11.2 Preliminary Design of the Port of Manzanillo

11.2.1 Design Policy and Scope of Design

(1) Design Codes and Standards

The approach and process in application of design codes and standards for the preliminary design of Manzanillo Port is the same as for Lazaro Cardenas Port.

(2) Scope of Design

The study deals with a master plan and a short-term plan, the scope of the master plan study is limited to drawing up overall port layout plans, while the short term plan covers the preliminary design of the main port facilities, including such components as quaywalls, pavement and container freight stations. Typical cross sections and plans have also been prepared.

The preliminary design in the study has been carried out on the basis of the limited information available on site, so further technical review is essential prior to construction of the port structures proposed in this report.

11.2.2 Design Criteria for Structural Design

(1) Ships and Wharf Cranes Considered for Quaywall Design

The loading conditions, vertical and horizontal, on the quaywall are substantially governed by the ships and wharf cranes to be docked or installed at the project berth. The key dimensions proposed for the quaywall design have been determined as follows:

Table 11.2.1 Design Ship and Crane

Item	Bulk Berth	Container Berth
(i) Vessel Size	20,000 DWT	50,000 DWT
(ii) Berth Length	200 @3=600m	300 @1=300m
(iii) Berth Water Depth	-14.0m C.D.L.	-14.0m C.D.L.
(iv) Docking Speed	15cm/sec	10cm/sec
(v) Surcharge	4 ton/m^2	3 ton/m^2
(vi) Crane and Cargo Carrier	Trailer truck, Fork-lift (25 ton)	Quayside Container Crane (40') Transfer Crane (40')

(2) Natural Condition

The natural conditions controlling the designing of the port facilities consist of the following key elements: surface/sub-soil conditions, tides, winds, waves, water depth, currents, rainfall, and earthquakes.

All these data on the bulk berth and container berth expansion area have been summarized below and the relevant drawings are also attached on Appendix 1.2.2.

Table 11.2.2 Natural Conditions

Item	Design Criteria	Remarks
(i) Water Depth	Berth front ... -10m~-14m Rear of berth...-5m	Refer to Appendix 11.2.1
(ii) Soil	Above -10m C.D.L. ..... clayey soil Between -10m and -18m ..... sandy soil Below -18m .... compacted sandy soil (N>30)	Refer to Fig. 11.2.1, 11.2.2
(iii) Wave	Less than 0.50m	
(iv) Wind	210km/h = 58.3m/sec	
(v) Rainfall	25 years return	Refer to Appendix 11.2.2
(vi) Earthquake	Seismic coefficient 0.48 Structure ductility 2.0 $kh = \frac{0.48}{2} = 0.24$ kv = 0.00	Refer to Appendix 11.1.4

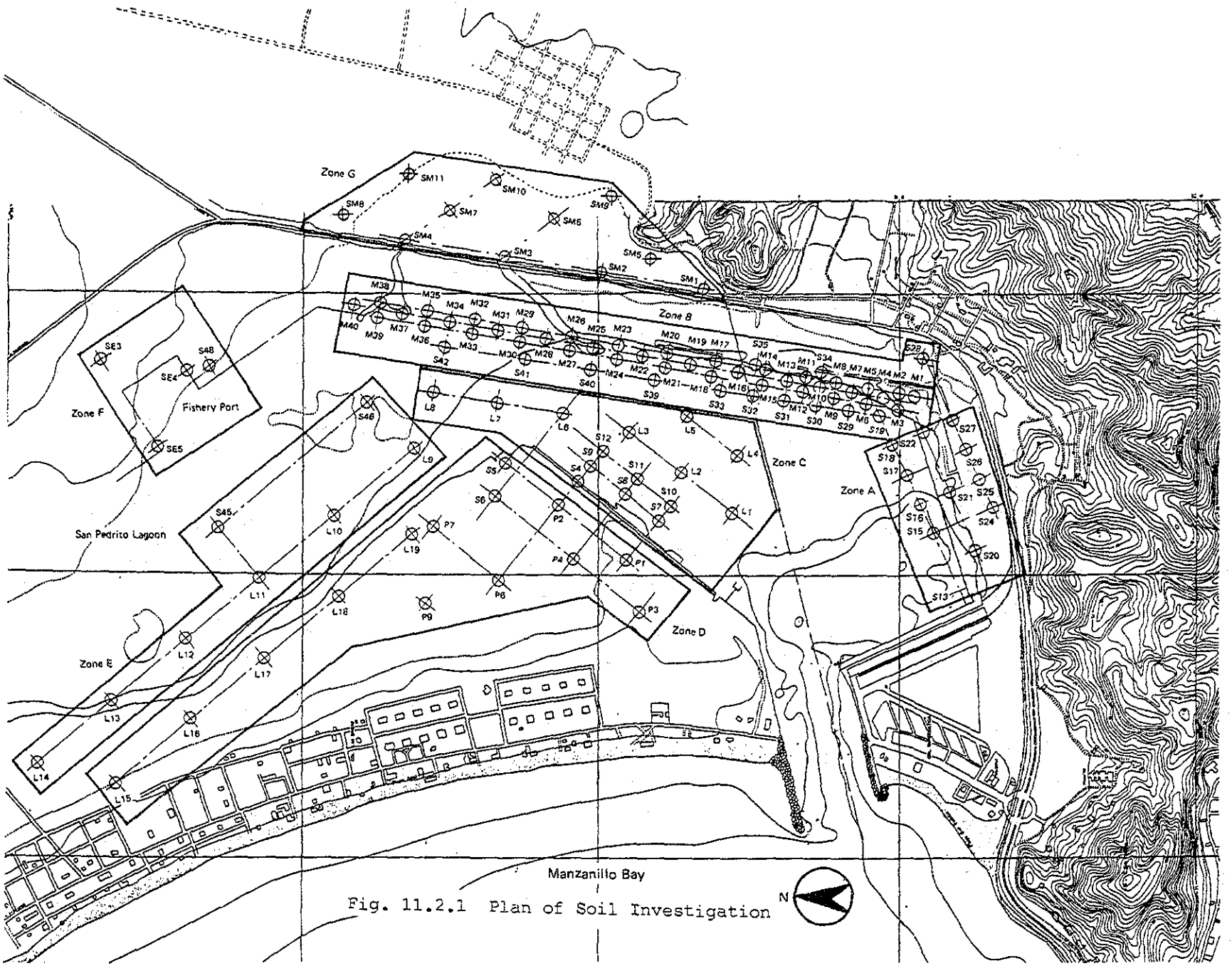


Fig. 11.2.1 Plan of Soil Investigation

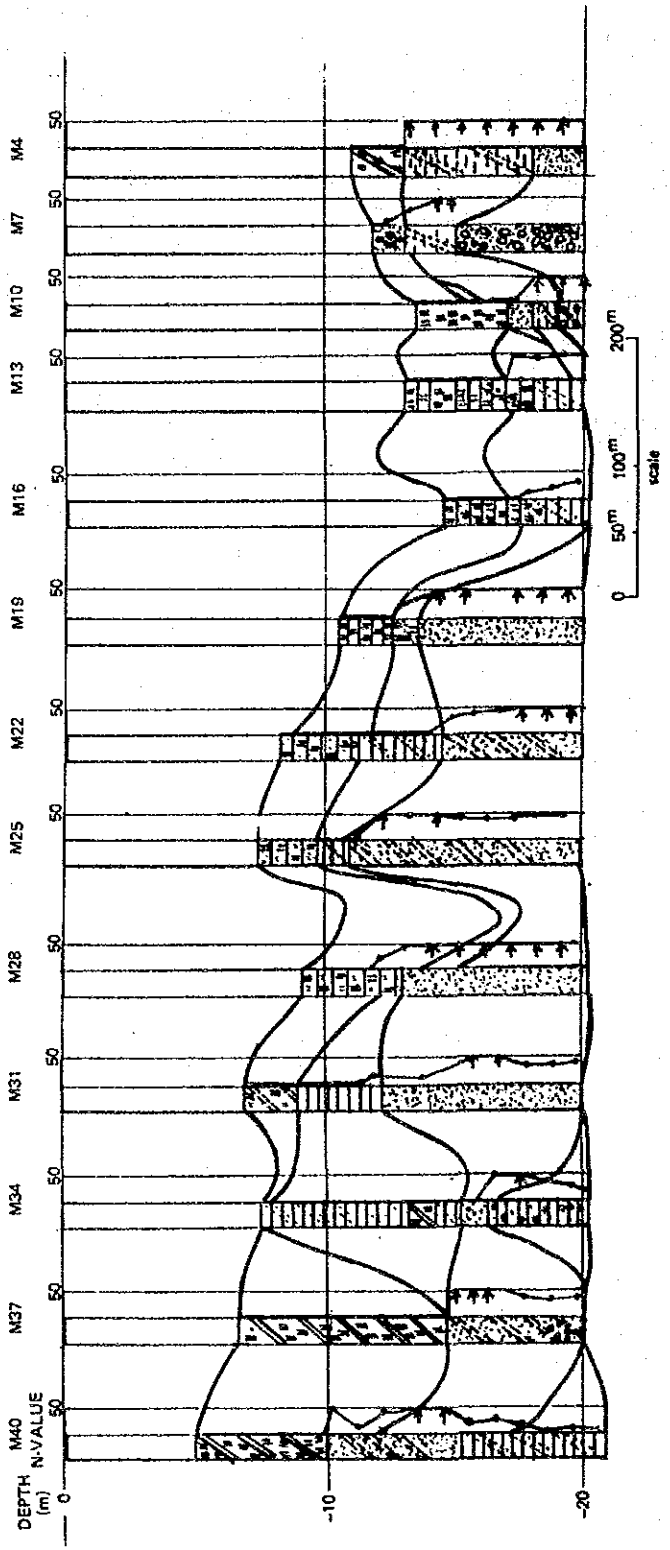


Fig. 11.2.2 Soil Profile, Section 1 - 1

11.2.3 Preliminary Design of Berth

(1) Bulk Berth

The bulk berths on "Band C" have been already constructed in the form of open deck piers with concrete piled foundations, but reclamation and construction of revetment behind the quaywall have not been initiated yet. The Study Team has carefully reviewed the existing design of quaywalls No.7, No.8 and No.9. As part of quaywall No.9 is to be built into the new container terminal wharf, the completed deck structure was carefully checked to determine whether it can be utilized structurally as a container berth. The review has shown its condition to be "not acceptable". The modifications necessary for container berth operation have been detailed in the following sections.

(2) Container Berth

For the new container terminal, a total of 300m of quaywall is considered necessary, consiting of 250m of new berth section and 50m of existing section which had been originally planned as a bulk berth. It is recommended that in addition to one berth expansion in the short-term plan, another 300m long container berth should be constructed in the long-term plan. The technical considerations for each component of the container berth have been outlined below.

1) Selection of optimum wharf structure

Judging from the existing subsoil condition, three alternative wharf structures can be considered. These are a gravity type structure like a concrete-box caisson, a sheet-piled structure and an open deck pier structure.

Of the gravity type wharves, the most recommendable structure would be a concrete caisson. In this case the establishment of a caisson fabrication yard or mobilization of a floating dock, one of which would be indispensable in a caisson-type wharf, would push up the total construction cost of a container berth. As such, this alternative has been deleted. The sheet-piled structure will require crane foundations for the gantry crane, which would require additional berth costs. As a result of cost comparison between a sheet-piled structure and an open deck structure, the latter has been selected as

the optimum berth structure for the new container terminal. As for the open-deck slab, a flat-slab structure and a beam and slab structure have been studied, and from a economical view point, a beam and slab structure has been adopted. An alternative study on pile structure has also been made between R.C. piles and steel pipe piles. As a result of cost comparison, precast R-C piles, 0.50 x 0.50m x 25.00m, have been selected.

2) Description of selected open-deck pier

a) Expansion of 250m container berth (short-term plan)
One block of the open deck will be 26.0m wide and 25.0m long, so 10 blocks will be required, totaling 250m linear long. The gantry crane rails will be installed on the deck slab, positioned above the front row of piles and the rear row of piles. The concrete piles will be made up of a combination of vertical piles (7 No./block) and batter piles (70 No./block). A typical cross section and plan are shown in Fig. 11.2.3.

b) Wharf modification of 50m span (short-term plan)
As explained in the previous paragraph, the existing wharf structure will be reinforced to accommodate the heavy load of a container crane. To mount the sea side rail of the gantry crane, additional vertical concrete piles (0.50 x 0.50 x 25.00m) will be driven, and similar vertical piles will be also driven under the shoreside crane rails. A typical cross section and plan are shown in Fig. 11.2.4.

c) Future Expansion of 300m span (long term-plan)
Structurally, the open deck pier will be applied, but with 30m long per blocks instead of 25m long blocks. A typical cross section and plan are shown in Appendix 11.2.3.

d) Retaining wall for open-deck pier
To retain the backfill and reclamation fill behind the open deck pier, a rock mound composed of rubble stones will be placed under the deck slab.

3) Reclamation bundwall

Since the land reclamation will be executed inside the lagoon, a well-

sheltered basin, the oceanographical climate will not necessitate the revetment structure for retaining the reclamation fill. The edge of reclaimed land will be trimmed and compacted to a natural slope.

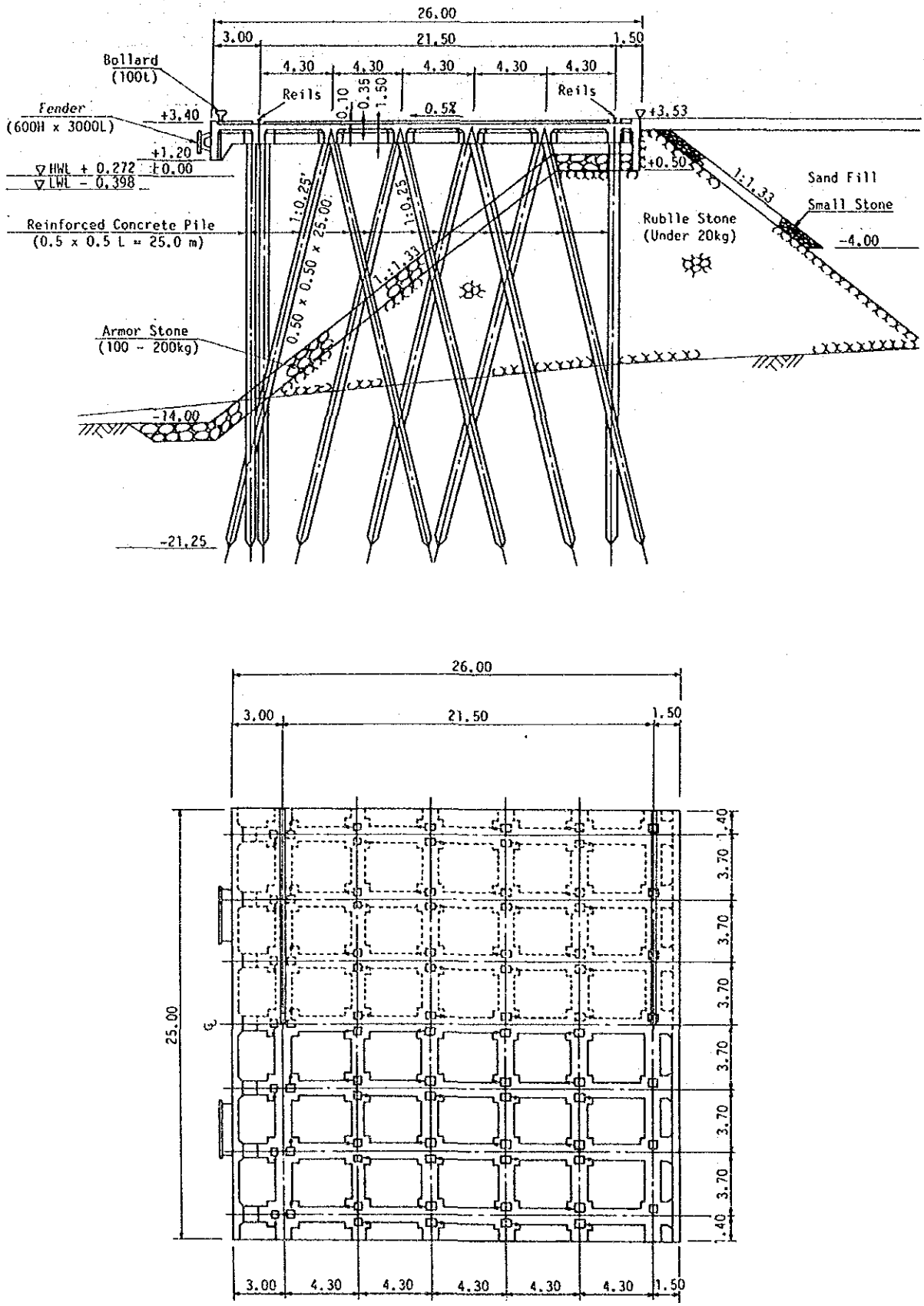
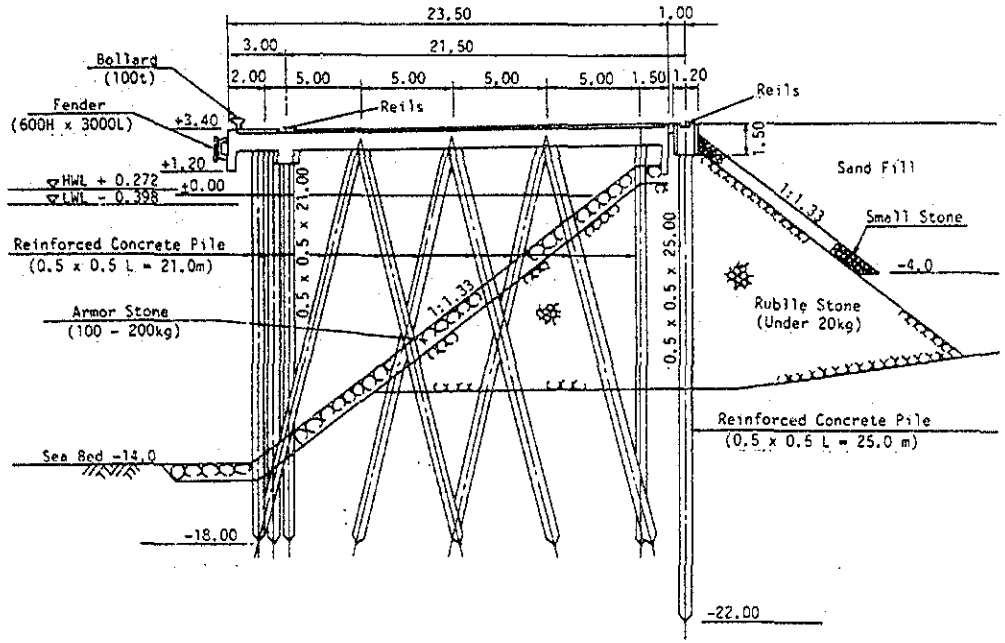


Fig. 11.2.3 Container Berth (Short Term Plan 1995 L=10@25m=250m)



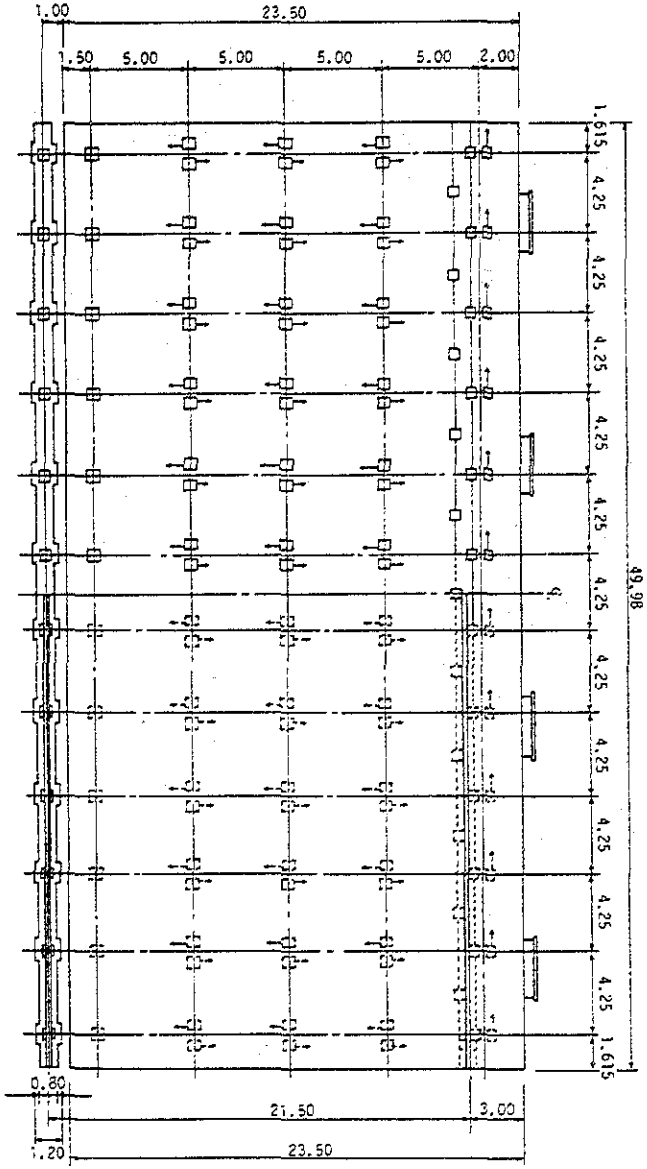


Fig. 11.2.4 Container Berth (Short Term Plan 1995 L=1@50m=50m EXISTING)

11.2.4 Preliminary Design of Onshore Facilities

(1) Onshore Facilities at Bulk Berth

The main onshore facilities behind of the bulk berth will be the yard pavement and drainage system.

