Cement) is under construction and will be operated from September of this year. These plants import bulk cement and pack it into bags for sale on the domestic market. The area between the quay wall to cement packing plants is not paved and causes some troubles for truck movement. Pipelines directly connected to cement packing plants transport bulk cement.

On the east part of the mooring basin, two new jetties are under construction by SLPA. The dimensions of the larger berth are 160m long and 9m deep and will accommodate an 8,000 D.W.T. cargo vessel. The smaller jetty is 86m long and it will be used for small crafts such as a tugboat and working vessels. The construction works are expected to be completed in February of 2001.

Table 4.2.1 shows present port facilities of Galle Port and Figure 4.2.1 shows the layout of Galle Port.

Table 4.2.1 Present Port Facilities of Galle Port

(1) Breakwater

	Length	Type
North	250m	Rubble mount
South	200m	Rubble mount

(2) Warehouse

	No. of Units	Capacity	Floor areas	Average Height	Av. Stacking Height	Remarks
No.1	6	14,244m^3	2,000m^2	8.7m	6.6m	Lease to army
No.2	12	28,488m^3	4,000m^2	8.0m	6.6m	

(3) Berth

	Length	Draught	Apron Width	Remarks
Closenburg Jetty 1	130m	7.3m	7.2m	
Closenburg Jetty 2	130m	7.3m	7.2m	
New Berth 1	160m	9.0m*		Under Construction
New Berth 2	86m	9.0m*		Under Construction For small vessels

Note) * shows depth of the berth

(4) Cargo Handling Equipment

	Number	Capacity
Crane	4 units	100t×1, 25t×1, 7t×1
Forklift	8 units	2.5t×7, 3.5t×1
Grab	13 units	3t×4, 2t×9

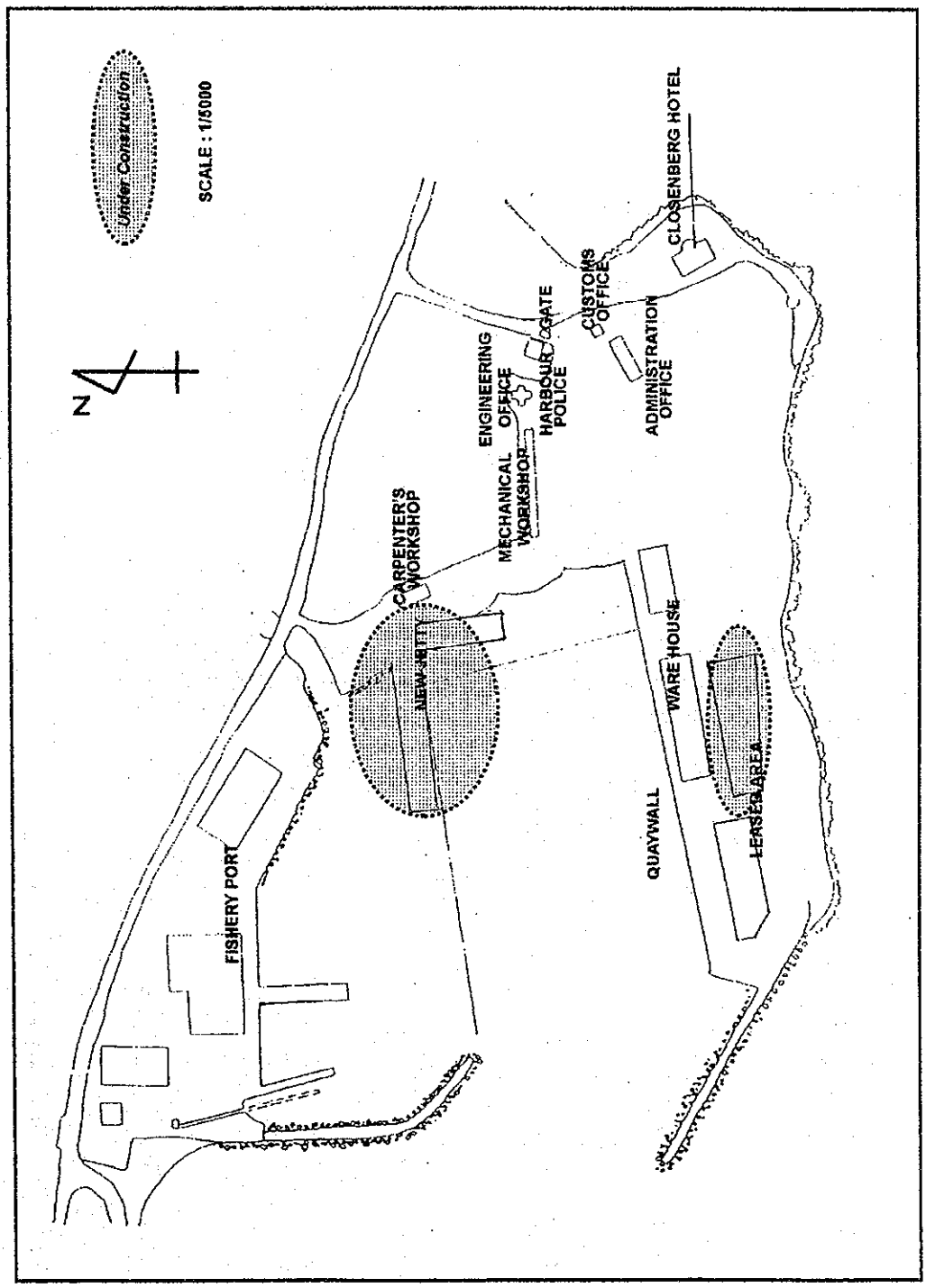


Figure 4.2.1 Layout of Galle Port

4.3 Navigation

Pilotage is compulsory for all vessels expect those exempted by the Harbour Master and as no lit navigational aids are provided, channel transit is limited to daylight hours only, basically from 6 a.m. to 6 p.m. As for navigational aides, a bell buoy and 6 other buoys are provided.

The approach channel begins at the location of bell buoy and is about 1.5 miles long and it bends almost at a right angle at the entrance of the Port. The depth of the approach channel is approximately -9.8m and its narrowest part is approximately 135m wide.

A tugboat waits in front of the breakwaters. To enter the Port, a ship has to change its direction by120° in the turning basin. One tug with 2,000 horsepower is available to assist if required. However, the 120° turn to enter the port is usually accomplished on ship's engine only, as the tug finds it difficult to maneuver in the high swell in south west monsoon season outside the breakwaters.

After entering the Port, the vessels are turned 180° on the anchor with assistance of the tug before being berthed. As the width of the inner harbour basin is only 220 - 250m , a 130m overall length restriction on vessels is currently adapted.

4.4 Calling Vessels

The number and the size of calling cargo vessels increased dramatically from 1998, largely due to the increase in the number of bulk carriers and oil tankers. From 1997 to 1999 the number of bulk carriers increased from 20 to 53 while that of oil tankers increased from 2 to 16.

Table 4.4.1 Total Number of Ships Arrived

	Galle Port			All Ports		
Year	No. of Ship	G.T. ('000)	Av. G.T. ('000)	No. of Ship	G.T. ('000)	Av. G.T. ('000)
1990	59	126	2.1	3,089	39,751	12.9
1991	54	158	2.9	3,178	41,503	13.1
1992	74	189	2.6	3,438	45,446	13.2
1993	62	203	3.3	3,631	52,230	14.4
1994	74	265	3.6	3,568	54,978	15.4
1995	69	185	2.7	3,612	57,842	16.0
1996	84	196	2.3	3,857	67,213	17.4
1997	56	173	3.1	4,087	73,080	17.9
1998	104	541	5.2	4,233	79,790	18.8
1999	97	512	5.3	4,339	81,802	18.9

Among 97 calling vessels, 81 vessels were vessels that discharged or loaded cargoes (excluding fishing crafts). Number of vessels more than 10,000D.W.T. is 17, which represents 20% of the total. As the standard dimensions of 10,000 D.W.T are 137m in length and 8.2m in full drought, the

restriction on length (less than 130m) and drought (less than 8.0m) of vessels practically limits the size of calling vessels at Galle Port .

4.5 Cargo Traffic

Table 4.5.1 shows the total cargo volumes handled at Galle Port from 1989 to 1999. Main commodities are bagged cement, bagged flour, bulk cement and clinker. Import of cement has increased sharply since 1998. Flour import by coastal service from Trincomalee Port is constant at the range between 33,000 ~ 48,000 M.T. for the last decade. In addition, fuel oil was transported by Ceylon Petroleum Corporation until May of 1999.

Table 4.5.1 Cargo Throughput of Galle Port

(000 tons)

Commodity	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Tonnage Discharged										
2.Break Bulk										
(1)Cement Bags					9	4		28	52	119
(2)Fertilizer Bags					6					
(3)Flour Bags	43	33	37	47	41	47	48	42	39	34
(6)Rice Bags	3	3	8	10	8					
(12)Other Break Bulk	131		0		12	4	4	1		2
(Sub-total)	178	36	45	57	76	55	52	71	91	155
3.CARGO-Dry Bulk										87
(1)Cement										
(2)Clinker			148	175	197	168	177	101	280	174
(4)Gypsum			9	6	15	12	4	4	11	9
(7)Other Dry Bulk		158								
(Sub-total)	0	158	157	181	212	180	181	105	291	270
4.Liquid Bulk										
(2)Fuel Oil			35	17	7	1	1	5	20	13
(Sub-total)	0	0	35	17	7	1	1	5	20	13
TOTAL DISCHARGED	178	194	236	255	295	236	234	181	402	438
Tonnage Loaded										
2.Break Bulk										
(5)Other Break Bulk	1				7	2	2	1		1
(Sub-total)	1	0	0	0	7	2	2	1	0	1
TOTAL LOADED	1	0	0	0	7	2	2	1	0	1
TOTAL TONNAGE	179	194	236	255	301	238	236	182	402	439

Source: SLPA

4.6 Management and Operation

4.6.1 Organization of Sri Lanka Ports Authority

SLPA was established in 1979 under the provisions of the Sri Lanka Ports Authority Act, No. 51 of 1979. According to the Act, main duties of the Ports Authority are to provide port services efficiently, control port activities regularly and manage the ports to be self supporting.
Galle Port is one of the three major ports under SLPA, consists of 7 sections and is managed by the Resident Manager.

4.6.2 Management

There are two existing berths which handle cargoes of Southern Provinces.
Infrastructure and fundamental service facilities are owned and operated by SLPA. However, in case of bulk cargo such as oil and cement, port users rent the land from SLPA and operate their own facilities.

4.6.3 Working Condition and Employment

Working hours at the port office is confined to daytime and that of operational section is 2 shifts including nighttime. Number of employees at SLPA is around 19,000, while that at Galle Port is 760.

4.6.4 Operation

Mechanization of cargo handling is applied to bulk cargo. Bulk cement is transported through pipes and bulk clinker is operated with crane, bulldozer and dump truck. Other bagged cargoes are handled and stacked by manual operation.

4.6.5 Document Control System at Galle Port

All documents necessary for removal of vessel are controlled by Asst. Harbour Master.
And necessary documents for cargo delivery are controlled by operational section with agreement by finance section and the Customs.

4.6.6 Customs Clearance

Customs officers at Galle carry out Customs clearance and conduct necessary inspection.

4.6.7 Current Issues and Problems at Galle Port

The current management and operation system at Galle Port is old fashioned. Areas where improvement is necessary are identified as follows:

(1) Certain essential procedures such as bonding are presently handled in Colombo. Necessary formalities in this connection should be decentralized.

(2) High efficiency vessels do not call a port mainly because the time lags in loading and discharging. As a result only old vessels call and crane operation is not speedy. That is obviously a vicious circle.

(3) The present working system is 2 shifts and the standard operation volume is set up, while the actual handling volume does not exceed this to any significant extent.

(4) Clinker and gypsum are imported as bulk cargo in Galle Port. Room for improvement is observed in terms of the capacity of grab, interval of crane and prevention of cargo overflow etc. due to present use of old vessels and trucks.

(5) Flour and cement are discharged as bagged cargo. In case of bagged cargo, environmental reform and productivity improvement are themes to be improved for achieving an efficient operation.

4.7 Bottlenecks of Galle Port

4.7.1 Shortage of Berths

In recent years, cargo throughput of Galle port has been increasing owing to the rapid increase of import of cement related materials. In addition to this increase, a new packing plant will start operation from September of 2000 and one new cement factory is under construction and will be put into operation in 2002. Even if the new berth begins to operate, the capacity of 3 berths will still be insufficient to handle cargo optimally.

4.7.2 Shallow Draught of Berths

The maximum draught of vessels which can enter the Port is currently limited to 7.3 m. The urgent dredging work is now being carried out and depths of water facilities and berths of the Port will be maintained to –8.9m. This depth can accept vessels of 8m draught which is equivalent to 10,000 DWT vessels. Compared with the standard draught of cargo vessels in international maritime transport, it is shallow and shipping companies and shippers cannot enjoy the scale of economies.

Even in Colombo Port, draught of berths for bulk carriers is limited. The maximum draught is mere 10.4m, which is also behind the international standard.

4.7.3 Restriction on Length of Vessels Calling at the Port

Because of the narrow turning basin, the length of vessels which can enter the Port is restricted to less than 130m. This length is almost equivalent to 10,000 D.W.T. vessel type. This situation also hinders optimum maritime transport.

4.7.4 Increased Waiting Time and Law Cargo Handing Productivity

Because of lack of berths, low cargo handling productivity and increase of cargo handled, the waiting time of vessels for berthing is increasing sharply. The average waiting time per vessel reached 54 hours per vessel in the second half of 1999, which is the double the figure in the first half of 1999.

Gross cargo handling productivity by commodity is shown in Table 4.7.1. These figures show the average productivity which is calculated by discharged and loaded cargo volume divided by berthing hours/days. The productivity of bagged cement is considerably lower than that of Colombo Port which is 50 t / hr / ship and the productivity of bagged flour is lower compared with other bagged cargoes.

Table 4.7.1 Gross Cargo Handling Productivity in 1999

Commodity	t / hr / ship	t / day / ship	Handling Equipment
Bagged Cement	31	748	Ship gear, net sling
Bagged Flour	15	370	Ship gear, net sling
General Cargo	4	95	Ship gear, net sling
Bulky cement	161	3,859	Pipe line
Clinker	45	1,102	Ship gear, grab
Gypsum	45	1,972	Ship gear, grab
Fly Ash	38	916	Ship gear, grab
Fuel Oil	34	818	Pipe line

Source: JICA Study Team

4.7.5 Difficulty of Vessel Maneuvering in South-west Monsoon Season

In the south-west monsoon season high swell reaches the inner Galle Bay. Before entering the port, vessels have to change direction by 120 degrees. When high swell reaches the turning basin in front of the entrance of the Port, a tug cannot assist the vessels to enter the Port and vessels have to change the direction by themselves. And also vessels have to enter the approaching channel at a speed of 6 – 7 knots. Under this condition the stopping distance is not sufficient.

4.7.6 Restriction of Night Navigation in the Approach Channel

Because of lack of light buoy in the approaching channel, navigation of the channel is prohibited at night. At present, the number of vessels calling at Galle Port is limited and the restriction of night navigation doesn't cause any problem. But in the future when the number of vessels becomes large, the introduction of a night navigation system may have to be considered.

