3-3. Dockyard Layout

3-3-1. Location of Dockyard

The construction site assigned by the Burmese Government covers 1,200M x 600M for the first stage of the project and about 900M x 600M for future expansion.

Out of the area for the first stage, a lot of 700M x 300M is reserved for the project. Based upon geological conditions, land surveying results, etc. The optimum location for the dockyard has been decided. Fig. III-3-3 shows the location of the dockyard.

3-3-2. Arrangement of Ship Repairing Facilities

The arrangement of ship repairing facilities is illustrated in Fig. III-3-4.

(1) Position and Lengthwise Direction of Dock

On the basis of the geological survey results, the dock has been laid in the most suitable position. Its lengthwise direction is fixed so that the dock entrance faces upstream.

This has been decided in consideration of the rising tide at docking or undocking (scheduled for high tide). Handling of a ship under repair holding its bow against the current is easier than doing so in the opposite direction. A space has been reserved for No. 2 dock which may be constructed next to this dock if it becomes

necessary in the future.

(2) Arrangement of Buildings

As many work shops as possible are arranged around the dock for two principal purposes. One is the efficient movement of materials and workers, and the other is reduction in construction costs by saving expenses for piping, etc. Buildings are arranged so as to avoid the south-western monsoon, while leaving suitable space for future expansion.

(3) Mooring Quay

Two mooring quays capable of accommodating a ship of 20,000 DWT type each are arranged along the Rangoon River at both the upstream and downstream ends, putting the dock between the two. Further, a space for a future 200M extension has been reserved in the downstream area.

(4) Access Ramp

An access ramp through the dock-end wall to the dock bottom is provided to facilitate the transportation by truck of materials and equipment.

(5) Hull Shop

In consideration of the flow of steel getting in the way of work at the dock and on the slipway, the hull shop is located between the dock and

the slipway, and outdoor assembly yards are arranged in extension areas at both ends of the hull shop so that overhead cranes in the shop may also serve at assembly yards. The inside layout of the hull shop is shown in Fig. III-3-5.

(6) Warehouses

Warehouses are arranged near the unloading quay close enough to one another as to make their management efficient and easy. The storage yards for material steel and heavy machinery are located in the surrounding areas.

(7) Pipe Shop

The pipe shop is so located as to occupy one bay of the engine repair shop. The layout can be seen in Fig. III-3-6.

(8) Machine Shop

The machine shop is set up adjoining the engine repair shop. Its layout is shown in Fig. III-3-7.

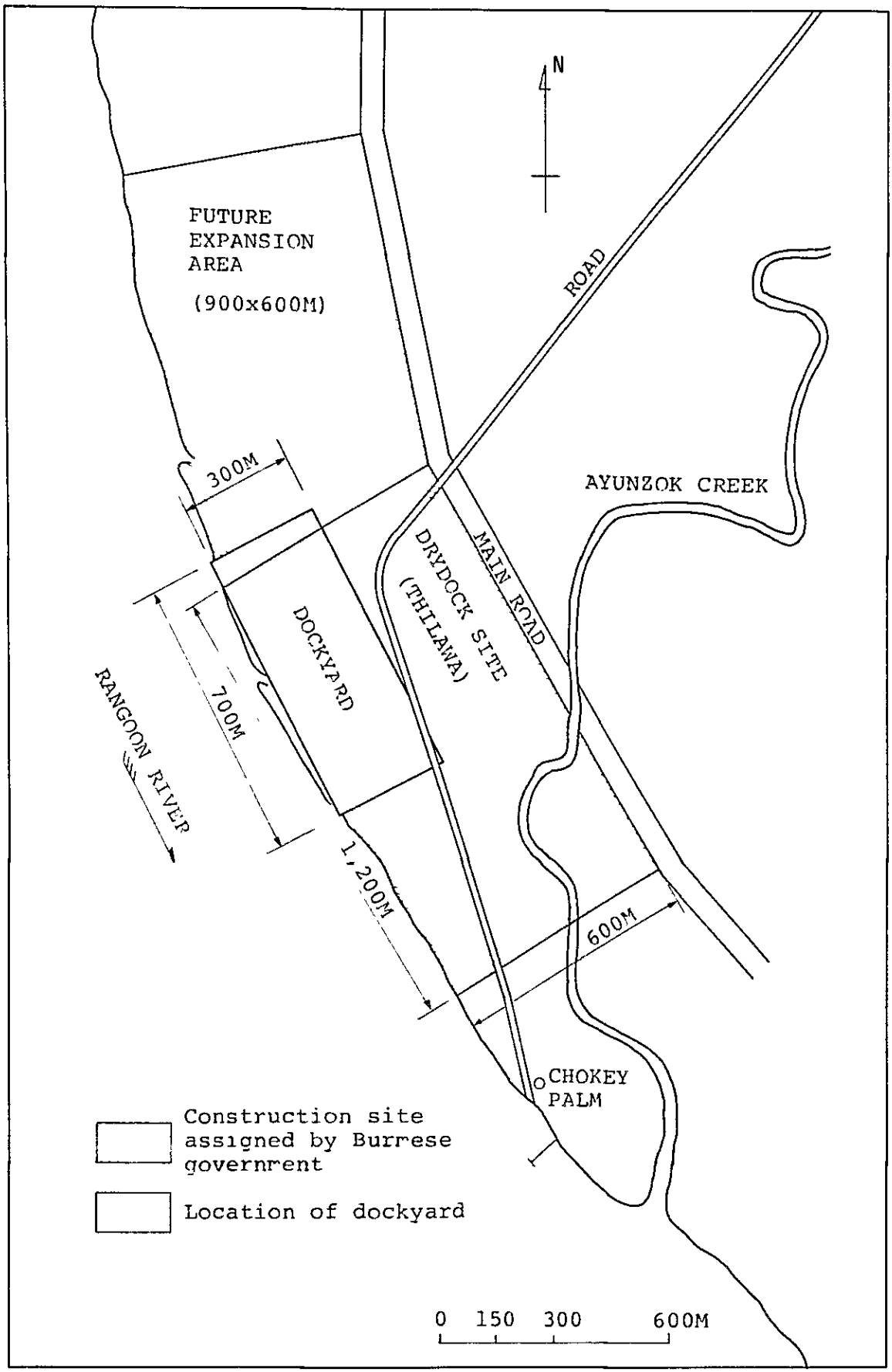
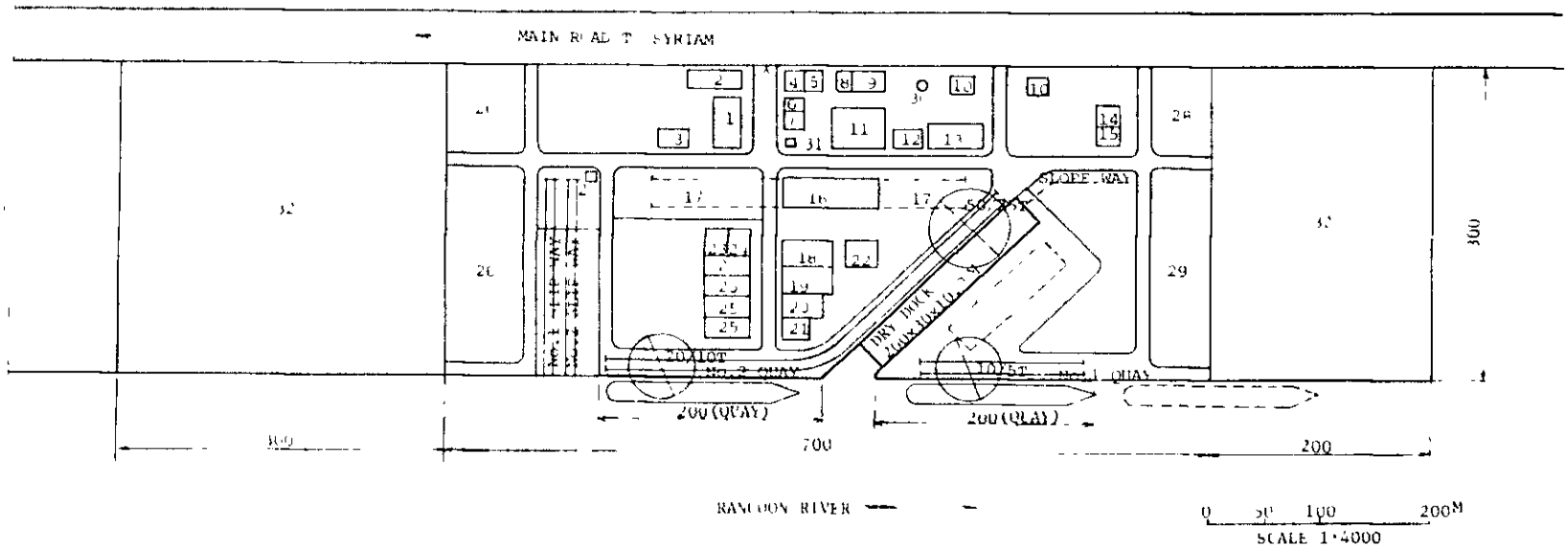


Fig. III-3-3 Location of Dockyard



1 ADMINISTRATION BUILDING & DESIGN OFFICE
2 PARKING AREA
3 GUEST & DOCK HOUSE
4 GATE OFFICE
5 DISPENSARY
6 FIRE-FIGHTING ROOM
7 GARAGE
8 ELECTRIC SUBSTATION
9 COMPRESSOR & GENERATOR ROOM
10 OXYGEN & ACETYLENE PLANT SHOP
11 WORKERS HOUSE & CANTEEN
12 MAINTENANCE & SERVICE SHOP
13 TRAINING CENTER
14 GALVANIZING SHOP
15 FOUNDRY SHOP
16 HULL SHOP
17 STEEL STRUCTURE ASSEMBLY YARD
18 ENGINE REPAIR SHOP & PIPE SHOP
19 MACHINE SHOP
20 ELECTRICAL SHOP
21 DOCKER STORE
22 PAINTING SHOP
23 CARPENTER SHOP
24 MOULD LOFT SHOP
25 STORAGE WARE HOUSE
26 STOCK YARD
27 WINCH HOUSE FOR SLIPWAY
28 INCINERATOR
29 SCRAP YARD
30 FRESH WATER TANK
31 TRUCK SCALE
32 STEEL STRUCTURE ASSEMBLY YARD
(FUTURE PLAN)

