9.2 Long-Term Development Plan for Containerized Cargoes in the Port of Manzanillo

9.2.1 Fundamentals of the Long-Term Development Plan

(1) Containerized Cargo Handling Volume in 2005

1) Containerized cargo

The containerized cargo volume handled at the Port of Manzanillo in the target year of 2005 is shown in Table 9.1.1 and Fig. 9.2.1. Both the containerized cargoes to/from the hinterland of Manzanillo and those transported to/from the port by domestic feeder vessels are presented in Fig. 9.2.1.

2) Container cargo volume at the container berths

The actual situation of containerized cargoes carried by each type of container vessels is summarized in Table 9.2.1.

Considering the smaller number of loading/discharging containers per vessel as well as the low occupancy rate of the existing berths, it would be reasonable for all the type III container vessels to utilize the general cargo berths. Given this, the study team assumes the share of each container vessel type of the cargo handling volume and the berth allotment of them in 2005 as Table 9.2.2.

(2) Forecast of Container Vessel Size and Type

Container vessels similar to those calling at the Port of Lazaro Cardenas are now calling at the Port of Manzanillo and this situation will continue. Therefore, the forecast of container vessel size adopted for the Port of Manzanillo is the same as that at the Port of Lazaro Cardenas (refer to section 9.1.1,(2)).

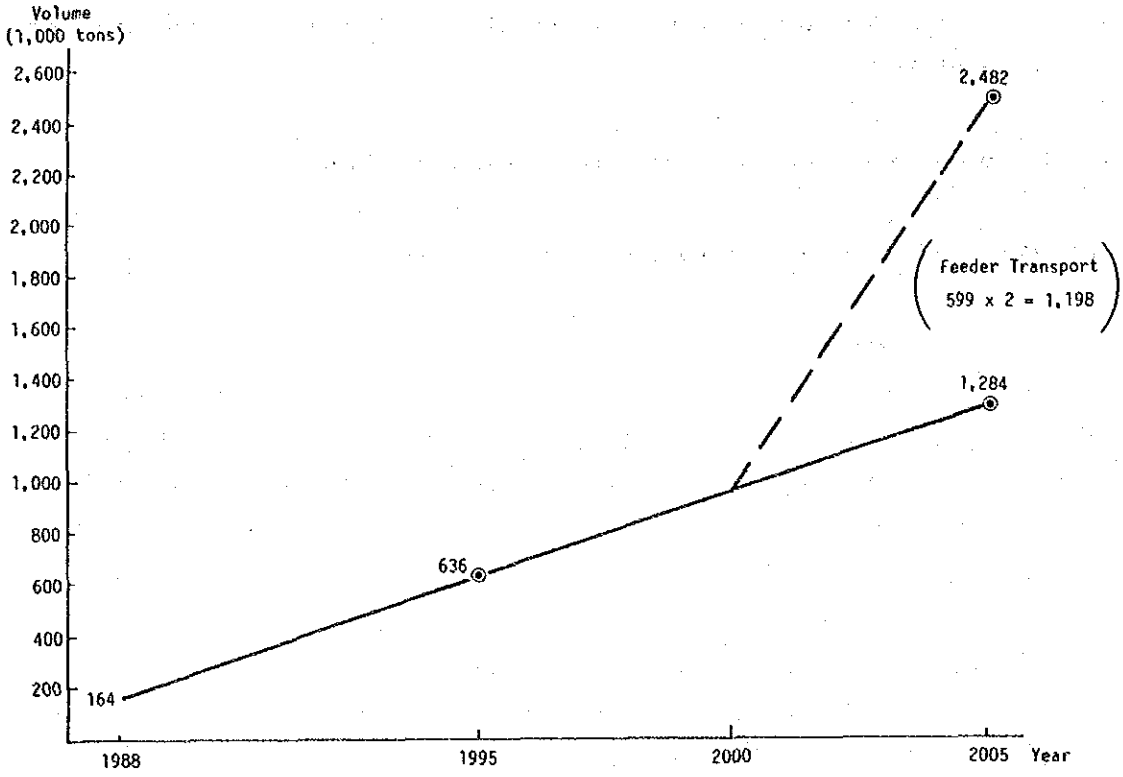


Fig. 9.2.1 Forecast Containerized Cargo Volume (Port of Manzanillo)

Table 9.2.1 Summary of Containerized Cargo by Container Vessel Type (Port of Manzanillo in 1988)

Type of Container Vessel	Shipping Lines	Loading/Discharging Number of Container per Vessel	Number of Calls per Month	Assumed Share in the Handling Volume
		box	call	%
I	TMM (Transportacion Maritima Mexicana	500 - 700	3	92
II	Nedlloyd Line	100	1	3
III	CACTUS	30 - 60	1 - 2	5
	Gran Colombia Line	15 - 20	1	
	Canadian Tropical Line	30 - 40	0 - 1	
	TMA (Transport Maritima Argentina)	30 - 40	0.5	

Source: Interviews at the port

Note : • Type I represents so-called mother vessels
• Type II represents international feeder vessels
• Type III represents multipurpose type vessels

Table 9.2.2 Containerized Cargoes by Container Vessel Type in the Year 2005 (Port of Manzanillo)

(Unit: 1,000 tons)

Type of Container Vessel		Assumed Share of Handling Volume	Containerized Cargo Volume		
			Container Berth	General Cargo Berth	Total
I	Import	92 %	358.8+217= 575.8	-	575.8
	Export	"	822.5+382= 1,204.5	-	1,204.5
	Sum	"	1,780.3	-	1,780.3
II	Import	3	11.7	-	11.7
	Export	"	26.8	-	26.8
	Sum	"	38.5	-	38.5
III	Import	5	-	19.5	19.5
	Export	"	-	44.7	44.7
	Sum	"	-	64.2	64.2
Sub Total	Import	100	587.5	19.5	607.0
	Export	"	1,231.3	44.7	1,276.0
	Sum	"	1,818.8	64.2	1,883.0
IV (Domestic Feeder)	Import	-	217.0	-	217.0
	Export	-	382.0	-	382.0
	Sum	-	599.0	-	598.0
Grand Total	Import	-	804.5	19.5	824.0
	Export	-	1,613.3	44.7	1,658.0
	Sum	-	2,417.8	64.2	2,482.0

Note: i. All of the domestic feeder cargoes are assumed to use type I container vessels.

(3) Required Number of Container Berths

1) Method of determining the number of berths

Refer to 9.1.1,(3),1).

2) Premises for calculation

The values for the short-term plan in 1995 are discussed together for purposes of comparison. Since the basic concept for examining the premises is the same as the Port of Lazaro Cardenas, further explanation of the premise can be found in section 9.1.1,(3),2).

a. Annual number of working days

The Number of days available for using berths is set at 340,given holidays and non-working days resulting from rainfall.

b. Cargo handling hours per day

Eighteen (18) hours is adopted as the number of planned hours.

c. The number of days necessary for purposes other than cargo handling

0.2 days per vessel are adopted which is the actual level at present.

d. Average cargo handling productivity per day per vessel

The same values as the Port of Lazaro Cardenas are adopted.

i. Containers

900 boxes/day/vessel	in 2005
720 "	in 1995

ii. Break bulk cargoes

2,700 boxes/day/vessel	in 2005
1,620 "	in 1995

e. Average number of container handled per vessel

i. Vessel type I

As explained in section 9.1.1, this value will show a great increase to 1,200 boxes/vessel in 2005 and a slight increase to 650 boxes/vessel in 1995 from the present 600 boxes/vessel.

ii. Vessel type II

The same value of 100 boxes/vessel is adopted both for 2005 and 1995.

iii. Vessel type IV

800 TEUs/vessel or 593 boxes/vessel is forecast, the same as at the Port of Lazaro Cardenas.

f. Average break bulk cargo volume handled per vessel

i. Vessel type I

This value will decrease to an estimated 400 tons/vessel in 2005 and 300 tons/vessel in 1995 from the present average of 800 tons/vessel.

ii. Vessel type III

A value of 700 tons/vessel is forecast.

iii. Vessel type IV

Considering the transportation of break bulk cargoes by domestic feeder vessels a value of 300 tons/vessel is assumed.

g. 20/40 foot container ratio

Presently 20 foot containers occupy around 62% at the total number of boxes handled at the Port of Manzanillo (refer to Appendix 9.2.1). In future the percentage of 40 foot containers is expected to increase in line with the world-wide trend, as the handling container throughput grows. In view of this, the 20/40 container ratio will be an estimated 56:44 in 1995 and 50:50 in 2005 (refer to Appendix 9.2.2).

h. Empty container ratio

This value will fall to an estimated 25% both in 1995 and 2005 from the present level of 38% (refer to Appendix 9.2.3). As for domestic feeder vessels a figure of 20% is adopted.

i. Unit weight of containers

The figure of 7 tons/TEU for imported containers and 11 tons/TEU for exported containers are adopted including domestic feeder containers for both in 1995 and 2005 (refer to Appendix 9.2.4).

j. Number of shifting containers

Based on the current level, 100 boxes/vessel is adopted for vessel type I.

3) Calculation of required number of container berths

Using each factor discussed above, the required number of container berths are calculated according to the procedures shown in Table 9.2.3.

Table 9.2.3 Calculation of Required Number of Berths

(Port of Lazaro Cardenas : 2005)

Items	Unit	Calculation	Vessel Type			
			I	II	IV	Total
① Containerized Cargo Volume (Import)	1000 tons		575.8	11.7	217	
② Containerized Cargo Volume (Export)	1000 tons		1,204.5	26.8	382	
③ Number of Loaded Containers	TEUs	①/7 +②/11	191,760	4,108	65,727	
④ Number of Loaded and Empty Containers	TEUs	③/(1-0.25)	255,680	5,480	82,200	343,360
⑤ Number of Loaded and Empty Containers	boxes	④/(1x0.50+2x0.50)	170,450	3,650	54,800	
⑥ Average Number of Containers Handled Per Vessel	boxes		1,200	60	593	
⑦ Number of Vessel Calls	calls	⑤/⑥	142	60.9	102	304.9
⑧ Container Handling Productivity per Day Per Vessel	box/day.vessel		900	900	900	
⑨ Berthing Days per Vessel for Container Handling	days	⑥/⑧	1.33	0.07	0.59	
⑩ Number of Shifting Containers	boxes		100	-	-	
⑪ Berthing Days per Vessel for Shifting Container Handling	days	⑩/⑧	0.11	-	-	
⑬ Average Break Bulk Cargo Volume Handled per Vessel	t		400	-	-	300
⑭ Break Bulk Cargo Handling Productivity per Day per Vessel	t/day.vessel		2,700	-	2,700	
⑮ Berthing Days per Vessel for Break Bulk Cargo Handling	days	⑬/⑭	0.15	-	0.11	
⑯ Number of Days Necessary other than Cargo Handling	days		0.2	0.2	0.1	
⑰ Total Berthing Days per Vessel	days	⑨+⑪+⑮+⑯	1.79	0.27	0.80	
⑱ Total Berthing Days	days	⑦x⑰	254	16	82	352
⑲ Berth Occupancy	%	⑱/(340xB)				
B (Number of Berth) : 1						104
2						52
3						35

Two (2) berths are required in 2005, which are deemed reasonable judging from the berth occupancy rate of 52% in the Table.

The number of type IV vessels, that is domestic feeder vessels calling implies about 8 round trips per month with 2 feeder vessel. This can be said to be an adequate frequency of feeder vessel service.

9.2.2 Site Selection

(1) Fundamental Policy

As outlined above, 2 container berths, 300m in length and 14m in water depth, are required in 2005. In the selection of the container terminal site, the following factors are considered essential:

i. Careful consideration of the actual geographical conditions
ii. Assuring enough area for container handling and storage
iii. Low level of construction costs
iv. Potential for the future expansion of the container terminal

(2) Alternatives for Terminal Site

Given the actual geographical conditions of the port and the requirement of early commencement of container terminal operation, the project site is limited to the extension area of "band C" of the inner port.

In these areas, the following three alternative sites are examined, as shown in Fig. 9.2.2:

Alternative I: The area adjacient to the existing C band quay involving 50m of the quay under construction.
Alternative II: The area adjacient to the existing C band quay beyond the portion of 50m of the quay mentioned above.
Alternative III: The area around 600m away from the existing C band quay.

(3) Evaluation of Alternatives

Alternative III is conceived so as to utilize the area that was reclaimed several years ago.

The comparison of the merits and defects of alternative III with

alternatives I and II is as follows (refer to Fig. 9.2.4 and Appendix 9.2.5).

i. The volume of reclamation in alternative III is smaller than that in alternatives I and II.

However, this will not affect the total construction cost greatly, because the share of reclamation cost to the total cost is not so large, as outlined in section 11.6.

ii. Alternative III enables provision of a much larger ares for the container terminal, although alternatives I or II can offer enough required area, as outlined later.

iii. Alternative III requires longer waterways as it is located far from the inner area of the port. This will cause increased dredging costs.

A considerable portion of the dredging costs may be possibly born by the reclamation project in the band C area. However, a turning basin for container vessels will be needed, especially when two berths are operated in the master plan, in front of the berths, to ensure the smooth and safe maneuvering of vessels (refer to appendix 9.2.5).

This will lend to huge dredging costs, a great problem in terms of implementing alternative III.

iv. Generally the volume of the settlement due to consolidation in alternative III is estimated to be smaller than in alternatives I and II. However, the condition will be the same as for the areas such as the empty container yard and the railway site. In addition, judging from the depth of the soft soil layer, the scale of the settlement at the site is estimated to be not that large.

v. In case of alternative III, it is necessary to draw up a master plan for the area between the band C area and the projected container terminal before implementation of the project.

vi. The site of alternative III is rather far away from the center of existing port.

Judging from the above considerations, alternative III is inferior to alternatives I or II.

The differences between alternatives I and II are not considered significant. From the viewpoint of the desirable layout of

facilities, alternative II is considered superior to alternative I, as outlined later, although alternative I does not seem to possess any major defects in this regard.

On the other hand, total construction cost, including the development of the band C area, would be higher in alternative II, because the length of the band wharves for three berths is considered adequate in the case of alternative I.

In view of the above, alternative I is adopted as the site of the container terminal.

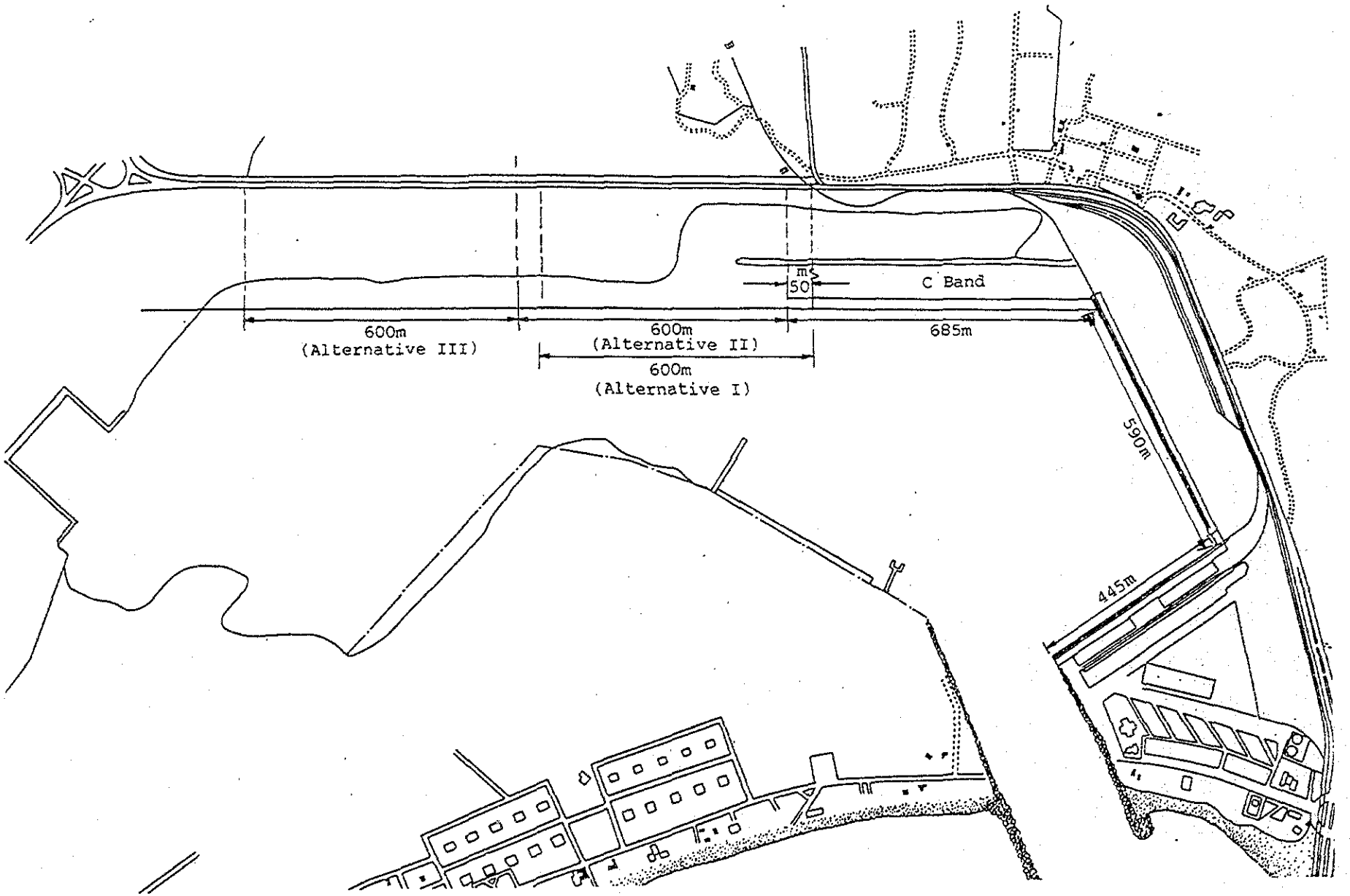


Fig. 9.2.2 Alternative Site for Container Terminal
(Port of Manzanillo)

9.2.3 Operation System

The container terminal at the Port of Manzanillo in 2005 is, as described later, planned at relatively wide area which does not have any definite obstacles for container handling operation. From the same reasons described in section 9.1.3, a transfer crane system is considered to be most preferable operation system at this port.

9.2.4 Required Scale of Facilities/Equipment

(1) Required Scale of Berths

Number of berth	2
Length of each berth	300 m
Depth of berth	-14 m

(2) Required Scale of Water Basin

The water basin for vessels' turning should ensure an area larger than a circle with a diameter of 2L (L: Length overall of planned vessel size, 270 m), in case of vessels' maneuvering assisted by tugboats, to allow the safe turning of vessels. This water area should be planned for the center of the water basin of the inner port.

(3) Required Scale of Storage Facilities

1) Premises for calculation

The values for the short-term plan in 1995 should be discussed together for purposes of comparison. Since the basic concept for examining the premises is the same as at the Port of Lazaro Cardenas, further explanation of the premises is available in section 9.1.4,(3),1).

a. *Stuffing/unstuffing ratio of container within the port*

The present actual value of this factor is estimated to be around 72% for imports 54% for exports and 70% in total which is too high, judging from the high FCL ratio of 85% in this port.

This stuffing/unstuffing ratio is forecast to and should decrease henceforth from the reasons given below.

. The LCL cargo ratio is expected to increase as the total number of container handled grow in the future.

- The obstacles which now cause the high ratio are expected to be removed gradually.

  These include the shortage of road trailers, the long procedure time for shipping, the large amount of ship convenience and the lack of inland depots.
- A governmental policy of reducing this ratio should be established so as to avoid the need for excessive volume of CFSs at container terminals.
- Shipping lines want to promote door-to-door transportation of containers.

In view of the above-mentioned conditions, the study team forecasts a ratio of around 40% in 1995 and 30% in 2005.

b. Dwelling time in CY and CFS

i. CY

At present, the average dwelling time in the CY (Container Yard) is estimated to be 8 days for imports, 5 days for exports and 10 days for empty containers. The reasons for the relatively short dwelling time for loaded import/export containers are that the stuffing/unstuffing ratio at the port is presently very high and that the cargoes are placed at other storage facilities, such as warehouses, for lengthy periods.

In the case of exclusive container terminals, the dwelling time of cargoes at CFS should be greatly decreased by implementing effective policies such as charging a high storage fee for CFS. Otherwise, CFS of a huge scale would be required, which is practically impossible. Here, it must be noticed that the reduction in dwelling time at the CFS area has a great effect in increasing the dwelling time of containers at the CY.

Taking these factors into consideration, the study team assumes the dwelling time at the CY to be 12 days in 1995 and 10 days in 2005 for loaded import containers and 10 days in 1995 and 8 days in 2005 for loaded export and empty containers.

As for domestic feeder containers a figure of 3 days of average dwelling time at CY is adopted.

ii. CFS

The average dwelling time of general cargoes for containers at the warehouses is presently around 15 days. As mentioned above,

the level of the dwelling time at the CFS area has to be greatly reduced. In view of the adequate scale of CFS and in line with the lengthening of dwelling time of containers at the CY, 6 days of average dwelling time at the CFS area is adopted both for 1995 and 2005.

c. Reefer containers

The reefer (or refrigerated container) is assumed to remain constant, that is, around 0.5 percent of the imported and 3 percent of exported containers, both for 1995 and 2005.

d. Returning empty containers

The percentage of returning empty containers is assumed to be 40% in 1995 and 30% in 2005 of the amount of loaded import containers, the same as at the Port of Lazaro Cardenas.

2) Scale of container yard

a. Calculation of storage volume

The required storage number of containers is calculated using the following formula:

$$M_L = \left(\frac{M_y}{D_y} \times D_w + M_I \right) \times P$$

where M_L : Required storage number of containers (TEUs)
M_y : Annual container throughput (TEUs)
D_w : Average dwelling days (days)
D_y : Operating days (350 days)
M_I : Half of the average number of container handled per vessel (TEUs)
P : Peak ratio (1.3)

Applying the premises mentioned previously to the above formula, the required storage number of containers is calculated as shown in Table 9.2.4.

b. Stacking height of containers

Shown in Table 9.2.4 (refer to section 9.1.4,(3),2)).

c. Required number of ground slots

$$S_L = M_L / L$$

where S_L : Required number of ground slots (TEUs)
M_L : Required storage number of containers (TEUs)
L : Stacking height of containers (Layers)

The results of the calculation are shown in Table 9.2.4.

3) Container freight station

The required area for CFS is calculated like that for the warehouse using the formula below:

$$A = (M_C \times D_W \times P) / (w \times \gamma \times D_y)$$

where A : Required floor area of CFS (m^2)
M_C : Annual handling volume of containerized cargo through CFS (tons)
D_W : Dwelling time at CFS (days)
P : Peak ratio (1.3)
w : Volume of cargoes per unit area (1.3 tons/m^2)
γ : Utilization rate of CFS floor (0.5)
D_y : Operating days of CFS (350 days)

Using the premises mentioned previously, the required CFS area is calculated as follows:

$$A = (360{,}530 \times 6 \times 1.3) / (1.3 \times 0.5 \times 350) = 12{,}360\ m^2$$

Table 9.2.4 Results of Required Storage Capacity in Container Yard (Port of Manzanillo in 2005)

Item	Unit	Loaded Containers				Empty Containers
		Import	Export	Reefer	Total	
M_L (Required Storage Number of Containers)	TEUs	3,190	2,600	100	5,890	1990
L (Stacking Height)	Layers	2.2	2.8	2		3
S_L (Required Number of Ground Slots)	Slots	1,450	929	50	2,429	663

(4) Required Amount of Cargo Handling Equipment

The basic ideas in this section is the same as the Port of Lazaro Cardenas. Therefore, the further explanation should be referred to section 9.1.4,(4).

1) Container handling system

a. From/to ship

Basic ideas are the same as at Lazallo Cardenas. Handling from/to ships will require a quay-side gantry (or container) crane system for the following reasons:

i. Quay-side gantry crane is the most popular system.

ii. It is the most expensive system. However it can get the highest throughput.

b. At terminals

Basic ideas are the same as at Lazaro Cardenas. Transfer crane system is recommended at the terminal.

2) Required number of units of cargo handling equipment

a. Design conditions

i. The container volumes to be handled at the port in the target years are as follows:

Import (Loaded)	52,930 TEU
Export (Loaded)	77,210 TEU
Empty	81,270 TEU
Feeder (Import)	62,000 TEU
Feeder (Export)	69,450 TEU
TOTAL	342,860 TEU

ii. Characteristics

Unit weight Import 7 t/TEU

Export 11 t/TEU

Ratio of 20/40 foot containers 50/50

Percentage of containers to be van/devan at port site

Import 40 %

Export 25 %

iii. Ship size

The maximum ship size planned for the quay-side gantry crane is

panamax size.

b. Quayside gantry crane

Basic ideas are the same as at Lazaro Cardenas. The required number of quayside gantry cranes is two units per berth.

In this case, the number of containers to be handled by each gantry crane per year will be as follows:

1995 43,340 TEU/Unit*year

2005 85,720 TEU/Unit*year

The above value in 2005 (85,720 TEU) seems to be rather large. Considering the ratio of 20/40 foot container, the number of containers which must be handled by each crane per year will be 57,150 boxes in 2005. The containers will be handled with difficulty.

General design of the planned quay-side gantry cranes is as shown in Fig. 9.2.3.

c. Minor cargo handling equipment

c-1. Introduction

Basic ideas are the same as at Lazaro Cardenas.

c-2. Transfer crane

The transfer crane system will be adopted at terminals. The detailed examination and calculation formula is stated in section 9.1.4,(4),1).

Rubber-tyred 10 units (6x3)

c-3. Chassis

The calculation formula is stated in a chapter on Lazaro Cardenas.

For shipping Nc = 16 units

For C.F.S. Nc = 48 units

Total N = 64 units

c-4. Tractors

N = 25 units

c-5. Fork-lifts

40t (Top lifter) for rail, reefer and general service (40 foot)

$$N = \frac{14,900 \times 0.5 \times 1.3}{350 \times 7 \times 6} = 0.58 = 1 \text{ unit}$$

25t (Top lifter) for rail, reefer and general service (20 foot)

$$N = \frac{14,900 \times 0.5 \times 1.3}{350 \times 7 \times 7} = 0.56 = 1 \text{ unit}$$

5t for empty containers

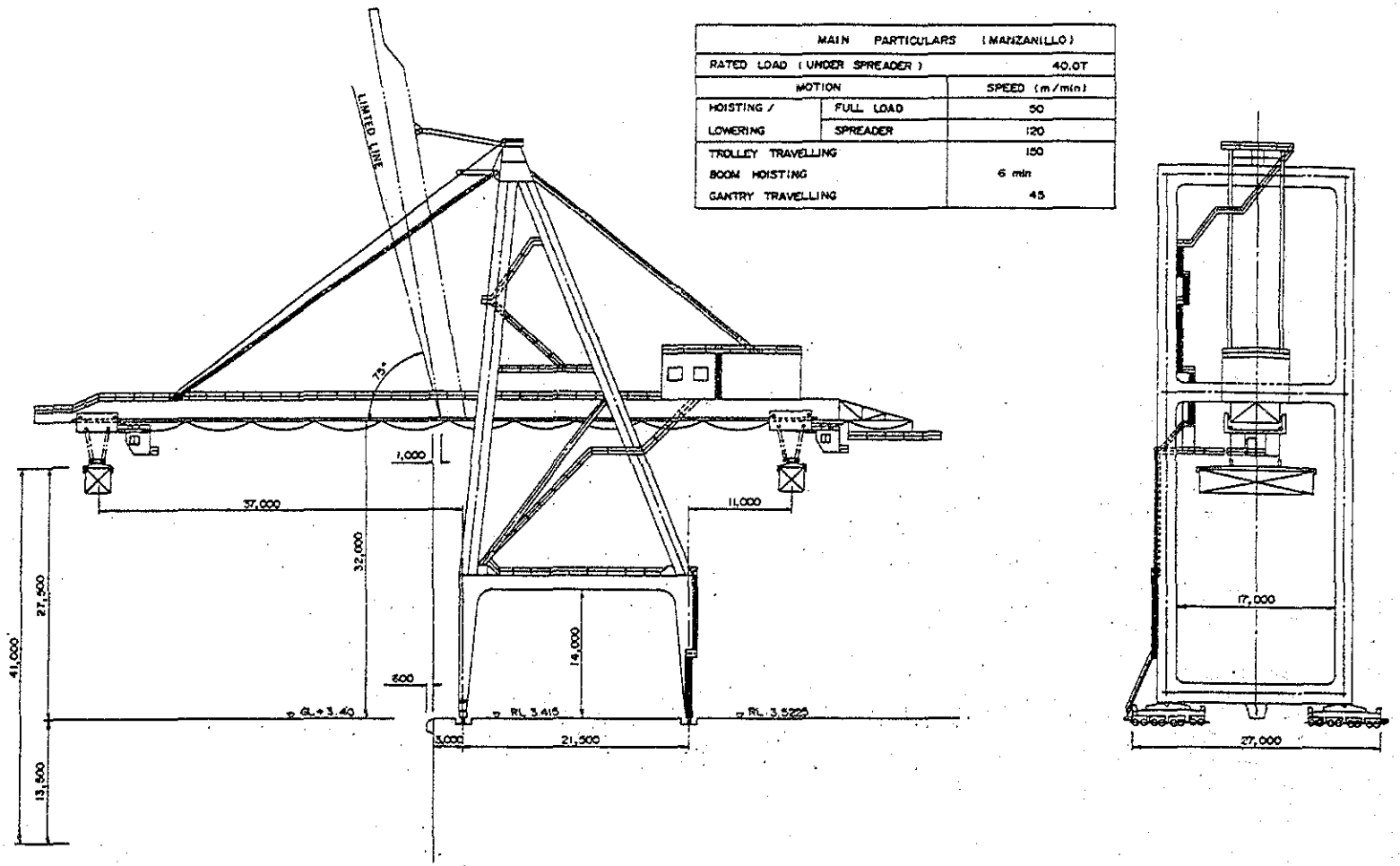
$$N = \frac{81,720 \times 1.3 \times 2 \times 1.05}{1.44(1.5) \times 350 \times 7 \times 10} = 6.07 = 7 \text{ units}$$

3t for trucks at C.F.S.