4.8 Present Financial Condition

4.8.1 Financial characteristic of SLPA

Colombo Port accounted for 95% of SLPA's total revenue and 96% of its total expenditure in 1999.

The revenue structure of Colombo Port is shown in Table 4.8.1. Cargo Handling charges generated the most revenue, 65% of the total. Local container handling and storage accounted for 49% of the total revenue. On the other hand, only 16% came from transhipment container handling and storage despite the fact that this type of cargo represented 69% of the total handling volume (TEU).

The expenditure structure of Colombo Port is shown in Table 4.8.2. Operational section costs generated the most expenditure, 34% of the total. By item, Personnel costs represented the largest expenditure (32% of the total).

4.8.2 Finance characteristic of Galle Port

Revenues and expenditures from Galle Port represented only 1% of SLPA's total revenues and expenditure.

The revenue structure of Galle Port is shown in Table 4.8.1.The main revenues of Galle Port are derived from handling import cargoes related to cement such as bagged cement, bulk cement, clinker and gypsum. Stevedoring charges generated the most revenue (74% of the total).

The expenditure structure of Galle Port is shown in Table 4.8.2. Most of the expenditure was derived from operation costs (56% of the total). By item, 83% of expenditures were for personnel costs.

4.8.3 Tariff

Revenues of SLPA are based on their tariff. The SLPA's tariff system can be subdivided into 5 sections such as:

- navigation and related services
- stevedoring and harbour tonnage dues
- landing and delivery and shipping
- general services and facilities
- hiring services

Table 4.8.3 provides a summary of the tariff structure.

Charges for navigation and related services include Light dues, Entering dues and so on. The tariff is divided into two rates by 3,000 gross ton of ship.

Stevedoring and harbour tonnage dues include Loading / Discharging, Tonnage dues and etc.

Landing, delivery and shipping tariff is comprised of Wharfage, Wharf handling charge, etc. If

stevedoring work is done by private companies a stevedoring charge is also applicable.

Charges for general services and facilities are for using facilities, and for various.

Hiring services refer to the hiring of forklifts, trucks, cranes, and trailers.

The charge for the transhipment container handling is very low compared to local container handling. The stevedoring charge for transhipment containers is half that of local containers and more over wharf handling and wharfage are not applicant.

Table 4.8.1The revenue stracture of the port of Colombo and Galle(1999)

		Colombo		Galle	
		1,000Rp	%	1,000Rp	%
Port activity	**Navigation,Harbour,Pilotage &Tags**				
	Light dues	210,369		770	
	Entering dues	261,169		3,674	
	Harbour tonnage dues	126,351		11,472	
	Pilotage & detention fees	279,491		2,054	
	Pilot launch charge	0		2,728	
	Tug charge	154,423		2,251	
	Sub-total	1,031,803	7%	22,949	10%
	Port Infrastructure				
	Stream anchorage	5,125		28	
	Dockage	319,349		10,731	
	Warfage-import	285,253			
	Warfage-export	94,655			
	Storage-conventional	536,071	4%		
	Storage-dom container	909,480	6%		
	Storage-trn container	44,502	0%		
	Storage-trn conventional	3,806	0%		
	other	436			
	Sub-total	2,198,677	15%	10,759	5%
	Cargo Handling				
	Container Steve(Dom)				
	Container(load & discharge)	4,269,503			
	Container(shift)	139,004			
	Stuffing, destuffing	76,580			
	other	168			
	Wharf handling	1,030,708		1	
	Sub-total	5,515,963	38%	1	
	Container Steve(Trn)				
	Container(load & discharge)	2,358,915			
	other	13,335			
	Sub-total	2,372,250	16%		
	Conventional Steve(Dom)				
	loading/discharging	1,247,448		135,181	
	Wharf handling	375,301		30,557	
	Sub-total	1,622,749	11%	165,738	74%
	Conventional Steve(Trn)				
	Convent (Load/Discharge)	8,083	0%		
	Total	9,519,045	65%	165,738	74%
	Other service	215,360	1%	0	0%
Other		39,787	0%	2,262	1%
Port Estate(Rent/Leases)		75,506	1%	9,167	4%
Financial		1,327,879	9%	14,619	6%
From SAGT		143,823	1%	0	
All-total		14,551,880	100%	225,495	100%

Source: Sri Lanka Port Authority

Table 4.8.2 The expenditure stracture of the port of Colombo and Galle(1999)

		Colombo		Galle	
		1000Rs	%	1000Rs	%
Operation					
	Wage,salaries & allowance	1,598,107		96,212	
	Fuel, Electricity, etc	239,442		754	
	Depreciation	2,049,708		6,458	
	Maintenance	17,428		3,036	
	other	20,976		0	
		3,925,661	34%	**106,460**	56%
Maintenance					
	Wage,salaries & allowance	1,003,551		26,135	
	Fuel, Electricity, etc	15,431		103	
	Depreciation	36,806		422	
	Maintenance	540,425		1,449	
	other	27,172		0	
		1,623,385	14%	**28,109**	15%
Administration					
	Wage,salaries & allowance	1,057,788		35,840	
	Fuel, Electricity, etc	123,990		5,060	
	Depreciation	439,947		2,305	
	Maintenance	62,345		1,136	
	Welfare	46,199		2,172	
	other	1,028,131		9,226	
		2,758,400	24%	**55,739**	29%
All section					
	Wage,salaries & allowance	3,659,446	32%	158,187	83%
	Fuel, Electricity, etc	378,863	3%	5,917	3%
	Depreciation	2,526,461	22%	9,185	5%
	Maintenance	620,198	5%	5,621	3%
	Welfare	46,199	0%	2,172	1%
	other	1,076,279	10%	9,226	5%
		8,307,446	72%	**190,308**	100%
Interest of foreign loans		**1,008,379**	9%	**0**	0%
Tax		**2,209,730**	19%	**0**	0%
Total		**11,525,555**	100%	**190,308**	100%

Source: Sri Lanka Port Authority

Table 4.8.3 Tariff Structure of SLPA(2000) for Galle Port

Section	Type of Tariff	Charging Base		Tariff(in US$)		Remarks
Navigation and Related Service	**Light Dues**	per 100GT		3.40		
	Entering Dues	per 100GT		4.55		Over hour dues should be paid in addition
	Over Hour Dues	per 100GT		2.30		Over 96h to 288h
	Pilotage (in and out)	per 100GT		4.55		There are cancellation and detention fees
	Professional Pilot Fees	per movement		24.00(day) 36.00(night)		Vessels up to 30,000DWT
	Tug service	per tug movement		161.00		
	Dockage	per 100GT per hour		0.22		There is a penalty charge occupying a berth after completion discharging / loading.
Stevedoring and harbour Tonnage Dues	**Container Handling Domestic** Discharging / loading	Per box		20feet	40feet	By SLPA gantry
			Laden	140.00	212.00	
			Empty	118.60	179.20	
			Laden	100.00	151.00	By ship's gear
			Empty	79.95	121.20	
	Storage on containers	Per box day	Empty	6.95	13.85	3days free after up to 31days
			Laden Export	5.20	10.40	7days free
	Container Transhipment Transhipment / re-stow container composite stevedorage	Per box		71.30	109.50	
	Bagged & General cargo Discharging / loading	Per ton		3.10 4.40 1.75		Non irritant Irritant flour on coastal services
	Bulk cargo Dry bulk (manual) (Mechanical) Liquid by pipeline	Per ton		5.00 2.00 – 5.00 0.35		Depend on daily average output
	Harbour Tonnage Dues	Per box	Import Export	8.00	16.00	For container
			Coastal	4.00	8.00	
		Per ton	Import Export	0.40		For conventional
			Coastal	0.20		

Section			B/B LCL Per ton	FCL 20feet per box	FCL 40feet per box	
Landing & Delivery and shipping	**Wharf handling charge**					
	Grain & grain products and sugar in bag	Import Export	0.29 0.92	8.70 27.60	17.40 55.20	
	Fertilizer in bag and milk food	Import	0.47	14.10	28.20	
	Tea, natural rubber, Coconut & coconut products	Export	0.51	15.30	30.60	
	Textile, hang garments	Import Export	1.59 1.72	47.70 51.60	95.40 103.20	
	All other cargo	Import Export	0.85 0.92	25.50 27.60	51.00 55.20	
	Wharfage	Import Export	0.22 0.23	6.60 6.90	13.20 13.80	There are some exception about petroleum products

Source: Tariff 2000 by Sri Lanka Port Authority

Part 2 SHORT-TERM DEVELOPMENT PLAN

Chapter 5 Development Potential in the Southern Area

There already exist a certain agglomeration of economic activities and there is potential for natural, cultural and human resources to be further developed. In this regard, increasing production and employment through optimum use of existing and indigenous resources should be the foremost priority. In addition, introduction of external resources to develop industries as a driving force for regional development and to produce goods primarily for exports should be another priority.

5.1 Regional Development Policy

Objectives of the southern area development should be stressed as follows.

- To reduce the regional disparity and the various demerits and inconveniences such as congestion and migration caused by an excessive concentration of economic activities in Colombo District and its vicinity, and to contribute to well balanced national land development.

- To strengthen the economic ties with the Colombo region by burden sharing with the region, and to serve as a driving engine to contribute to realizing an open and competitive economy the context of globalization.

To achieve the objectives, strategies for the southern area development should be pursued as follows.

(1) For the enhancement of production and employment through optimum use of existing natural and human resources, local small/medium manufacturing industries such as tea production and garments as well as tourism industry which have a relatively large potential in the area should be further developed.

(2) More sophisticated, demand and market driven and value-added oriented industries such as electronics and automobile rather than conventional ones should be accelerated.
To make it easier to introduce these rather new industries in the region, further incentives for private sector participation should be taken into account.

(3) Improving accessibility to the Colombo region is crucial for creating a symbiotic economic relationship. Infrastructure development, especially in the fields of road network, electricity and telecommunications, is of utmost importance to cope with the requirements.

(4) Development of port facilities in the area which directly connect the area and the outer world is, needless to say, urgently needed.

The Sri Lanka Government has paid serious attention to the southern area development. The Government has stipulated the various short and medium term development and/or investment plans.

5.2 Future Trends in Major Sector Development

SDA predictions of sector contribution in the area in short term are given in Table 5.2.1. The analysis indicates a significant increase in manufacturing Contribution from other sector shows a decline by the end of the plan period

Table 5.2.1 Southern Area Output – Composition of Sector Contribution

SECTOR	1999	2000	2001	2002
Agriculture	26.1	24.9	24.5	24.0
Mining	1.0	1.4	1.4	1.5
Manufacturing	11.8	14.1	14.3	14.9
Consruction	9.1	8.9	8.8	8.8
Transport & Communication	9.6	9.4	9.4	9.3
Electricty & Gas	1.8	1.8	1.9	1.9
Trade	20.3	19.8	19.7	19.6
Banking	8.0	7.9	8.2	8.3
Other Services	12.3	11.8	11.8	11.7
Total	100.0	100.0	100.0	100.0

Some typical projects that might seriously affect the regional development are given below.

5.2.1 Agriculture

The Plantation Reform Project provides long-term loans to privatized plantation companies and helps improve environmental conditions in the project area including Galle and Ratnapura Districts. The total investment for 1999-2001 is Rs. 6466 million. Target output is estimated in replanting 1,050 ha of tea, 2040 ha of rubber and 930 ha of coconut, while yield is expected to increase by 35%, 25% and 60% respectively.

5.2.2 Industry

1) Industrial Estate Development Programme

As one of the three supra-class industrial estates project, a special industrial estate for the tannery and leather processing industries has been established on 105 acres of state land at Bata-atha in Hanbantota District. Project cost estimated at Rs. 210million will be funded with UNDP and NORAD aid.

2) Koggala EPZ

In addition to the 15 existing enterprises in Koggala EPZ, 17 newly approved projects, 6 of which are expansion projects of existing enterprises, will commence shortly. As indicated in application to BOI, main business of the enterprises is in the field of textile and electronics, and the number of employees in the EPZ is expected to double.

3) 50 Garment Factory Programme

The 50 Garment Factory Programme (50 GFP) announced in 1998 envisages 20 new garment factories in Southern Province and the balance in districts outside the Western and Southern Provinces. The factories set up under this programme are accorded BOI status and are entitled to an attractive package of incentives and concessions. Each project requires a minimum investment of Rs. 20 million and should employ a minimum of 250 employees.

5.2.3 Tourism

(1) Tourism Infrastructure Development Project

To improve existing infrastructure facilities and create a pollution free environment from Marawila (about 15km north to Negonbo in the Western Province) to Unawatuna (adjacent to Galle city) on the west and south coast, a feasibility study on this project commenced in 1999. The project components include; 1) development of water and solid waste disposal systems, 2) Improvement of storm water drainage systems and improvement of roadways, 3) introduction of a systematic garbage disposal system. Estimated total cost is Rs. 522 million to be funded by UNDP and World Tourism Organization.

5.2.4 Other Sector

(1) Energy

1) Development of electricity generation to meet the demand for electricity is sought in the southern area. One of the projects is identified as follows,

   2×20MW Medium Term Power Plants at Matara and Anuradhapura on BOO basis is under negotiation, which is expected to generate 334 GWh per year for the next ten years.

2) Transmission and Grid Substation Development Project with JBIC assistance will cover the construction of some grid substations including in Ambalangoda and Galle in Galle District and a new 132 kV Line will be installed connecting to Galle City as well.

(2) Telecommunication

Rural Telecommunications Development Project in Galle District will be implemented with collaboration from SIDA for the supply, installation and commissioning of a fixed wireless local and telephone service for more than 1500 subscribers.

5.2.5 Transportation

1) Southern Highway Construction Project (Southern Transport Development Project)

To provide a bypass to the existing Galle Road (A2 Road), which suffers from deteriorating traffic and safety conditions, and to provide a catalyst for development in the economically deprived the southern area, a construction project of a new highway, linking Colombo with Galle and Matara has been planned. The project will be co-financed by the Japan Bank for International Cooperation (JBIC) and the Asian Development Bank (ADB), and it consists of the following components, namely; four lanes road of 33 km from Kottawa (south east of Colombo) to Dogangoda out of 75 km of JBIC portion, and 53km of ADB portion of two lane road to Matara including 4km of Galle port access road. Total investment is estimated at Rs. 21.3 billion or about US$ 300 million and opening of the highway is expected before 2005.

Realization of the project would bring about huge effects on the southern area as follows,

- Promotion of socioeconomic development in the south area

- Provision of an alternative route to reduce traffic congestion, travel time, vehicle-operating costs and accidents for road users on the existing Colombo-Galle-Matara road

- Developing the hinterland through improvement of transport facilities

This project would expand the probability that some portion of cargo handling will be shifted from Colombo Port to Galle Port after completion of the latter port cum the Highway due to the benefits mentioned above.

Chapter 6 Demand Forecast

When conducting demand forecast, the entire cargo volumes through the three major ports, viz. Colombo, Galle and Trincomalee, were first estimated on a commodity-wise basis and then the volumes of cargo to be potentially handled at Galle Port were determined. For cargoes generated from or destined to the Southern Area most were allocated to Galle Port (long-sea-route container cargoes were excluded.) due to its economical inter-modal transport options. The capacity of Colombo in conventional cargo handling was also taken into account, though it seems unlikely to be saturated before the year 2009 if Galle Port is developed.

