouse in Table II-3-12 with parameters used in calculation. The area of open shed will be 38100 m^2 adding 30000 m^2 for container cargo.

Table II-3-12 Required Area of Warehouse and Open Shed in Case 1A and 1B

Parameter \ Cargo	Solid Bulk (open shed)	Solid Bulk (warehouse)	Other Cargo (warehouse)
Annual Handling Volume (ton)	341,500	341,500	763,000
Ratio of Storage		0.5	
Volume through Warehouse	170,750	170,750	381,500
Peak Ratio		1.0	
Turnover Ratio		12	
Volume per Unit Area (ton/m^2)		2.5	
Utilization Ratio		0.7	
Required Area (m^2)	8,131	8,131	18,167

(d) Total Area of Multi-Purpose Terminal

71. Based on the requirements of each of the above elements, the multi-purpose terminal is planned as follows. The physical requirement for aprons, transit sheds and sorting areas, warehouses and open sheds is as follows;

Number of Berth ; 9 or 10 (185 m in length)
Apron ; 30 m in width
Transit Shed ; 17,482 m^2
Sorting area ; 4,566 m^2
Warehouse ; 26,300 m^2
Open shed ; 38,100 m^2

5) Bulk Terminal

72. It is assumed that the grain and liquid bulk are handled through this terminal. The total cargo volume is forecasted as 420000 tons in 2010. This volume is less than the planning capacity, 412170 tons per year, of existing facilities.

73. The forecasted cargo volume through the terminal is more than 2 times the present volume. The capacity of the silo is insufficient for even the present cargo volume. The actual turnover ratio is calculated as less than 10 times per year. If the turnover ratio were increased more cargo could be handled through the present silos.

6) Road to Port

74. The number of necessary lanes for roads is calculated based on the cargo volume in future. The road network in the port is determined considering the land use in the port. Here the number of lanes are calculated by each terminal.

75. The traffic volume is calculated by the following formula and the parameters are assumed as follows. Average tonnage per truck is assumed as 8 ton for a general truck and 1 box for container cargo. Daily variation and related vehicle rate are obtained from the APS's survey.

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

N	:	Proposed traffic volume (cars/hour)
V	:	Annual cargo volume
a	:	Share by vehicle(1.0)
W	:	Average tonnage per truck
b	:	Monthly variation(1.0)
c	:	Daily variation(1.66)
d	:	Related vehicle rate(0.45)
e	:	Real load rate(0.5)
f	:	Hourly variation(0.1)

76. The result is 330 cars per hour will pass thrpugh the conntainer terminal, 608 for multi-purpose terminal and 70 for bulk terminal. Total number of cars amounts to 1008 and this figure corresponds to 4 lanes of a road.

7) Basin

77. The depth of the basin and channel in the harbor is obtained according to the formula, $d > 1.1 \times D$ (d : Water depth of water facilities, D : Draft of standard ships).

78. The area of a basin for turning of the bow of ship with tug boats should exceed an area of circle with the radius of 1.5 times the overall length of the ship. The circle with radius of 285 m should be prepared for the biggest length among standard ship dimensions.

8) Requirement in Case 2B

79. The requirements in Case 2B are calculated according to the same methods and steps of Case 1A and 1B. Only the results are shown here.

(a) Number of Berth

80. The requirement of berth in Case 2B is calculated under the condition shown in Table II-3-5 for larger requirement. The result and procedures are shown in Table II-3-13. It is assumed that container cargo handling is attains the high level of efficiency.

81. As a result, the required number of berth in Case 2B is equal to that of Case 1B. This is the reason why the difference of cargo volume between these cases is not very big and why an additional berth is not required.

Table II-3-13 Required Number of Berth in 2010 for Case 2B

Case 2	<Container terminal>		<Multi-Purpose Terminal>			<Bulk Terminal>		
Parameter / cargo	Banana	General	Container	Conventional	Banana	Grain	Liquid	note
Cargo Volume ton(box)/year*	105,000	206,741	912,897	1,616,000	1,332,000	390,000	30,000	-
Cargo Volume /Berthing Time	41	16	82	48	84	110	102	-
Required Berthing Time (hour)	2,585	11,097	10,461	33,999	15,852	3,556	295	77,845
Calculated Number of Berth	0.49	2.42	1.81	5.54	2.59	0.58	0.05	
Required Number of Berth	3 (2.91)			10 (9.94)		1 (0.63)		14

Note: ton; for multi-Purpose Terminal, Bulk Terminal
box; for Container Terminal

(b) Container Terminal

82. The requirements of facilities in a container terminal are summarized as follows.

Number of Berth	; 3 (220 m in length)
Apron	; 40 m x 660 m
Container Yard	; 120,000 m² (220 m x 660 m)
CFS	; 105,000 m²
Attached Area for Other Facilities	; 7,000 m² (70 m x 660 m)
Lane of Gate	; 8 lanes

Table II-3-14 Required Area of Container Yard in Case 2B

Parameter / Cargo	Import	Export	Banana	Empty	Transit	Total
Throughput(TEU)	107,986	77,323	140,000	190,651	2,100	518,061
Dwelling Days	4	3	1.5	10	3	-
Peak Ratio	1.3					-
Operating Days	365					-
Required Number	1,538	826	748	6,790	22	9,925
Stacking Height	3	3	2	3	3	-
Required slots	513	275	374	2,263	7.5	3,443

Table II-3-15 Required Area of CFS for Case 2B

Parameter / Cargo	Import	Export	Total
Annual Handling Volume (ton)	1,057,200	767,903	1,825,103
Ratio of Storage in Port	0.95	0.97	-
Ratio of LCL	0.1	0.4	-
Annual Volume of LCL (ton)	100,434	297,946	398,380
Dwelling Day at CFS	7	5	-
Peak Ratio	1.3		-
Volume of cargo per Unit Area (ton/m²)	1.5		-
Utilization Ratio of CFS	0.5		-
Operating Days per Year	365		-
Required Area of CFS (m²)	3,339	7,074	10,413

(c) Multi-Purpose Terminal

83. Based on the requirements of each of the above elements, the multi-purpose terminal is planned as follows. The physical requirement for aprons, transit sheds and sorting areas, warehouses and open sheds

Number of Berth ; 10 (185 m in length)
Apron ; 30 m in width
Transit Shed ; 19,400 m²
Sorting area ; 5,000 m²
Warehouse ; 29,700 m²
Open shed ; 42,000 m²

Table II-3-16 Required Area of Transit Shed and Sorting Area for Case 2B

Parameter / Cargo	Banana	Solid Bulk	Other Cargo
Annual Handling Volume (ton)	1,332,000	736,000	880,000
Ratio of Transit Shed	1.0	0.9	0.9
Volume through Transit Shed (ton)	1,332,000	662,400	792,000
Peak Ratio	1.3		
Turnover Ratio	365	50	
Volume per Unit Area (ton/m²)	2.5		
Utilization Ratio	0.7		
Required Area (m²)	2,711	9,841	11,767

note: other 33,322 m² for container cargo

Table II-3-17 Required Area of Warehouse and Open Shed in Case 2B

Parameter / Cargo	Solid Bulk (open shed)	Solid Bulk (warehouse)	Other Cargo (warehouse)
Annual Handling Volume (ton)	368,000	368,000	880,000
Ratio of Storage	0.5		
Volume through Warehouse (ton)	184,000	184,000	440,000
Peak Ratio	1.0		
Turnover Ratio	12		
Volume per Unit Area (ton/m^2)	2.5		
Utilization Ratio	0.7		
Required Area (m^2)	8,761	8,761	20,952

(d) Bulk Terminal

84. The cargo volume to be handled in the bulk terminal are not different among four cases therefore the requirement in Case 2B is equal to that in Case 1A and 1B.

(e) Access Road

85. The planning traffic volumes are calculated as 417 cars per hour for a container terminal, 645 for a multi-purpose terminal and 70 for a bulk terminal. Total number of cars amounts to 1,132 which corresponds to 4 lanes.

D. Layout Plan

1) Principle of Functional Layout

86. Land area which APG possesses is approximately 250 ha. A multi-purpose terminal, a container terminal and a bulk terminal have been developed on 97 ha. Most of the remaining area is not used for port activities.

87. A conventional terminal was developed in 1958 and covers approximately 50 ha where the marginal wharf, warehouses and open sheds are located. The main entrance gate, the administration office buildings and maintenance area also located here.

88. A container terminal was developed in 1980 and it is approximately 30 ha. This terminal consists of a container berth with one gantry crane, container yard, container freight station and a warehouse. Next to the berth the waterfront of about 165 m in length is reserved for future expansion of the berth.

89. A bulk terminal was developed at the same time of the Area B development. The area ia approximately 17 ha and 151 m pier is located in front of the area. In the terminal silos, tanks and warehouse as well as loading/unloading system are installed. But the system does not work to its full capacity and the loading equipment designed for sugar export is not used because there is no export cargo.

90. The other area is divided into two areas. One is approximately 80 ha and not fully arranged for utilization. Only the document house and the office of port captain have been constructed. The area near the port captains office will house the new customs office which is currently located near the main gate. Another is approximately 70 ha and almost the entire area is covered by mangrove. The area along the road is used as the parking area for trucks waiting to enter the port.

91. Land use in the Master Plan is prepared under the following principle.

(1) sufficient utilization of the port area
(2) functional separation
(3) high efficiency of cargo handling
(4) rational transportation in port area
(5) environmental consideration
(6) utilization of existing facilities, if possible

92. Based on the present situation and the principle mentioned above, the functional layout is planned among terminal zone, administration zone, port related activity zone and mangrove zone.

2) Zoning Plan

93. Characteristics of each zone are described below and the basic layout on these zones is planned as Figure II-3-3.

(a) Terminal Zone

94. This zone consists of a container terminal, a multi-purpose terminal and a bulk terminal. The location of each terminal is discussed later. The berths are planned at the front of this zone and this zone should face the water area.

95. The location of this zone should be planned especially under consideration on physical and functional continuity of the present port facilities and function.

(b) Administration Facilities Zone

96. From the viewpoint of efficient port management it is required that administaration facilities should be located in close proximity to the port. Smooth communication between APG and other organizations is important for good service to port users.

97. In the sense this zone is planned at the center of the port area.

(c) Port Related Industry and Commercial Zone

98. The land possessed by APG should be utilized for promoting the port activities. The area near the port has high potentiality for various kinds of economic activities. The full use of the area is important for the port of Guayaquil as well as the Ecuadorian economy.

(d) Mangrove zone

99. Some of the mangrove forest will remain in the stage of the Master Plan. Many parts of the waterfront area of the Gulf of Guayaquil are covered by mangrove but this mangrove area is situated near the city area. From the view point of the coexistence of port and nature, especially waterfront eco-system, some of this area will remain as at present.

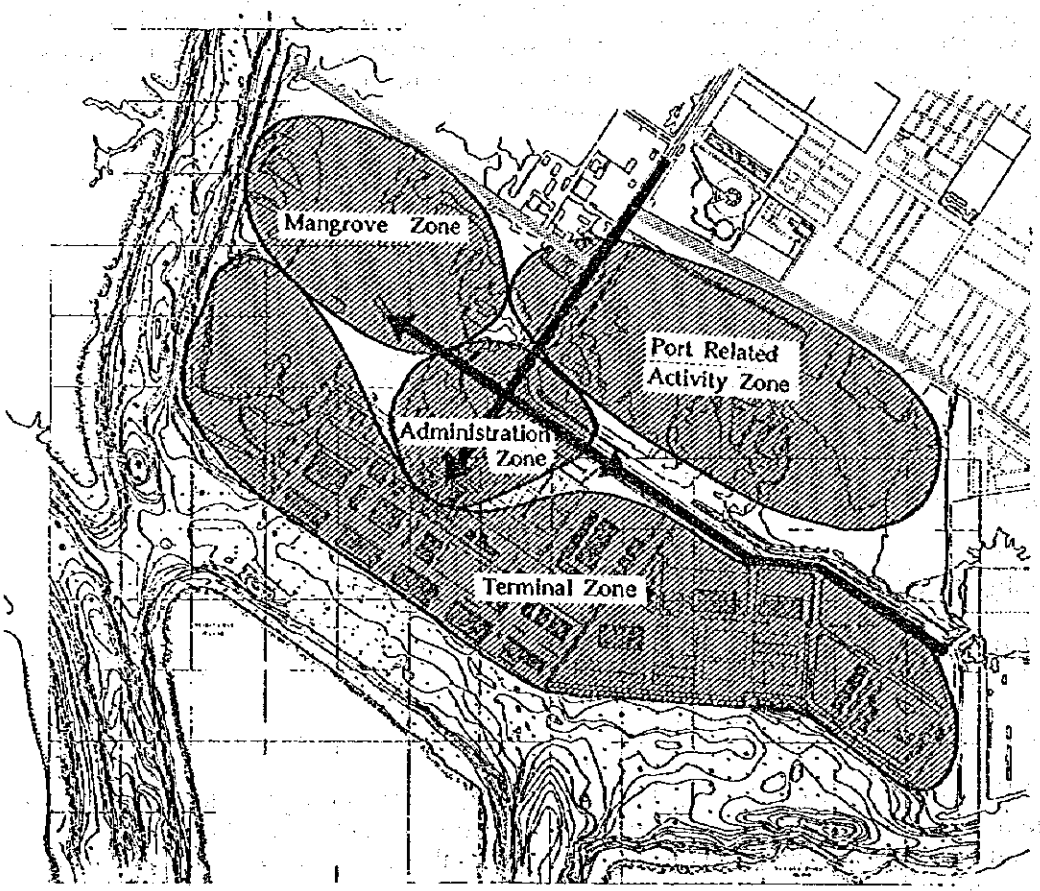


Fig II-3-3 Zoning Plan of Port Area

3) Location of Each Terminal in Terminal Zone

100. The location of each terminal will be determined mainly based on the layout of berth because there is sufficient space area for other facilities.

101. The bulk terminal is planned at present area because existing facilities have enough capacity for future cargo volume.

102. Concerning location of a container terminal and a multi-purpose terminal, two alternative ideas are prepared. In one alternative, a container terminal in the Master Plan is planned at the present container terminal area while the other calls for a container terminal to be constructed in the western expansion area.

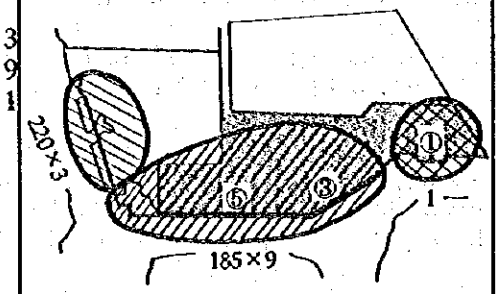
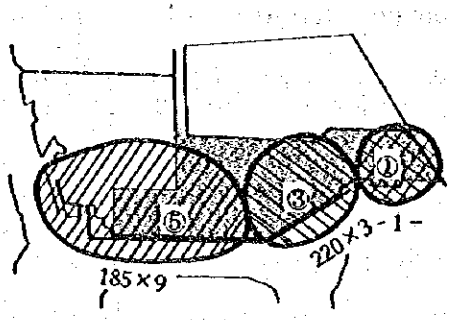
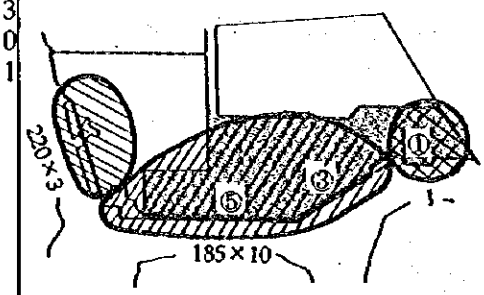
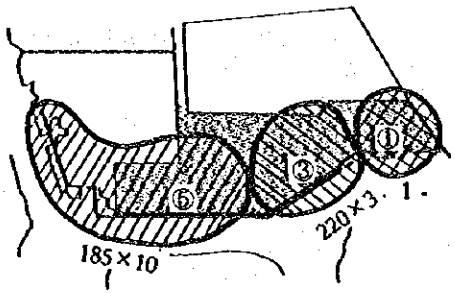
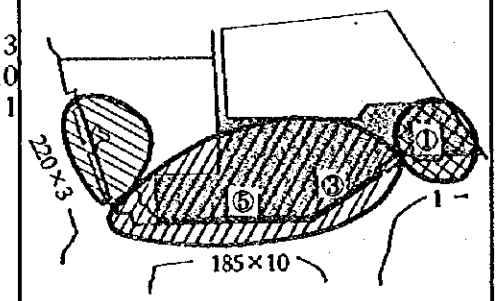
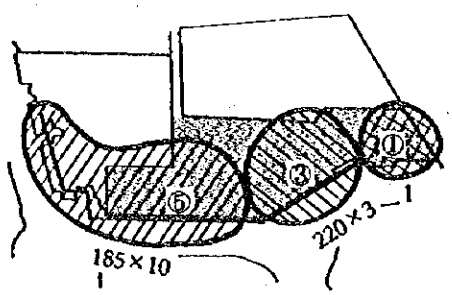
103. The general layout of berths for each alternative, zoning plan 1 and zoning plan 2, in Case 1A, Case 1B and Case 2B is shown in Table II-3-18.

104. Zoning plan 1 and zoning plan 2 are compared from such points of view as functional separation, utilization of existing facilities, continuity of present port, use of reserved area, investment, future expansion for containerization and flexibility according to the progress of modernization. The results are summarized in Table II-3-19.

105. According to Table II-3-18, in Case 1A zoning plan 2 has an advantage and in Case 2B zoning plan 1 has an advantage. In Case 1B, both plans will be examined. The required number of berths is equal in both Case 1B and Case 2B and the zoning plan 2 in Case 1A is only adding one berth to Case 1B along the new berth at western area.