N = 28 units

2t for containers at C.F.S.

N = 56 units



Notes:

1. All dimensions are in millimeters unless otherwise indicated no dimensions shall be scaled
2. All elevations are in meters above mean sea level (MSL)
3. "A" type crane is shown but are also acceptable "H" type crane or "Transformed H" type crane

Fig. 9.2.3 Quayside Container Crane (40')

(5) Other Facilities

1) Terminal gate

A terminal gate with 8 truck lanes, 4 being equipped with truck scales, will be required. For a detailed examination, refer to the short-term plan.

2) Railway facilities

i. Share of railway in the land transportation of containers

Presently an estimated 18% of containers exported through the port of Manzanillo use railway freight cars for land transportation, according to interviews at the port. This ratio is not expected to increase significantly in the future, because of the condition of the roads connecting this port with its hinterland.

In this report, this share is assumed to be 10% both in 1995 and 2005 for imported containers and 20% both in 1995 and 2005 for exported containers.

ii. Share of railways in the land transportation of break bulk cargoes

Presently, around 13% of break bulk cargoes for stuffing containers are carried into the port by railway. It is assumed that this condition will not change significantly and so a ratio of 15% is forecast for both 1995 and 2005.

iii. Railway facilities

According to calculations, an estimated 80 TEUs of containers per day will be transported by railway into/out of the port in 2005. Assuming 25 - 30 freight cars comprise a train, one train is forecast to arrive at the port every two days.

3) Maintenance of the container handling equipment and containers

The basic ideas in the section is the same as the port of Lazaro Cardenas. Therefore, the further explanation should be referred to section 9.1.4,(5),3).

i. Method of maintenance

< Container handling equipment >

The study team recommends that the additional cargo handling

equipment for containers shall be repaired at the existing workshop.

Basic ideas are the same as at Lazaro Cardenas.

< Damaged containers >

Basic ideas are the same as at Lazaro Cardenas. The slightly damaged containers will be repaired with portable repair facilities at the repair block which will be provided at the terminal.

The seriously damaged containers will be repaired at the workshop.

< Dirty containers >

Basic ideas are the same as at Lazaro Cardenas. Most of the dirty containers will be cleaned with high pressure water at the block which will be prepared at the terminal.

If the containers cannot be cleaned with high pressure water, they shall be cleaned with steam at the workshop.

ii. Required facilities at the workshop

Basic ideas are the same as at Lazaro Cardenas. The required facilities of the workshop will be as follows:

. All types of tools for disassembling and assembling.
. Measuring tools.
. Rust removers, painting tools (brushes, rollers, sprays).
. Handling machinery (chain-blocks, hydraulic-jacks, vise).
. Machinery (compressor, battery charger, gas cutting and welding sets, electric welding machine, drilling machine (table type), grinder, steam cleaner, lathe (small universal type), hacksaw, centering surface plate).

iii. Arrangement of the persons in charge of the cargo handling facilities equipment of machine and electricity.

< Engineers >

Basic ideas are the same as at Lazaro Cardenas. The required number of engineers will be about 14 persons in the year 2005.

< Workers >

Basic ideas are the same as at Lazaro Cardenas. The required numbers of workers are follows:

1995	51 persons
2005	78 persons

9.2.5 Layout Plan

Based on the points discussed thus far, the layout plan of the facilities at the container terminals is examined in this section. The general layout plan is as illustrated in Fig. 9.2.4.

(1) General

The layout plan of the container terminal in 2005 is shown in Fig 9.2.5. The projected site has a spacious non-use area which provides sufficient room for a container terminal. However, the rear side of the site is limited by the hills behind the lagoon. The plan is drawn up so as to make the best use of the available area.

As mentioned in section 9.2.2, if the container berths are planned 50m northward, land use will become more efficient, as illustrated in Annex 9.2.6. However this alternative plan will incur higher total costs for the construction of berths on the band wharf.

(2) Layout of Facilities

i. An adequate number of ground slots for the storage of loaded import/export containers is planned in the container yards. Some of the backside stacking blocks are used for the stacking of empty containers.

ii. An empty container yard with sufficient storage capacity is planned beyond the trunk road running behind CFS.

iii. Two CFSs are planned corresponding to the required scale of operations. For the storage of break bulk cargoes carried by container vessels, a warehouse is installed outside the terminal. The location of the warehouse is decided considering the railway track connecting to the berths on C band.

As for break bulk cargoes handling, it is possible to shift the container vessels to the existing general cargo berths and there to load/discharge break bulk cargoes. However, this will cause the lengthening of vessels staying time in the port and increase charge to shipping lines for shifting vessels.

iv. Two quayside gantry cranes and five rubber tyerd transfer cranes are provided at each berth.

Sufficient space is ensured for the apron and passages to allow the

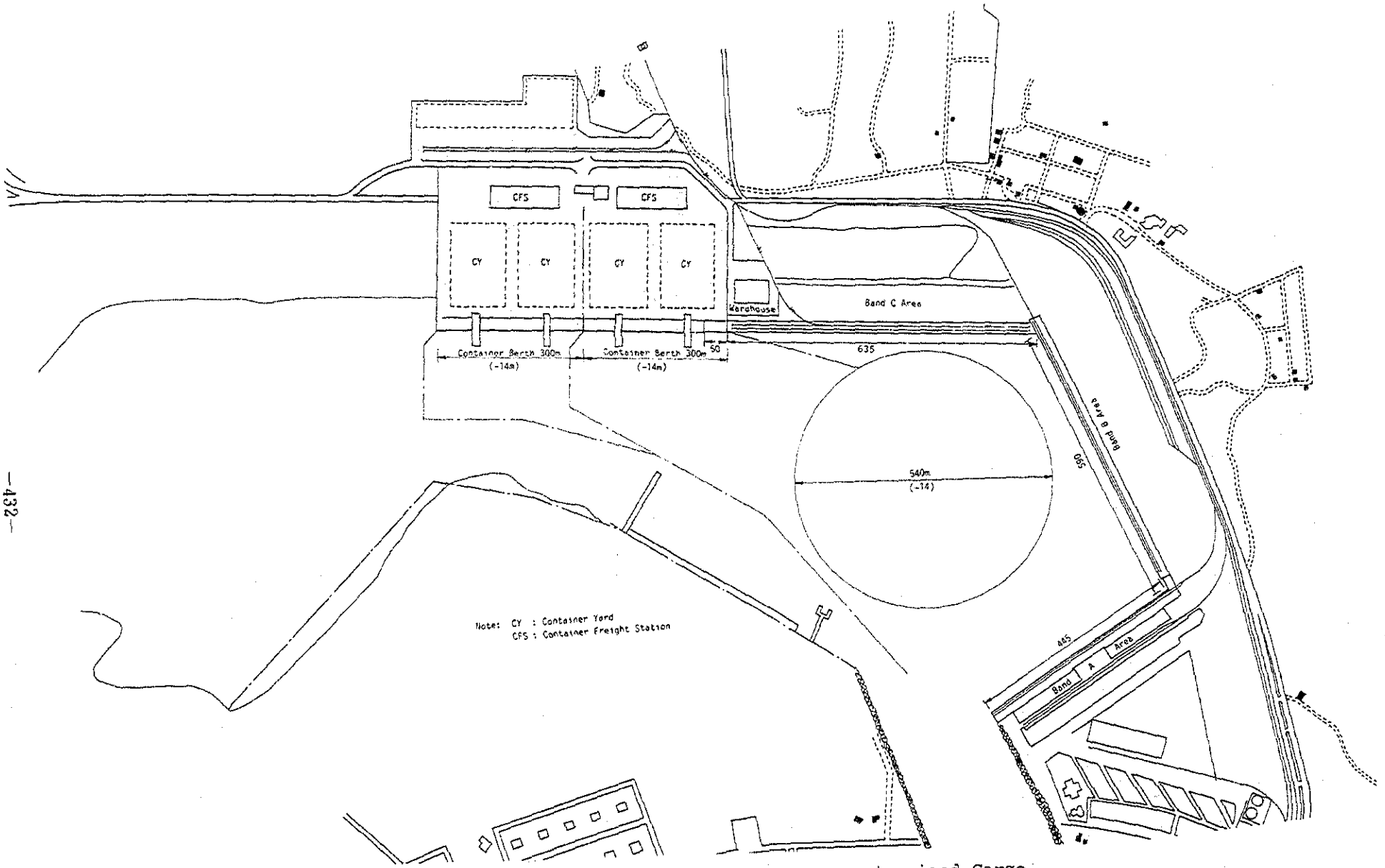


Fig. 9.2.4 General Layout Plan for Containerized Cargo
(Port of Manzanillo 2005)

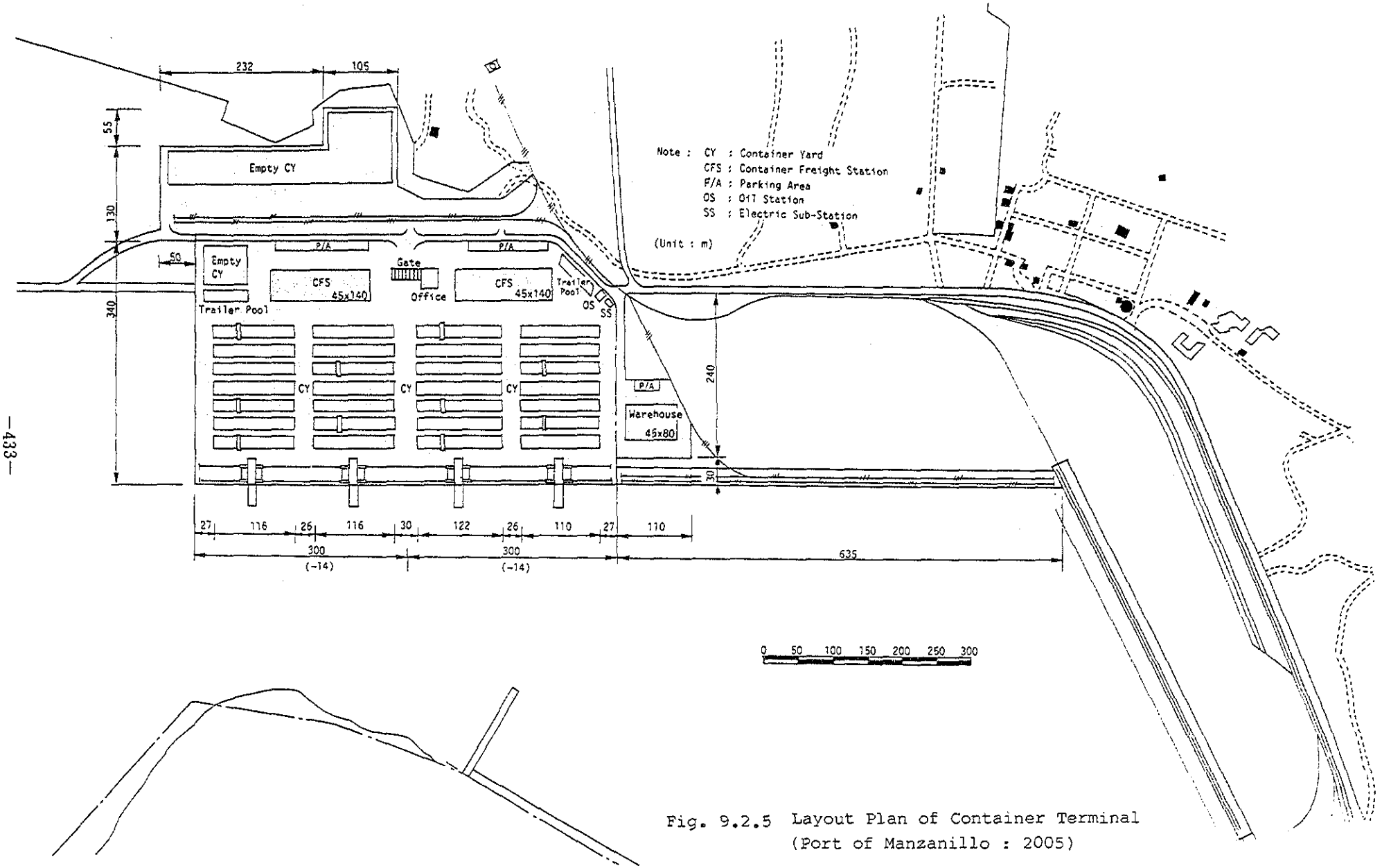


Fig. 9.2.5 Layout Plan of Container Terminal
(Port of Manzanillo : 2005)

smooth movement of trailers.

The central passage between the two berths is wider, because two-way movement of trailers is projected for this passage.

v. The terminal gate and office are located in the central position near the entrance.

vi. A maintenance shop is not planned for this container terminal for the reasons mentioned previously.

vii. Two railway tracks with lengths of 400 - 450m each are located behind the truck road.

viii. The trunk road is located 340m behind the quay line considering the necessary width for container yards and other facilities.

9.2.6 Operation System

(1) Management

In the port of Manzanillo, as in the case of the Port of Lazaro Cardenas, it is necessary to prepare a special container handling section in the ESP for the same reasons as the Port of Lazaro Cardenas except the estimated cargo volume of 2482 thousand tons in cluding feeder cargo in 2005.

The new container terminal organization in the ESP is proposed as shown in Fig. 9.2.6. The required numbers of personnels of the container terminal and operation section in the years of 1995 and 2005 are estimated as shown in the same Fig, based on the demand forecast.

(2) Premises Handling Operation Method

The container terminal master plan in 2005 is planned as two continuous terminals with 300 meters berth length and minus 14 meters water depth at each terminal. The container handling operation system will be transfer crane system, which has been selected for the reasons stated in this report in section 9.1.3, Operation System.

The study team estimated the following conditions for terminal master plan at the Port of Manzanillo.

a. Container berths	2 berths(berth length 600m)	
b. Quayside gantry cranes	4 units	
c. Transfer cranes	10 "	(6 lanes, 3 layer high)

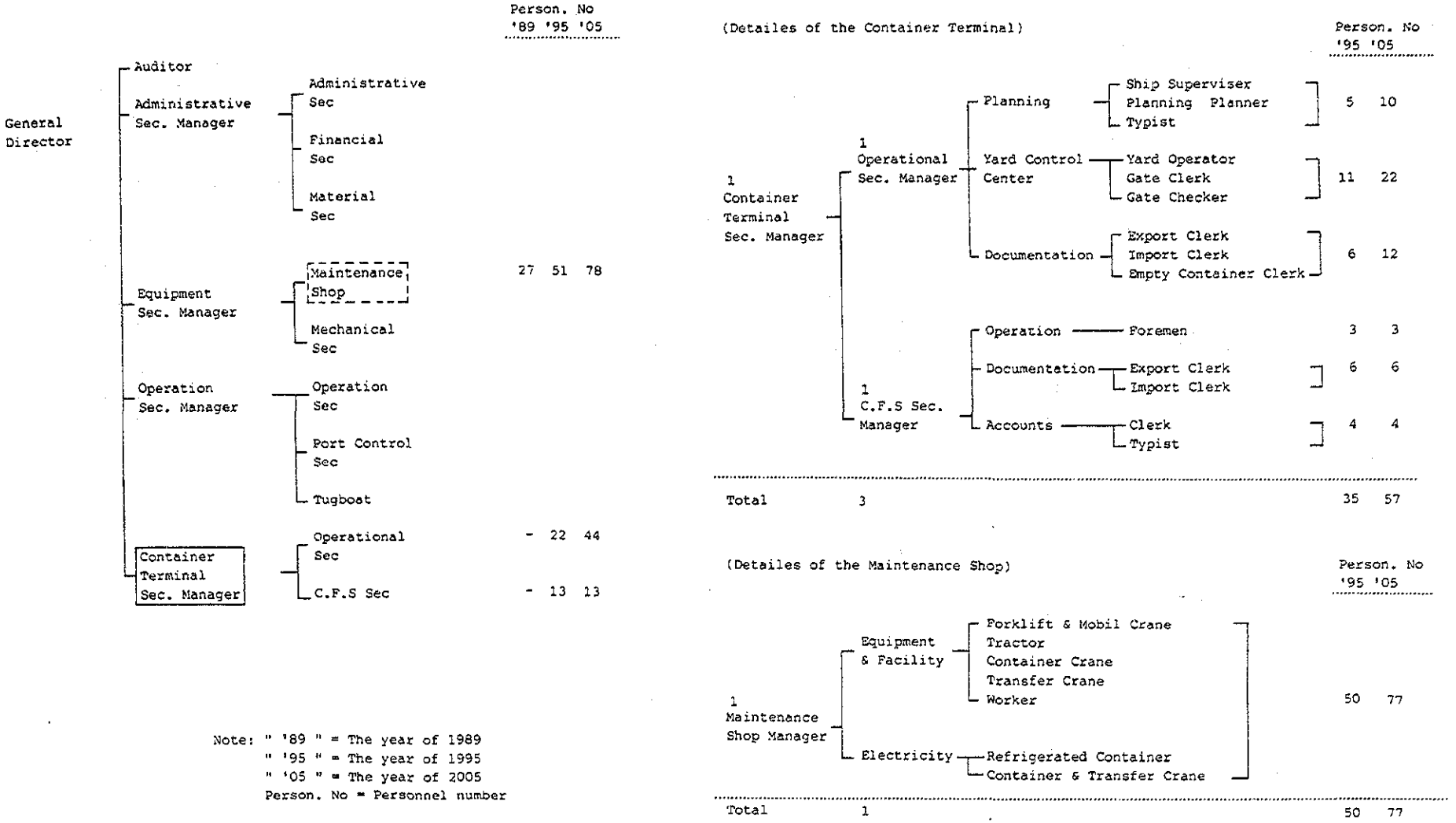


Fig. 9.2.6 Example of New Organization for the Container Terminal (Port of Manzanillo)

d.	Tractor heads	25 units
e.	Container chassis	74 " (20'/40' concurrent use)
f.	Containers handled per year	343,320 TEU
g.	Ships' calling at port per year	305 ships/year 1,800 TEU/ship(Vessel Type I) 90 TEU/ship(Vessel Type II) 800 TEU/ship(Vessel Type IV)
h.	Handling containers needed	
i.	CY storage containers needed	7,880 TEU

1) Terminal operation

Terminal operation consists of the following sections:

a.	Ship's planning section	(Ships discharging/loading operation)
b.	Yard control center section	(CY container movement/administration)
c.	Gate clerk section	(Gate check operation)
d.	Import and export documentation section	

Apart from the above, there are maintenance and CFS sections, as shown in organization chart Fig.9.2.6.

It is necessary that both sections have close contact with operation sections to ensure smooth terminal operation.

Each section's business details are shown in appendices 8.1.2 and 8.1.3 of this report. So that the outline of import and export container flow and operations of the Manzanillo port at 2005 year long-term plan are explained as follows.

2) Handling of imported containers

a. The ship's planner allocates the storage slots in the container yard for the discharging containers which are picked up from the ship's discharging stowage plan and ship's manifest and makes a discharging container sequence checklist.
b. The operation control center instructs each machine operator to implement terminal container operation exactly according to the

discharging container sequence checklist and if necessary sends extra orders to the machine operators by wireless telephone.

c. The yard control men check the concerned yard lanes when the ship's operation is finished and confirm whether the containers are placed exactly in the scheduled yard location.

   Also, container numbers in the yard are checked against the container numbers of the ship's manifest and the result of this checking is reported to the imported container documentation section.

d. The documentation section will send an arrival notice to the consignee and report to the confirmed discharging container list to the Customs procedures.

   When delivery schedules of containers are presented by the consignee, the documentation section will contact the gate clerk and at same time check the container's free time. If necessary, a storage charge for the overtime is assessed when the containers are brought out from the gate.

e. The gate clerk will check the delivery slip which is shown by the consignee trailer driver and confirm Customs import clearance and the paid storage receipt, if necessary. Then he will issue the EIR (out) and take the signature of the trailer driver and let the container leave the terminal.

3) *Handling exported containers*

a. The gate clerk will check the containers which are received from shippers by the time of 16:00 one day before the ship's arrival data and makes confirmation of the Customs export permission documents and gate in slip.

   Then he will issue EIR (in) and send the gate-in slip to the ship planner.

b. The yard clerk will confirm the container number and its yard storage location. He makes a container yard plan and sends it to the ship planner.

c. The export documentation clerk will confirm if the container cargo's Customs export clearance has been obtained or not by checking Customs documents.

When he finds uncleared Customs export permission, he should contact the shipper and arrange to prevent export of containers not cleared by Customs.

d. The ship planner will make a loading ship stowage plan by checking the container yard plan and Customs clearance. Then according to the loading ship stowage plan, the planner will make a loading container sequence checklist.

e. The operation control center will pass the details of the loading export container operation to the transfer crane operator and yard tractor driver according to the loading container sequence checklist.

The export container will then be transferred from the CY storage place to the gantry crane for loading onto the ship.

4) Shifting containers

Containers that are unloaded temporarily and reloaded before ship's departure time, on account of proper stowage in the ship, must be stowed temporarily into the container yard.

For shifting containers, the following points must be made:

a. They should be assorted and block-stowed according to their final destination.

b. They should be stowed as near as possible to the ship's berth apron.

Therefore when there are a lot of shifting containers, they should be block-stowed in the part of the container yard, close to the ship. When there are few containers to be shifted, containers are temporarily stowed on the ship side apron.

The operation control center men should control the number of containers to be shifted and their location so that he may not forget to reload it.

It is necessary to confirm that the shifted containers have finished being reloaded by the yard checking before the ship's departure.

5) Transshipped container

Containers which are unloaded from one vessel to be reloaded on

another vessel are stored in a given location in the container yard for the following reasons:

a. How long they are going to stay in the container yard before the second vessel's arrival.
b. When containers are to be reloaded onto several vessels they should be assorted and separately block-stowed in the container yard.

It is necessary to confirm transhiped containers' numbers and yard locations and to make sure they are reloaded onto another vessel to prevent delivery to the wrong consignee.

Also Customs transship permission should be confirmed properly.

(3) Terminal Operating Organization

Regarding the organization of operations at the new container terminal in 1995 and 2005 the following scenarios are possible.

a. System directly managed by ESP.
b. System directly managed by the shipping company.
c. Container terminal system managed by a private company with the will and necessary capital.

Given the present situation of Mexico's Pacific coast ports, direct ESP management system is assumed to be the most suitable. The reasons are as follows:

a. The volume of containerized cargo at the terminal is estimated not large enough for commercial economic bases and an adequate financial balance may not be maintained.
b. Many shipping companies are expected to call at the container terminal. Under this situation, an government-involved organization will be preferable as a management body.
c. The terminal also handles break bulk general cargoes which require warehouses and yard for this storage.
d. To maintain the present good relationship with the labor union, it is desirable to have long experience in this connection.
e. It is necessary to avoid overlapping organization between the new terminal management and the present ESP. It is preferable to have unified port area operation.

(4) Terminal Operating Staffs

When the new terminal opens, container ship operations will be handled at the new terminal. The necessary new container terminal staff members will be taken from the present ESP operational and maintenance staff members.

However, it will be necessary to recruit new staff members for new service starting at the terminal, like the CFS operation.

The administrative organization such as general affairs, accounting and finance sections will continue their present business and the new terminal's similar types of work will be managed concurrently by the same staff.

The present Manzanillo ESP organization has 173 staff members.

Operation and maintenance section	68 persons
General affairs and others	56 "
Secretaries	10 "
Port area patrol and administration	39 "

The new container terminal organization will have 97 staff memebers.

Shifted from ESP operation section	76 "
Administrative staff	8 (concurrent with ESP)
CFS operation staff	13 (increased)

When ships are operating, it will be necessary to obtain 44 workers from the labor union.

Container gantry crane operators	4 persons
Transfer crane operator	8 "
Tractor head driver	12 "
Top lifter driver	4 "
Lashing/unleashing workers	16 "

Chapter 10. Short-Term Improvement Plans in the Selected Ports

The short-term improvement plans in the target year of 1995 for containerized cargoes and bulk cargoes in the Ports of Lazaro Cardenas and Manzanillo are described in this chapter. The short-term plans for containerized cargoes are formulated based on the master plans in the previous chapter. On the other hand, the short-term plans for bulk cargoes focus on the main issues that the two ports are facing now.

10.1 Short-Term Improvement Plan for Containerized Cargoes in the Port of Lazaro Cardenas

10.1.1 Fundamentals of Short-Term Improvement Plan

(1) Containerized Cargo Handling Volume in 1995

The volume of containerized cargo through the port in 1995 is described in Table 9.1.1.

Assuming that the share of handling volume by vessel type and the berth allocation follow the same line as the master plan, the container cargo handling volume at the container berth is obtained as shown in Table 10.1.1.

Table 10.1.1 Containerized Cargoes by Container Vessel Type in the Year 1995 (Port of Lazaro Cardenas)

(Unit: 1,000 tons)

Type of Container Vessel		Assumed Share of the Handling Volume	Containerized Cargo Volume		
			Container Berth	General Cargo Berth	Total
I	Import	86 %	207.3	-	20.7
	Export	86	241.7	-	241.7
	Sum	86	449.0	-	449.0
II	Import	9	21.7	-	21.7
	Export	9	25.3	-	25.3
	Sum	9	47.0	-	47.0
III	Import	5	7.2	4.8	12.0
	Export	5	8.4	5.6	14.0
	Sum	5	15.6	10.4	26.0
Total	Import	100	236.2	4.8	241.0
	Export	100	257.4	5.6	281.0
	Sum	100	511.6	10.4	241.0

Note: i. Two-fifths of the containerized cargoes by vessel type III are assumed to go through the general cargo berths.

(2) Forecast of Container Vessel Size

Considering the sizes of the vessel now calling at the port and planned vessels in the master plan, the planned maximum vessel size in 1995 is assumed as shown in Table 10.1.2.

Table 10.1.2 Physical Characteristics of Planned Container Vessel and Container Berth in 1995

Type of Container	Container Capacity	Dead Weight Tonnage	Length Overall	Width Overall	Draught
I (Mother Vessel)	TEU 2500	tons 40,000	m 240	m 32	m 12

(3) Required Number of Container Berths

The method and premises for calculation are as represented in section 9.1.1,(3). Then, the required number of container berths is calculated according to the procedures show in Table 10.1.3.

From the berth occupancies in Table 10.1.3, one berth is adopted for the short term plan. Therefore, the existing container berth is the objective berth for the short-term plan.

10.1.2 Operating System

The Port of Lazaro Cardenas operates a container terminal which has one quayside gantry crane, two transfer cranes and two toplifters. According to this report, in 1995, this berth will have improved its facilities to remain a modern container terminal and will be able to cope with the increased container handling volume in 1995.

The operating system will be a transfer crane system because the Lazaro Cardenas ESP has experience in using that system. For further explanation, refer to section 9.1.3,(1).

10.1.3 Required Scale of Facilities/Equipment

(1) Required Scale of Berth

The existing container berth has a length of 286 m and a depth of 14 m, which are sufficient given the planned vessel size. The standard required water depth of berth for the planned vessel size is 13m.

(2) Required Scale of Water Basin

As described in 9.1.4,(2), an area larger than a circle with a diameter of 2L (L : Length Overall of planned vessel size 240 m) is required for vessels' turning, which is proposed for the water area in front of the berth. The required water depth of basin is 13m which is the same as the required water depth of berth.

Table 10.1.3 Calculation of Required Number of Berths

(Port of Lazaro Cardenas : 1995)

Items	Unit	Calculation	Vessel Type			
			I	II	III	Total
① Containerized Cargo Volume (Import)	1000 tons		207.3	21.7	7.2	
② Containerized Cargo Volume (Export)	1000 tons		241.7	25.3	8.4	
③ Number of Loaded Containers	TEUs	①/7+②/11	49,756	5,208	1,729	
④ Number of Loaded and Empty Containers	TEUs	③/(1-0.25)	66,341	6,944	2,305	75,590
⑤ Number of Loaded and Empty Containers	boxes	④/(1x0.75+2x0.25)	53,072	5,555	1,844	
⑥ Average Number of Containers Handled Per Vessel	boxes		700	100	90	
⑦ Number of Vessel Calls	calls	⑤/⑥	75.8	55.5	20.4	151.7
⑧ Container Handling Productivity per Day Per Vessel	box/day.vessel		720	720	720	
⑨ Berthing Days per Vessel for Container Handling	days	⑥/⑧	0.97	0.14	0.13	
⑩ Number of Shifting Containers	boxes		100	-	-	
⑪ Berthing Days per Vessel for Shifting Container Handling	days	⑩/⑧	0.14	-	-	
⑬ Average Break Bulk Cargo Volume Handled per Vessel	t		400	-	700	
⑭ Break Bulk Cargo Handling Productivity per Day per Vessel	t/day.vessel		1,620	-	1,620	
⑮ Berthing Days per Vessel for Break Bulk Cargo Handling	days	⑬/⑭	0.25	-	0.43	
⑯ Number of Days Necessary other than Cargo Handling	days		0.2	0.2	0.2	
⑰ Total Berthing Days per Vessel	days	⑨+⑪+⑮+⑯	1.56	0.34	0.76	
⑱ Total Berthing Days	days	⑦x⑰	118	19	15	152
⑲ Berth Occupancy	%	⑱/(350xB)				
B (Number of Berth) : 1						43
2						22

(3) **Required Scale of Storage Facilities**

The premises for calculation are as mentioned in section 9.1.4,(3),1).