1) Yard Area

a) Pavement

The paving area has not yet been reclaimed. Once the yard area has been reclaimed, the pavement work will proceed, with due consideration to the status of consolidation in the reclamation area. Some monitoring system will be advisable to monitor settlement. It is believed that a flexible pavement will be the most suitable solution. Accordingly, all the paved areas have been designed with asphalt-concrete class-C to accommodate such heavy equipment as trailer trucks and fork-lifts. Pavement structures are shown in Fig. 11.2.5.

b) Drainage

Two main open ditches are proposed parallel to the berth line to cater for heavy rainfall with a 25 year return. Concrete pipe drainage with a diameter of 1,200 mm and 1,800 will be installed underground perpendicular to the berth line to drain flood water from the main open ditch into the quay-front.

(2) Onshore Facilities at Container Berth

The main components of container berth will be the container yard, buildings, railways, and roads.

1) Yard Area

a) Pavement

The container yard has been classified into three class, class-A, class-B and class-C. Class-A, which will take care of heavy load from 40 ton-class transfer cranes, will be paved with 30cm thick concrete pavement. The rigid pavement will be fully resistant to heavy equipment. Class-B, which will bear the loads of 40 ton-

class fork-lifts, will be paved with 15cm thick asphalt concrete. Class-C, which will cope with comparatively lighter loads of trailer-trucks and 25 ton-class fork-lifts, will be paved with 10cm thick asphalt concrete. The area surrounding the warehouse will be also paved with class-C specification. The basis for the paving design is as follows: sub-grade (reclaimed fill) is of CBR 6% or 7kg/cm^2 in K30, and 20cm thick filter layer is to be placed in the bottom layer. Pavement structure are shown in Fig. 11.2.5. Plan of pavement zone are shown in Fig. 11.2.6.

b) Drainage

Like the bulk berth, two lanes of open ditches and underground R.C. pipes will be installed in the pavement area. At the empty-container-stacking-yard, a drainage system independent of the main yard drainage system will be provided due to the existence of a railway line and access road which separate the two paved areas.

2) Buildings

The main component the of building works will consist of one container freight station (CFS), one administration building and one warehouse to be sited behind No.9 berth. Structurally, CFS and warehouse will be of steel-framed, and administration building of R.C. concrete. Typical sections and plans are shown in Appendix 11.2.4.

3) Railway

Two lines of railway track will be laid out, linking to the empty-container-stacking yard. The track (50kg/m rails) will be placed on a 1.0m thick ballast foundation.

4) Roadway

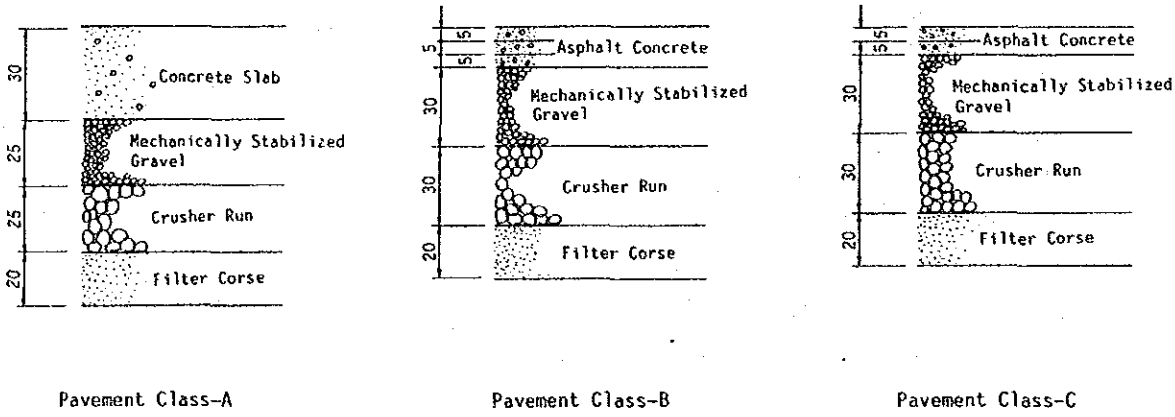
Since the existing port access road will run through the new container yard, a new access road will be laid out, skirting the container yard. 70m of the existing road will be re-routed by use of the new port road which will traverse the lagoon area. The new road will be formed by rock mound and paved on top by asphalt concrete, equivalent to class-B specification.

5) Utilities

Power lines and water supply lines will be the main utilities. Both lines will be installed 1.2m below the ground surface and protected by concrete where likely to be subject to heavy traffic loads.

6) Lighting

Lighting poles similar to existing ones will be erected in the container yard and road area. The open door lighting has been designed to produce 20 lx lighting intensity at the ground level except for the area near the warehouse, where about 10 lx is sufficient.



Pavement Class-A Pavement Class-B Pavement Class-C

Fig. 11.2.5 Pavement Structure

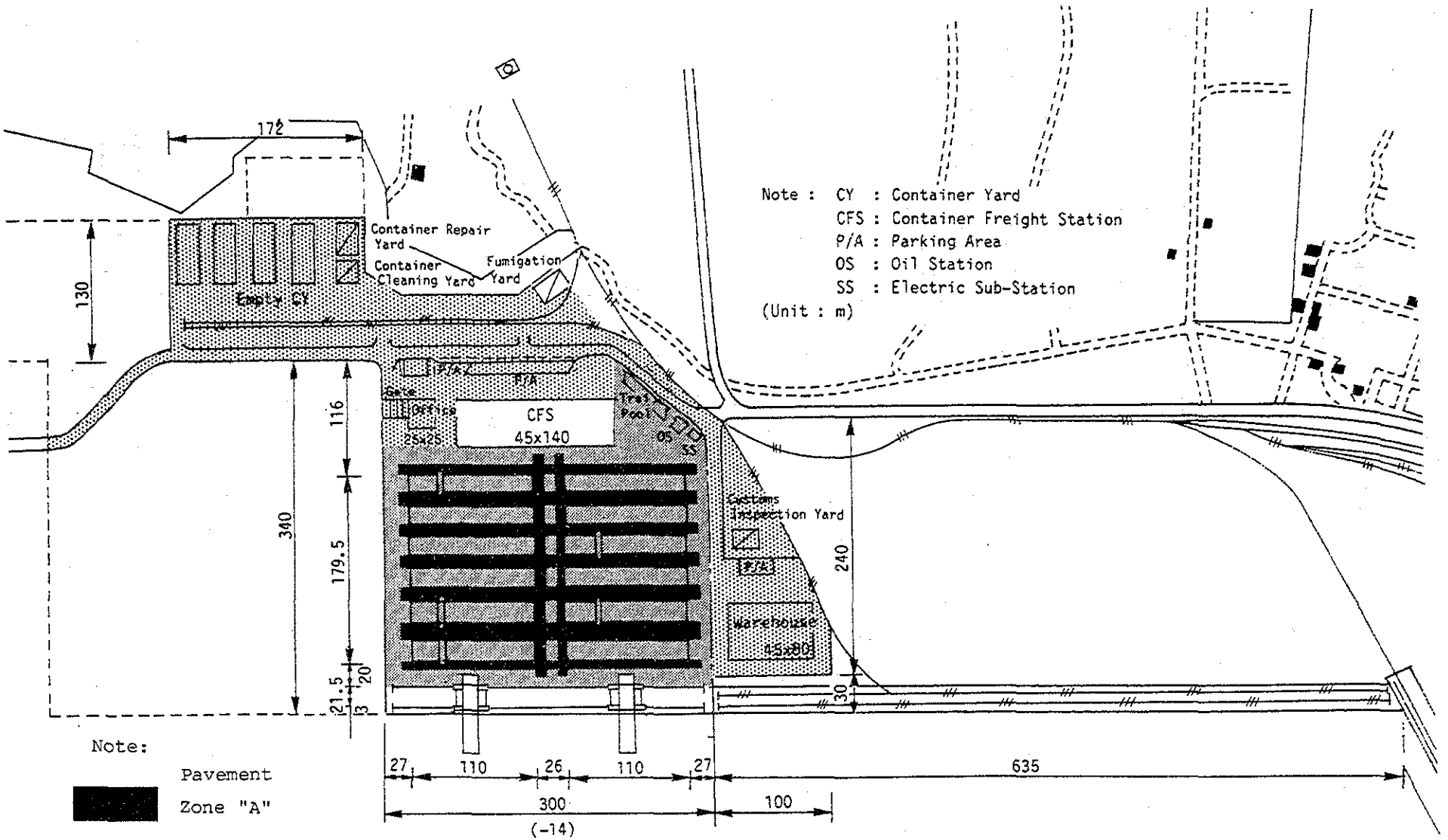


Fig. 11.2.6 Plane of Pavement Zone

11.3 Construction Planning of the Port of Lazaro Cardenas

11.3.1 Construction Site Condition

(1) Construction site

The Port of Lazaro Cardenas is an artificially excavated port with the port entrance facing southeast to the Pacific Ocean. The quaywall line of the target general cargo berth is aligned along the NE-SW oriented inner channel, with a bending portion of 45 degree halfway at the corner. The project is to modify this existing general cargo berth to a functional container terminal. The existing general cargo berth now operates busily for handling the shipment of bulk and unitized cargoes. The railway lines run along the quay front, the rear of the warehouse as well as along shoreside of open storage area. A number of containers are stacked 2-3 tiers high in the terminal yard.

The modernization-required project berth is located in the congested operational port zone, so that a well-woven construction program would be essential so as to minimize likely interruption and constraint imposed on actual port operation in and around the project area.

(2) Meteorology and Hydrography

The past meteorological data foretells no noteworthy obstructions in the execution of the project. According to the construction records in the port, of 80 rainy days a year, a total of 15 days was actually linked to non-workable days in the onshore works such as paving, concrete placing and building works. The port has been struck nine times by cyclones in the past 43 years, but has not been severely damaged yet. Since the project site is located in the well-sheltered basin, wave effect is negligible in construction planning. The tidal range is also no fatal factor in terms of marine works.

(3) Major Source of Construction Material and Equipment

Most of local construction materials can be obtained either from Lazaro Cardenas or Morelia, a major city of Mexico, about 250 km north of Lazaro Cardenas city. The concrete aggregate and sand can be easily obtained from the river-bed close to the port, though, rocks particularly large sized rocks are hard to be obtained. The nearest quarry site is

located 40 km away from the port and haul- road is winding through steep-sloped mountain road to Moreria, so that two trips a day for rock transportation by dump-truck would be a possible transport capacity for construction planning. Its deposit volume seems sufficient and characteristics of rocks are hard and endurable enough for structural materials. There are three commercial concrete plants in Lazaro Candenas city, being capable of supplying sufficient volume of concrete for port construction.

11.3.2 Major Project Components

Unlike the Manzanillo Port Development, the Lazaro Cardenas Port Project is a redevelopment project aimed at renovations of old wharf to a modernized container terminal. The modernization works will be limited to the onshore facilities, including upgrading of the existing pavement structure, a new construction of C.F.S building, demolition of the existing reefer area and some minor rearrangement of utilities. The main project components are shown in the following table.

Table 11.3.1 Summary of Project Components
(excluding mechanical components)

Work Item	Quantity	Main Features
1. CIVIL WORKS		
1.1 Concrete Pavement	16,000 m^2	t = 30 cm
1.2 Asphalt Pavement	8,950 m^2	t = 10 cm
1.3 Asphalt Overlay	24,100 m^2	t = 5 cm
1.4 Demolition of Reefer	16 Nos.	
2. BUILDING		
2.1 Container Freight Station	2,880 m^2	
2.2 Gate	2 Nos	
3. UTILITIES		
3.1 Open Ditch Drainage	690 m	
3.2 R-C Pipe Drainage	530 m	ø 1200mm
3.3 R-C Pipe Drainage	90 m	ø 1800mm
3.4 Manhole	6 nos.	
4. ELECTRIC WORKS		
4.1 Yard Lighting	17 nos.	
4.2 Cable Conduit	700 m	
5. FENCE		
5.1 Fence	830 m	

11.3.3 Construction Method of Major Works

(1) Pavement Works

The empty-container-stacking-yard will be paved by 30 cm thick concrete, while other area will be paved with asphalt concrete, including 5 cm thick overlay pavement around the C.F.S building. All the pavement work will be executed on a section by section basis to put the completed

section into use as early as possible.

(2) Building and other works

Most of the construction works will be carried out at the already developed area, which means that the redevelopment works needs to be implemented, giving due consideration to the layout, alignment and formation of the existing facilities. Detours and interconnections of drain pipes and power lines will take adequate pre-arrangement so as not to block the actual port operation.

11.4 Cost Estimate of Lazaro Cardenas Port

11.4.1 Basic condition for Cost Estimate

(1) Currency for Cost Estimate

The cost estimate has been made both in foreign currency (Japanese Yen ¥) and local currency of Mexican Peso ($). Portion of local/foreign components on the major construction materials have been reasonably set up, following the figures generally accepted in public works projects in Mexico.

(2) Exchange Rate

The exchange rate for the cost estimate has been taken from the official rate as of November 1989. The exchange rate adopted is US$ 1 = $ 2600 = ¥ 143.

(3) Price Level and Price Escalation

The cost estimate has been fixed at the price level as of Nov. 1989, and price escalation has not been considered.

11.4.2 Construction Cost (Direct)

The direct construction costs exclusive of construction overhead, profit, technical overhead and etc. have been estimated, following the basic concepts as described for Manzanillo Port project. The cost basis - construction materials, labour rates and equipment cost - are detailed in section 11.6.2 and section 11.6.3.

Table 11.4.1 Construction Cost (Direct)

Work Item	Quantity	Rate($)	Amount (million$)
1. CIVIL WORKS			
1.1 Concrete Pavement	16,000 m^2	106,000	1,696
1.2 Asphalt Pavement	8,950 m^2	51,600	462
1.3 Asphalt Overlay	24,100 m^2	11,200	270
1.4 Demolition of Reefer	16 Nos.	150,000	3
			2,431
2. BUILDING			
2.1 Container Freight Station	2,880 m^2	450,000	1,296
2.2 Gate	2 Nos	216,000,000	432
			1,728
3. UTILITIES			
3.1 Open Ditch	690 m	610,000	421
3.2 R-C Pipe(ϕ1200)	530 m	653,000	346
3.3 R-C Pipe(ϕ1800)	90 m	1,690,000	152
3.4 Manhole	6 nos.	2,642,000	16
			935
4. ELECTRIC WORKS			
4.1 Yard Lighting	17 nos.	12,000,000	204
4.2 Cable Conduit	700 m	107,000	75
			279
5. FENCE	830 m	162,000	134
6. MECHANICAL WORK			
6.1 Quayside Container Crane	1 no.	$14,040 \times 10^6$	14,040
6.2 Transfer Crane (Tire-mount)	4 nos.	$3,432 \times 10^6$	13,728
6.3 Chasiss	5 nos.	52×10^6	260
6.4 Tractor	4 nos.	156×10^6	624
6.5 Top-Lifter (25T)	2 nos.	920×10^6	1,840
6.6 Fork-lift (5T)	2 nos.	156×10^6	312
6.7 Fork-lift (2T)	4 nos.	52×10^6	208
			31,012
Total			36,519

Table 11.4.2 Breakdown of Currency Component (Direct)

(million ¢)

Work Item	Foreign	Local	Total
1. CIVIL WORK			
1.1 Concrete Pavement	226	1,470	1,696
1.2 Asphalt Pavement	75	387	462
1.3 Asphalt Overlay	29	241	270
1.4 Demolition of Reefer	-	3	3
	330	2,101	2,431
2. BUILDINGS			
2.1 Container Freight Station	130	1,166	1,296
2.2 Gate	432	-	432
	562	1,166	1,728
3. UTILITIES			
3.1 Open Ditch	-	421	421
3.2 R.C. Pipe (ø1200)	-	346	346
3.3 R.C. Pipe (ø1800)	-	152	152
3.4 Manhole	-	16	16
		935	935
4. ELECTRIC WORK			
4.1 Yard Lighting	61	143	204
4.2 Cable Conduit	-	75	75
	61	218	279
5. FENCE	-	134	134
Sub total	953	4,554	5,507
6. MECHANICAL WORK			
6.1 Quayside Container Crane	11,700	2,340	14,040
6.2 Transfer Crane	11,440	2,288	13,728
6.3 Chassis	260	-	260
6.4 Tractor	624	-	624
6.5 Top-Lifter	1,559	281	1,840
6.6 Fork-Lift (5T)	312	-	312
6.7 Fork-Lift (2T)	208	-	208
	26,103	4,909	31,012
Total	27,056	9,463	36,519

11.4.3 Project Cost of Lagaro Cardenas

Adding the indirect cost components and other cost components as stipulated in the section 11.4.2 (4), (5), (6), the project cost of Lagaro Cardenas Port Expansion has been preliminarilly estimated as shown in Table 11.4.3.

Table 11.4.3 Project Cost of Lagaro Cardenas Port

	Foreign (Million $)	Local (Million $)	Total (Million $)
1. Direct Cost	27,056	9,463	36,519
2. Indirect Cost	410	1,958	2,368
3. Sub-total (1.+2.)	27,466	11,421	38,887
4. Physical Contingency	204	977	11,810
5. Sub-total (3.+4.)	27,670	12,398	40,068
6. Technical Overhead 5. x 0.05	1,001	1,002	2,003
Total (5.+6.)	28,671	13,400	42,071
7. IVA (5.+6.) x 0.15	-	6,311	6,311
Grand Total (5.+6.+7.)	28,671	19,711	48,382

11.5 Construction Planning of Port of Manzanillo

11.5.1 Construction Site Condition

(1) Construction Site

The Port of Manzanillo consists of two port zones - an outer port and an inner port. The inner port zone is made up of three marginal wharves, namely "Band A", "Band B" and "Band C". These berths expand counter-clockwise from the port entrance to the inside the port. As for the "Band C", the construction of the berth No. 7, No. 8 and part of No. 9 have been already competed, ready for operation to moor cargo vessels. Now, bulk carriers, working boats and dredgers occasionally berth along the completed sections of the wharf. These three berths (No. 7, No. 8 and No. 9) are to serve the shipment of bulk cargo in future.

North of the completed berths, a 50 m section of the berth No. 9 is being left with the concrete piles driven, but not concreted on deck slabs. The construction site of the new container terminal is to be located immediately next to the already piled berth No. 9 expansion area.