106. As a result the layout plans are prepared for zoning plan 2 in Case 1A and zonig plan 1 in Case 1B.

Table II-3-18 Berth Layout

	Zoning Plan 1	Zoning Plan 2
Container Terminal	at western expansion area	at present container terminal
Multi-purpose terminal	at present port area	at present terminal and western expansion area
Case 1A Container 3 Multi-p. 9 Bulk 1		
Case 1B Container 3 Multi-p. 10 Bulk 1		
Case 2B Container 3 Multi-p. 10 Bulk 1		

Note:

——— : existing berth
⑥ : number of existing berths
185×10 : length of berth x number of berth in 2010

Container terminal
Multipurpose terminal
Bulk terminal

Table II-3-19 Comparison of Zoning Plan

Items	Zoning Plan 1	Zoning Plan 2
functional separation	O	
utilization of existing facilities		O
continuity of present port		O
use of reserved area	O	
size of investment		O
future expansion for containerization	O	
flexibility for progress of modernization		O

note: O advantage

4) Layout of Main Port Facilities

107. The model layouts of container terminals for three types of handling systems are shown in Figure II-3-4. In the Master Plan, the straddle carrier system is adopted as described in Chapter 7. One gantry crane will be installed at each berth and these cranes will be used in a body in the terminal.

108. The berths newly constructed in existing port areas are located at areas next to Berth No 1B and next to Berth No 6. The pier head line of each berth should coincide with the existing berth.

109. The basic concept of the area behind the berth in multi-purpose terminal is shown in Figure II-3-6. APG has a plan to demolished existing transit sheds to gain neccessary space along the apron. Figure II-3-6 corresponds to APG's plan.

110. For container handling at existing berths for conventional ships, setting the pier headline of the multi-purpose terminal 20 m from the existing berth was examined. As the cost of this plan was estimated at more than 70 billion sucre, this idea was abandoned at the beginning of the study.

111. Pontoon for service boats is planned to be situated at the corner of the western expansion area in zoning plan 1. In zoning plan 2 it will be planned near existing area.

112. The water area in front of western expansion area is used by other ships to enter facilities at inner area of Estero Salado at present. Water depth greater than 10 m is found approximately 120 m offshore and is equal to the design width of access channel. The pier head line of new berths at the western expansion area is planned along the line which is 120 m behind the area deeper than 10 m. Turning basin for ships using berths at a westen expansion area is planed as in Figure II-3-6.

113. The roads in the existing terminal are to remain as at present except the road behind the open area in the multi-purpose terminal. The road will be widened in the Master Plan because it will be a main road in the terminal.

114. New access road to the western expansion area will be planned to prevent the congestion at the entrance of the port.

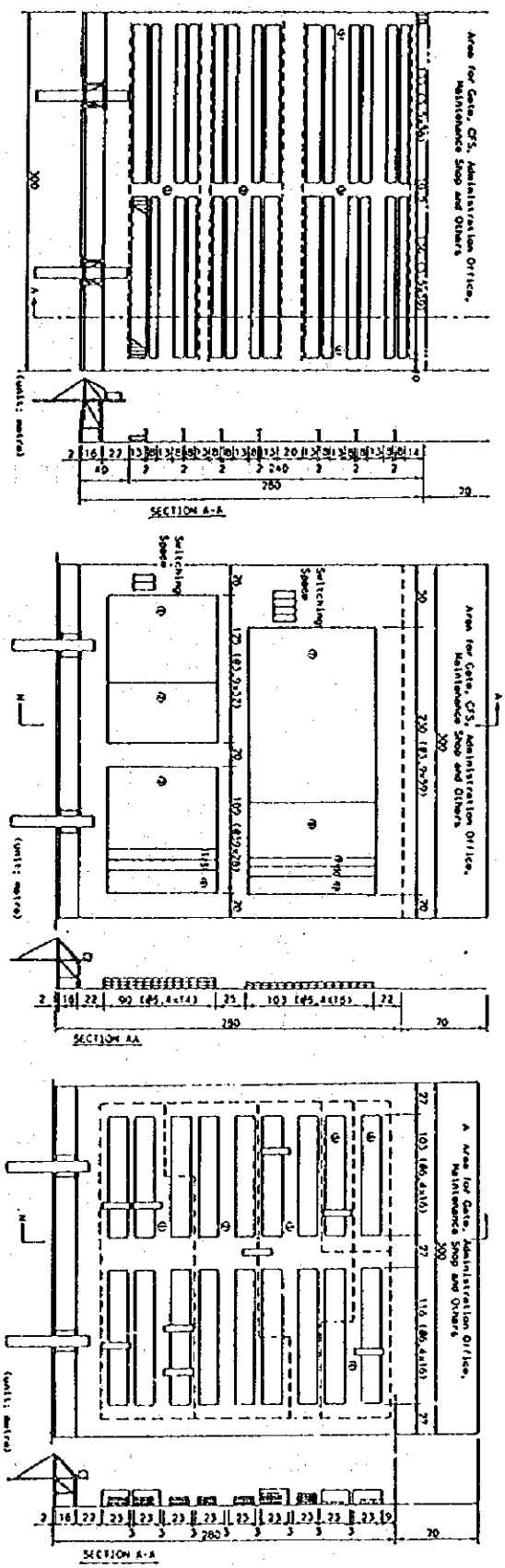
115. The parking areas are prepared near the entrances of each terminal for the trucks waiting to enter the port area. The location and area is decided considering the location of each road and entrance.

116. The existing facilities will be used as much as possible at the stage of the Master Plan. The scale of main existing facilities are as follows. The figures show that there is no necessity for construction of new facilities.

multi-purpose terminal area
- transit sheds ; 25,000 m^2 (5000 m^2 x 2)
- sorting yard ; not exactly appointed
- warehouse ; 27,500 m^2
- open sheds ; 70,000 m^2

container terminal
- container yard ; 63,000 m^2
- refrigerating container yard ; 6000 m^2
- CFS ; 15,252 m^2 (7626 m^2x 2)
- warehouse ; 7,200 m^2
- open space ; more than 30000 m^2

117. Under the above described, two layout plans for Case 1A, and for Case 1B are prepared as in Figure II-3-7 and II-3-8.



Source; Japan Port and harbor Association

Figure II-3-4 Model Layout of Container Terminal

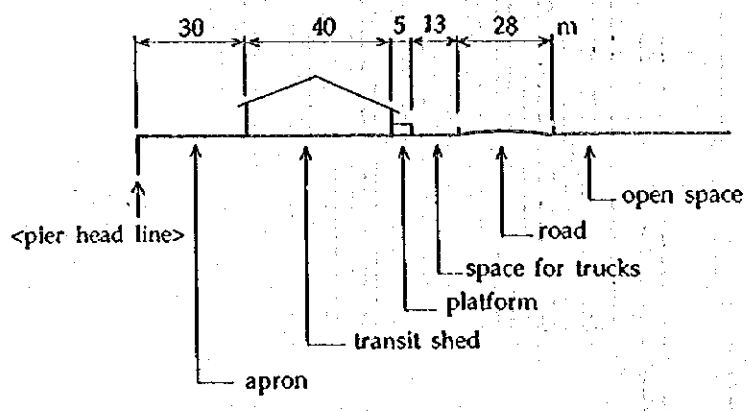


Figure II-3-5 The Basic Pattern behind Berths in Multi-purpose Terminal

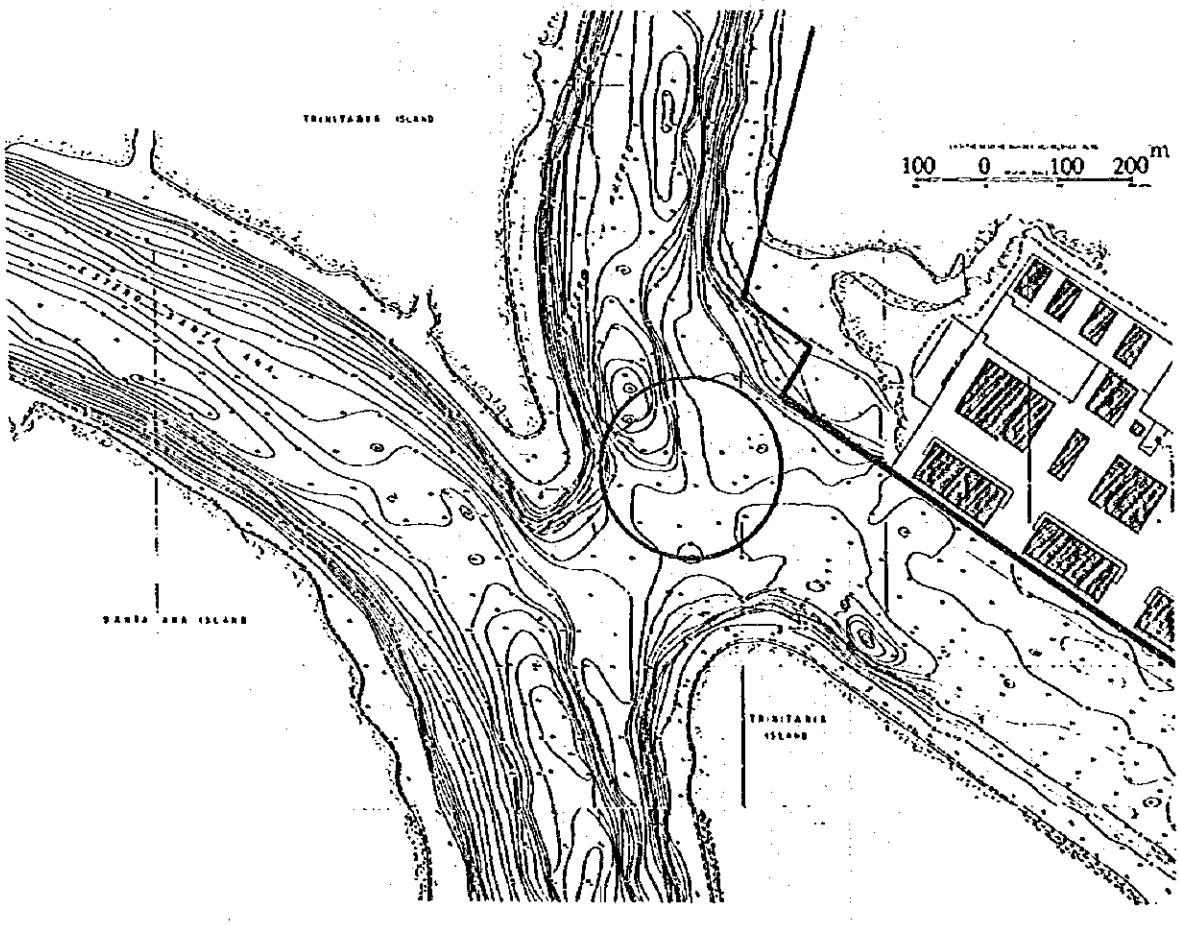
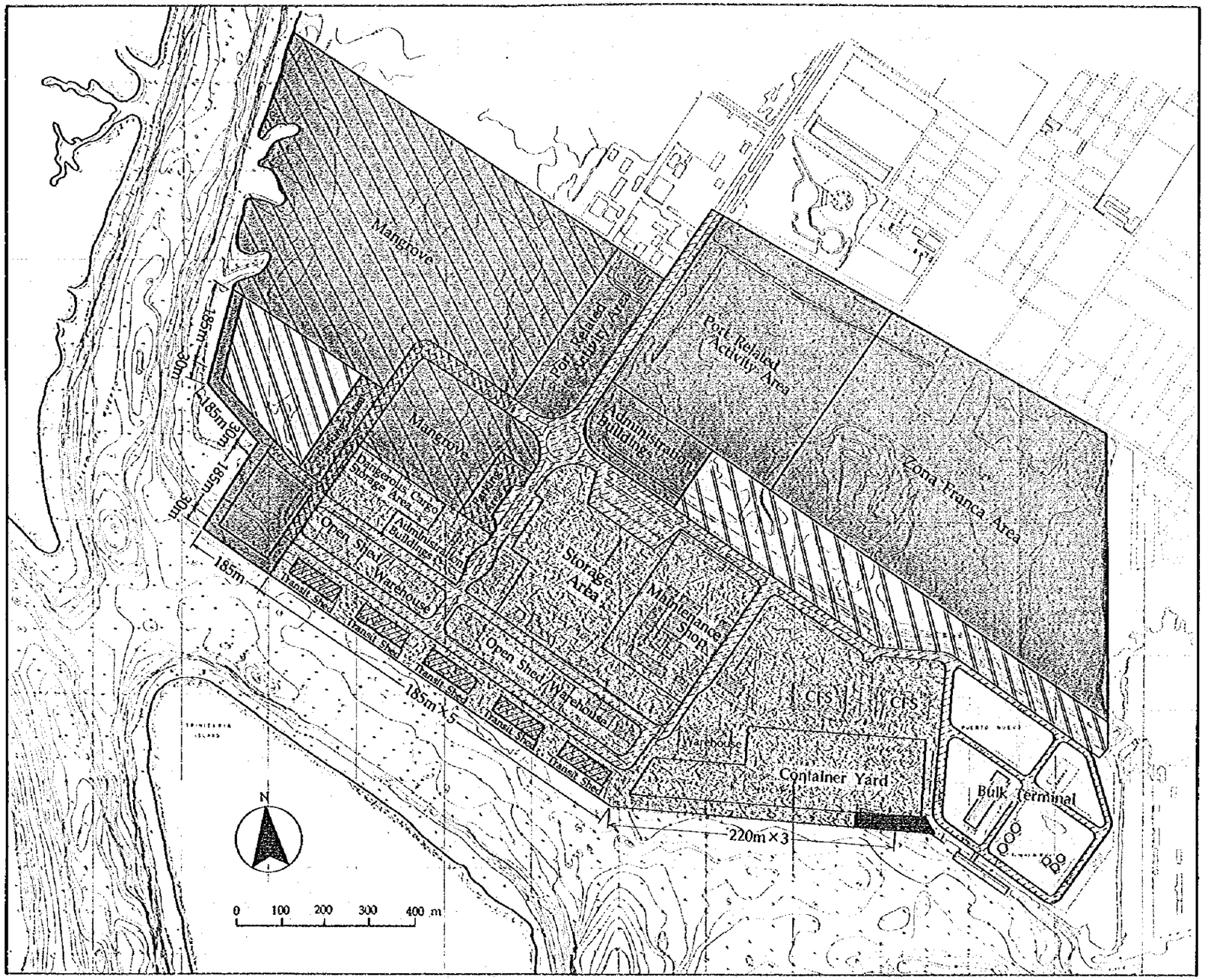


Figure II-3-6 Turning Basin for Ships out of a Western Expansion Area



Container Terminal
Multi-Purpose Terminal
Bulk Terminal
Road and parking Area
Port Related Activity Area
Mangrove Area
Reserved Area
New Development
Rehabilitated Facilities
Remained Facilities/Area