1) Container yard

a. Calculation of storage volume by average dwelling time

As explained in section 9.1.4,(3),2), the required storage number of containers is calculated according to the following formula. The definition of each term in the formula should be referred to in the same section.

$$M_L = \left(\frac{M_y}{D_y} \times D_w + M_I \right) \times P$$

As for empty containers, the required storage volume for returning empty containers (refer to section 9.1.4 (3), 1), d) must be added, which is obtained by the following formula:

$$M_{LR} = \frac{M_{yR}}{D_y} \times D_{wR} \times P$$

where M_{LR} : Required storage number of returning contaienrs (TEUs)

M_{yR} : Annual volume of returning empty contaners (TEUs)

D_{wR} : Average dwelling days of returning containers (7 days)

D_y : Operating days (350 days)

P : Peak ratio (1.3)

Table 10.1.4 Required Storage Number of Container Calculated by Average Dwelling Days (Port of Lazaro Cargonas in 1995)

Items	Unit	Loaded Containers		Empty Containers	Total
		Import	Export		
Container Handling Volume	tons	236,000	275,400	--	511,600
Annual Container Throughput (M_y)	TEUs	33,740	22,950	18,900	75,590
① $\frac{M_y}{D_y} \times D_w \times P$	TEUs	1,504	852	702	569
② $M_I \times P$	"	254	173	142	569
③ M_{LR}	"	--	--	350	350
Total Required Storage Number (① + ② + ③)	"	1,758	1,025	1,194	3,977

Note : M_I is the half of average number of containers handled per vessels by type I vessel

b. Calculation of storage volume by dwelling curve

The storage volume can be calculated more precisely by examining the dwelling curve of containers into/out of container yard and overlapping the dwelling curves.

An actual example of a dwelling curve is shown in Appendix 10.1.1. Since there is no data concerning the actual dwelling curve at the Port of Lazaro Cardenas, the curve is assumed to be as shown in Fig. 10.1.1, which is represented by a exponential function which has the planned average dwelling time.

Prior to a vessel's arrival, the export containers at CY continue to be accumulated. From the moment of a vessel's arrival, the import containers begin to be discharged, followed by the loading of export containers. Then the import containers begin to be delivered from the CY. Thus, the storage number of containers at the CY by one vessel follows the change illustrated in the figure according to the time process.

The storage number of containers at the CY is then obtained by overlapping these dwelling curves of arriving vessels.

Fig. 10.1.2 shows the overlapping of the dwelling curves of type I vessels, assuming equal arrival intervals. Actually, the vessels will not arrive at equal intervals in 1995. However, the results are not considered to differ greatly.

It is obvious from Fig. 10.1.2 that the maximum storage number of containers in the CY is reached when all the import containers are loaded onto the CY. Then, counting the numbers of containers by all the vessels in the figure at this point and adding the dwelling containers by other types of vessels, the storage number of containers is obtained, as shown in Table 10.1.5.

The storage numbers by this method shows slightly larger figures than those in Table 10.1.4 and are adopted for developing the short-term plan.

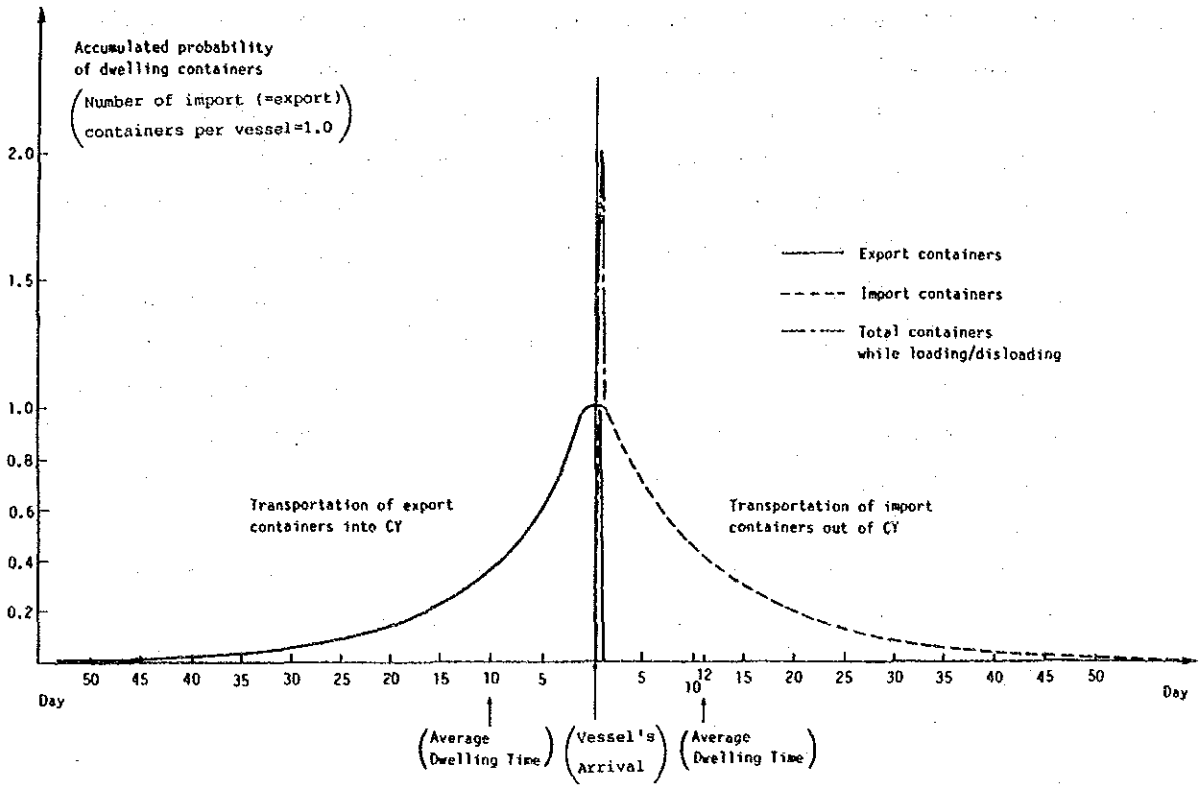


Fig. 10.1.1 Model of Dwelling Containers at Container Yard

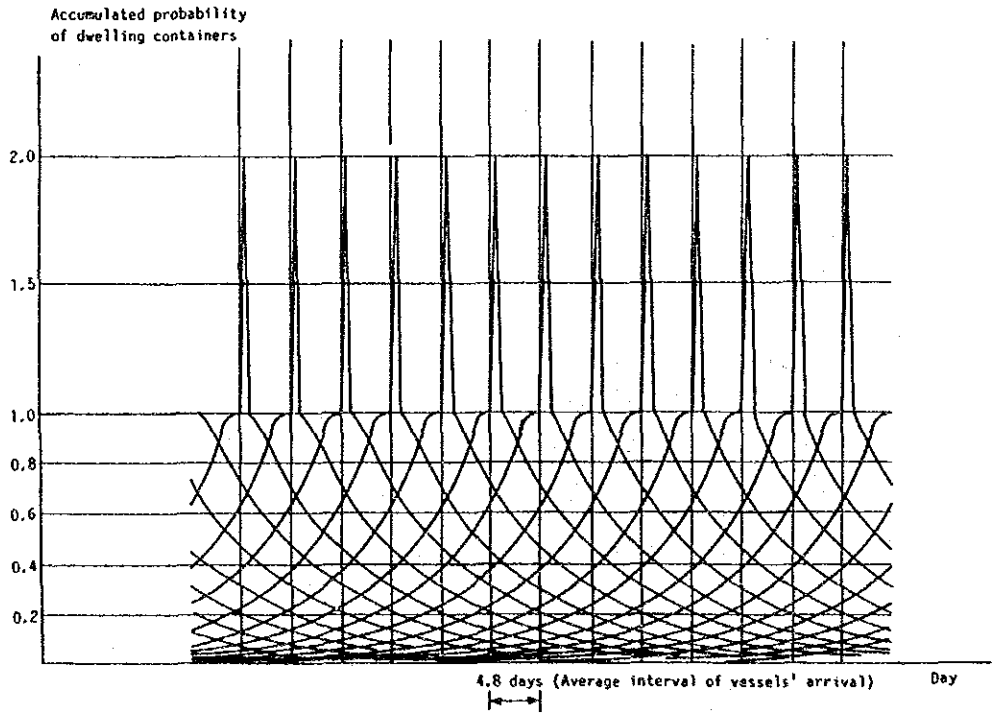


Fig. 10.1.2 Movement of Dwelling Container by Arrival of Type I Container Vessel (Port of Lazaro Cardenas)

Table 10.1.5 Required Storage Number of Containers Calculated by Dwelling Curves (Port of Lazaro Cardenas in 1995)

(Unit: TEUs)

Loaded Containers		Empty Containers	Total
Import	Export		
1,800	1,020	1,190	4,010

Note: i. Peak ratio of 1.3 is assumed.
ii. Empty containers include returning empty containers.
iii. 30 TEUs of the export are reefers.

c. Required number of ground slots

Using the same stacking height as used in the master plan, the required number of ground slots in the container yard is calculated and is shown in Table 10.1.6.

Table 10.1.6 Results of Required Storage Capacity in Container Yard (Port of Lazaro Cardenas in 1995)

Item	Unit	Loaded Containers				Empty Container
		Import	Export	Reefer	Total	
Required Storage Number of Containers	TEUs	1,800	990	30	2,820	1,190
Stacking Height	Layers	2.2	2.8	2		3
Required Number of Ground Slots	Slots	818	354	15	1,187	397

2) Container freight station

Using the same formula and premises used in the master plan, the required CFS area is calculated as follows:

$$A = (M_C \times D_W \times P) / (w \times \gamma \times D_y)$$
$$= (51,160 \times 10 \times 1.3) / (1.3 \times 0.5 \times 350) = 2,920\ m^2$$

Considering that the width of the existing CFS is 32 m, the required length of the CFS becomes around 90m, less than the actual length of 160m.

3) Storage facility for break bulk cargoes

The annual volume of break bulk cargoes carried by container vessels is calculated to be around 44,600 tons by multiplying the average break bulk cargo volume per vessel and number of vessel calls, as shown in Table 10.1.3.

The required area of storage area is calculated as follows:

$$A = (M_S \times D_W \times P) / (w \times \gamma \times D_y)$$
$$= (44,600 \times 15 \times 1.3) / (1.3 \times 0.5 \times 350) = 3,820\ m^2$$

These break bulk cargoes are stored at the existing warehouses and the planned open storage yard.

(4) Required Amount of Cargo Handling Equipment

1) Required amount of cargo handling equipment

The basic ideas and the calculation methods are the same as the master plan. Therefore, the further explanation should be referred to section 9.1.4,(4).

a. Design conditions

i. The container volumes to be handled at the port in the target years are as follows:

Import	33,740	TEU
Export	22,950	TEU
Empty	18,900	TEU
TOTAL	75,590	TEU

ii. Characteristics

Unit weight	Import	7	t/TEU
	Export	12	t/TEU
	Export(Feeder)	15	t/TEU
Ratio of 20/40 feet container		20 feet	75 %
		40 feet	25 %
Percentage of containers to be Stuffed/unstuffed at port site		10 %	

iii. Ship size

The maximum ship size planned for the quay-side container cranes is panamax size.

b. Quay-side containers cranes

Basic ideas are stated in section 9.1.4,(4). Two quay-side container cranes will be provided.

c. Minor cargo handling equipment

Basic ideas and detailed calculations are stated in section 9.1.4,(4).

The required number of cargo handling items are as follows:

Transfer cranes

Rubber-tyred	4 units	(6x3)
Rubber-tyred	2 units	(3x2) (Existing)

Chassis 15 units

Fork-lifts

40 t (Top-lift)	1 units
25 t (Top-lift)	2 units
5 t	2 units
3 t	3 units
2 t	6 units

2) Outline of proposed cargo handling equipment

a. Quay-side gantry cranes

i. Type

< Trolley type >

There are three trolley types of quay-side gantry crane. The rope trolley type is the most common (its share is about 60% - 70%). In this type, motors both for hoisting and for travelling are located in the machinery room. The features of this type of crane are as follows:

. Weight of the crane is minimized. (Small initial cost)

. High reliability because of few power cables to the trolley.

. Large maintenance cost for wire rope.

The rope trolley type crane is recommended.

< Number of trolleys >

The double trolley system was developed a few years ago and is already employed in some large ports.

Its productivity is about twice that of the single trolley

system and the price is about twice as much as that system.

The conditions required to introduce the double trolley type are as follows:

- The containers to be handled at the berth are very large.
- Handling capacity of the container terminals is large.
- Handling technique and operation system at the container terminal have been developed.

The single trolley system is recommended for this port.

< Main frame profile of the quay-side gantry cranes >

In general, the quay-side gantry crane frames are classified into two types : A-frame and H-frame. Each manufacturer of the crane has introduced A-shape, H-shape or transformed H-shape. It is not appropriate to determine the frame type before procurement.

< Control system >

Generally control systems of the crane are classified into 2 types : M-G System (Ward-Leonard Control System, Motor-Generator sets), and Thyristor Control System.

If arrangements are made to ensure an even and reliable power supply, the consultant recommends introduction of a thyristor control system.

ii. Basic Dimensions

Hoisting capacity (under spreader)	min.	40 t
Outreach	min.	36 m (21.5 m)
Span		16.76 m
Backreach	min.	11 m
Lift	min.	41 m
Lift (above rail)	min.	27.5 m
Lift (below rail)	min.	13.5 m
Width (buffer to buffer)	smaller than	27 m
Portal clearance (between sea side legs)	min.	17 m
Cross beam height (between front legs)	max.	4 m
Height under cross beam (between front/rear legs)	min.	14 m
Boom width	max.	6.1 m

iii. Operating speed

Main hoist	
with full load	50 m/min.
with 18t load under spreader	85 m/min.
with empty spreader	120 m/min.
Trolley travelling	150 m/min.
Gantry travelling	45 m/min.
Boom hoisting (to raise and lower)	6 m/min.

b. Minor cargo handling equipment

i. Transfer crane

< Basic dimensions >

Hoisting capacity	
Including spreader	40 t
Under spreader	30.5 t
Span	23.47 m
Lift (under spreader)	12.20 m
Trolley travelling range	19.0 m
Wheel base	6.9 m
Number of wheels	8 (8 or 16) wheels

< Operating speed >

Hoisting	
with full load	12 m/min.
with empty spreader	24 m/min.
Trolley travelling	55 m/min.
Gantry travelling (with no load)	90 m/min.

< Others >

Spreader

Telescopic type for 20, 40, 45 feet containers

Power supply Self-contained diesel generator set min. 260 PS

The basic dimensions and operating speed of the other minor cargo handling equipment (Chassis, Tractor and Fork-lift) are neglected because they are not so important at this stage.

(5) Other Facilities

1) Terminal gate

The required number of truck lanes is calculated by the following formula:

$$N = V \times S / 60$$

where N : Required number of truck lanes
V : Hourly number of trucks into/out of terminal at peak hour (cars/hour)
S : Necessary procedure time per truck (minutes)

Using Fig. 10.1.2 to obtain the daily number of trucks into/out of terminal and taking into account the hourly variation in the number of trucks, the value V in the above formula is estimated at around 27 for incoming and 17 for outgoing trucks. Then, taking an adequate value for S, the required number of truck lanes is calculated as follows:

Lanes for incoming tracks $N = 27 \times 4 / 60 = 1.8$
Lanes for outgoing tracks $N = 17 \times 3 / 60 = 0.9$

Considering some necessary allowance, 4 lanes are planned, 2 of which should be equipped with truck scales.

2) Terminal office

The required area for the terminal office will depend on the method of operation and other factors. Assuming around 10 m^2 of required floor area per person and considering some allowance for uncertainty, around 600 m^2 of terminal office will be required.

3) Railway facilities

Based on the premises described in sections 9.1.4,(5),2), around 100 TEUs of containers per day are estimated to be transported by railway into/out of the port in 1995. Assuming 20 - 25 freight cars comprise a train, one train is projected to arrive at the port per day.

4) Maintenance of the container handling equipment and containers

a. Method of maintenance

Basic ideas are stated in section 9.1.4,(5),3).

The additional new handling equipment will be repaired at the improved workshop.

Most of the damaged containers will be repaired with portable repair facilities at the repair block which will be prepared at the terminal. A few containers will be repaired at the workshop.

Most of the dirty containers will be cleaned with high pressure water at the block which will be prepared at the terminal. A few containers will be cleaned with steam at the workshop.

b. Required facilities at maintenance shop

Basic ideas and details are stated in section 9.1.4,(5),3). Most of the facilities listed in Chapter 9 will be installed in 1995.

c. Arrangement of the persons in charge of cargo handling facilities/ equipment (of machine and electricity)

Basic ideas and details are stated in section 9.1.4,(5),3). The required number of engineers will be about 10 persons in 1995.

The required number of workers will be 40 persons in 1995.

5) Others

a. Repair of damaged containers

On the assumption that about 5 % of the loaded containers the container terminal will receive will be damaged, a container repair yard of around 600 m^2 is allowed for.

b. Fumigation of containers

In Mexico almost all loaded import containers must be fumigated at present which seems unusual compared to the present situation in other countries. This situation should be reformed. Otherwise, the container terminal will need a large area of fumigation yard.

Assuming that 10 % of loaded import containers have to be transferred to an exclusive yard for fumigation and considering 3 days of dwelling time, a fumigation yard of around 600m^2 is allowed for.

c. Washing and cleaning containers

For washing and cleaning of empty containers, a yard of around 300m² is allowed for.

d. Customs inspection

Based on the actual situation, around 10 % of loaded import containers are assumed to go through the physical check by Customs, including some checked by unstuffing containers. Thus a Customs inspection yard of about 400 m² is included.

e. Others

Necessary facilities such as an electric sub-station, an oil station, parking areas for road trailers, roads trucks and yard tractor-chassis are included in the facilities layout.

10.1.4 Layout Plan

(1) Existing Container Terminal

The layout plan of this area is shown in Fig. 10.1.3.

i. The berth is equipped with two quayside gantry cranes, one of which is the existing one.

ii. The existence of lighting poles in the CY is fully considered in planning the stacking yard.

4 6-lines type transfer cranes are introduced as shown in Fig. 10.1.3, while the existing 2 3-lines type transfer cranes are placed in the area behind the CY.

iii. The general ground slot allotment is as shown in Fig. 10.1.4. The empty container yard is laid out at the most backward position of CY where the existing reefer plugs should be removed.

iv. Adequate space for apron and passages is planned so as to allow the smooth movement of trailers.

v. The necessary area for the terminal office is ensured by rebuilding the existing office.

vi. The Customs inspection yard is laid out adjacent to the reefer yard.

(2) Area behind the General Cargo Berths

The facility layout plan is shown in Fig. 10.1.3. This is formulated in line with the master plan.

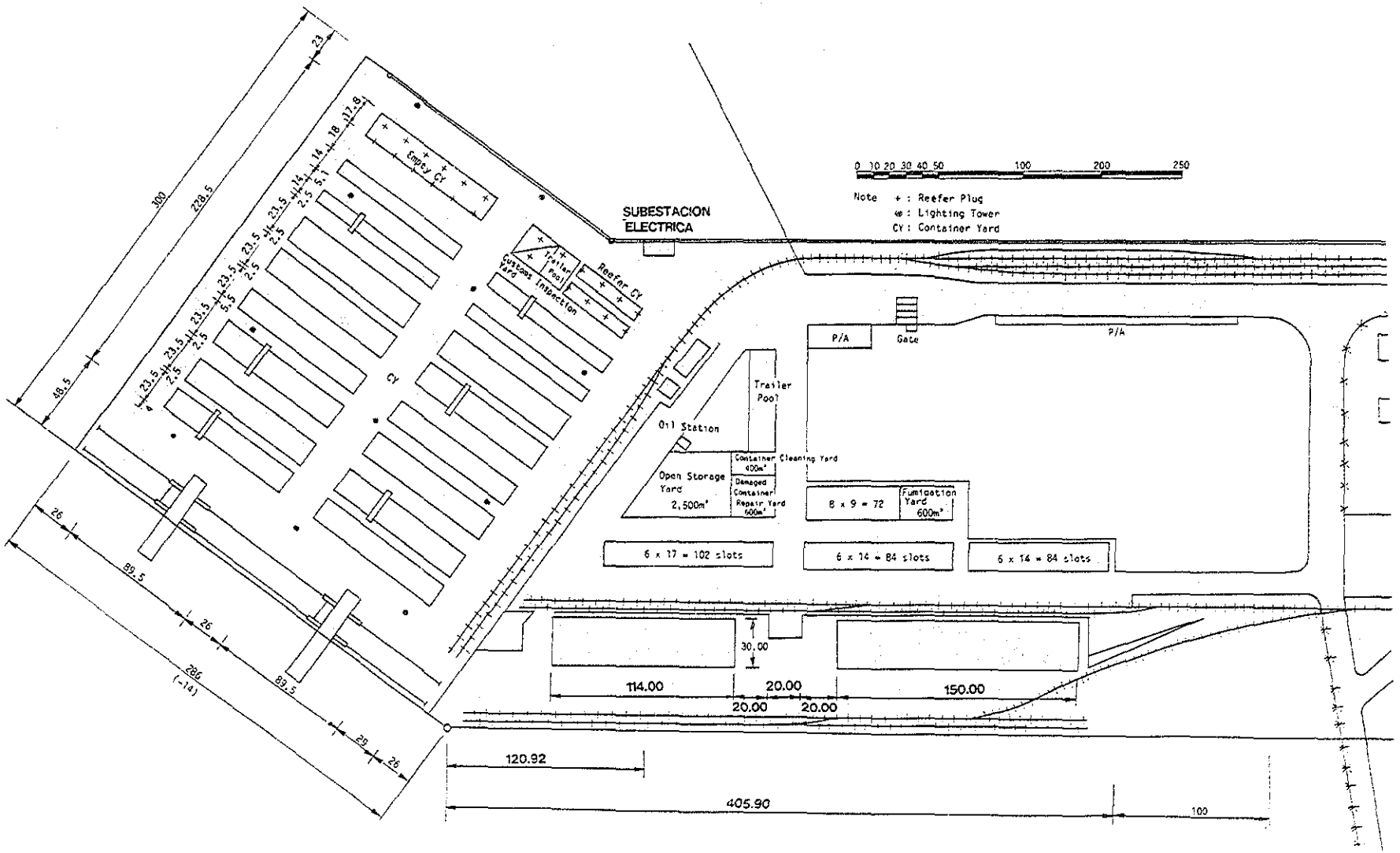


Fig. 10.1.3 Layout Plan of Exsisting Container Terminal and the Area behind the General Cargo Berths (Port of Lazaro Cardenas)

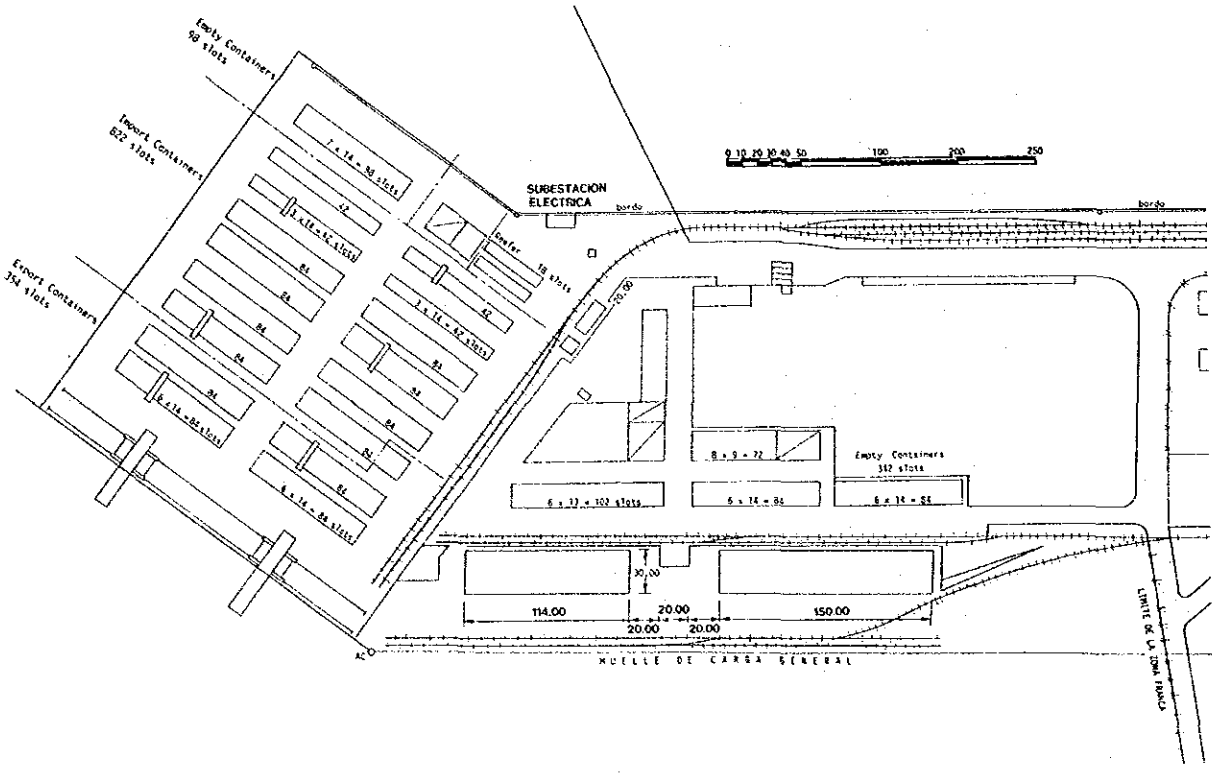


Fig. 10.1.4 Ground Slot Allotment of Container Yard
(Port of Lazaro Cardenas : 1995)

i. A road is laid out in the area adjacent to the container terminal. This road is planned for the smooth passage of trailers into/out of the container terminal and that of trucks into/out of the general cargo berths. Another road linked with the access road of the port is planned behind the warehouses.

ii. The empty container yard is laid out parallel to the railway tracks, considering that a considerable number of empty containers are carried by railway.

iii. The terminal gate is placed at the entrance to the container terminal with parking areas for incoming and outgoing road trailers.

iv. An open storage yard is placed for the storage of break bulk cargoes for container vessels and conventional liners.

v. The required scale of damaged container yard, container cleaning yard and fumigation yard are laid out at the back of empty container yard.

vi. The yard trailer parking area is positioned near the terminal office with the oil station.

(3) CFS Area

Fig. 10.1.5 shows the layout plan of the CFS area.

i. Required scale of the CFS is illustrated in the figure.

ii. Adequate parking areas for both trailers and trucks are arranged

iii. An empty container yard is provided in order to store empty containers related to the CFS.

10.1.5 Management and Operation System

(1) Management

The containerized cargo volume treated in this port is estimated at 522 thousand tons in 1995. In order to handle the antisipated container traffic at the container terminal efficiently, a special container terminal section is required as described in section 9.1.6.

The new container terminal organization in ESP and the required number of personnels are reffered to section 9.1.6.