6.1 Future Socioeconomic Framework

6.1.1 Population

(1) Sri Lanka

Future population figures are adopted from the "Demographic Projections for Sri Lanka Dec.1998" by Population Information Center, Ministry of Health and Indigenous Medicine.

Table 6.1.1 Population in 2005 and 2010 in Sri Lanka

(In thousands)

Year	2005	2010
Population	20,151	21,028

Table 6.1.2 Future Growth Rate of Population in Sri Lanka

Year	1998-2005	2005-2010
Growth Rate	1.01 %	0.86 %

(2) Southern Province

The share of population in the Southern Province compared to that of the whole of Sri Lanka was constant and approx.13 % from 1989 to 1998 as shown in Table A.6.1. Therefore, a growth rate comparable to that of the national population is adopted for the Southern Province. Future population in the Southern Province can be estimated using the adopted growth rate.

Table 6.1.3 Future Population in 2005 and 2010 in the Southern Province

(In thousands)

Year	2005	2010
Population	2,618	2,733

Table 6.1.4 Future Growth Rate of Population in the Southern Province

Year	1998-2005	2005-2010
Growth Rate	1.01 %	0.86 %

6.1.2 Gross Domestic Product (GDP)

(1) Sri Lanka

The GDP growth rate forecast in the "Six Year Development Programme 1999-2004 / Macro Framework & Sector Review in Nov.1998" by National Planning Department, Ministry of Finance and Planning, and "Master Plan Study for Industrialization and Investment Promotion in the Democratic Socialist Republic of Sri Lanka in Aug. 1999" by JICA / Ministry of Industrial Development are similar and more realistic than other available forecasts. Therefore, the future annual growth rate of GDP in Sri Lanka is estimated based on the forecast by JICA / Ministry of Industrial Development as shown in Table 6.1.5.

Table 6.1.5 Future Annual Growth Rate of GDP

Year	1998-2005	2005-2010
Growth Rate	6.2%	7.2%

The future GDP at 1990 constant prices in 2005 and 2010 is shown in Table 6.1.6, based on the past records provided by the National Planning Department, Ministry of Finance and Planning in Sri Lanka.

Table 6.1.6 Future GDP at 1990 Constant Prices in 2005 and 2010

(Rs. Million)

Year	2005	2010
GDP	730,800	1,034,600

The future GDP and sectorial GDP at 1982 constant prices in 2005 and 2010 are shown in Table 6.1.7, based on the "Master Plan Study for Industrialization and Investment Promotion in the Democratic Socialist Republic of Sri Lanka, Aug. 1999" by JICA / Ministry of Industrial Development.

Table 6.1.7 Future GDP and Sectorial GDP at 1982 Constant Prices

(Rs. Million)

Year	2005	2010
GDP(Total)	297,916	423,743
Agriculture	40,793	44,424
Manufacturing Industries	72,396	119,260
Non-Manufacturing Industries	28,492	40,112
Services	156,235	219,947

(2) Southern Province

It is assumed that the future annual growth rate of the GDP in the Southern Province will follow a pattern similar to that of Sri Lanka with a variation of 0.5 %, which is the same difference observed between the growth rate in Sri Lanka and that of the Southern Province in the last decade.

Table 6.1.8 Future Annual Growth Rate of GDP

Year	1998-2005	2005-2010
GDP	6.7%	7.7%

The provincial GDP at 1990 constant prices in 2005 and 2010 is estimated as follows.

Table 6.1.9 Future Provincial GDP at 1990 Constant Prices in 2005 and 2010

(Rs. Million)

Year	2005	2010
GDP	73,560	106,591

6.2 Methodology of Cargo Demand Forecast

Future cargo demand is forecasted as follows.

- Import/Export cargo volumes in Sri Lanka are forecasted based on the "Port Statistics Sri Lanka" by Sri Lanka Ports Authority.
- Future cargo demand in Sri Lanka is estimated as a whole. Then, the forecast cargo volumes are allocated based on the roles/functions of Colombo and Galle Port.

6.3 Forecast Cargo Volumes

Import/export cargoes are categorized as non-containerizable cargoes and containerizable cargoes. Containerizable cargoes comprise break bulk cargoes which might be handled as container cargoes. The future import/export cargo volumes are estimated based on the following ideas.

- The future import containerizable cargoes in Sri Lanka will correlate with the future GDP in Sri Lanka.
- The future export containerizable cargoes in Sri Lanka will be in line with the growth rate for the last decade.
- The volumes of major commodity in export container cargoes are estimated using an elastic value which is calculated based on the difference between rate of the export volumes and the GDP of countries to which these commodities are exported from Sri Lanka.
- The future export cargo volumes handled at Galle Port are estimated using the short sea route ratio, which is obtained by analyzing detailed container cargo movement at Colombo port.

The volumes of container cargo and the number of containers are forecasted using the following procedure:

- Selection of containerizable cargoes
- Estimation of the ratio of container cargoes to containerizable cargoes
- Estimation of the volumes of container cargoes and the number of containers

The ratio of container cargoes to containerizable cargoes and the cargo volumes handled at Galle Port by commodity are shown in Table 6.3.1 and Table 6.3.2 respectively.

Table 6.3.1 Ratio of Containerization

		Import(%)	Export(%)
Past Trend	1990	58.99	68.75
	1991	60.66	69.02
	1992	60.40	78.63
	1993	65.11	83.55
	1994	67.63	82.82
	1995	85.12	90.15
	1996	80.46	89.25
	1997	87.63	96.06
	1998	88.02	93.17
	1999	90.96	93.42
Estimate	2005	97.49	98.79
	2010	99.23	99.65

Table 6.3.2 Cargo Volumes at Galle Port by Commodity

(Unit: '000 M.T.)

	2005	2010
(Import)		
1.Non Containerizable		
- Sugar	87	96
- Fertilizer	119	129
- Cement	500	700
- Clinker	475	950
- Gypsum	25	50
- Iron/Steel	36	61
- Maize	27	33
Subtotal	1,269	2,019
2.Containerizable		
- Break Bulk Cargo	0	0
- Container Cargo	158	205
Subtotal	158	205
Import Total	1,427	2,224
(Export)		
1.Containerizable		
- Break Bulk cargo	1	1
- Container Cargo	112	148
Export Total	113	149
(Coastal Service)		
- Flour	105	109
- Petroleum Product	20	20
Coastal Service Total	125	129
Grand Total	1,665	2,502

The cargo volumes by handling mode are shown in Table 6.3.3.

Table 6.3.3 Cargo Volumes at Galle Port by Handling Mode

	2005	2010
(Import)		
Non Containerizable ('000 M.T.)	1,394	2,148
Cotainerizable		
Break Bulk ('000 M.T.)	0	0
Container ('000 M.T.)	158	205
Laden ('000 TEU)	11.8	15.3
Empty ('000 TEU)	2.3	2.9
Total ('000 TEU)	14.0	18.2
(Export)		
Containerizable		
Break Bulk ('000 M.T.)	1	1
Container ('000 M.T.))	112	148
Laden ('000 TEU)	9.3	12.3
Empty ('000 TEU)	4.7	5.9
Total ('000 TEU)	14.0	18.2
(Total)		
Non Containerizable ('000 M.T.)	1,394	2,148
Containerizable		
Break Bulk ('000 M.T.)	1	1
Container ('000 M.T.)	270	353
Laden ('000 TEU)	21.1	27.6
Empty ('000 TEU)	7.0	8.8
Total ('000 TEU)	28.0	36.4

Graphical charts and a summary table of the import/export cargo volumes in future including Port Statistics in the last decade are shown in Table 6.3.4, Figure 6.3.1 and 6.3.2 respectively.

Table 6.3.4 Port Cargo Handling in Sri Lanka and at the Port of Galle

	Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Growth Rate %	2005	Growth Rate %	2010
1.Socioeconomic Index												(1990-1998)		(1998-2005)	
(1)Population															
- Sri Lanka	Thousand	16,993	17,247	17,405	17,619	17,865	18,136	18,315	18,552	18,774		1.23	20,151	1.01	21,028
- Southern Province	Thousand	2,207	2,239	2,268	2,299	2,330	2,374	2,388	2,415	2,440		1.25	2,618	1.01	2,733
(2)GDP Growth Rate															
- Sri Lanka	(%)	6.2	4.8	4.4	6.9	5.6	5.5	3.8	6.4	4.7		5.28		6.2	
- Southern Province	(%)		12.7	2.4	7.8	2.9	4.8	3.4	6.4			5.73		6.7	
2.Cargo Volume												(1990-1999)		(1999-2005)	
(1) Sri Lanka															
1) Import															
(Non Containerizable Cargo)															
-Wheat	000 M.T.	684	698	707	830	864	1,090	880	779	892	861		1,240		1,294
-Sugar	000 M.T.	287	388	372	382	343	431	385	547	333	472		604		673
-Fertilizer	000 M.T.	497	428	338	478	444	523	472	395	480	526		659		719
-Cement/Clinker	000 M.T.	425	362	558	938	1,131	1,398	1,315	1,398	1,676	1,998		3,748		6,209
-Gypsum	000 M.T.	0	0	9	27	40	44	43	34	53	26		67		111
-Iron/Steel	000 M.T.	0	0	0	0	0	167	216	204	251	225		362		596
-M/Vehicle	000 M.T.	0	0	0	0	0	54	43	54	77	71		104		148
-Maize	000 M.T.	0	0	0	0	0	62	77	72	107	106		204		256
-Others	000 M.T.	262	425	349	127	103	18	6	0	5	23		25		25
Subtotal	000 M.T.	2,155	2,300	2,333	2,782	2,925	3,787	3,437	3,483	3,874	4,308	8.0	7,013	8.5	10,031
(Containerizable cargo)															
-Break Bulk Cargo	000 M.T.	649	631	771	750	779	323	490	346	382	285		130		60
-Container Cargo	000 M.T.	933	973	1,176	1,400	1,628	1,847	2,018	2,450	2,806	2,866		5,045		7,758
Subtotal	000 M.T.	1,582	1,604	1,947	2,150	2,407	2,170	2,508	2,796	3,188	3,151	8.0	5,175	8.6	7,818
-No. of Container	TEU	87,917	95,197	107,033	127,405	146,636	165,158	179,632	209,973	237,570	256,776		448,200		689,240
Laden	TEU	66,927	71,434	83,851		122,048	137,550	145,856	177,008	202,757	214,612		376,490		578,960
Empty	TEU	20,990	23,763	23,182		24,588	27,608	33,776	32,965	34,813	42,164		71,710		110,280
Import Total	000 M.T.	3,738	3,903	4,280	4,932	5,332	5,957	5,945	6,279	7,062	7,459	8.0	12,188	8.5	17,849
2) Export															
(Containerizable Cargo)															
-Break Bulk Cargo	000 M.T.	374	380	242	203	248	149	173	69	125	128		33		12
-Container Cargo	000 M.T.	821	844	887	1,031	1,193	1,363	1,436	1,681	1,706	1,816		2,657		3,513
Export Total	000 M.T.	1,195	1,223	1,128	1,234	1,441	1,512	1,609	1,750	1,831	1,944	5.6	2,690	5.6	3,525
-No. of Container	TEU	85,122	92,986	104,898	124,494	142,839	163,096	170,168	206,824	241,128	254,842		448,200		689,240
Laden	TEU	66,545	72,090	76,842		102,871	118,354	121,523	140,909	143,300	151,920		221,420		292,750
Empty	TEU	18,577	20,896	28,056		39,968	44,742	48,645	65,915	97,828	102,922		226,780		396,490
Sri Lanka Total	000M.T.	4,932	5,127	5,408	6,166	6,773	7,469	7,554	8,029	8,893	9,403	7.4	14,878	7.9	21,374
(Excluding Coastal Service, Export of Wheat Bran & Liquid Bulk Cargo)															
(2) Galle Port															
1) Import															
(Non Containerizable Cargo)															
-Sugar	000 M.T.	0	0	0	0	0	0	0	0	0	0		87		96
-Fertilizer	000 M.T.	0	0	0	0	6	0	0	0	0	0		119		129
-Cement	000 M.T.	0	0	0	0	9	4	0	28	52	206		500		700
-Clinker	000 M.T.	0	0	148	175	196	168	177	101	280	174		475		950
-Gypsum	000 M.T.	0	0	9	6	15	12	4	4	11	9		25		50
-Iron/Steel	000 M.T.	0	0	0	0	0	0	0	0	0	0		36		61
-Maize	000 M.T.	0	0	0	0	0	0	0	0	0	0		27		33
-Others	000 M.T.	131	158	0	0	0	0	0	0	0	0				
Subtotal	000 M.T.	131	158	157	181	226	184	181	133	343	389		1,269		2,019
(Containerizable cargo)															
-Break Bulk Cargo	000 M.T.	3	3	8	10	20	4	4	1	0	3		0		0
-Container Cargo	000 M.T.	0	0	0	0	0	0	0	0	0	0		158		205
Subtotal	000 M.T.	3	3	8	10	20	4	4	1	0	3		158		205
-No. of Container	TEU	0	0	0	0	0	0		0	0	0		14,040		18,210
Laden	TEU	0	0	0	0	0	0		0	0	0		11,790		15,300
Empty	TEU	0	0	0	0	0	0		0	0	0		2,250		2,910
Import Total	000 M.T.	134	161	165	191	246	188	185	134	343	392		1,427		2,224
2) Export															
(Containerizable Cargo)															
-Break Bulk Cargo	000 M.T.	1	0	0	0	7	2	2	1	0	1		1		1
-Container Cargo	000 M.T.	0	0	0	0	0	0	0	0	0	0		112		148
Export Total	000 M.T.	1	0	0	0	7	2	2	1	0	1		113		149
-No. of Container	TEU	0	0	0	0	0	0	0	0	0	0		14,040		18,210
Laden	TEU	0	0	0	0	0	0	0	0	0	0		9,330		12,330
Empty	TEU	0	0	0	0	0	0	0	0	0	0		4,710		5,880
3) Coastal Service															
-Flour	000 M.T.	43	33	37	47	41	47	48	43	39	34		105		109
-Petroleum Product	000 M.T.	0	0	35	17	7	1	1	5	20	13		20		20
Coastal S. Total	000 M.T.	43	33	72	64	48	48	49	47	59	47		125		129
Galle Port Total	000 M.T.	178	194	237	255	301	238	236	182	402	440		1,665		2,502