Figure II-3-7 Layout Plan for Case 1A

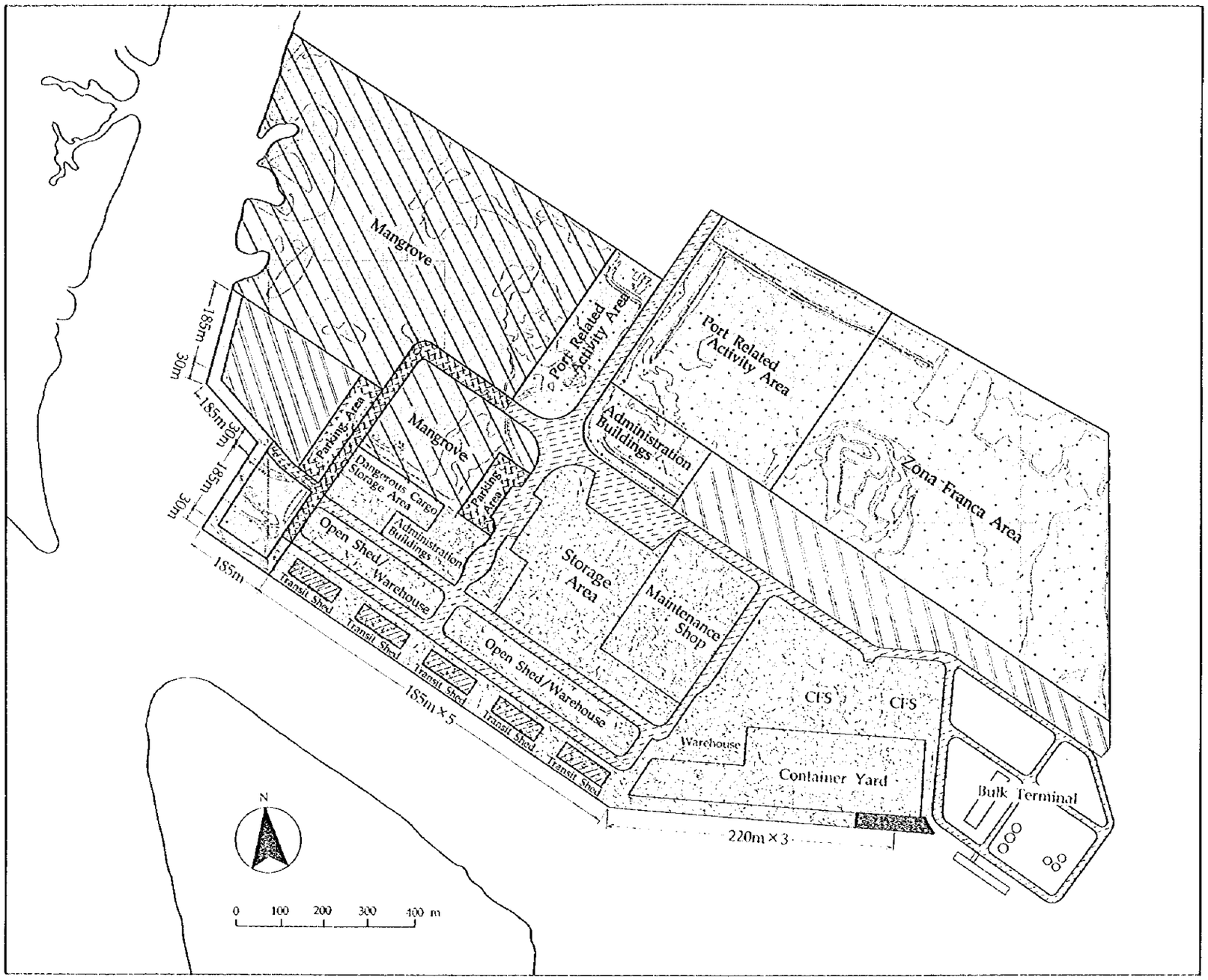
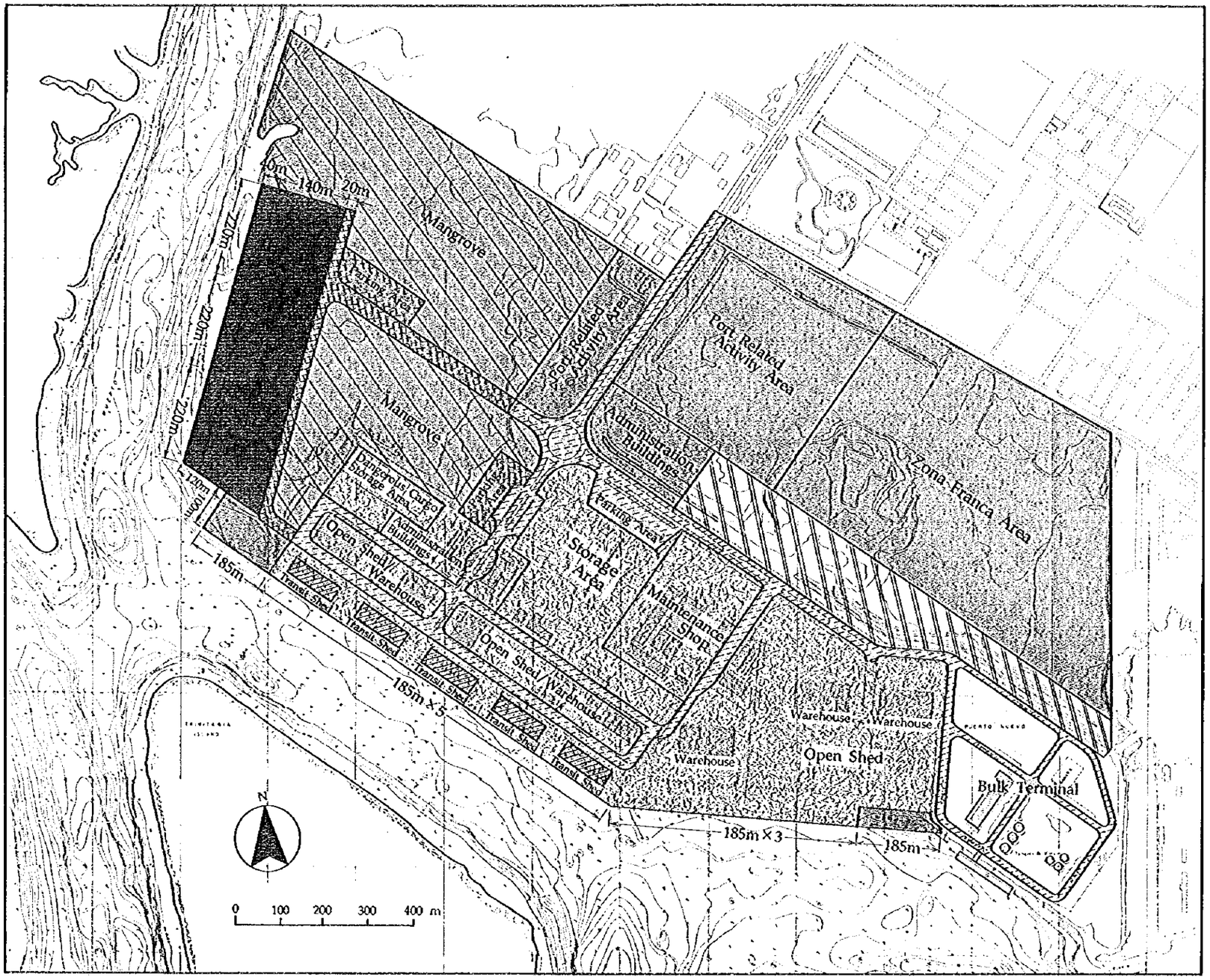
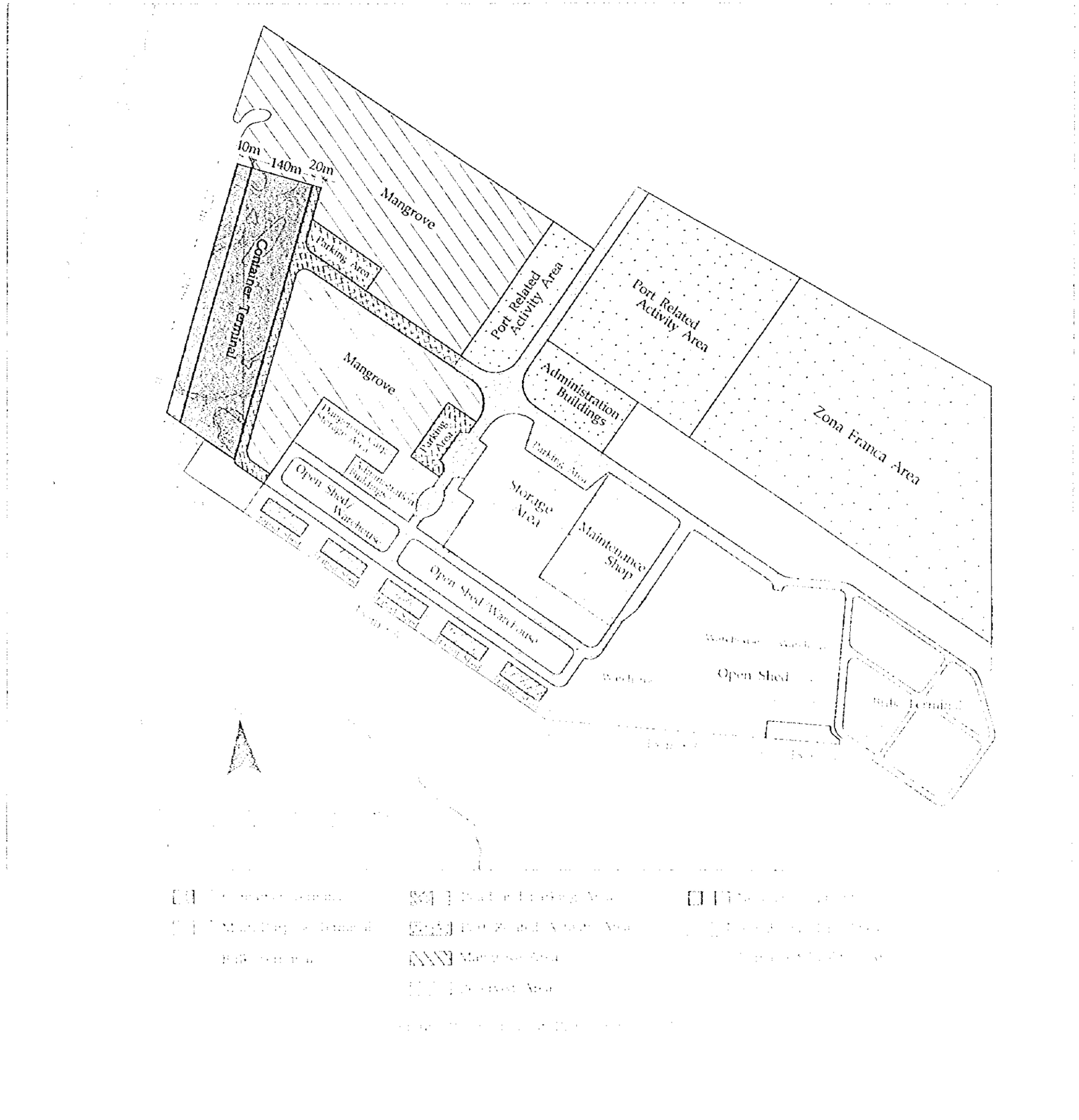


Figure II-3-7 Layout Plan for Case 1A



Container Terminal
Multi-Purpose Terminal
Bulk Terminal
Road and parking Area
Port Related Activity Area
Mangrove Area
Reserved Area
New Development
Rehabilitated Facilities
Remained Facilities/Area

Figure II-3-8 Layout Plan for Case 1B


10m
140m
20m
Mangrove
Container Terminal
Parking Area
Port Related Activity Area
Port Related Activity Area
Administration Buildings
Zona Franca Area
Mangrove
Parking Area
Parking Area
Storage Area
Maintenance Shop
Open Shed/ Warehouse
Open Shed/ Warehouse
Open Shed

E. Port Related Industry and Commercial Activities

118. The area near the port has the potentiality to attract many types of business. Fortunately APG has a large amount of space in the port area. These business activities will vitalize the port activities as well as the regional economy. Therefore in the Master Plan the 80 ha area to the left side of the road to the port and the belt area along the road on the right are allocated for port related activities.

119. Zona Franca is one of the most attractive types of land use in this area and 40 % of the area is allocated for this purpose in the Master Plan.

120. As mentioned in Part I Chapter 2 there are two Zona Francas in Ecuador at present in the area of Esmeraldas and Riobanba. Since Zona Franca Law and its Regulations were issued in 1991, many territorial districts have shown an interest in realizing Zona Franca projects.

121. According to the survey which was carried out by the JICA study team in 1991 at the request of the Government of Ecuador (CENDES), 33 companies of Guayas province and 2 companies of Pichincha province showed an interest in investing in Zona Franca in Guayasu province. Moreover it is likely that foreign investors will also want to invest in this Zona Faranca.

122. The main functions of Zona Franca are to process the goods imported from abroad for posterior re-export mainly through the port. Therefore, it is favorable and beneficial to set up a Zona Franca near the port. The above JICA team has made not only technical and financial feasibility studies on the establishment of the Zona Franca of Esmeraldas, but also a preliminary study on the possibility of establishing other Zonas Francas near the other commercial ports of Ecuador, that is, the ports of Guayaquil, Manta and Bolivar. Comparison among these four commercial ports is shown in Table 2-3-20. According to the Table, the port of Guayaquil has available land, labor force, public services and existing industries. Moreover there exists strong interest in establishing a Zone Franca in Guayaquil port area. Major problem of the port is, however, an unfavorable customs clearance system.

123. The possible industrial types to be located in Zona Franca of the port of Guayaquil, according to the above JICA survey, are apparel, food processing, chemical, metal, electric device, transportation machinery and others. In keeping with the labor-intensive nature of the Zona Franca, main industries will be those of apparel textile and food processing. Actually, most of the Maquila industries, whose functions are similar to industrial Zona Franca, under operation in Guayaquil are these type.

124. The Zona Franca is located in the port related activities zone and a 40-ha area is prepared in the Master Plan.

125. Almost all import and re-export of the goods which will be processed in this Zona Franca will take place via the port of Guayaquil due to its advantageous location. Therefore, if a Zona Franca will be set up in the Guayaquil port area, the volume of cargo through the port of Guayaquil will further increase. It is also likely that domestic raw materials will be used in processing goods of the industrial Zona Franca, which will serve the regional development of the country.

126. There are some container van-pools and warehouses in which cargo through the port is stored near the port. It is desirable that those facilities are located next to the port from the viewpoint of both of efficient port activities and ordered land use of the city area. In the Master Plan the land for these port related activities is prepared for the private sector at this zone.

Table II-3-20 Ports and Port Based EPZ

		Esmeraldas Port - EPZ	Guayaquil Port - EPZ	Manta Port - EPZ	Bolivar Port - EPZ
Available land:	Area	22 ha.	approx. 50~70 ha	approx. 20~30 ha	approx. 25 ha
	Location	Within the port boundary	Within the port boundary	approx. 11 km from Port (Inland type EPZ)	Within the port boundary
Port facilities:	Access to port	Excellent	Excellent	Far from Port	Excellent
	Shipping chance	Fair, but much to be improved	Excellent	Poor	Poor
	Ship size accommodation	Good (Max. 25,000 DWT)	Good (Max. 20,000 DWT)	Small (Max. 15,000 DWT) insufficient for large container	Small (Max. 14,000 DWT) insufficient for large container
	Berthing priority	Excellent	Fair	Fair	Poor
	Container handling	Good (Minimum requirement)	Excellent	Poor (No container facility)	Poor (No container facility)
	Reef container	Unavailable	Available	Unavailable	Unavailable
	Custom clearance	Fair	Poor	Fair	Fair
Labor force:	Urban center	Esmeraldas city (pop. 98,000)	Guayaquil city (pop. 1.5 million)	Manta city (away from EPZ)	Machala city (away from EPZ)
	Unemployment rate	High	High	Fairly high	High
	Skilled labor	Not easily available	Available	Not easily available	Not easily available
Public services:	Inland transportation	Fair	Excellent	Fair	Poor
	Communications	Poor (at present)	Fair	Poor	Poor
	Power supply	Excellent	Excellent	Fair	Fair
	Water supply	Poor (at present)	Fair	Poor	Poor
Existing industry:	Availability in urban center	Limited	Abundant	Limited	Limited
	Availability of raw materials	Limited	Abundant	Limited	limited
Possible industrial categories to be located in EPZ:		Apparel Food processing Wood/furnitures Plastic/cosmetic Metal Others	Apparel Food processing Chemical Metal Electric device Transportation machinery Others	Apparel Food processing Others	Apparel Food processing Others
Interest of local enterprises in locating industries in EPZ:		Fair	Strong	Fair	Slight

Source; JICA's Final Report (Annex) of the Study on the Esmeraldas Export Processing Zone Development Project, December 1991.

Chapter 4 ROUCH STRUCTURAL DESIGN OF MAJOR FACILITIES

A. General

1. In the Long Term Port Development Plan by 2010, the necessary for the port facilities and the layout plan are proposed in Chapter 4, and the major port facilities are summarized as follows:

Table II-4-1 Main Facilities in Long Term Plan

Facility	Design Depth	Case 1A	Case 1B	Location
New Container Berth	-11.00 m	-	660 m	New Port Area; north-western part of the Port
Multi-Purpose Berth	-10.50 m	185m × 4B	185 m	Next to existing general cargo berth - No. 6
Extension of Container-Berth	-10.50 m	185 m	185 m	Next to existing container berth - No. 1B
Landing Stage for Small Boats	-	45 m	45 m	-

B. Design Conditions

1) Datum Level

2. The datum level for the design and construction work should be the same level as that in Chart, which is approximately equal to the lowest low water. Several levels are adopted as the datum in the countries.

Pacific coast in the USA : M.L.L.W.
Atlantic coast in the USA : M.L.W.
Japan : M.L.W.S. (Approx.)

3. In the Chart of the port of Guayaquil (Chart No. 22113 and 22114), the tidal information is described as below, and the mean low water springs is adopted as the datum of soundings.

Table II-4-2 Tidal Information in Chart

No. of Chart	Height above datum soundings			
	Mean High Water		Mean Low Water	
	Springs	Neaps	Springs	Neaps
22113	4.30	3.90	0.00	0.60
22114	4.30	4.02	0.00	0.38

Note: Chart datum is Mean Low Water Springs
No. 22113 Approaches to the Estero Salado and Puerto Maritimo de Guayaquil
No. 22114 Rio Guayas

4. Tide level in the Port of Guayaquil is mentioned in Chapter 4, Part I. The difference between both levels is calculated based on the tide table which is published by the Division of Hydrographic and Dredging of APG in 1994, and the difference is 0.24 meters at Guayaquil. And the difference between the mean sea level and the mean low water springs is 2.02 meters.

5. As a result, M.L.W. Spring should be datum of this project.

2) Dimension of Vessels

6. The maximum dimensions of vessels for the new berth is determined in the previous chapter of the Master plan.

Table II-4-3 Dimensions of Vessels

Vessel Type	DWT	Length	Breadth	Draft
Container Ship	19,000	180 m	26 m	9.5 m
Conventional Type Ship	17,000	155 m	22 m	9.5 m
Bulk Carrier	20,000	160 m	23 m	9.5 m

3) Crown Height and Water Depth

7. The Crown Height of a large vessels is generally the values above the M.H.W. in Japan are as follows:

The Crown Height (Tide is more than 3.0 m): 0.5-1.5 m
(Tide is less than 3.0 m): 1.0-2.0 m

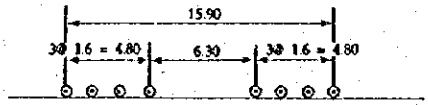
8. In the Port of Guayaquil, the crown height of the existing berths is fixed as 5.7 m above the M.L.W. S. (1.80 m above M.H.H.W.), and this is a suitable height for the new berth.

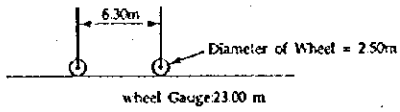
9. The water depth for design, that is design depth, should be appropriate no less than the full load of the draft of the coming vessels plus some allowance. The draft of the vessels depends on the dead weight ton (D/W) of the vessels, and the allowance varies with such natural conditions as seabed, wave, seabed materials and etc., in front of the berth. Taking allowance as 1.0 m, the design depth is fixed as 11.0m for new container berth and 10.5m for conventional berth.

4) Surcharge on Apron

10. The surcharge on the apron of the existing container berth is mentioned in Chapter 7, Part 1. Comparing the values with that in Japan, surcharge on the new container berth is fixed as mentioned in Table II-4-4.