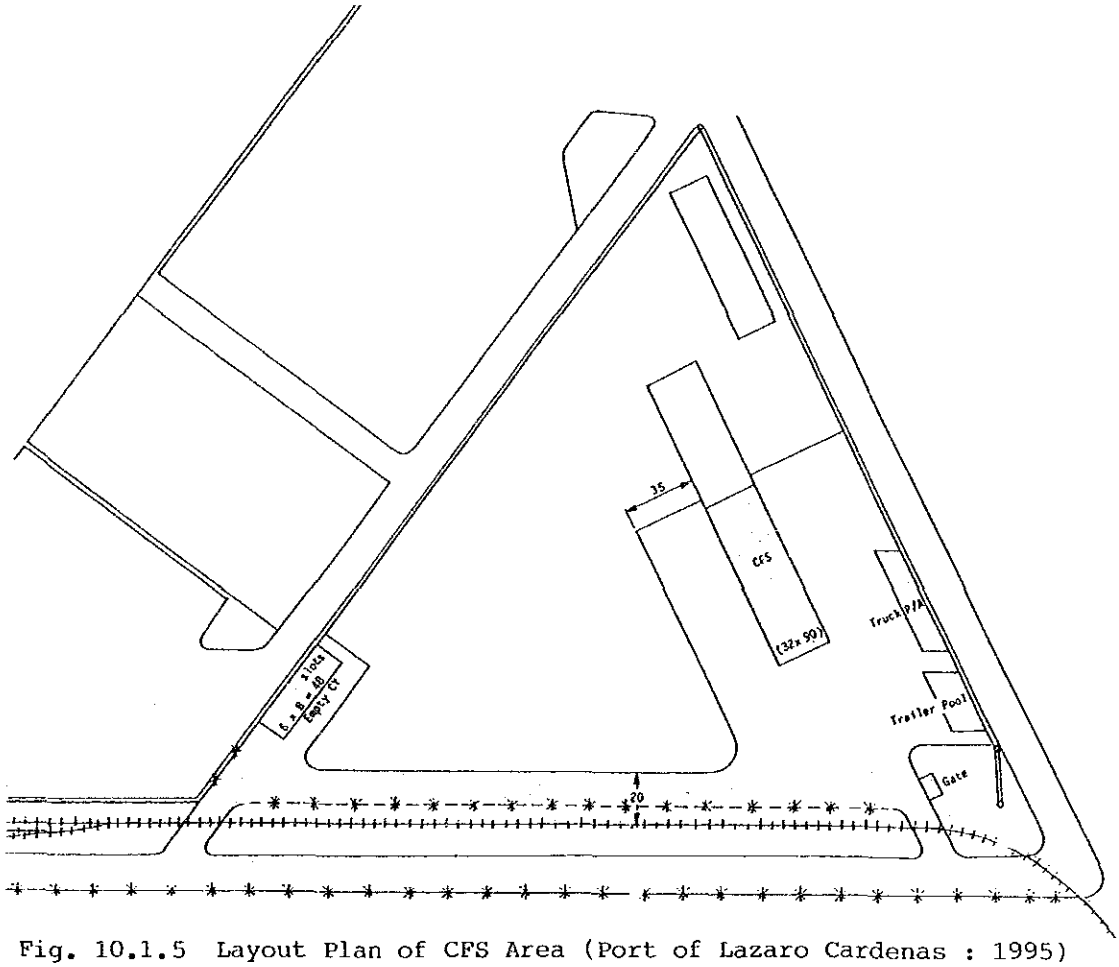


Fig. 10.1.5 Layout Plan of CFS Area (Port of Lazaro Cardenas : 1995)

(2) Premises and Handling Operation Method

The study team forecasts the container terminal conditions in 1995 at the Port of Lazaro Cardenas to be as follows:

a. Container berth	1 berth (berth length 286m)
b. Gantry cranes	2 units
c. Transfer cranes	2 units (3 lanes, 2 layers high)
	4 " (6 lanes, 3 layers high)
d. Tractor heads	11 "
e. Container chassis	15 " (20'/40' concurrent use)
f. Containers handled per year	56,690 TEU
g. Ships calling at port per year	152 ships/year
h. Containers handled per ship	875 TEU/ship (Vessel type I)
	125 " (" II)
	113 " (" III)
i. Necessary CY storage	4,010 TEU

1) General cargo handling

The break bulk general cargo which is discharged from the ships berthing at the new container terminal is handled as follows:

In both loading and discharging operations, general cargoes are handled by the ship's gear and cargoes from 10 tons up to 50 tons are handled by the quayside gantry crane.

All the general cargoes used to be handled via the pier apron. Discharged general cargo pass through the berth apron and are directly transferred to the warehouse that belongs to the general cargo berth.

Loading general cargoes are loaded from the pier apron directly or are received at the general cargo berth warehouse before the ship's arrival.

The transfer operation uses trucks and forklifts (3 - 20 tons). The point to be noted is that general cargoes should be transferred as quickly as possible to the general cargo berth warehouse in order to avoid disturbing smooth container terminal operation.

2) Container cargo handling

Detailed explanations of each terminal section operation are described in the appendices 8.1.2 and 8.1.3 of this report.

The following are the key points of the transfer crane system

container terminal operation, which is based on the short-term plan at Lazaro Cardenas in 1995, and the container export/import traffic at the container terminal.

a. Key points of transfer crane system container terminal operation

i. The traffic flow system of vehicles such as tractor head and chassis should be controlled by basically using a oneway traffic system.

ii. On the ship side apron, vehicles should travel in one direction, from the ship's stern to the bow.

iii. Under the transfer crane lane passage, the container chassis should be strictly controlled by using a oneway traffic system.

iv. Lines dividing lanes and directional arrows should be painted clearly in the container terminal.

v. Before beginning terminal operations, an transfer crane operators, tractor head drivers and quayside gantry crane operators should be well instructed the day's work operations in terms of the yard plan and the container loading/unloading sequence checklist.

They should have good understanding of the terminal operations, which are under the control of the operation center.

When changing an operation plan, the new plan should be communicated to the section concerned by the operation control center using a wireless phone.

vi. Each operator and worker should report at once if they have questions regarding operations and get clear instructions.

vii. When the ship's operation is interrupted by a labor shift change or completion, the yard clerk will check the yard plan and actual container number and location. The yard clerk can then confirm the correct actual yard plan.

viii. When questionable container movement has occurred in the container terminal operation, the control center will check the container number and storage location by asking transfer crane/gantry crane operators via wireless phone.

b. Export container cargo flow

Before a ship's arrival, the terminal operator begins the delivery of empty containers to the shippers. The receiving of export

loaded containers from the shippers will be suspended at 16:00 hours the one day before the ship's arrival.

The export containers received should be stored in the container yard export lanes by classified separately according to 20'/40', special container, dangerous cargo container, refrigerated container, etc.

The gate clerk will receive information regarding available export yard space allotment from the yard clerk and when the shipper's export containers arrived at the gate, the gate clerk will receive the delivery slip from the trailer driver.

The delivery slip must include at least the following items.

i. Container number
ii. Gross container weight
iii. Name of ship to be loaded and voyage number
iv. Destination, discharging port names
v. Name of shipping company
vi. Classification such as 20'/40', refrigerated container (appointed temperature) special cargo container
vii. Name of Customs forwarder, shipper, telephone number and person in charge.
Same delivery slips have an item column which will be filled out by the terminal side.
viii. Customs clearance paper or relevant papers such as dock receipts, export declarations, and container load plans.
ix. Container storage location number (gate clerk will assign this).
x. Received date (gate clerk will record this).

The container number and outside condition will be checked by the gate checker and the gate clerk will issue an EIR (in) with the signature of shipper's trailer driver.

The EIR (in) and delivery slip will be sent to the operation center and the yard clerk will make a container yard plan according to the EIR (in) and delivery slip.

After passing the gate lane, the shipper's trailer will proceed to the lane passage and bay designated by the gate clerk, waiting for the transfer crane, which will pick up the export container.

The transfer crane operator will report the container number and its storage location slot number by wireless pone to the control center when it is taken down from the shipper's trailer and the yard clerk will record that number on the yard plan.

The yard clerk then checks yard containers according to number and location every day when the gate is closed. Then he will make an accurate yard plan which is up to date.

The gate clerk will stop receiving containers at 16:00 hours the day before the ship's arrival, and the yard clerk the total number of containers received and confirm the kinds of containers. He then sends the latest container yard plan to the ship planner.

The ship planner will fill the empty available space on the loading ship stowage plan with the received containers and makes a scheduled ship loading stowage plan.

The following points are to be noted when making a ship loading stowage plan.

i. Ship's stability should remain firm
ii. The shortest total loading operation time must be assured at the loading port. Two quayside gantry cranes should work side-by-side.
iii. Considering ship's calling ports rotation, the planner avoids overstowage of loading containers.
iv. Not to concentrate for discharging containers at one port in one hatch as much as possible, because at the discharging port the container cranes should be used equally.

According to the completed ship loading stowage plan, the planner will make loading sequence checklist which shows working schedule order of containers transferred from CY storage slots to the quayside gantry crane.

The loading sequence checklist will be made separately for each gantry crane.

The completed ship loading stowage plan and loading sequence checklist will be taken with required copies and distributed to the concerned sections and workers.

Distribution points and necessary number of copies are as follows:

Ship's checker use	2 sets
Transfer crane operator	4 "
Gantry crane operator	2 "
Control center use	2 "
Tractor head driver use	4 "
Ship supervisor	1 set
Lasher boss	1 "
Maintenance section	1 "
Ship planner file	1 "
	18 sets

When the ship arrives at the berth, the ship planner will hand the ship loading stowage plan to the captain or chief officer and get their approval of the operation plan.

The operation control center staff members will stand by the wireless phone table and watch whole ship's operation from the beginning to completion.

If any kind of trouble happens to equipment such as the quayside gantry crane, transfer crane, tractor head or other accidents to disturb container operation, the control center staff will deal with it.

The control center will try to keep continuous terminal opera-tion, arrange repairs with the maintenance section, and if necessary, change of the working schedule by consulting with the ship planner, if required.

When all the cargo operation is finished, the ship planner will confirm whether ship stowage has been carried out accurately according to the ship loading stowage plan and make a final ship stowage plan and take the required number of copies and deliver to the shipping company or its agent.

c. Imported container cargo flow

The ship planner will obtain the ship's discharging stowage plan and manifest about five days before the ship's arrival. The ship planner will secure the necessary empty yard space according to the number and type of discharged containers stowage plan such as 20'/40', refrigerated and special type containers.

The planner will decide each gantry crane's handling number and

operation plan. Then he will make a discharging sequence checklist, which shows each container's movement from quayside gantry crane to the CY storage location slot.

Comparing the two gantry cranes' operation plans, the planner estimates the ship's possible sailing time and reports this to the shipping company or its agent. After making required number of copies of discharging sequence checklist and discharging stowage plan, the planner will distribute them to the concerned sections and workers. Distribution of the checklist and the required copies are same as in export container flow.

The ship planner/ship supervisor will inform the captain or chief officer when the ship will be able to finish cargo works and the shipping company or its agent will arrange the ship's sailing time.

The control center will watch the import container operation using the same procedures as described for the export container flow, but the container flow is the reverse. When the ship discharging operation is finished, the yard clerk will check the container number in the container yard storage slots and confirm if the containers are planned scheduled position and makes an accurate yard plan.

That yard plan will be sent to the ship planner and import documentation clerk. If the import documentation clerk finds any unusual points regarding the container number and the number of containers by comparing these with the ship's manifest, he will report to the shipping company or its agent.

The import documentation clerk will send the next day's delivery schedule to the yard control center and the gate clerk. The yard clerk will make a container gate out schedule list and distribute it to the gate clerk and other concerned section.

Distribution points and necessary copies are as follows:

Gate clerk	2 sets
Transfer crane operator	5 "
Yard control center use	1 set
	8 sets

The gate clerk will inform the yard control center when the trailer passes through the gate. He will also check containers' conditions and issue EIR (out) and obtain the signature of driver on it.

For CFS containers, the yard control center will make contact with the CFS section when the CFS containers are to be unstuffed.

According to the CFS operation schedule, the yard control center will arrange for the necessary CFS containers and dray them to CFS unstuffing platform.

The empty containers which return from the consignee's place and CFS will be checked in terms of their in/outside conditions at the gate house and EIR (in) are issued, then delivered to the empty container deposit.

The damaged empty containers will be sent to the repair yard separately.

d. CFS operation

The main object of the container transport system is "Door to Door" service. However, there may be a higher ratio of stuffing/unstuffing at the port area CFS, because of railway wagon shortages, road conditions and container chassis shortages.

In case of imported containers, quick delivery of container cargoes is preferable, thus the CFS containers should be transferred to the CFS as soon as possible.

The points to be noted regarding the CFS operation are as follows:

i. As an LCL cargo is separated into many small lots, assorting cargo and confirmation of cargo marks and number of packages should be carefully carried out.

ii. Separate lot of cargo should be stacked on the same pallet and stored in the CFS for delivery.

iii. There should be a large locker space as there is much valuable and eacy-to-steal cargoes in the CFS containers.

iv. As there are many CFS cargo lots, it is necessary to ensure good storage and to avoid missing delivery.

v. For the export CFS stuffing operation, the stowage of different style cargo should be carried out carefully and thus it is necessary to make CLP (Container Load Plan).

vi. Goods destined for many ports are handled in the CFS stuffing operation. A careful stuffing plan is required and the stuffing operation should be carried out carefully in order to avoid stuffing goods into the wrong containers.

(3) Introduction of Computer System to the Container Terminal

Container terminals at the world's main ports have their own computer systems to control terminal operations and storage administration. Some big shipping companies have their own computer system to control their container operations by using a real time system.

In the future, Mexican ports container terminal should introduce computer systems to rationalize their operation. However, based on the experience at major Japanese ports, terminal container operation can be handled on a manual basis up to 5,000 TEU per month.

For the sake of good training in the fundamental operation of container terminal, it is desirable to study container terminal fundamental operation by using a manual operating system at first.

Introduction of computer system should be made in the second stage, after staff members have gained experience.

Generally, the container terminal computer systems comprise the three following operations:

a. Container terminal administration subsystem
   Container terminal general affairs
   Terminal operation bill making
   Stored containers maintenance and administration
   Loaded containers registry file
   Whole container history file
b. Container gate in and out subsystem
   The gate operation which is the interchange point between the shipping companies and the shippers/consignees is managed by this subsystem.
   Also, when loaded/empty containers arrive at the gate, this system will assign a storage slot number using a computer program.
c. Container loading/unloading subsystem
   Concerning the ship's operation, the whole container movement operation in the container yard is included.

The yard planning for unloading containers
Making the ship's loading stowage plan
The ship's stability calculation
Making unloading/loading container sequence checklist

When introducing the above subsystems to the terminal, it is easier to introduce them step-by-step in the above order.
Anyhow, it is very important for a welltrained terminal planner and an excellent computer programmer to cooperate in making the best computer programs for the container terminal.

(4) Terminal Organization and Necessary Staffs

As described in section 9.1.6(3), the terminal operating organization should operate as part of the present ESP organization in the 1995 short-term plan.

See Fig.9.1.6, which presents an ESP organizational chart for a container terminal.

When the ship is in operation, extra workers from the labor union are required as follows:

Container crane operators	4
Transfer crane operators	8
Tractor head drivers	12
Toplifter drivers	2
Mobile crane operators	2
Lashing/unlashing workers	16
	44 persons

(5) Recommendations

1) Selecting terminal workers from the labor union

As described above 10.1.5(4), about 50 persons from the labor union are needed when ships are in operation.

At present, the ESP has no right to select skillful laborers against the union staff's wishes.

For the container terminal operation, it is very important to maintain an adequate pool of skillful fixed workers in order to increase container

handling efficiency.

The following points must be addressed in negotiating with union members and to realize a system of selecting workers.

a. Selection of operators of container and transfer cranes is necessary.

   The ESP will carry out driving tests for crane operators and select about 20 persons, and the union will arrange for them to work as terminal crane operators.

b. Container chassis tractor driver

   The union will select about 50 persons as suitable container chassis tractor drivers from among its members and supply them preferentially when terminal operation requires their services.

2) Desirable legal procedures for container treatment

As the main object of sea container transport system is simplification, decreasing of cargo damages and high efficiency of handling containers at the terminal.

It is necessary to simplify the procedures of government inspection, which interrupts "Door to Door" services of container systems, such as Customs clearance inspection, plant quarantine and animal quarantine.

In Mexican ports especially, plant quarantine law is applied very severely and fumigation is necessary for all the wooden cases of general cargo cases in the containers. This system is abused and it seems that is unnecessary.

The amount of plant quarantine objective cargo should be limited and cargo items should be described clearly in the Quarantine Law.

For Customs clearance procedures, the Mexican government is advised to ratify the "Customs convention on container and Customs convention on the international transport of goods under cover of TIR cornets" which is followed by most countries using the container system, and to change its domestic Customs law and regulations in accordance with the above conventions.

The government will thus be able to simplify and standardize container Customs clearance procedures.

The following are examples of practices which are already in general use.

a. Import Customs declaration of containers will be done by attached container number list after completion of the entire container discharging operation. Export Customs declaration of containers will also be done by using an attached loading container list.

b. Customs permission for moving containers within the domestic transportation system will be not necessary. But the container tracking information needed by the Customs office, in the course of tracking investigations, will be reported by the container administrator, who must record all the container inventory under his custody, anytime, according to the Customs request.

c. The Customs authorities say that if all the items necessary for Customs inquiry are recorded on the shipping company's manifest, a copy of the manifest itself can be used as the Customs from.
Customs will permit the seal of the shipping company to be used as the Customs seal when bonded cargo is transported in containers.

d. When cargoes stowed in TIR containers pass the borders with the USA and Guatemala by road transportation, Customs procedures should be simplified.

e. Customs will be cooperative during Custom procedures and permit cargo stuffing/unstuffing and storing at the CFS area outside the port at the container deposit area operated by reliable private container handling companies.

3) Others

a. Railway tracks are located at the edge of the container terminal since the loading/unloading operation of containers onto/from a train is considered to hinder the movement of trailers at this area, the planned roads located at the area adjacent should be used effectively while the above loading/unloading operation.

b. As for other recommendations, refer to relevant section in Chapter 8.

10.2 Short-Term Development Plan for Containerized Cargoes in the Port of Manzanillo

10.2.1 Fundamentals of the Improvement Plan

(1) Containerized Cargo Handling Volume in 1995

The containerized cargo volume through the port in 1995 is as described in Table 9.1.1.

Supposing that the share of handling volume by vessel type and berth allocation are on the same lines as the master plan, the container cargo handling volume at the container berth is obtained as shown in Table 10.2.1.

(2) Forecast of Container Vessel Size

Refer to section 10.1.1,(2).

Table 10.2.1 Containerized Cargoes by Container Vessel Type in the Year 1995 (Port of Manzanillo)

(Unit: 1,000 tons)

Type of Container Vessel		Assumed Share of Handling Volume	Containerized Cargo Volume		
			Container Berth	General Cargo Berth	Total
I	Import	92 %	187.7	-	187.7
	Export	"	397.4	-	397.4
	Sum	"	585.1	-	585.1
II	Import	3	6.1	-	6.1
	Export	"	13.0	-	13.0
	Sum	"	19.1	-	19.1
III	Import	5	-	10.2	10.2
	Export	"	-	21.6	21.6
	Sum	"	-	31.8	31.8
Total	Import	100	193.8	10.2	204.0
	Export	"	410.4	21.6	432.0
	Sum	"	604.2	31.8	636.0

(3) Required Number of Container Berths

The method and premises for calculation are as represented in section 9.1.1,(3). The required number of container berth is then calculated according to the procedures shown in Table 10.2.2.

From the berth occupancies in Table 10.2.2, one berth is adopted for the short term plan.

10.2.2 Operation System

At present, the containers are discharged and loaded by the ship's equipment of the Port of Manzanillo.

From December 1989, one transfer crane (3 lanes, 2-tier-high stacks) were introduced behind the berths and started operating.

An exclusive container terminal is planned for the 1995 short-term plan and its location is the "C" band area next to berth No.9. The berth length is 300 meters and depth of water is -14 meters.

For the reasons described in section 9.1.3, the study team will recommend a transfer crane system for the operating system.

10.2.3 Required Scale of Facilities/Equipment

(1) Required Scale of Berth

Refer to section 9.2.4,(1).

Berth length	300m
Berth water depth	-13m

(2) Required Scale of Water Basin

As described in 9.2.4,(2), an area larger than a circle with a diameter of 2L (L : Length overall of planned vessel size, 240m) is required for vessels' turning, which should be planned in the center of the water basin in the inner port. The required water depth of basin is 13m which is the same as the required water depth of berth.

Table 10.2.2 Calculation of Required Number of Berths

(Port of Manzanillo : 1995)

Items	Unit	Calculation	Vessel Type		
			I	II	Total
① Containerized Cargo Volume (Import)	1000 tons		187.7	6.1	
② Containerized Cargo Volume (Export)	1000 tons		397.4	13.0	
③ Number of Loaded Containers	TEUs	①/7 +②/11	62,942	2,053	
④ Number of Loaded and Empty Containers	TEUs	③/(1-0.25)	83,923	2,737	86,660
⑤ Number of Loaded and Empty Containers	boxes	④/(1x0.56+2x0.44)	58,280	1,901	
⑥ Average Number of Containers Handled Per Vessel	boxes		650	60	
⑦ Number of Vessel Calls	calls	⑤ / ⑥	89.7	31.7	121.4
⑧ Container Handling Productivity per Day Per Vessel	box/day.vessel		720	720	
⑨ Berthing Days per Vessel for Container Handling	days	⑥ / ⑧	0.90	0.08	
⑩ Number of Shifting Containers	boxes		100	-	
⑪ Berthing Days per Vessel for Shifting Container Handling	days	⑩ / ⑧	0.14	-	
⑬ Average Break Bulk Cargo Volume Handled per Vessel	t		300	-	
⑭ Break Bulk Cargo Handling Productivity per Day per Vessel	t/day.vessel				
⑮ Berthing Days per Vessel for Break Bulk Cargo Handling	days	⑬ / ⑭	0.19	-	
⑯ Number of Days Necessary other than for Cargo Handling	days		0.2	0.2	
⑰ Total Berthing Days per Vessel	days	⑨ + ⑪ + ⑮ + ⑯	1.43	0.28	
⑱ Total Berthing Days	days	⑦ x ⑰	128	9	137
⑲ Berth Occupancy'	%	⑱ /(340xB)			
B (Number of Berth) : 1					40
2					20

(3) Required Scale of Storage Facilities

The basis for calculation is as mentioned in section 9.2.4,(3),1).

1) Container yard

a. Calculation of storage volume by average dwelling time

As explained in section 9.2.4,(3),2), the required number of storage containers is calculated according to following formula.

The definition of each term in the formula can be found in the same section:

$$M_L = \left(\frac{M_y}{D_y} \times D_w + M_I \right) \times P$$

As for empty containers, the required storage volume for the returning empty containers (refer to section 9.2.4,(3),1),d) must be added which is obtained by the following formula:

$$M_{LR} = \frac{M_{yR}}{D_y} \times D_{wR} \times P$$

where M_{LR} : Required storage number of returning containers (TEUs)

M_{yR} : Annual volume of returning empty containers(TEUs)

D_{wR} : Average dwelling days of returning container(7days)

D_y : Operating days (350 days)

P : Peak ratio (1.3)

Applying the premises mentioned previously to the above formula, the required storage number of containers is calculated as shown in Table 10.2.3.

Table 10.2.3 Required Storage Number of Container Calculated by Average Dwell Days (Port of Manzanillo in 1995)

Items	Unit	Loaded Containers		Empty Containers	Total
		Import	Export		
Container Handling Volume	tons	193,800	410,400	--	604,200
Annual Container Throughput (M_y)	TEUs	27,690	37,310	21,670	86,670
① $\frac{M_y}{D_y} \times D_w \times P$	"	1,234	1,386	805	3,425
② $M_I \times P$	"	194	262	152	608
③ M_{LR}	"	--	--	290	290
Total Required Storage Number (① + ② + ③)	"	1,428	1,684	1,247	4,359

Note : M_I is the half of average number of containers handled per vessels by type I vessel

b. Calculation of storage volume by dwelling curve

The storage volume can be calculated more precisely by examining the dwelling curve of containers into/out of container yard and overlapping the dwell curves, as described in section 10.1.3,(3), 1),b.

Following the calculation method in the same section and using the dwelling curves of type I vessels in Fig. 10.1.1, the storage numbers of containers are obtained as shown in Table 10.2.4.

The values in this table, showing slightly larger values than Table 10.2.3, are used for the planning of the C.Y.

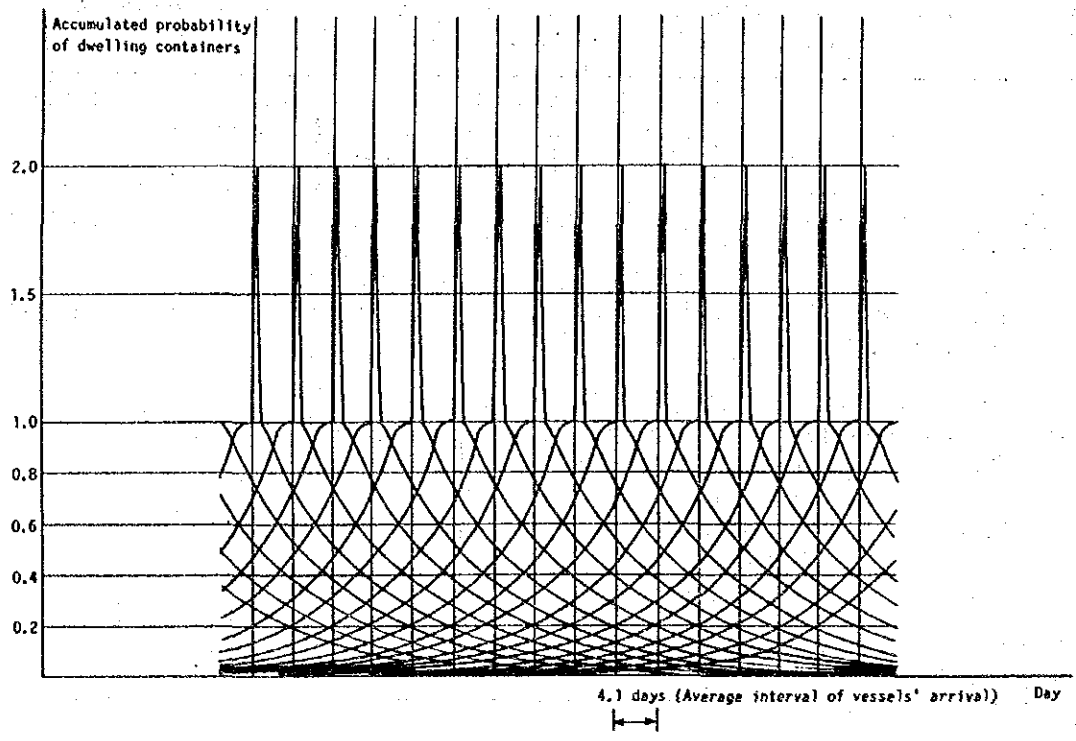


Fig. 10.2.1 Movement of Dwelling Container by Arrival of Type I Container Vessel (Port of Manzanillo)

Table 10.2.4 Required Storage Number of Containers Calculated by Dwelling Curves

Loaded Containers		Empty Containers	Total
Import	Export		
1,500	1,690	1,270	4,460

Note: i. A peak ratio of 1.3 is assumed.
ii. Empty containers include returning empty containers.
iii. 50 TEUs of the export and 10 of the import are reefers.

c. Required number of ground slots

Using the same stacking height as in the master plan, the required number of ground slots at the container yard is calculated and shown in Table 10.2.5.

Table 10.2.5 Results of Required Storage Capacity in Container Yard (Port of Manzanillo in 1995)

Item	Unit	Loaded Containers				Empty Container
		Import	Export	Reefer	Total	
Required Storage Number of Containers	TEUs	1,490	1,640	60	3,190	1,270
Stacking Height	Layers	2.2	2.8	2		3
Required Number of Ground Slots	Slots	677	586	30	1,293	423

2) Container freight station

Using the same formula and premises as in the master plan, the required CFS area is calculated as follows:

$$A = (M_C \times D_W \times P) / (w \times \gamma \times D_Y)$$
$$= (240,540 \times 6 \times 1.3) / (1.3 \times 0.5 \times 350) = 8,250m^2$$

This value of this area is too large for a CFS area in the container terminal. Taking the CFS area in the terminal as 45m x 140m = 6,300m^2, the remaining 1,950m2 is planned to be added to the area of the warehouse, as mentioned below.

3) Storage facility for break bulk cargoes

The volume of break bulk cargoes carried by container vessels through the planned berth is calculated to be around 26,910 tons by multiplying the average break bulk cargo volume per vessel and the number of vessel calls given in Table 10.2.2.

The required storage area is calculated as follows:

$$A = (M_S \times D_W \times P) / (w \times \gamma \times D_Y)$$
$$= (26,910 \times 10 \times 1.3) / (1.3 \times 0.5 \times 350) = 1,540m^2$$

Adding the above-mentioned shortage of CFS area of 1,950m^3, which should be used mainly for stuffing of export containers the total required area of the warehouse will be 3,490m^2.

(4) Required Amount of Cargo Handling Equipment

1) Required number of units of cargo handling equipment

The basic ideas and the calculation methods are the same as the master plan. Therefore, the further explanation should be referred to section 9.2.4,(4).

a. Design conditions

i. The container volumes to be handled at the port in the target years are as follows:

Import	27,690 TEU
Export	37,310 TEU
Empty (Total)	21,670 TEU
TOTAL	86,670 TEU

ii. Characteristics

Unit weight Import 7 t/TEU

Export 11 t/TEU

Ratio of 20/40 feet containers 20 feet 56%

40 feet 44%

Ratio of containers to be stuffed/unstuffed at port site

Import 50 %

Export 35 %

iii. Ship size

The maximum ship size planned for the quay-side gantry crane is panamax size.

b. Quay-side gantry cranes

Basic ideas are the same in section 9.2.4,(4). Two quay-side cranes will be erected.

c. Minor cargo handling equipment

c-1. Introduction

Basic ideas are detailed calculations are stated in section 9.2.4,(4).