Figure 6.3.1 Import/Export Cargo Volumes in Galle Port

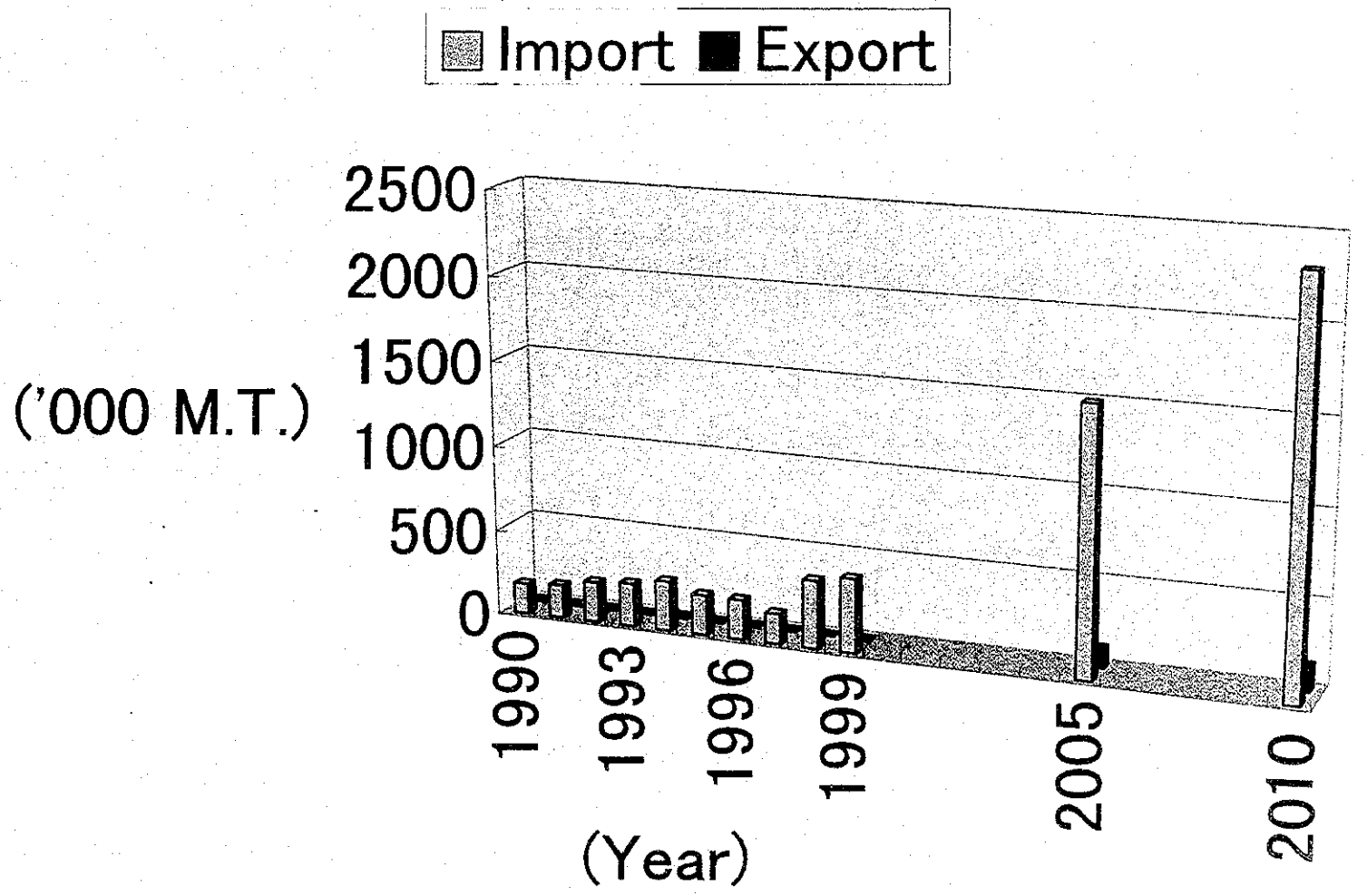
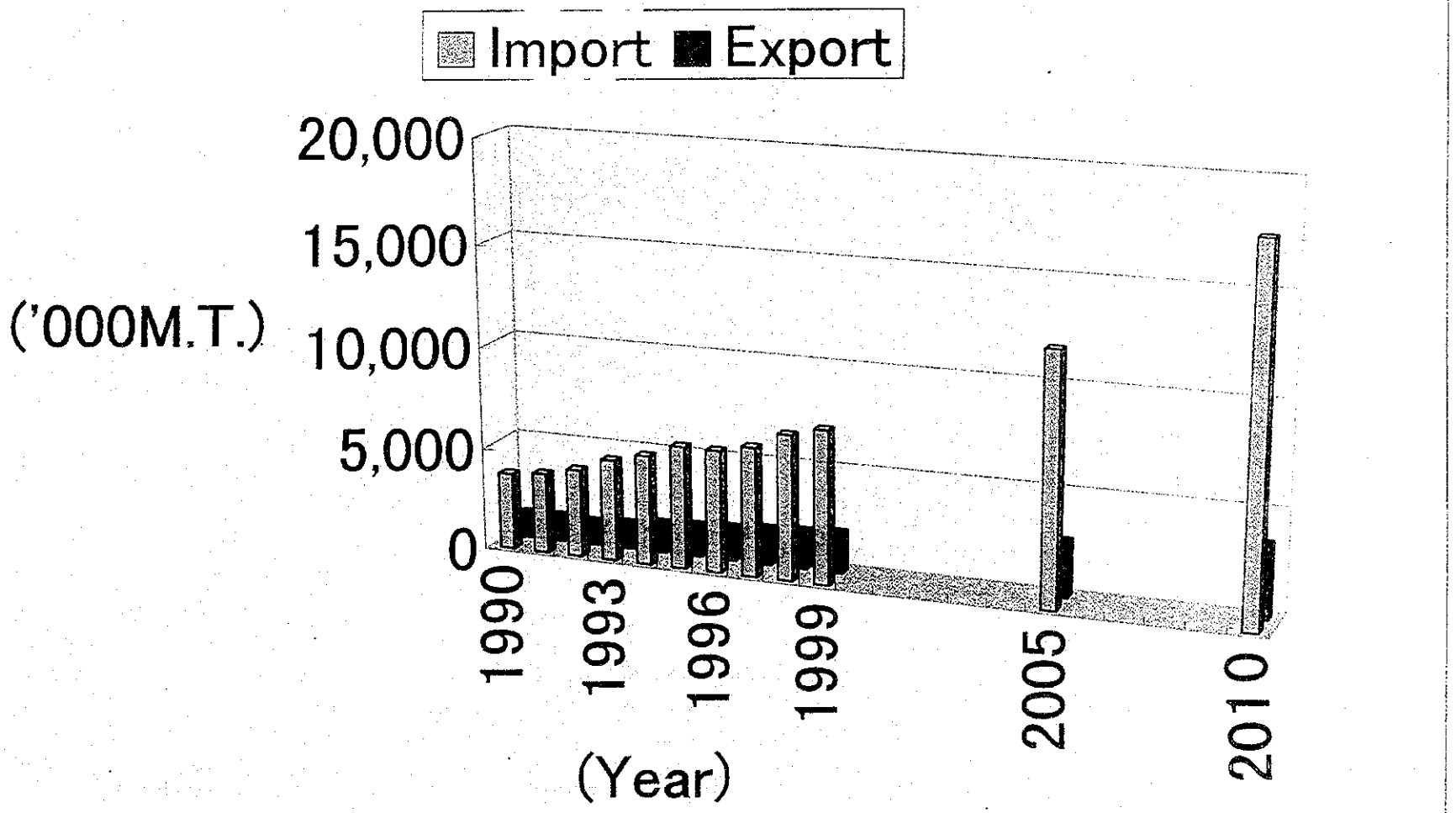


Figure 6.3.2 Import/Export Cargo Volumes in Sri Lanka



Chapter 7 Development Policy of Galle Port

7.1 Development Principle

Principle 1

To meet the demand of cargo traffic by providing an optimum transportation service in the Southern Area in a manner beneficial to the whole nation

As a commercial port in the Southern Area, Galle Port is expected to provide high quality services to meet the present and future demand for cargo traffic which is growing due to the economic and social development of the Southern Area. Due to limited permissible vessel draught, the narrow turning basin and shortage of berths and yard space at Galle Port, it is evident that the present Galle Port is not providing satisfactory services for port users to fulfill the above expectations. The purpose of the Galle Port Development is to meet the present and projected requirements of the Port and consequently to contribute to the regional and the national economy. The potential cargoes to be handled at the new Galle Port are bulky and/or long cargoes such as cement fertilizer and steel products unsuitable for container transport. And local containers from/to the Southern Area which support the regional economy should be included in the potential cargoes.

Principle 2

To function as a catalyst to energize the economic and social development of the Southern Area

To stimulate the economic and social development of the Southern Area, in accordance with the national policy of the Sri Lankan Government, Galle Port could be developed as a front runner. For industrial development, urban development and enhancement of living standards, the Port is expected to function as a catalyst by providing a rational transportation gateway for materials, crops, manufactured goods and consumer goods.

For Galle Port to fulfill this task meaningfully, the promotion of Galle Port and adaptation of appropriate measures to enhance the utilization of the Port are indispensable.

7.2 Purposes of the Development

(1) Enhancing the potential of a bulk cargo distribution base for items such as cement and clinker, fuel, and flour, accommodating large bulk carriers and exploiting its geographical advantage.

(2) Supporting the regional agriculture by providing necessary facilities for import of fertilizer and export of crops.

(3) Supporting the EPZ and industrial estates by providing necessary facilities for import of materials and export of manufactured goods.

(4) Providing necessary facilities for the transportation of food and consumer goods in the hinterland of the Port.

(5) Providing necessary facilities for working crafts such as tugboats, barges and ship chandler's crafts and industries directly related to the Port.

(6) Supporting other activities conducted within the Bay area

1) Maintaining the condition of the present fishery port facilities, to ensure their full utilization
2) Securing some spaces for yacht anchoring now being conducted within the basin

(7) Securing safe navigation in the harbour taking into consideration natural conditions

(8) Connecting the Port to land transportation facilities while avoiding traffic congestion

(9) Consideration of environmental and archeological conservation

(10) Providing employment opportunities for persons in the Southern Area in direct port services as well as numerous ancillary services

Chapter 8 Short-term Development Plan

8.1 Planning Requirement for Main Facilities

(1) Optimum Number of New Berths

Optimum number of new berths is determined by comparison of the total costs consisting of offshore ship waiting cost and new berth construction cost in three cases: construction of one new berth, two new berths, and three new berths. The resulting optimum berth number is two.

(2) Optimum Water Depth of New Berths and Vessel Size

Optimum water depth of new berths is determined by comparison of the total cost consisting of sea transportation cost and new berth construction cost in five cases: depth is set at 10m, 11m, 12m, 13m and 14m respectively. Optimum depth of new berths is 11m and 12m. As deeper berths accommodate larger vessels, berths with 12m depth, which can accommodate 30,000DWT in vessel size under full draft condition, are recommended.

Vessel size for port facilities is as follows

Type of vessel	Cargo Vessel
DWT	30,000DWT
Overall Length	185m
Molded Breadth	27.5m
Full-Load Draft	11.0m

(3) Shed / Open Yard

The required area of sheds and open yards is calculated at 8,000 sq.m and 1 ha respectively.

(4) Container Yard

◆ **Container handling system in container yard**

There are several container-handling systems including those of transfer crane, straddle carrier and forklift. Since there is a limited container volume for the time being, the forklift system, which requires the minimum investment, is recommended.

◆ **Area of container yard**

Required number of slots is calculated based on number of containers at peak time and assumed container stacking system. The result is as follows;

Export and import container	215
Empty container	110

The estimated area of container yard is 2.9 ha.

(5) CFS

Required floor space of CFS is calculated based on the number of containers at peak time. As the required floor space of CFS is small, it is proposed to allocate same space for the CFS cargoes in the new shed to be used mainly for the storage of conventional cargo.

(6) Approach Channel

Two ships will use the approach channel on average per day at the target year. One way channel is enough to handle this traffic level. The proposed width of the approach channel is 160m based on methods proposed by PIANC and UNCTAD.

(7) Turning Basin

Turning basin is to be located in front of new berths and has a diameter of two times of overall length of design vessel.

(8) Main Access Road

The main access road will be constructed from Galle - Matara Road (A2 road) to the new multipurpose terminal through reclaimed land. The traffic volume generated by port activities was estimated and a four lane road is proposed.

8.2 Alternatives of Port Facility Layout Plan

Four alternative port facility layout plans are proposed. There are two main concerns in formulating these alternatives, that is, how to minimize the construction cost and how to harmonize new facilities with the environment.

8.3 Comparison of Alternatives

Comparison of alternatives was carried out on the items such as calmness, navigation safety, disturbing existing port activity, access to inland, future development, cost and harmonization with the environment. As a result, Alternative-1 is recommended as the short-term development plan of Galle Port.

8.4 Other Facilities

(1) Navigational aids

It is proposed that buoys are installed along the approach channel and turning basin so as to allow vessels to enter and departure from the new berths even at night.

(2) Tugboats

One tug with a total of 3,000 ps or two tugs with 1,500 ps each are required for assisting a 30,000 DWT mother vessel. According to information from SLPA, 2 tugboats, which have enough power to move a

30,000 DWT mother vessel, have already been ordered.

(3) Berths for working vessels

Berths for working vessels such as tugboats, barges and ship chandler's crafts are allocated north of the new berths.

(4) Bunkering facility

In the future, after operation of the new berths begins, along with the increase of calling vessels, bunkering service is likely to be required at Galle Port. It is advisable to make a bunkering facility plan upon the request of a possible bunker service operator at the right timing.

8.5 List and layout of Port Facilities

Table 8.5.1 shows the list of main facilities of short-term development plan and Fig. 8.5.1 shows the detailed layout plan of port facilities

Table 8.5.1 List of Main Facilities

Facility	No.	Dimension / Capacity
Multipurpose berths	2	Length 240m, depth 12m
Approach channel	1	One way, width 160m
Turning basin	1	Diameter 240m, depth 12m
Navigational aids	1	5 Buoys, 4 Beacons, 2 Leading light
Berth for small crafts	1	Length 170m, depth 4.5m
Shed	2	4,000 m^2, one story
Open yard	1	10,000 m^2
Container yard	1	2.9 ha
CFS	—	A part of shed is allocated
Outer breakwater	1	Length 800m
Inner breakwater	1	Length 350m
Revetment	4	Length 500m, 350m, 470m, 1,050m
Main road	1	4-lane, 1.2 km
Connecting road	1	2-lane, 300m
Multipurpose crane	1	35 tons
Toplifter	3	2 x 35 tons, 1 x 15 tons
Forklift	8	4 x 8 tons, 2 x 2 tons
Tractor head	10	For container cargo
Trailer	14	For container cargo