The seabed inshore of the new berth line of the new container terminal has been partially reclaimed to an average water depth of 5 m below C.D.L. and approximately 250 m wide. That area will be used as the container yard by filling additional reclamation material to +3.20 m above C.D.L.

Behind the partly reclaimed area lies an artificial pond made by past reclamation works. Between the reclamation area and the pond runs a two-lane port access road linked to the town area of Manzanillo, approximately 5 km away from the port.

The seabed offshore of the planned berth line had been already dredged to -12 - -13 m. These topographic and bathymetric conditions surrounding the port development area will allow easy access to the construction site both from seaside and shoreside. Furthermore, as the new berth expansion zone lies within the well-developed port complex, the power and water supply necessary for construction will be easily tapped from the nearby main outlets. As such, it can be generally said that no significant obstacles and constraints in the course of the new container terminal construction is expected.

(2) Geology

According to the test borings previously performed on the site, the surface and subsoil conditions of the new terminal area can be classified into the following four strata patterns.

Table 11.5.1 Typical Stratum Pattern at the Project Terminal Area

Stratum	Engineering Classification	Average N-Value	Average Thickness
Top layer	Soft organic soil or clay	0	3-8 m
Second layer	Clayey sand or sandy clay	0	0-8 m
Third layer	Sand	30 <	2-8 m
Bottom layer	Composite layer mixed with sandy, silty and clayey soil	40-50	5 m <

Judging from the stratum pattern, the bearing piles of the open deck pier will penetrate into either the third layer or bottom layer which have N value of more than 30. Dredging work will be required to deepen the water depth to the planned 14m below C.D.L, and mostly concentrated on the second layer or the third layer with an average N value of 20. These soil conditions are the basis for construction planning.

(3) Meteorology and Hydrography

The weather condition at the site are comparatively mild, causing no significant constraints on the progress of the terminal construction, both onshore and offshore works. The frequency of cyclones directly hitting the port site is very low, and strong winds of more than 15 m/sec occur only several times a year. As the tidal difference between MHW and MLLW is about 0.7m, marine works will not be adversely influenced by tidal changes. The wave conditions will not be a controlling factor either for construction planning due to the existence of the breakwater protecting the port.

(4) Major Sources of Construction Materials and Equipments

Most local construction materials can be obtained either from Manzanillo or Guadalajara, one of the major cities of Mexico located about 200 km north of Manzanillo. Such materials as sand, aggregates, stones, timber and lumber are preferably obtained in and around the project site. Within an economical reach from the construction site three quarry sites are in operation. Large-sized stones can be supplied from "Banco Colomo" and base/subbase materials from "Banco Bosque". The locations of the existing quarries are shown in Fig. 11.5.1 The concrete aggregates can be also obtained from the adjacent river beds. In the Manzanillo city, three commercial concrete plants are operational including "Concrete Guadalajara", S.A. de C.V. and "Concrete Premagclados" S.A. de C.V. "Concrete Guadalajara" is provided with mixing plant capable of supplying 30 m^3 concrete per hour and owns 6 nos of 7 m^3-transit mixers.

For concrete placing, ready-mix concrete from these plants will be utilized especially for major concrete works like open-deck pier and concrete pavement. For small amounts of concrete production, on-site concrete mixers will be also utilized.

As for construction equipment, core of the onshore facilities such as trucks, bulldozers and cranes will be transported from Guadalajara or nearby motor pools in and around Manzanillo City.

The construction fleet such as dredgers and pile-driving barges will be mobilized from the ports - Topolobampo, Salina Cruz or Mazatlan. The dredger will be probably mobilized from "Gerencia de Dragado del Paeitico", Mazatlan.

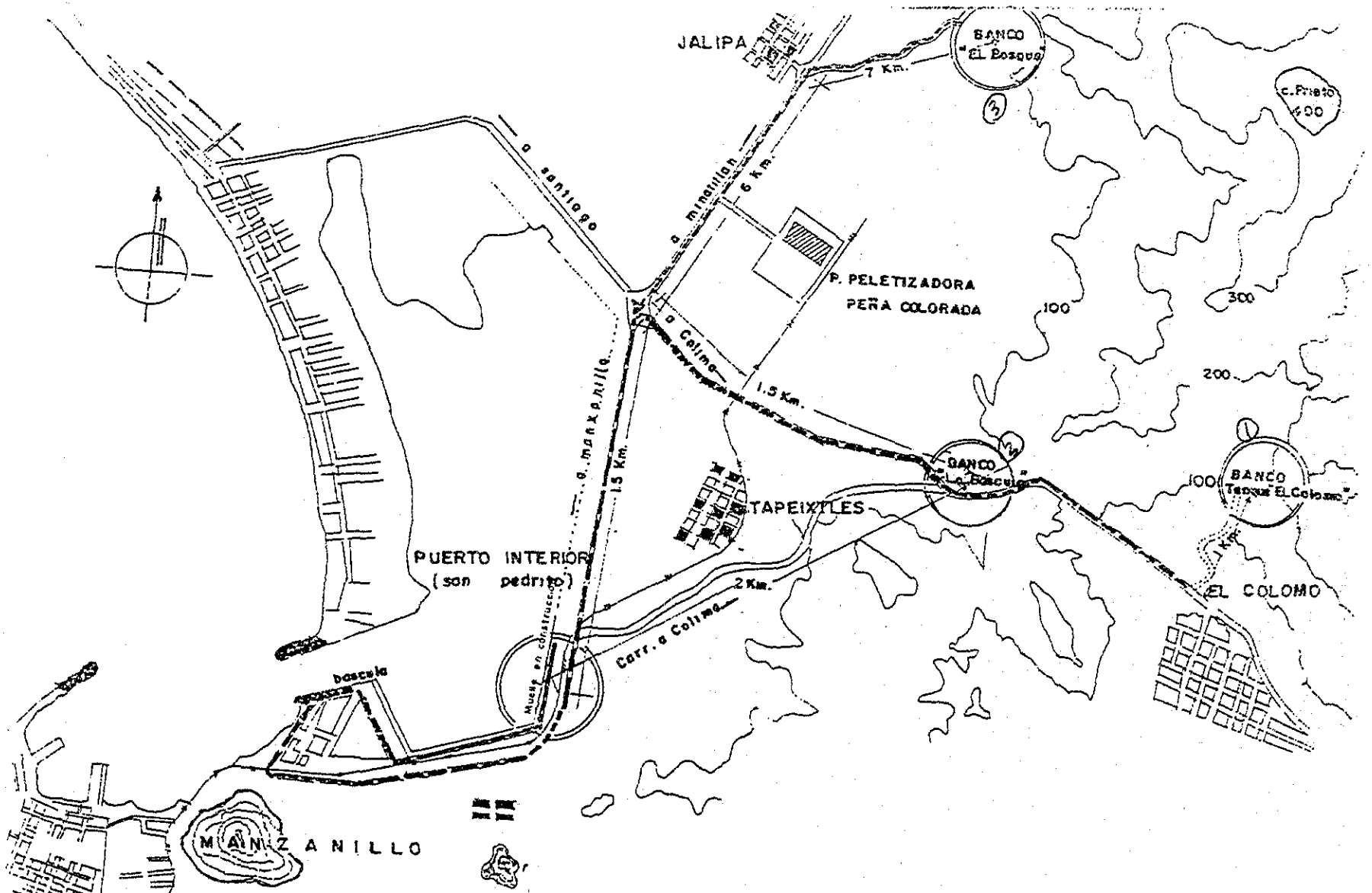


Fig. 11.5.1 Location of Quarry Sites, Manzanillo Port Zone

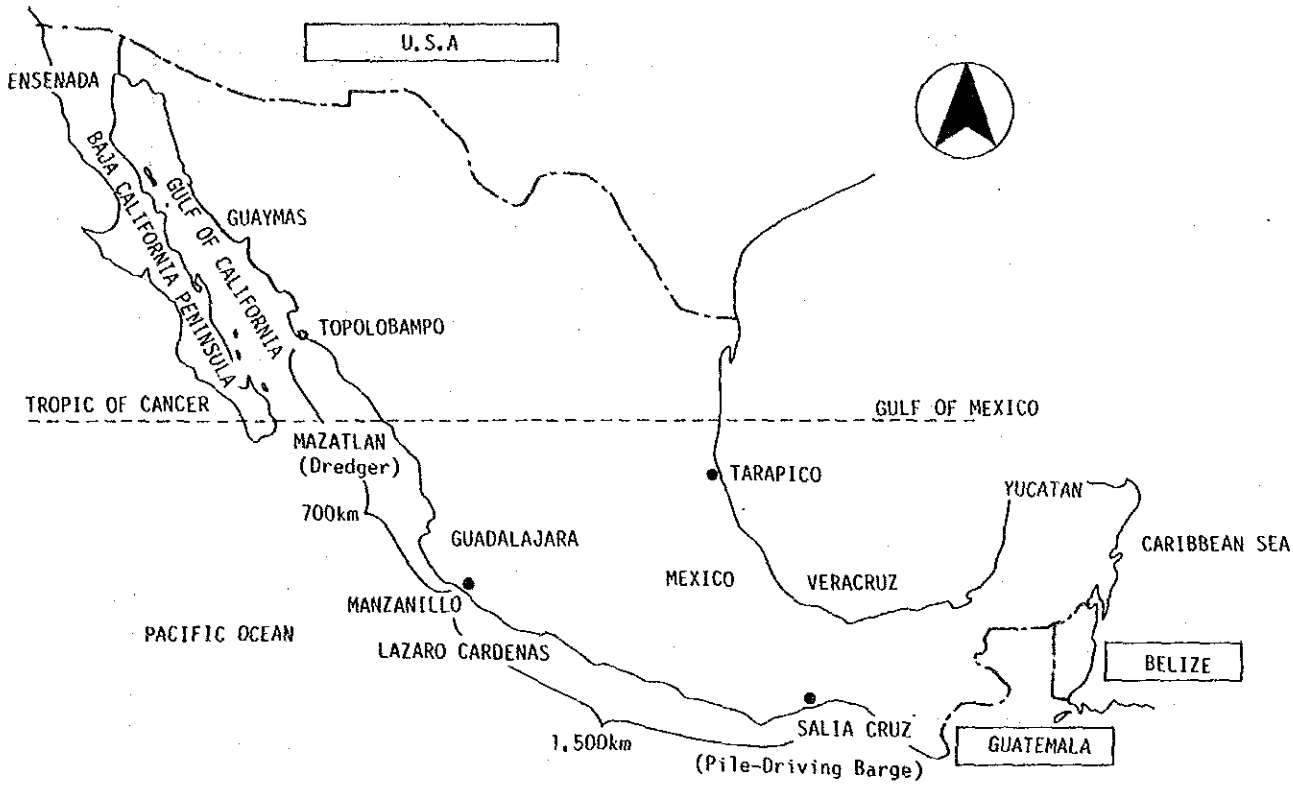


Fig. 11.5.2 Mother Port of Construction Crafts

11.5.2 Major Project Components

The Manzanillo Container Terminal Project includes many work components: expansion of a berth, reclamation for container terminal, construction of various onshore facilities in the paved reclamation area and dredging works at the navigational zone. These project components are broadly categorized into such work components as civil works, building works, mechanical works and utilities works.

(1) Civil Works

The civil works of the project comprise the marine works like berth construction, dredging and reclamation, road and paving works. The major work quantities for these civil works are summarized below.

Table 11.5.2 Summary of Civil Works

Work Item	Quantity	Main Features
1. EARTH WORKS		
1.1 Dredging	750,000 m^3	
1.2 Reclamation by sea	750,000 m^3	
1.3 Reclamation by land	250,000 m^3	
1.4 Rock mound	13,000 m^3	
2. ROAD/PAVING WORKS		
2.1 Concrete pavement	7,900 m^2	t = 30 cm
2.2 Asphalt pavement	61,800 m^2	t = 10 cm
2.3 Asphalt pavement	63,300 m^2	t = 15 cm
3. OPEN DECK PIER		
3.1 Concrete piles	793 nos.	0.5x0.5x25.0 m
3.2 Deck slab	11 units	26 m x 25-30 m
3.3 Rubber fender	20 sets	600H x 3000L
3.4 Bollard	8 sets	100 Ton

(2) Mechanical Works

The mechanical works on this project will consist of procurement and installation of the following container-handling equipment.

Table 11.5.3 Summary of Mechanical Works

Equipment	Quantity	Main Features
1. Quayside container crane	2 Nos.	40 Ton x 37 m
2. Transfer crane (rubber tire)	4 Nos.	6 rows x 3 tires
3. Yard Chassis	29 Nos.	40'/20'
4. Tractor	4 Nos.	40'/20'
5. Fork-lift (3 Ton)	5 Nos.	
Fork lift (2 Ton)	25 Nos.	

(3) Building Works

The buildings to be newly built as project components will consist of one administration building, one container freight station, one warehouse and a gate house. The required space for each building is shown below.

Table 11.5.4 Summary of Building Works

Building	Area	Main Features
1. Administration Building	720 m^2	R.C.
2. Container Freight Station	6,920 m^2	Steel Structure
3. Warehouse	5,000 m^2	Steel Structure

(4) Utilities and Others

The utilities works of the project include following major work components.

Table 11.5.5 Summary of Utility Works

Work Item	Quantity	Main Features
1. DRAINAGE		
1.1 Open ditch	1,580 m	
1.2 R.C. pipe	440 m	ϕ1,200
1.3 R.C. pipe	160 m	ϕ1,800
1.4 Manhole	10 Nos.	
2. ELECTRIC WORKS		
2.1 Yard lighting	49 Nos.	18m high steel frame
2.2 Cable duct	3,000 m	
2.3 Sub-station	1 No.	
3. WATER SUPPLY		
3.1 Water line	660 m	ϕ150
4. FENCE	2,100 m	
5. RAILWAY	400 m	
6. TRUCK SCALE	2 Nos.	

11.5.3 Construction Method of Major Works

(1) Dredging and Reclamation

The natural water depth at the new terminal area is briefly as follows: the depth in front of the berth line averages -13 m, the apron area varies shoreward from -5 m to ±0 m and the lagoon area to be reclaimed for the project is about ±0 m. To secure navigable space, the berth-front area will be dredged down to the required water depth of -14 m. All the dredged material, which has been judged to be suitable for reclamation, will be utilized for reclamation fill. Approximately, 750,000 m^3 of sea bed will be dredged by use of a 2000-3000 HP pump dredger with a monthly output of around 100,000 m^3 and the dredged material will be directly dumped into the reclamation area through pipe lines.

The balance of reclamation fill other than by dredging will be supplemented by borrowed materials to be obtained from the nearby borrow pit. The top 1.2 m of the land reclamation fill will be sufficiently compacted to produce enough bearing capacity for heavy traffic load of container handling equipment. The reclamation area will not be protected by revetment, only trimmed to the natural earth slope with sufficient space left outside of the shoulder portion of the paved area.

(2) Wharf Construction (Open Deck Pier)

The concrete piles, 0.50 m x 0.50 m x 25.0 m, will be fabricated on the completed sections of the pier deck. Once the concrete piles have been fabricated, the piling barge fleet will set their positions to start piling work. It is assumed that a D-35 mounted driving barge will be able to place and drive 5 -8 no. piles per day. Assuming that a total of 793 piles are driven for 300 linear meter long berth, a total of about 120 days (net) will be required for the piling works.

Toward the completion of the piling works, the rip-rap works will be carried out by bucket-crane mounted barge, with the assistance of several groups of divers. The armour stones will be neatly placed on the slope of rip-rap stones in tightly interconnected manner. In parallel with this underwater work, the treatment of pile heads will be executed with assistance of crane-mounted flat barge. Then, keeping pace with the tidal change, scaffolding works will proceed, followed by the preparation for concrete works.

Supply of materials for scaffolding works and formworks will be executed partly from shoreside, using the completed section of the pier. In addition to this shoreside connection, flat barge, crane barge, tugboat will be fully utilized to help erect the fabrication of various kinds of bracing and welding works above water level. On completion of the formwork and reinforcement arrangements on the pier, the cast-in-situ concrete will be placed by pneumatic pump or directly placed from transit-mixers.

The concrete for the open deck pier will be placed on each block (26 m x 25 m) probably in two shifts: one for the beam portion and other for slab portion to form a coherent structure on each block. A total of about 260 m^3 concrete will be placed for this first shift placing, so mechanical placing would be preferable. Five to seven transit-mixers and pneumatic pumps of 50 ps would be employed to this end. The slab concrete will be placed in the same manner. The construction speed for open deck slab is assumed to be one month each.

Out of a total of 300 m of container berth, a 250 m portion will be newly built, while the remaining 50 m portion immediately next to the existing pier will be reinforced to meet the requirement for container berth by adding two row of the additional piled foundation for the container crane, one row near the berth line and another row behind the existing open deck pier.

(3) Pavement Work

As summarized in the foregoing pages, the core of the paving work will be asphalt pavement, totaling about 125,100 m^2 against 7,900 m^2 of concrete pavement. The asphalt concrete requirement is estimated at 37,000 tons. Assuming that 60 t/h-capacity mixing plant is erected on site, roughly 5,000 ton asphalt-mix will be produced on monthly basis, thus requiring 7 months for paving work. Considering the series of pavement works, including plant preparation, formation and compaction of sub-soil and base course, it will take a year to complete all the pavements of a new terminal area. For concrete pavement, ready-mix concrete will be supplied from a commercial mixing plant by use of transit-mixers. The soil plant will be also installed either on the port site or on the quarry site very close to the port.

(4) Building Works

Once the reclamation fill has been fully graded and compacted, the building works will start with the foundation works and piling works may be required for heavy foundation like CFS subject to the further soil investigation.

Considering the local condition, it is assumed to take about 8-10 months for erection of all the buildings.

11.5.4 Overall Construction Schedule

Based on the construction method outlined in the previous section, the preliminary construction schedule has been drawn up as shown in Fig. 11.5.3.

Including 2 months of site preparation, a total construction period has been estimated at 3.0 years.

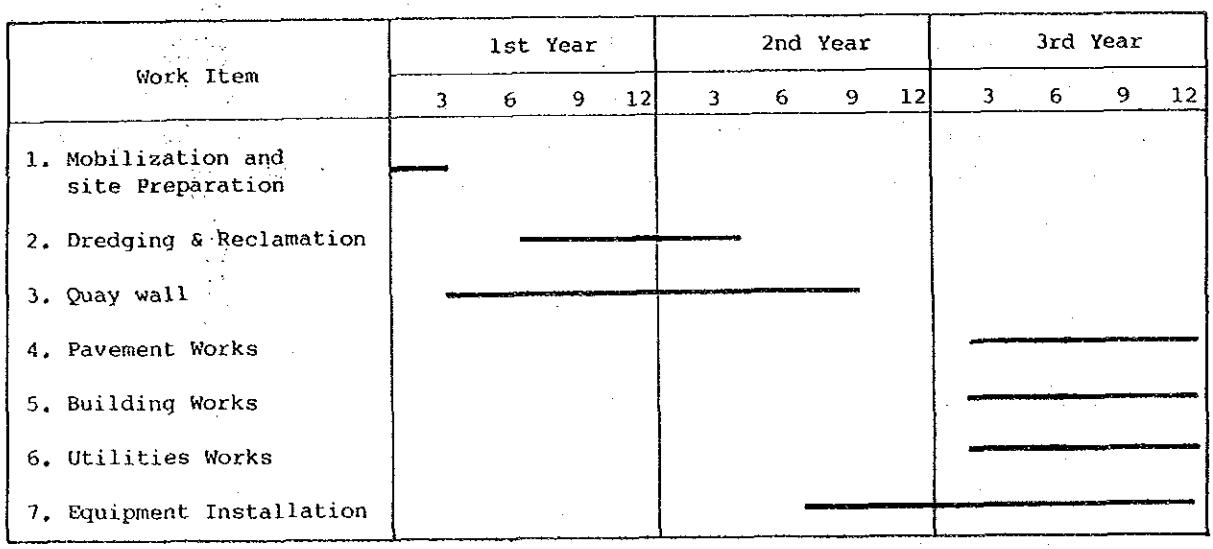


Fig. 11.5.3 Preliminary Construction Schedule (Manzanillo Port)

11.6 Cost Estimate of the Port of Manzanillo

11.6.1 Basis for Cost Estimate

The basic condition for cost estimate for Manzanillo Port is the same as applied for Lazaro Cardenas Port.