The required number of cargo handling items are as follows:

Transfer cranes	
Rubber-tyred	5 units (6x3)
Chassis	34 units
Fork-lift	
40t (Top lift)	1 unit
25t (Top lift)	1 unit
5t	2 units
3t	12 units
2t	25 units

2) Outline of proposed cargo handling equipment

As for the further explanation, refer to 10.1.4,(4),2).

a. Quay-side gantry cranes

i. Type

< Trolley type >

Rope trolley type cranes are recommended. The reasons for recommendation are the same as at Lazaro Cardenas.

< Number of trolleys >

The single trolley system is recommended. The reasons for recommendation are the same as at Lazaro Cardenas.

< Main frame profile of the gantry cranes >

It is not appropriate to determine the frame type before procurement.

< Control system >

A thyristor control system is recommended. The reasons for recommendation are the same as at Lazaro Cardenas.

ii. Basic Dimensions

Hoisting capacity (under spreader)	min.	40 t
Outreach	min.	37 m
Span		21.5 m
Backreach	min.	11 m
Lift	min.	41 m
Lift (above rail)	min.	27.5 m
Lift (below rail)	min.	13.5 m

Width (buffer to buffer)	smaller than	27 m
Portal clearance (between sea side legs)	min.	17 m
Cross beam height (between front/rear legs)	man.	14 m
Boom width	max.	6.1 m

iii. Operating speed

Main hoist	
with full load	50 m/min.
with 18t load under spreader	85 m/min.
with empty spreader	120 m/min.
Trolley travelling	150 m/min.
Gantry travelling	45 m/min.
Boom hoisting (to raise and lower)	6 m/min.

b. Minor cargo handling equipment

i. Transfer crane

‹ Basic dimensions ›

Hoisting capacity	
Including spreader	40 t
Under spreader	30.5 t
Span	23.47 m
Lift (under spreader)	12.20 m
Trolley travelling range	19.0 m
Wheel base	6.9 m
Number of wheels	8 (8 or 16) wheels

‹ Operating speed ›

Hoisting	
with full load	12 m/min.
with empty spreader	24 m/min.
Trolley travelling	55 m/min.
Gantry travelling (with no load)	90 m/min.

‹ Others ›

Spreader

Telescopic type for 20, 40, 45 feet containers.

Power supply Self-contained diesel generator set min. 260 PS

The basic dimensions and operating speed of the other minor cargo

handling equipment (chassis, tractor and fork-lift) are neglected because they are not so important at this stage.

(5) Other Facilities

1) Terminal gate

The required number of truck lanes is calculated by the following formula:

$$N = V \times S / 60$$

where N : Required number of truck lanes
V : Hourly number of trucks into/out of terminal at peak hour (trucks/hour)
S : Necessary procedure time per truck (minutes)

Applying the same procedures for calculation as in section 10.1.3,(5), 1), the required number of truck lanes is obtained as follows:

Lane for incoming trucks $N = 25 \times 4 / 60 = 1.7$
Lane for outgoing trucks $N = 15 \times 3 / 60 = 0.8$

Considering some necessary allowance, 4 lanes are planned 2 of which should be equipped with truck scales.

2) Terminal office

The area required for the terminal office will depend on the method of operation and other factors. Assuming that around 10m² floor area is required per person and considering some necessary allowance, around 600m² of terminal office space will be required.

3) Railway facilities

Based on the premises described in section 9.2.4,(5),2), around 35 TEUs of containers per day are estimated to be transported by railway into/out of the port in 1995. Assuming that around 20 freight cars comprise a train, one train is forecast to arrive at the port every two days.

4) Maintenance of the container handling equipment and containers

i. Method of maintenance

Basic ideas and details are the same as at Lazaro Cardenas (refer to section 10.1.4,(5),4)).

ii. Required facilities at the workshop

Basic ideas and details are the same as at Lazaro Cardenas (refer to section 10.1.4,(5),4)).

iii. Arrangement of the persons in charge of the cargo handling facilities equipment (of machine and electricity).

Basic ideas are the same as at Lazaro Cardenas.

The required number of engineers will be about 10 persons in 1995.

The required number of workers will be 51 persons in 1995.

5) Others

a. Repair of damaged containers

On the assumption that the container terminal will receive about 5% of loaded containers in a damaged state, around 600m² for a container repair yard is proposed.

b. Fumigation of containers

As mentioned in section 10.1.3,5), the present situation of the fumigation of imported containers should be reformed.

Assuming that 10% of loaded import containers have to be transferred to an exclusive yard for fumigation and considering 3 days of dwelling time, around 600m² for a fumigation yard is proposed.

c. Washing and cleaning containers

For washing and cleaning empty containers around 300m² of yard space is proposed.

d. Customs inspection

Based on the present situation, an estimated 10% of loaded import containers go through the physical check by customs including some through checks by unstuffing containers. Thus around 400m² of exclusive yard are provided for customs inspection.

e. Others

Such necessary facilities as an electric sub-station, an oil

station, parking areas for road trailers road trucks and yard tractor-chassis are provided for in the facility layout.

10.2.4 Layout Plan

Based on the master plan, the layout plan of the container terminals is drawn up as shown in Fig. 10.2.2. For explanation of the facility layout refer also to the master plan.

i. The necessary number of ground slots for the storage of loaded import/export containers are planned for the container yards. The general ground slot allotment is shown in Fig. 10.2.3.

ii. Required scale of CFS and warehouse are located in the terminal and at neighboring position respectively.

iii. Two railway tracks with length of 300 - 350m each are located behind the trunk road.

iv. Two quayside gantry cranes and five 6-lines type transfer cranes are provided.

v. The terminal gate and office are located in the north part of the port near the entrance.

vi. A maintenance shop is not planned for this container terminal, as mentioned before.

vii. The customs inspection yard is laid out near the warehouse.

viii. The fumigation, damaged container repair and container cleaning yards are located around the empty container yard, considering their functions.

ix. The parking area for yard tractor-chassis is laid out on the eastern edge of the terminal, near which the electric substation and oil station are located.

x. The parking areas for trailers and trucks into/out of the terminal are located near the gate, and CFS out of consideration of convenience of utilization.

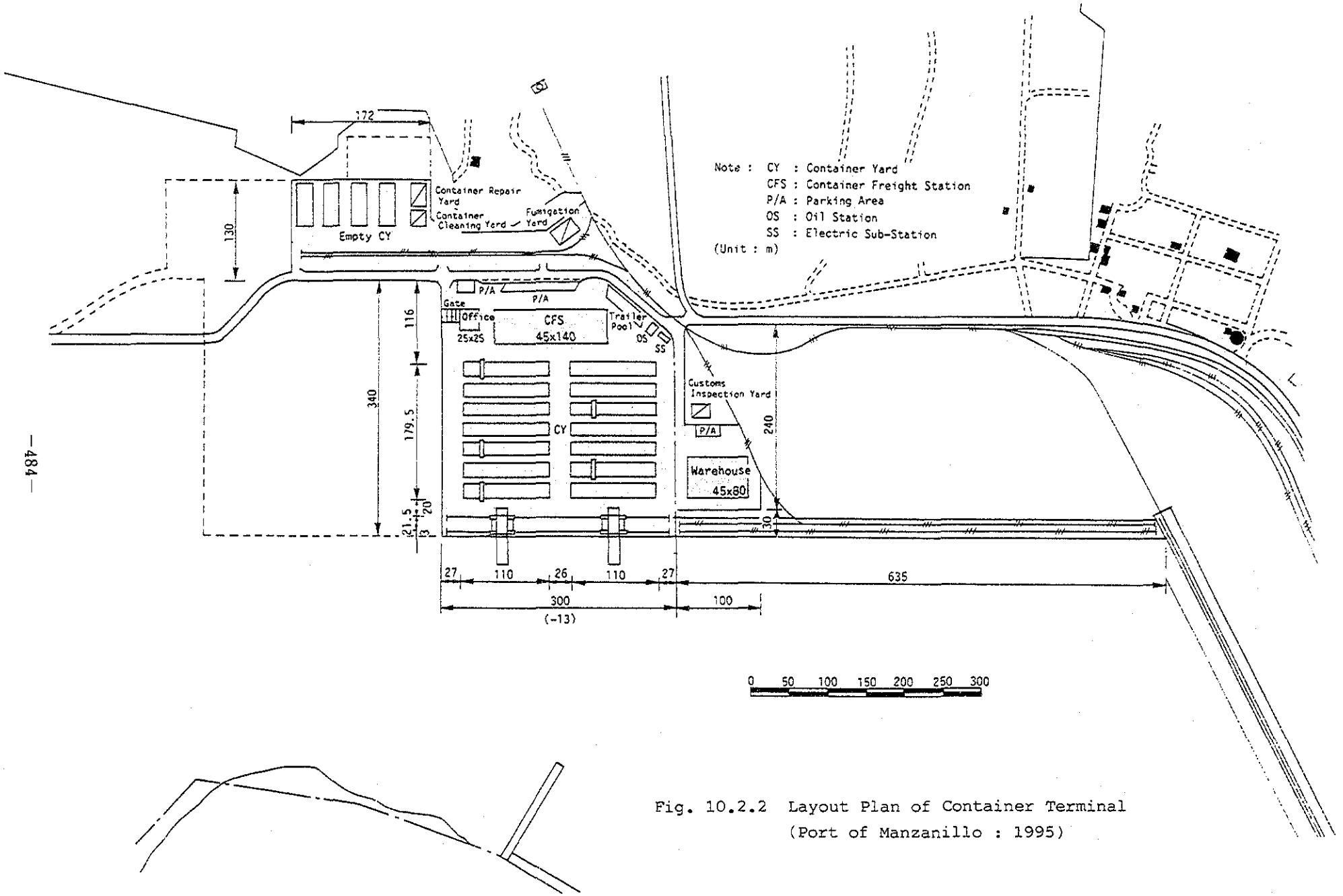


Fig. 10.2.2 Layout Plan of Container Terminal
(Port of Manzanillo : 1995)

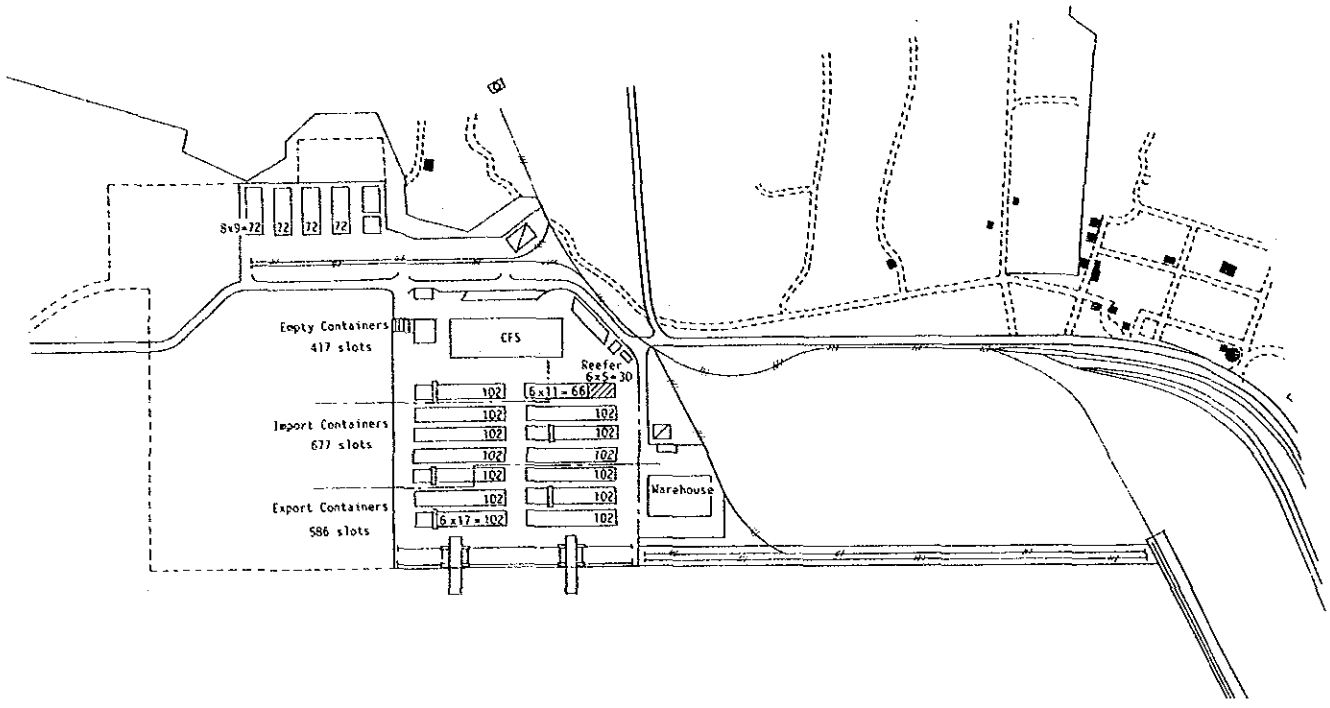


Fig. 10.2.3 Ground Slot Allotment of Container Yard
(Port of Manzanillo : 1995)

10.2.5 Management and Operating System

(1) Management

The containerized cargo volume treated in this port is estimated at 604 thousand tons in 1995. In order to handle the anticipated container traffic at the container terminal efficiently, a special container terminal section is required as described in section 9.2.6.

The new container terminal organization in ESP and the required number of personnels are referred to section 9.2.6.

(2) Premises and Handling Operation Method

The estimated terminal conditions for 1995 by the study team are as follows:

a.	Container berths	1 berths(length 300m)
b.	Quay side Gantry cranes	2 units
c.	Transfer cranes	5 " (6 lanes, 3 tiers high)
d.	Tractor heads	12 "

e.	Container chassis	34 " (20'/40' use)
f.	Containers handled per year	86,670 TEU/year
g.	Ships' calling at port per year	121 ships/year
h.	Containers handled per ship	936 TEU/ship(Vessel Type I) 86 TEU/ship(Vessel Type II)
i.	Required amount of CY storage	4,460 TEU

The terminal operation sections consists of the following sections:

a. Ship's planning (Ships operation)
b. Yard control center (Container control in the yard)
c. Gate clerk (Gate office, container in and out business)
d. Export/import documentation section

Besides the above, as is seen in the Figure, there are maintenance and CFS sections.

Good coordination is necessary for smooth container terminal operation. Each section's business and manual is described in Appendices 8.1.1, 8.1.2 and 8.1.3.

Concerning the transfer crane system terminal operation, it is described in the 1995 short-term plan for Lazaro Cardenas in sections 10.1.5-(2),(3),(4) and (5) of this report.

(3) Recommendations

1) Countermeasures for quick delivery of CFS cargo

In order to prevent long staying of cargo in CFS, the following measures as well as the recommendations in section 8.1.6, (4) will be effective:

a. For most export cargo, Customs clearance should be obtained before

the cargo is received at the CFS. Cargo that has not yet cleared Customs should immediately receive Customs clearance arriving in the CFS area.

Then the cargo can be stuffed into the container and shifted to the container yard for export.

b. For import cargo, an over-free-time penalty system should be strictly enforced.

c. If the imported cargo has stayed over a week it should be transferred to an other warehouse in the port area and an extra storage fee should be charged to the consignee.

d. A part of the planned warehouse is assumed to be used for stuffing/unstuffing containers, due to the shortage of area of the CFS. For this purpose, the warehouse should be used mainly for stuffing export containers.

2) Others

a. As for recommendations for terminal workers and legal procedures of container treatment, refer to section 10.1.5,(5).

b. The new terminal is located at the farthest area in the inner port from offices and maintenance shop as well as from the general cargo berths. The sufficient communication will be required among these areas for the smooth operation at the terminal.

c. As for other recommendations, refer to relevant sections in Chapter 8.

10.3 Short-Term Improvement Plans for Bulk Cargoes in the Port of Lazaro Cardenas

The agricultural bulk cargoes are scheduled to be removed to the grain silo berth, after completion of repair work, from the general cargo berths. Thus the public berths for handling bulk cargoes at the Port of Lazaro Cardenas will be the SICARTSA berths and the grain berth. Therefore, the short-term improvement plans for these two wharves are examined in this chapter.

10.3.1 Improvement Plan of Cargo Handing of Grain Silo Complex

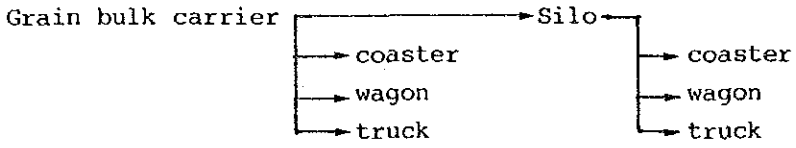
(1) Grain Silo Complex

1) General

The grain silo and related handling equipment were constructed for efficient storage and handling of agricultural bulk cargoes. However, the facilities were damaged by a big earthquake in 1986 just before the operation of the same. The repairings of damaged parts and remained works have started in 1989 and they are to finish at the end of 1990.

The facilities consist of a pneumatic unloader, unloading line, loading line, storage silo bins and machinery tower and auxiliary facilities.

Grain cargoes are unloaded by a pneumatic unloader and sent to silo bins through the conveying system in unloading line and then discharged to wagons, trucks and barges by discharge equipment in loading line. The grain unloaded or loaded from ship and silo are handled as the following routes.



Major kinds of cargoes to be stocked in the silo bins are expected as maize, corn, wheat and sorghum.

The main specifications of the facilities are as follows:

Unloader:

Type ——— pneumatic type

Nominal Capacity ——— 600 t/h (300t/h x 2 units/(unloader))

Silo:

Structure ——— reinforced concrete

Capacity ——— 80,000t

The plane sketch of the grain silo complex is shown in Fig. 10.3.1.

2) Evaluation of handling and storage capacities

a. Handling capacity

The handling capacity of an unloader is calculated from handling capacity per hour, daily work hours and total work days a year. The conditions for calculations are as follows:

Average cargo tonnage per ship	: 20,000t, 40,000t, and 60,000t
Nominal capacity	: 600 t/h
Handling efficiency	: 0.7
Daily work hours	: 18 hrs
Total work days per year	: 300 days

The evaluation of cargo handling capacity is estimated under the conditions of berth occupancy of 50% which is said to be proper for one berth.

The results of calculations of berth occupancies, berthing time and berth waiting time against annual cargo handling quantity of 400,000t, 600,000t, 800,000t, 1,000,000t and 1,200,000t are shown in Table 10.3.1.

The berth occupancies for ship sizes of 40,000t and 60,000t are less than 50%. On the other hand, the occupancy for ship size of 20,000t, the value is more than 50%.

As the ship sizes calling the same berth are expected over 40,000 DWT class carriers, because most of bulk carriers come from the Pacific Ocean side through Panama Canal. It is concluded that this berth can handle the annual cargo volume of 1,000,000 tonnage by evaluating from berth occupancy of 50%.

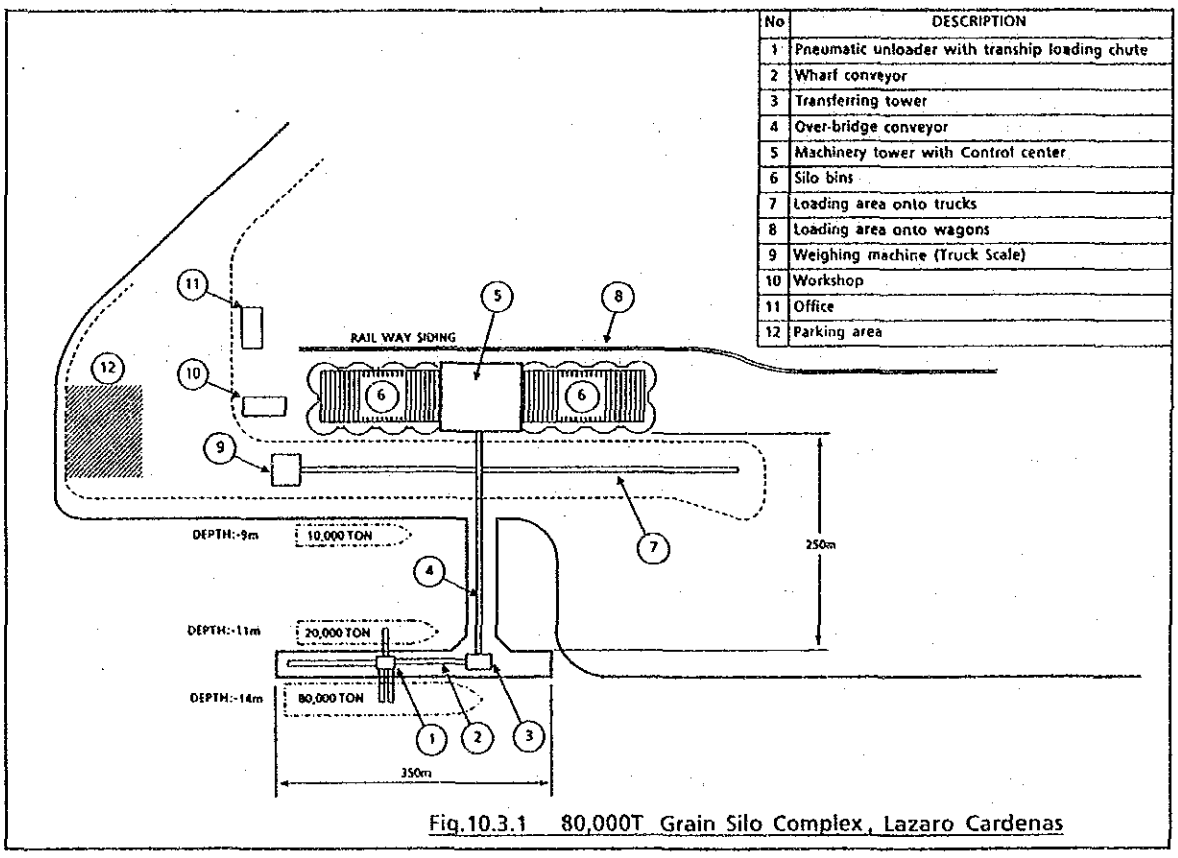


Fig.10.3.1 80,000T Grain Silo Complex, Lazaro Cardenas

Table 10.3.1 Cargo Volume, Berth Occupancy and Berth Waiting Time

Cargo Volume (* 10^3t)	400	600	800	1,000	1,200
Cargo per ship (t)	20,000				
Service time (days)	3.83				
Berth occupancy	0.26	0.31	0.42	0.52	0.63
Berth waiting time (days)	1.01	1.75	2.76	4.22	6.58
Cargo per ship (t)	40,000				
Service time (days)	7.05				
Berth occupancy	0.19	0.29	0.39	0.48	0.58
Berth waiting time (days)	1.54	2.86	4.47	6.48	9.66
Cargo per ship (t)	60,000				
Service time (days)	10.26				
Berth occupancy	0.19	0.28	0.37	0.47	0.56
Berth waiting time (days)	2.23	3.93	6.00	9.02	13.27

b. Storage capacity

The storage capacity is calculated from dividing the annual cargo volume by annual cycle time as follows:

$$W = V/R$$

W : capacity of silo (t)
V : annual cargo volume (t)
R : annual cycle time (10 - 15 times)

The necessary silo capacity becomes W=67,000t for V=1,000,000t and R=15 times.

The silo storage capacity is said to be sufficient. However, the cycle time is greatly affected by the land transportation. When storages or delays of wagons or trucks occur, much larger storage capacity should be needed because cargoes have to be kept in silo for long period.

Proper arrangement and sufficient preparation of land transportation is therefore very important in realizing smooth cargo flow and related quick dispatches of vessels.

In addition to the above, the silo control must be done such as to make cargo space in silo vacant before ship arriving or during cargo unloading operation, because maximum ship size is the same as the silo capacity of 80,000t.

3) Ways and means to be required for the future increase of cargo

There is one unloader and one set of storage facility at present. The capacities of these handling and storage facilities are evaluated as proper for dealing with annual cargo volume of 1,000,000t.

Another one unloader on the same wharf is preferable in accordance with increase of cargo in the future. Two units of unloader are ideal in case of break down of one of them and also meeting with the requirement of quick dispatch of ship. The related silo capacity shall be expanded.

The improvement of conveyors from wharf to silo and those in the silo are needed.

(2) Recommendation on Operation Improvement

1) Inventory control

Discharging from silo bins should be performed deliberately, for adequate storage space have to be evacuated in accordance with the unloading plannings before the next vessel berthing.

The ability to coordinate arrangement of consumers/consignees and land transportation.

Lack of above-mentioned considerations causes obstructions to efficiency/turnover of the facilities.

2) Shortage

Allowances of shortage rate are considered internationally as less than 1 % as shown in Table 10.3.2, but actual shortage rate in Mexico is deemed around 5 %.

Cargo shortage is caused mainly by rough handling operation and brings undesirable results in handling operation such as deterioration, contamination and other operating hazards.

Table 10.3.2 Shortage (weight: M/T Percentage)

Unit:%

Grain	1984	1985	1986	1987	1988
U.S. Corn	0.36518	0.40951	0.39251	0.40225	0.41426
U.S. Waxcy Corn	0.24609	0.48383	+0.68955	0.50105	0.51937
Argentine Maize	-	1.45070	0.46441	0.63272	0.58951
Australian Maize	-	-	0.63558	0.26380	0.44535
Chinese Maize	-	-	0.66668	1.12473	1.00460
U.S. Milo	0.44026	0.39163	0.38835	0.36050	0.33320
Australian Grain Sorghum	0.42274	0.41371	0.59469	0.32465	0.34263
Argentine Grain Sorghum	0.70451	0.92679	0.17708	0.64741	0.61079
Chinese Milo	-	-	-	0.80497	1.70297
Canada Rye	0.90609	0.59361	0.80897	0.79053	0.66050

3) Quality control

To keep quality grade is considered commonly as one of the most major matters.

Check on moisture content and cargo temperature should be done especially at each process of handling and storaging to prevent grain from its deterioration. Contamination is also paid attention so as to keep grain quality.

4) Maintenance and repairing

Thorough maintenance and repairing make the facilities possible to keep higher efficiency through preventing those from various breakdowns, for a serious accident causes forfeits not only routine operation on purpose but also expected benefits from management.

5) Circumstance and working conditions

Bulk cargo handling, not limited to grain, is prone to disperse dust which is to be avoided to the utmost. Lack in consideration of dust scattering causes problems of circumstance sanitary/pollution, moreover, and hazards such as dust-explosion.

(3) Examination of the Management and Operations System of Grain Silo

The effective management and operation system of the grain silo at the Port of Lazaro Cardenas is examined in this section, focusing on the comparison between the ESP and private sector as a management and operation body.

1) Premises and conditions for examination

Premises for the examination are as follows:

‹ Regarding the demand and hinterland of grains ›

i. As described in Chapter 5, the demand for imported grains through the ports on the Pacific coast will show a fluctuation for the

time being and increase considerably in the long term.

ii. The increase in the handling volume of grains through the Port of Lazaro Cardenas greatly depends on the cargo shift from the Port of Manzanillo to this port.

iii. Therefore, the hinterland of the Port of Lazaro Cardenas in the future will cover that of the Port of Manzanillo which is very wide, as shown in Fig. 5.4.16.

It must be noted, as mentioned previously, that the main hinterland will not be Mexico City, but Guadalajajara, in the future.

iv. Judging from the present situation at the Port of Manzanillo, the kinds of grains handled at the Port of Lazaro Cardenas in the future will be greatly varied, such as maize, wheat, soybeans and seeds.

v. From the conditions mentioned above, a considerable number of consignees will require the import of grains.

< Regarding the transportation of grains >

vi. The facility/equipment with respect to the grain silo are as described in the previous sections.

vii. Judging from the scale of the grain berth, panamax type carriers are expected to call at the port for the import of grains.

viii. Secondary transportation from the port to the hinterland will mainly be carried out by trucks and railway freight cars. Some secondary transport by sea is also forecast.

ix. Securing the required number of freight cars and trucks for the land transportation of grains will continue to present a great difficulty for the time being.

< Regarding cargo handling operation at the port >

x. A silo complex requires a large amount of construction/maintenance costs as well as operating costs. Thus a silo complex should be operated at the best possible productivity to recover the investment for it.

xi. Cargo handling at a silo is a specialized system for the storage of grains requiring a high standard of technology.

xii. The cargo handling of grains from/onto vessels and from the silo to freight cars and trucks is provided by the ESP/union within the scope of their present services.

‹ Regarding the ESP ›

xiii. The present situation of the ESP, such as the wage system, the scope of services and the relations with the government are considered fundamentally unchanged.

xiv. The ESP has no experience in silo operation.

‹ Regarding the private sector ›

xv. As a management and operation body of the grain silo, candidates from the private sector will be grain transportation companies such as Transterencias Graneleda de Occident, ANDSA (a national enterprise), warehouse companies, associations of food production companies and trading companies.

‹ Others ›

xvi. The silo and grain berth belong to Puertos Mexicanos at present.

xvii. The Mexican Government has made a huge investment in the construction and restoration of the silo and related facilities/ equipment following the earthquake in 1985.

2) Alternative of management and operation body

Alternative I : ESP

Alternative II : Private sector

Alternative III : Third sector

Alternative III is supposed to be a half-government/half-private corporation. The private companies participating in this corporation, whether one or more, should occupy the majority of the organization's membership and be able to obtain a reasonable profit from the business. On the other hand, the government should be able to control the corporation from the viewpoint of governmental policy and achieve the required efficient coordination of port activities by participating in this

corporation.

As for historical trend of management/operation body of silo in the world, refer to Appendix 10.3.1.