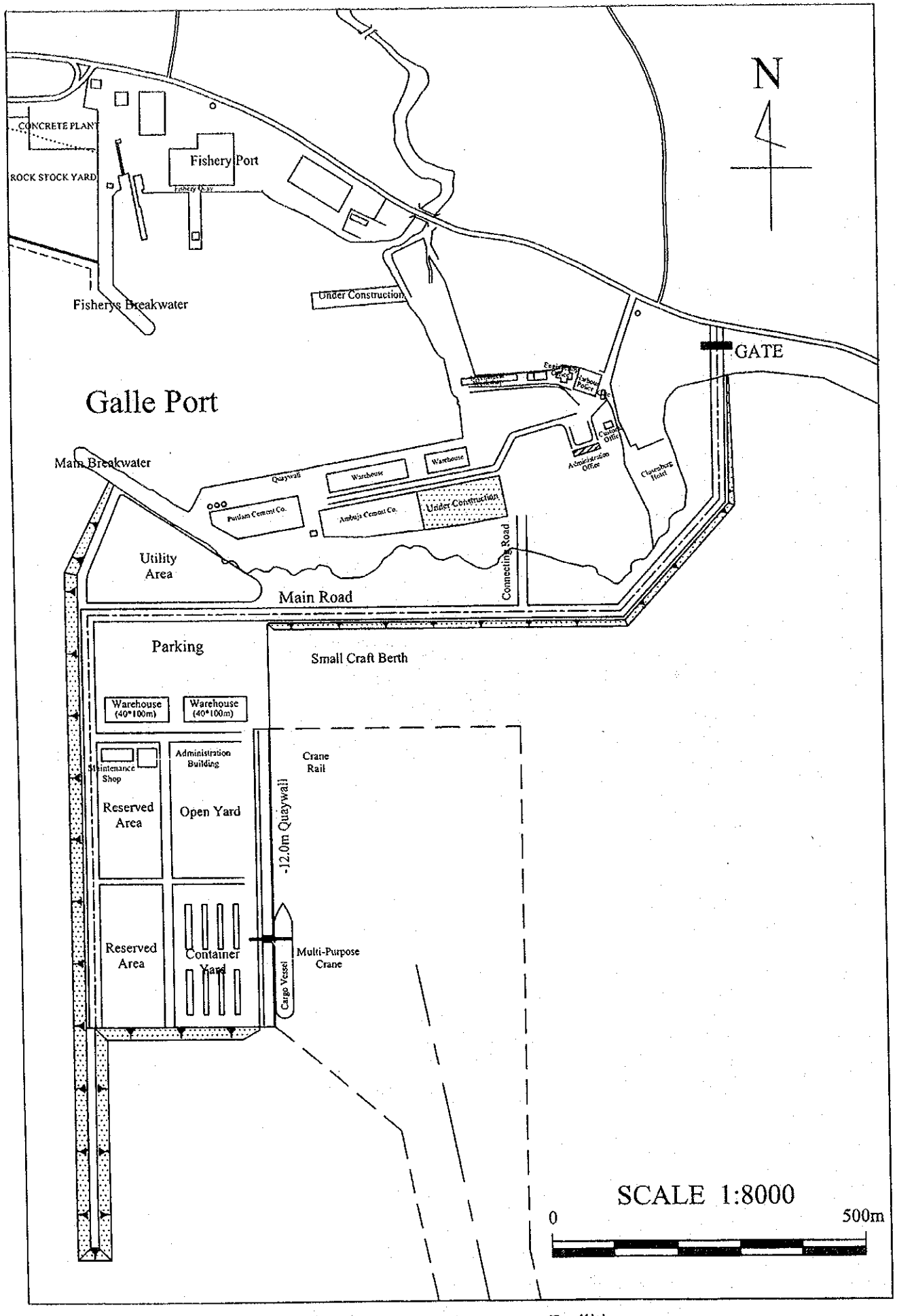


Fig. 8.5.1 Detailed Layout Plan of Port Facilities

8.6 Analysis of In-Harbour Calmness

8.6.1 Condition for Analysis

(1) Determination of Entrance

The typical wave condition for use in the analysis of the in-harbour calmness were chosen from the deepwater wave data. For the typical wave period and height of the value given in Table 8.6.1 which were considered as showing a wave height exceedance frequency of approximately 5% for various wave directions, were established with a view to achieving the target calmness degree of 95%.

Table 8.6.1 Deepwater Wave Parameters for Analysis of In-Harbour Calmness

Wave direction	Wave height (m)	Wave period (sec)
SE	1.50	7.5
SSE	1.50	7.5
S	2.25	10.5
SSW	2.75	11.5
SW	2.75	9.5
WSW	3.00	8.5
W	3.25	7.5

(2) Wave Reflection Rates for Harbour Structure

For the wave reflection rates for the existing and planned structures within the harbour area values were assumed for Case 1 and Case 2 as shown in Table 8.6.2.

Table 8.6.2 Wave Reflection Rates Assumed for Analysis of In-harbour Calmness

Structure	General Value	Assumed Values	
		Case 1	Case 2
Vertical wall	0.7 ~ 1.0	0.9	0.9
Rubble mound	0.3 ~ 0.6	0.5	0.3
Deformed wave-absorbing blocks	0.3 ~ 0.5	0.4	0.3
Natural coast	0.05 ~ 0.2	0.1	0.1

8.6.2 Determination of Degree of In-harbour Calmness for Quayside Cargo Handling

(1) Target Degree of Calmness

The target degree of calmness for the operation of the proposed berths was established as indicated below.

Critical wave height for quayside cargo handling : 0.5 m

Degree of calmness : Over 95%

(2) Calculation Results

Table 8.6.3 and 8.6.4 present the calculation results for the degree of in-harbour calmness for quayside cargo handling in respect of Case 1 and Case 2 considered for wave reflection rate determination.

Table 8.6.3 Degree of In-harbour Calmness for Quayside Cargo Handling under Alternative 1 (Reflection Rates in Case 1)

Deep-water wave height	Berth 1			Berth 2		
	Wave height ratio	Critical deep-water wave height	Exceedance frequency	Wave height ratio	Critical deep-water wave height	Exceedance frequency
SE	0.232	2.15 m	0.00%	0.270	1.85 m	0.01%
SSE	0.278	1.80 m	0.15%	0.308	1.62 m	0.28%
S	0.209	2.39 m	0.58%	0.236	2.12 m	1.61%
SSW	0.167	2.99 m	0.23%	0.197	2.54 m	1.87%
SW	0.112	4.46 m	0.00%	0.145	3.45 m	0.07%
WSW	0.073	6.85 m	0.00%	0.101	4.95 m	0.02%
W	0.040	12.50 m	0.00%	0.060	8.33 m	0.00%
Total			0.96%			3.86%
Calmness (%)			99.04%			96.14%

Table 8.6.4 Degree of In-harbour Calmness for Quayside Cargo Handling under Alternative 1 (Reflection Rates in Case 2)

Deep-water wave height	Berth 1			Berth 2		
	Wave height ratio	Critical deep-water wave height	Exceedance frequency	Wave height ratio	Critical deep-water wave height	Exceedance frequency
SE	0.217	2.30 m	0.00%	0.254	1.97 m	0.00%
SSE	0.256	1.95 m	0.11%	0.289	1.73 m	0.18%
S	0.195	2.56 m	0.16%	0.222	2.25 m	1.06%
SSW	0.156	3.21 m	0.05%	0.187	2.67 m	1.19%
SW	0.104	4.81 m	0.00%	0.137	3.65 m	0.03%
WSW	0.068	7.35 m	0.00%	0.095	5.26 m	0.00%
W	0.037	13.51 m	0.00%	0.056	8.93 m	0.00%
Total			0.32%			2.46%
Calmness (%)			99.68%			97.54%

Chapter 9. Preliminary Design

9.1 Design Criteria

This sub-clause describes the design criteria established on the basis of the data contained in Part I, Chapter 3 Natural Conditions of Coastal Area Adjacent to Galle Bay.

(1) Tidal Level

The tide levels in Galle Port are as given below:

Mean High Water Level	+0.60 m
Mean Sea Level	+0.34 m
Mean Low Water Level	+0.10 m
Datum Level	±0.00 m

(2) Waves

The design wave characteristics with a 50-year return period have been defined as follows:

Direction	Height ($H_{1/3}$)	Height (H_{max})	Period
WSW	6.2 m	10.7 m	12.3 sec

(3) Geology

At the location where the outer and inner breakwaters are to be constructed, sediments are formed to a limited extent and the substratum consists primarily of relatively well graded sand and gravel. At the proposed construction sites of the Multi-Purpose Cargo Wharf, however, the substratum is composed primarily of silty sand and cohesive clay layers (N-value = 0~ 1) of about 10 m thick.

(4) Earthquakes

Earthquakes are not considered in the design of the project facilities.

(5) Wind

A wind speed of 40 m/sec has been adopted for design purposes.

(6) Design Ship Characteristics

The proposed quay will be designed for receiving cargo vessels of 30,000 D.W.T which are 185 m in overall length, 27.5 m in molded breadth, and 11.0 m in full-load draft.

(7) Crown Height of Quay

Basically, the same crown heights as for the existing quays in the Port of Galle will be taken for the

proposed quay structures. Therefore it is designed as +2.50m.

(8) Surcharge on Quay Faceline

The surcharge load considered is in principle 3.0 tons/m^2 (uniformly distributed load). Special cargo handling vehicles and crane wheel loads are considered where appropriate.

Also, bathymetric survey and sonic survey were carried out to utilize these results for our consideration of the layout plan.

9.2 Preliminary Design

(1) Basic Plan of Port Facilities

Preliminary designs have been prepared in respect of the following in Table 9.2.1. The layout plan is shown in Figure 9.2.1.

Table 9.2.1 Proposed Port Facilities

Facilities	Length (m)	Depth of Construction (m)
Breakwater		
Outer breakwater	800	On existing water depth
Inner breakwater	350	On existing water depth
General cargo berths		
Berth 1	240	-12.0 m
Berth 2	240	-12.0 m
Revetment		
Revetment (1)	500	On existing water depth
Revetment (2)	350	On existing water depth
Revetment (3)	470	On existing water depth
Revetment (4)	1,050	On existing water depth

Notes:
1) One unit of multipurpose crane will be installed on the general cargo berth.
2) The breakwaters and all the revetments will be constructed on the existing seabed.

(2) Structural Type of Breakwater

The rubble mound type with concrete block protection was selected for the outer and inner breakwaters with the following factors taken into consideration.

1) With 50-year waves taken for design purposes, their heights are assumed as follows:

For Outer Breakwater :
$H_{1/3}$: 6.2 m
$T_{1/3}$: 12.3 sec
Direction : WSW

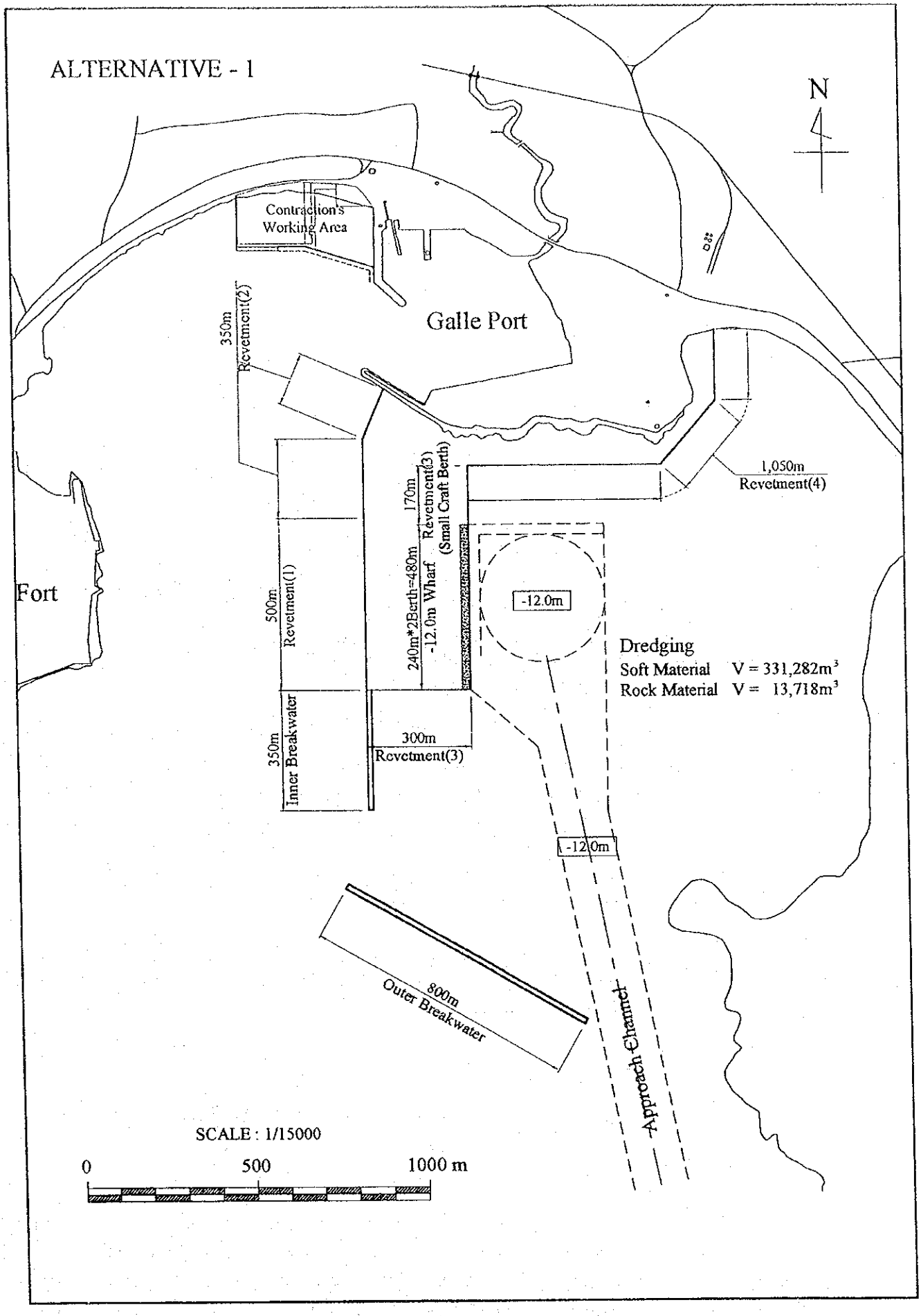


Figure 9.2.1 Port Facility Layout Plan

For Inner Breakwater :

$H_{1/3}$	:	4.9 m
$T_{1/3}$	:	12.3 sec
Direction	:	SW

2) Necessity of rapid construction in non-monsoon periods

3) Necessity of minimizing possibility of having to re-do finished work

4) Necessity of minimizing possibility of wave transmission due to permeability of the breakwater structures

5) Necessity of providing fabrication and temporary storage yards for caissons

6) Necessity of providing fabrication and temporary storage yards for concrete blocks and various sizes of stone

7) Need for maximum possible utilization of materials from local sources

8) Need for cost-effective construction of the breakwater structures

The typical cross section of the outer breakwater is shown in Figure 9.2.2.

(3) Selection of Structural Type for Quays

For the selection of the appropriate structural type for the proposed quays evaluation was made of such factors as structural strength, environmental impact, and the cost, time and relative ease of construction.

The comparative evaluation was undertaken with respect to two alternative types, namely, gravity type quay and piled open type pier, on the following assumptions:

1) In view of the fact that the depth of the bearing stratum generally is a major factor influencing the choice of the construction type of port structures, the available boring data from an area close to the quay construction site were examined.

2) Soft soils will be replaced as necessary.

3) The design water depth is 12.0 m and the design ship size is 30,000 D.W.T.

4) Earthquakes are not considered.

Comparative evaluation was undertaken in terms of the above factors. In consequence, the piled open type pier has been selected primarily in terms of such factors as impossibility of temporary placing and building up of caisson, greater cost-effectiveness, and overall construction schedule. The results of the comparative evaluation are presented in Table 9.2.2.

(4) Revetments for Reclaimed Area

A rubble mound structure (partly armored with wave-breaking blocks) has been selected for the proposed revetments for reasons of the following considerations:

a) Reliability in protecting the reclaimed area against waves and surging storm;

b) Prevention of possible outflow of filling material from the reclaimed area; and

c) Capability of providing greater flexibility in adapting to the uneven ground of the construction site.

The typical cross section of the proposed revetment is shown in Figure 9.2.3.