11.6.2 Composition of Construction Cost

(1) Direct Cost

The unit cost of the direct cost has been estimated on the basis of unit prices of labour, material, and equipment.

1) Labour Cost

Consistent with common practice, cost of local labor has been computed taking into consideration the existing laws, rules and regulations governing its use. The cost estimate has been based on the prevailing rate on the date of preparation as authorized by the Puertos Mexicanos.

Labour rates used for cost estimate are summarized in Table 11.6.1.

Table 11.6.1 Labour Rate for Cost Estimate

Labors Classification	Rate per day ($)
1. Foreman	50,000
2. Heavy Equipment Operator	50,000
3. Light Equipment Operator	35,000
4. Carpenter	40,000
5. Mason	40,000
6. Welder	40,000
7. Shop Electrician	45,000
8. Mechanic of Equipment	50,000
9. Skilled Laborer	45,000
10. Common Laborer	40,000
11. Captain of Floating Construction Equipment	100,000
12. Crew of Floating Construction	50,000
13. Diver	100,000
14. Engineer A (more than 20 years experience)	300,000
15. Engineer B (more than 15 years experience)	200,000
16. Engineer C (more than 10 years experience)	100,000
17. Chief Administrator	80,000
18. Clerk	40,000
19. Draftman	30,000
20. Driver	25,000

(Source: Puertos Mexicanos)

2) Material Cost

The unit price of local material identified on site and confirmed by Regional Office of PM, Manzanillo and Lazaro Cordenas in November 1989 have been basically used for the cost estimate. The local materials not available or difficult to be obtained on site have been costed adding adequate transportation cost from the nearest major cities capable of supplying them. Only the material which cannot be supplied in Mexico have been costed on the import basis. The costs of major materials used for the cost estimate are listed in Table 11.6.2.

The following materials are assumed to be procured from the local market.

- Cement
- Sand and gravel
- Wooden materials including plywood
- Fuel and lubricants
- Reinforced steel bar, regular structural steel materials, minor manufacturing wire, nails, etc.
- Bituminous materials
- Ordinary electric cable, wire, fixture and accessories
- Building fixture and office furnitures
- Materials for water supply/sewage facilities
- Admixture for concrete mixtures
- Other local materials needed

The materials to be imported are limited to:

- Steel materials manufactured such as special structural steel, rails etc.
- Special cable, wire, fixture and other accessories for telecommunications works
- Other materials which are not available in the local market

Table 11.6.2 Material Cost for Cost Estimate

Material	Price	Remarks
Cement	$ 190,000/ton	
Reinforcement bar	$1,300,000/ton	
Structural Steel	$1,900,000/ton	
Plywood 1/2" x 4' x 8'	$ 24,000/m^2	
Plywood 3/4" x 4' x 8'	$ 32,000/m^2	
Sand	$ 18,000/m^3	
Gravel (mixed)	$ 18,000/m^3	
Rubble Stone (10-2 cm)	$ 15,000/m^3	
Rubble Stone (20-5 cm)	$ 15,000/m^3	
Rubble Stone (more than 1 ton)	$ 25,000/m^3	
Gasoline	$ 500/l	
Diesel	$ 385/l	
Bunker Oil	$ 7,000/l	
PVC pipe ø75 m/m	$ 15,000/m	
Oxygen	$ 100/kg	
Welding lod	$ 8,000/kg	
Asphalt	$ 380/kg	(cement asphalt)
R.C. Pipe ø200 mm (simple)	$ 4,600	
R.C. Pipe ø300 mm (simple)	$ 8,900	
R.C. Pipe ø600 mm (Reinforced)	$ 35,300	
R.C. Pipe ø1200 mm (Reinforced)	$ 350,000	
R.C. Pipe ø1800 mm (Reinforced)	$ 700,000	

(Source: Puertos Mexicanos)

3) Equipment Cost

The basic information on the equipment cost have been obtained from Puertos Mexicanos and supplemented by other authorized reference books. The project will include various types of construction works, both onshore and offshore.

The "Costos y Presupuertos - Edificacion by Peimbert, Oct. 1989" gives the most reliable and latest information on equipment cost estimate, especially for onshore works, including buildings and various civil works. The operating costs of major equipment are listed up in Table 11.6.3.

Table 11.6.3 Equipment Cost for Cost Estimate

Name of Equipment	Capacity	Daily Operating Cost ($/hour)
Pump Dredger	2600 Hp	$2,000,000
Flat Barge	200 ton	$100,000
Flat Barge	200 ton	$ 80,000
Tugboat	260 Hp	$200,000
Tugboat	100 Hp	$150,000
Crane Barge	60 ton	$180,000
Compactor roller	10 ton	$ 80,000
Bulldozer	Cat D-8	$160,000
Bulldozer	Cat D-6	$140,000
Motor Grader	110 Hp	$ 90,000
Back Hoe	1 m^3	$300,000
Cargo Truck	11 ton	$ 45,000
Dump truck	11 ton	$ 45,000
Crawler Crane	100 ton	$200,000
Crawler Crane	50 ton	$ 85,000
Crawler Crane	30 ton	$ 80,000
Crawler Crane	25 ton	$ 70,000
Crawler Crane	20 ton	$ 60,000
Crawler Crane	15 ton	$ 50,000
Truck Crane	10 ton	$ 60,000
Vibrator	5 m^3	$ 6,000
Trailer	20-30 ton	$ 80,000
Concrete Mixer	2-bagger	$ 20,000
Concrete Mixer	1-bagger	$ 10,000
Water Truck	10 ton	$ 46,000
Vibrator Roller		$ 65,000
Concrete Cutter		$ 12,000
Welding Machine	E300A	$ 8,000
Welding Machine	E400A	$ 8,000
Concrete Pump	95 Hp	$120,000
Plate Compactor	7 Hp	$ 20,000
Plate Compactor	12 Hp	$ 20,000
Asphalt Distributor		$ 45,000
Concrete Breaker		$ 12,000
Transit Mixer		$ 80,000

(Source: Puertos Mexicanos)

(4) Indirect Cost

The Indirect cost consists of the following components:

1) General Overhead, Job Overhead, Contingency and Miscellaneous
   - Salary and site allowance
   - Travelling expense
   - Local employee fee
   - Safety facilities
   - Miscellaneous
2) Contractor's Profit
3) Contractor's tax on the estimated contract cost.

In order to cover all the cost requirements mentioned above, the Indirect Cost has been imposed on the Direct Cost with the following percentages for the all project components except for equipment. For the procurement of mechanical equipments only IVA (15%) has been considered.

Percentage Shared by Indirect Cost

- Composition of overhead, contingency and miscellaneous	30%
- Contractor's profit	10%
- Contractor's tax (IVA)	15%

(5) Physical Contingency

The physical contingency for the construction works except for mechanical components has been assumed to be 15% of total cost of foreign and local currency portions.

(6) Engineering Fee (Technical Overhead)

The engineering fee for supervising the project has been assumed to be 5% of the Project Cost.

11.6.3 Proportion of Local and Foreign Components

The cost estimate has been made in foreign currency and local currency. The ratios of foreign currency against local currency has been assumed as follows for each components of project cost.

The foreign currency portion will cover the following items:

a) Foreign currency portion of equipment (depreciation cost for imported equipment)
b) Imported materials and products
c) Foreign currency portion of indirect cost
d) Foreign currency portion of physical contingency
e) Cost of engineering services by foreign consultant

The local currency portion will cover the following items:

a) Cost of labour
b) Cost of locally produced material and products
c) Local currency portion of indirect cost
d) Foreign currency portion of physical contingency
e) Cost of engineering services by local consultant

11.6.4 Construction Cost (Direct) of Manzanillo Port

The direct construction costs exclusive of overhead, profit, consulting fee and etc. have been estimated following the basic concepts described in the foregoing sections.

Table 11.6.4 Construction Cost (Direct)

Work Item	Quantity	Rate ($)	Amount (million $)
1. EARTHWORK			
1.1 Dredging	750,000 m^3	5,200	3,900
1.2 Reclamation by sea	750,000 m^3	1,300	975
1.3 Reclamation by land	250,000 m^3	21,000	5,250
1.4 Rock Mound	13,000 m^3	35,000	455
			10,580
2. PAVEMENT			
2.1 Concrete Paving	7,900 m^2	116,000	916
2.2 Asphalt Paving (A)	61,800 m^2	38,000	2,348
2.3 Asphalt Paving (B)	63,300 m^2	51,600	3,266
			6,530
3. QUAYWALL			
3.1 Open Deck (A)	10 Nos.	1238.9×10^6	12,389
3.2 Open Deck (B)	1 Nos.	1735.7×10^6	1,736
			14,125
4. BUILDING			
4.1 Container Freight Station	6,920 m^2	450,000	3,114
4.2 Administration Build.	750 m^2	550,000	413
4.3 Warehouse	5,000 m^2	450,000	2,250
4.4 Gate	2 Nos.		432
			6,209
5. UTILITIES AND OTHERS			
5.1 Open Ditch	1,580 m	610,000	964
5.2 R.C. Pipe (ϕ1200)	440 m	653,000	287
5.3 R.C. Pipe (ϕ1800)	160 m	1,690,000	270
5.4 Manhole	10 Nos.	2,642,000	26
5.5 Yard Lighting	49 Nos.	12,000,000	588
5.6 Power Cable	3,000 m	107,000	321
5.7 Sub-station	1 No.	L.S.	110
5.8 Water Supply	660 m	123,000	81
5.9 Fence	2,100 m	162,000	340
5.10 Rail	400 m	1,500,000	600
			3,587
6. MECHANICAL WORK			
6.1 Quayside Container Crane	2 Nos.	$14,040 \times 10^6$	28,000
6.2 Transfer Crane	4 Nos.	$3,432 \times 10^6$	13,728
6.3 Yard Chassis	29 Nos.	52×10^6	1,508
6.4 Tractor	4 Nos.	156×10^6	624
6.5 Forklift (3T)	5 Nos.	73×10^6	365
6.6 Forklift (2T)	25 Nos.	52×10^6	1,300
			45,525
Total			86,556

Table 11.6.5 Breakdown of Currency Component (Direct)

(million ¥)

Work Item	Foreign	Local	Total
1. EARTHWORK			
1.1 Dredging	3,315	585	3,900
1.2 Reclamation by sea	829	146	975
1.3 Reclamation by land	1,732	3,518	5,250
1.4 Rock Mound	150	305	455
	6,026	4,554	10,580
2. PAVEMENT			
2.1 Concrete Pavement	122	794	916
2.2 Asphalt Pavement (A)	377	1,971	2,348
2.3 Asphalt Pavement (B)	524	2,742	3,266
	1,023	5,507	6,530
3. QUAY WALL			
3.1 Open Deck (A)	1,870	10,519	12,389
3.2 Open Deck (B)	372	1,364	1,736
	2,242	11,883	14,125
4. BUILDINGS			
4.1 Container Freight Station	311	2,803	3,114
4.2 Administration Building	41	372	413
4.3 Warehouse	225	2,025	2,250
4.4 Gate	432	-	432
	1,009	5,200	6,209
5. UTILITIES AND OTHERS			
5.1 Open Ditch	-	964	964
5.2 R.C. Pipe (ø1200)	-	287	287
5.3 R.C. Pipe (ø1800)	-	270	270
5.4 Manhole	-	26	26
5.5 Yard lighting	176	412	588
5.6 Power Cable	-	321	321
5.7 Sub-station	11	99	110
5.8 Water Supply	-	81	81
5.9 Fence	-	340	340
5.10 Rail	480	120	600
	667	2,920	3,587
6. MECHANICAL WORK			
6.1 Quayside Crane	23,332	4,668	28,000
6.2 Transfer Crane	11,444	2,284	13,728
6.3 Yard Chassis	1,508	-	1,508
6.4 Tractor	624	-	624
6.5 Forklift (3T)	365	-	365
6.6 Forklift (2T)	1,300	-	1,300
	38,573	6,952	45,525
Total Cost (Direct)	49,540	37,016	86,556

11.6.5 Project Cost of Manzanillo Port

Adding the indirect cost components and other cost, the project cost of Manganillo Port Expansion has been preliminarilly estimated as shown in Table 11.6.6.

Table 11.6.6 Project Cost of Manzanillo Port

	Foreign (Million $)	Local (Million $)	Total (Million $)
1. Direct Cost	49,540	37,016	86,556
2. Indirect Cost	4,716	12,928	17,644
3. Sub-total (1.+2.)	54,256	49,944	104,200
4. Physical Contingency	2,352	6,448	8,800
5. Sub-total (3.+4.)	56,608	56,392	113,000
6. Technical Overhead 5. x 0.05	2,830	2,820	5,650
Total (5.+6.)	59,438	59,212	118,650
7. IVA (5.+6.) x 0.15	-	17,798	17,798
Grand Total (5.+6.+7.)	59,438	77,010	136,448

Chapter 12. Economic Analysis

12.1 General

12.1.1 Purpose and Methodology of Economic Analysis

The purpose and methodology of Economic Analysis are as follows :

i. In this chapter, feasibility of the short-term improvement plan is analyzed from the economic point of view considering economic costs and benefits.

ii. The purpose of the analysis is to determine whether the net benefits of the project exceed costs which could be derived from other investment opportunities in Mexico.

iii. The economic internal rate of (EIRR) return based on cost benefit analysis is used in order to appraise the feasibility of the project. In estimating the economic costs and benefits of this short-term improvement plan, "shadow pricing" is applied.

iv. Economic pricing refers to the appraisal of costs and benefits in terms of international prices (border prices). Fig.12.1.1 shows the process of the economic analysis in this chapter.

v. Analyses of investments for the bulk berths are carried out through qualitative analyses.

12.1.2 Prerequisites to the Economic Analysis

The following prerequisites are assumed in this analysis :

i. All the costs and benefits are calculated at 1989 prices and the foreign exchange rate is fixed as following :

1 dollar =143 yen = 2600 pesos

ii. The period of economic calculation (project life) is assumed as 30 years. As the useful lifetime of main facilities such as the wharf and the warehouse are 40 and 25 years, respectively, thirty (30) years is considered as the working life and the period of economic calculation.

iii. The figures such as the standard ship size, and cargo volume are the same as in other chapters. It is assumed that cargo volume from 1989 to 1995 will increase linearly along the demand forecast

line.

iv. When the Lazaro Cardenas project is analyzed, the Manzanillo project is assumed to have been carried out. When the Manzanillo project is analyzed, the Lazaro Cardenas project is assumed to have carried out.

v. In the without case cargoes are assumed to be handled at alternative ports. The cargo volume overflow is decided by yard capacity not by the berth occupancy rate because the former limits the handling operation more rigidly than the later. (refer to appendix 12.1.1)

vi. The cargoes are substitutively transported by trucks and trailers to/from the hinterland.

vii. The cost of construction of infrastructures which are closely related to the projects such as railways, roads, water drainage and power supply, are excluded. However the costs within the ports are included.

viii. The type of ship that carries the shifted container cargo in "without case" is assumed to be vessel type I defined in section 9.1.1.

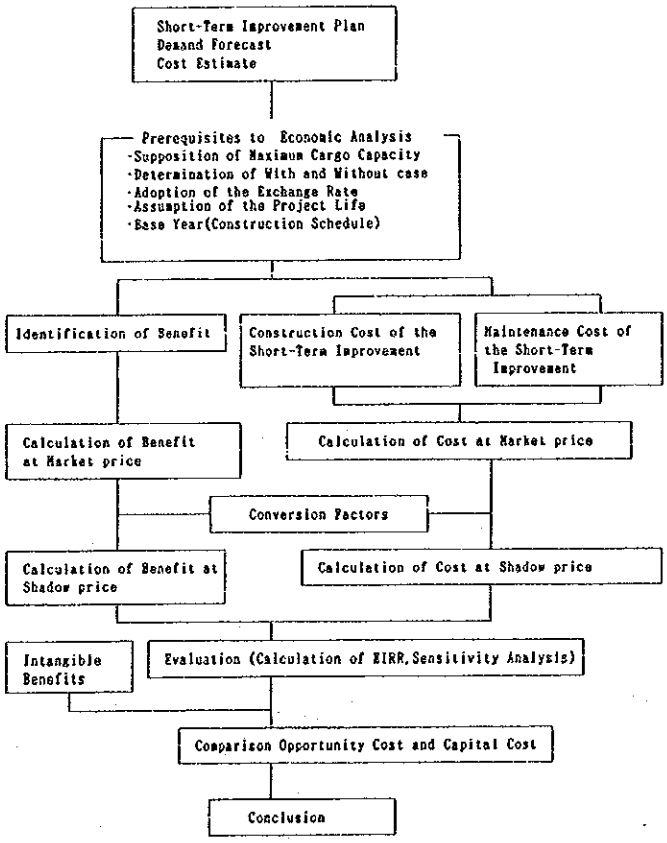


Fig. 12.1.1 Process of Economic Analysis

12.1.3 Benefits

(1) Benefits Items

When investment in the projects at the Ports of Manzanillo and Lazaro Cardenas is carried out,the following benefits are considered to occur:

i. Contribution to national economic development through modernization of the port and regional economy promotion through development of port-related industries (including an increase in employment opportunities and incomes)
ii. Savings in cargo handling costs by raising cargo handling productivity through mechanization and containerization
iii. Saving of cargo transportation costs by curtailment of the convey distance both on sea and on the road (saving of navigation cost and land transportation cost)
iv. Saving of the transport period (time cost) both through increasing the efficiency of port activities and by curtailment of the convey time.
v. Saving of ships the staying cost (while berth-waiting and cargo handling) through upgrading of port service
vi. Improvement of cargo handling efficiency and safety
vii. Reduction of damage to cargo through mechanization and containerization

Among the expected benefits, not all can be evaluated in monetary terms. Here five benefits are examined and evaluated in monetary terms:

- Saving of land transportation costs
- Saving of navigation costs
- Saving of ship's staying costs
- Saving in time costs
- Saving of labor costs

But the following benefits are intangible,so only a qualitative analysis is undertaken:

- Contribution to national economic development and regional economy promotion through development of port-related industries
- Improvement of cargo handling efficiency and safety.
- An increase in employment opportunities and incomes

12.1.4 Shadow Pricing

(1) Calculation of Shadow Pricing

The purpose of economic analysis is to examine the cost and benefit of the project from the view of efficient resource-allocation in the national economy. But market prices do not always represent the values for this purpose. Thus "shadow pricing" method is often used to evaluate the true value of the project, and this is applied for the costs as well as for the benefits.

All the costs and benefits that are calculated at the real market price include tax, subsidy and the goods and services, which are provided at government-restricted prices. Those prices are revised into shadow prices by selectively using various conversion factors. These shadow prices generally intend to represent international market prices, the frontier prices, in the other words ,of the costs of goods and services .

In this section shadow pricing method is applied in an effort to exclude transfer items and to correct the distortion of market prices.

1) Exclusion of transfer items.

Import (or export) duties, sales taxes (such as IVA) and import (or export) subsidies are merely transfer items, which do not actually reflect the consumption of any of the national economy's resources. Therefore, these factors should be excluded from calculation of the value of the project in economic analysis, as was mentioned before.

For example, imported materials and services at CIF prices include neither import duties nor sales taxes, but local goods and services includes both of them. So including foreign currency portion in the construction cost is a reasonable, but the local currency portion of this should exclude these transfer items to reflect rational prices.

2) Method of applying conversion factors

Generally, all benefit and cost are divided into labor, foreign goods and local goods. Labor is further divided into skilled labor and unskilled labor. The cost of skilled labor is obtained by multiplying its market price by the conversion factor for consumption (CFC), and the cost of unskilled labor is calculated by multiplying market prices by a ratio of the shadow wage rate and the CFC. Traded goods are expressed by the CIF

value for imports and by the FOB value for exports. As world prices cannot be directly applied in the case of non-trade goods, a further breakdown is made into some items. These items ms are divided into the categories of materials and equipments, labor and other individable items. The standard conversion factor (SCF) is then applied to the materials and equipment.