3) Evaluation of the alternatives

The general evaluation of the alternatives is summarized in Table 10.3.3.

< Regarding governmental involvement >

i. As mentioned above, the consignees for imported grains are estimated to be considerably large in number. Therefore, it is preferable that the silo be available to every consignee.

ii. Puertos Mexicanos should make efforts to make a reasonable profit because of its large amount of investment in the silo.

iii. In the management and operation of the silo, Puertos Mexicanos should achieve the necessary coordination in shifting cargoes from the Port of Manzanillo to the Port of Lazaro Cardenas and ensuring the required number of freight cars and trucks.

iv. These factors require appropriate involvement of the government in the management/operation of the silo. Alternatives I and III are superior to Alternative II in this regard.

v. On the other hand, Alternative III may lead to complexity in the administration regarding the silo management/operation.

< Regarding organization >

vi. The management/operation of the silo requires many specialists and engineer from many areas of expertise. It would be very difficult for the ESP to ensure presence of this type of personnel or to train the present personnel of the ESP.

Even if the ESP could train the required personnel successfully, it would be quite probable for them to leave the ESP due to the

Table 10.3.3 Evaluation of Management Bodies for Grain Silo Operation

Evaluation Items		Alternative I ESP	Alternative II Private Sector	Alternative III Third Sector
Governmental Involvement	.Securing Public Interests	○	△	○
	.Securing Government Control	○	△	○
	.Complexity of Administration	○	○	△
Organization	.Securing Required Personnel	△	○	○
	.Safety and Stability	○	△	○
	.Efficiency and Flexibility of Organization	△	○	△
Operation	.Efficiency of Operation	△	○	○
	.Sales Activities and Inducement of Users	△	○	◎
	.Coordination of Secondary Transportation	△	○	○
	.Consistent Contracts from Purchase to Delivering	×	○	○
Others	.Relation with Cargo Handling Union	◎	○	○
Overall Evaluation		△	○	○

Note: ◎ (Especially superior), ○ (Superior),
△ (Comparatively Interior), × (Interior)

relatively low salary level of the ESP.

vii. Alternative I would be meaningful from the viewpoint of effective utilization of the existing organization.

viii. In order to carry out the complicated and systematic activities in the silo management/operation, the organization must be vital and flexible. This would be realized most efficiently by the private sector. Although the ESP is a joint stock company, it would be difficult to expect the ESP to have the vitality and maneuverability of a private company.

ix. On the other hand, the private sector essentially seeks profit in operating a silo. Under the present conditions of a fluctuating

volume of imported grains the private sector may give up the business if there is an unexpectedly small profit from operating the silo, or may not even be interested in managing operating the silo.

x. Alternatives II and III follow the governmental policy of privatization.

< Regarding silo operation >

xi. Operating a silo requires high overall efficiency which could be attained only with the capability and vitality provided by a group of specialists and engineers. In this regard, as mentioned above, Alternatives II and III seem to be superior.

xii. In the case of the silo at the Port of Lazaro Cardenas, sales activities to promote the silo's services by the management/operation body itself is of great importance, as mentioned above. Countermeasures to ensure adequate inland transportation means are also very significant. These activities could be carried out more effectively by the private sector.

Alternative III would enable these activities to be carried out even more effectively by adding some incentives for handling cargoes and coordinating measures from the governmental side.

the silo's services is of great importance, as mentioned above. Countermeasures to ensure adequate inland transportation means are also very significant. These activities could be carried out more effectively by the private sector.

Alternative III would enable these activities to be carried out even more effectively by adding some incentives for handling cargoes and coordinating measures from the governmental side.

xiii. In order to ensure that a sufficient volume of grain is handled at the silo, it would be a useful means for the management/operation body to carry out, on a regular basis, such businesses as purchasing, transportation, and storage of grain. This would be possible only if the silo management/operation body were to include a private-sector body, such as a trading company, as one of its

constituent members.

This kind of regular business is impossible if Alternative I is adopted.

From the comprehensive comparison of the items examined above both Alternatives II and III are found preferable.

4) Recommendations regarding necessary measures

i. Measures to encourage the participation of the private sector in the management/operation of the silo will be required. From this point of view, a study into reasonable levels of concession fees should be carefully carried out.

ii. Government coordination to ensure the required number of freight cars and Trucks, is essentially important. Without this, land transportation will become a bottle neck in a silo system, resulting in a shortage of silo storage capacity.

iii. The reasonable allocation of handling volume of grains between the Ports of Lazaro Cardenas and Manzanillo should be studied more in detail.

iv. In organization of Alternative III, the practical operation should be allotted to the private sector, while limiting the role of the government to the necessary coordination among the bodies concerned and basic control of the operation.

10.3.2 Improvement Plan of Cargo Handling at SICARTSA Berth

(1) Present Handling Facility and Quantity of Cargo

1) Outline of facility

The present cargo handling facilities are specialized for handling raw materials of pellet and coal for the steel plant, and consist of an unloader, belt conveyers, a stack reclaimer, a stacker and storage yards. The pellet and coal are unloaded from vessels by an unloader, conveyed to stock yards by belt conveyers and then stocked or reclaimed by a stack-reclaimer at the storage yards.

The pellet is directly sent to the blast furnace or the temporal storage yard by a belt conveyer system. The coal stacked at a storage yard is sent to mixing yards and then sent to the steel plant after mixing by mixers. As the belt conveyer line is not usable during mixing operation of coal and also in case of repairing, the pellet and coal unloaded from vessels are temporarily stacked on the storage yard just behind the berth. The raw materials handled by such ways are transferred to a berth side belt conveyer by the same unloader and conveyed to the storage yard or the pellet plant.

The principal spec's of facilities are as follows:

Unloader:

Type	:	rope trolley type bridge unloader
Hoisting load	:	30t
Nominal capacity	:	1,000t/h

Stack-reclaimer:

Type	:	wheel type
Capacity	:	1,000t/h (for stacking)
		400t/h (for reclaiming)

Belt conveyer:

Capacity : 1,500t/h

The lay-out of the present facility is as shown in Fig. 10.3.2.

2) Quantity of cargo

The quantity of cargo from 1988 to as of the end of Sept. 1989 is shown in Table 10.3.4.

Table 10.3.4 Cargo Volume

(unit: ton)

Cargo \ Year	1988	As of the end of Sept. 1989
Pellet (Import)	124,998	427,504
(Domestic)	-	250,798
Coal (Import)	230,890	66,619
Rod, Bar (Export)	116,210	127,758
Wire Coil (Export)	46,339	26,088
Slab (Export)	-	218,056
Total	518,437	1,116,823

3) Productivity

a. Pellet and coal

The productivity (cargo volume per hour), handling time, loss time of the eleven vessels called at the SICARTSA berth in 1989 are shown in Table 10.3.5.

The productivities of pellet and coal are 456.8t/h and 214.8t/h respectively as shown in Table 10.3.5.

Although the productivity of coal is less than one-half of pellet, this is due to the result of uing the same grab bucket for both cargoes under the different specific gravities (pellet: 2.2, coal: 0.8). The larger size of grab bucket will result in the similar productivity for coal. The actual working hours a day are 13.8 hrs.

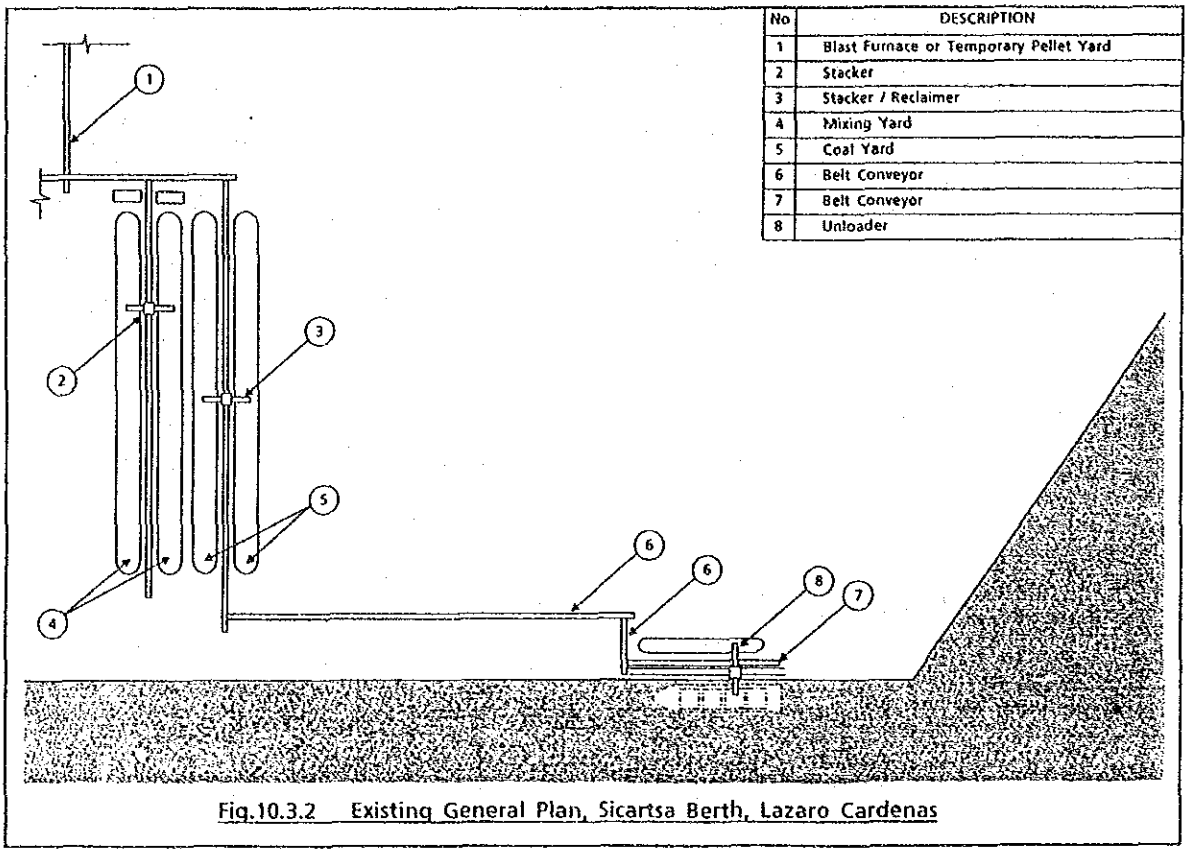


Fig.10.3.2 Existing General Plan, Sicartsa Berth, Lazaro Cardenas

Table 10.3.5 Productivities of Pellet and Coal

Carrier	Cargo	Work Time (hr.)	Loss Time (hr.)	Worker (person)	Cargo Volume (t)	Productivity (t/hr.)
A[7,200G.T]	Pellet	32.00	16.25	13	10,800	337.5
B[34,313G.T]	Pellet	136.25	34.75	10	58,285	427.8
C[48,983G.T]	Pellet	142.00	34.75	9	70,166	494.1
D[7,020G.T]	Pellet	49.50	17.75	8	10,800	218.2
E[36,237G.T]	Pellet	110.00	40.25	8	61,518	559.3
F[23,909G.T]	Pellet	78.25	46.50	10	37,400	477.9
G[4,248G.T]	Pellet	17.50	36.25	6	6,500	371.4
H[34,359G.T]	Pellet	95.25	51.75	9	55,053	577.9
I[12,779G.T]	Pellet	40.25	36.25	7	22,000	546.6
J[22,000G.T]	Pellet	39.50	18.75	8	22,000	556.9
T o t a l		740.50	333.25	88	354,522	
Average		-	-	8.8		456.8
[27,168G.T]	Coal	126.50	33.50	8	27,168	214.8

b. Final and semi-final products

i. Rod and bar

These cargoes are final products and are loaded into a vessel by ship cranes with 40 to 50 tonnage lifting load, and are stacked in the hold by fork-lift trucks with 15 tonnage.

The productivity of the same cargoes is shown in Table 10.3.6.

Table 10.3.6 Productivity of Rod & Bar

Productivity / Ship	Cargo Volume/hr./gang (t/hr./g)	Cargo Volume/hr./ship (t/hr./s)
A	57.8	141.7
B	64.4	121.1
C	52.1	117.8
D	60.6	151.1
E	58.5	170.8
Average	58.7	140.5

ii. Wire coil

This product is handled and stacked by the same ways as rod and bar.

The productivity is as Table 10.3.7.

Table 10.3.7 Productivity of Coil

Productivity / Ship	Cargo Volume/hr./gang (t/hr./g)	Cargo Volume/hr./ship (t/hr./s)
A	61.7	117.6
B	83.2	50.7
C	86.7	151.1
D	51.4	110.1
E	38.4	90.4
Average	64.3	104.0

iii. Slab

This is semi-final product and handled by the same ways as rod and bar. The productivity is as Table 10.3.8.

Table 10.3.8 Productivity of Slab

Productivity / Ship	Cargo Volume/hr./gang (t/hr./g)	Cargo Volume/hr./ship (t/hr./s)
A	102.2	211.8
B	121.4	327.0
C	127.0	352.0
Average	116.9	296.6

iv. Scrap

Scrap is unloaded by a special grab bucket and its productivity is 40t/h per ship and 14.6t/h per gang.

(2) Improvement plan and Evaluation of Cargo Quantity

1) Outline of facility

SICARTSA has the improvement plan of cargo handling facilities to meet the need for construction of the second new blast furnace.

The improvement includes the constructions of one multipurpose crane, lengthening rails and relocation of the existing unloader to berth No.3. This construction has already been started and is to be finished at the end of 1990.

The constructions of belt conveyer and related facilities are not included in this improvement plan.

The lay-out of the improvement plan is shown in Fig. 10.3.3.

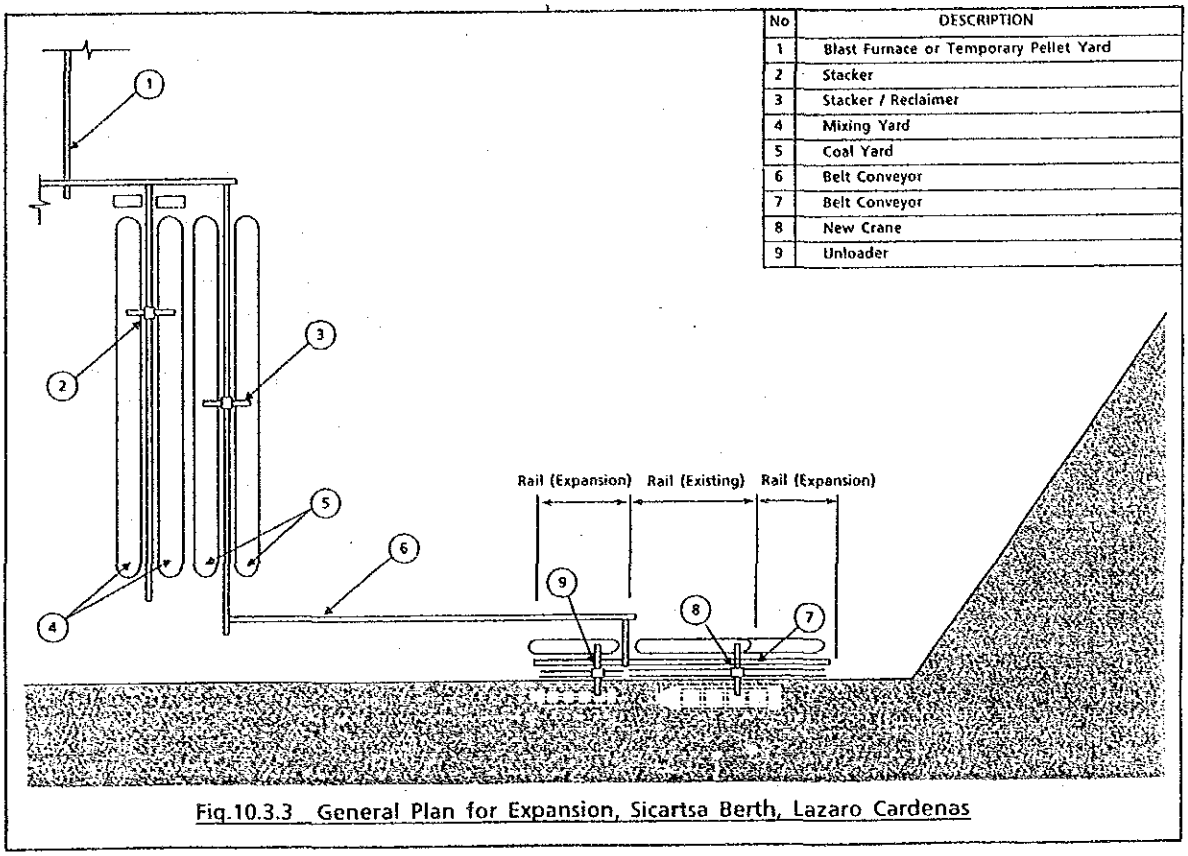
The multi-purpose crane is designed for the purpose of both loading and unloading of bulk cargoes, final and semi-final cargoes and scrap.

The principal spec's of the crane is as follows:

Type : rope trolley type bridge crane

Hoisting load : 70t

Nominal capacity: 2,132t/h



No	DESCRIPTION
1	Blast Furnace or Temporary Pellet Yard
2	Stacker
3	Stacker / Reclaimer
4	Mixing Yard
5	Coal Yard
6	Belt Conveyor
7	Belt Conveyor
8	New Crane
9	Unloader

Fig.10.3.3 General Plan for Expansion, Sicartsa Berth, Lazaro Cardenas

2) Cargoes on subjects

Raw materials, final and semi-final products and scrap are programmed to be handled after completion of the improvement plan.

These cargoes and volumes are shown in Table 10.3.9.

Table 10.3.9 Programmed Cargo Volume on SICARTA Berth

(Unit: ton)

Year / Cargo	1990	1991	1992	1993	1994	1995
Pellet	1,800,000	1,800,000	1,800,000	1,300,000	800,000	-
Coal	250,000	250,000	250,000	250,000	250,000	250,000
Rod.Bar & Coil	300,000	300,000	300,000	300,000	300,000	300,000
Slab	400,000	400,000	800,000	600,000	300,000	100,000
Sheet	-	120,000	200,000	300,000	500,000	750,000
Scrap	400,000	400,000	400,000	400,000	400,000	400,000
Total	3,150,000	3,270,000	3,750,000	3,150,000	2,550,000	1,800,000

3) Cargo handling on each wharf

Three berths are in operation after completion of the improvement plan to handle the cargoes in Table 10.3.9.

The existing unloader is transferred to berth No.3 and is used only for unloading raw materials such as pellet and coal.

One multi-purpose crane and conventional ship cranes are operated on berths No.1 and No.2, and handle raw materials, steel products and scrap.

One multi-purpose crane and ship cranes are simultaneously used for one ship because a multi-purpose crane can cover one or two hatches, and another one or two hatches are left for ship cranes. When two ship arrive at the same time, cargo handling operation for one ship is done only by ship cranes for the reasons mentioned above.

4) Productivicy

a. Existing unloader

The productivity of the existing unloader is shown in Table 10.3.5 as 456.8t/h for pellet and 214.8t/h for coal.

In the evaluation of the cargo capacity of this unloader mentioned later in this report, the productivity for both cargoes of pellet and coal is taken as 500t/h, which is 50% of the nominal capacity of the unloader, because the cargo capacity for coal can be increased by using large-size grab buckets.

b. Multi-purpose crane

The productivities of a multi-purpose crane are not determined yet. However, the productivities are assumed here as the followings from the experiences so far.

For pellet and coal : Productivity will be about 50% of the nominal capacity of the crane and is set as 1,000t/h.

For rod, bar and coil: Productivity will be unit weight (10t) x numbers of cycle per hour (20 times) = 200t/h.

For slab: Productivity will be unit weight (12t) x number of pieces handled at one cycle (3 pieces) x number of cycle per hour (15 times) = 500 t/h.

For sheet: Productivity will be unit weight (16t) x numbers of pieces handled at one cycle (3 pieces) x number of cycle per hour (15 times) = 700t/h

For scrup : Productivity will be grab capacity ($8.0m^3$) x specific gravity of scrap (1.5) x numbers of cycle per hour (15 times) = 180t/h.

c. Ship cranes

Productivities of the conventional ship cranes are the same values as shown in Table 10.3.6, Table 10.3.7 and Table 10.3.8.

d. Productivities on each wharf

The productivities on each wharf are shown in the data mentioned above.

Table 10.3.10 Handling capacity per berth

Berth / Cargo	Berth No.3	Berth No.1 & No.2		
	[existing unloader] t/h	[ship gear] t/h	[new crane + ship gear] t/h	[average] t/h
Pellet	500	-	1,000	1,000
Coal	500	-	-	-
Rod, Bar & Coil	-	150	300 [200 + 100]	230
Slab	-	300	700 [500+200]	500
Sheet	-	300	900 [700+200]	600
Scrap	-	40	200	120

5) Evaluation of cargo quantity on each wharf

There are some methods to evaluate the cargo quantity on berth. The O.R. method which is used widely to estimate optimum numbers of berth and optimum cargo handling capacity of equipment is employed here. The formulas of berthing times, berth occupancies and calculated data are described in Appendix 10.3.2.

a. Conditions for calculations

The conditions for calculations are assumed as follows:

Work hours a day	: 24 hrs
Efficiency of working hours	: 0.75
Actual work hours	: 18 hrs
Actual work hours	: 340 days
Number of berth	: berth No.3 (one berth) berths No.1 and No.2 (two berths)
Times for berthing and deberthing	: 0.5days
Average cargo volume per ship	: 25,000t

Concerning actual work days a year, another 25 days are loss times (days) due to had weathers and/or repairings.

On the number of berths, berth No.3 (which is considered as independent one berth) is used only for bulk carriers but berths No.1 and No.2 are simultaneously used for bulk carriers and general cargo vessels, and become two berths.

b. Annual cargo volume

The results of the calculation are shown in Table 10.3.11.

In evaluating the cargo quantity, the berth occupancies were taken as follows:

For berths No.1 and No.2: occupancy rate = 60% (as two berths)
For berth No.3 : occupancy rate = 50% (as one berth)

In Table 10.3.11 the programmed cargoes in each year of the improvement plan can be handled by cargo handling equipment of an unloader, a multi-purpose crane and conventional ship cranes.

However cargoes in 1992 and 1993 are little bit over the capacities of the three berths under the conditions of the berth occupancies of 50% and 60%. As the excess amounts of cargoes in 1992 and 1993 are comparatively small, it is considered that all the amount of cargo will be handled by making use of berths for a longer period.

Table 10.3.11 Annual handling capacity per berth

(Unit:Ton)

		berth No.3 [existing unloader]	berth No.1 & No.2 [ship gear]& [new crane+ship gear]	excessing cargo volume	total
1990	Coal	250,000			250,000
	Pellet	1,050,000	750,000		1,800,000
	Rod,bar & Coll		300,000		300,000
	Slab		400,000		400,000
	Scrap		400,000		400,000
	Total	1,300,000	1,850,000		3,150,000
1991	Coal	250,000			250,000
	Pellet	1,050,000	750,000		1,800,000
	Rod,Bar & Coil		300,000		300,000
	Slab		400,000		400,000
	Sheet		120,000		120,000
	Scrap		400,000		400,000
	Total	1,300,000	1,970,000		3,270,000
1992	Coal	250,000			250,000
	Pellet	1,050,000	750,000		1,800,000
	Rod,Bar & Coil		300,000		300,000
	Slab		800,000		800,000
	Sheet		200,000		200,000
	Scrap		340,000	60,000	400,000
	Total	1,180,000	2,390,000	60,000	3,750,000
1993	Coal	250,000			250,000
	Pellet	1,050,000	250,000		1,300,000
	Rod,Bar & Coil		300,000		300,000
	Slab		600,000		600,000
	Sheet		300,000		300,000
	Scrap		396,000	4,000	400,000
	Total	1,300,000	1,846,000	4,000	3,150,000
1994	Coal	250,000			250,000
	Pellet	800,000			800,000
	Rod,Bar & Coil		300,000		300,000
	Slab		300,000		300,000
	Sheet		500,000		500,000
	Scrap		400,000		400,000
	Total	1,050,000	1,500,000		2,550,000
1995	Coal	250,0000			250,000
	Rod,Bar & Coil		300,000		300,000
	Slab		100,000		100,000
	Sheet		750,000		750,000
	Scrap		400,000		400,000
	Total	250,000	1,550,000		1,800,000

(3) Recommendations

It is concluded that all the amount of cargo in the improvement plan could be handled, however there exist some matters to be resolved in cargo handlings. The followings are recommendations for these matters.

1) Improvement in working hours

The working hours for net cargo handling work are approximately 14hrs a day in SICARTSA berth. As the expensive investment has been put in the improvement plan, the new equipment must be used as fully as possible.

The net work hours and loss hours are 740.5 hrs (69%) and 333.25 hrs(31%) respectively as in Table 10.3.5.

According to the analysis of the data obtained at the site survey, the main causes of loss times are as follows:

due to union	:	224.0 hrs	(67%)
due to ship	:	102.7 hrs	(31%)
due to weather:		3.2 hrs	(1%)
due to others	:	3.35 hrs	(1%)
Total	:	333.25 hrs	(100%)

The loss time due to union is nearly two thirds of the total loss. It is said that the details of losses due to union are the delay in work shift, delay in time of meals, lack or unproper handling of devices.

The daily net working hours will be increased approximately up to 18 hours by reducing the above losses due to union.

2) In crease in a unit weight of products

The present unit weights of products are 10 - 12 tonnages. As the hoisting load of multi-crane is 70 tonnage (which is possible to lift weight to 60t excluding a hook load), it is too wasteful to handle a small weight of cargo by this crane.

Increase in weights of unit of handling cargoes is very important to realize a high efficiency in handling work. Some ways to make a larger unit for handling are as follows:

a. Rod and bar products

The unit weights of these products are almost 10 tonnages. One way is to bundle some pieces of them and to make one larger and heavier

unit for handling. This bundling is easily conducted by wire ropes.

b. Coil product

It is not preferable to lift coil by bundling like rod and bar products, due to possible damages to coil products in handling.

This product is usually handled in one unit. The way to increase wights of the coil is to make one heavier unit in the production stage. Almost 30 tonnage of one coil is produced in Japan.

c. Slab and sheet

These products are usually handled by a magnet system, called lifting magnet. Two or three pieces of these products are loaded into ship at one time by this lifting magnet. Employment of the magnet system is quite preferable for handling these products. An example of lifting number of slabs and sheets is shown in Table 10.3.12.

Table 10.3.12 Example of Lifting Numbers of Slabs

width		1,500mm	2,500mm	4,000mm
thickness (mm)	6	8	6	4
	8	6	5	3
	10	6	5	3
	12	4	4	3
	16	3	3	2
	20	3	3	2
	32	2	2	1
	46	1	1	1

d. Work in the cargo hold

The movements of products in the cargo hold have been carried out by fork-lift trucks. The operation of fork-lift trucks is very difficult due to the cargo hold being narrow as compared with the lengths of the materials. It is necessary to employ fork-lift trucks with enough capacity for the weight of cargoes.

A special type of fork-lift trucks equipped with the lifting magnet system is also necessary for handling slab and sheet products.

3) Improvement of cargo handling equipment

As mentioned above, a relatively large amount of cargoes must be handled by conventional ship cranes. However, ship cranes are very inefficient and not proper in view of safe handling of cargoes because the net lifting load of ship cranes is limited and they need a lot of workers on quays and in holds. The following improvements of equipment are preferable in accordance with the increase in cargoes.

a. Berth No. 1 and No.2

Although one multi-purpose crane is set on berths No.1 and No.2 after completion of the improvement plan, another two cranes for handling products and scrap on the same berths are much desirable, because one crane is not enough in case of break-down and there is enough length (355m) of wharves for three cranes. The crane in Fig. 10.3.4 will be proper for this purpose. The annual cargo quantity per wharf will greatly increase compared with the capacity of conventional ship cranes, thus cantributing quick dispatch of vessels.

In addition, the installation of multi-purpose cranes will be preferable in order to accommodate various type of cargoes and secure safety in cargo handling operation. However, further cost analysis will be required to introduce the cranes.

b. Berth No.3

As the volume of pellet becomes zero in 1995 and the age of an unloader on berth No.3 becomes 19 years (which is over the durable age of 17 years), it should be replaced in or before 1995 with a multi-purpose crane like the one shown in Fig. 10.3.5.

The crane in Fig. 10.3.5 called a level luffing crane is proper for handling longer products by hook and bulk cargoes by grab buckets, as this crane can travel and slue and can cover a wide range of handling works.

c. Belt conveyer and related facilities

Only one belt conveyer is used after the improvement plan despite of the two unloaders on quay-sides. Therefore, two unloaders could not use simultaneously the belt conveyer system and this hinders the effective cargo operation of bulk cargoes.

Emergency stock yards behind the wharves are prepared to continue

unloading work in case of two ship calling at the same time. In addition to this, another belt conveyer and related facilities are more preferable to realize quick despatch of vessels. However, the investment in these conveyer and related facilities is not necessarily recommended because no pellet cargo is unloaded at SICARTSA berth in 1995.