Table II-4-4 Surcharge on Apron

<table>
<tr><td>Items</td><td>Container Berth</td></tr>
<tr><td>1) Live Load</td><td>Within the Crane : 1 t/m²
Out of the Crane : 3 t/m²</td></tr>
<tr><td>2) Automobile</td><td>AASHTO, H3-20
(20 Ton)</td></tr>
<tr><td>3) Container Crane</td><td>1) Wheel Anagement
 

Wheel gauge: 15.25 m
Rail gauge: 15.15 m
2) Wheel Load (t/wheel)
<table>
<tr><td></td><td colspan="2">Water Side</td><td colspan="2">Land Side</td></tr>
<tr><td></td><td>Vertical</td><td>Lateral</td><td>Vertical</td><td>Lateral</td></tr>
<tr><td>In service</td><td>39</td><td>3</td><td>35</td><td>2.5</td></tr>
<tr><td>Out of Service</td><td>28</td><td>3.5</td><td>46</td><td>3.5</td></tr>
<tr><td>In Case of Earthquake</td><td>47</td><td>3.5</td><td>49</td><td>3.5</td></tr>
</table></td></tr>
<tr><td>4) Straddle Carrier</td><td> 

The Wheel load is unknowns</td></tr>
<tr><td>5) Berthing Impact</td><td>Vessels: 15,000 DW
Velocity: 0.15 m/sec(normal)</td></tr>
<tr><td>6) Mooring Thrust and/or Pull</td><td>50 tons per berth</td></tr>
<tr><td>7) Extra percentage of Allowable Stress in case of Earthquake</td><td>Dead Load + Lateral Forces 30% up
D.L. + 1/2 Live Load + L.F. 50% up
D.L. + (D.L + L.L) of Crane + L.F. 50% up</td></tr>
</table>

11. On the other hands, the surcharge on the apron is fixed as 3.0 tons per one square meter only, because the container crane will not be installed on the Multi-Purpose Berth.

5) Soil Conditions

12. The ten boring were carried out in the project area of the Port of Guayaquil (Refer to Chapter 4, Part I), and 7 borings were done in the neighborhood of new terminals as shown in Figure II-4-1; that is Boring No. 2, 3, and 4 on the new container terminal, Boring No. 5 and 6 on the multi-purpose berth and No. 8 on the extension of Container berth.

13. From the boring results, the borinig-log as well as N-values corresponding to each terminals are shown in Figure II-4-2 in which the last column is the derived soil index which are adopted in the design.

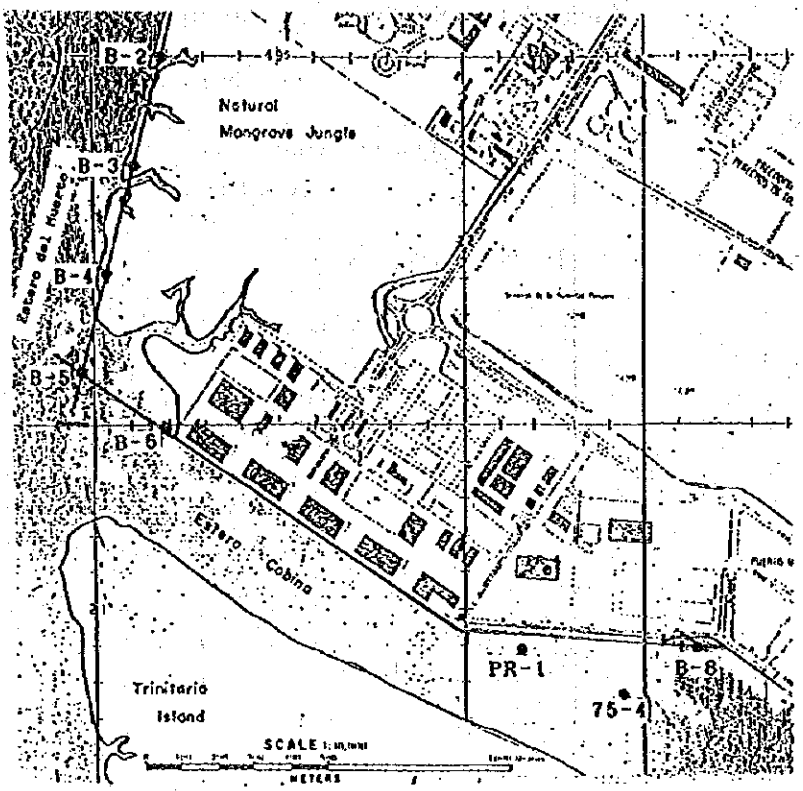


Figure II-4-1 Location of Borings

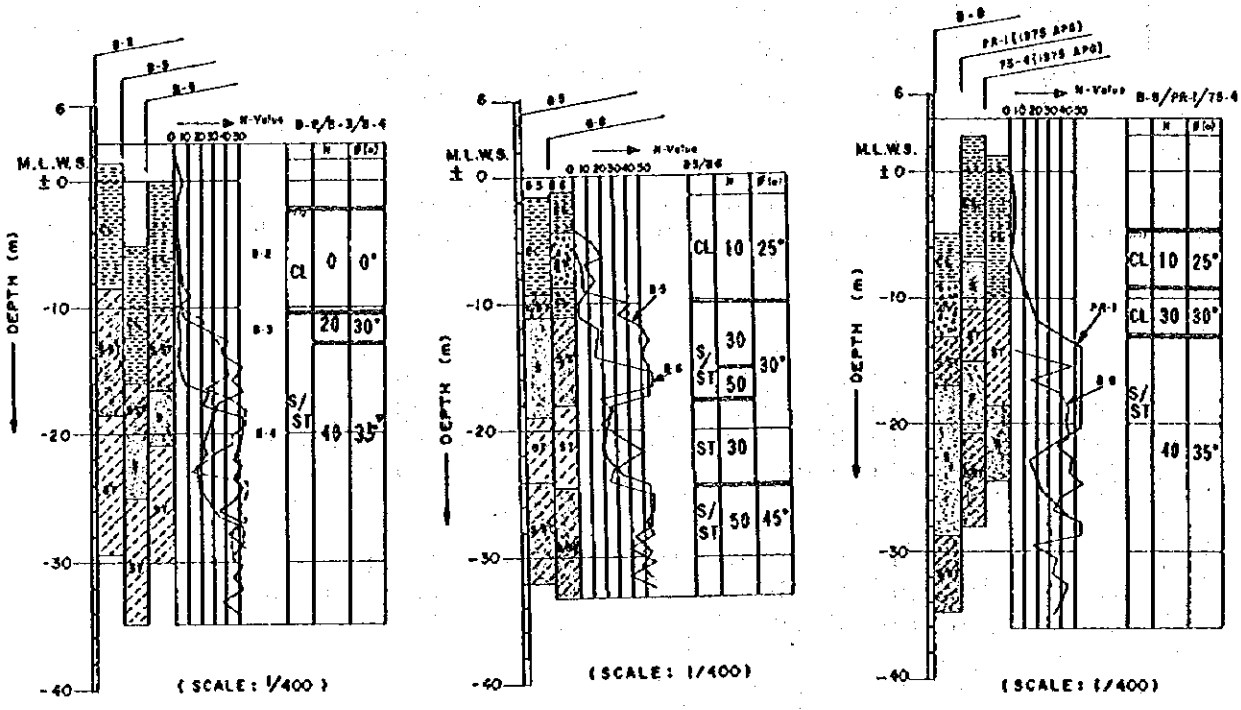


Figure II-4-2 Soil Index for Design

6) Allowable Stress

14. As the design is carried out roughly, allowable stress is not necessary in the Master Plan Phase.

7) Seismic Force

15. The design seismic coefficient (the ratio of lateral force against vertical force in the case of earthquake), should be determined with the following formula with consideration given to the classification of region where structure is located, that of the soil condition and the degree of importance of the structure.

$$Kh = K \times Cs \times Ci$$

where Kh = Design seismic coefficient
K = Regional seismic coefficient
Cs = Factor for subsoil condition
Ci = Coefficient of importanc

16. According to the analysis in Chapter 4, Part I "Natural Conditions", K, Cs and Ci should be 0.15, 1.0 and 1.0, respectively, and Kh should be 0.15 as an appropriate value for the Project.

8) Safety factor

17. The safety factor of the structure is empirically determined based on the investigation tests, importance and design formulas. In this project, the values of safety factor are decided according to the Japanese manual for Technical Design of port and Harbor Facilities, as shown below:

Table II-4-5 Safety Factor

	Items	Normal Conditions	Special Conditions
Gravity Type	Sliding	1.2	1.1
	Overturn	1.2	1.1
	Bearing	2.5	-
Pile Capacity	Compressive	-	-
	Stress	2.5	2.5
	Pulling Stress	3.0	2.5
Sheet Pile	Sandy soil	1.5	1.2
	Cohesive soil	1.2	1.2

C. Structural Type of Berth

18. The structural type of the berth are typically mentioned as below:

- Gravity Type — Concrete caisson type; Cellular cofferdam type; Concrete block type
- Sheet pile type — Steel sheet type
- Open deck type — Open deck on concrete piles type; Open deck on steel piles type

19. The merits and demerits of each type are briefed as below:

- Concrete caisson type
(1) A large fabricating facility and a caisson yard are required.
(2) As the seabed is very soft at the project area, the seabed is in danger of subsidence.
(3) The same back-fill often causes the circle failure.
(4) Cession type is not popular in Ecuador.

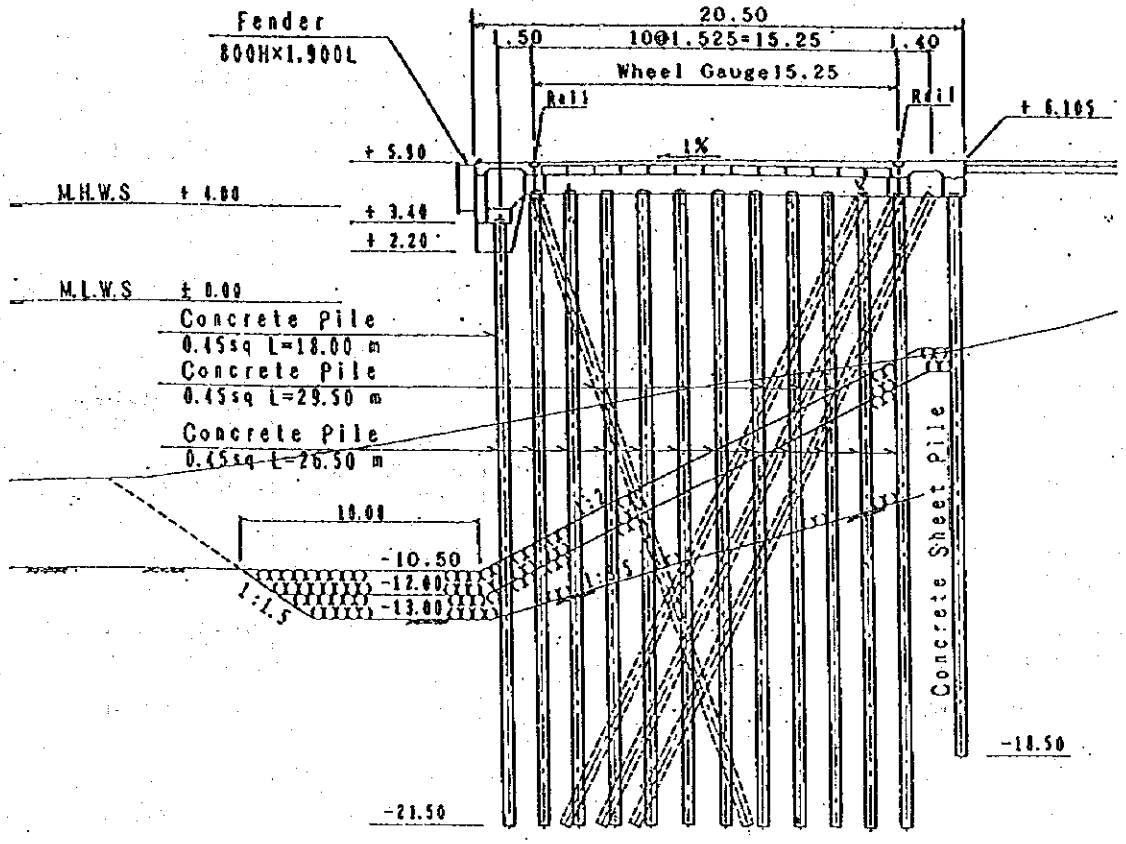
- The cellar type as cell as concrete type have almost the same demerits as mentioned above, and the gravity types are excluded from the comparative.

20. - Sheet pile type
(1) The implementation of construction is simple and easy.
(2) The construction period is shorter than that of the others.
(3) Steel sheet piles are imported from aboard.
(4) As back-fill often causes circle failure, some measures are needed.
(5) There are no berths of this type in Ecuador at present.

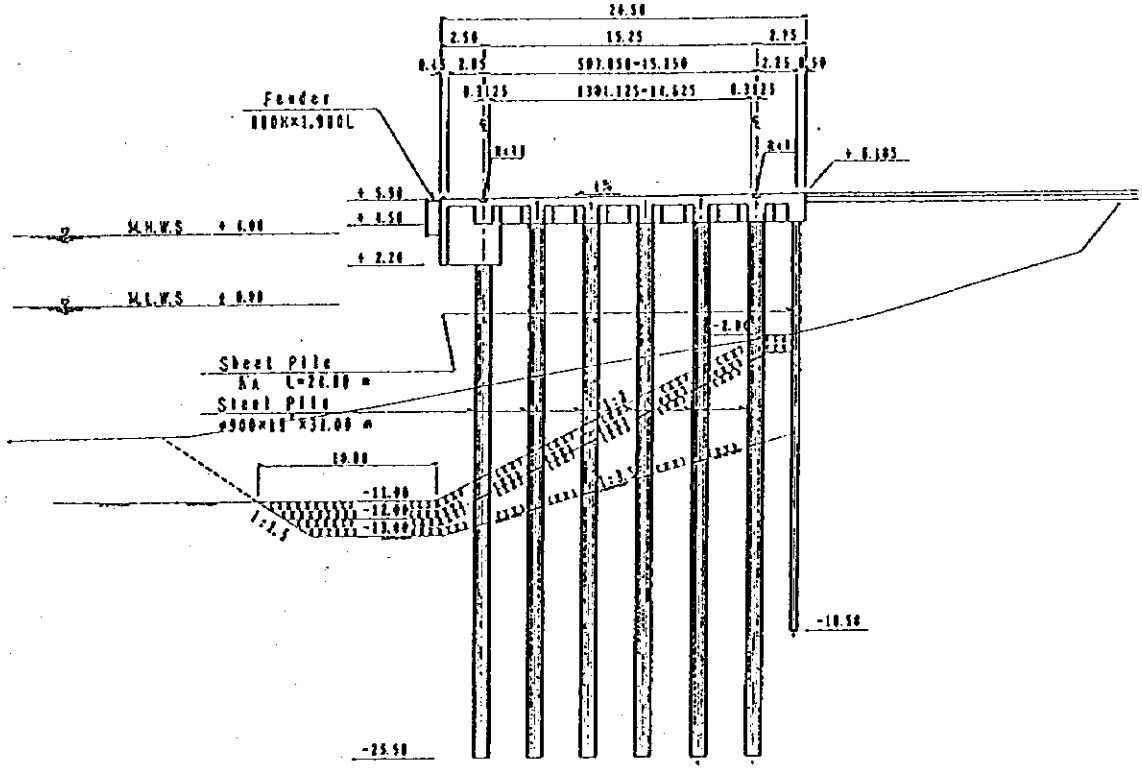
21. - Open-deck on piles
(1) The implement of construction is complex compared with that of the sheet pile type.
(2) A revetment is required at the end of the deck to embark the back-fill materials.
(3) Long period is needed to complete.
(4) The open-deck on concrete piles is popular in Ecuador, for example, the existing berths in the Port of Guayaquil were constructed using concrete piles. In Japan, steel piles are often used instead of concrete piles.

22. Comparing each type mentioned above, the most important item to be considered is the necessity of the measures of circle failure, and the popularity of the type. In view of these points, the open-deck on the concrete piles or steel piles are recommended as the alternatives in the project.

23. Figure II-4-3 shows the typical cross sections of the open-deck on concrete piles and steel piles, respectively, and Table II-4-6 shows a comparison of concrete piles and steel piles about several items such as difficulty of work, construction period and cost, and the popularity, etc.



(a) Concrete Piles



(b) Steel Piles

(Scale = 1:400 Unit = Meter)

Figure II-4-3 Typical Cross Section of Open-Deck Type

Table II-4-6 Comparison of Concrete Piles and Steel Piles

Item	Degree of Weight	Concrete Piles	Steel Piles
Flexibility to Earthquakes	1	Less than the other	Flexible
Corrosion of Piles	1	No corrosion	Protection required
Difficulty of Work	2	Difficult	Simple
Major Equip. required	1	Almost the same	Almost the same
Construction Yard	2	Large area required for piles	Standard
Construction Period	1	Longer than the other	Standard
Difference of Construction Cost	4	-	10-20% higher than the other
Popularity in APG	3	Many precedents	Unprecedented
Procurement of Piles	1	Available in Guayaquil	Imported

24. As the result of comparing, the open-deck on concrete piles is recommendable to the structure type of berth of this project.

Chapter 5 CONSTRUCTION WORK AND ROUGH COST ESTIMATE

A. Conditions for Implementation of Construction Work

1. The following conditions should be considered for the implementation of the construction works.

1) Workable Days

2. The weather patterns are divided into the dry season (June-November) and rainy season (December-May), and usually there are about 14 rainy days per month during the rainy season. Although El Nino can at times cause heavy rainfall of over 100 mm per day thus adversely affecting construction work both on land and off shore, the average precipitation is only 1,130 mm with a monthly average of 180 mm during the rainy season as shown below. The return period of the large-scale El Nino in 1983 is assumed to be at least 100 years while for the small-scale El Nino it is about 5 or 6 years. Therefore, the weather condition does not greatly affect the construction work.