Fig. III-3-4 Layout Plan

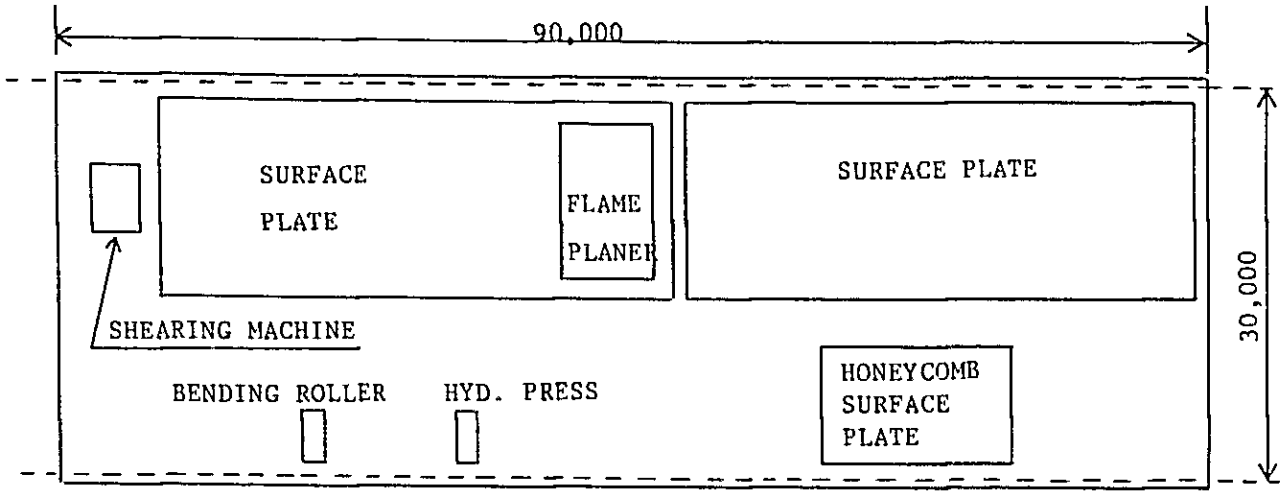


Fig. III-3-5 Layout of Hull Shop

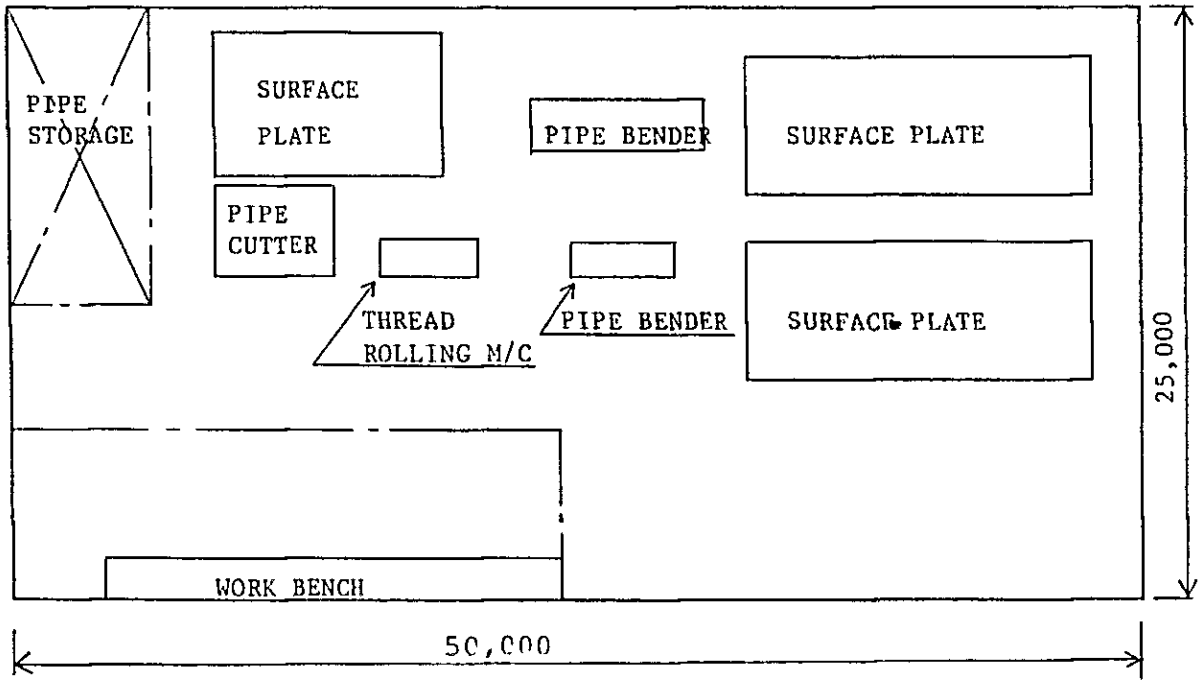


Fig. III-3-6 Layout of Engine Repair Shop and Pipe Shop

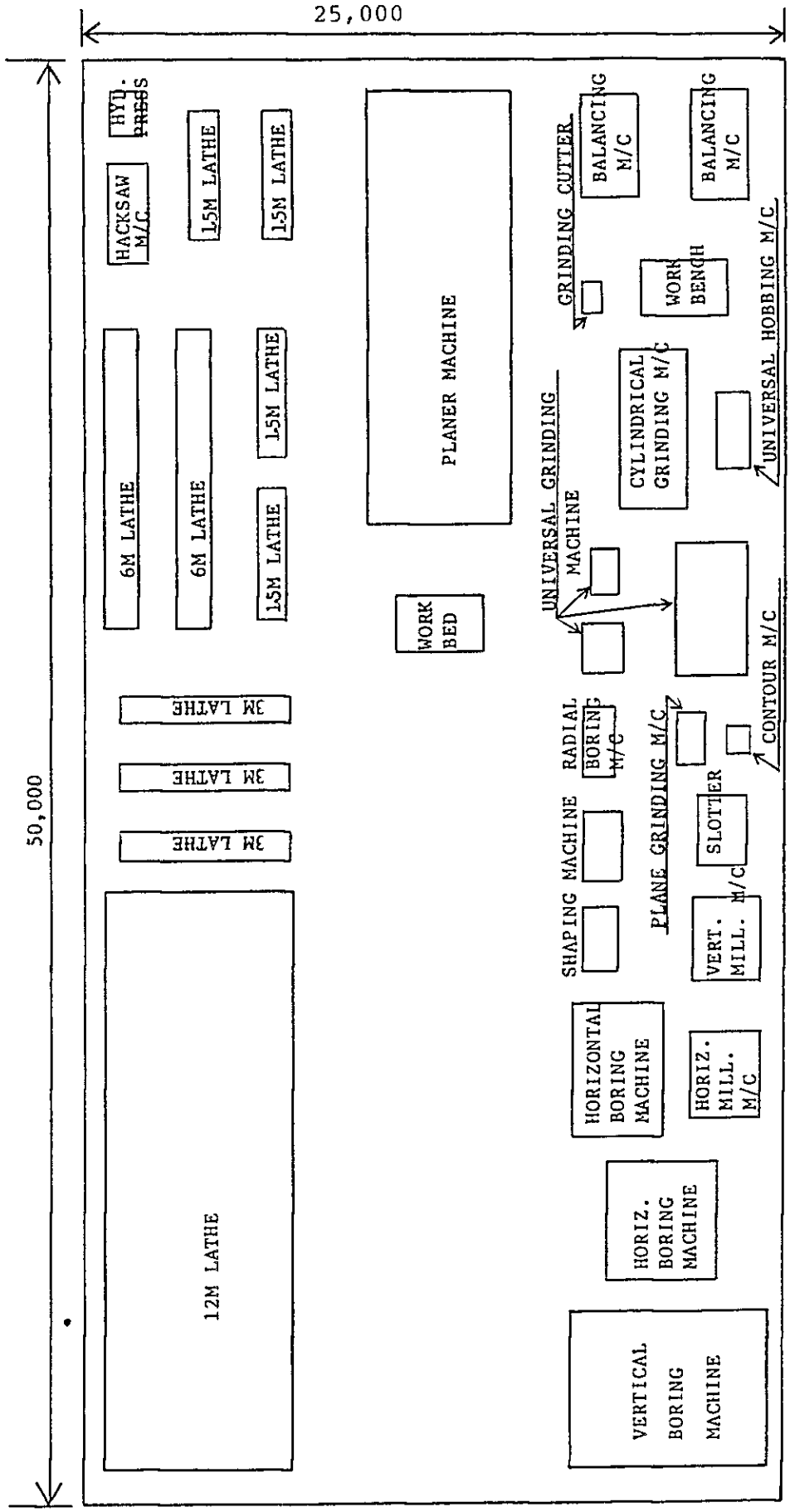


Fig. III-3-7 Layout of Machine Shop

3-4. Design of Civil Engineering Works

(1) Dock

1) Particulars of Planned Dock

A.	Vessel class	20,000 DWT (max draft: 4.5m)
B.	Dock dimensions	Depth = 10.5 m Width = 30.0 m Length= 200.0 m Dock bottom slope: vertical = 1/300 longitudinal = 1/200

2) Dock Structure and Type

The subsoil of the planned project site primarily consists of a soft clay-like layer with comparatively low permeability which prevents it from directly supporting structures. In view of this, the dock structure and type were determined as follows:

A. Structure of dock bottom slab

Owing to the fact that the subsoil, where the dock bottom slabs are installed, is non-permeable and contains a small quantity of gushing water, a system for reducing uplift shall be provided under the bottom slab to decrease the volume of bottom slab concrete. The bottom slab and ship weight are designed

to be supported by pile foundations.

B. Structure of dock wall

A reinforced concrete buttress-type retaining wall is most commonly used for the dock wall structure. However, since the subsoil is poor and the wall is high, a great amount of lateral earth pressure is exerted, making support by a retaining wall difficult. The retaining wall construction entails a considerable amount of excavation and backfill and higher construction costs; therefore the dock wall shall be of a relieving platform type which employs steel pipe piles. The dock wall is united with the crane foundation to eliminate the need of the crane foundation pile.

C. Pump room

A pump room to simultaneously serve as a vertical sill of the gate shall be provided at the entrance, so that the travelling distance of cranes or trucks do not interfere. As a result, the pump room shall be built of reinforced concrete half embedded in the ground.

Fig. III-3-8, III-3-9, and III-3-10 show typical dock cross sections, entrance cross sections and longitudinal sections, respectively.