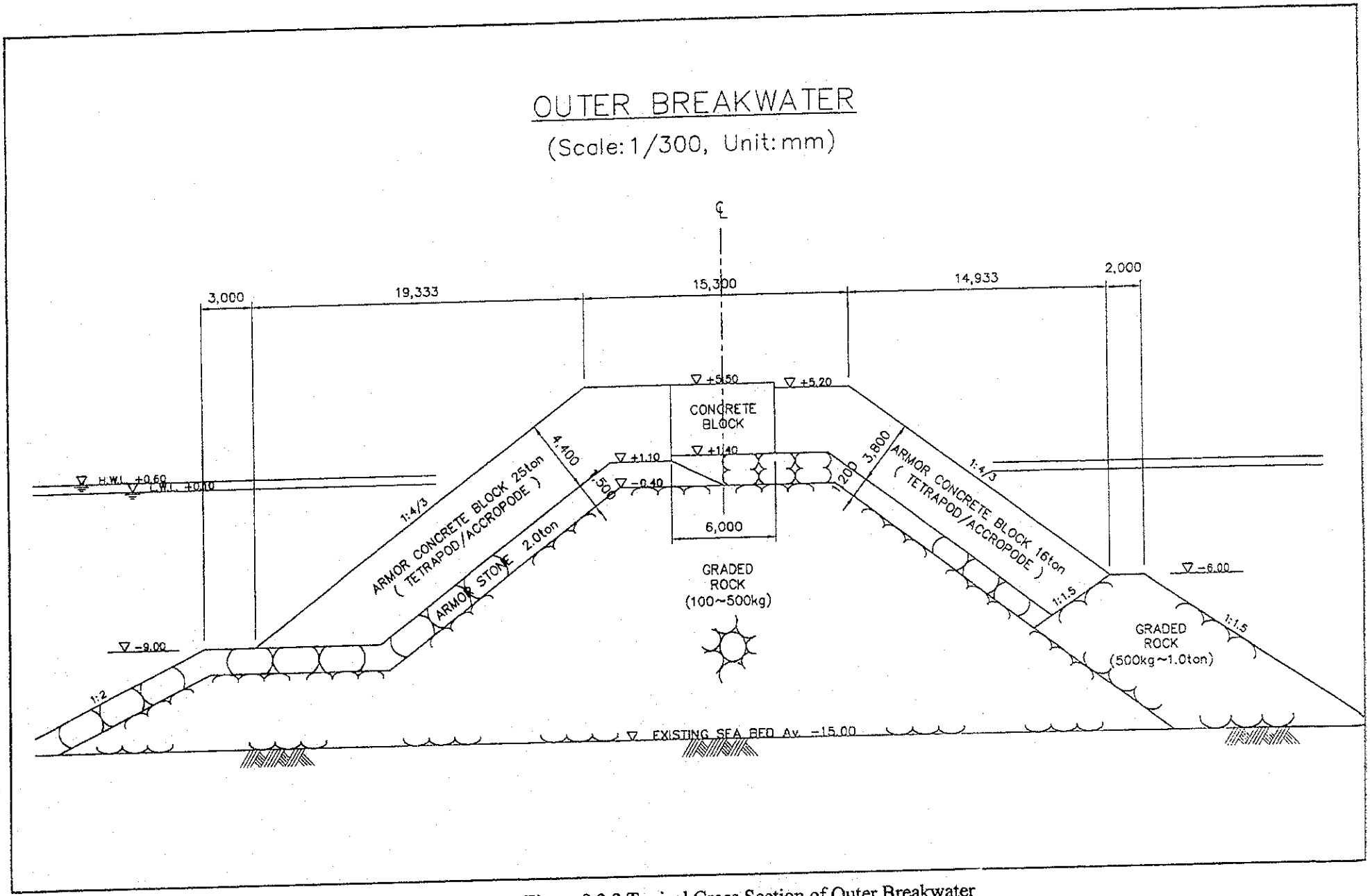
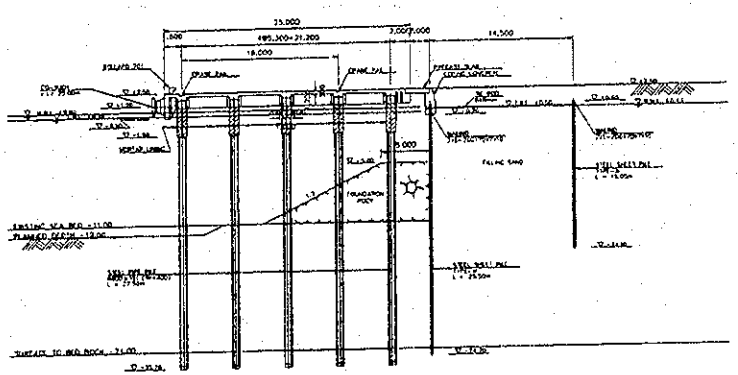
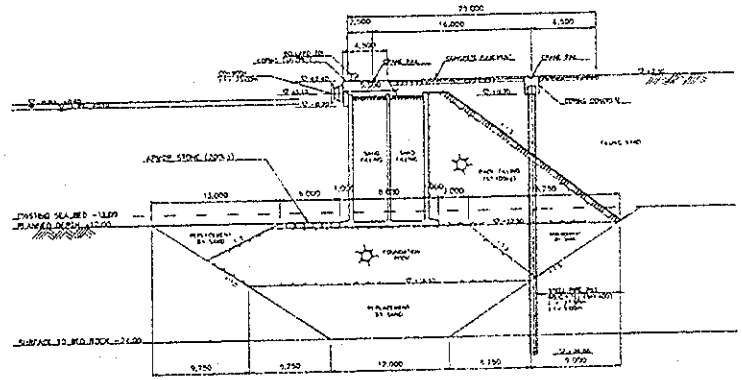


Figure 9.2.2 Typical Cross Section of Outer Breakwater

Table 9.2.2 Comparison of Structural Types for Proposed -12.m Quay in the Port of Galle

	Type A - Piled Open Type Pier	Type B ~ Caisson Type Quay
1. Typical Cross Section		
2. Design Conditions	1) Physical conditions Tide : H.W.L +0.60 , L.W.L ±0.00 Soils: Sandy soil (N =10 , -11.00~-15.00), Cohesive soil (N = 1 , -15.00~-20.00), Cohesive soil (N =11 , -20.00~-21.00). Cohesive soil (N = 9 , -21.00~-24.00) , Weathered rock (N ≧50 , -24.00~) 2) Design ship size: 30,000D.W.T cargo vessel (Loa =185m ,B =27.5m ,Df =11.0m), Fender type: CO-900H, Bitt type: 70T 3) Quay dimensions: Berth length = 480 m (240 m*2); apron width = 25 m; exising seabed level = -11.00 m (design depth = -12.00 m) apron crown level = +2.50 m 4) Loading: Dead load of pier superstructure = 2.0 t/m^2; Fender reaction = 107 tf (V =15cm/s), Tractive force = 70 tf (all directions); Apron superimposed load = 3.0t/m^2 ; crane load during operation = 28 t/wheel (sea side), 27 t/wheel (land side); wheel base : 4; No. of wheels per wheel base: 8	
3. Results of Structural Analysis	· Loading case analyzed : During berthing · Steel pipe pile : φ800×16t , L=27,500 mm · Material of steel pipe pile : SKK400 · Safety factor for pile bearing capacity (compression) : 2.9 > 2.5 (302t) · Max. displacement : 7.6 cm	· Loading case analyzed : At the time of completion of quay (earth pressures assumed to be acting) · Caisson dimensions : 8.0m B×15.0m L×13.5m H · Factor of safety against sliding : 2.5 > 1.3 · Factor of safety against overturning : 4.5 > 1.3 · Bishop factor of safety : 1.45 > 1.2 · Factor of safety against circular slip : 1.38 > 1.3
4. Structural Type	Open type pier supported on vertical steel pipe piles (superstructure formed by reinforced concrete slab system)	Quay constructed of caissons with rubble mound built after removal of soft subsoils by dredging and their replacement with sand.
5. Structural Characteristics	· Bearing capacity can be obtained by driving piles into the bearing stratum. · A retaining wall behind the pier structure will be needed. · Some horizontal displacement will develop duirng berthing of ships. · Effects of reflectd waves will be relatively limited, thus permitting greater ship maneuverability. · Cathodic protection or other appropriate means of maintenance will be required for greater durability.	· Improvement of the soft foundation soils will be needed to provide adequate bearing capacity. · Some residual settlement will develop after soil improvement. · No need for a retaining wall. · The effects of reflected waves will be relatively significant. · Greater durability.
6. Constructional Advantage/Problem		
1) Operational Aspect	· A large fabrication yard will not be necessary. · Reliable pile bearing capacity can be secured through proper control of refusal points. · However, it will be necesary to carry out a detailed pre-driving investigation of the bearing stratum depth. · Field work will be fairly diversified and will involve rather complex procedures of operations.	· A floating dock for caisson production and a quaywall for mooring the dock will be required, but spaces for these facilities can hardly be found in the Port of Galle. · A calm water area required for temporary storage of caissons can hardly be found in the Port. · Rapid execution of the foundation work may increase residual settlement. · Caisson production and foundation work can be carried out simultaneously.
2) Cost	2,971 (Million Yen / Meter)	3,640 (Million Yen / Meter)
7. Maintenance and Repairs	*Cathodic protection will be needed for the steel pipe piles.	No need for maintenance except for repairs which may be necessitated after residual settlement.
8. Overall Evaluation	○	△

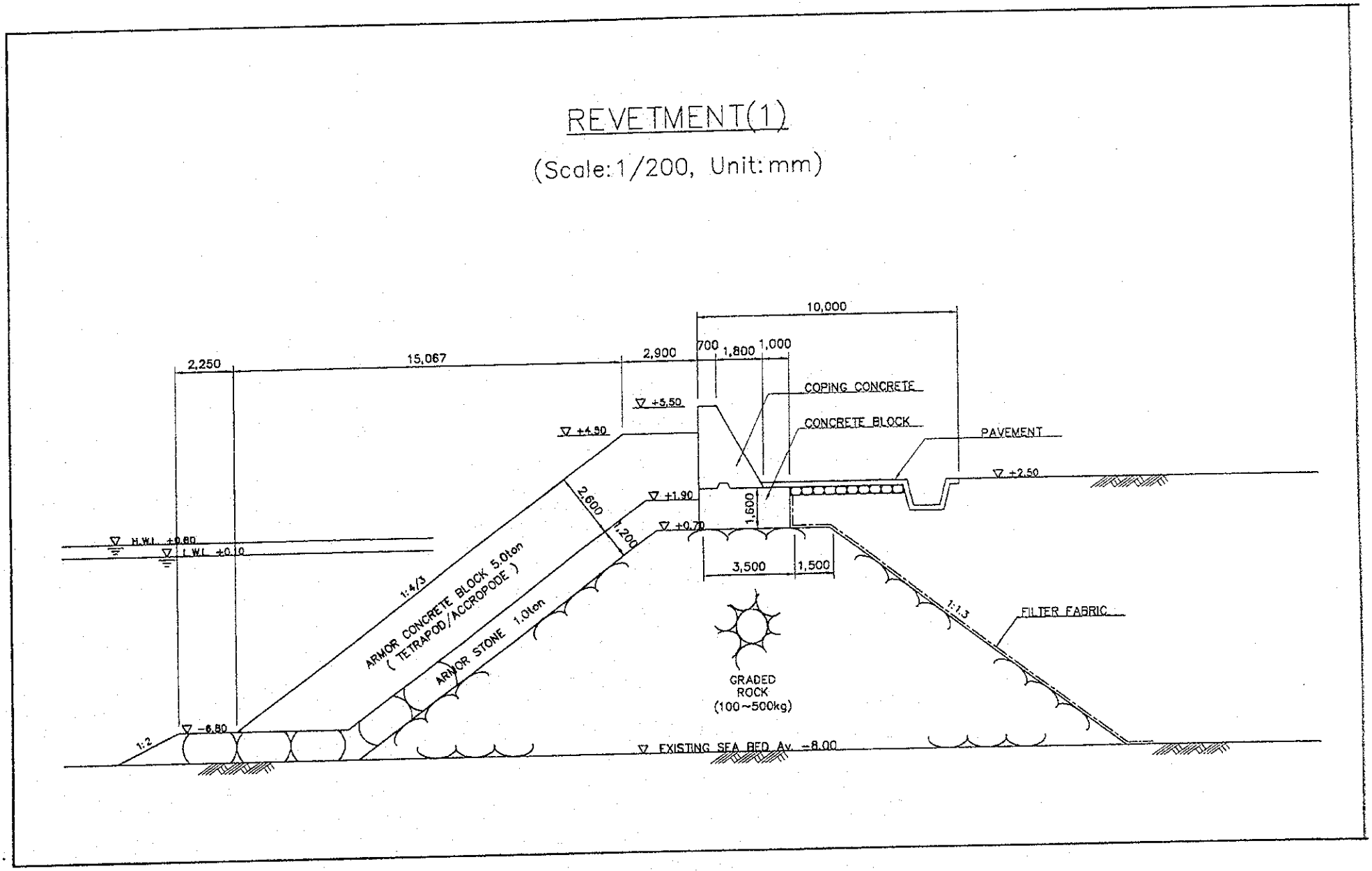


Figure 9.2.3 Typical Cross Section of Revetment

Chapter 10 Implementation Program and Cost Estimates

10.1 Implementation Program

10.1.1 Summary of the Works

The Project consists of the following construction works and procurement.

(1) Dredging	approximate 340,000m^3
(2) Reclamation	approximate 3,200,000m^3
(3) Outer Breakwater	800m
(4) Inner Breakwater	350m
(5) Revetment (1)	500m
(6) Revetment (2)	350m
(7) Revetment (3)	470m
(8) Revetment (4)	1,050m
(9) -12m Wharf	480m
(10) Navigation Aids	lump sum (Light Buoys, Light Beacons and Sector Light)
(11) Road and Yard Pavement	approximate 310,000m^2
(12) Building Works	lump sum (Administration Building, Transit shed, Maintenance shop Electrical Sub-station, Water Tower, Gate Office and Utility Works)
(13) Procurement of Equipment	lump sum (Cargo Handling Equipments)

Above-mentioned project is planned 47.5 months as construction terms (Figure 10.1.1). It should be noted that the cost estimates of the Project are deeply studied with the important elements like difficulty of the marine constructions for breakwaters in severe oceanographic conditions, importance of securing calm marine construction area for wharf, necessity of ensuring the production and stockpile of stones, essential care for environmental protection of corals and sunken vessels at Galle Bay and etc.