Table II-5-1 Average Rainfall at Guayaquil

(1915 – 1989)

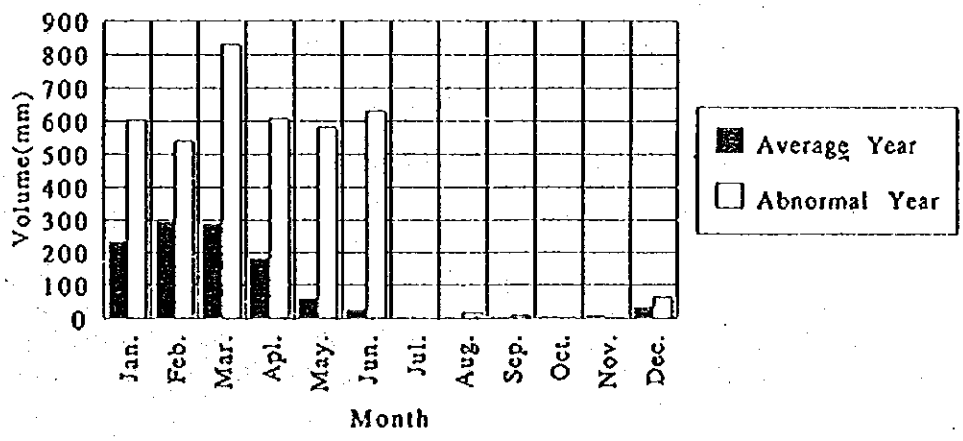
Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Share (%)	20.5	26.0	25.5	16.0	5.2	2.3	0.2	02	0.2	0.3	0.6	3.0	100
Volume(mm)	232	294	288	181	59	26	2	2	2	3	7	34	1,130

Table II-5-2 Abnormal Rainfall at Guayaquil

(1983)

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Share (%)	15.4	13.8	21.2	15.5	14.8	16.1	0.0	0.5	0.2	0.0	0.0	1.6	100
Volume(mm)	602	539	830	606	580	630	0	18	9	1	1	63	3,879

Rainfall at Guayaquil



3. The average monthly wind velocity is 2.2 to 3.8 m/sec with the prevailing wind directions being E-NE between January and April, and S-SW between May and December. The maximum wind velocity recorded was only 7 m/sec in September 1988.

Table II-5-3 Maximum Wind Velocity at Guayaquil (1988)

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Max. (m/sec)	5.0	6.0	4.0	4.0	4.0	5.0	5.0	5.0	7.0	6.0	6.0	3.0
WindDirection	NE	S	E	NE	SW	SW	SW	SW	SW	SW	SW	NE

* Predominant Wind Direction;
E-NE (January-April)
S-SW (May-December)
* Average Monthly Wind Velocity
2.2-3.8 m/sec

4. The Guayaquil Port is located at the deepest point of the estuary, Estero Salado, which is some 90 km long having calm water conditions. As such, it is expected that the construction work will not be interrupted by waves.

5. Generally, the weather and marine conditions at the Port are favorable, and construction work can be performed continuously throughout the year. According to the information given by local contractors, non-workable days caused by heavy winds and rainfall are approximately negligible.

6. In Ecuador, the fiscal year corresponds with the calendar year with holidays and weekends being listed as follows:

Saturdays & Sundays	96
National Holidays	13
Total	109

So, the net workable days per year are assumed to be 256 days or 21 days per month.

2) Working Space

7. The required working space which will be necessary as working space for the implementation of construction work is given below.

- Yard space for construction work activities
- Yard space for storage of construction materials
- Parking area for construction machines
- Berthing facilities for working vessels

8. There is an area owned by APG adjoining to the port, and it can be made available for working space. Existing berths can be used for unloading and loading of construction equipment and materials. Small craft berths next to general cargo terminal having sufficient water depth can be facilitated as idling berth for working vessels.

3) Spoil Disposal

9. For a project having the following types of conditions, various ways of spoil disposal have been contemplated. (Reference: Estudios Hidrograficos, Oceanograficos y Geologicos para resolver los problemas de sedimentacion en el Canal de Acceso al Puerto Maritimo de Guayaquil y en el area de la Esclusa (Rio Guayas-Estero Cobina), 1986, INOCAR.)

(a) The envisaged work is typical channel improvement work.

(b) The work is characterized as typical "area dredging": large movements in the direction XY with a relatively small amount in the Z direction.

(c) The materials to be dredged are predominantly non-cohesive sands of the finer fractions with admixtures of silts and mud.

(d) The areas of the work form part of a waterway frequently used by seagoing vessels.

10. Alternatives for the spoil disposal proposed in the preceding report are as follows:

- Compartment: spoil is discharged into confined areas enclosed by banks through pipelines and pipeline terminals.

- Open discharge: spoil is discharged either through pipelines and/or bottom dumps into selected places in the estuary. Possible selected places are secondary channels and deep pools. With pipeline discharge or jetting arrangement, shoals could also be a potential dump site. A variation of this method is the discharge of spoil parallel to and at a short distance from the channel axis and at the downstream side thereof. The resulting more or less continuous ridge would act as a flow guide and to concentrate the flow in the channel. In clayey deposits, ridge formation will hardly take place, so spoil will be dispersed and flow under gravity.

- Agitation: to spoil water mixture emerging from the dredge pump(s) is either directly discharged into the flowing water masses via a floating discharge line and terminal with diffuser, or via a jetstream. The object is to bring the bottom materials outside of the dredging-site, thereby being assisted by dispersion through the currents.

- Via the overflow system of a hopper dredger. Added advantage of this is that the coarser fractions of the dredged material are retained in the hopper, while the finer fractions in the overflow are more apt to be dispersed. In this regard, it can be noted however that while the discharge takes place in the immediate vicinity of the dredging site, turbulence created by the dredger's propellers assists in the dispersion process.

11. When dredging work is planned, environmental aspects as well as economic view points should be considered. Generally, the spoil disposal is recommended as follows based on the field conditions.

- Dredging works will be done within the sheltered waters of the Estero Salado or Estero Cobina.

- According to the characteristics of the waterbed materials, dredging work should predominantly deal with soft clay deposits having a high water content.

- The Gulf of Guayaquil is entirely open to the Pacific Ocean and its eastuarine system actually consists of two estuaries. But the Canal del Morro, the entrance of the channel, is narrow with only 3 km width. Although the intrusion of salt water and the tidal motion from the sea are observed, there is no constant discharge of fresh water. So, water change seems to be relatively small.

- Therefore, although discharged spoil into the estuary is dispersed, it is not settled easily. This might affect the shrimp ponds located along the Estero Salado. Spoil disposal into the open sea is not economically feasible due to the long transportation that would be involved.

- As a result, the compartment method is the preferable one. But, most land areas along the Estero Salado are used for mangroves and shrimp ponds, so there are supposedly no suitable space for the compartment.

- On the other hand, APG owns a plain tract of some 150 hectors behind the port area which can be made acceptable for about 2 million cubic meters of dredged materials. These materials, consisting of mainly silts and clay, will be consolidated naturally and will be available for the future usage.

- Besides, there is some land with low elevation along the Estero Cobina, and it can also be used as an alternative for spoil disposal.

B. Conditions of Cost Estimate

12. Construction costs for the project have been estimated on the basis of the preliminary design. Unit prices for each work item were established considering local conditions, available construction equipment and materials and the suitability of the construction method. Assumptions and conditions applied for the cost estimate are set as follows:

1) Exchange Rate

13. Price level : Price as of August 1994
Exchange rates : 1 US$ = 2,240 Sucres
1 US$ = 100 Japanese Yen

2) Taxes

14. For imported construction materials and construction equipment mobilized from the foreign countries, import taxes are excluded from the cost estimate.

3) Labor Force for the Construction Work

15. Skilled craftsmen and laborers required for the construction works are available any time in Ecuador; however foreign personnel may be required for special skills such as seamen for the working vessels. The hourly labor rates for various classifications of works are shown in Table II-5-4.

4) Construction Materials

16. In general, riverbed materials in the Guayas River and the ESTERO SALADO Canal are characterized mostly as silty sand or silt. But, some sites in the Guayas River have sand layers, and this sand is used for fine aggregates in the construction work. Though sand materials can be produced from rock quarries as a by-product, river sand is available in large volume. Some companies dredge the sand from the riverbed by using the suction pump (D=14") and a barge of 200-240 m^3 capacity. They stock the sand along the river, and supply it to the contractors in Guayaquil.

17. There are several rock quarries in the suburbs of Guayaquil. The biggest one is located 14 km northwest from Guayaquil Port, and is connected to the Port area by a 6-lane road called "PERIMETRAL". The quarry produces many kinds of aggregates acceptable to the ASTM's standards. Usually, the quarry produces aggregate under 50 mm diameter, but large stones are also available on order.

18. Usually, portland cement used in Ecuador is supplied domestically depending on the fluctuation of the demand. The total amount of the cement production in 1992 was some 2,000,000 tons that was produced from four cement factories. The biggest cement factory which makes up 70% of the total is located in Guayaquil 20 km northwest from the Port. Ready-mixed concrete is also obtainable from a plant near the Port.

19. As for the concrete products, items such as piles, slabs, beams, etc. are produced by order at the local plants. Prestressed concrete products are also available and they are used mainly in port construction, bridges and building foundations.

20. There are two steel manufacturing companies in Ecuador. One is in Quito and the another in Guayaquil. The company in Guayaquil, named ANDEC-FUNASA, is located on the coastal area along the ESTERO COBINA which is 4 km away from the Guayaquil Port. The company imports the ingots from Venezuela and Turkey, and manufactures the steel bars amounting to 1,300,000 tons per year and are supplied mainly for use on the public works in Ecuador. 75% of all the ingots used there are imported and the remaining 25% are produced by using a furnace owned by the company. The main products of the company are round and corrugated steel bars. So, large scale iron products, such as steel pipe pile, steel sheet piles and bollard etc., depend on the import if necessary. The unit prices for the main construction materials are shown in Table 6-11.

21. Riverbed materials of the upper layers in ESTERO COBINA, ESTERO DEL MUERTO and ESTERO SALADO are silt or silty sand consisting of fine particles, and are thus not suitable for the reclamation. It is said that the dredged materials were used for the reclamation when the container terminal was constructed; however, this is not clear due to no records that show how much volume of dredged materials was totally used for the reclamation and how much the effective rate of the reclaimed volume to the dredged volume was. Here, the effective rate is defined as:

$$\frac{\text{Appropriate soil volume for reclamation}}{\text{Total dredged volume}}$$

22. When the usage of the dredged materials is planned, the sandy portion that is separated from silt could be used as the reclaimed materials so as to have the required bearing capacity. As such, the silty portion should be washed away at the site in order to get the sandy portion.

23. Assuming the effective rate to be 50%, the dredged materials of some 400,000 m3 might be needed for the planned reclamation volume of 200,000 m^3. Thus, the unit price of reclamation is 7,000 S/. per cubic meters according to the Figure II-5-1 below. (See Figure II-5-1). On the other hand, earth cutting materials are to cost 6,600 S/. per cubic meter (including transportation cost). So, the earth cutting materials appear to be cheaper than the dredged materials in this case.

24. Furthermore, it should be noted that the reclamation method should be planned considering the environmental aspects as well as the construction cost.

5) Construction Equipment

25. The standard type and size of construction equipment has been used for construction work on the land and is usually available in Ecuador. But, the working vessels are limited to a few types such as, pontoons, tug boats and surveyor boats. Thus, working vessels such as dredgers, pusher barges and pontoons equipped with cranes should be brought in from the overseas areas if necessary. The hourly/daily rental rates for the main construction equipment are shown in Table II-5-6.

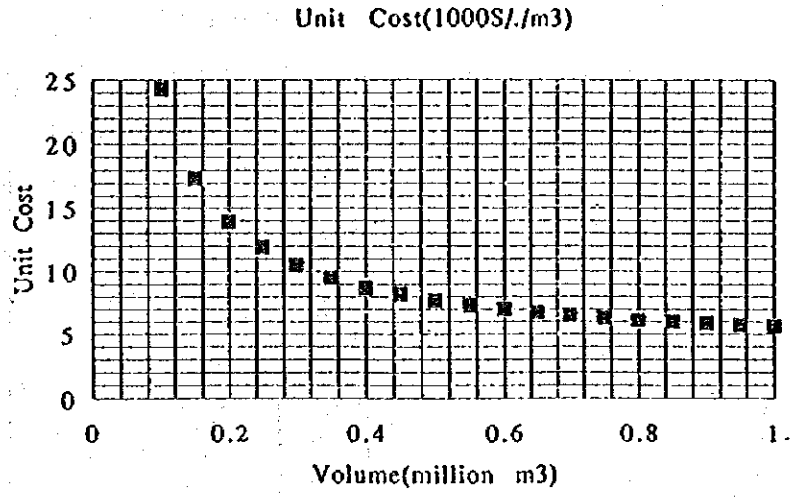


Figure II-5-1 Unit Cost of Dredging

Table II-5-4 Daily/Hourly Labor Rates

Classification	Unit	Foreign Currency (US$)	Local Currency (S/.)
Foreman, foreign*	day	234	
Technician, foreign*	day	156	
Foreman	day		17,291
Mechanic	day		25,742
Electrician	day		19,047
Operator, heavy	day		20,181
Operator, light	day		19,047
Assistant operator	day		17,949
Seaman, officer*	day		46,000
Seaman, crew*	day		23,000
Diver*	hour	51	
Assistant for diver	day		18,095
Driver, dump truck	day		19,120
Driver, ordinary	day		18,534
Steeplejack	day		19,047
Carpenter	day		19,047
Form worker	day		19,047
Concrete worker	day		19,047
Reinforcing worker	day		19,047
Brick layer	day		19,047
Mason	day		19,047
Plumber	day		19,047
Painter	day		19,047
Welder	day		25,742
Plasterer	day		19,047
Skilled worker	day		20,181
Semi-skilled worker	day		18,534
Common labor	day		17,291

As of July 1994
* Estimated
Source: Autoridad Portuaria de Guayaquil (APG).

Table II-5-5 Construction Material Prices

(Unit: Sucres)

Material	Unit	Cost		
		Foreign	Local	Total
Gasoline	liter			700
Diesel oil	liter			430
Heavy oil	liter			790
Lubricanting oil	liter			1,050
Grease	kg			8,800
Electricity	kwh			80
Asphalt, RC-2	ton			186,000
Asphalt, AP-3	ton			186,000
Emulsion, K170	ton			186,000
Plant mixed asphalt concrete	ton			91,26-0
Stone & aggregate:				
Fine sand	m^3			18,080
Coarse sand	m^3			21,080
Fine gravel	m^3			24,580
Coarse gravel	m^3			18,080
Stone chippings (3/4"-7")	m^3			20,000-26,675
Rubble (D=30 cm)	m^3			41,400
Rubble (D=50 cm)	m^3			41,400
Rubble (D=0-100 cm)	m^3			32,400
Portland cement	ton			175,400
Ready-mixed concrete:				
Max. aggregate 25 mm (100 kg/cm^2)	m^3			108,430
Max. aggregate 12 mm				
(140 kg/cm^2)	m^3			129,970
(180 kg/cm^2)	m^3			135,140
(210 kg/cm^2)	m^3			145,480
(240 kg/cm^2)	m^3			149,110
(280 kg/cm^2)	m^3			158,790
(300 kg/cm^2)	m^3			164,950
(320 kg/cm^2)	m^3			167,480
(350 kg/cm^2)	m^3			173,200
Concrete products:				
Concrete blocks				
(10x20x40 cm)	piece			250
(20x15x40 cm)	piece			450
(20x20x40 cm)	piece			500
Brick	piece			100
Rough-face brick	piece			40
Reinforced concrete pile (0.35mx0.35m, l=24m)	m			83,300
Reinforced concrete pile (0.46mx0.46m, l=27m)	m			224,400

Material	Unit	Cost		
		Foreign	Local	Total
Prestressed concrete pile (0.45mx0.45 m)	m			221,700
Prestressed concrete pile	m^3			1,005,200
Prestressed concrete beam	m^3			1,276,800
Prestressed concrete slab	m^3			1,080,700
Iron & steel:				
Reinforcement, smooth	ton	580,675	446,678	828,800
Reinforcement, deformed	ton	589,210	453,264	840,000
Angle steel (100x100x6mm 6m)	each			77,100
Angle steel (150x150x6mm, 6m)	each			118,100
Angle steel (250x250x6mm, 6m)	each			200,000
H-shaped steel (100x50x4mm, 6m)	each			51,069
H-shaped steel (100x50x5mm, 6m)	each			62,640
H-shaped steel (200x60x6mm, 6m)	each			117,200
Steel plate (1.22mx2.44mx3mm)	each			77,110
Steel plate (1.22mx2.44mx4mm)	each			112,820
Metal form (100x1500)	each	34,653	2,419	37,072
Metal form (200x1500)	each	50,042	3,494	53,536
Metal form (300x1500)	each	50,042	3,494	53,536
Scaffolding pipe	m	5,757	405	6,160
Wood products:				
Timber, squqre	m^3	59,114	274,109	333,222
Timber, plank	m^3	52,550	249,626	302,176
Timber, log	m^3	52,550	249,626	302,176
Plywood	m^3	394,128	512,378	906,506

Sources: (1) Camara de La Construccion de Guayaquil
Boletin Estadistico, Julio 1994.
(2) Quotations from the local material suppliers.