(2) Mooring Quay

1) Particulars of Planned Mooring Quay

A. Vessel class 20,000 DWT
B. Mooring quay dimensions Front water depth: DL -5m
Entire Length: 400m
C. Appurtenant facilities
Crane ..... each one (1) unit of 20t and 10t LLC
Other ..... bitt, fenders

2) Structural Type of Mooring Quay

There are two types: a gravity type and a sheet pile type. In the case of the gravity type, the structure is generally supported on the subsoil which is improved by displacement with sand. Owing to the considerable depth of the weak subsoil, relatively higher costs and a greater amount of time are required to undertake subsoil improvement. Therefore, the sheet pile type structure, which requires no subsoil improvement, shall be adopted. Also, because of the passing of the crane behind the mooring quay, a relieving platform also serving as a crane foundation shall be used, as in the case of the dock wall. Fig. III-3-11 shows a typical cross section of a mooring quay.

(3) Slipway

1) Particulars of Planned Slipway

A.	Vessel class	1,500 DWT
B.	Slipway dimensions	Depth: DL -2.5 to +8.5
		Slope: i=6/100
		Width: B=40m
		Overall length: 190m x 2

2) Slipway Structure

A. Bottom Slab

The bottom slab and rail support base shall be steel-reinforced concrete. The structure and the ship weight shall be supported by the piles.

B. Sidewalls

Sidewalls below a depth of DL+4m shall be of the relieving platform type which is greatly suited to a weak subsoil; a steel-reinforced concrete retaining wall structure shall be adopted above this depth, owing to relatively easy excavation and drainage.

Fig. III-3-12 shows longitudinal section of slipway.

(4) Office Building

In order to enhance the building's function as an office area capable of adapting to a wide diversity of office spatial needs, the number of pillars has been reduced to a minimum and movable partitions have been adopted between rooms. A simplified structure has been selected to pare down building costs.

Structure:	Two-storey RC building with wooden truss roof	
Total floorspace:	2,500m^2	
Exterior finish:	Walls	: brick masonry
	Roof	: asphalt lining, corrugated steel plate
	Doors, windows	: aluminum sash
	Floors	: mortar base, vinyl tile
	Walls	: mortar base, vinyl paint
	Ceilings	: asbestos sound-insulated board

Fig. III-3-13 shows plan and section of administration building.

(5) Shops

The shops have been planned to offer maximum versatility in order to adapt to the needs of each production line, and to offer an optimally favorable working environment for each shop's employees.

Structure:	Steel-frame 1-storey structure with steel-truss roof	
Exterior finish:	Walls	: block masonry, painted steel, ventilation louvre on crane top
	Roof	: asphalt lining, corrugated steel plate
	Floors	: mortar trowel finish
	Walls	: block masonry
	Ceiling	: none (heat insulating material below roof)

Fig. III-3-14 shows plan and section of hull shop.