12.1.5 Calculation of the Conversion Factors

(1) The Standard Conversion Factor

Import duties and export subsidies create a price differential between the domestic market and the international market. For the purpose of analysis the standard conversion factor is applied in order to convert domestic prices into international market prices.

The standard conversion factor is obtained by the following formula:

$$SCF = \frac{I + E}{I + DI + E - DE}$$

where I : Total Amount of Imports
E : Total Amount of Exports
DI: Total Amount of Import Duties
DE: Total Amount of Export Duties

The standard conversion factor for the three years from 1986 to 1988 are listed in Table 12.1.1.

In this Study, the average value for three years is adopted as the standard conversion factor has a value of 0.974.

(2) Coversion Factor for Consumption

This factor is adopted for converting the price of consumer goods from domestic to international prices. This is particularly required to change domestic labor cost into the corresponding international prices. The conversion factor for consumption is normally by calculated using the same formula as the standard conversion factor, replacing only total imports and exports by imports and exports of consumer goods.

However,due to a lack of required data, the conversion factor for

consumption could not be calculated directly. In this study the export duty rate is assumed to equal 0% because the active promotion of exports keeps it very low generally. As for the average import duty rate, a value of 25% is assumed that is between the low, 10%, and the high, 50%. The latter is applied to insufficiently supplied goods by the domestic producers. And the figures of the import and export consumption goods are so normalized through a year that a seasonal fluctuation is neglected in the calculation.

Thus,the conversion factor for consumption has a value of 0.930, calculated based on the above assumptions and the figures presented in table 12.1.2.

(3) Shadow Wage Rate

For economic analysis,labor costs are usually measured in terms of their opportunity costs,that is the necessary value of marginal production allocated to the other purposes arising from the employment of laborers for a given project.

The cost of skilled labor is first calculated at the real market wage rate. The real market wage rate of skilled labor is assumed to represent a proper wage rate for optimum resources-allocation in the market mechanism. But as the cost of skilled labor is based on the domestic prices, this figure should be converted to an international price by multiplying the local market wage by the conversion factor for consumption. Then, the conversion factor for skilled labor can be calculated as follows:

the conversion factor for skilled labor
= (the local market wage rate)*(CFC)
= 1*0.930
= 0.930

Table 12.1.1 Standard Conversion Factors (SCF)

(unit: million dollars)

Item	1986	1987	1988	1986-1988
Imports(C.I.F)	11,918	12,761	19,725	14,801
Exports(F.O.B.)	16,031	20,656	20,658	19,115
Import Duties	941	1,074	796	937
Export Duties	76	12	15	34
SCF	0.970	0.969	0.981	0.974

Source: Poder Ejection Federal, "Primer Informe de Gobierno 1989"

Table 12.1.2 Foreign Trade by Type of Goods

(unit: million dollars)

Period	Total	Consumption Goods	Intermdiate Goods	Capital Goods
Export				
1988 Jan - Jun	10,713	2,198	8,098	417
1989 Jan - Aug	15,274	2,947	11,461	866
Import				
1988 Jan - Jun	8,322	640	6,004	1,678
1989 Jan - Aug	15,000	2,140	10,012	2,848

Source: Banco de Mexico "Indicadores del Sector Externo" 1989

The unskilled labor wages at economic prices are calculated based on a simplified measure of opportunity cost because of the difficulty of measuring the real price. There are some official guaranteed minimum wages in Mexico on which are based the calculation of the wages actually paid. However through examining the wage costs used in the cost estimation, the unit wage of the unskilled labors greatly exceeds the official guaranteed minimum wages. Thus the official guaranteed minimum wages are not employed in this analysis. The unit-wage cost used in the Cost Estimation is used in calculating the value for unskilled labor cost.

The opportunity cost is equal to the value of lost marginal product,

which is assumed to equal to half the additional value per worker in the main production sector according to the law of diminishing yield. (This estimate is done considering the fact that the marginal product of unskilled labor is usually less than the average product per worker.) As not only primary industries such as agriculture, but also the secondary and tertiary industries such as manufacturing and the communications sector are well developed in this country, the average additional value per worker of the Mexican national economy is adopted for this estimation instead of the value per worker in the main production sector.

In Mexico, half the average additional value per worker of the nation was estimated at approximately 24,471 pesos/worker a day in the 1988, while the unit-wage cost using in the cost estimation was 40,000 pesos/worker a day. Then, the conversion factor for additional value of unskilled labor is estimated at 0.612, and the conversion factor for unskilled labor is estimated as follows:

the conversion factor for unskilled labor(CF_{UL})
=(Conversion factor for additional value of unskilled labor)*(CFC)
=0.612*0.930
=0.569

12.2 Port of Lazaro Cardenas

12.2.1 Alternative Case

In order to determine the return on the project a cost-benefit analysis should be conducted, where the costs incurred in the project are subtracted from the benefits gained. To calculate costs and benefits the cases when an investment is made (hereinafter called "with case") are compared with cases when no investment is made (hereinafter called "without case"). In this study the following conditions are adopted for the without case:

i. The existing general cargo berth adjacent to the container berth is utilized for foreign and domestic general cargo vessels of the conventional type.

ii. The Ports of Salina Cruz and Guaymas are assumed to be chosen as the alternative calling ports, where the cargoes are transported to/from the hinterlands. Generally speaking, container vessels try to maintain their time schedules, so they don't call the ports that keep them waiting without berthing for a long time. The port of Mazatlan is not selected as a calling port in the without case because of the following reasons:

- Many cruising ships call at this port in the tourism season and are expected to increase in the future. This will hinder the schedules of calling container vessels.
- The construction of new berth will be needed to avoid above situation. The construction of a new berth and relevant facilities/equipment will require more investment compared with the increase of the land transportation cost by vessels' calling at the Port of Guaymas.

The port of Manzanillo is also not chosen because cargo volume is forecast to be handled so much that the occupancy rate of the berth exceeds 40%. That may make the calling container vessels wait for a long time, and may delay their time schedules. There is only one container berth each at Salina Cruz and Guaymas. As it is said that occupation of about 40% rate is proper for berth construction when comparing investment costs with benefits,so container vessels assumed to put up with congestion at berths up to a 40% occupation rate in case of one berth.

iii. The handling productivities at Port of Lazaro Cardenas (both with case and without), Salina Cruz and Guaymas are assumed in the calculation as shown in Appendix 12.2.1. The handling cargo volume per ship at each port is assumed as in Appendix 12.2.2, considering the facilities at each port.

The handling cargo volume as limited by stacked yard capacity is indicated in Table 12.2.1. Here the loaded containers are stacked by 2.5 layers high for imports and 3 for exports. The empties are then stacked at another place in the port with enough room. Then 53.3% of the container cargo volume in the with case is adopted as that in the without case, and cargo volume is calculated as follows:

Without Case Cargo Volume = With Case Cargo Volume * 0.533
= 272.7 thousand tons(30,216TEU)

The cargo volume handled at each Port of Salina Cruz, Guaymas, and Lazaro Cardenas is determined as shown in Table 12.2.2 (through calculating based on the figures of the productivities and the yard capacity).

Table 12.2.1 Yard Capacity Limited by the Slots' Number(without case)
(Lazaro Cardenas)

	Loaded Containers
(A) Necessary Numbers of Slots	1,050
(B) Possible Number of Slots	560
(C) Portion (B)/(A)	0.533

Table 12.2.2 Allocation of the Cargo Volume

(unit: TEUs, tons)

Port	With Case			Without Case		
	Container Cargo TEU		General Cargo	Container Cargo TEU		General Cargo
Lazaro Cardenas	511,600	56,690	44,600	272,700	30,216	33,300
Salina Cruz	194,000	24,900	10,600	359,400	43,228	18,400
Guaymas	301,000	20,600	8,800	374,500	28,746	12,300

12.2.2 Benefits

(1) Saving of Land Transportation Cost

In the without case overflow cargo from the port of Lazaro Cardenas is handled at the ports of Salina Cruz or Guaymas. These cargoes are assumed to be carried to/from the hinterlands by trucks of trailers.

Through examining the origins and destinations of the hinterlands in the O/D analysis in Chapter 5 of this report, these cargoes are assumed to be delivered to/from the hinterlands as shown in Table 12.2.3, and Table 12.2.4 shows the transport distance and time between the ports and the hinterlands. Calculating the average transportation distance based on these figures, it becomes shorter to carry to/from Lazaro Cardenas than to/from Salina Cruz or Guaymas.

The transportation cost is estimated based on the Tariff of Mexican States due to insufficient data, which says 802 thousand pesos/TEU, (70 thousand pesos/ton with general cargo) for 350km, 891 thousand pesos/TEU (78 thousand pesos/ton with general cargo) for 420km transportation. However according to interviews with local truck carriers in Mexico, real transportation fees are 1.3 times more than in the tariff of Mexican States. In addition it is forecast that transportation fees will rise higher in order to meet the renewed investment in trailers and trucks as cargo volume increases in the future. Thus the transportation costs adopted are 1.5 times those in the tariff of Mexican States.

Among these container cargoes, some are carried by container trailers other by truck, to/from the hinterlands. Here each cargo volume is estimated at 460,400 tons (51,021 TEU) and 51,160 tons respectively.

Saving of transportation cost is estimated to be 133.5 thousand pesos/TEU (12 thousand pesos/ton with geral cargo) in 1995, which amounts to 7,941 million pesos/year (1,130 million pesos/year with general cargo, with 10tons truck by 60% loading rate) in 1995.

Table 12.2.3 Share of the Cargo Volume by Hinterlands (1995)
(Lazaro Cardenas)

(unit: %)

Case	Hinterland / Port	Lazaro Cardenas	D.F.	MOR.	COL.	JAL.	Total
With case	Lazaro Cardenas	50.0	30.0	10.0	5.0	5.0	100.0
Without case	Lazaro Cardenas	50.0	-	-	3.3	-	53.3
	Salina Cruz	-	22.3	10.0	-	-	32.3
	Guaymas	-	7.7	-	1.7	5.0	14.4

Note: Calculated from the data of SCT

Table 12.2.4 Transport Distance and Time between Ports and Hinterland
(Lazaro Cardenas)

(unit: Km, hour)

Hinterland / Port		Lazaro Cardenas	Distirto Federal	Morelos	Colina	Jalisco
Lazaro Cardenas	Distance	0 ·	764	679	332	556
	Time	0	14	11	8	12
Salina Cruz	Distance		855	730		
	Time		17	15		
Guaymas	Distance		1,930		1,500	1,300
	Time		38		34	28

Note: Calculated from the data of SCT

(2) Saving of the Ships' Staying Costs

Ships' staying costs are incurred when ships are waiting for berth openings, and handling (loading or unloading) and in the water and oil feeding.

In this examination the container service operators are assumed to arrange the time schedules with each other, and they do not sustain the disturbance and losses incurred from their berth-waiting time in both the with and without cases.

1) *Difference in waiting time*

The waiting time is assumed to be negligible in this analysis.

2) Difference in handling time

As assumed in section 12.2.1, determination of without case, some cargoes are handled at lazaro Cardenas, some at Salina Cruz or Guaymas. Each port's productivity is so different that different handling times at the berths are produced. The Table 12.2.5 shows differences in handling time between "with case" and "without case".

Table 12.2.5 Reduction in Handling Time (1995)
(Lazaro Cardenas)

(unit:day)

Port	With Case	Without Case	Difference
Lazaro Cardenas	118	68	-50
Salina Cruz	76	132	56
Guaymas	63	88	25
Total	257	288	31

3) Estimation of ship cost

"Staying Costs" are such costs that occur when a ship stays within the port. One method of calculating staying costs is estimating the ship cost per day item by item, such as labor, depreciation cost, fuel consumption, etc. Another method is simply to add the international cost per day and the cost of the fuel consumed in the port. Due to the insufficient data on ship cost in Mexico, it is estimated according to the interviews with the Mexican ship company. They said the charterage rate per day of COMBO ship with 1,500-2,000 TEU, 26,000-30,000G/T ranged from 15,000 to 20,000 dollars. Referring to calculation of the ship cost estimated from the interviews with a Japanese shipping company in the former method, these range 15,000-17,000 dollars per day with a full container ship of 2,000-2,500TEU, 30,000-36,000G/T. The ship staying cost is assumed to be 18,000 dollars per day the standard container ship size (with2,000-2,500TEU)in this study, including the fuel consumption costs in the port.

4) Attribution of the benefit reduction staying cost

Reduction staying costs of vessels calling and berthing at the port will benefit the overall world economy through the international trade. But this would primarily benefit ship operators. The benefits to the Mexican economy are made via the Mexican ship operators.

Table 12.2.6 shows the Mexican share of dry cargo by commodity for all vessels calling at Mexican ports. The Mexican share for domestic trade is high, but for international trade is very low.

Most container vessels (type I vessel) calling and handling at Pacific side ports belong to TMM, the Mexican shipping company, which is supposed to carry around 70% of these cargoes not only by their own ships but also by chartered ships from foreign country. According to an interview with the TMM, they have a plan to expand the portion of their own ships in the total in the future, up to the point where 100% of the TMM operated ships belong to the company.

Table 12.2.6 Mexican Share in Dry Cargo by Commodity
(Excluding petroleum and its related products)

(Unit: '000t, %)

Item	1986			1987			1988		
	Total	Native	Ratio	Total	Native	Ratio	Total	Native	Ratio
General Cargo	3,651	573	16	4,192	503	12	4,681	670	14
Agricultural Bulk	2,767	358	13	4,392	235	5	4,702	93	2
Mineral Bulk	13,790	1,609	12	14,910	1,222	8	17,023	990	6
Others	1,445	3	-	1,581	-	-	1,886	143	7
Foreign Trade Total	21,653	2,542	11	25,076	1,960	8	28,292	1,895	7
Domestic Trade Total	12,726	10,651	84	17,416	15,803	91	19,304	16,267	84
Grand Total	34,379	13,194	38	42,492	17,763	42	47,586	18,162	38

Source: DGODP,"Movements Portuario Nacional de Caraga y Buque" 1986,1987,1988.

Additionally, staying costs are reduced due to the improved facilities, so the port management body may raise the port tariffs through which savings in staying costs borne by foreign ships would be transferred to the

Mexican economy. But in this case, raising tariffs should be limited to the amount of costs saved from reduced staying time, taking into consideration the competitive position with other ports.

On the other hand, the saving benefits are assumed to feed back to Mexican economy through the market mechanisms of the international economy.

Accordingly, it is assumed that 50% of the benefits attributed to foreign ships will be transferred to the Mexican economy. And the portions of attribution of the container ships are assumed as follows:

1990 - 1994: 80%
1995 - 1999: 90%
2000 - : 100%

Thus the total benefits to the Mexican economy through savings in staying time are 1,306 million pesos/year from 1995 to 1999, and 1,451 million pesos/year from 2000.

(3) Saving of Navigation Costs

The cargo volume handled at the port per ship is determined by the facilities, infrastructures, topographical features of the port and so on. But it is too difficult to indicate these factors quantatively. So each cargo volume loaded/unloaded per ship is assumed in section 12.2.1 taking into consideration such factors as those mentioned above.

Based on this assumption, Table 12.2.7 shows the number of ships on which cargoes are conveyed to/from the port of Salina Cruz or Guaymas instead of to/from Lazaro Cardenas. Among those ships half are assumed to call at Lazaro Cardenas directly when the project is excuted. Thus navigation cost will be saved.

The navigation costs consist of shipping cost and fuel consumption costs, which are divided into the route from the Port of Lazaro Cardenas to Salina Cruz, and route from the Port of Guaymas to the edge of California Peninsular.

It takes 2 days to go and return between Lazaro Cardenas and Salina Cruz (750km). And it takes 1.5 days to go and return between the port of Guaymas and the edge of California Peninsular (600km). Here the fuel consumption is 50kl/day with 18knot/hour (33.3km/hour) on TMM type ship of which cost is 18,000 dollars/day(the same as in calculating staying cost).

The unit price of oil is assumed at 180 dollars/kl. The calculated results are indicated in Table 12.2.10.

Table 12.2.7 The Number of Calling Ship
(Type I Vessel)

(unit: ships)

Port	With Case	Without Case	Difference
Lazaro Cardenas	76	36	-40
Salina Cruz	53	92	39
Guaymas	44	61	17

Table 12.2.8 Benefit of the Saving of the Navigation Cost
(Lazaro Cardenas)

(unit: million pesos)

Year	Guaymas-The Top of California Peninsular		Lazaro Cardenas-Salina Cruz		Total
1995	537	268	1,545	772	3,122
1996	↓	↓	↓	↓	↓
1997	↓	↓	↓	↓	↓
1998	↓	↓	↓	↓	↓
1999	↓	↓	↓	↓	↓
2000	597	298	1,716	858	3,469
	↓	↓	↓	↓	↓

(4) Saving in Time Cost

The reduction in staying time, navigation time and, land transportation time lead to saving in the usance interest by the faster delivery from the shippers to the consignees. Using the following equation saving time is estimated in monetary terms:

$$S\ T\ C = Q * D * V * I/365$$

where, Q: Average Transport Cargo Volume(ton/ship,trailer,truck)
D: Reduction of Time(days)
V: Average Cargo Value(US$/ton)
I: Usance Interest Rate(%/year)

The average cargo value of export goods is estimated based on the container freight, which is said to be around 10-20% of the value of cargo goods. And more than 50% of export cargoes at the Pacific ports are transported to Japan, Far East and Asia, of which the freight is around 1,600-2,000 dollars/TEU. If the average weight of loaded cargo is 12 tons, the average cargo value is estimated as follows:

$$AVC = \frac{\text{(A) Average freigh of a container(TEU)}}{\text{(B)Average weight of loaded cargo} * \text{(C)Portion of the freight against the average cargo value}}$$

If (A)is 1,800 dollars, (B)is 12 tons and (C) is 15%, ACV becomes 1,000 dollars per ton, which is adopted as the average value of the container cargo in this analysis. For calculation, usance interest rate is estimated as 8% per year based on the American B/A (Bank Acceptance) rate.

Table 12.2.9 presents the estimated saving in time cost for cargoes, that is the benefits from saving usance which accrue to the Mexican economy.

Table 12.2.9 Saving in Time Cost (Lazaro Cardenas)

(unit: '000 dollars)

Item	Volume of Cargo (tons)	Numbers of Ships or Truck	Average Cargo Volume (tons)	Reduction in Time (days)	STC
Reduction in Ships' time Staying	556,200	168	3,311	34	24.7
Reduction Transportation Time by trucks	95,760	15,760	16.0	1,970	2.6
Reduction in Transportation Time by Trailer	460,440	51,021	9.0	6,378	12.6
Reduction by Navigation time	250,200	56	4,468	49	48.0

(5) Saving in Labour Cost

If the project is carried out, the the cargo volume which stevedoores handle per hour will increase significantly. Accordingly, the labor cost that is necessary to operate handling work will be reduced and diverted to other production opportunities.

In this analysis the handling prductivitiy of each unit of equipment of the port is the same as mentioned in section 12.2.1, and the administration cost is assumed not to change between the with and without cases. Here only labor costs are considered. (It is very difficult to estimate the difference in operational costs between various kinds of equipments. The administrative cost is supposed not to differ in the Pacific side ports in Mexico).

The number of the workers comprising the gangs is assumed as follows:

Gang engaged in handling operation with quay side gantry crane: 11 workers/gang

Gang engaged in handling operation with ship crane : 13 workers/gang

And the unit cost of worker is assumed 50,000 pesos/day preliminarily. Calclating based on these figures, 31 million pesos are saved in 1995.

(6) Other Intangible Benefits

1) Development of port related industry

The implementation of the project would encouraged the development of factories around the port including locating new ones. The value added by these factories leads to economical benefits of the improvement plan.