10.1.2 Construction Base

South direction of Galle Bay is opened to Indian Ocean, which affect oceanographic condition in the Bay predominantly. Namely waves of 0.5m height have been generated annually, especially waves of 1.5m heights generated by wind waves and swells have been appeared with the frequency of 70-80% probability. Therefore construction methods are studied with availability of workable days conditioned by critical waves heights. These are found 1.5m as maximum limit for rubble

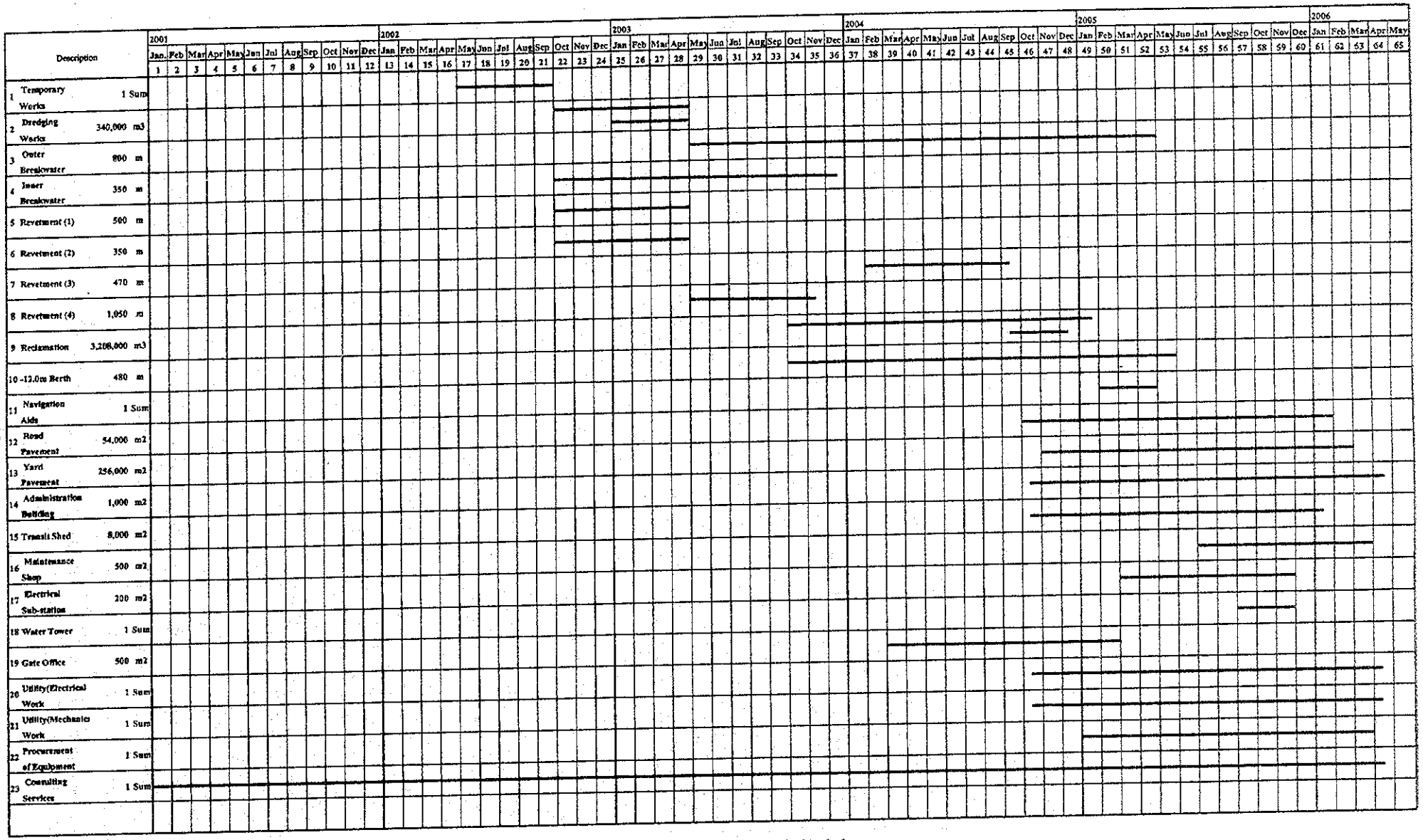


Figure10.1.1 Construction Schedule

stones works of breakwater and revetment, and 1.0m as maximum limit for placing works of armour concrete blocks of said structures.

10.2 Cost Estimates

10.2.1 Unit Price

The cost estimates were prepared by applying the basic prices of labours, equipments, plants and materials, which were obtained through the Study Team field survey conducted in April 2000.

(1) Exchange Rate

The exchange rate, ¥1.00=Rp.0.75 (as on June 2000), are applied in working out the cost estimates which are made up of foreign and local currency components.

(2) Import Tax

No allowance was made for the import duties applicable to imported construction materials, equipments and plants.

(3) Domestic Taxes like G.S.T. and N.S.L.

No allowance was made for various taxes to be levied on construction works.

(4) Physical Contingency

Below contingency was calculated with the rates on each item.

Construction Works	:	10% of total amount
Procurement	:	3% of total amount

10.2.2 Project Cost

The project cost is summarized in Table 10.2.1. Total amount is Rs.11,653,361,156 (as equal exchanged to ¥15,537, 814,874). Breakdown of foreign and local currency of the project cost is described below.

Foreign Currency Portion	:	¥11,830,140,753
Local Currency Portion	:	Rs.2,780,755,606

Table 10.2.1 Construction Cost

	Description	Quantity	Unit	Construction cost			Remarks
				Foreign Yen(1,000)	Local Rs.(1,000)	Total Yen(1,000)	
Construction of Civil and Building	Temporary Works (Included Mob./Demob.)	1	Sum	717,533	102,990	854,853	
	Dredging Works (Soft : 325,400m3, Rock : 13,725m3)	339,128	m3	309,225	26,717	344,848	
	Outer Breakwater	800	m	2,584,315	758,507	3,595,658	
	Inner Breakwater	350	m	1,003,767	266,314	1,358,852	
	Revetment (1)	500	m	576,800	153,719	781,759	
	Revetment (2)	350	m	252,958	73,563	351,042	
	Revetment (3)	470	m	343,688	116,128	498,525	
	Revetment (4)	1,050	m	165,970	85,828	280,407	
	Reclamation (Road and Yard)	3,208,000	m3	775,260	200,162	1,042,143	
	-12.0m Berth	480	m	1,387,269	135,891	1,568,457	
	Navigation Aids	1	Sum	168,839	1,431	170,747	
	Pavement (Road and Yard)	312,700	m2	334,651	350,529	802,023	
	Administration Building	1,000	m2	64,595	9,918	77,819	
	Transit Shed (4,000m2 : 2Units)	8,000	m2	348,179	30,378	388,683	
	Maintenance Shop	500	m2	26,597	4,140	32,117	
	Electrical Sub-station	200	m2	8,800	1,881	11,308	
	Water Tower	1	Sum	11,000	5,500	18,333	
	Gate Office	500	m2	55,000	5,988	62,984	
	Utility (Electrical Works)	1	Sum	282,260	59,417	361,483	
	Utility (Mechanical Works)	1	Sum	29,966	8,203	40,903	
	Sub-Total (1)			**9,446,672**	**2,397,204**	**12,642,944**	
Procurement	Crane (Mulipurpose) and						
	Cargo Handling Equipment	1	Sum	800,000	0	800,000	
	Sub-Total (2)			**800,000**	**0**	**800,000**	
	Total (1) + (2)			**10,246,672**	**2,397,204**	**13,442,944**	
	Consulting Survice			614,800	143,832	806,577	
	Physical Contingency Sub-Total (1)x10%+(2)x3%			968,667	239,720	1,288,294	
	Ground Total			**11,830,140**	**2,780,757**	**15,537,815**	

Chapter 11 Management and Operation Plan and Port Promotion

11.1 General

A port is an economic infrastructure that should basically served the public. Where port management is perceived to be profitable, private capital is easily attracted. Regional ports, however, are often unprofitable. Nevertheless, they are vital to the regional economy and lives of people in those area. Therefore it is common a regional port to be managed by a public rather than private organization.

11.1.1 Basic Types of Management and Operation as a Regional Port

Possible private participation in the development and operation of Galle Port is treated in the following section.

The planning and construction of Galle Port are managed by SLPA and the ownership of the land belongs to SLPA. Regarding the management and operation of facilities, three types are considered as follows; (A)SLPA manages and operates directly, (B)SLPA manages and private company operates and (C)facilities are owned by private company which conducts both management and operation.

The above three types are summarized in the following table.

Table 11.1.1 Port and Private company Participation

Stage		Type(A)	Type(B)	Type(C)
Planning		SLPA	SLPA	SLPA
Construction		SLPA	SLPA	SLPA
Ownership	Land	SLPA	SLPA	SLPA
	Facility	SLPA	SLPA	Private
Management	Land	SLPA	SLPA	Leased to Private
	Facility	SLPA	SLPA	Private
Operation	Facility	SLPA	Private	Private
Navigation		SLPA	SLPA	SLPA

11.1.2 Comparison of Three Basic Types

As a result of above comparisons concerning three items, Type(A) is recognized as the most reasonable type for Galle Port, because a fairness of service is the most required item to a regional port and large job opportunity is necessary for SLPA.

Table 11.1.2 Comparison of Management and Operation by Type

Item	Type(A)	Type(B)	Type(C)
Job Opportunity within SLPA	Yes	Partial	No
Fairness of Service to Port Users	Yes	Yes	Partial
Risk-taking	By SLPA	By SLPA	By Private

11.2 Management and Operation Plan

11.2.1 Basic Policy on Port Management and Operation System

In general, handling works of all cargoes are to be shifted to the new terminal corresponding to the enlargement of vessel. However, bulk cement is to be handled at the existing terminal, because the factory has already been established there. Furthermore, flour is to be discharging at the same berth, because no possibility of an enlargement due to a domestic transportation and its distribution center of the three southern provinces is located at the existing terminal. And clinker is assigned to new pier.

11.2.2 Organization of the New Terminal

The organization structure of the new terminal shall be headed by the terminal manager and consists of necessary number of workers to manage and operate the new terminal. Six sections, namely administration/finance/commercial/security/engineering and operation, and Harbour Master office shall be established.

11.2.3 Cargo Handling System of the New Terminal

(1) Three Shifts System for Cargo Handling Operation

The nightshift which is currently played by low efficiency, shall divided into two shifts in order to increase the handling volume.

(2) Handling System of Container Cargo

One multipurpose crane and one vessel crane are applied to container handling. As for the work efficiency of a crane, the number of handling box per hour is 25 boxes for the former and 15 boxes for the latter.

(3) Handling System of Steel

Iron and steel products are basically handled by three vessel cranes, although a multipurpose crane may be applied for heavy units. Handling productivity of crane is set at 20 times per hour and 2 tons is available as a handling unit weight.

(4) Handling System of Bagged Cargo

Pallet system is being introduced to increase handling weight of bagged cargo. One discharged unit typically consists of fifty bags(2.5 tons). The number of standard operations is planned at 15 per hour.

(5) Handling System of Bulk Cargo

To improve handling productivity, size of grab is enlarged to 5 tons. The increased mechanical power of vessel will result in faster operation: 24 movements per hour. A hopper system shall be introduced.

11.2.4 Measures on Port Management and Operation at the New Terminal

Five items are examined as improvement measures on port management and operation.
(1) Port function shall be enhanced by localizing formalities on port entry.

(2) Introduction of an information system shall be carried out so as to provide vessel information to the relevant offices.

(3) SLPA shall introduce and improve measures for activation of the organization such as QC circles and proposal activities system.

(4) The personnel management system shall introduce not only proper evaluation system on achievement and ability but also training policy on the job.

(5) The training programs shall be planned at Gallle in order to operate and maintain modern equipment efficiently.

11.3 Port Promotion Plan

To make potential users aware that Galle Port is located on an international maritime route, it is necessary for the port to publicize its activities as well as its existence. It is also important to grasp users demands.
Setting up a homepage is an effective means of PR, especially to the many small-scale users.

Chapter 12 Economic Analysis

The economic analysis tries to evaluate the economic feasibility of the proposed project by comparing the economic benefits arising from the urgent development plan with the economic cost of the plan.

12.1 Assumption of the Economic Analysis

(1) The project life is assumed as thirty-five years from the starting of the construction works. The construction works will take six years to be finished. The facility will be able to be used at the seventh year.

(2) If this project will not be implemented, as the Port of Colombo will not have extra capacity to handle the estimated cargo volume, new port facilities have to be constructed elsewhere. As Trincomalee Bay could enable to construct a port economically without breakwater and dredging works, the cargo supposed to be handled at new berths of Trincomalee Port.

12.2 Conversion to the Economic Price

Due to the prevailing existence of import duties and plenty amount of unemployment in unskilled labor force etc., the market price in developing countries usually does not reflect the true cost of the resources, i.e., opportunity cost. Therefore, the benefits and costs at market price are converted to the benefits and costs at economic price applying the respective conversion factors.

12.3 Economic Benefits

As for the cargo, which will be generated in the Southern Province, the estimated land transportation cost from Galle to Trincomalee (road distance 357 km) is assumed as the economic benefit. As for the cargo, which will be the overflow of the Port of Colombo, the economic benefit will be the difference of the estimated land transportation cost between from Colombo to Trincomalee and from Colombo to Galle. In addition, the economic benefit such as the economic effect on the development in the Southern Province, the impact on employment and income arising from the port construction and the port operation and the additional value added in port-related industries are surely envisaged but they are mentioned qualitatively.

12.4 Economic Costs

(1) The Construction Cost

In order to handle the estimated cargo volume, the capacity of the Port of Trincomalee has to be expanded also. But in case of Trincomalee, the construction of breakwaters and dredging works is unnecessary because of the physical condition. The extra works required at the construction of the Port of Galle is assumed as the economic cost of the project. Indirect cost and common cost such as consultant fee, preparation cost and contingency etc. are allocated proportionally.

(2) Re-investment Cost

As there is no difference between "With case" and "Without case" in re-investment cost, the re-investment cost is excluded from the economic analysis.

(3) Maintenance and Operation Cost

As for the annual maintenance cost, the one-percent of civil construction cost and four percent of equipment cost is assumed. The required additional employment is 340 persons. As for the additional operation cost other than personnel cost, twenty percent of personnel cost is assumed.

12.5 Evaluation of the Project

(1) Method of Evaluation

NPV (Net Present Value), B/C (Benefit/Cost) Ratio and EIRR (Economic Internal Rate of Return) are calculated for evaluation. As for the discount rate in NPV and B/C Ratio, the prevailing real interest rate of 7.5 percent for prime lending is adopted.

(2) Sensitivity Analysis

The following three alternatives were calculated as the sensitivity analysis in order to examine the effect of unexpected factors on the economic feasibility of the urgent development plan.

Case A: The construction cost increases by ten percent.
Case B: The cargo volume decreases by ten percent.
Case C: Both Case A and Case B occur.

(3) The Result

	NPV (M Rs.)	B/C Ratio	EIRR
Base Case	8,113	2.52	17.32%
Case A	7,696	2.34	16.29%
Case B	6,767	2.27	16.06%
Case C	6,351	2.10	15.08%

(4) The Conclusion

The NPV, B/C Ratio and EIRR support the implementation of the urgent development plan in terms of national economic point of view in all cases (the base case and three alternatives).

Especially, the three sensitivity analysis show the stable desirability of the project even in case of unfavorable direction of movement in construction cost and expected cargo volume.