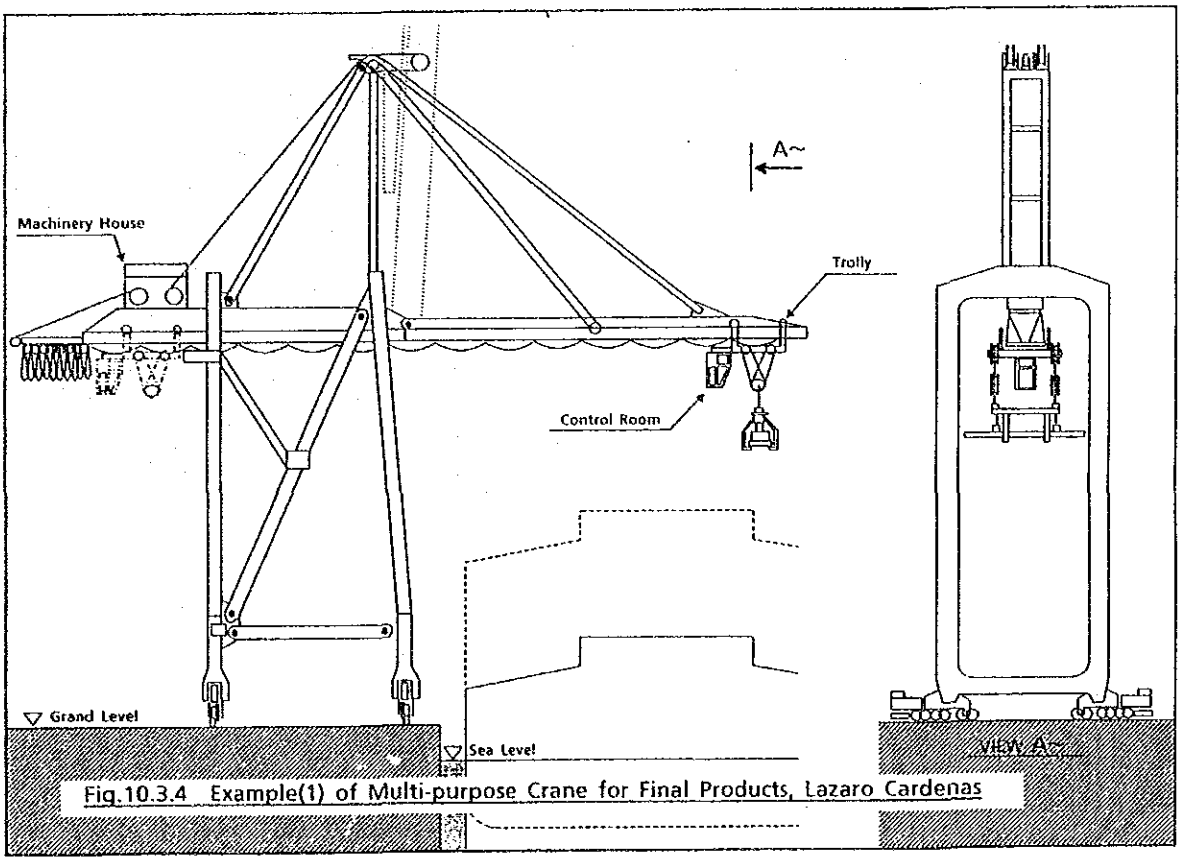


Fig.10.3.4 Example(1) of Multi-purpose Crane for Final Products, Lazaro Cardenas

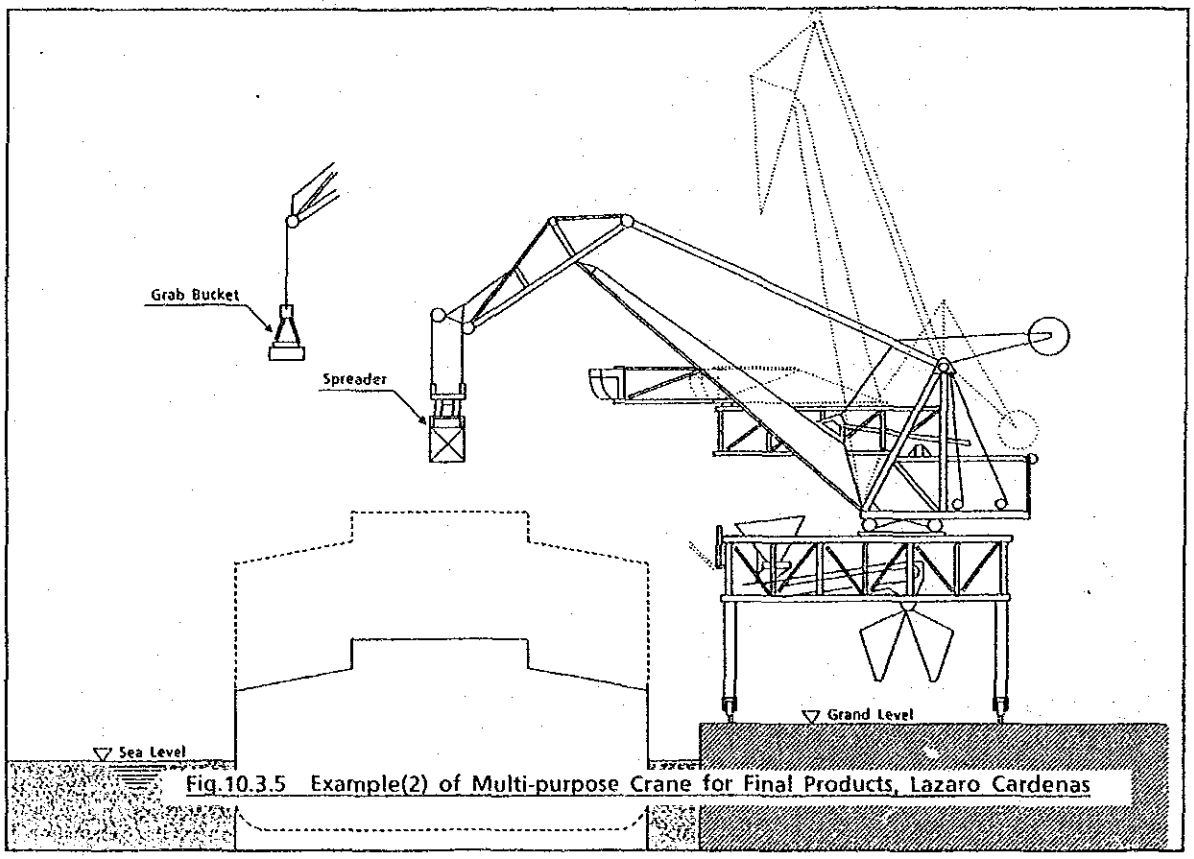


Fig.10.3.5 Example(2) of Multi-purpose Crane for Final Products, Lazaro Cardenas

10.4 Short-Term Improvement Plan for Bulk Cargoes in the Port of Manzanillo

Agricultural and mineral bulk cargoes at the Port of Manzanillo are handled at the band B and a portion of band C areas of the inner port. It is expected that construction of the band C area will be completed and the area will render operational service for bulk cargo handling by 1995.

In this chapter the berth and wharf use plan and the improvement plan of bulk cargo handling in the band B and C areas are examined.

10.4.1 Berth and Wharf Use Plan

The berth and wharf use plan of the band B and C areas is examined in the section, including a rough consideration of the band A area. Also, the handling of general cargoes and containerized cargoes will be examined from the viewpoint of reasonable allocation of berth and land use in these areas.

(1) Fundamentals of the Berth and Wharf Use Plan

1) Cargo volume in 1995

a. Break bulk and containerized cargoes

The forecast values and berth allotment for these cargoes are shown in Table 10.4.1, which is based on the examined results in Chapter 5 and section 9.2.1 in this chapter.

b. Bulk cargoes

Table 10.4.2 shows the forecast value of bulk cargoes which is examined in section 5.6. Among the bulk cargoes passing through the port, the imported agricultural bulks are forecast to grow greatly over the long term because of increasing grain consumption in Mexico. Exports of cement may also increase in the future because of increased cement production in the hinterland.

As a whole, the handling volume of the import/export bulk cargoes at the port is expected to show a considerable increase over the long term, including the handling of some newly generated cargoes to/from the hinterland.

2) Vessel size

The average vessel sizes by vessel type are assumed as shown in Table 10.4.3.

Table 10.4.1 Forecast Values of Break Bulk and Container Cargoes (Port of Manzanillo)

(Unit: 1,000 tons)

		Actual Values	Forecast Value		Berth Allocation in 1995	
		1988	1995	2005	Container Berth	General Cargo Berth
Foreign Trade	Containerized Cargoes	163.5	632	1,284	600.2	31.8
	Break Bulk Cargoes	219	245	231	26.9	218.1
	Total General Cargoes	382.5	877	1,515	627.1	249.9
Domestic Trade	Total General Cargoes	61.8	90	-	-	90

Note: The total domestic general cargoes in 1995 are estimated by assuming a roughly 50 % increase in the handling volume in the year 1988.

Table 10.4.2 Forecast Values of Bulk Cargoes (Port of Manzanillo)

(Unit : 1,000 tons)

Year			Actual Values in 1988	Forecast Values in 1995
Agricultural Bulk Cargoes	Foreign Trade	Import	434	570
		Export	0	0
	Domestic Trade	Inward	66	80
		Outward	0	0
Mineral Bulk Cargoes	Foreign Trade	Import	132	227
		Export	407	1,300
		(cement)	(397)	(900)
		(Iron Ore Pellets)	(0)	(400)
	Domestic Trade	Inward	33	60
		Outward	50	0

Table 10.4.3 Physical Characteristics of Average Size of Vessels and Scale of Berths

Vessel Type		Physical Characteristics				Scale of Berths	
		Dead Weight Tonnage	Length	Width	Draught	Length	Water Depth
General Cargoes	Foreign Trade	15,000	153	22.3	9.3	180	11
	Domestic Trade	5,000	109	16.4	6.8	130	7.5
Containers (Mult-purpose Vessels)	Foreign Trade	20,000	177	23.4	10.0	200	12
Bulk Cargoes other than Cement and Pellets	Foreign Trade	25,000	180	25.0	10.5	210	12
	Domestic Trade	10,000	137	19.9	8.5	160	10
Cement	Foreign Trade	20,000	177	23.4	10.0	200	11
Iron Ore Pellets	Foreign Trade	30,000	186	27.1	10.9	220	12

Note : i. The values basically follow the technical standards of Japan.

ii. The length of the scale of the berths is modified from the above standards.

3) Concession for bulk cargo handling

As mentioned above, the Federal Government of Mexico has recently been encouraging investments in construction and operation of port facilities by the private sector. This system for bulk cargo handling in which exclusive concessions are awarded to the private sector is considered reasonable and should be encouraged because bulk cargoes are characterized by a relatively small number of consigners/consignees and large volumes of cargo, which requires high cargo-handling, cargo storage and land transportation efficiency with specialized and costly facilities/equipment. In line with this policy, many concessions for bulk cargo handling are being given to private companies at many ports in Mexico.

At the Port of Manzanillo, the concessions have been given or are in the process of being evaluated as follows:

. Concession A : Handling of agricultural bulk cargo, mainly imports of grains

. Concession B : Handling of agricultural bulk cargo, mainly imports of grain

. Concession C : Handling of mineral bulk cargoes, mainly materials for fertilizers

. Concession D : Handling of cement, mainly for export

. Concession E : Handling of mineral bulk cargoes, mainly petrochemical products

(2) Berth Use Plan

1) Physical conditions

i. Band A should be counted as two berths based on the lengths and the sizes of calling vessels.

ii. It is difficult to simultaneously moor three vessels with long lengths at the band B berths.

iii. Necessary allowance for berth length should be made at the corner of each band.

iv. General cargoes and containers should be handled at the band A berths and berth C-1, because of their proximity to the warehouses and open storage yards.

v. The positions of the sites scheduled to be awarded to the concessionees should be considered for berth allocation.

2) Berth use plan

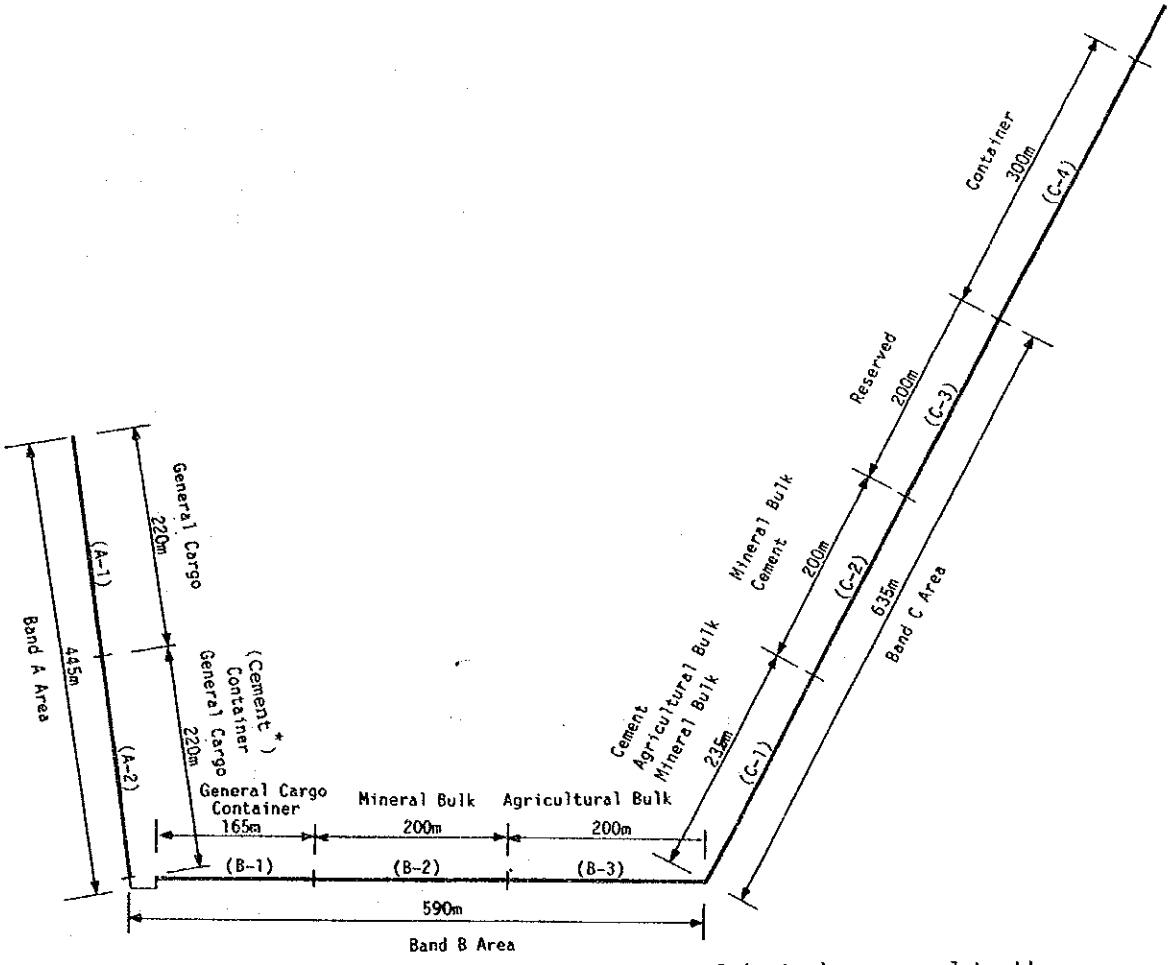
The berth use plan is shown in Fig. 10.4.1.

a. General cargoes and containers

i. According to the results of calculations, the berth occupancy of vessels for general cargoes is less than 40% in the case of 3 berths. Considering the utilization of berths by bulk carriers, 3 berths are allotted, giving a considerable allowance.

ii. Berths A-1, A-2 and B-1 (See Fig. 10.4.1) are allocated for these vessels.

iii. Multipurpose vessels are allocated to berths A-2 and C-1.



Note: Cement at A-2 berth is temporary and is to be removed to the concessioned site in future.

Fig. 10.4.1 Berth Allocation Plan of Inner Port Area (Port of Manzanillo : 1995)

iv. However, bulk carriers with long lengths will frequently occupy berths B-2 and B-3. Therefore it would be reasonable for berth B-1 to be used mainly by smaller vessels, such as vessels carrying general domestic cargoes.

b. Bulk cargoes

i. Taking into consideration the scheduled site for each concession for the handling of bulk cargoes, berth allocation is planned as shown in Fig. 10.4.1.

ii. Iron ore pellets are allocated to berth B-2. Two-thirds and one-third of agricultural bulk cargoes are allocated to berths B-3 and C-1, respectively.

iii. According to the results of our calculations, the berth

occupancy of berths B-2/B-3 and C-1/C-2 are around 40%.

iv. Berth C-3 is reserved for the increase of bulk cargoes including newly generated cargoes. This berth could be used by container vessels in the occasional cases when two vessels arrive at the container berth, and also in the long term by domestic feeder vessels as a staying berth.

(3) Wharf Use Plan

The wharf use plan of the inner port area is shown in Fig. 10.4.1.

a. Land use plan

i. The scheduled and prospective concession sites are shown in Fig. 10.4.1.

ii. The areas behind berth C-2 and C-3 are planned for the future concession sites.

iii. The area between the concession sites and the berths are used for transit storage yards.

b. Roads and railway tracks

i. The roads are laid out at the area behind the band C wharf.

ii. Connection lines of the railway tracks to the band C quay is laid as in Fig. 10.4.1

iii. Two railway sidings are extended behind the concession sites.

iv. For the marshalling of freight cars to/from the concession storage facilities and for the loading/unloading of general cargoes between freight cars and the planned warehouse, it is planned that 3 more sidings will be extended to the band A wharf.

v. The railway planning is deemed to require a further detailed study including the installation of a large-scale marshalling yard for freight-cars outside the port.

c. Storage facilities for general cargoes and containers

i. The required volume of storage facilities in 1995 is estimated to be around 30,000 m^2, which will also be approximately sufficient for long-term demand.

ii. Considering the capacity of all the existing warehouses, a new warehouse of around 8,000 m^2 is required. This warehouse is laid out near the railway track as shown in Fig. 10.4.2.

iii. The container yards and the yards for storing general cargoes are planned as shown in the same Fig.

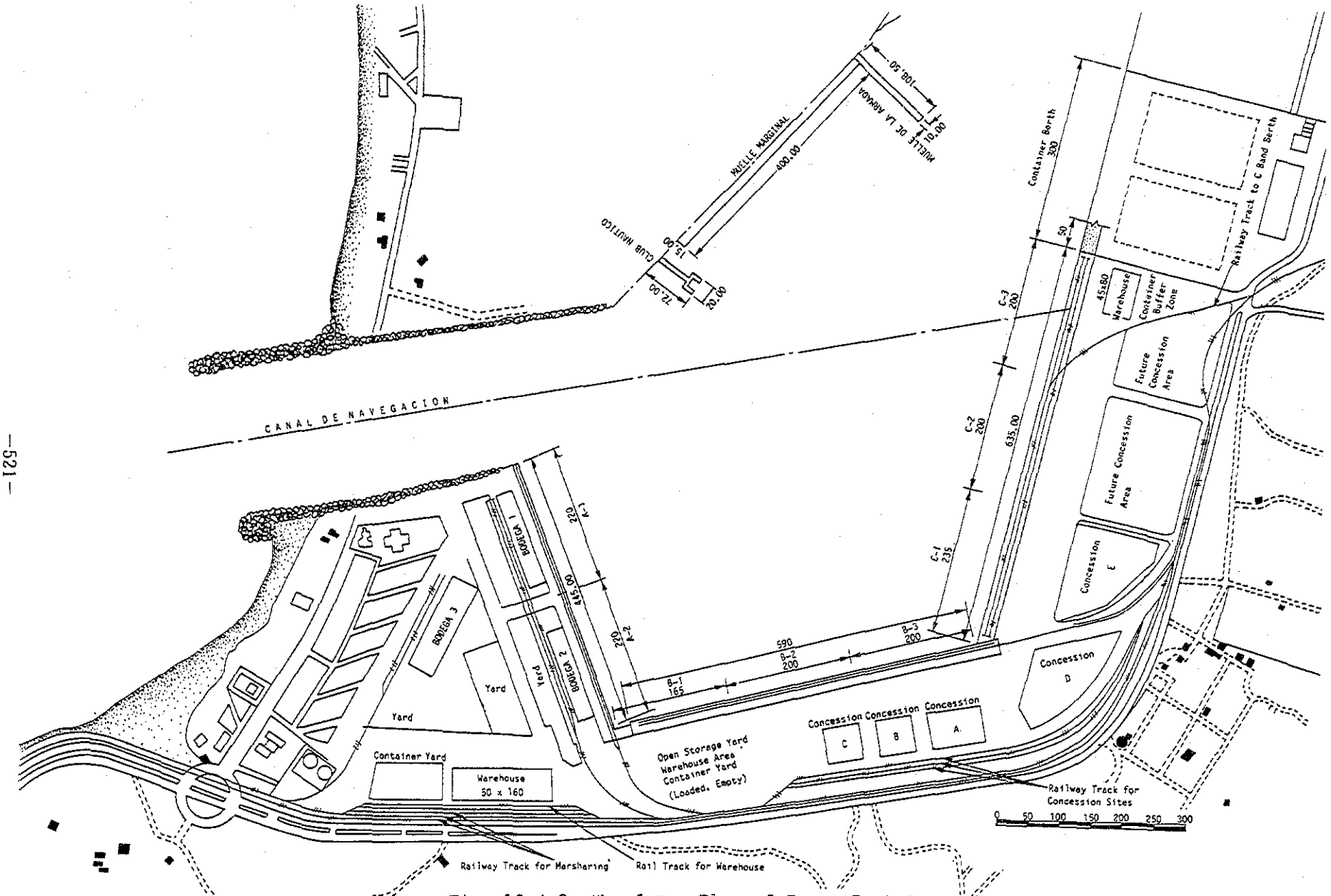


Fig. 10.4.2 Wharf Use Plan of Inner Port Area
(Port of Manzanillo : 1995)

10.4.2 Improvement Plan of Bulk Cargo Handling

Although as mentioned in the previous section the concessions for bulk cargo handing are not definite as yet, an examination of agricultural bulk cargo handling is roughly carried out in this section with respect to these concessions.

(1) Outline of Facilities

Agricultural bulk cargoes have been unloaded by ship gears and discharged directly to trains and trucks in this port. This direct discharge method is very efficient when all the handling and transporting systems are properly functioning, and also this method has a merit of reducing handling time.

However, as this system has no buffer system like storage facility to maintain its functions, there have occasionally occurred stoppages and delays in handling works due to shortage of trains and trucks in this port.

One way to solve this problem is to prepare a storage facility such as shed, warehouse or silo, in or near the port. Recently private companies have planned to construct warehouses for storing agricultural bulk cargoes. Private companies conduct the cargo handling and storing operations by getting concessions from the government. The concessiions and their facilities under consideration are as shown in Table 10.4.4.

Table 10.4.4 Concessions and facilities

Concession	A	B
Facility	Warehouse (width 40m x length 70m x 2 units) Capacity: 20,000t	Warehouse or silo (not fixed) Capacity: not fixed
Location	Behind the berth B-3	Behind the berth B-3
Berth usage Cargo	B-3, C-1 Maiz, sorghum	B-3 Maiz, sorghum
Cargo volume	600,000t	400,000t

The lay-out of the facilities will be as shown in Fig. 10.4.3.

The agricultural cargoes are unloaded by ship gears, conveyed by quay-

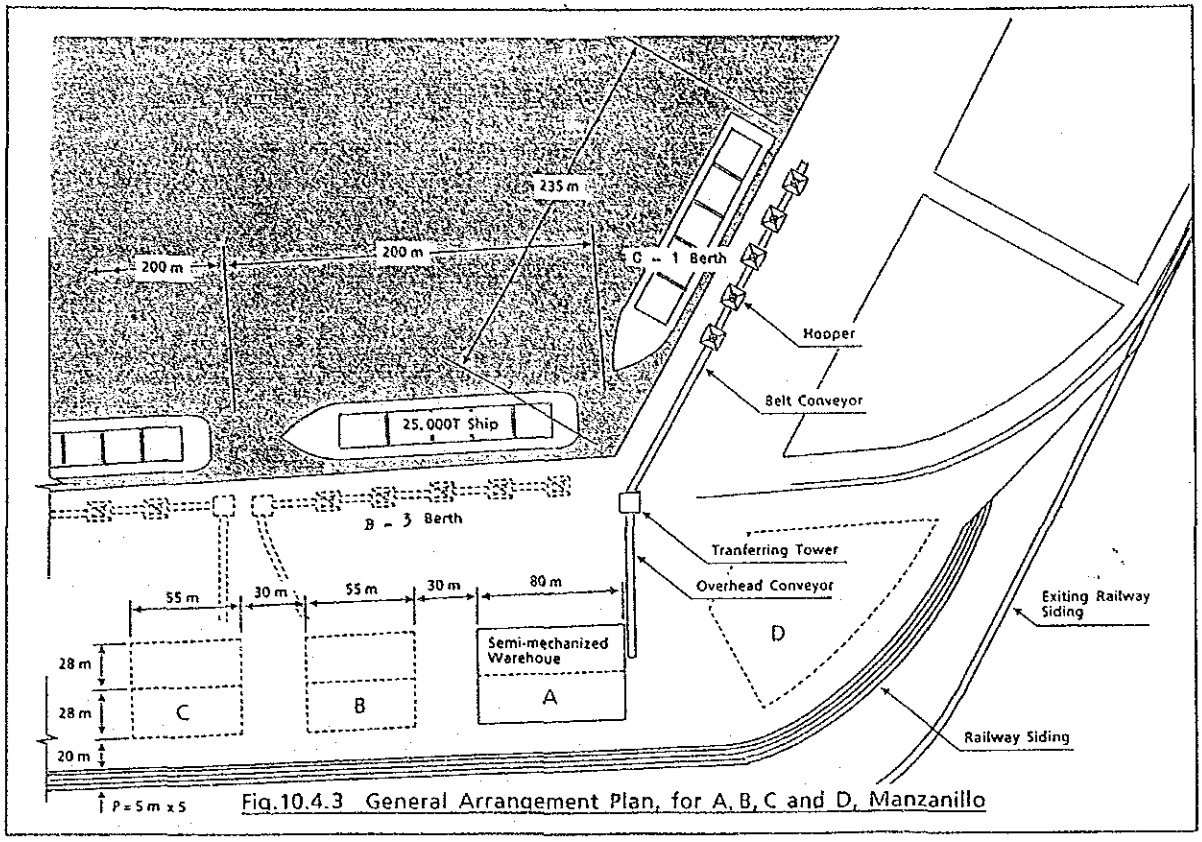


Fig.10.4.3 General Arrangement Plan, for A, B, C and D, Manzanillo

side belt conveyer and overhead conveyer, and stored in the warehouse. Then the same cargoes are transported by underground conveyer and discharged to trains and trucks.

(2) Evaluation of Storage Capacities

The storage capacity of a warehouse for the annual cargo volume of 600,000t and 400,000t under the cycle times of 15 is calculated to be 40,000t and 27,000t respectively.

From this calculation, the planned storage capacity of Concession A is said to small. It is necessary to prepare enough land transportation vehicles in order to cover a small warehouse capacity. The minimum capacity of 27,000 tonnage will be needed for Concession B storage facility.

(3) Recommendations

a. Warehouse

The necessary storage capacity of the warehouse of Concession A is considered to be 40,000 tonnage under the condition of 15 cycle times. In order to discharge total cargo of 600,000t by this warehouse, 30 times are needed as the annual cycle times. In addition, as the space utilization of storage warehouse is 70-80%, more than 30 times in cycle will be necessary. To realize such high cycle times, enough numbers of trains and trucks must be guaranteed.

b. Quay-side belt conveyers

The quay-side belt conveyers will be of a portable type because these conveyers must be moved to and from quay-side before and after handling works.

The less numbers of conveyers are preferable in view of smooth belt moving work and reducing numbers of workers. In order to meet this requirement, longer belts are desirable, but longer conveyers are more difficult to move.

A shiftable conveyer which has a proper moving device on the belt girder like Fig. 10.4.4 will be one way to move a longer belt conveyer effectively.

The quay-side belt conveyers are better to be open type because several hoppers must be set on the conveyers at various positions of hatches of vessels.

c. Overhead conveyers

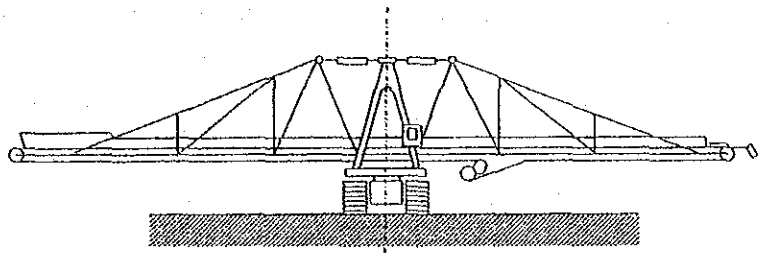
These conveyers located as such in cross vertically to the face line to wharf transfer cargoes from quay-side belt conveyers to the storage warehouse.

As many vehicles such as cranes, trucks and tractors pass under the overhead conveyer, enough clearance must be made underneath the same conveyer.