2) Improvement of Cargo Handling Efficiency and Safety

Efficient and safe cargo handling will be realized by improvement of the cargo handling facilities/equipment. In addition the progress of the containerization of the general cargo will increase the safety, certainly and frequency of the cargo transportation.

3) Other benefits for port users

Some other benefits can be expected for the port users such as shipping lines and shippers/consignees as follows:

These benefits may not be simply due to the implementation of the project. However, all the benefits can be said possible only when the project is carried out.

i. The improvement of container handling facilities/equipment will induce new containerized cargoes through the port to a great extent.

ii. Through the increase of handling cargoes, the imbalance of import/export containers will be improved, as mentioned in section 9.1.1, leading to a considerable decrease of empty containers transported on vessel. This will be a great benefit for shippers.

iii. Completion of the CFS will have a great effect regarding security of the cargoes stuffed/unstaffed in the port, thus increasing LCL cargoes.

12.2.3 Costs

(1) Construction Costs

Table 11.4.3 in chapter 11 shows construction costs, including procured handling equipment, which are divided into local and foreign currency portions.

(2) Maintenance Costs

The maintenance costs for port facilities, such as the wharf and warehouse cargo handling equipment, are estimated as a fixed portion (1% for structures, 4% for machines every year) of the initial construction costs. An annual breakdown of the maintenance cost based on this calclation is 1,716 million pesos/year from 1995.

(3) Summary of Market Prices

The "market prices of both benefit and cost are summarized in appendix 12.2.4.

12.2.4 Conversion into Shadow Pricecs

(1) Shadow Prices of Benefits Items

1) Saving of land transportation cost

The calculation of land transportation cost is based upon the domestic fees of the Mexican tariff, which have to be converted into the shadow prices by multiplying these figures using some kind of conversion factor, such as SCF, CFC SWR.

However, as the elements' portion of these factors is too difficult to calculate exactly, it is assumed that land transportation costs consist of 80% for material and equipment, 10% for skilled labor, and 10% for unskilled labor. Thus the conversion factor for saving of land transpiration cost is calculated as follows:

$$CF_{STC} = 0.8*SCF + 0.1*CF_{SL} + 0.1*CF_{UL}$$
$$= 0.8*0.974+0.1*0.930+0.1*0.569$$
$$= 0.929$$

The saving of land transpiration cost at shadow prises coverted by above $CF_{STC}$is 7,377 million pesos/year from 1995.

2) Saving of staying costs

The calculation of savings of ships' staying costs is based on ship costs which can be quoted from international prices. Thus, these figures do not have to be converted for economic analysis.

3) Savings of navigation costs

As with the calculation of staying costs, this can be worked out using ship costs which is quoted from international prices. And the cost of fuel is done in the same way. These figures do not have to be converted for economic analysis.

4) Saving in time costs

Since time costs are based on FOB price and B/A (Bank Acceptance) rate in the USA, these figures do not have to be converted.

5) Saving of labor cost

The conversien factor for skilled labor and the conversion factor for unskilled labor are applied with the following ratio:

$0.8*CF_{SL}+0.2*CF_{UL}$
$= 0.8*0.930+0.2*0.569$
$= 0.858$

The saving of the labor cost is converted to 27 million pesos/year in 1995.

(2)Shadow Prices of Cost Items

1) Construction costs

The breakdown of construction costs by work items and by currency is shown in Table 11.4.3 in chapter 11 as mention above. However as the local portion of the construction costs consists of materials, equipment, skilled labor, unskilled labor and other transfer items, it is difficult to evaluate the individual shadow prices. Thus the integrated conversion factors are adopted to calculate the shadow prices of the construction costs, which are applyed to each work item.

The integrated conversion factors are determined at first by excluding the portion of IVA(15%), at second by multiplying SCF, CF_{SL}, CF_{UL}, and other coeffients by the portion of each items. In Table 12.2.10 shows the integrated conversion factors, with which the shadow prices of the construction costs are changed as follows:

the shadow prices of the construction cost
= the integrated conversion factor*the construction cost at the market price
= 0.754*48,382 million pesos
= 36,480 million pesos

2) Maintenances costs

Since the maintenance costs include various elements such repair costs, a weighted average of three conversion factors are adopted in the same way as land transportation costs:

$$CFmc = 0.8*SCF + 0.1*CF_{SL} + 0.1*CF_{UL}$$
$$= 0.8*0.974+0.1*0.930+0.1*0.569$$
$$= 0.929$$

The shadow prices of the maintenance cost is converted to 1,594 million pesos per year.

3) Summary of the shadow prices

The shadow prices of the project expence are summarized in Appendix 12.2.5.

Table 12.2.10 Integrated Conversion Factors

Work Item	Total	Foreign	Local	Materials and Equipment	Skilled Labor	Unskilled Labor	Others	Each Coversion Factors
(Conversion Factor)		(1.000)		(0.974)	(0.93)	(0.569)	(0)	
1.Civilwork	1.000	0.136	0.864	0.802	0.017	0.04	0.005	0.956
Concreate Pavement	1.000	0.132	0.868	0.795	0.021	0.048	0.004	0.954
Asphalt Pavement	1.000	0.163	0.837	0.805	0.004	0.015	0.013	0.958
Asphalt Overlay	1.000	0.107	0.983	0.848	0.019	0.026	0	0.965
Demonition of Reefer	1.000	0	1.000	0.333	0	0.667	0	0.704
2.Fuildings	1.000	0.325	0.675	0.398	0.135	0.142	0	0.919
C.F.S.	1.000							
Gate								
3.Utiliyies & Others	1.000	0	1.000	0.91	0.03	0.06	0	0.948
4.Electlic Work	1.000	0.218	0.782	0.699	0.011	0.072	0	0.951
5.Fence	1.000	0	1.000	0.896	0.03	0.075	0	0.943
6.Mechanical Work	1.000	0.842	0.158	0	0	0	0.158	0.842
7.Indirect Cost	1.000	0.173	0.827	0.744	0.05	0.033	0	0.963
8.fthers	1.000	0.378	0.622	0.276	0.176	0.17	0	0.907
9.IVA	1.000	0	1.000	0	0	0	1.000	0
T o t a l	1.000	0.593	0.407	0.133	0.02	0.022	0.232	0.752

12.2.5 Economic Profitability

(1) Definition of the Economic Internal Rate of Return

As mentioned in 12.1.1, the economic profitability of the project is evaluated in terms of the economic internal rate of return (EIRR). The economic internal rate of return is express as as a discount ratio satisfying the following equation:

$$\sum_{i=o}^{n-1} \frac{Bi - Ci}{(1+EIRR)^i} = 0$$

where, n : Period of Calculating EIRR
Bi : Total Amount Benefits at i-th Year
Ci : Total Amount Costs at i-th Year

(2) Calculation and Assessment of the Economic Internal Rate of Retern

Table 12.2.11 shows the flow of costs and benefits calculatied using the shadow prices. The EIRR is 29.05%.

There are diverse views concerning the evalution of the percentage of EIRR used in judging whether a project is feasible or not. The leading view is that the project is feasible if the EIRR exceeds the any other opportunity costs of capital.

In port investment projects, EIRRs usually range from 10 to 20%. It is generally considered that a project of more than around 10% is economically feasible. Even if the economic calculation only takes into account tangigle items in monetary terms,the EIRR of the project is 29.05%. Therefore, the project is considered feasible.

Table 12.2.11 Calculation of EIRR
(Lazaro Cardenas)

(unit: million pesos)

Year	Benefits	Costs	Difference	Present Value
1994	0	36,480	-36,480	-36,480
1995	12,060	1,594	10,466	8,110
1996	12,060	1,594	10,466	6,284
1997	12,060	1,594	10,466	4,870
1998	12,060	1,594	10,466	3,774
1999	12,060	1,594	10,466	2,924
2000	12,552	1,594	10,985	2,372
2001	12,552	1,594	10,958	1,838
2002	12,552	1,594	10,958	1,425
2003	12,552	1,594	10,958	1,104
2004	12,552	1,594	10,958	855
2005	12,552	1,594	10,958	663
2006	12,552	1,594	10,958	514
2007	12,552	1,594	10,958	398
2008	12,552	1,594	10,958	308
2009	12,552	1,594	10,958	239
2010	12,552	1,594	10,958	185
2011	12,552	1,594	10,958	143
2012	12,552	1,594	10,958	111
2013	12,552	1,594	10,958	86
2014	12,552	1,594	10,958	67
2015	12,552	1,594	10,958	52
2016	12,552	1,594	10,958	40
2017	12,552	1,594	10,958	31
2018	12,552	1,594	10,598	24
2019	12,552	1,594	10,958	19
2020	12,552	1,594	10,958	14
2021	12,552	1,594	10,958	11
2022	12,552	1,594	10,958	9
2023	12,552	1,594	10,958	7
Total	361,548	82,706	278,842	0

EIRR(%) = 29.05

12.2.6 Sensitivity Analysis

(1) Identification of Cases

Sensitivity analysis made to see if the project is justifiable in case of some factors vary uncertainly.

If this study is conducted in the following cases:

Case A. 10% increase in costs

Case B. 10% decrease in benefits

Case C. Both of A and B

(2) Results of the Sensitivity Analysis

The results of the sensitivity analysis are presented in Table 12.2.12, where EIRRs exceed 10%.

It is concluded that the short term improvement project of the Port of Lazaro Cardenas is feasible from an economical point of view considering the EIRR as well as the intangible benefits.

Table 12.2.12 The Result of Sensitivity Analysis

Case	EIRR(%)
A: 10%increase in costs	26.04
B: 10% decrease in Benefits	25.73
C: Both A and B	23.00

12.2.7 Qualitative Analysis of the Improvement Plan for Bulk Cargo

The improvement of the handling equipment and operation of the bulk cargo berth (SICARTSA berth) will bring about an increase in productivity. Thus through more efficient handling the staying time of the bulk vessels will be reduce and staying costs will be saved.

On the other hand the reasonable utilization of the port area will be realized when the handling of agricultured bulk cargoes is removed from the general cargo berth to the grain silo berth.

Taking into consideration the above merits and a low level of the project investment. The improvement plan is found to be reasonable and feasible from the economical point of view.

12.3 Port of Manzanillo

12.3.1 Alternative Case

The alternative case is set up for the same reason explained in Section 12.2.1. In this study the following condition are assumed as the without case.

i. The existing commercial port functions in the outer port are abolished.

ii. No investments are made except 3 transfer cranes for an efficient utilization of the narrow container yard, and the CFS suitable for the cargo volume required for the increasing LCL container cargoes.

iii. Berths A1-A2 are utilized for foreign and domestic general cargo vessels of the conventional type, berth B1 is for container vessels, Nos.B2-B3 for the agricaltual and mineral bulk cargo vessels.

iv. Investment in the Berths C1-C3 is assumed to have already been done and they are used to handle mineral bulk cargo.

v. The ports of Salina Cruz and Guaymas are assumed to be chosen as the alternative calling ports, and the cargoes are transported to/from the hinterlands due to the same reason in Section 12.2.1.

vi. The handling productivities at the ports of Manzanillo (both with case and without), Salina Cruz, Guaymas are shown in the Appendix 12.3.1. And handling cargo volume per ship at each port is assumed as in Appendix 12.3.2 considering its port facilities.

The handling cargo volume limited by the yard capacity is indicated in the Table 12.3.1. Here the both loaded and empty containers are stacked up by 2-3 layers high. The empties are assumed to be stacked by 4 layers high, then 51.9% of the container cargoes in the with case are adopted as that in the without case, and the cargo volume is calculated as following:

Without Case Cargo Volume = With Case Cargo Volume * 0.519
= 313.6 thousand tons(33,735TEU)

Calculating the productivities and the yard capacity at port of Manzanillo, the cargo volume handled at each port of Salina Cruz or Guaymas is determined as shown in Table 12.3.2.

Table 12.3.1 Yard Capacity of Limited by the slots Number (without case) (Manzanillo)

(units: TEUs)

	Loaded	Empty
(A) Necessary Number of Slots	1,173	423
(B) Possible Number of Slots	609	208
(C) Portion (B/A)	0.519	0.492

Table 12.3.2 Allocation of the Cargo Volume

(unit: TEU, tons)

Item / Port	With Case			Without Case		
	Container Cargo		General Cargo	Container Cargo		General Cargo
		TEU			TEU	
Manzanillo	604,200	65,000	26,900	313,600	33,735	13,600
Salina Cruz	301,000	24,900	10,600	421,200	43,228	18,400
Guaymas	194,000	20,600	8,800	364,200	33,537	14,300

Note: General cargo inculdes only cargo transported on the container vessels.

12.3.2 Benefits

(1) Saving of Land Transpotation Cost

In the without case overflow cargo from the Port of Manzanillo is handled at the port of Salina Cruz or Guaymas. These cargoes are assumed to be carried to/from the hinterlands by trucks or trailers.

Through examining the origins and destinations of the hinterlands by O/D analysis in Chapter 5 of this report,these cargoes are supposed to be delivered to/and from the hinterlands as shown in Table 12.3.3, and Table 12.3.4 shows the transport distance and time between ports and the hinterland. Calculating the average transpotation distance based on these figures, it becomes shorter to carry to/from Manzanillo than to/from Salina Cruz or Guaymasas.

Table 12.3.3 Share of the Cargo Volume by Hinterland (1995)

(Manzanillo)

(unit: %)

Case	Port	D.F.	DGO	S.L.P	JAL	MEXICO	PUE	AGS	N.L	Total
With Case	Manzanillo	30	10	10	20	7	3	10	10	100
Without Case	Manzanillo	15	-	10	10	-	-	10	6	51
	Salina Cruz	15	-	-	4	7	3	-	-	29
	Guaymas	-	10	-	6	-	-	-	4	20

Table 12.3.4 Transport Distance and Time between Ports and Hinterland (Manzanillo)

(unit: Km,hours)

Port \ Hinterland		D.F.	DGO.	S.L.P.	JAL	MEXICO	PUE	AGS	N.L.
Manzanillo	Distance	810	1,000	750	360	750	900	630	1,100
	Time	16	18	13	6	13	18	10	22
Salina Cruz	Distance	855			1,300	900	730		
	Time	17			26	18	15		
Guaymas	Distance		1,100		1,300				1,600
	Time		24		28				27

Transportation costs are estimated based on the Traffic of Mexican States due to insuficient data, which says 997 thousand pesos/TEU, (116 thousand pesos/ton with general cargo) for 740km, 1,104 thousand pesos/TEU,(130 thousand pesos/ton with general cargo) for 850 km. However transpotation costs adopted are 1.5 times those in the tarrif for the same reson in section 12.2.2,(1).

Of these container cargoes, some are carried by the container trailers, others are by truck, to/from the hinterlands. Here each cargo volume is estimated at 363,660 tons (38,093TEU) and 267,446 tons respectively.

The saving of transpotation cost estimated to be 161 thousand pesos/TEU (21 thousand pesos/ton with geral cargo)in 1995, which amounts to 11,294 milion pesos/year(5,616milion pesos/year with general cargo, with 10 tons truk by 60% loading rate) in 1995.

(2) Saving of the Ships' Staying Cost

Staying costs consist of both ships'waiting cost and the cost of ships' handling time. Waiting time costs occur when ships are waiting for berths and handling time costs occur when they are loading, unloading cargoes, and feeding water and oil.

As the cargo volume handled at the port of Manzanillo is increasing, some cagoes will shift to Salina Cruz or Guaymas due to extream yard congestion. As the operators of container sevice lines try to maintain their time schedules, they make efforts to avoid disturbance service time because of their high ship costs. On the other hand, port managers try to arrange berth utilzation and give high priority to container ships over other ships. So container ships would be allowed to use existing berths B1 - B3 in priority to other types of ships.

However, if container ships are allowed to use Berths B1 - B3 or priority basis the number of berth-waiting ships would increase to the point where port congestion comes to be a sever problem.

1) Difference in waiting time

The average waitimg time is estimated by the result of a simulation made using Queuing Theory. In order to avoid misestimating waiting time, it is assumed that the distribution both of ships arrival and of cargo handling time are randamly distributed.

Differences in waiting time by ship type are shown in Table 12.3.5 comparing "without case" with "with case", where container ships are assumed to be arranged to use the berths with priority over to the others, avoiding intolerable berth waiting time.

Table 12.3.5 Waiting Time of Bulk Ships (1995)
(Manzanillo)

(Unit: days)

Type of ship	Without	With	Difference
Agricultural Bulk (Foreign)	4	9	5
Agricultural Bulk (Domstic)	-	2	2
Mineral Bulk (Foreign)	3	5	2
Mineral Bulk (Domestic)	7	17	10
T o t a l	14	33	19

2) Difference in handling time

As is assumed in section 12.3.1, determination of without case, some cargoes are handled at Manzanillo, some are at Salina Cruz or Guaymas. Each part's productivity is so different that different handling times at the berth is produced. The Table 12.3.6 shows differences in handling time between the "with case" and "without case".

Table 12.3.6 Reduction in Handling Time (1995)
(Manzanillo)

(unit: days)

Port	With Case	Without Case	Difference
Manzanillo	128	89	-39
Salina Cruz	76	132	56
Guaymas	63	102	39
Total	267	322	56

Note: Including only type I vessels

3) Estimation of ship cost

As is discussed in section 12.2.2,(2) the ship cost of container vessel is assumed 18,000 dollars per day with the type I vessels(with 2,000TEU-2,500TEU) in this study including the fuel consumption.

On the other hand there is such little data on bulk ship costs in Mexico that it is estimated 7,800 dollars/day for the bulk cargo ship (20,000 DWT), 6,000 dollars/day for the domestic bulk cargo ship (10,000 DWT) based on the interview with the Japanese ship company in the former method as mentioned previously.

4) Attribution of the benefit of reduction of staying cost

Table 12.2.6 shows the Mexican share of dry cargo by comodity for all those vessels calling at Mexican ports. The Mexican share for domestic trade is high, but international trade is very low.

As mentioned before most container vessels (type I vessel) calling and handling at Pacific side ports belong to the TMM, the Mexican ship company, and they have a plan to expand the portion of their own ships in the

future, to the point where 100% of their operating ships belong to their company as is already mensioned.

On the other hand, staying costs are reduced due to improved facilities and construction of the new berth, so the port management body may raise the port tariffs, through which saving of staying cost accrued to for ships would be transferred to the Mexican economy and the saving benefits are assumed to feed back to Mexican economy through the mechanisms of the world economy.

Accordingly, it is assumed that 50% of the benefits atributed to foreign ships will be transferrd to the Mexican economy. And the portions of attribution are adopted as is in section 12.2.2,(2) for the container ships and as in follows for bulk cargo ships:

Foreign Bulk Cargo Ships 55 % (0.1F+0.9F*0.5 = 0.55F)
Domestic Bulk Cargo Ships 100 %

Thus the total benefits to the Mexican economy through savings of staying time are presented in Table 12.3.7.

Table 12.3.7 Benefit to the Maxican Economy through Sarring in the Staying cost (Manzanillo)

(Unit: million pesos)

Year	Saving in Staying Cost	Benefit to the Mexican Economy
1995	2,950	2,623
1996	↓	↓
1997	↓	↓
1998	↓	↓
1999	↓	↓
2000	↓	2,886
⋮	↓	↓

(3) Saving of Navigation Costs

The Cargo volume handled at the port per ship is determined by the facilities, infrastractires, topographical features of the port and so on. But it is too difficult to indicate these relations quantatively. Then

each cargo volume loaded/unloaded per ship is assumed when the without case is determined taking into consideration such factors mentioned above.

Based on the assumption the section in 12.3.1, Table 12.3.8 shows the numbers of ships in which cargoes are conveyed to/from the port of Salina Cruz or Guaymas instead of to/from Manzanillo. Among these ships, half the difference between with case and without case are assumed to come to call at the port of Manzanillo directly, to/from which cargoes are delivered from/to the hinterlands. The benefits of saving in excess navigation costs will be produced when investment in the project is carried out.