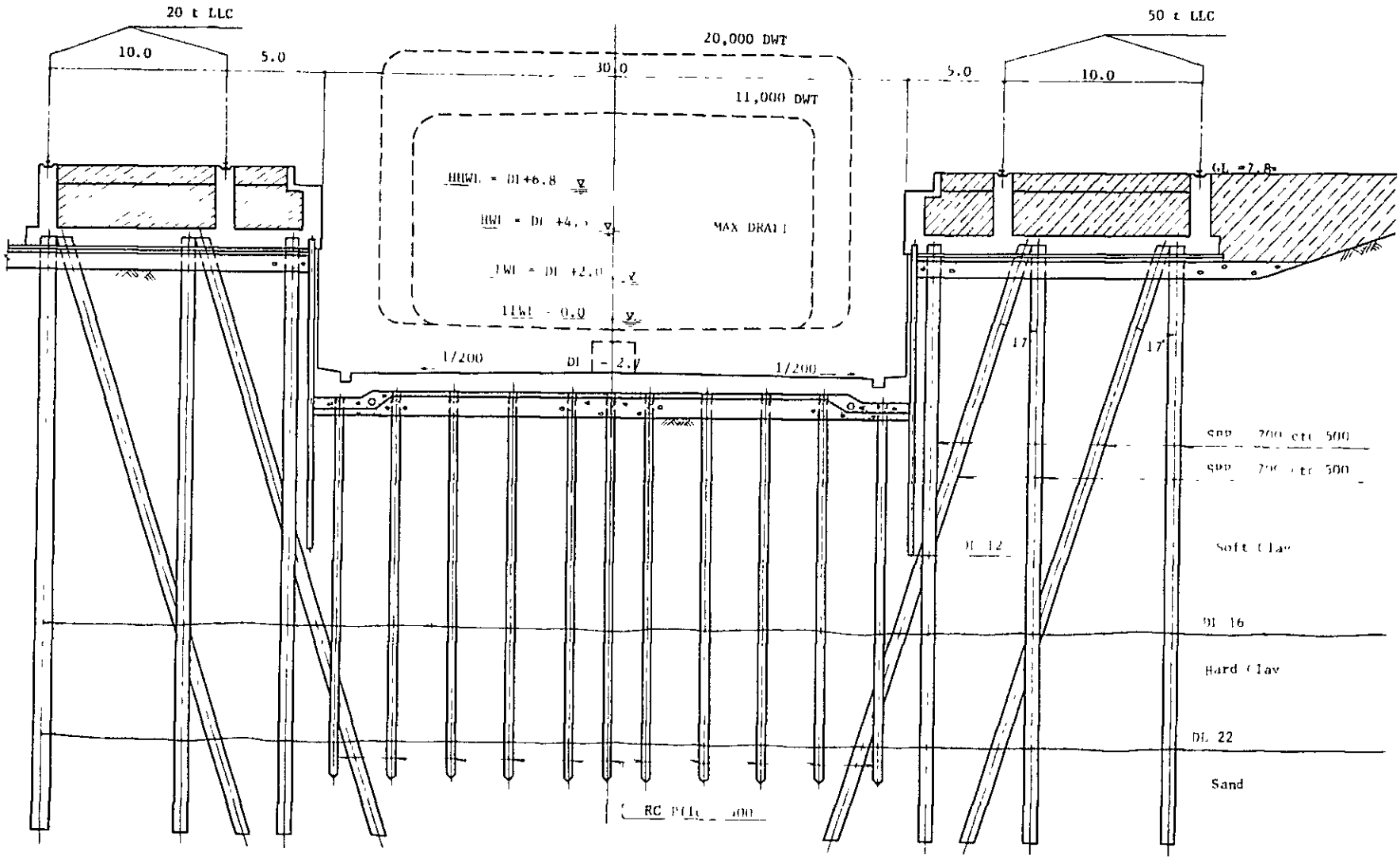


Fig III-3-8 Typical Cross Section of Dock

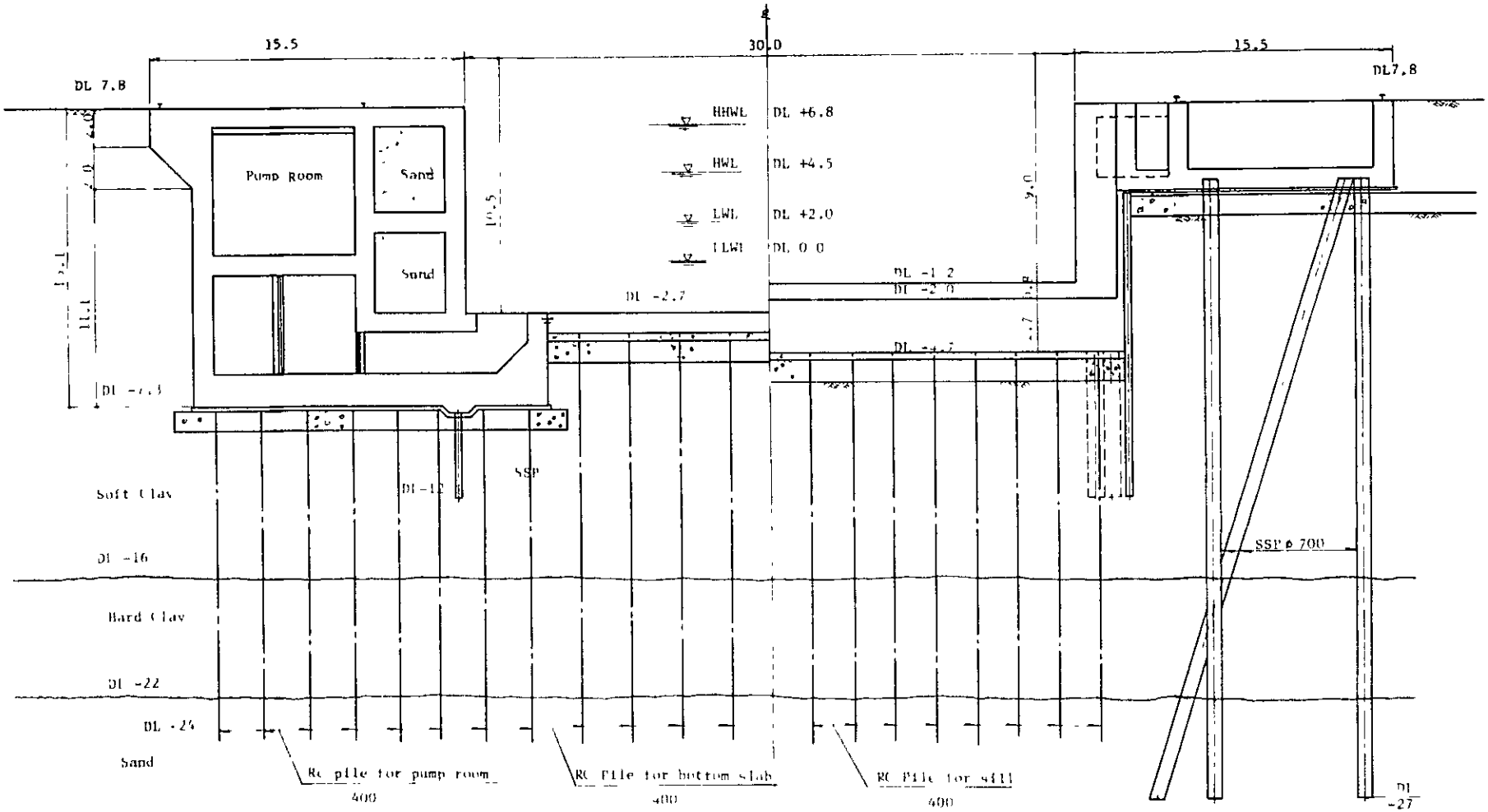


Fig III-3-9 Entrance Cross Section of Dock

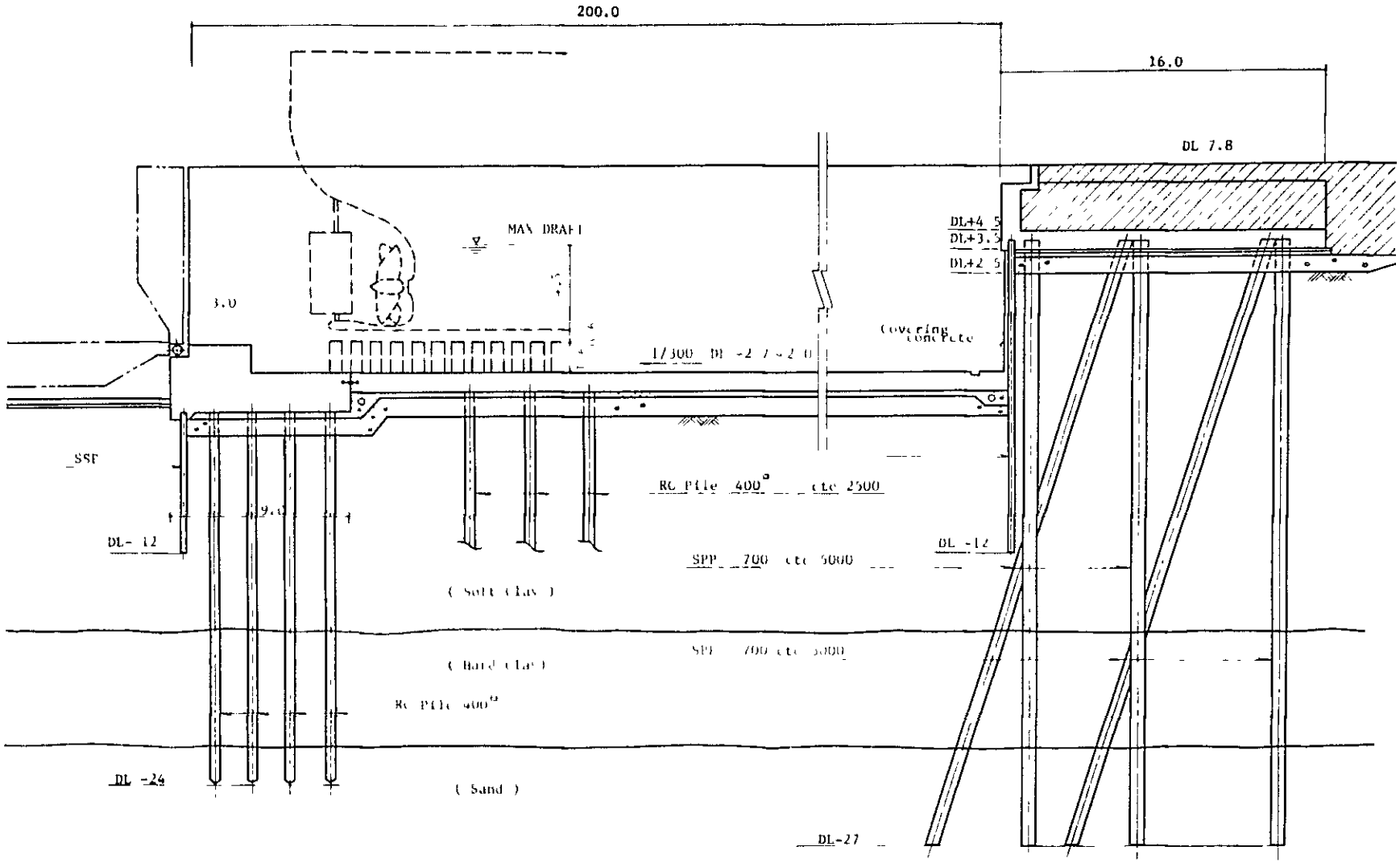


Fig III-3-10 Longitudinal Section of Dock

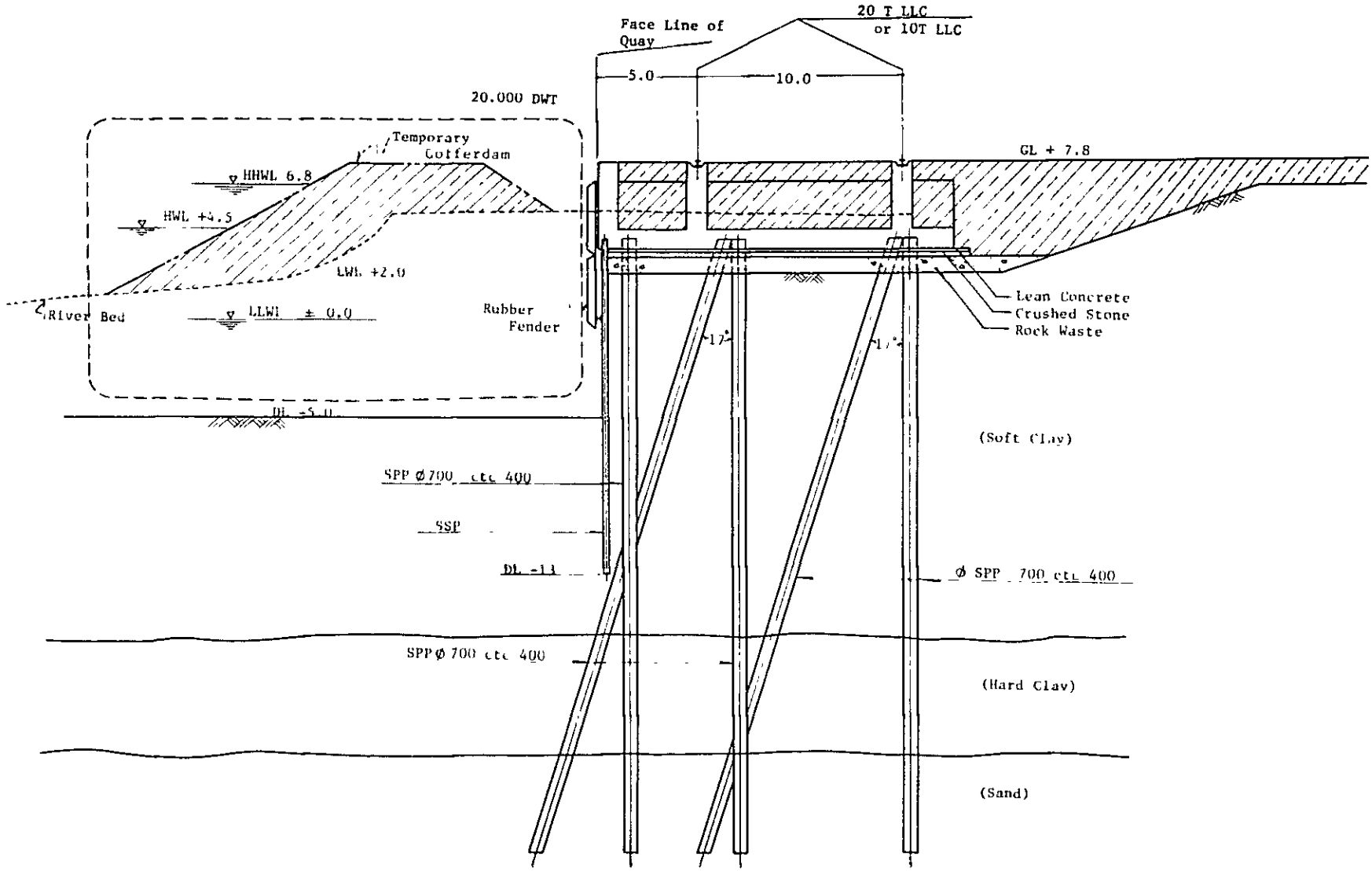


Fig III-3-11 Typical Cross Section of Mooring Quay

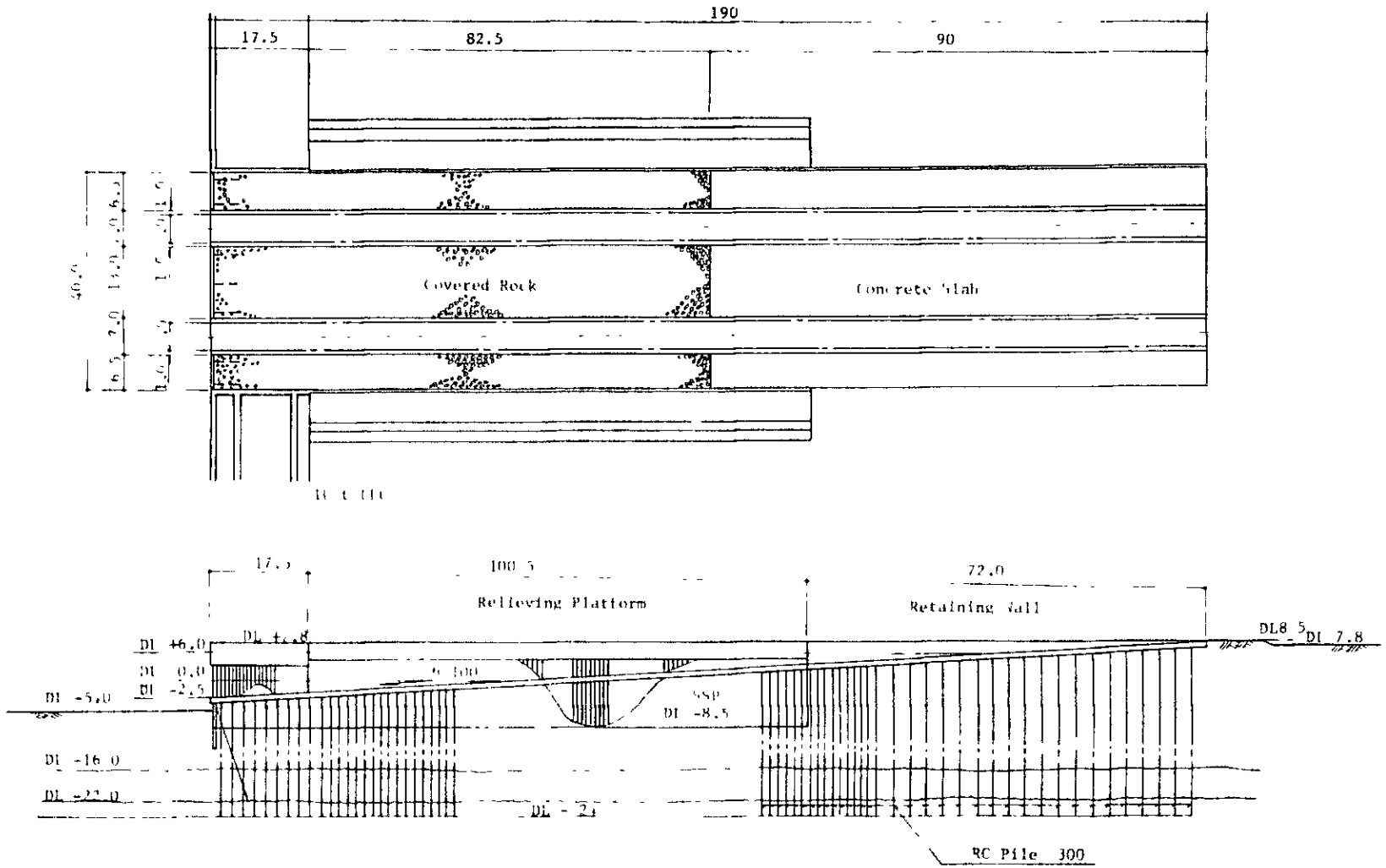
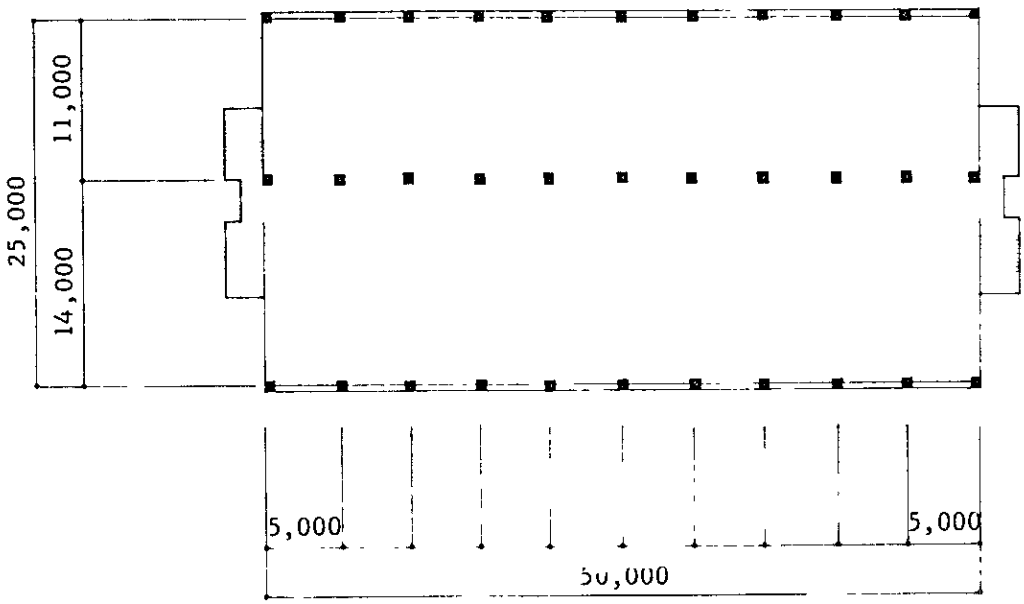
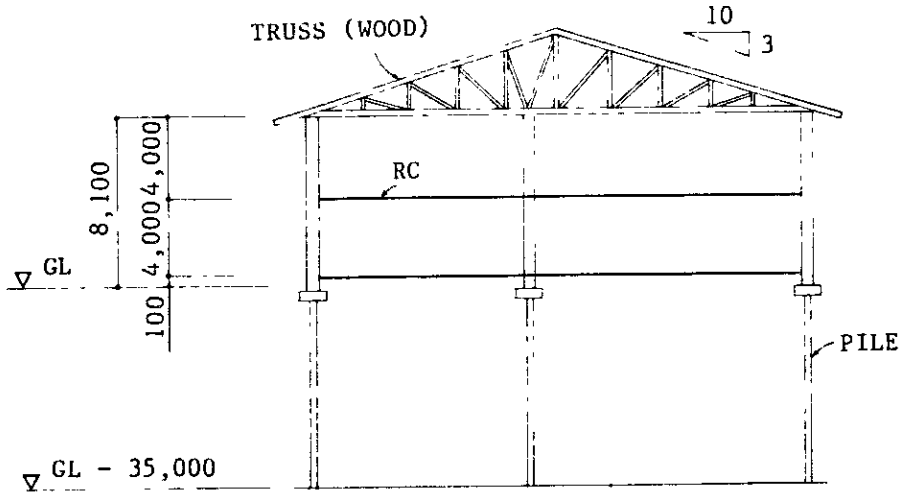


Fig III-3-12 Plan and Longitudinal Sectior of Slipway



PLAN



SECTION

Fig III-3-13 Administration Building

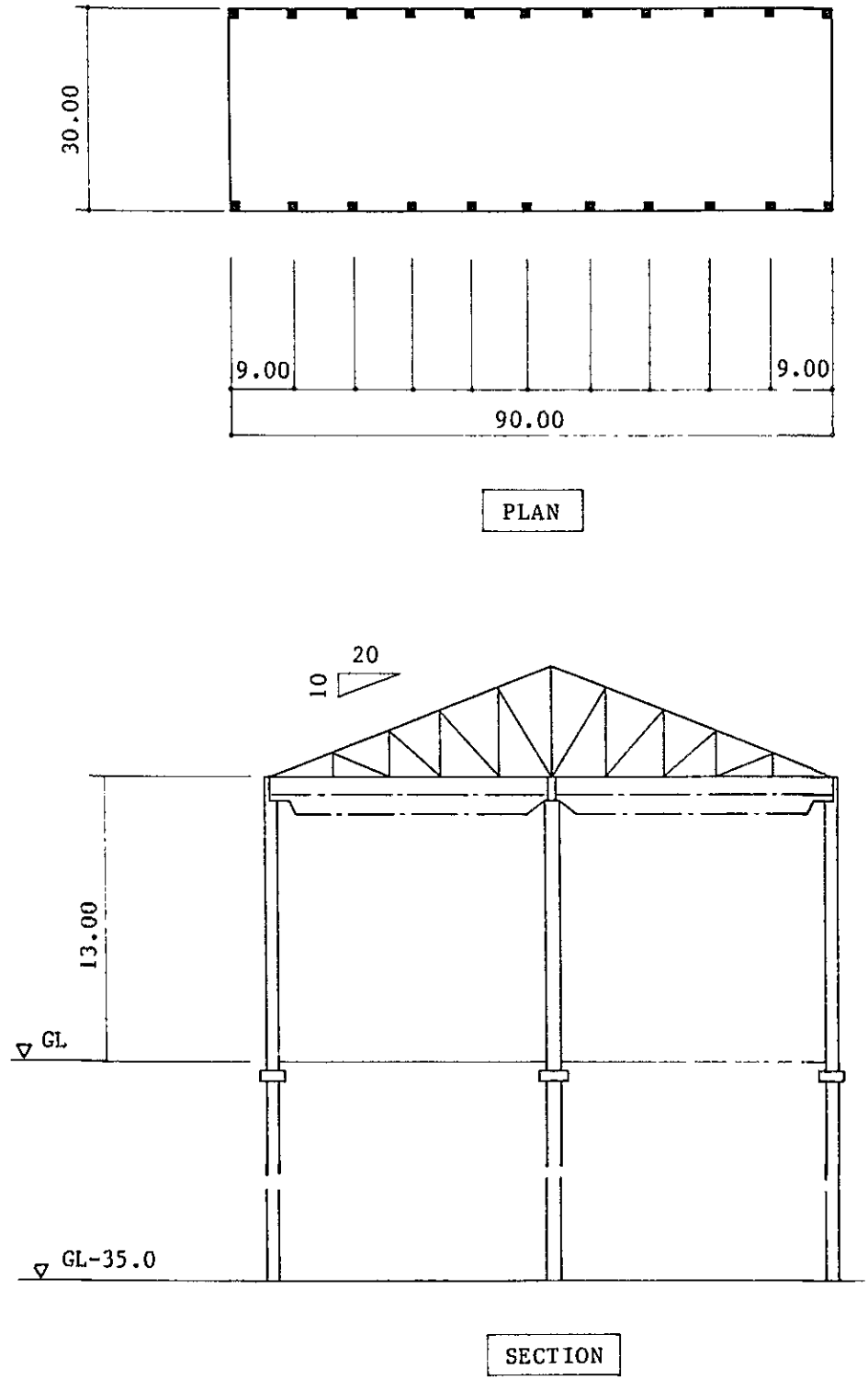


Fig III-3-14 Hull Shop

4. CONSTRUCTION IMPLEMENTATION PLAN

4-1. Progress Planning

This progress planning has been worked out on the assumption that a definite outlook for financing will have been acquired by June of 1985.

April 1986	Start of Construction
April 1990	Completion of Construction

Nevertheless, the dockyard will start operations in April 1989 when the principal production facilities are thoroughly completed. The implementation plan consolidating various programs for construction, training and education, dockyard operation, etc. is shown in Fig. III-4-1.

4-2. Capital Investment

The capital investment in this project is as shown in Table III-4-1 and Table III-4-1(A). These figures are based on values as of 1983.

4-3. Execution of Construction Work

In planning for the execution of construction relating to the project, materials and labor locally available in Burma shall be used whenever possible.

The major portion of all construction carried out in Burma is performed by the Construction Corporation; this Corporation has no previous