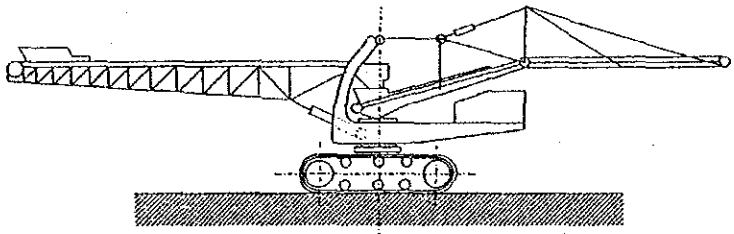
The conveyer structure is preferable to be closed for prevention of dust dispersed by wind.

d. Hoppers

Hoppers are the devices to receive cargoes directly from ship gears on the quay-side belt conveyers. It is desirable to employ larger



(a) Wing Type



(b) Rotary Type

Fig.10.4.4 Examples of Shiftable Conveyor

size hoppers in preventing spillages of grains and easy setting of grab buckets during cargo handling operations. The size of hoppers is usualy taken more than three times of the volume of a grab bucket.

Larger hoppers are better to set as close to ship-side as possible in order to make a higher cycle time and easy positioning of grab buckets. Hoppers must also be equipped with flow controllers in order to prevent grain from overflow.

e. Discharge equipment

Loading in wagon cars causes lots of grain spillages due to unproper discharge equipment.

The present car loading operating needs two workers in a car and one fork-lift truck outside for moving grains from one point to another. And also the actual utilization of a car space is nearly half.

In order to reduce the spillages, to eliminate workers in a car and to make full use of a car space, effective discharge methods must

be employed.

Fig. 10.4.5 and 10.4.6 are the examples for this purpose. The 10.4.5 is an equipment with a rotating trimmer set at the end of a discharge shoot. Fig. 10.4.6 is similar one with a rotating shuttle conveyer. These trimmer and shuttle conveyers will be able to carry grain materials into necessary positions of wagon cars.

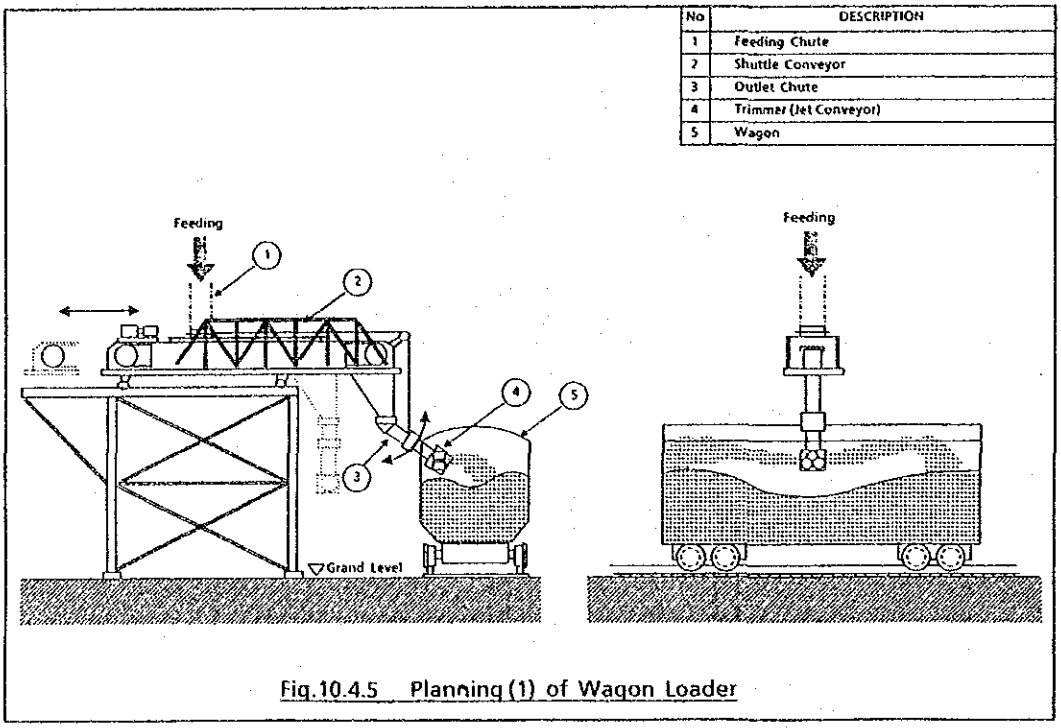


Fig.10.4.5 Planning (1) of Wagon Loader

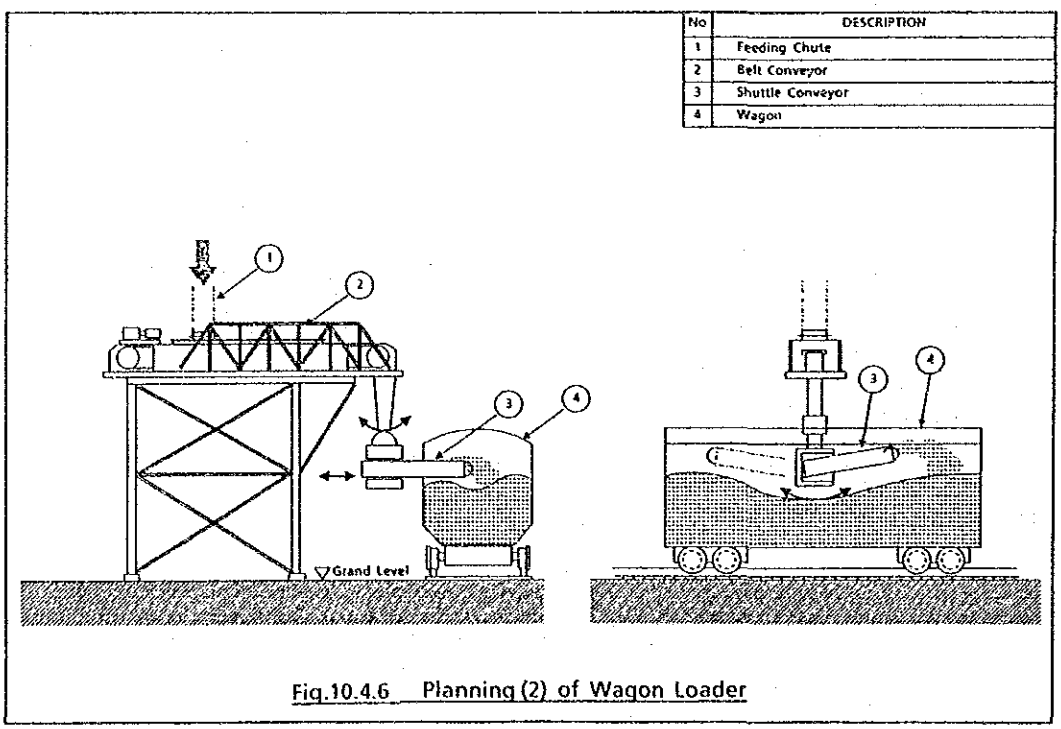


Fig.10.4.6 Planning (2) of Wagon Loader

Chapter 11. Preliminary Design and Cost Estimate

11.1 Preliminary Design of Port of Lazaro Cardenas

11.1.1 Design Policy and Scope of Design

(1) Design Codes and Standards

In Mexico, there are no specific design codes and design manuals which are applicable exclusively to port facilities. Design codes for civil and structural engineering are generally used. Accordingly, the design of marine structures such as quaywalls, revetment, etc. for Lazaro Cardenas Port development has been carried out on the basis of Technical Standards for Port and Harbour Facilities in Japan which are used as the basis for port design in Japan as well as in many developing countries worldwide. In the process of design, technical information and approaches now prevailing in Mexican Ports, most of which had been given by the Engineers in Puertos Mexicanos during the stay of the Study Team, have been also duly considered to reflect local conditions in design particularly in the interpretation of structural properties of construction materials available on site and various kinds of environmental conditions, including seismic disturbances.

(2) Scope of Design

Like the Manzanillo Port, the short term plan is targetted at the year 1995 and the long term plan at the year 2005. The port facilities covered by the study include a bulk berth, a silo berth and a container berth.

1) Bulk Berth

The bulk berth, now exclusively serving the shipment of SICARTSA's cargo, still has enough capacity left to cater for the projected cargo demand in future, so that no definite expansion plan has been made yet. The cargo handling equipment is now building up and the envisaged reinforcement plan is considered sufficient for the time being. The designing for bulk berth has been concentrated on the apron pavement and road in the port area.

2) Silo Berth

As the rehabilitation work on the silo berth is under way, the design work is limited to general review on the going plan.

3) Container Berth

In the short term plan, the open storage yard will be modified to accommodate an integrated container handling system. To this end, the pavement of the existing terminal will be upgraded and/or rehabilitated and a container freight station will be constructed together with supplementary utilities works. In the long-term plan, a 300m long container berth is envisaged next to the existing general cargo berth.

11.1.2 Design Criteria for Structural Design

(1) Ships and Wharf Cranes Considered for Quaywall Design

The load conditions from ships and wharf cranes which will govern the quaywall structure design have been determined as follows:

Table 11.1.1 Design Ships and Crane

	Bulk Berth	Silo Berth	Container Berth
(i) Vessel Size	40,000 DWT	80,000 DWT	50,000 DWT
(ii) Berth Length	700m	420m	286m (+300m in future)
(iii) Berth Water Depth	-14.0m C.D.L.	-11.0m - C.D.L.	-14.0m C.D.L.
(iv) Docking Speed	10cm/sec	10cm/sec	10cm/sec
(v) Surcharge	4t/m^2	-	3t/m^2
(vi) Crane and Cargo Carrier	Gantry crane 1,000t/h, 2,132t/h	Pneumatic crane 300t/hr x 2	Quayside gantry crane (40') Fork-lift 40', 25'

(2) Natural Condition

The natural condition governing the port design has been summarized as below. Most of information has been taken from the report "X1 Reunion

Nacional de Mecania de Suelos" in 1982 and through the interview to the technical staff of Puertos Mexicanos.

Table 11.1.2 Natural Condition

Item	Design Criteria	Remarks
(i) Soil	Sandy soil, N=20 between -7m - -17m	Refer to Fig. 11.1.1, 11,1,2
(ii) Wave	Less than 0.50m	
(iii) Wind	210km/h = 59m/sec	
(iv) Rainfall	25 year return	Refer to Appendix 11.1.3
(v) Earthquake	Seismic coefficient 0.64 Structural ductility 2.0 $kh = \frac{0.64}{2} = 0.32$ kv = 0.0	Refer to Appendix 11.1.4

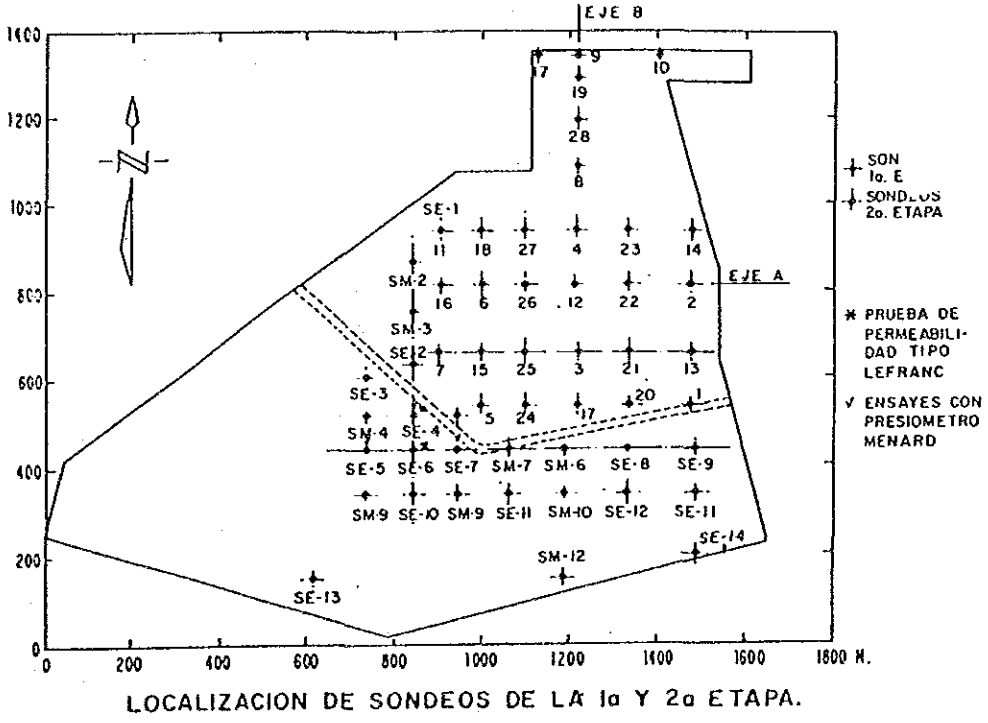


Fig. 11.1.1 Plan of Soil Investigation

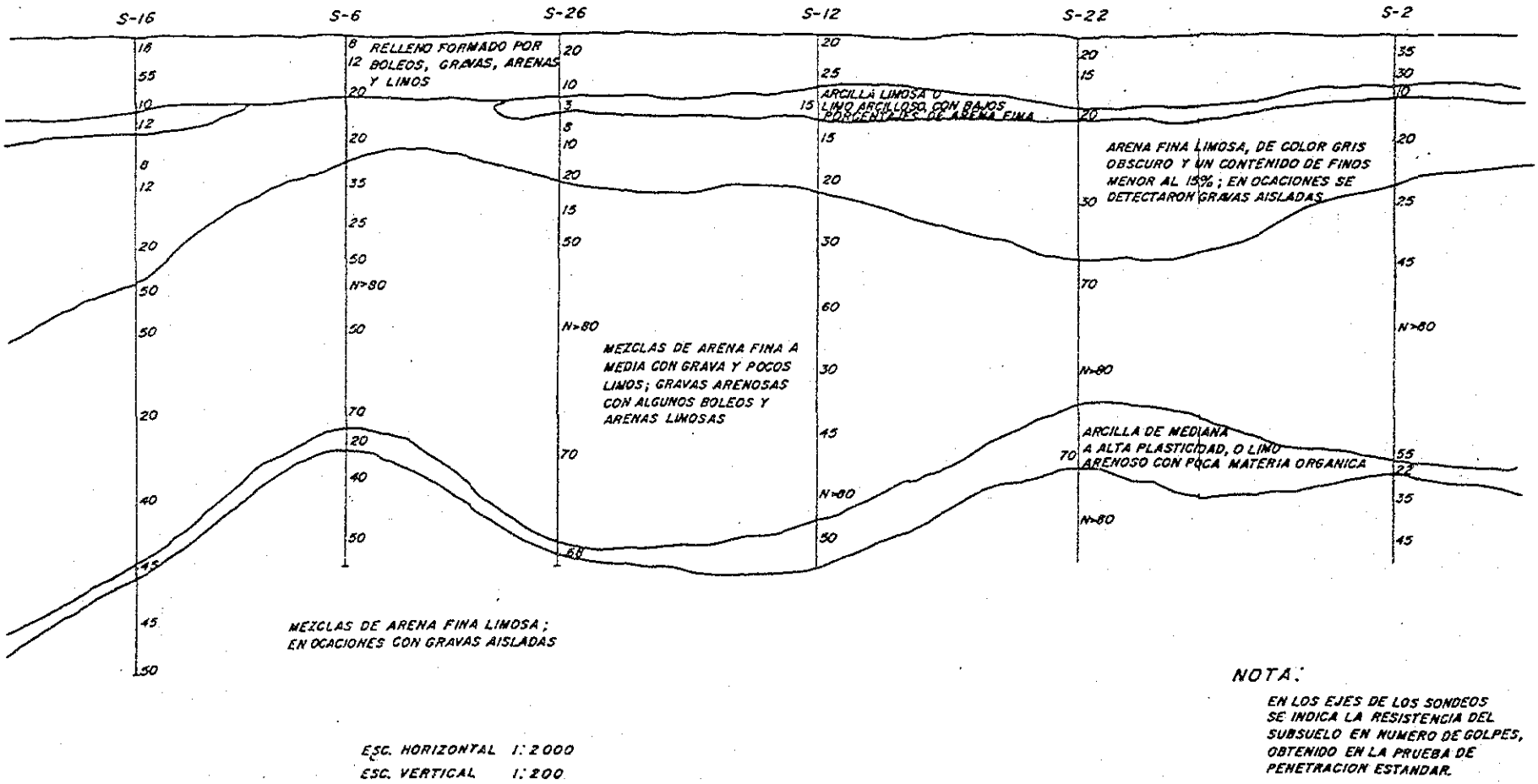


Fig. 11.1.2 Soil Profile at the Port of Lazaro Cardenas

11.1.3 Project Components

(1) Bulk Berth

The pavement and drainage systems have been studied in the same manner as applied for Manzanillo Port.

(2) Silo Berth

No definite plan has been established yet for the future expansion of silo berth. It is considered that thorough consideration to seismographic force shall be taken into account in designing the rehabilitation works on the damaged facilities.

The going rehabilitation process has been preliminarily reviewed by the Study Team, but the information is so limited that no in-depth study on the existing rehabilitation process has been conducted.

(3) Container Berth

In the short-term plan, onshore facilities of the existing wharf are to be modernized to handle the growing numbers of containers in Lazaro Cardenas Port. In the long-term plan, a new container berth will be constructed next to the general cargo berth.

1) Selection of optimum wharf structure

For the long-term plan, a new wharf is to be developed. Since this berth expansion area is on land already reclaimed, in-situ concrete walls called "Milano Wall" which is being applied in Altamira or other Mexican Ports, may be one alternative. In our master plan study, a conventional wharf like open deck pier and sheet-piled structure have also been studied. An open deck pier was finally selected following the same structure applied in the existing general cargo wharf of the Lazaro Cardenas Port.

2) Description of Selected Wharf Structure

a) Expansion of 300m container berth (a long-term plan)

The foundations of the open deck pier will be made of in-situ concrete piles of ϕ1,500mm and deck portion in the form of flat slab. The flat slab beneath the container crane rails will be

reasonably increased in thickness and reinforced by additional reinforcement. The typical plan is shown in Fig. 11.1.3.

b) Expansion of 55m General Cargo Berth

The general cargo berth expansion is, structurally, the same as in the container berth. The water depth in berth front will vary from -12.0m to -14.0m.

c) Retaining wall for open deck pier

The area behind the open deck pier has been already reclaimed. The berth area will be dredged to -12.0m～-14.0m and the dredged area under the deck slab will be left in natural earth slope and protected on top by the retaining wall.

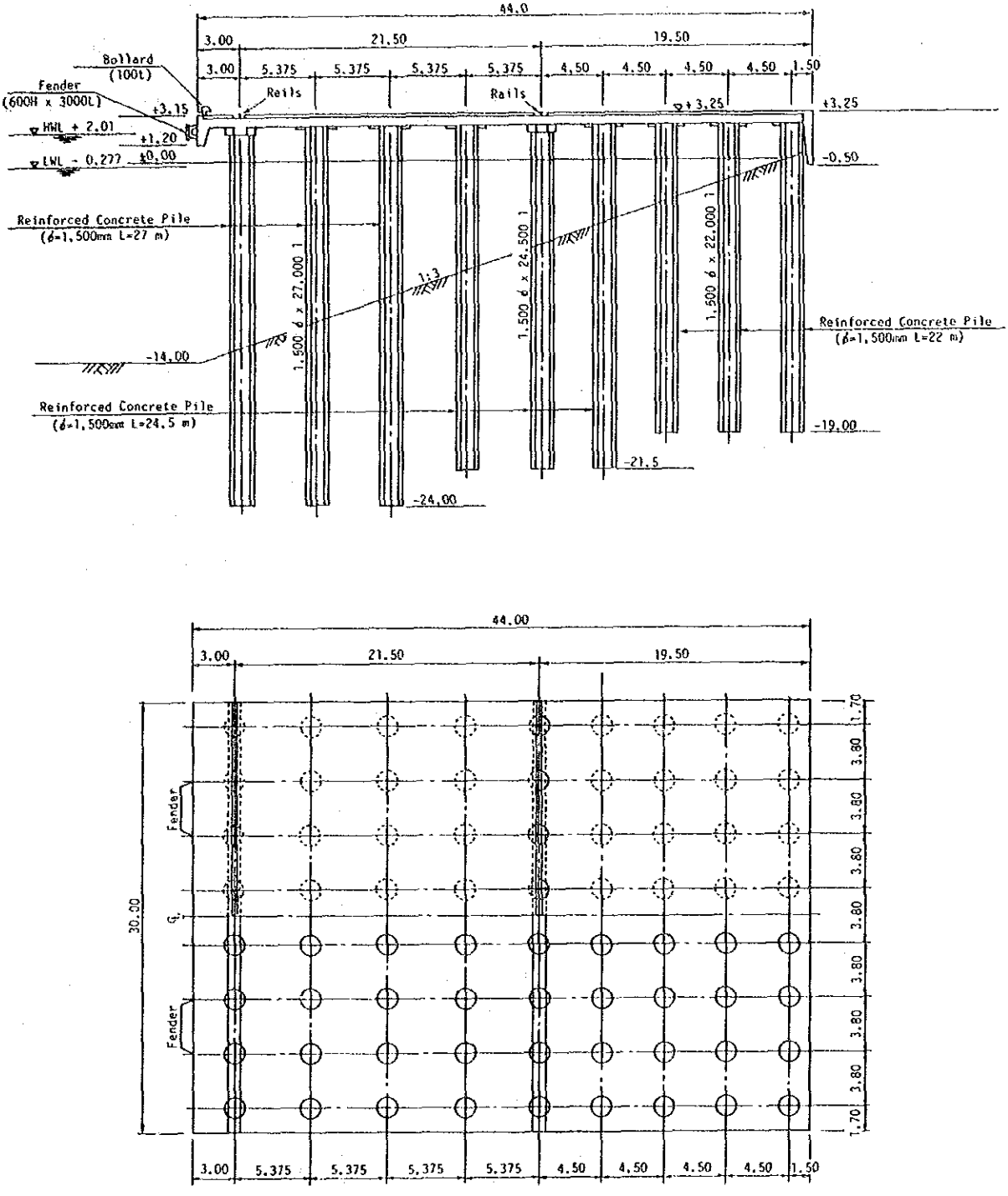


Fig. 11.1.3 Container Berth (Long-term Plan

2005 L = 10@30m = 300m)

11.1.4 Onshore Work

(1) Bulk Berth

The major onshore works on the bulk berth will be pavements and drainage.

1) Yard Area

a) Pavement

The surface condition of the pavement at the bulk berth is judged poor, requiring overlay works. The pavement structure will follow the class-C specification.(See Fig. 11.1.4)

b) Drainage

The open ditch covered by the steel grating will be lined along the shoreside of the open yard. The pent-up water by the open ditch will be drained to the berth front through underground R.C. pipes of 1,200mm-diameter.

2) Road

The road behind the open yard will be paved with asphalt concrete (class-B). Pavement structure are shown in Fig. 11.1.4.

(2) Container Berth

The main onshore works will be the yard pavement and road.

1) Yard Area

The existing container yard will be rehabilitated and the drainage system will be also repaired as briefed below.

a) Pavement

The rehabilitation of the pavement will be restricted to the reefer zone. The empty-container-stacking-yard, already consolidated in the surface soil, will be paved with the concrete pavement (class-A) to cope with heavy traffic from fork-lift (25 ton) and yard chassis. The plan is shown in Fig. 11.1.5.

Since the area behind the existing general cargo berth and near the railway lines and the container freight station have been lightly

paved, the asphalt pavement class-C will be applied for reinforcement.

b) Drainage

The drainage system will be the same as that in other berth area, a combination of open ditch and R.C. pipes.

2) Road

a) Pavement

The pavement structure will be the asphalt pavement (class-B). Pavement structure are shown in Fig. 11.1.4.

3) Utilities

The utilities lines for the short-term plan will be limited to power lines, which will be installed in the same manner as in the Manzanillo Port.

4) Outdoor Lighting

The existing lighting system at the container yard will remain intact, while the lighting facilities in the empty-container-stacking-yard will be increased.

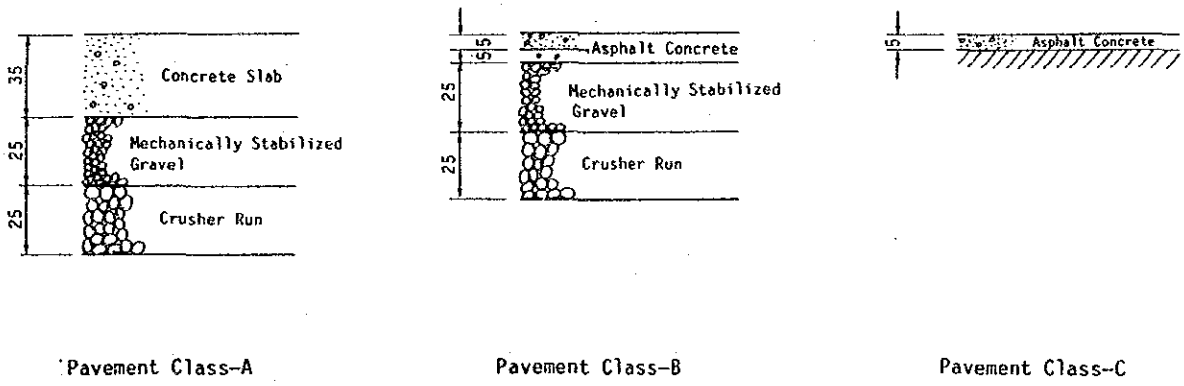


Fig. 11.1.4 Pavement Structure

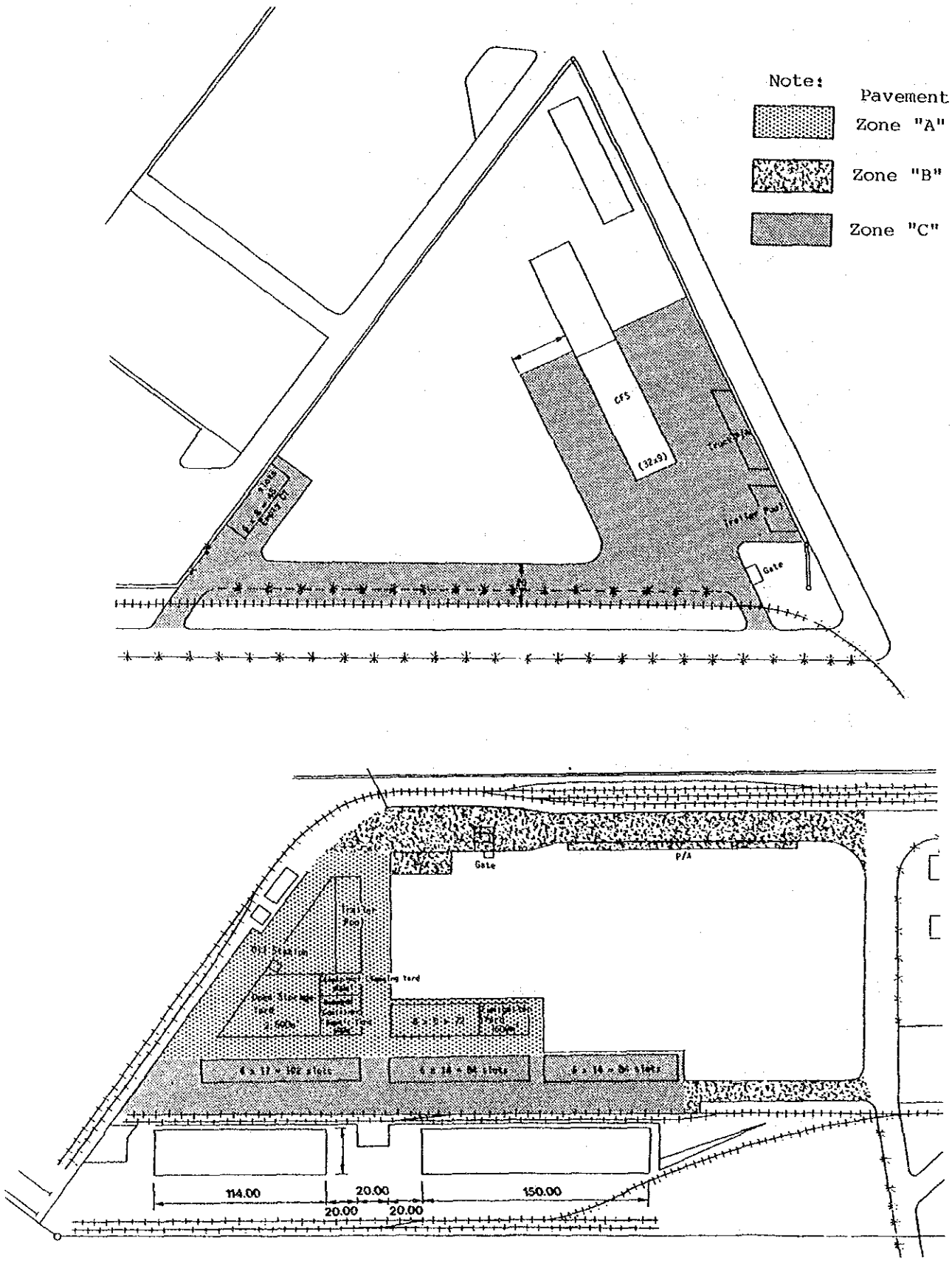


Fig. 11.1.5 Plan of Pavement Zone