Table II-5-6 Hourly/Daily Rates for Construction Equipment

(Unit: Sucres)

Item of Equipment		Unit	Rental Rate	Owner
EARTH/ROCK MOVING				
Bulldozer:	9 ton	hour	54,000	
	15 ton	hour	67,000	
	21 ton	hour	107,500	
	32 ton	hour	171,000	
Backhoe:	0.2 m^3	hour	32,000	
	06 m^3	hour	63,000	
Tractor shovel:	1.2 m^3	hour	43,000	
	2.2 m^3	hour	80,000	
Tractor:	110 HP	hour	75,000	
	140 HP	hour	90,000	
	145 HP	hour	90,000	
	155 HP	hour	95,000	
	200 HP	hour	115,000	
	220 HP	hour	130,000	
	300 HP	hour	150,000	
	320 HP	hour	170,000	
Payloader:	125 HP	hour	60,000	
	130 HP	hour	85,000	
	170 HP	hour	85,000	
Motorscraper:	225 HP, 10 m^3	hour	130,000	
	300 HP, 14 m^3	hour	170,000	
Excavator:	131 HP	hour	100,000	
	185 HP	hour	110,000	
GRADING/COMPACTING				
Motorgrader:	120 HP	hour	95,000	
	150 HP	hour	100,000	
Tire roller:	130 HP	hour	70,000	
Vibro-roller:	1 ton	hour	60,000	
Tandem roller:	210 HP	hour	62,000	
Macadam roller:	10 - 12 ton	hour	70,000	
HAULING				
Dump truck:	8 ton	hour	26,000	
	11 ton	hour	36,400	
Platform truck:	6 ton	hour	21,100-30,600	
Tractor-trailer:	12 ton	hour	104,000	
LIFTING				
Mobil crane:	20 ton	hour	100,000	
	40 ton	hour	140,000	
Truck crane:	30 ton		128,200	
PAVING				
Asphalt distributor:		hour	73,000	
Asphalt finisher:		hour	80,000	
CONCRETE				
Concrete plant:	0.75 x 2	hour	235,000	
Transit mixer	3 m^3	hour	67,000	
Concrete pump:	45 m^3/hr	hour	102,500	
Air compressor:	27 m^3/min.	hour	34,000	
Concrete bucket:	1 m3	day	46,000	
Concrete vibrator:	60 mmø	day	14,000	

Item of Equipment		Unit	Rental Rate	Owner
WORKING VESSELS				
Suction dredger:	3000 HP	hour	800,000	Foreign
Tugboat:	210 HP, 15 GT	hour	88,000	
Pusher:	1700 HP, 150 GT	hour	600,000	Foreign
Surveyor boat:	15 GT	hour	60,000	
Pilot boat:	170 HP, 15 GT	hour	60,000	
OTHERS				
Water pump:	4"	hour	4,500	
Winch:	200 kw	hour	4,500	
Diesel generator:	200 kVA	day	155,000	
Diesel generator:	300 kVA	day	231,000	

Sources: (1) Camara de La Construccion de Guayaquil
Boletin Estadistico, Julio 1994.
(2) Quotations from the local material suppliers.

C. Construction Cost for the Master Plan

26. The main port facilities are planned for the Master Plan in 2010 with the estimated construction cost being based on this.

27. The following items should be noted for the Project cost.

(a) The structural types of the wharves are given in the previous chapter, with two alternatives being proposed. The comparison of these alternatives shows that the construction cost of the open-type wharf with concrete piles is cheaper than the cost of the open-type with steel pipe piles. This is largely due to the difference of the costs between concrete piles and steel pipe piles.

The open-type wharves with concrete piles are used to prepare the cost estimate.

Table II-5-7 Comparison of Construction costs for Wharves A, B & C

(Unit: Thousand Sucres)

Wharf	Steel Pipe Piles	Concrete Piles
A	92,850	86,364
B	78,920	66,663
C	101,943	84,805

Note: Above costs show only direct costs.

(b) The percentages of the ratios of the utilities for various facilities, engineering fee and the physical contingency are shown below.

Table II-5-8 Utility Ratios for facilities

Facilities	Utilities
Wharf/Dolphin	4%
Dredging/Reclamation	0%
Container Yard	6%
Yard/Road	4%
CFS/Warehouse	8%

Note: The term utilities includes electricity, water supply, sewage, etc.

- Engineering Fee
  - Civil Works 5%
  - Cargo Handling Equipment 3%

- Physical Contingency

Wharves/Training Walls/Dolphins and Building	8%
Dredging/Reclamation/Revetment/ Yard and Open Space/Roads/ Pavement	4%
Cargo Handling Equipment	0%

(c) The cost of land acquisition is excluded from the cost estimate.

28. As a result, the various construction costs for the Master Plan are tabulated in Table II-5-9, 10. The construction costs for the Master Plan are estimated at around 200,214,781 thousands Sucres in Case 1-A and 240,631,296 thousand Sucres in Case-2B respectively.

Case-1A

(Unit: 1000 Sucres)

Civil Works	122,773,761
Utilities	4,596,774
Cargo Handling Equipment	55,431,452
Engineering Fee/Physical Contingency	17,412,594
Total	200,214,781

Case-1B

(Unit: 1000 Sucres)

Civil Works	156,825,464
Utilities	6,988,221
Cargo Handling Equipment	55,431,452
Engineering Fee/Physical Contingency	21,386,159
Total	240,631,296

Table II-5-9 Project Cost of the Master Plan (Case-1A)

(Unit: Thousand Sucres)

Facilities	Unit	Q'ty	Unit Cost	Total
Container Terminal:				22,589,643
Wharf	m	185	119,625	22,130,625
Reclamation	m3	14,430	6.61	95,382
Pavement	m2	3,700	47	173,900
Dredging	m3	29,600	6.41	189,736
Multi-Purpose Terminal:				99,235,118
Water Basin	m3	654,000	6.72	4,394,880
Reclamation	m3	480,275	6.61	3,174,618
Wharf	m	830	107,629	89,332,070
Parking Lot	m2	14,000	47	658,000
Pavement	m2	25,900	47	1,217,300
Road	m2	9,750	47	458,250
Service Boats Area:				291,200
Pontoon	No.	1	291,200	291,200
Administrative Zone:				658,000
Parking Lot	m2	14,000	47	658,000
Sub-Total				122,773,961
Utilities	L.S.	1	4,596,774	4,596,774
Cargo Handling Equipment:				55,431,452
Gantry Crane	Nos.	2	19,857,600	39,715,200
Straddle Carrier	Nos.	4	2,074,016	8,296,064
Toplifter(42ton)	No.	1	1,702,400	1,702,400
Toplifter(18ton)	No.	1	772,800	772,800
Tractor Head	Nos.	10	315,074	3,150,740
Chassis	Nos.	20	45,452	909,040
Folklift(7.5ton)	Nos.	2	202,548	405,096
Folklift(4.0ton)	Nos.	4	120,028	480,112
Sub-Total				60,028,226
Total Cost				182,802,187
Engineering Service	L.S.	1	8,031,480	8,031,480
Physical Contingency	L.S.	1	9,381,114	9,381,114
Grand Total				200,214,781

Table II-5-10 Project Cost of the Master Plan (Case-1B)

(Unit: Thousand Sucres)

Facilities	Unit	Q'ty	Unit Cost	Total
Multi-Purpose Terminal:				22,589,643
Wharf	m	185	119,625	22,130,625
Reclamation	m3	14,430	6.61	95,382
Pavement	m2	3,700	47	173,900
Dredging	m3	29,600	6.41	189,736
Multi-Purpose Terminal:				36,290,335
Wharf	m	185	83,937	15,528,345
Revetment	m	100	19,909	1,990,900
Reclamation	m3	189,810	6.61	1,254,644
Pavement	m2	18,043	47	848,021
Road	m2	2,775	47	130,425
Transit Shed	m2	20,000	794	15,880,000
New Container Terminal:				94,607,206
Water Basin	m3	663,600	6.72	4,459,392
Reclamation	m3	395,400	6.61	2,613,594
Wharf	m	660	107,629	71,035,140
Container Yard	m2	84,900	94	7,980,600
CFS	m2	7,500	883	6,622,500
Parking Lot	m2	14,000	47	658,000
Pavement	m2	24,900	47	1,170,300
Road	m2	1,440	47	67,680
Service Boats Area:				2,680,280
Pontoon	No.	1	291,200	291,200
Revetment	m	120	19,909	2,389,080
Administrative Zone:				658,000
Parking Lot	m2	14,000	47	658,000
Sub-Total				156,825,464
Utilities	L.S.	1	6,988,221	6,988,221
Cargo Handling Equipment:				55,431,452
Gantry Crane	Nos.	2	19,857,600	39,715,200
Straddle Carrier	Nos.	4	2,074,016	8,296,064
Toplifter(42ton)	No.	1	1,702,400	1,702,400
Toplifter(18ton)	No.	1	772,800	772,800
Tractor Head	Nos.	10	315,074	3,150,740
Chassis	Nos.	20	45,452	909,040
Folklift(7.5ton)	Nos.	2	202,548	405,096
Folklift(4.0ton)	Nos.	4	120,028	480,112
Sub-Total				62,419,673
Total Cost				219,245,137
Engineering Service	L.S.	1	9,853,628	9,853,628
Physical Contingency	L.S.	1	11,532,531	11,532,531
Grand Total				240,631,296

Chapter 6 PORT MANAGEMENT

A. Principles of Management

1. Proper port planning and efficient management and operation are fundamental requirements in executing port projects. The functional layout and design of facilities must be based on excellent port planning to successfully realize port projects. Under an inappropriate management and operation system, the full benefits of modernized port facilities cannot be enjoyed. In this sense, there is an interdependent relationship between management and operation and facility design and installation.

2. There is no definitive management and operation system that has been adopted in ports all over the world. The structure of the port management body at each port is slightly different depending on historical, socio-economic and institutional factors. However, the final goal is the same: to utilize the port facilities in a such a way that the maximum benefits are generated.

3. This chapter outlines the general principles of port management and operation and the present condition of APG. Then port operation and management systems which take into account the modernization being studied by UNCEMP are proposed.

4. Finally, the basic idea of privatization, which has allowed ports throughout the world to streamline and increase the efficiency of their operations, is set forth. At present, the central government of Ecuador is examining the privatization of public and semipublic institutions.

1) National business

5. Port activity has a great influence on the national economy. Safeguarding the national interest should be the first priority of port management and operation.

6. In particular, in developing countries, ports are one of the vital instruments of the national economic policy to achieve a so called economic take-off. Therefore, it is better for ports to be under the strong supervision of the government to facilitate optimum capital distribution and the realization of a trade policy.

7. In other words, the basic role of ports is normally considered to function as a public facility. Port infrastructure and facilities should be basically operated in open use to the public.

2) Commercial business

8. In principle, port management is a kind of commercial business, so a port can never be managed efficiently under rules and regulations established for quite different purposes and different kinds of activities. A much more flexible, business-like system of management is required, free from political pressures and frictions.

9. From the commercial business standpoint, following three points are commonly required by users for port management and operation around the world.

- Dealing with matters promptly
  In order to ensure efficient utilization of the port facilities and port services,

and to minimize the cost of transportation through the port, complying with the requests of port users quickly and dealing with problems quickly are indispensable.

- Provision of services at reasonable charges
  Port provides various services to users. If a port provides high-quality service and charges less than neighboring ports, port users will chose that port. But, if revenues become too low and management is unable to improve the port and its facilities, the quality of services will deteriorate. Thus, balancing of the above issues must be pursued.
- Reliability and safety
  Delivery/receiving or unloading/loading of cargo and arrival/departure of vessels must be carried out on time and correctly. Operation of cargo and vessels must be carried out in a safe manner.

10. Even if the above factors are given different priorities, it is impossible to attract users to ports without all of them. When the above requirements are satisfied, port activities can be promoted and the port management body can make the best use of port facilities.

3) Port Authority

11. A port is on the one hand a public enterprise and on the other a commercial one. A Port Authority is established to reconcile this dualistic nature of ports.

12. Port Authority is an autonomous entity under the general supervision of the government, and in charge of the administration and development of the port, within the framework of the national economic policy.

13. On the other hand, autonomy cannot achieved by a port unless it has a wide measure of financial independence. Financial independence, or self-sufficiency, makes the port administration body more sensitive to cost and benefits.

14. To raise the capacity of the Port Authority to its highest level, it is necessary to adhere to the following principles.

- Autonomy
- Authority over whole port area and main port functions
- Financial independence
- Commercial management methods

The relation between port user's requirement and these principles are shown in Figure II-6-1.

15. While both "Port Administration Body" and "Port Management Body" are appropriate terms, the word "Port Authority" is generally preferred because of its narrower meaning; in addition, ports in Ecuador are administrated by Port Authorities.

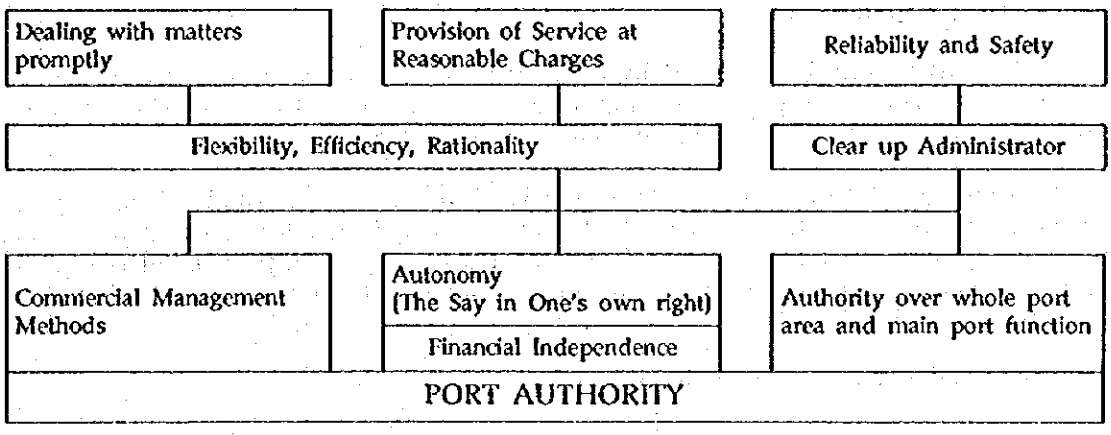


Figure II-6-1 Mechanism of Port Authority

(a) Autonomy

16. Port Authority should be responsible for port improvement and expansion plans and for maintenance of all existing port facilities. It should have the right to select and appoint personnel in accordance with their professional abilities. It should be able to lease some property to private firms in case of need, incur financial obligations in its own name and in general to act as a legal entity. Therefore, government's control should be limited to a minimum number of areas.

17. However the following should be subject to government approval.

- Plans for major port expansion and improvement
- General level of main port dues
- Annual budgets
- Loans and obligations exceeding a certain limit
- Sale or long-term lease of property exceeding a certain amount

18. The two requirements, autonomy and government control, should be reconciled to realize efficient port management without deviating from the general economic policy of the government.

(b) Authority

19. Port Authority should have authority over the whole port area and main port functions. Port operation cannot be performed with full efficiency unless the Port Authority owns all land and facilities, such as infrastructure, quay cranes and so on, in the port area to control and coordinate all port activities on wharves and piers, land facilities and port waters. Also, the planning of future port expansion cannot be made properly unless the port can freely dispose of the entire undeveloped water frontage within the port area.

20. However, highly specialized terminals, which are used by one single customer with sufficient volume of cargo for example berths for loading ores or crude oil, can remain in private ownership, under a certain degree of supervision by the Port Authority.

(c) Financial independence

21. Autonomy cannot be achieved by a port unless it has a wide measure of financial independence. Therefore, port charges and any other receipts of the port should be used exclusively for port administration, maintenance and improvement.

22. Port charges should be kept at a reasonable level to cover normal current expenses, including amortization and repayment of loans. Only funds for investment to major infrastructure and superstructure based on a port extension or improvement plan should in case of need be supplied by the government, either in the form of direct donation or of low-interest loans.

(d) Commercial management methods

23. In port operation and management, new problems constantly arise and must be solved quickly. Port management is a kind of business so the Port Authority must always fight against rising costs. Therefore, ports cannot be managed in accordance with the bureaucratic systems prevailing in most governmental departments. The management must be flexible and be able to make decisions according to the merits of each case, rather than according to formalities and rigid regulations.

24. Clearly defining job responsibilities is an essential condition of efficient management. An organization chart with responsibilities of each section should be publicized to enhance internal cooperation among related departments or sections and the control of organization by the staff of an Administration Department.

25. The port administration must have the freedom to adjust its organization and the level of expenses to the changing requirements of traffic and condition of port operations. A certain section should be in charge of analysis of those changing situations, correction of related information and research of needs of port users.

26. Port Authority should not sit and wait for the traffic to come but should make all efforts to attract traffic. A reasonable amount of publicity and close contact with ship companies and their agents, local and international commerce, industrial organization and with all actual and potential port users can greatly contribute to improving the image of the port, making known its advantages and opportunities and promoting a steady growth of traffic. Also, those activities of port promotion can bring to light current problems of the port and stimulate their quick resolution.

B. Identification of Problems

27. Autonomy, authority, financial independence and commercial management methods are essential principles for port management, as shown above. In this section, the present condition of management and operation of APG is set forth.

1) For Autonomy

(a) Government control

28. Port management is a kind of commercial business, so a much more flexible, business-like system of management is required.

29. The central government appoint the Entity President, member of Director, General manager of APG. Following are subject to central government approval mainly.

- Tariff regulation and any changes or modifications.
- Financial result and balance of accounts.
- Annual budgets.
- Organic personnel.
- Port regulation and planning.

30. This control is within the allowable limits from the viewpoint of business-like and flexible management of APG, and does not disturb the autonomy of Port Authority.

(b) Control of personnel administration

31. It is desirable that each port be able to evaluate and appoint its own personnel to cope with the particular problems of each port. It is not rational that government control all personnel affairs, because the procedure usually takes a long time and the system should reflect the actual condition of each port site. Therefore, Port Authority should have the competence to decide personnel affairs.