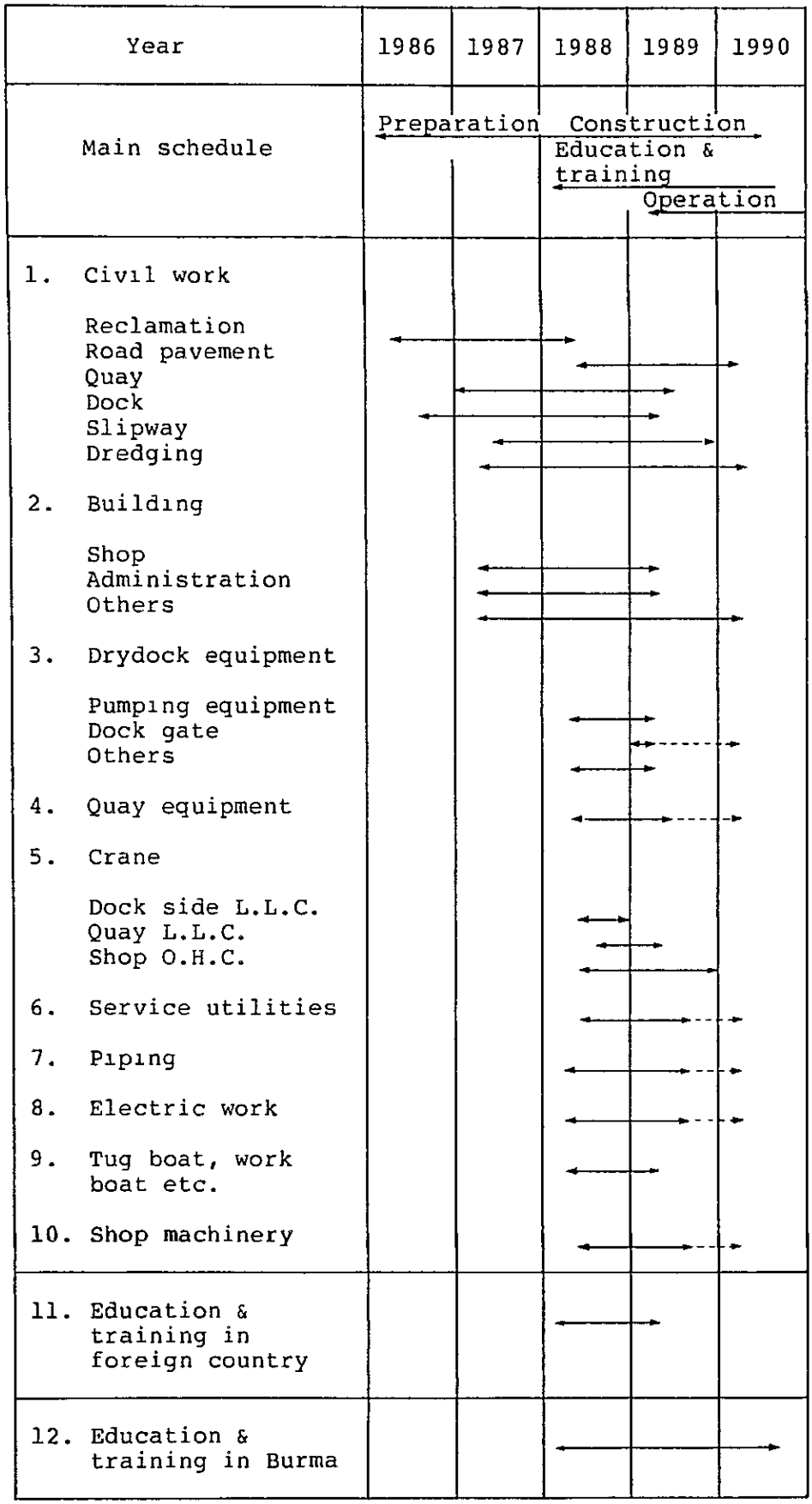


Fig. III-4-1 Implementation Plan

Table III-4-1 Capital Investment in Construction Project

As of 1983

	Foreign currenty portion (1,000US$)	Local currency portion (1,000US$)	Total (1,000US$)
1. Civil work	31,070	16,290	47,360
2. Building	5,180	2,600	7,780
3. Drydock equipment	1,710	390	2,100
4. Quay equipment	910	40	950
5. Crane	5,100	20	5,120
6. Service utilities and piping	3,140	130	3,270
7. Electric work	3,520	130	3,650
8. Vessel, mobil crane and transporter	4,660	1,000	5,660
9. Shop machinery	9,580	350	9,930
(Sub total)	64,870	20,950	85,820
10. Engineering fee	4,340	480	4,820
11. Educational and training fee	1,750	190	1,940
12. Contingencies	2,170	-	2,170
(Sub total)	8,260	670	8,930
Total investment	73,130	21,620	94,750
(Import tax)	-	(6,437)	(6,437)

Exchange rate 1US$ = 230 yen

Import tax is not included in Total investment.

Table III-4-1 (A) Details of Estimated Cost

Item	Unit	Foreign Currency Portion (1,000US$)	Local Currency Portion (1,000US$)	Total (1,000US$)
1. Civil works		31,070	16,290	47,360
Reclamation		264	709	973
Road		1,619	2,177	3,796
Quay		10,409	2,719	13,128
Dock		10,507	5,208	15,715
Slipway		4,068	2,412	6,480
Dredging		2,350	1,742	4,092
Temporary works		1,853	1,323	3,176
* Power supply system		(173)	(10)	(183)
* Water supply system		(10)	(203)	(213)
* Quality control test		(208)	(20)	(228)
* Temporary jetty		(62)	(8)	(70)
* Unloading		(163)	(195)	(358)
* Stage for excavation		(657)	(82)	(739)
* Temporary building with equipment (office, engineer's house, labour house, laboratory, etc.)		(238)	(458)	(696)
* Facilities for safety, security and sanitary		(52)	(17)	(69)
* Drainage system during construction			(15)	(15)
* Cleaning and removal of temporary facilities			(4)	(4)
* Repair shop for construction		(20)	(65)	(85)
* Motor pool			(3)	(3)
* Maintenance cost for road			(221)	(221)
* Measurement with equipment		(270)	(22)	(292)

Item	Unit	Foreign Currency Portion (1,000US$)	Local Currency Portion (1,000US$)	Total (1,000US$)
2. Shops and buildings		5,180	2,600	7,780
Administration building		253	423	676
Guest and dock house		121	202	323
Oxygen & acetylene plant shop		93	36	129
Facilities service shop		73	30	103
Galvanizing shop		130	50	180
Foundry shop		130	50	180
Carpenter, Mold shop		326	125	451
Machine shop		326	125	451
Engine repair, pipe shop		407	157	564
Electrical shop		154	59	213
Painting shop		245	94	339
Hull shop		1,207	375	1,582
Garage		77	29	106
Dispensary		40	68	108
Gate office		30	51	81
Electric sub-station		27	44	71
Fire-fighting room		18	30	48
Compressor room		53	89	142
Storage ware house		495	189	684
Docker store		62	23	85
Canteen & worker's house		705	271	976
Training center		193	74	267
Winch house		15	6	21

Item	Unit	Foreign Currency Portion (1,000US$)	Local Currency Portion (1,000US$)	Total (1,000US$)
3. Drydock equipment		1,710	390	2,100
Dock gate		1,140	152	1,292
Pumping equipment		210		210
Block			195	195
Docking and undocking eq.		327		327
Access equipment		38		38
Labour & temporary works			43	43
4. Quay equipment		910	40	950
Mooring equipment		901		901
Access equipment		10		10
Labour & temporary works			40	40
5. Crane		5,100	20	5,120
Dockside L.L.C.		1,346		1,346
Quay L.L.C.		1,470		1,470
Shop O.H.C.		2,291		2,291
Labour & temporary works			20	20
6. Service utilities & piping		3,140	130	3,270
Water supply equipment		115		115
Air compressor		642		642
C2H2&02 generating plant		1,203		1,203
Dryice generator		183		183
Piping		1,000		1,000
Labour & temporary works			130	130
7. Electric work		3,520	130	3,650
Power substation		2,145		2,145

Item	Unit	Foreign Currency Portion (1,000US$)	Local Currency Portion (1,000US$)	Total (1,000US$)
Cable & material		870		870
Emergency generator		399		399
Light (drydock & slipway)		55		55
Portable transformer, water resistance, reacter		52		52
Labour & temporary works			130	130
8. Vessel, mobile crane and transporter		4,660	1,000	5,660
Vessel		2,929	1,000	3,929
Mobile crane		1,011		1,011
Transporter		649		649
Fire engine, ambulance car, and business car		75		75
9. Shop machinery		9,580	350	9,930
Hull shop		691	130	821
Engine repair shop		2		2
Pipe shop		127		127
Machine shop		2,842		2,842
Electrical shop		173		173
Foundry shop		1,206		1,206
Galvanizing shop		340	43	383
Carpenter shop		16		16
Painting shop		819		819
Slipway equipment		1,000	52	1,052
Pollution preventive eq.		367		367
Welding machine		425		425
Tools		1,572		1,572
Labour & temporary works			130	130

Item	Unit	Foreign Currency Portion (1,000US$)	Local Currency Portion (1,000US$)	Total (1,000US$)
10. Engineering fee		4,340	480	4,820
Soil investigation		122	34	156
Detail design		2,168	81	2,249
Supervision		2,050	365	2,415
11. Educational & training fee		1,750	190	1,940
12. Contingencies		2,170		2,170
TOTAL		73,130	21,620	94,750
Import tax			6,437	6,437
	Rate			
Civil work material	10%		1,824	1,824
Building material	10%		554	554
Machine	15%		4,059	4,059
Import tax is not included in total investment.				

experience in the construction of large-scale drydocks, however. Moreover, the proposed construction site of the dockyard features a weak subsoil which will demand a high level of technological skill in construction. For this reason, the technical assistance of overseas engineers is seen to be indispensable to the smooth execution of the project. Also, it is deemed necessary that the construction be performed primarily by a contractor having rich experience in the construction of such large-scale drydocks.

(1) Site Preparation

Approximately 300,000m^3 of earth are required for site preparation. This earth is scheduled to be transported to the site from a borrow pit located near the Payagon Pagoda, approximately 10km away. Although there is an existing roadway linking the site and this borrow pit (the glass factory roadway), this road is both narrow and poorly paved, and repair work is necessary before this road can be used for the transport of earth material.

(2) Dock and Quay

Owing to unfavorable soil conditions at the site, a relieving platform structure shall be adopted for both the dock and the quay, requiring the driving of numerous steel piles. Also, because all other heavy structures shall also require piles, piling work shall occupy a

large portion of the work schedule. Five pile drivers are to be used. Construction of the quay shall be carried out on land by constructing a temporary coffer using an embankment in front of the quay. Because heavy construction machinery cannot be operated on top of the excavation surface owing to the weak subsoil, dock excavation shall be performed using a clamshell on the stage installed.

(3) Dredging

Dredging shall be performed using 1 grab-bucket boat, 2 soil carriers, and 1 tugboat. The tidal current at the site is extermely fast, reaching a maximum of 6 knots. Because dredging can be carried out only in a current force of 2 knots or less, actual operation time is estimated to be limited to approximately 9 hours per day. Dredged soil is to be disposed of 1km downstream in the Rangoon River.

(4) Other Temporary Construction

Because there is no existing road linking Rangoon City with the site at present, it shall be necessary to transport a vast quantity of the construction materials and equipment to the site via river from Rangoon. A temporary jetty shall therefore be constructed for unloading such materials and equipment. It will also be necessary to acquire a yard in Rangoon for temporary stocking of the materials and equipment.

Table III-4-2 shows the supply breakdown for major construction materials. Table III-4-3 is a list of the major construction machinery required.