Table 12.3.8 The Mumber of Calling Ships (TMM Type Ship)

(unit: ships)

	With Case	Without Case	Difference
Manzanillo	90	45	-45
Salina Cruz	53	92	39
Guaymas	44	71	27

It takes 2.3 days to go and return between Manzanillo and Salina Cruz (900km). And it takes 1.5 days to go and return between the port of Guaymas and the edge of the California Peninsular (600km). Here the fuel consumption is 50kl/day with 18knot/hour(33.3km/hour)on a TMM type ship of which cost is 18,000 dollars/day(the same figure in calclating staying cost). The unit price of oil is assumed 180 dollars/kl. The calculated results are indicated in Table 12.3.9.

Table 12.3.9 Benefit of Saving of Navigation Cost

(unit: Million pesos)

Year	Guaymas-the top of the California Peninsular		Manzanillo-Salina Cruz		Total
	Ship Cost	Fuel Consumption Cost	Ship Cost	Fuel Consumption Cost	
1995	854	426	1,889	945	4,114
1996	↓	↓	↓	↓	↓
1997	↓	↓	↓	↓	↓
1998	↓	↓	↓	↓	↓
1999	↓	↓	↓	↓	↓
2000	949	473	2,099	1,050	4,571

(4) Saving in Time Cost

The reduction in staying time, navigation time, land transpotation time leads to saving in the interest through faster delivery between the shippers to the cosignees, both of whom would enjoy the benefits in Mexico. Using the same equation as in section 12.2.2,(4), the saving time is estimated in monetary terms:

The average cago value of export goods is estimated based on the same way in section 12.2.2,(4), and the volume of 1,000 dollars per ton is adopted as the average value of container cargo in this analysis too. For calculation, interest rate is estimated as 8% per year based on the American B/A(Bank Acceptance) rate.

Table 12.3.10 presents the estimated saving in time cost for cargoes, that is the benefits from saving which accrue to the Mexican economy.

Table 12.3.10 Saving in Time Cost (1995)
(Manzanillo)

(unit: 1,000 dollars)

Item	Volume of Cargo (tons)	Number of Ships or Trucks	Average Cargo Volume (tons)	Reduction in Time (days)	S T C
Reduction in Ships' Staying Time	631,100	143	4,413	57	55.1
Reduction in Tronsportation Time by Trucks	267,440	44,573	6.0	5,572	7.3
Reduction Transportation Time by Trailers	363,660	38,093	9.5	4,762	9.9
Reduction in Navigation Time	303,900	66	4,605	65	65.6

(5) Saving of the Labor Costs

As was mentioned in section 12.2.2,(5), if the project is carried out, the the cargo volume which stevedores handle per hour will increase significantly. Accordingly the labor cost necesarry to carry out handling work will be saved and diverted to the other productive opportunities.

Based on these figures 82 million pesos of the labor cost are saved in 1995 as in the same way of calcualtion in section 12.2.2, (5).

(6) Other Intangible Benefits

1) Improvement of cargo handling efficiency and safety

The existing yard are not wide enough for efficient and safe cargo handling. Efficient and safe cargo handling will be realized by improvement of the cargo handling facilities/equipment and operation. In addition the progress of the containerization of general cargo will increase the safety, certainty and frequency of the transportation.

2) An increase in employment opportunities and income

As for the additional employment arising from the project, employment for construction during the construction period and for operation after the

facilities are completed are considered. Employment is one of major benefits of the project.

3) Other benefits for port users

The same kind of benefits are expected as discribed in section 12.2.2, (6). In addition, the decrease of dwelling time of containers at the container yard and CFS will become a benefit for shippers/consignees.

12.3.3 Costs

(1) Construction Costs

Table 11.6.6 in Chapter 11 shows construction costs including procured handling equipment, which are divided into local and foreign currency portions.

(2) Maintenace Costs

The maintenance costs for port facilites,such as the wharf, warehouse and cargo handling equipement, are estimated as a fixed portion(1% for structures, 4% for machines every year) of the initial construction costs. An annual breakdown of the maintenance cost based on this calclation is shown in Table 12.3.11.

Table 12.3.11 Maintenance Cost (Market Price)
(Manzanillo)

(unit: million pesos)

	Value of Facilities in Newly Operate	Total	Rate(%)	Maintenance Cost
1992	25,175	25,175	1-4	-
1993	66,390	91,565	1-4	252
1994	44,883	136,448	1-4	1,820
1995	0	136,448	1-4	3,014
⋮	↓	↓	↓	↓

(3) Construction Costs and Maintenace Costs in Without Case

As mentioned in the section 12.3.1 in this chapter, 3 transfer cranes and CFS are procured and built in without case in order to ensure efficient utilization of the narrow container yard of this port. If this procurement and building are not done, fewer cargoes ishandled. That will cost too much for the Mexican economy in terms of not meeting the increasing container cargo and hindering the progress containerization. Thus it is assumed to invest for the 3 transfer cranes and the CFS as the minimum investment for this analysis.

The cost for this procurement is estimated at 1,518 thousand dollares/a tranfer crane, amounting to 4,554 thousand dollares in total.(11,840 million pesos)

And cost for CFS construction is estimted 2,329 million pesos by allocating the amount of "with case" with the necessary squares of CFS.

In addition the maintenance cost for these equipment amount 497 million pesos (1% of the CFS initial cost,4% of the transfer cranes).

(4) Summary of Market Prices

The market prices both of benefits and costs are summerized in Appendix 12.3.3.

12.3.4 Conversion into Shadow Prices

As is already mentioned in section 12.2.4 the costs and benefits are converted into shadow prices. Here the results of the calcutation are presented.

(1) Shadow Price of Benefit Items

1) The saving of land transport cost
   It is converted to 10,492 million pesos per year from 1995.
2) Saving of labor cost
   It is converted to 70 million pesos per year from 1995.
3) Other benefits
   Other benefits are not converted

(2) Shadow Prices of Cost Items

1) Construction costs

The shadow prices of the construction costs are presented in Tabale 12.3.13(Integrated conversion factors are shown Table 12.3.12).

2) Maintenance costs

The shadow prices of maintenance cost is converted to 234 million pesos per year in 1993, 1,691 million pesos per year in 1994, 2,800 million pesos per year from 1995.

3) Construction costs and maintenance costs in without case

They are converted in the same way of the with case. The construction cost become 11,971 million pesos, and the maintenance costs become 462 million pesos per year.

(3) The Summary of the Shadow Prices

They are summeriyed in appendix 12.3.4.

12.3.5 Economic Profitability

As is analiyed in section 12.2.5, the economic profitability is evaluated in terms of EIRR.

(1) Calculation and Assessment of the Economic Internal Rate of Return

Table 13.3.14 shows the flow of costs and benefits calculated using the shadow prices. The EIRR is 13.75%.

There are diverse views concerning the evalution of the percentage of EIRR used in judging whether a project is feasible or not. The leading view is that the project is feasible if the EIRR exceeds any other opportunity costs of capital.

In port investment projects, EIRRs range from 10 to 20%. It is generally considered that a project of more than around 10% is economically feasible. Even if the economic calculation only takes into account items in monetary terms, the EIRR of the project is 13.75%. Therefore, the project is considered feasible.

Table 12.3.12 Integrated Convension Factors
(Manzanillo)

Work Items	Total	Foreign	Local	Materials and Equipment	Skilled Labor	Unskilled Labor	Others	Conversion Factors
(Convension Factor)	(1,000)			(0.974)	(0.930)	(0.569)	(0)	
1. Earthwork	1.000	0.537	0.463	0.409	0.012	0.034	0.008	0.966
Dredging	1.000	0.85	0.15	0.09	0.01	0.03	0.02	0.964
Reclamation by Sea	1.000	0.85	0.15	0.091	0.011	0.03	0.018	0.966
Reclamation by Land	1.000	0.33	0.67	0.623	0.012	0.035	0	0.968
Rock mound	1.000	0.33	0.67	0.591	0.024	0.055	0	0.959
	1.000							
2. Pavement	1.000	0.157	0.843	0.806	0.01	0.023	0.003	0.964
Concreate Pavement	1.000	0.133	0.867	0.795	0.021	0.049	0.002	0.955
Asphalt Pavement (A)	1.000	0.161	0.839	0.808	0.008	0.018	0.006	0.966
Asphalt Pavement (B)	1.000	0.16	0.84	0.809	0.009	0.019	0.002	0.967
3. Quay Wall	1.000	0.225	0.775	0.671	0.046	0.058	0.001	0.954
Open Deck (A)	1.000	0.226	0.774	0.67	0.046	0.058	0.001	0.954
Open Deck (B)	1.000	0.214	0.786	0.68	0.046	0.059	0.001	0.953
4. Buildings	1.000	0.163	0.837	0.494	0.167	0.176	0	0.9
5. Utilities and Others	1.000	0.186	0.814	0.741	0.025	0.049	0	0.959
6. Mechanical Work	1.000	0.847	0.153	0	0	0	0.153	0.847
Quayside Container crane	1.000	0.833	0.167	0	0	0	0.167	0.833
Transfer Crane	1.000	0.834	0.166	0	0	0	0.166	0.834
Yard Chassis	1.000	1.000	0	0	0	0	0	1.000
Tractor	1.000	1.000	0	0	0	0	0	1.000
Forklift (2T)	1.000	1.000	0	0	0	0	0	1.000
Forklift (3T)	1.000	1.000	0	0	0	0	0	1.000
7. Indirect Cost	1.000	0.267	0.733	0.659	0.022	0.051	0	0.958
8. Others	1.000	0.359	0.641	0.401	0.124	0.116	0	0.931
9. IVA	1.000	0	1.000	0	0	0	1.000	0

Table 12.3.13 Flow of Construction Costs
(Manzanillo)

Construction	1992		1993		1994		Total	
	Market	Economy	Market	Economy	Market	Economy	Market	Economy
1 Movilization and Site Preparation	177	147					177	147
2 Dredging and Reclamation	17,050	14,352					17,050	14,352
3 Quaywall	7,948	6,593	23,881	19,811			31,829	26,404
4 Pavement Work			6,484	5,452	6,484	5,452	12,968	10,904
5 Building Work			6,165	4,825	6,165	4,825	12,330	9,650
6 Utilities Work			2,374	1,978	4,748	3,959	7,122	5,937
7 Mechanic Work			27,486	19,933	27,486	19,933	54,972	39,866
Total	25,175	21,092	66,390	51,999	44,883	34,169	136,448	107,260

Table 12.3.14 Calculation of EIRR

(Manzanillo)

(Unit: million pesos)

Year	Benefits	Costs	Difference	Present Value
1992	0	21,092	-21,092	-21,092
1993	0	52,233	-52,233	-45,919
1994	0	23,889	-23,889	-18,463
1995	17,658	2,338	15,320	10,409
1996	17,658	2,338	15,320	9,151
1997	17,658	2,338	15,320	8,045
1998	17,658	2,338	15,320	7,072
1999	17,658	2,338	15,320	6,217
2000	18,378	2,338	16,040	5,723
2001	18,378	2,338	16,040	5,031
2002	18,378	2,338	16,040	4,423
2003	18,378	2,338	16,040	3,888
2004	18,378	2,338	16,040	3,418
2005	18,378	2,338	16,040	3,005
2006	18,378	2,338	16,040	2,642
2007	18,378	2,338	16,040	2,322
2008	18,378	2,338	16,040	2,042
2009	18,378	2,338	16,040	1,795
2010	18,378	2,338	16,040	1,578
2011	18,378	2,338	16,040	1,387
2012	18,378	2,338	16,040	1,219
2013	18,378	2,338	16,040	1,072
2014	18,378	2,338	16,040	942
2015	18,378	2,338	16,040	829
2016	18,378	2,338	16,040	728
2017	18,378	2,338	16,040	640
2018	18,378	2,338	16,040	563
2019	18,378	2,338	16,040	495
2020	18,378	2,338	16,040	435
2021	18,378	2,338	16,040	382
Total	492,646	160,339	332,307	0

EIRR (%) = 13.75

12.3.6 Sensitivity Analysis

As is analyzed in section 12.2.6, the sensitivity analysis is made concering the same 3 case.

The results of the sensitivity analyses are presented in Table 12.3.15, where EIRRs exceed 10%.

It is concluded that the short-term development project of the port of Manzanillo is feasible from an economical point of view considering the EIRR as well as intangible benefits.

Table 12.3.15 Result of Sensitivity Analysis
(Manzanillo)

Case	EIRR (%)
A: 10% increase in costs	12.33
B: 10% decrease in benefits	12.18
C: Both A and B	10.84

12.3.7 Qualitative Analysis of the Improvement Plan for Bulk Cargo

Bulk cargo handling is characterized by the large amount of cargo volume handled at a time per ship. If the berth allotment is made as planned in section 10.2.3 from the reasonable port area utilization point of view as well as the efficient port operation, the following benefits are expected to be produced:

- Saving of Ship Cost
- Reduction of the Damage ,Loss,and Pilferage and Theft
- Promotion of the Amenity
- Advanced Utlization of the Port

1) Saving of ship cost

The completion of the bond C wharf will curtail the ships' waiting time in the port and the ships operation cost would be reduced. And if the new warehouses are built behind the berths, staying time of ships as well as trucks and freight cars will be reduced. In addition the improvement of cargo handling operation leads to the efficient operation that brings about the same benefits.

2) Reduction of the damage, loss,and pilferage and theft

The efficient cargo handling would reduce the cargo damage and loss during handling period. And the storage in the warehouse also reduce damage, loss, pilferage and theft. Not only these can be counted into the saving of the comersial value but also promote the quality control of the materials.

3) Promotion of amenity

The improvement of handling operation reduces the nuisance and pollusion caused by scattering powdered meterial in and around the port. This would prevent the port workers from sickness and promote the amenity of the port under which efficient port service can be provided.

4) Advanced utlization of the port

The storage in the newly built warehoses will expand the handling capacity of cargo at the port, thus bringing about the advance utilization the port.

5) Evaluation of the project

Taking into consideration the above benefits and low level of the projects cost, it is concluded that the improvement plan will be economically feasible.

Chapter 13. Financial Analysis

13.1 Purpose and Methodology of the Financial Analysis

13.1.1 Purpose

In the Economic Analysis of the preceding Chapter 12, the economic effectiveness of the investment is studied from the point of view of national economy. The purpose of the Financial Analysis is (1) To ascertain the impact of the present project on the financial condition of the port management body, (2) To examine the profitability of the project itself, to determine whether the project is sound from a financial view point.

In other words, based on the promise that financial control is carried out by the business accounting under a self-supporting accounting system, this chapter examines the effects of the project, that is to say based on the balance of revenues and expenditures, to ascertain the financing situation, and presents the problems found and the measures to be taken.

In Mexico, the accounting of port is carried out by each management body. So the financial analysis of profit/loss statement and cash flow statement is analyzed about ESP and the local office of Puertos Mexicanos, and the financial analysis of FIRR is carried about the united management body of ESP and the local office of Puertos Mexicanos for the purpose of evaluating the project itself from financial point of view.

13.1.2 Methodology

The investment effects of each project are analyzed by the following two methods:

i. Analysis by financial statements
   The financial viability of the project is apprised based on the projected financial statements (profit/loss statement, cash flow statement) to analyze revenues and expenditures based on fund raising conditions (Table 13.1.1 and 13.1.2).

ii. Analysis discount cash flow
   The profitability of the project itself is analyzed seeking the Financial Internal Rate of Return (FIRR) using the Discount Cash

Flow Method.

The flow of the financial analysis is shown in Fig. 13.1.1.

* The "FIRR" is a discount rate which makes the net present value of the cash flow equal zero.

13.1.3 Assumptions for Financial Analysis

The following points are assumed for the analysis:

a. Only the container terminal functions in the port are analyzed.
b. The cost of the construction of infrastructures which do not exist in the area of this project are excluded.
c. Accounting is carried out according to the business accounting system.
d. The financial analysis covers the period from 1989 to 2024.
e. The funds necessary to execute this project are to be raised as shown in Table 13.1.1.

   The self-fund comprises the ESP's own revenues and the initial contribution by the government. According to the present system of port finance in Mexico, the surplus of the ESP's revenues excluding necessary ESP's expenditure is to return to the government.

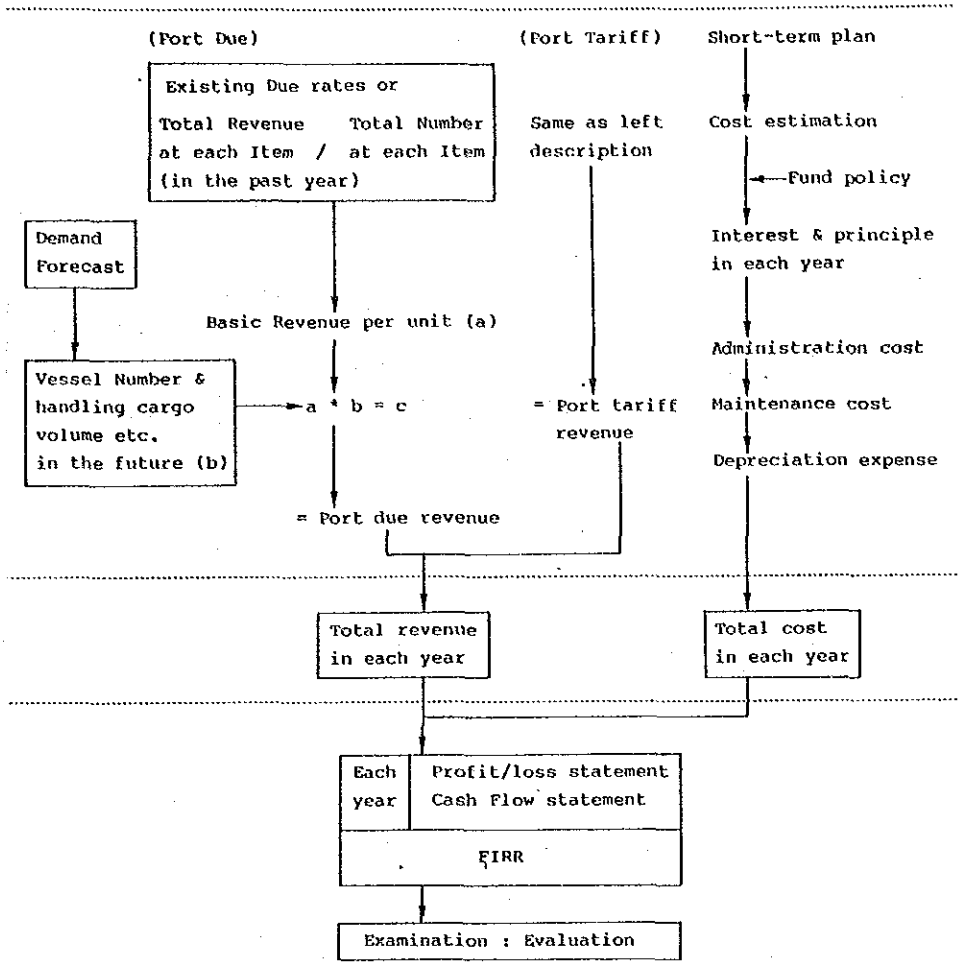


Fig. 13.1.1 Flow Chart of Financial Analysis

Table 13.1.1 Source of Fund

Unit: Million Pesos

Port	Body	Source	Amount	Allotment			
				1991	1992	1993	1994
Lazaro Cardenas	ESP	Loan	15,600	15,600			
		Self-Fund	21,847	21,847			
		Total	37,447	37,447			
	Puertos Mexicanos	Loan	-	-			
		Self-Fund	10,935	10,935			
		Total	10,935	10,935			
Manzanillo	ESP	Loan	6,760			3,380	3,380
		Self-Fund	48,212			24,106	24,106
		Total	54,972			27,486	27,486
	Puertos Mexicanos	Loan	4,680		2,340	2,340	
		Self-Fund	76,796		22,835	36,564	17,397
		Total	81,476		25,175	38,904	17,397

f. The conditions for the loans referred to above are shown in Table 13.1.2.