32. In Ecuadorian ports, Entity President, members of Director and General Manager are appointed by CNMMP. Such control of personnel administration as is permissible from a standpoint of national economic growth, especially in developing countries.

2) For Authority

(a) Port policy and plan

33. The port policy and plan indicates future conditions of ports. Furthermore, the port policy and plan controls various kinds of activities in port areas. In other words, to execute proper port development, port operation and management should be based on the port policy and plan formed by Port Authority.

34. APG has jurisdiction only over the port zone determined by law. Planning, construction, investment, improvement and maintenance of maritime terminals full under the jurisdiction of APG.

(b) Control of water area

35. Proper and strict control of water area by Port Authority is a necessity. Any kind of exclusive use or activities at the water area should be regulated with permission of Port Authority.

36. APG's jurisdiction covers not only land area but also water area, from pilot station DATA to wharf, and every ships navigating or maneuvering within the area is subject to the control of APG.

(c) Control of land area

37. It is impossible to control and coordinate all port activities with full efficiency unless the Port Authority owns all land and facilities in the port area. If a private company or other governmental organization owns land or facilities in port area it makes it difficult to achieve full unity of control. However, it is a possible to lease land to private companies in case of need.

38. The properties of APG are all properties and installations that it owns at present and will acquire in future. Therefore, sources of income of APG include revenue from port services, use of pier and anchorage, technical assistance, and donations.

3) For Financial independence

(a) Financial system

39. Sound finance is essential for financial independence and autonomy of Port Authority. If the government is obliged to cover yearly operating deficits of a port, in addition to having financed the initial capital investments, it will be reluctant to entrust port management to a separate autonomous body. Sound finance should be the aim of every major port.

40. APG is financially independent from the central government getting no subsidy. Conversely, APG contributes to DIGMER, General Auditor and Culture House, as stipulated by law.

41. Concerning the financial condition of APG, net income had been increasing till 1992, but a loss was recorded in 1993 due to the low increase in operation revenue and a sudden increase in personnel expense. The main reason for the increase in personnel expense was salary payments retroactive to 1992, as for the collective agreement concluded every two years. Thus, this kind of expense will appear every two years. To make matters worse, the personnel expense will increase in 1994 due to severance packages paid out to the approximately 900 personnel who were dismissed in 1993. From this point of view, APG's financial condition cannot be said to be sound.

42. Also, the above-mentioned contribution is too heavy a burden, because a fixed percentage of APG's revenue, by law, must be set aside for this contribution, regardless of whether APG shows a profit or not.

43. Concerning the working ratio, the value decreased since 1990 and in 1992 it was almost 60%, but it suddenly increased in 1993, reaching 85%. Generally speaking, it is desirable that the working ratio is less than 50%, so the working ratio of APG is too high to maintain a sound financial condition.

(b) Port tariff

44. The tariff should be set at a proper level to obtain sufficient income and to make the necessary investments. On the other hand, tariff should be set taking levels of neighboring ports into consideration to attract more port users.

45. Since June 1994, each port has been able to decide its own tariff. However, APG is using a tariff table which was established before 1993 and it is same at all ports in Ecuador. Therefore, UNCEMP is studying a new tariff system on the assumption that a modernization program will be introduced.

46. In the present tariff table, berth hire charge is fixed amount for 24 hours, that is to say, there is no charge difference whether a ship stays at berth for one hour or 24 hours. This results in ships staying at berth for long periods at time, often forcing other ships to wait outside the port.

47. On the other hand, period of free storage for import and export general cargoes is 10 days, counted from the date the cargo enters storage. And all transhipment and international transit cargos can be stored 15 days free of payment. It seems that the period of free storage is a little longer than other ports in the world.

4) Commercial management methods

(a) Organization and personnel

48. In general, an enterprise's organization should be formed as a functional one which make it possible to accomplish its purposes with minimum costs. To that end, rapid and clear decision making is required and matters decided should be relayed to all members of the organization. They also need to be competently executed without any delay.

49. However, there is a tendency for the decision-making process to become complicated and slower as an organization grows in size and as the number of persons who take part in the process increases. And once it matures and its members are fixed, orders which are given by high ranking officials become unclear as they go to lower ranks.

50. The organization of APG comprises Director, General Manager, five counsel function and eight departments, and there are seventeen divisions under the departments. General Manager is maximum person to manage APG and Director is supervise the management. The number of departments or divisions are not so many compared with other major ports, as long as cargo handling is operated by APG.

51. According to our observation, the Board of Directors must be notified or approve of decisions, even those concerned with daily administration matters. This may be an obstacle to coping smoothing with port users request, and may also lower the morale of key officers by depriving them of that feeling of satisfaction that accompanies decision-making and problem solving.

52. Total number of employees had been increasing till 1992, but suddenly decreased in 1993 as a result of more than 550 employee dismissals under the modernization plan of APG. At present, the number of employees stands at about 1250, and this is the proper number as long as cargo handling is operated by APG.

(b) Training system

53. The object of employee training is to improve the capability of each worker, which in turn will lead to efficient port management and operation. Through training, employees should gain expert knowledge, leadership ability, skill to operate port equipment and so on. They should understand the current port condition and manage and operate the ports considering problems which are expected to occur in future.

54. There is a training center in APG run by the Personnel Department for the purpose of developing personnel's administrative and operative faculties. But there is no general administration training course for all employees.

55. Also, there are no criteria for selecting employees who will participate in the training. The heads of each department, division and section make decisions without clearly defined criteria. From the view point of the efficiency of training, it is desirable to do periodical training for many employees and special training for executives or technical employees/staffs.

(c) Cargo handling

56. As is commonly understood, public sector is normally not flexible in providing personnel or investment in response to the actual fluctuation of demand. In this sense, full involvement of the Port Authority in cargo handling service is not always suitable for increasing of efficiency of such service under a competitive market, and increased situation of cargo flow in particular. Also, it is desired that port administration and operation are carried out under the control of a single entity throughout every stage.

57. In the port of Guayaquil, unloading/loading cargos from/to vessels to landside/from waterside is carried by syndicate prepared by the ships operator or agent. APG is in charge of shore handling, transferring cargos between quay side and sheds/warehouses/open storage by folk-lifts, trucks. Shore handling is under the control of Operation Department, and 270 employees and 304 labors belong to the department. And, APG has adopted a three shift system with 8 hours of net working time in each shift and render cargo handling every day of the year without any interruption 24 hours a day.

(d) Ship operation

58. Safety of ship navigation is supported by port facilities, for example, channel marks, sea route which is maintained in full depth, etc. and by service for ship, for example, pilot service, tug service etc.. And, smooth berthing for efficient transportation is put into practice by proper birth allocation, skillful tug service and line handling.

59. Berth allocation, in particular from the view point of port operation, influences not only the ships waiting times outside of the port, but also the delay of receipt of cargoes and rise in transport cost.

60. At APG, the priority for docks, berths and other facilities is provided in order of arrival to the quarantine area in the port of Guayaquil, under a "First Come First Serve" basis. But banana vessels are given priority over the general cargo, so sometimes there are many ships waiting at quarantine area.

61. Pilot service and tugboat service are mandatory for every ship. There are eight tugboats officially, but our observation revealed that only a few of them are in good working order.

(e) Information system

62. Computer can be used in highly integrated business systems. A computer is a machine that can perform logical and arithmetic operation. It can also record the results for immediate or future reference. With the use of IC and LSI technology, computer have become more and more precise in computation. As a result, it is now possible for a large volume of information to be processed with a shorter span of time. Integration of computer systems means that computer can do many tasks much more quickly and correctly than if these tasks were not integrated.

63. As to port operation, various computer application systems, such as container terminal operation, payroll, stock control, financial, vessel/pier information, for efficient port activities have been developed in the past decade.

64. There is an Information Division in APG in charge of maintenance of computer hardware and software, data processing, programming and so on.

65. Approximately 22 terminals are connected to the host computer in the Information Division, some of them are in the Information Division and are used as control equipment of host computer. On the other hand, APG has installed different types of Microcomputers for the business peculiar to each section.

66. Computers are mainly for the register of goods, materials, institution and shipmaster, register and control of the containers, processing of financial affairs, salary payments to the Staff, import and export statement, control of purveyor and purchases.

67. APG thus possesses a lot of useful hardware, software and data in the Information Division. But, this system and data are not shared with other divisions and are not used for each sections' business. This is perhaps because, many employees are not aware of the importance of data, nor are they concerned about the business of other divisions. Furthermore, an information network has not been established and training for computer terminal operation requires more refinement.

68. According to the data of UNCEMP, the business of Information Division will be transferred to private company/entity and this division will be abolished.

(f) Statistic System

69. To formulate port promotion strategy, analysis of cargo turnover is necessary. It also necessary to provide easy access to port information with port users. This service will make the ports more attractive. Proper information service is mandatory to survive competition with rival ports.

70. The statistics of the port of Guayaquil have been ostensibly put into order already. There are, however, several points to be improved by the Statistics Section and in cooperation with the relative divisions/section in terms of quality of the statistics, analyses of data, format and method of data collection, development of information service, practical use of data in central computer.

(g) Port promotion

71. To promote use of the port, it is essential to establish a more useful and attractive port in terms of both facilities and management and operation for user such as shipping lines, shipping agents, forwarders, shippers consignees, etc.. For that purpose, it is necessary to have a real time, broad, systematic grasp of the users' needs and to reflect their needs in the practical development and management of the port. The port should be marketed positively, providing users with pertinent information.

72. The only department concerned with port promotion is Public Relations. But the size of this department, in 1993 there was only 1 staff-member, is too small to carry out this important business.

(h) Procurement system

73. It is very important in operating a modern container terminal to minimize idling time of cargo handling equipment, and thus more effective procurement activities for spare parts of maintenance works are required in order to avoid possible delay of cargo handling for highly time conscious container vessels.

74. According to our observation, APG requires a lot of time to conclude procurement procedures because the General Manager's consent is necessary and also the Director must be informed when the cost exceeds 200,000 sucres.

5) Conclusion

75. Table II-6-1 is a synopsis of the above points. Weak points identified in the table are discussed later in this chapter.

Table II-6-1 Present Condition of APG

INDICATOR	PRESENT CONDITION OF APG	
1. For Autonomy		
a.Government control	There are no serious defects.	
b.Control of Personnel administration	There are no serious defects.	
2. For Authority		
a.Port policy and plan	There are no serious defects.	
b.Control of water area	There are no serious defects.	
c.Control of land area	There are no serious defects.	
3. For Financial independence		
a.Financial system	Financial condition seems not in sound in recently.	*
b.Port tariff	It has been studying in UNCEMP.	*
4. For Commercial management methods		
a.Organization and personnel	There are some problems at morale of employees.	*
b.Training system	There are no general training cause and no self-education systems.	*
c.Cargo handling	Efficiency is low.	*
d.Ship operation	There are some problems at berth allowance and so on.	*
e.Information system	There are some problems such as joint ownership of data etc.	*
f.Statistic system	There are some problems such as efficient use of computer etc.	*
g.Port promotion	Importance is not recognized.	*
h.Procurement system	Requires a lot of time to conclude procurement procedures.	*

Notes: Mark * means there are some weak points which should be improved.

C. Port Management of APG in Future

76. This section discusses the measures to improve managerial weak points in APG which were identified in the Table II-6-1.

1) Financial system

77. If some of APG's business is transferred to private sector under the modernization of port, personnel expense will be reduced accordingly, but some item of revenue, such as cargo handling will also be decreased. Consequently, financial condition will be drastically changed. Therefore, if financial system is reconstructed, it is important to do feasibility study include future demand forecast, development plan, improvement plan, operation revenue, operation income and so on.

78. If the present port management and operation system is maintained, APG should develop a financial strategy to realize a sound financial condition. For example, APG should rationalize its management through simplification of its organization.

79. On the other hand, the contribution to the three institutions has been too heavy a burden on the financial condition of APG in these two years. Because it is calculated based on a fixed percentage of the operation revenue, regardless of whether a profit is shown. APG should appeal to the central government to change the contribution system so that it is based on net income, the same as tax.

2) Port tariff

80. Financial system based on economic principles should be established to realize financially sound port management and operation. APG should set its tariff at a proper level to obtain sufficient income to maintain sound financial condition and to make the necessary investment.

81. On the other hand, tariff should be set taking levels of neighboring ports into consideration to attract more port users. APG should vigilantly monitor and analyze tariffs of neighboring ports and revise its tariff when necessary. In particular, tariffs related to shipping companies must be reduced. If the tariff structure is not competitive with other ports, it will be difficult to attract more users.

82. The following points should be considered in terms of the port tariff structure.

- The revenue from the tariff can cover costs for construction, management, maintenance and repair.
- The tariff should be relational in correspondence with the service provided.
- The tariff structure should include a system which leads to more effective management and operation of the port. This implies that the tariff structure provides an incentive for vessels and cargo to move efficiently through the port.
- The tariff structure and the way of imposition should be as simple as possible.

83. With the introduction of privatization, the income structure will be changed drastically. After privatization, the consignees will pay charges such as cargo handling charge to the private entities, then the private entities will pay port charge and duties such as transit sheds to APG. The consignees will pay the APG the port duties such as wharfage. The shipping companies will pay the port duties such as berth charge to APG. If pilot service, tug service etc. are privatized, the shipping companies will pay these charges to the private entities.

3) Organization and personnel

(a) Organization

84. Generally speaking, inner organization of executive department should be simplified and streamlined. The following points need to be considered in order to activate the organization.

- Training middle-ranked staff for positions of authority.
  (Adjustment of gap between the few high ranked staffs and the majority of workers)
- Establishment of objective and clear criteria for promotion of regular staff.
  (Personnel changes not influenced by high-ranked staff's change)
- Sharing information for strengthening organization.
- Necessity of incentive for workers.
  (Preventive measures for well-trained personnel flowing out from the organization)
- Establishment of task force for improving organization consisting of efficiency specialists.
  (Objective proposal to improve the organization)

85. For activation of the organization, not only its reformation but also the improvement of minds of its personnel toward rational and efficient management are important. For this purpose, many companies adopt a Quality Control (QC) circle and a Proposal Activity by personnel.

86. A QC circle is an activity for improvement involving each individual employee. Normally it is carried out by a group within a single division or section. Members of the group identify problems concerning quality, safety, efficiency etc. and voluntarily try to solve the problems with everyone's cooperation. It also has an effect on the improvement of working mind of personnel since many people take part in the activity and find satisfaction in seeing their suggestions implemented. Many companies hold presentation conferences or award ceremonies in order to promote it and to learn from other activities. It is also done by a project team extending through several divisions concerned.

87. A Proposal Activities system is a system whereby top managers invite proposal or new ideas on concrete improvement measures from all employees and adopt what they consider to be the best proposals. These kinds of activities would give all personnel a good opportunity to think over their own tasks and to contribute to their rationalization. It is recommended that APG introduces and develops these kinds of activities throughout its organization.

88. However there are many cases where these activities begin to lose their novelty and the number of proposals decreases as time goes by, although they work well at first. Therefore it is important for top managers to make quick and effective decisions.

(b) Personnel administration

89. It is thought necessary to raise morale of port authorities' staff and to promote their ability to discharge duties for proper port management. Personnel management system to realize this will be important.

90. One solution will be the introduction of a modern personnel evaluation system by which APG staffs can be objectively evaluated. Proper promotion and transfer of APG personnel based on ability of each staff will be possible by the system.

91. Introducing a staff evaluation report system is one effective means. This system should be introduced as soon as possible. When introduction and designing this report, following items should be taken into consideration for objective evaluation.

- Evaluation items should be objective as much as possible.
- Various staff evaluation reports should be carefully designed corresponding with the type of job and rank.
- Certain fixed evaluation period should be adopted.

92. Contribution to improvement of port management should be counted in evaluating staff performance. Whether a person made any proposal to develop the management system, working efficiency should be included in the evaluation items. Based on the evaluation, proper measures should be taken such as sending a person to proper training courses, or having his superior give him the necessary guidance. A well designed promotion system will stimulate the personnel incentives and will greatly contribute to developing overall quality of APG organization.

4) Training system

93. At APG, employees in each department should control port activities appropriately to materialize efficient management and operation such as quick cargo handling, farsighted investment, profitable financial management and so on.

94. The objective of employee training is to improve the capability of each worker, which in tern will lead to efficient port management and operation.

95. Through training, employees should gain expert knowledge, leadership ability, skill to operate port equipment and so on. They should understand the current port condition and manage and operate the ports considering problems which are expected to occur in future. In addition, to gain more effect, they should make efforts to self-educate.

96. The concrete objectives by kinds of employees are as follows.

(a) For all staff

97. Training courses for all staff begin at the time of employment and continue periodically. By attending these courses, employees gain basic knowledge on general administration and leadership ability. Employees will gradually develop a broader understanding of the nature of ports which will help them to cope with problems of port administration.

(b) For Secretaries (Staff mainly engaged in management or finance)

98. By attending training courses on general administration, financial management, accounts system, related laws and regulations and so on, secretaries gain a better understanding of port management, and will thus execute their duties more effectively.

(c) For Engineers (Staff mainly engaged in construction or maintenance and repair)

99. By attending training courses on civil engineering, architecture, electrical engineering, mechanical engineering and so on, engineers gain a better understanding of port construction and maintenance, and will thus execute their duties more effectively.

(d) For Operators (Staff mainly engaged in marine and port operation)

100. By attending training courses on navigation, cargo handling, operation of port equipment and so on, operators will attain a higher level of skill and thus the efficiency of port operations will be enhanced.

5) Cargo handling

101. Efficient cargo handling is one of most important matter for port activities, and the suitable systems of cargo handling are vary by the package type such as break bulk cargo, container cargo, sacked cargo and so on. A detailed explanation of cargo handling systems is given in PART II Chapter 7. Therefore, the cargo handling plan and the arrangement that accompany it are mentioned below.