Table III-4-2 Breakdown for Major Construction Material

No	Items	Description	Procurement	
			Foreign	Local
1	Civil and Building			
	(1) Design		○	
	(2) Material	Dock, Quay		
		Steel sheet pile Steel pipe pile	○	
		Reinforced concrete		
		Steel bar	○	
		Cement		○
		Wooden form		○
		Steel form	○	
		Bitt, Fender	○	
		Road		
		Asphalt	○	
		Sub-base		○
		Building		
		Shape steel	○	
		Corrugated steel plate	○	
		Brick		○
	(3) Construction machinery		○	
	(4) Man power	Labor		○
2	Equipment			
	(1) Design		○	
	(2) Manufacture		○	
	(3) Man power	Labor for erection		○
3	Vessels			
	(1) Design		○	
	(2) Material		○	
	(3) Man power	Labor for building		○
4	Wiring and Piping			
	(1) Design		○	
	(2) Material		○	
	(3) Man power	Labor		○

Table III-4-3 Major construction machinery

Item	Remark	Quantity
Tractor shovel	30 m^3	2
Bulldozer	30 t	2
Bulldozer	60 t	2
Dump truck	11 t	20
Backhoe excavator	0.7 m^3	2
Backhoe excavator	2 m^3	1
Clamshell	1.2 m^3	2
Clamshell	0.7 m^3	1
Tire roller	15 t	1
Vibrating roller	1 t	1
Motor grader		2
Macadam roller		2
Pile driver		5
Crawler crane	40 t	2
Diesel hummer	35 t	5
Vibrating hummer		2
Truck crane	20 t	1
Truck crane	16 t	1
Batcher plant	40 t/h	1
Asphalt plant	35 t/h	1
Concrete mixing truck	6 m^3	5
Pump truck		1
Grab-bucket boat	2 m^3	1
Soil carrier	500 t	2
Tug boat		1
Trailer	20 t	2
Truck	10 t	2
Pontoon	300 - 500 t	1
Others	Pump, welder, generator, etc.	

5. PLANNING FOR MANAGEMENT AND OPERATION OF DOCKYARD

5-1. Production Planning

5-1-1. Quantity of Production in Ship Repair

The quantity of production in ship repair is to be estimated from the aforementioned demand prediction. The production on the slipway is assumed at 10% of the total repairs of the B.F.S.S.C.'s vessels.

5-1-2. Steel Structure

The production quantity of steel structures is aimed at 400 tons in the first operation year. It is forecast to increase gradually onwards. The chief objectives will be various kinds of assembling or fabricating steel structures which will be utilized in the New Rangoon Port Project, etc.

5-1-3. Miscellaneous

The items for production in other fields include offshore repair, and manufacture of castings, forgings, galvanized articles, etc. which will be required at cement mills and various other plants.

A production programme based upon the above is indicated in Table III-5-1.

To proceed with the operation of the dockyard on the basis of the above production programme, various articles have to be procured systematically.

Table III-5-1 Annual Production Programme

Year	Ship-repair in dock (DWT)		Ship-repair on slipway (DWT)	Production of steel structure (TON)	Production of foundry shop (TON)
	BFSSC's vessel	Foreign vessel			
1989	154,200	0	15,400	400	200
1993	201,100	30,000	20,100	600	300
1998	244,200	80,000	24,400	800	400
2003	326,800	80,000	32,700	1,000	500
2008	387,300	80,000	38,700	1,200	600
2013	481,000	0	48,100	1,400	700
2018	500,000	0	50,000	1,600	800

The standard inventory of materials and parts is mentioned below. Almost all of these articles have to be imported from abroad, so a detailed procurement scheme shall be worked out to assist the dockyard operations.

- Steel materials - steel sheet, shape, pipe, flat bar, round bar, stainless steel, etc.

· Secondary steel product and nonferrous materials	- wire net, expand metal, copper sheet and bar, aluminum sheet and bar, steel wire rope, etc.
· Piping material	- valve, flange, bolt and nut, commercial piece (elbow, reducer, etc.), etc.
· Electric material	- cable, insulation, wiring material, parts, etc.
· Hull and engine parts	- bearing, seal, O-ring, packing, cleaning oil, bolt and nut, zinc anode, shackle, welding rod, etc.
· Material for carpenter work	- cement, tile, timber, etc.
· Material for casting, forging and galvanizing	- gray iron casting, steel forging, white metal, zinc, steel casting, etc.

5-2. Manpower Planning

The necessary manpower has been estimated on the basis of the above-mentioned production programme and the following conditions.

* Individual working time per month
  = 170 hours/man-month

* Individual working time per year
  = 170 hours/man-month x 12 months
  = 2,040 hours/man

* Daily working time = 8 hours,
  Monthly working days = 20 days,
  Total overtime per month = 26 hours/man
  Attendance ratio = 90%

According to this planning, around 500 employees are necessary in the first year of operation, and this number shall gradually increase as production grows.

Table III-5-2 indicates the estimated annual working hours and Table III-5-3 indicates the manpower planning.

Table III-5-2 Estimated Annual Working Hour

Year	Annual working hour							
	Expected improvement of productivity	1. Ship repair in dock	2. Ship repair on slipway	3. Steel structure	4. Foundry shop	5. Machine shop	6. Others	Total
		3H/GT	6H/GT	160H/TON	128H/TON	3 PERSON/ MACHINE	10% of 1+2+3+4+5	1+2+3+4+5+6
1989	1	333,000	66,500	64,000	25,600	61,200	55,000	605,300
1993	1.397	357,300	62,100	68,700	27,400	65,700	58,100	639,300
1998	1.905	367,500	55,300	67,100	26,800	64,200	58,000	638,900
2003	2.336	376,100	60,400	68,400	27,300	65,400	59,700	657,300
2008	2.591	389,500	64,500	74,100	29,600	66,100	62,300	686,100
2013	2.725	381,200	76,200	82,200	32,800	62,800	63,500	698,700
2018	2.865	376,900	75,300	89,300	35,700	59,800	63,700	700,700

Annual working hour = Annual production x Working hour/unit ÷ Expected improvement of productivity
GT = DWT x 0.72

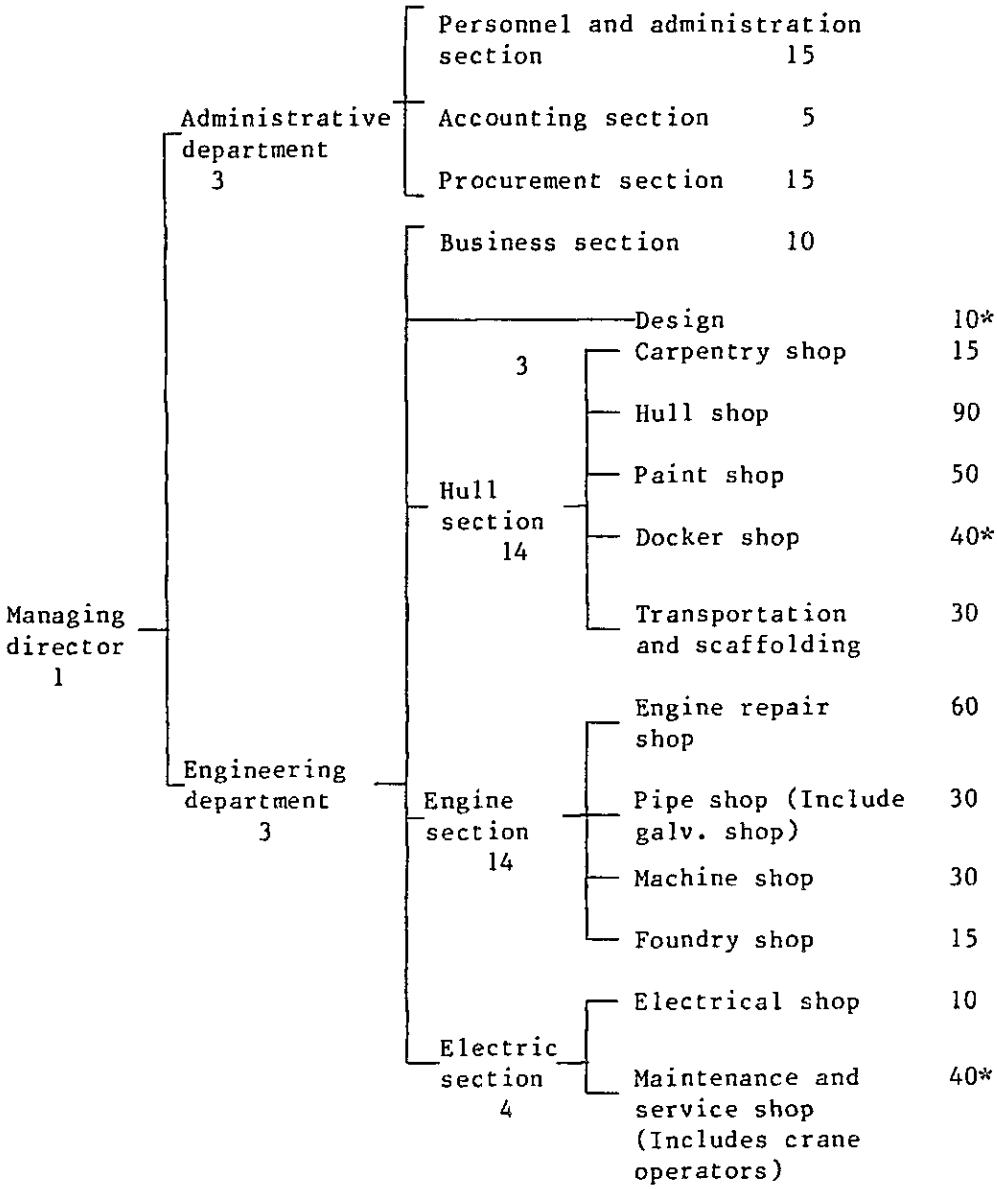
Table III-5-3 Manpower Planning

Year	Officers and Engineers	Indirect - Workers	Direct - Workers	Total
1989	80	90	330	500
1993	80	90	350	520
1998	80	90	350	520
2003	80	90	360	530
2008	80	90	370	540
2013	80	90	380	550
2018	80	90	380	550

Remarks: Indirect-workers: Workers for public service & tug boat crew. Administrative members are not included in the table.

5-3. Organization

As this dockyard specializes in ship repair, it tends to suffer a wide fluctuation in work load. Thus, it is advisable to train the workers in multitrade craftsmanship so as to facilitate their transfer among different trades instead of fostering specialized workers in a single trade only. The organization and manning plan is shown for reference in Fig. III-5-1.



Numbers show the number of persons.

Marks (*) show the indirect workers.