Table 12.7.1 The Estimated NPV, B/C and EIRR of Galle Port Project
Sensitivity Analysis (Case A)

(M Rs.,2000 Price)

Year	Benefit	Cost			Difference	Net Present Value (NPV)			EIRR
	Land Transportation Cost	Construction Cost	Maintenance and operation	Total Cost	Benefit - Cost	Benefit	Cost	Benefit - Cost	
1	0	66	0	66	-66	0	66	-66	
2	0	1,559	0	1,559	-1,559	0	1,450	-1,450	
3	0	3,040	0	3,040	-3,040	0	2,631	-2,631	
4	0	541	0	541	-541	0	436	-436	
5	0	0	0	0	0	0	0	0	
6	0	0	0	0	0	0	0	0	
7	1,078	0	144	144	934	699	93	605	
8	1,211	0	144	144	1,067	730	87	643	
9	1,349	0	144	144	1,205	756	81	676	
10	1,476	0	144	144	1,332	770	75	695	
11	1,668	0	144	144	1,524	809	70	739	
12	1,818	0	144	144	1,674	821	65	756	
13	1,818	0	144	144	1,674	763	60	703	
14	1,818	0	144	144	1,674	710	56	654	
15	1,818	0	144	144	1,674	661	52	608	
16	1,818	0	144	144	1,674	614	49	566	
17	1,818	0	144	144	1,674	572	45	526	
18	1,818	0	144	144	1,674	532	42	490	
19	1,818	0	144	144	1,674	495	39	455	
20	1,818	0	144	144	1,674	460	36	424	
21	1,818	0	144	144	1,674	428	34	394	
22	1,818	0	144	144	1,674	398	32	367	
23	1,818	0	144	144	1,674	370	29	341	
24	1,818	0	144	144	1,674	345	27	317	
25	1,818	0	144	144	1,674	320	25	295	
26	1,818	0	144	144	1,674	298	24	275	
27	1,818	0	144	144	1,674	277	22	255	
28	1,818	0	144	144	1,674	258	20	238	
29	1,818	0	144	144	1,674	240	19	221	
30	1,818	0	144	144	1,674	223	18	206	
31	1,818	0	144	144	1,674	208	16	191	
32	1,818	0	144	144	1,674	193	15	178	
33	1,818	0	144	144	1,674	180	14	165	
34	1,818	0	144	144	1,674	167	13	154	
35	1,818	0	144	144	1,674	155	12	143	**16.29%**
Total						13,452	5,756	**7,696**	
						B/C=	**2.34**		

Note: Construction Cost increases by 10 percent.

Table 12.7.2 The Estimated NPV, B/C and EIRR of Galle Port Project
Sensitivity Analysis (Case B)

(M Rs.,2000 Price)

Year	Benefit	Cost			Difference	Net Present Value (NPV)			EIRR
	Land Transportation Cost	Construction Cost	Maintenance and Operation Cost	Total Cost	Benefit - Cost	Benefit	Cost	Benefit - Cost	
1	0	60	0	60	-60	0	60	-60	
2	0	1,417	0	1,417	-1,417	0	1,318	-1,318	
3	0	2,764	0	2,764	-2,764	0	2,392	-2,392	
4	0	492	0	492	-492	0	396	-396	
5	0	0	0	0	0	0	0	0	
6	0	0	0	0	0	0	0	0	
7	970	0	144	144	826	629	93	535	
8	1,090	0	144	144	946	657	87	570	
9	1,214	0	144	144	1,070	681	81	600	
10	1,328	0	144	144	1,184	693	75	618	
11	1,501	0	144	144	1,357	728	70	659	
12	1,636	0	144	144	1,492	738	65	673	
13	1,636	0	144	144	1,492	687	60	627	
14	1,636	0	144	144	1,492	639	56	583	
15	1,636	0	144	144	1,492	594	52	542	
16	1,636	0	144	144	1,492	553	49	504	
17	1,636	0	144	144	1,492	514	45	469	
18	1,636	0	144	144	1,492	479	42	436	
19	1,636	0	144	144	1,492	445	39	406	
20	1,636	0	144	144	1,492	414	36	378	
21	1,636	0	144	144	1,492	385	34	351	
22	1,636	0	144	144	1,492	358	32	327	
23	1,636	0	144	144	1,492	333	29	304	
24	1,636	0	144	144	1,492	310	27	283	
25	1,636	0	144	144	1,492	288	25	263	
26	1,636	0	144	144	1,492	268	24	245	
27	1,636	0	144	144	1,492	250	22	228	
28	1,636	0	144	144	1,492	232	20	212	
29	1,636	0	144	144	1,492	216	19	197	
30	1,636	0	144	144	1,492	201	18	183	
31	1,636	0	144	144	1,492	187	16	170	
32	1,636	0	144	144	1,492	174	15	159	
33	1,636	0	144	144	1,492	162	14	147	
34	1,636	0	144	144	1,492	150	13	137	
35	1,636	0	144	144	1,492	140	12	128	**16.06%**
Total						12,107	5,339	**6,768**	
						B/C=	**2.27**		

Note: The cargo volume decreases by 10 percent

Table 12.7.3 The Estimated NPV, B/C and EIRR of Galle Port Project
Sensitivity Analysis (Case C)

(M Rs.,2000 Price)

Year	Benefit	Cost			Difference	Net Present Value (NPV)			EIRR
	Land Transportation Cost	Construction Cost	Maintenance and Operation Cost	Total Cost	Benefit - Cost	Benefit	Cost	Benefit - Cost	
1	0	66	0	66	-66	0	66	-66	
2	0	1,559	0	1,559	-1,559	0	1,450	-1,450	
3	0	3,040	0	3,040	-3,040	0	2,631	-2,631	
4	0	541	0	541	-541	0	436	-436	
5	0	0	0	0	0	0	0	0	
6	0	0	0	0	0	0	0	0	
7	970	0	144	144	826	629	93	535	
8	1,090	0	144	144	946	657	87	570	
9	1,214	0	144	144	1,070	681	81	600	
10	1,328	0	144	144	1,184	693	75	618	
11	1,501	0	144	144	1,357	728	70	659	
12	1,636	0	144	144	1,492	738	65	673	
13	1,636	0	144	144	1,492	687	60	627	
14	1,636	0	144	144	1,492	639	56	583	
15	1,636	0	144	144	1,492	594	52	542	
16	1,636	0	144	144	1,492	553	49	504	
17	1,636	0	144	144	1,492	514	45	469	
18	1,636	0	144	144	1,492	479	42	436	
19	1,636	0	144	144	1,492	445	39	406	
20	1,636	0	144	144	1,492	414	36	378	
21	1,636	0	144	144	1,492	385	34	351	
22	1,636	0	144	144	1,492	358	32	327	
23	1,636	0	144	144	1,492	333	29	304	
24	1,636	0	144	144	1,492	310	27	283	
25	1,636	0	144	144	1,492	288	25	263	
26	1,636	0	144	144	1,492	268	24	245	
27	1,636	0	144	144	1,492	250	22	228	
28	1,636	0	144	144	1,492	232	20	212	
29	1,636	0	144	144	1,492	216	19	197	
30	1,636	0	144	144	1,492	201	18	183	
31	1,636	0	144	144	1,492	187	16	170	
32	1,636	0	144	144	1,492	174	15	159	
33	1,636	0	144	144	1,492	162	14	147	
34	1,636	0	144	144	1,492	150	13	137	
35	1,636	0	144	144	1,492	140	12	128	**15.08%**
Total						12,107	5,756	**6,351**	
						B/C =	**2.10**		

Note: The construction cost increases by 10 percent and the cargo volume decreases by 10 percent.

Chapter 13 Financial Analysis

13.1 Purpose of the Financial Analysis

The purpose of the financial analysis is to examine the viability of the project. (The project means the short-term development plan for the Galle port in this chapter.) When evaluating financial viability of the project, financial soundness of the executing agency of the project, viz SLPA, is assessed.

13.2 Methodology of the Financial Analysis

The viability of the project is analyzed using the Financial Internal Rate of Return (FIRR) by means of the discount cash flow method.

The financial soundness of the executing agency is appraised based on its projected financial statements.

13.3 Assumption for the Financial Analysis

Preconditions of financial analysis are shown in Table 13.3.1.

Table 13.3.1 Precondition of Financial Analysis

Base year	Year 2000			
Project Life	35years			
Revenue	Caluculation based on tariff 2000 and forcast of cargo volume			
Expenditure				
Investment	Initial investment costs include tax			
re-investment	Multi purpose crane 20 years each Forklift and other mobile crane 10 years each			
Maintenance & repair	Inflastructure 1.0% of original construction cost Equipement 4.0% of original construction cost			
Personnel	caliculation based on personnel plan and the existing scale of pay			
Administration	40% of the total annual personnel costs			
Depreciation	Caluculation based on SLPA standard			
Tax	Income tax, deemed diviidend tax			
Fand Raising	Loan period	Interest rate	Grace period	Propotion
Soft loans	30 years	2.2%	10 years	75% of initial construction cost
Domestic loans	10 years	7.5%	3 years	25% of initial construction cost
Other short loans	1 year	7.5%	0 year	

13.4 Evaluation of the project

13.4.1 Viability

The FIRR of the project was 5.1%, exceeding the weighted average interest rate of funds of 3.5%

13.4.2 Financial Soundness

The projected financial statements and financial indicators (rate of return on net fixed assets, debt service coverage ratio, operating ratio, and working ratio) with regard to the project are shown below.

(1) Profitability

The rate of return on net fixed assets exceeded the weighted average interest rate of funds (3.5%) in 3 years from the beginning of operation.

(2) Loan Repayment Capacity

Throughout the project life, the debt service coverage ratios exceeded 1.0, satisfying required criteria.

(3) Operational Efficiency

Both the operating ratios and the working ratios maintained positive levels.

13.4.3 Sensitivity Analysis

Sensitivity analysis was conducted to examine the impact of unexpected future changes such as cargo volume, construction cost, inflation or exchange rate. The following cases were envisioned.

Case 1 : The investment costs increase by 10%
Case 2 : The revenues decrease by 10%
Case 3 : The investment costs increase by 10% and the revenues decrease by 10%

The results of the sensitivity analysis were shown in Table 13.4.1. In all the cases, FIRR exceeded the weighted average interest rate of the funds (3.5%).

Table 13.4.1 Sensitivity Analysis for FIRR

Case	FIRR
Base case	5.1%
Case 1	4.4%
Case 2	4.3%
Case 3	3.6%

13.4.4 Financial soundness of the Executing Agency

Together with the above-mentioned financial analysis of the Galle port project, overall financial soundness of SLPA as the executing agency of the Gall port project was assessed to confirm the feasibility of the project. In the assessment, current financial statements, loan repayment programs and income prospects for the future were considered covering the three principal ports, namely, Colombo, Galle and Trincomalee.

13.4.5 Conclusions

Judging from the above analysis, the project is regarded as financially feasible. And the Financial soundness of executing agency, viz SLPA, is considered to be sound.

Chapter 14 Environmental Impact Assessment

14.1 Introduction

Preliminary Environmental Study (PES) has been carried out in view of assessing the environmental issues that are related with the urgent development of Port of Galle as a Regional Port. This study has been entrusted with Department of Civil Engineering, University of Moratuwa from which eight consultants on different areas of environment have worked to make this study a success. Terms of reference for the entire study have been prepared according to the JICA guideline on the preparation of Environmental Impact Assessment (EIA) in the Harbour sector.

No attempt is however made to follow the local EIA guideline prepared by Central Environmental Authority as the present study follows the EIA process in accordance with JICA guidelines. Nevertheless, the report which is presented separately as a supplementary document would be a valuable source for subsequent EIA to be carried out in accordance with Sri Lankan regulations.

Four different, distinct harbour configurations have been considered for the entire study and the best possible alternative with minimum adverse impacts has been selected.

The total environment survey is split into two major segments, namely natural and social respectively. Natural environment includes water and sediment quality, air quality and noise level, flora and fauna whilst the social environment encompasses built environment, heritage buildings, marine archaeology, tourism, income of the people, population, fisheries, recreation activities and transport etc.

The study comprises the comprehensive anticipated significant impacts and their mitigation measures for significant impacts, monitoring plan. The following sections elucidate the aforesaid information respectively.

14.2 Anticipated Significant Impacts

In this study, impacts are graded qualitatively rather than quantitatively. The study identifies three major impacts such as

(i) Coral reef and its associated fauna

(ii) Fishing in the Dewata area and

(iii) Transportation of quarry products, etc.

It is apparent with the proposed project that the coral reef is subject to more sheltered environment due to the calmness introduced by breakwaters. This might lead to poor exchange of marine water of the area inside the breakwaters depriving of food and other essentials for coral growth. Further, there could be a potential for pollution probably due to chemical contamination or accidental oil spills or ship discharges, etc. Hence, its associated fish could also be adversely affected and further, the enhanced ship movement may disturb the fish movement and their spawning activities.

With the proposed project, fishing in Dewata area could be affected in terms of restricted fishing boat movement for reasons of security and the fish catch which might be reduced. It is clear from the alternatives that the alternative 1 gives the least disturbance for the fishing ground. Even the beach seine fishing could be carried out with the alternative 1 without much hindrance.

Transport of quarry products is another significant impact which has to be dealt in detail. About 250 truckloads per-day have to be brought in during the construction period for the construction of breakwater and other structures. This could heavily impose traffic congestion particularly in the Galle - Matara Road (A2 road) causing inconvenience to public.

14.3 Mitigation Measures for Significant Impacts

Mitigation measures only for significant impacts are described here.

In the event of coral reef and its associated fauna, current velocity measurement on the coral reef is proposed and is in progress. Sedimentation rate of silt and other sediments and current velocity play a major role in the survival of corals. For this reason, it is necessary to implement measures for minimization of sedimentation over coral reef by installing silt contains particularly during construction phase. Further, phisical disturbance to ecological balance in the reef area by ship traffic should be avoided to the maximum extent possible. Care must also be taken to have oil contingency plan besides making clean-up equipment available in case of accidental oil spills. In addition to the above mitigation measures, re-plantation of corals in other suitable sites such as Galle Fort area, Unawatuna and leeward side of outer breakwater is proposed by way of additional measures.

For fishing in the Dewata area, fishermen should be either allowed to keep their activities as they are or they should be treated by the appropriate measures including relocation if their activities are not allowed due to security and other reasons. It is advisable that some possible measures should be pursued by SLPA for the policy of amicable coexistence and co-prosperity between SLPA and the fishermen who are likely to be affected by the project, and that an appropriate ad hoc organization should be set up between both parties to discuss and decide on mutually agreeable measures for achieving the said objective. During such discussions it may be conceivable that SLPA will propose supplying those fishermen operating traditional local fishing boats with upgraded boats to enable them to operate in deeper waters outside Galle Bay for increased fish catches.

Transport of metals from quarries is another adverse impact in the project area. A large number of heavy vehicles coming in to the port through public roads would undoubtedly create traffic congestion in the roads. Conveyance of material through Galle town area must be completely stopped and instead, alternative routes should be looked for. Present status of routes must be improved whenever necessary in order to bring heavier loads in to the port. Designated site for storage of such material has to be demarcated with adequate space so that the truck waiting time could be reduced. Proper coordination with Road Development Authority is advisable in view of maintaining of improving the existing road network.

14.4 Monitoring Plan

Monitoring plan is also given here only for significant impacts. Monitoring plan is to be implemented both during construction and operation phases.

In the case of coral reef and its associated fish, diversity and abundance must be monitored. In addition coral cover must be identified from time to time. If cleanup processes are necessary, such programmes are implemented with wider participation from relevant authorities.

In the case of fisheries, records on fish catch must be collected from season to season. This would give an idea of fish abundance in the project area. Number of fishermen and their fishing techniques must also be recorded regularly. Fisherman organization is to be set up for Dewata area so that proper communication with SLPA could be channeled through it. Working - time zone for fishermen must be drafted for their movement so that they could avoid the time periods during which ships call in the proposed port.

Vehicular movement must be monitored so as to minimize the traffic congestion in public roads.

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