102. The efficiency of cargo handling, on board a conventional cargo ship, whether loading or unloading, greatly depends on a cargo handling plan and the various arrangements that follow it before port entry. Concerning the cargo handling plan, the following is a list items requiring study.

- Stowage plan. Decision on the berth and ship's side to use.
- Allocation of proper number of gangs of stevedores.
- Sorting of direct delivery/storage in yard or warehouses and preparation of operation plan.
- Necessary cargo handling equipment and materials.
- Safety measures.

103. Examples of arrangements accompanying cargo handling plan are as follows.

- Exchange of information with the Operation Department and Pilot Department on the expected time of arrival and departure, berths, previous and following vessels, and request for arrangements.
- Instruction to the foreman on the cargo handling plan and precautions to be taken.
- Prearrangement with consignees about the schedule of truck arrangement.
- Arrangement for storage in yards or warehouses and preparations for the necessary operations.

6) Ship operation

104. In order to enhance the prosperity of the port of Guayaquil, it is necessary to provide good service to clients in the aspect of ship operation such as reduction of turn-round time by direct berthing or high efficiency of cargo handling works.

105. In view of the present congestion of the port and the present situation of shipping companies using the port, the introduction of the Preferential Berth System should be studied and, if viable, put into operation. To achieve the most efficient output of all berths, a computer-aided berth assignment and control system is indispensable because of difficulty to effectively manage a large number of ships and volume of cargoes manually.

106. All tug boats should be keeping good condition.

107. Recommendations for high efficiency of cargo handling including the cut-off time System are mentioned in PART II Chapter 7.

7) Information system

108. A computer has three great strengths: data processing at electronic speeds, maintaining great accuracy and processing many different types of symbols into useful information. In addition, a computer can store internally a program instructions, and it can be programmed to modify the processed sequence.

109. Therefore, a computer can be used for various kinds of business and excellent results can be obtained. However, in business, it is not practical or economical to use it to do a single, simple and isolated task. Computers are very expensive and such things as programming, data-input, data collecting, data processing, running, maintenance etc. are very time-consuming. So, introduction of computer in port activity is worthwhile any if the computer will be used for all aspects of container terminal operation, payroll, stock control, financial etc. and will be part of an information net work among related organs.

110. In computer processing, there are two important factors from the viewpoint of programming. One is to examine the available data that can be used for data processing. The other is to decide what is required as output from computer run for users.

111. At present APG intends to entrust a private software company with software development. If APG makes a contract with a private software company to develop a computer program, APG has to clarify its requirements to the company for the purpose of ordering software that can be applied several kinds of tasks. Examples of these requirements are as follows.

- The processing has the desired effect, moreover, can it be realized by present level of technology?
- The processing must be applicable to the hardware, if the software company is different from the hardware company.
- Is it possible to verify the requirements?
- Freedom of design reform should not be limited. Flexible enough accept other ideas.
- There are no contradictions in the requirements.
- All expression have been written correctly.

112. Moreover, it is necessary to set up a system to prevent data leaks, or a security system such as access code, pass word, etc.; this is especially true for the public sector. This system is all the more important if computer operation is not done by APG itself.

113. In addition, it is important to provide training and to make a manual for use of computer. One of the most important merits of computer is that data can be shared with related organs by information net work or diskette. Therefore many employees should have the ability to use a computer as long as the data are general and not secret.

8) Statistics System

114. It is necessary to improve the statistic system in APG, to support formulation of the port plan, port strategy and promotion of the port. In order to improve contents and quality of the statistics, the related divisions should cooperate to streamline the methods and formats of data collection and to construct a data base automatically through the collection work.

115. The statistics should be provided timely to the management of APG and to the public. The contents of the annual statistics should be improved, and monthly statistics and other publications should be planned as a means of information service.

116. In addition, it is necessary to strengthen the training of stuff in the Statistic Section on handling of central computer terminals, because it is difficult to collect statistics without computer.

9) Port promotion

117. For performing port promotion activities, it will be effective to take aim at main targets and to make strategies to attack the targets. For example, as a port trying to attract transhipment cargo to became a hub port, it is necessary to make sales calls at the shipping agents and shippers which carry the transhipment cargo. In this case, sales point should be focused on not only on the port facilities but on the merit of using the port for the companies.

118. To make an attractive brochure for this purpose will be necessary. According to our observation of some ports in Ecuador, the brochure of APG is a little poor in contents and does not attract the attention of readers.

119. On other hand, the department/division which is in charge of port promotion should collect information on users' requirements, and should be able to function as an advisory organization to other department/division by providing information collected on users' requirements. Such cross relation of organization could revitalize APG as a whole.

10) Procurement system

120. It is desirable that APG is able to purchase materials, goods, spare parts for port activities through a more simplified procedure. APG should delegate of responsibility and power about procurement to the chief of department or division to a certain extent.

D. Privatization of Port

1) Merit of privatization

121. Generally speaking, the private sector runs business more efficiently than public sector because of the following reasons.

(a) Incentive

122. When a business is run by the public sector, incentives to make the management efficient by reducing deficits doesn't work well since there is no possibility of bankruptcy. On the contrary, the prospect of bankruptcy compels private companies to run an efficient operation.

123. Workers in the public sector lack incentives to perform the best possible job. Wage systems are often so rigid that the diligence or ability of an employee go unrewarded. This type of situation usually results in lackadaisical efforts on the part of workers.

(b) Competition

124. Introduction of principle of competition will induce incentives for effective management.

125. When services are monopolized by a single company without any competition, it is difficult to judge whether the company provides effective services or not. Participation of plural companies makes a comparison possible.

(c) Flexibility

126. Introduction of flexible management free from budget system, seniority system, formalism, strict application of regulations which are peculiar to officialism.

2) Concept of port privatization

127. There is a marked trend towards privatization in ports throughout the world, and many port authorities have already adopted privatization or are considering its adoption. However, it is very difficult to define and evaluate this so-called "privatization" because of peculiarities among individual ports and countries. In addition, each Port Authority has its own jurisdiction and duties.

128. When examples of some leading port in the world, Central American port and South American port are examined as shown in Table II-6-2. It should be recognized that the definition of "privatization" is a relative matter. The privatization scheme to be adopted depends upon the degree of remaining duties in the public sector.

129. Generally speaking, the privatization methods can be taken as Table II-6-3.

Table II-6-2 Port Authority's Duties in the World

	YOKOHAMA JAPAN	NEW YORK U.S.A	ROTTERDAM HOLLAND	SANTO TOMAS GUATEMALA	RIO HAINA DOMINICA	VALPARAISO CHILE	SINGAPORE
Ownership	•	•	•	•	•	•	•
Berth Allocation	•	•	•	•	•	•	•
Fee and Charge	•	•	•	•	•	•	•
Statistics	•	•	•	•	•	•	•
Shed and Heaping Yard	•				•		•
CY Operation				•			•
CFS Operation				•			•
Stevedoring				•			•
Longshore cargo handling				•			•
Warehouse				•	•	•	•
Tug				•			•
Line handling				•			•
Water supply				•	•	•	•
pilot				•	•		•
Tally				•	•		•

Source: OCDI Survey Report

Table II-6-3(a) Methods of the Privatization

Case	Land		Port facilities		
	Ownership	Operation	Construction	Ownership	Operation
A	public	public	public	public	Table II-6-3(b)
B	public	private	public	public	
C	public	private	private	private	private
D	private	private	private	private	private

Table II-6-3(b) Methods of the Privatization

Case	Stevedoring	Shore-side cargo handling	Operation of facilities
A-1	public	public	public
A-2	private	public	public
A-3	private	private	public
B-1	private	private	public/private
B-2	private	private	private

130. In Case-A and Case-B, Port Authority owns both land and main port facilities. These methods are able to classified as Table II-6-3(b), according to terminal operation method.

131. In Case-C, private entities constructs and owns main port facilities such as gantry crane, apron, berth and so on, but land is owned by Port Authority. In this method, all of cargo handling (stevedoring and shore-side cargo handling) and most of port operation such as cargo handling operation, berth allotment etc. are in the hands of private entities.

132. In Case-D, private entities owns land and port facilities. Therefore, a private entity operate all of port by itself. This method is only adopted in the case of a special terminal, for instance, an exclusive terminal for coal, iron ore and so on.

133. The degree of privatization progressively increases the farther down one goes in Table II-6-3. Ports should contribute to the national interest, development of hinterland cities and their economies, especially in developing countries. From this point of view, Case-A or Case-B is recommended.

3) Terminal operation

134. There are basically two methods of terminal operation around the world. One is where a Port Authority takes charge of not only public duties such as port planning, construction of port facilities, maintenance and management but also cargo handling business which is of a commercial nature (Case-A-1 and Case-A-2 in Table II-6-3(b)). The other is that the role of the Port Authority is limited to the public duties and commercial business like cargo handling is done by private enterprises under the general control of the Port Authority (Case-A-3, Case-B-1 and Case-B-2 in Table II-6-3(b)).

135. These methods of port operation, peculiar to each port, are not the result of careful selection by port management. Rather, they have been chosen by reasons of regional condition like customs and historical background. So it is very dangerous to seek a common method of port operation for all ports in the world without considering the various local conditions. The important thing to be considered is to choose the best method which enable a Port Authority to operate a port efficiently and without sacrificing public interest, based on a detailed examination of the present situation of the study port.

136. As the terminal operation, it is said that operation methods differ by the cargos, such as container, general cargoes and bulk, which have been treated at the terminal respectively.

137. For container transportation, safe and punctual operation is the most vital requirement. In this sense, container terminals are required to adopt commercial management methods, and provide quick, reliable and economical service to users.

138. General cargo terminals are normally used by various users and handle a smaller amount of cargoes compared with container terminals. Naturally, these terminals should be open to public use.

139. In the case of terminals for bulk cargo such as fruits, grain and maize, on-land facilities can be used by a specified entity, while the berth will be used by many shipping companies. Therefore, the berth should be open to public use.

4) Trend of port privatization in APG

140. At present, privatization of APG has been studied by UNCEMP since Apr.1993, as a means to modernize ports in Ecuador, which conforms with national policy of modernization for public and semipublic institutions.

141. The laws and regulation concerned with the policy, the General Regulations of National Modernization Law, Privatizing Law, Present Public Services by Private Initiative Law and as well as other general laws of modernization, were drafted by CONAM and legislated on Dec.31,1993.

142. According to the present result by UNCEMP's study, the work related to the port service should be shifted from APG to the private sectors for competition on the quality and cost. At least the following services should be privatized in due order as the number.

(1) Cargo handling
(2) Tug boat service
(3) Operation of crane
(4) Security
(5) Garbage

143. In case of cargo handling except at bulk terminal, whole responsibility for cargo handling will belong to private companies or entities which make a concession contract with APG.

144. Basic concept of port of Guayaquil after concession is as follows.

- Berth and apron is owned and managed by APG for all users.
- Storage area is divided into some sections and private sectors have each area's concession through tender.

145. Therefore, responsibility of APG should be administration, maintenance, financial issues and improvement of infrastructure.

5) Application of privatization

146. According to above mentioned policies, Case-A-3 or Case-B-1 or a combination of these are considered the best selection for APG.

147. Present operation of monopolistic shore-side cargo handling service by APG should be modernized. APG should encourage private sector to enter into the field of cargo handling service by providing an attractive environment.

148. It is sound for the port of Guayaquil to commercialize cargo handling function as soon as possible and improve their efficiency through competition among private companies.

149. It is advisable to privatize terminal operation by lease/concession. Containerization will progress in Ecuador. In the beginning, semi container ships or small full container ships operated by various shipping companies will call on the ports rather than big full container mother ships operated by the major shipping companies. This kind of container terminal should not be used as a exclusive berth but be a public berth.

150. There are many cases where privatization is applicable, though in all cases,

ownership of land and main port facilities should be by public sector or entity under proper control of the government.

151. Port which have undergone the port privatization have enjoyed the merit of privatization as shown in Table II-6-4.

152. The items which have to be decided carefully when APG introduce privatization are explained below.

(a) Selection of private company

153. If APG privatizes shore-handling, it is very important to decide qualification criteria for private companies wishing to participate. Examples of criteria are as follows.

- Companies which are able to perform efficient cargo handling to fit customer demand.
- Companies which can provide reliable service.

Furthermore, APG should consider plural cargo handling companies to increase competition.

154. APG may privatize the whole terminal operation by concession/lease of land/terminal to private companies. As the container terminal comprises the main facilities of many ports, selection of a private company as the container terminal operator is examined based on the following points.

155. Container terminal operation includes wide range of works such as container inventory, gate operation, container loading and unloading (include yard and stowage planing), documentation to port related agencies, maintenance of equipment and container cleaning etc.. Since safe and punctual operation is the most vital requirement for container transportation, container terminals are required to provide quick, reliable and economical service to users. Operators are required to hold enough and competent personnel, know-how, capital and credits to handle those works. At the same time, it is necessary to concede the terminal to the designated operator(s) for a certain period, which is actually done in many leading container terminals.

156. When criteria for selection of terminal operators are examined from the above view points,

- Companies which are able to perform efficient container cargo handling and handle wide range of works as mentioned above to fit customer demand.
- Companies which can collect adequate quantity of container cargo while keeping sound financial position.
- Companies which can provide reliable service throughout its leasing term.

are considered.

157. In selection of these cases, the following points should be taken into consideration.

- Guayaquil port is an important public port which supports the national economy. Public ports should be managed and operated not only for limited or specified users but for the open public and should impartially accept and handle all ships and cargos of different companies.
- Evil effects brought from the monopolized terminal operation should be avoided (inefficient operations and unreasonable tariffs etc.) as much as possible.

Table II-6-4 Examples of Port Privatization

Country	Object	Contents of Reforms	Effects of Reforms	Future Problems
Malaysia	Container terminal at Kelang Port	Operation by Port Authority (invested 100% by Gov't) ↓ Establishment of new enterprise partly invested by private sector and 1)disposal of movable equipment 2)rental of port facilities 3)agreement on management and operation against the new enterprise	1)Decrease of personnel cost through reduction of emplyee for Port Authority 2)Money gained by the disposal could be used for repayment of loan for construction of container terminal	Since container terminal is the most profitable facility in Kelang Port. the following problems remain: 1)Since profitability of remaining parts are low. total privatizaton of Port Authority becomes difficult. 2)It is possible that gov'tal subsidy to Port Authority is required.
Chile	Supply System of Port Labor	Monopolistic supply of port labor by its registration system ↓ Liberalization of port labor by abolishment of the registration	1)Reduction of stevedoring cost 2)Improvement of efficiency in cago handling	1)Liberalization of labor market will bring about deterioration of labor conditions by excessive competition. Their improvements are now under consideration by the gov't. 2)It is necessary to improve port development system such as clearification of the share of construction cost of new facility between public and private sectors.
	Port Management Body (EMPORCHI)	Monopoly of shoreside cargo handling by EMPORCHI ↓ Free participation of private sector to shoreside cargo handling and scale down of EMPORCHI business (limited to facility construction. management. planning etc.)	Rationalization of EMPORCHI through personnel reduction (5.300→1.300)	
	Other	1)Reform of tariff structure to encourage effective usage of facilities so that tariff rate increases in proportion to berthing time and storage period 2)Simplification of procedures for customs clearance such as swift cargo check		

Source: OCDI Survey Report on Modernization of Port Management and Operation (entrusted by Ministry of Transport of Japanese Government)

158. It is possible to keep a competitive circumstance by dividing terminals into two or three yards and conceding them to operators separately. Even in this case, it is advisable that the apron and some portion of container yard just behind the quay side be kept for common space, mainly for container pre-stacking.

(b) Selection of concession fee system

159. There are three types of charges in general as follows.

- Flat rate type
  The owner (leaser) gives the user (lessee) the right to use assets for a specific period in exchange for a fixed amount of money.
- Mini-max rate type
  The owner gives the user the right to use fixed assets for a specific period in exchange for a variable amount of money. There is a minimum and a maximum amount of money for lease depending on the amount of activity.
- Shared revenue type
  The owner gives the user the right to use fixed assets for a specific period in exchange for a variable amount of the money, even though there is a minimum.

160. Concerning flat rate type, both lessor and lessee can easily forecast financial condition. The lessee may be able to generate excess profits if he can collect cargo of more than certain level. This system can educe the power of the private sector.

161. Concerning mini-max rate type, the lessee in this case may also be able to generate excess profits if he can collect cargo of more than a certain level. This system can withdraw the power of the private sector. The lessee is always subject to checks on its cargo turnover or revenue by the lessor, and there is a possibility that the public sector intervenes with private activities.

162. Concerning shared revenue type, revenue of the lessee is increased if cargo turn over is increased. The lessee has demerit that even if he makes effort to make revenue, a certain share of it is drawn up. The lessee is always subject to checks on its cargo turnover or revenue by the lessor, and the public sector intervenes with private activities. It is difficult for both sides to forecast financial condition.

163. APG has to examine which type of leasing scheme is better. It should be borne in mind, however, that flat-rate type and mini-max rate type is the better selection to attract the private sector, and thereby utilize the private sector's power to increase cargo turnover. This system would raise the ability of the lessee to collect cargo, the morale of employees, and would contribute to the future prosperity of APG.

(c) Countermeasures of a personnel cut

164. If privatization is introduced in APG, from the management point of view, reduction of personnel is considered to be necessary. However, the conclusion of this subject should be drawn after sufficient examinations of necessary matters such as national conditions, or labor problems, social customs, financial pressure by dismissal allowance etc..

165. As a course of actions that should be taken, a determination of the desirable organization necessary for effective management, a study of streamlining plans of organization, a review of volume of jobs at each division and section and determination of a reorganization plan and a proper number of personnel should be carried out as the first step.

166. As the next step, a proper plans for reshuffling of personnel and for personnel reduction should be made and implemented. For commercial management, it is important to keep a organization slender as much as possible. This will contribute to reduction of operating expenses (personnel cost and official expenditure).