Table 13.1.2 Loan Condition

Port	Body	Items	Long-Term Loan	Short-Term
Lazaro Cardenas	ESP	Interest Rate	7.9%	Interest Rate
		Repayment Term	15 Years	
		Grace Period	3 Years	Borrowing :
Manzanillo	ESP	Interest Rate	7.8%	
		Repayment Term	15 Years	12%
		Grace Period	5 Years	
	Puertos Mexicanos	Interest Rate	7.8%	Deposit :
		Repayment Term	15 Years	7%
		Grace Period	5 Years	

g. The revenue of Puertos Mexicanos is calculated based on the current port dues rate. The ESP's tariff of container operation is assumed to be raised to 30% up of the present tariff rate of the Port of Lazaro Cardenas. This raising of tariff level is considered possible and necessary taking into account (1) the benefits that the users will gain due to upgraded cargo handling productivity, (2) increase of operation cost caused by the investment for the project and (3) the tariff level at rival ports such as the Port of Los Angels. Other tariff rate is set up based on the present rate in Mexico. The summary of these rates is shown in Table 13.1.3.

Table 13.1.3 Summary of Tariff or Due Rate

Tariff of ESP		Dues of Puertos Mexicanos	
Item	Rate	Item	Rate
Operation : Container	36,400 $/t	Ship's Entrance	765 $/GT
: General	3,200 $/t	Berthing	120 $/m*day
Tugboat	825 $/HP*h	Wharf usage : Import	900 $/t
		: Export	420 $/t
C.F.S	4,000 $/t		820 $/t

Note : "$" = represents "peso"

h. The costs of the ESP and Puertos Mexicanos are calculated using the following factors:

i. Personnel costs

In the case of the ESP, the new container operation terminal section is established in the present organization, and in the case of Puertos Mexicanos, the operation is carried out by the present organization. And its includes the cost of the head office of Puertos Mexicanos by the rate of 30% of the local office.

ii. Union costs

The costs for the union are estimated at 40% of the operating income because of the progress of mechanization now in operation. And in the "Without Case", this rate is maintained at the present value (Lazaro Cardenas : 52%, Manzanillo : 64%).

iii. Maintenance costs

The maintenance costs of facilities/equipments are estimated as a certain proportion (1% for structures, 4% for machines) of the construction or purchase cost of each facility.

iv. Administrative costs

Administrative costs are estimated at 130% of personnel costs in the case of the ESP, and at 50% of personnel costs in the case of Puertos Mexicanos according to the interview.

v. Depreciation expenses

The depreciation expenses of the existing fixed assets are calculated based on the details of the financial data for each asset. The additional facilities provided by the project are regarded as additional fixed assets. The service life and depreciation rate of each facility are listed in Table 13.1.4.

Based on the depreciation rates, the annual depreciation expenses are calculated by the straight line method shown in Appendix 13.1.1, Table (1) - (4).

The replacement schedule is indicated in Appendix 13.1.1, Table (5) - (8).

i. Tax

The income tax rate is estimated at 35% in the case of the ESP, and 0% in the case of Puertos Mexicanos because of its public sector status.

13.1.4 Principal Policy of Evaluating FIRR

According to the low ratio of loan to the total fund required for the project, especially in case of the project at the Port of Manzanillo, and the Mexican policy regarding the governmental investment to the construction of port infrastructure, the FIRR does not necessarily require high rate. Simply from the viewpoint of the profitability for repaying the loan, the required minimum FIRR will be less than 3% for the Lazaro Cardenas project and less than 1% for the Manzanillo project, due to the reason mentioned above.

Essentially, however, the most of the investments for port development /improvement project are desirable to be paid back by the revenues from port management/operation, especially in case of ESPs, which provide profitable services at ports.

Therefore, the estimated FIRR at each project should be also evaluated from the viewpoint of the profitability that would allow higher ratio of loan, or from the viewpoint of reasonable level of return to the investor, the Mexican government.

13.1.5 Financial Ratios Used for Analysis

The following four financial ratios are to be used for analysis.

These ratios are adopted for analysis in the study considering those financial ratios which are most widely used for the financial analysis of feasibility studies project by the World Bank, etc.

Operating Ratio --- To ascertain the income position.

$$\frac{\text{(Total operating expenses)}}{\text{(Total operating revenues)}} * 100\%$$

Working Ratio --- To ascertain the income position.

$$\frac{\text{(Operating expenses - Depreciation expenses)}}{\text{(Operating revenues)}} * 100\%$$

Interest Earned Ratio -- To ascertain the interest payment capacity.

$$\frac{\text{(Profit after depreciation)}}{\text{(Interest on long-term loans)}}$$

Debt Service Coverage Ratio --- To ascertain loan repayment capacity

$$\frac{\text{(Operating profit + Depreciation expenses)}}{\text{(Repayment and interest on loans)}}$$

Table 13.1.4 Life Cycle and Depreciation Rate of Main Facilities/Equipment

Facilities/Equipment	Life Cycle	Depreciation Rate per year
(Facilities)	40	0.025
Breakwater	40	0.025
Quay wall	25	0.04
C.F.S	7	0.14
Navigation Aids	25	0.04
Pavement	25	0.04
Warehouse	25	0.04
Gate	25	0.04
Utilities	25	0.04
Electricity	7	0.14
Fence	7	0.14
(Equipment)		
Quayside Gantry Crane	15	0.067
Transfer Crane	7	0.14
Chasis 40' & 20'	7	0.14
Tractor	7	0.14
Fork lift 40T - 20T	7	0.14
Tugboat	15	0.067

13.2 Port of Lazaro Cardenas

13.2.1 Financial Analysis of the ESP

1) Revenues

The objective cargo volumes and the number of ships call are estimated in Table 13.2.1 according to the result of economic analysis. And the revenues of the ESP are calculated as shown in Table 13.2.2.

Table 13.2.1 The Objective Cargo Volumes and the Number of Ships

Item		With Case		Without Case	
		Volume	Remark	Volume	Remark
Cargo	Container	511,600 t	Import:236,200 t	272,700 t	Import:141,000 t
	General	44,600 t	Export:257,400 t	33,300 t	Export:165,000 t
	Total	556,200 t		306,000 t	
Ship	I type	75.8	220m 35000t 118d	35.5	220m 35000t 68d
	II type	55.5	92m 3000t 19d	55.5	92m 3000t 21d
	III type	20.4	92m 3000t 15d	20.4	92m 3000t 16d
C.F.S		51,160 t		27,270 t	

Table 13.2.2 ESP Revenues

Unit: Million Pesos

Item		With Case	Without Case
Cargo	Container	36,400 @ 511,600 = 18,622	28,000 @ 272,700 = 7,635
	General	3,200 @ 44,600 = 142	3,200 @ 33,300 = 106
C.F.S.		4,000 @ 51,160 = 204	4,000 @ 27,270 = 109
Tugboat		1,980 @ 556,200 = 1,101	1,980 @ 306,000 = 605
Total		20,069	8,455

2) Expenditure

The expenditures of the ESP are calculated in Table 13.2.3 according to the preceding assumption.

Table 13.2.3 Expenditures of ESP

Unit: Million Pesos

Item	With Case			Without Case		
	Volume	Rate	Sum	Volume	Rate	Sum
Personnel Cost			788			276
Union Cost	18,968	0.4	7,587	7,741	0.52	4,025
Maintenance Cost	69,518	0.04	2,780	40,048	0.04	1,601
Administration Cost	788	1.3	1,024	276	1.3	358
Depreciation Expenses*			6,966			3,257
Total			19,145			9,517

* See Appendix 13.1.1 Table (1)

3) Financial Situation

a. Result

Financial statements from 1989 to 2024 are prepared according to the above estimation of revenues and expenditures.

Appendix 13.2.1, Table (1) is the profit/loss statement and Appendix 13.2.1, Table (2) is the cash-flow statement.

b. Evaluation of the financial statement

The evaluation of these statements is as follows:

i. The profit/loss statement shows that the operating revenues are sufficient to cover operating expenditures.

ii. All the renewal costs of cargo handling equipment can be taken from the ESP's reveneu.

iii. The accumulated net income of the ESP in the year 2024 will be an estimated 75,971 million pesos. Most of this accumulated income, excluding a reasonable amount of revenue reserved for the use of the ESP, should be returned to the government as compensation for its initial contribution.

Assuming 10% of the revenue is allotted to the ESP and a 7.9% of rate of return, it is estimated that around 90% of the initial

contribution by the government can be recovered.

iv. The cash flow statement shows that the management body can pay off the long-term loans completely.

v. The working ratio is calculated as 61%, as shown Appendix 13.2.1 Table (2). The desirable level of the working ratio is recommended to be below 70 - 75% by the World Bank. Based on this calculation, the working rations can be said to be favorable.

vi. Based on the above evaluation with regard to the financial statements, it can be concluded that the ESP will operate soundly as management body of the project.

13.2.2 Financial Analysis of Puertos Mexicanos

The analysis method of financial statements is as same as ESP.

1) Revenues

The revenues of Puertos Mexicanos are calculated according to Table 13.2.4:

Table 13.2.4 The Revenues of Puertos Mexicanos

Item		With case			Without case		
		Volume	Rate	Sum	Volume	Rate	Sum
Entrance Due	I type	75.8*35,000	765	2,029	35.5*35,500	765	950
	II type	55.5* 3,000		127	55.5* 3,000		127
	III type	20.4* 3,000		46	20.4* 3,000		46
	Subtotal			2,202			1,123
Berthing Due	I type	220*118	120	3	220*68	120	2
	II type	92* 19		0	92*21		0
	III type	92* 15		0	92*16		0
	Subtotal			3			2
Wharf Usage Due	Import	236,200	900	212	141,000	900	126
	Export	275,400	420	115	165,000	420	69
	Subtotal			327			195
C.F.S.		51,160	820	81	27,270	820	22
Total				2,613			1,342

2) Expenditures

The expenditures of Puertos Mexicanos are calculated in Table 13.2.5 according to the preceding assumptions:

Table 13.2.5 Expenditures of Puertos Mexicanos

Unit: Million Pesos

Item	With Case			Without Case		
	Volume	Rate	Sum	Volume	Rate	Sum
Maintenance Dredging	21,000	5,200	100	21,000	5,200	100
Personnel Costs			71			71
Maintenance Costs *	86,631	0.01	866	78,311	0.01	783
Administration Costs	71	0.5	35	71	0.5	35
Depreciation Expense *			2,769			2,354
Total			3,841			3,343

* See Appendix 13.1.1 Table (2)

3) Financial situation

a. Result

Financial statements from 1989 to 2024 are prepared according to the above estimation of revenues and expenditures. Appendix 13.2.2, Table (1) is the profit/loss statement and Appendix 13.2.2, Table (2) is the cash flow statement.

b. Evaluation of financial statement

The evaluation of these statements is as follows:

i. The profit/loss statement shows that net income becomes profit after the year of 2004 and it indicates the upward tendency.

ii. The working ratio is calculated as 70% in Appendix 13.2.2, Table (1) and can be said to be favorable.

iii. Based on the above evaluation with regard to the financial statements, it can be concluded that Puertos Mexicanos will operate soundly as a management body of the project.

13.2.3 Financial Analysis by the FIRR

1) Method and calculated result

The profitability of the project itself is analysed based on the financial internal rate of return (FIRR) using the Discount Cash Flow Method. The FIRR is a discount rate which makes the net present value of the cash flow equal to zero.

The condition of the "without case" is the same as described in the Economic Analysis. The calculated result is shown in Table 13.2.6.

2) Evaluation of FIRR

The value of FIRR of the project is calculated as 10.06 %. This shows that there is no problem from the view point of the profitability for repaying the loan, as described in section 13.1.4.

On the other hand, the value implies that the project could be feasible if all the funds were procured by a loan with the interest rate of 10%, or that the investor could expect the same amount of return.

Judging from the above, the project itself can be regarded as sufficiently feasible.

13.2.4 Sensitive Analysis

1) Assumption of Cases

Sensitive analysis is executed for two cases as follows:

i. Case A : Expenditures increase by 10%

ii. Case B : Revenues decrease by 10%

2) Results

The FIRR is calculated for each of the two cases. The calculated result are Case A 8.44% and Case B 8.27% as showin in Table 13.2.6. The result of the sensitive analysis proves that each case would be feasible.

Table 13.2.6 Calculated Value of FIRR

Case	FIRR (%)
Base Case	10.06
Case A: Expenditures increase by 10%	8.44
Case B: Revenues decrease by 10%	8.27

13.3 Port of Manzanillo

13.3.1 Financial analysis of ESP

1) Revenues

The objective cargo volumes and the number of ships are estimated in Table 13.3.1 according to the economic analysis. And the revenues of the ESP are calculated as in Table 13.3.2.

Table 13.3.1 The Objective Cargo Volumes and the Number of Ships

Item		With Case		Without Case	
		Volume	Remark	Volume	Remark
Cargo	Container	604,200t	Import : 193,800t	313,600t	Import : 114,000t
	General	26,900t	Export : 410,400t	13,600t	Export : 258,000t
	Total	631,100t		327,200t	
Ship	I type	89.7	l=220m 35,000t 128	45.1	l=220m 35,000t 89
	II type	31.7	l=126m 8,000t 9	31.7	l=126m 8,000t 10
C.F.S		240,540t		124,840t	

Table 13.3.2 The Revenue of ESP

Item		With Case million pesos	Without Case million pesos
Cargo	Container	36,400 @604,200 = 21,992	28,000 @313,600 = 8,780
	General	3,200 @ 26,900 = 86	3,200 @ 13,600 = 43
C.F.S		4,000 @240,540 = 962	4,000 @124,840 = 489
Tugboat		1,210 @631,100 = 763	1,210 @327,200 = 395
Total		23,803	9,717

2) Expenditure

The expenditures of the ESP are calculated in table 13.3.3 according to the preceding assumptions.

Table 13.3.3 Expenditures of ESP

unit: million pesos

	Item With Case			Without Case		
	Volume	Rate	Sum	Volume	Rate	Sum
Personnel Costs	1	-	1,152	1	-	640
Union Costs	23,040	0.40	9,216	5,687	0.64	3,639
Maintenance Costs *	77,401	0.04	3,096	38,505	0.04	1,540
Administration Costs	1,152	1.30	1,497	640	1.30	832
Depreciation Expense *	-	-	7,437	-	-	4,469
Total			22,398			11,120

* See Appendix 13.1.1 Table (3)

3) Financial Situation

a. Results

Financial statements from 1989 to 2024 are prepared according to the above estimation of revenues and expenditures Appendix 13.3.1, Table (1) is the profit/loss statement and Appendix 13.3.1, Table (2) is the cash flow statement.

b. Evaluation

The evaluation of these statements is as follows:

i. The profit/loss statement shows that the operating revenue is sufficient to cover the operating expenditures.

ii. All the renewal costs of cargo handling equipment can be taken from the ESP's reveneus.

iii. The accumulated net income of the ESP in the year of 2024 will an estimated 178,278 million pesos. Most of this accumulated income, excluding a reasonable amount of revenue reserved for the use of the ESP, should be returned to the government as a compensation for its initial contribution.

Assuming 10% of the revenue is allotted to the ESP and a 7.8% of rate of return, it is estimated that around 95% of the initial contribution by the government can be recovered.

iv The cash flow statement shows that the management body could pay off the long-term loans completely

v. The working ratio is calculated as 63% in Appendix 13.3.1, Table (1), and this shows that the financial situation of the management body is sound.

vi. Based on the above evaluation with regard to the financial

statements, it can be concluded that the ESP will operate soundly as a management body of the project.

13.3.2 Financial analysis of Puertos Mexicanos

The analysis method of financial statement is as same as for the ESP.

1) Revenues

The revenues of Puertos Mexicanos are calculated according to Table 13.3.4.

Table 13.3.4 The Revenues of Puertos Mexicanos

unit:million pesos

Items		With Case			Without Case		
		Volume	Rate	Sum	Volume	Rate	Sum
Entrance dues	I type	89.7 x 35,000	765	2,401	45.1 x 35,000	765	1,218
	II type	31.7 x 8,000	"	184	31.7 x 8,000	765	194
	Sub Total			2,595			1,402
Berthing dues	I type	220 x 128	120	3	220 x 98	120	2
	II type	126 x 9	"	0	126 x 10	"	0
	Sub total			3			2
Using wharf dues	Imports	193,800	900	174	114,000	900	102
	Exports	410,000	420	172	258,000	420	108
	Subtotal			346			210
C.F.S		240,540	820	197	124,840	820	102
Total				3,141			1,716

2) Expenditures

The expenditures of Puertos Mexicanos are calculated in Table 13.3.5 according to the preceding assumptions.

Table 13.3.5 Expenditures of Puertos Mexicanos

unit:million pesos

Item	With Case			Without Case		
	Volume	Rate	Sum	Volume	Rate	Sum
Maintenance Dredging	130,000	5,200	670	130,000	5,200	670
Personnel Cost	1	-	105	1	-	105
Maintenance Cost*	90,874	0.01	908	70,849	0.01	708
Administration cost	105	0.5	52	105	0.5	52
Depreciation Expense*			2,826			2,105
Total			4,561			3,641

* See Appendix 13.1.1 Table (4)

3) Financial Situation

a. Results

Financial statements from 1989 to 2024 are prepared according to the above estimation of revenues and expenditures. Appendix 13.3.2, Table (1) is the profit/loss statement and Appendix 13.3.2, Table (2) is the cash flow statement.

b. Evaluation

The evaluation of these statements is as follows:

i The profit/loss statement shows that the net income becomes profit after the year of 2006 and it indicates the upward tendency.

ii. The cash flow statement shows that the management body could pay off the long-term loans completely.

iii. The working ratio is calculated as 34% in Appendix 13.3.2, Table (1) and it shows that the financial situation of the management body is sound.

iv. Based on the above evaluation with regard to the financial statements, it can be concluded that Puertos Mexicanos will operate soundly as a management body of the project.

13.3.3 Financial Analysis by the FIRR

1) Method and calculated result

The method of the analysis of FIRR is as same as the case of Port of Lazaro Cardenas. And the coudition of the "without case" is described in the preceding Chapter of Economic Analysis. The calculated result is shown in Table 13.3.1.

2) Evaluation of FIRR

The value of FIRR of the project is calculated to be 6.58%. This value shows that there is no problem from the view point of profitability for repaying the loan, as described in section 13.1.4.

On the other hand, the value of FIRR implies that the project could be feasible, if all the fund were raised by a loan with 6.5% of interest rate, or that the investor could expect the same amount of return, or given the loan condition assumed in this report, the project would be feasible if the most portion of the project fund were procured by this loan.

Based on the above, the project itself can be regarded as feasible.

13.3.4 Sensitive Analysis

1) Assumption of cases

Sensitive analysis is executed for throe cases as follows:

i. Case A: The Expenditures increase by 10%

ii. Case B: The JRevenues decrease by 10%

2) Results

The FIRR is calculated for each of the two cases. The result obtained are Case A 5.16% and Case B 5.01% as shown in Table 13.3.6. The result of the sensitive analysis proves that each case would be feasible.

13.3.5 Financial Analyses of Bulk Cargo Project

1) ESP

The revenue from the bulk terminal may not increase so much because a considerable portion of the cargo handling operation will be carried out by the private companies concessioned. The expected revenues are from the loading/discharging operation onto/from ships, tugboat service, potable

supply service, fuel supply service and others.

However, the concessions will lead to higher productivity and increase of the total handling capacity of the port.

Judged from the above and low level of investment by ESP, the project will be feasible from financial point of view.

The ESP acts as an coordinator among the concessionners and arranger of cargo handling union affairs. So it is recommendable to examine new tariff system for these services.

2) Puertos Mexicanos

The revenue component of Puertos Mexicanos does not change by the introduction of concession system: entrance dues, berthing dues, wharf usage dues and warehouse dues. The dues of concessionner become the income of Federal Government. This income should be used by the Puertos mexicanos because the initial investment in port facilities could be covered by this income.

Judged from the above and low level of the investment by Puertos Mexicanos, the project will be financially feasible.

Table 13.3.6 Calculated Value of FIRR

Case	FIRR (%)
Base Case	6.58
Case A: Expenditures increase by 10%	5.16
Case B: Revenues decrease by 10%	5.01