Fig. III-5-1 Organization and Manning Plan

5-4. Training Programme

Although some techniques and experience have accumulated at the Sinmalike Dockyard in the 13 years since its founding, adequate education and training programmes have to be implemented for engineers and workers respectively in order to increase their proficiency and improve their usefulness. Education in dockyard maintenance and ship repairs shall be conducted for the engineers, in production planning, lofting hull structure, engine and electric outfitting, shop machinery, etc., and for general workers in the lofting, marking, flame-cutting, plater's work, welding, docking and undocking, piping, galvanizing, machining, mechanical assembly, shafting, electric outfitting, painting, and shop machinery departments.

These educational activities may desirably be implemented through:

(1) dispatch of engineers and workers to advanced shipbuilding countries,

(2) engagement, in the initial stage of dockyard operations, of experts specializing in technical guidance from advanced shipbuilding countries,

(3) cultivation of skilled workers at domestic training centers,

(4) on-the-job training at the time of dockyard construction.

Table III-5-4 gives the training schedule for dockyard operation.

Table III-5-4 Training Schedule

Year	1988	1989	1990	1991
Main schedule				
Construction	←	—	→	
Operation		←	—	—
Training	←	—	→	
To be sent to technically advanced country				
Engineers				
Hull	← 2 →			
Engine	← 2 →			
Electric	← 1 →			
Technicians and skilled workers				
Hull	← 4	4 →		
Dock operation	← 2	2 →		
Piping and galvanizing	← 2	2 →		
Machine	← 1	1 →		
Engine	← 2	2 →		
Electric	← 2	2 →		
Paint	← 2	2 →		
Foundry	← 1	1 →		

Total 32 persons are devided in 2 groups.

Year	1988	1989	1990	1991
To obtain technical assistance from technically advanced country				
Hull		1 ←	→	
Engine		1 ←	→	
Electric		←	1 →	
Welding		←	1 →	
Dock operation		1 ←	→	
Machine		1 ←	→	
Paint and galvanizing		1 ←	→	
Training in Burma to workers	←			→

6. FINANCIAL ANALYSIS

6-1. Sales Estimations

6-1-1. Sales from ship repair

(1) Annual and special surveys

The repair cost of a ship depends upon the type and the age of the ship and the nature of the repair work. It is deeply influenced also by the shipping market, demand for ship repairs, dockyard capacity for ship repairs, shipping and shipbuilding policies, technical innovations, etc.

The figures for last three-years (1981-1983) of repairs on Burmese ships at foreign dockyards for annual and special surveys are shown in Table III-6-1, implying that the average unit cost of ship repairs on a Gross Tonnage basis is equal to US$38/G.T. Viewed from the age of a ship, the average unit cost of repairs for a vessel 20 to 22 years old is US$46/G.T., while that for a vessel 3 to 4 years old is US$10/G.T. The above data shows the general trend that the older the ship is, the higher the repair cost becomes.

In this analysis, taking into account the rejuvenation of ships to be effected by the Burmese Fleet Expansion Programme, the average unit cost of repair works for annual and special surveys is assumed at US$35/G.T. (base on 1983 prices)

Table III-6-1 BFSSC Docking Records at Foreign Dockyards

Year	DWT	GT	Year built	(*1) Kind of work	Period	Cost (US$)
1980	10,120	7,435	1963	A	28.1 - 8.2	216,117
	10,075	7,458	1963	A	31.1 - 5.2	232,279
	7,082	5,496	1961	S	12.4 - 21.4	228,667
	10,120	7,435	1963	A	5.5 - 9.5	263,425
	10,010	7,423	1963	A	27.7 - 9.8	281,899
	11,660	7,567	1979	A	6.9 - 10.9	59,925
	1,720	944	1961	A	9.10- 23.10	107,293
1981	10,120	7,435	1963	A	13.8 - 24.8	235,834
	4,000	2,749	1961	A	27.8 - 1.9	155,753
	10,075	7,458	1963	A	16.9 - 30.9	351,031
	2,076	1,620	1979	A	27.10- 31.10	42,028
	7,082	5,496	1961	A	5.11- 9.11	163,333
1982	10,120	7,435	1963	A	8.1 - 22.1	847,571
	10,010	7,423	1963	A	15.2 - 19.2	106,847
	11,660	7,567	1980	A	23.3 - 29.3	56,866
	2,076	1,620	1979	A	23.4 - 26.4	53,115
	11,660	7,567	1979	A	13.5 - 18.5	50,792
	1,720	944	1961	A	16.7 - 4.8	104,339
1983 (As of Aug.)	10,075	7,458	1963	A	4.5 - 17.5	384,464
	4,000	2,749	1961	A	4.6 - 18.6	179,607
	10,120	7,435	1963	S	19.7 - 7.8	408,441

Average unit cost

Year built	GT	Cost (US$)	Ave. Unit Cost (US$/GT)
'61 - '63	92,773	4,266,900	46.0
'79 - '80	25,941	262,726	10.1
Total	118,714	4,529,626	38.2

Note: (*1) A: Annual survey, S: Special survey

(Source: BFSSC)

on the basis of actual data on Burmese ships receiving repairs at foreign dockyards. This unit cost is to be applicable to the repair works as follows.

* 95% of domestic ships repaired both in the drydock and on the slipways.
* All foreign ships repaired in the drydock.

(2) Damage repairs and conversion work:

Projecting that this dockyard will undertake the repairs of ships damaged by sea casualty, etc., and conversion work of a simple type, the unit cost of these works is set at US$46/G.T. based on the actual results of ship repairs in Japan. It is assumed that the amount of these repair works corresponds to 5% of the total demand for repairing domestic vessels both in drydock and on slipways.

(3) Afloat repairs:

The sales from afloat repairs are assumed at 5% of the total sales from annual and special surveys, damage repairs, and conversion work.

6-1-2. Sales from other work

Improvement of the infrastructure is an important subject in the national development of Burma. In line with this, an increase in demand can be expected for steel structures such as bridges. This dockyard is also scheduled to manufacture steel structures (e.g. bridges), castings and forgings in order to contribute to the effective utilization of facilities and the equalization of work loads. The unit cost of these articles is assumed at US$1,300/Ton (based on 1983 prices) on the average.

6-1-3. Sales forecast

Based upon the above-mentioned assumptions and production planning (III-5-1), sales are estimated in Table III-6-2.

In this estimation, it is considered that the payment for ship repairs will be done by lump-sum at the time of completion, while for other works, such payment shall be done with primarily a piece rate system. The unit costs are assumed to increase by 5% every year in consideration of the tendency of world price rises.

Table III-6-2 Sales Estimation

(Unit in 1,000 US$)

Item \ Year	1 1989	2 1990	3 1991	4 1992	5 1993	6 1994	7 1995	8 1996	9 1997	10 1998	11 1999	12 2000	13 2001	14 2002	15 2003
1. Ship Repair															
(1) A & S Survey in drydock (BFSSC)	4,940	5,590	6,280	7,030	7,840	8,580	9,390	10,240	11,160	12,160	13,620	15,220	16,920	18,780	20,750
(2) " (Foreign vessels)					1,240	1,730	2,260	2,850	3,480	4,200	4,410	4,630	4,860	5,100	5,360
(3) A & S Survey on slipways	500	560	630	700	780	860	940	1,020	1,120	1,220	1,360	1,520	1,690	1,880	2,070
(4) Damage Repair and Conversion Work	380	420	480	540	600	650	720	770	850	940	1,050	1,160	1,300	1,440	1,590
(5) Afloat Repair	290	320	370	420	520	600	660	750	830	920	1,020	1,120	1,250	1,360	1,490
Sub-total	6,110	6,890	7,760	8,690	10,980	12,420	13,970	15,630	17,440	19,440	21,460	23,650	26,020	28,560	31,260
2. Other Works	870	1,030	1,200	1,380	1,580	1,780	1,980	2,210	2,440	2,700	2,990	3,280	3,610	3,940	4,330
Total	6,980	7,920	8,960	10,070	12,560	14,200	15,950	17,840	19,880	22,140	24,450	26,930	29,630	32,500	35,590

Item \ Year	16 2004	17 2005	18 2006	19 2007	20 2008	21 2009	22 2010	23 2011	24 2012	25 2013	26 2014	27 2015	28 2016	29 2017	30 2018
1 Ship Repair															
(1) A & S Survey in drydock (BFSSC)	22,590	24,570	26,690	28,960	31,390	34,560	37,970	41,630	45,570	49,790	52,690	55,750	58,990	62,420	66,030
(2) " (Foreign vessels)	5,630	5,910	6,210	6,520	6,840	5,720	4,520	3,170	1,650	-	-	-			
(3) A & S Survey on slipways	2,260	2,460	2,670	2,900	3,140	3,460	3,800	4,160	4,560	4,980	5,270	5,570	5,900	6,240	6,610
(4) Damage Repair and Conversion Work	1,730	1,870	2,030	2,190	2,410	2,630	2,880	3,170	3,460	3,800	3,990	4,240	4,500	4,730	5,020
(5) Afloat Repair	1,610	1,760	1,870	2,030	2,210	2,310	2,460	2,630	2,760	2,930	3,080	3,290	3,460	3,680	3,870
Sub-total	33,820	36,570	39,470	42,600	45,990	48,680	51,630	54,760	58,000	61,500	65,030	68,850	72,850	77,070	81,530
2. Other Works	4,710	5,150	5,590	6,100	6,600	7,180	7,770	8,430	9,100	9,850	10,620	11,480	12,360	13,340	14,340
Total	38,530	41,720	45,060	48,700	52,590	55,860	59,400	63,190	67,100	71,320	75,650	80,330	85,210	90,410	95,870

Note: A & S Survey; Annual and Special Survey

6-2. Estimations for Capital Investment Flow

6-2-1. Flow of capital for initial investment

For the purpose of assisting a financial analysis, the flow of capital for the initial investment is inferred on the basis of the implementation plan in Fig. III-4-1. In this estimation, there is the assumption that orders of materials, machinery and equipment to be imported will be placed a half or a whole year prior to the start of the site construction work, allowing for a certain number of days for preparation and manufacture of purchases in foreign countries and also for transportation into Burma. The investment (based on 1983 prices) shown in Table III-4-1 has been converted into the nominal prices at the time when the capital is actually employed, taking into account the rises in price for materials, equipment, etc., based upon the time of placing orders for materials and machinery and the duration of the site construction.

In this analysis, to evaluate this project from an enterprise point of view, the import duties of materials and equipment have, as a matter of course, been taken into consideration. As for import duties, the Import Duty Act of Burma imposes the following duty rates on the import amounts: 10% for articles of civil works and building and 15% for machinery and equipment.

The estimated results concerning capital flow for the initial investment is exhibited in Fig. III-6-1.

6-2-2. Reinvestment

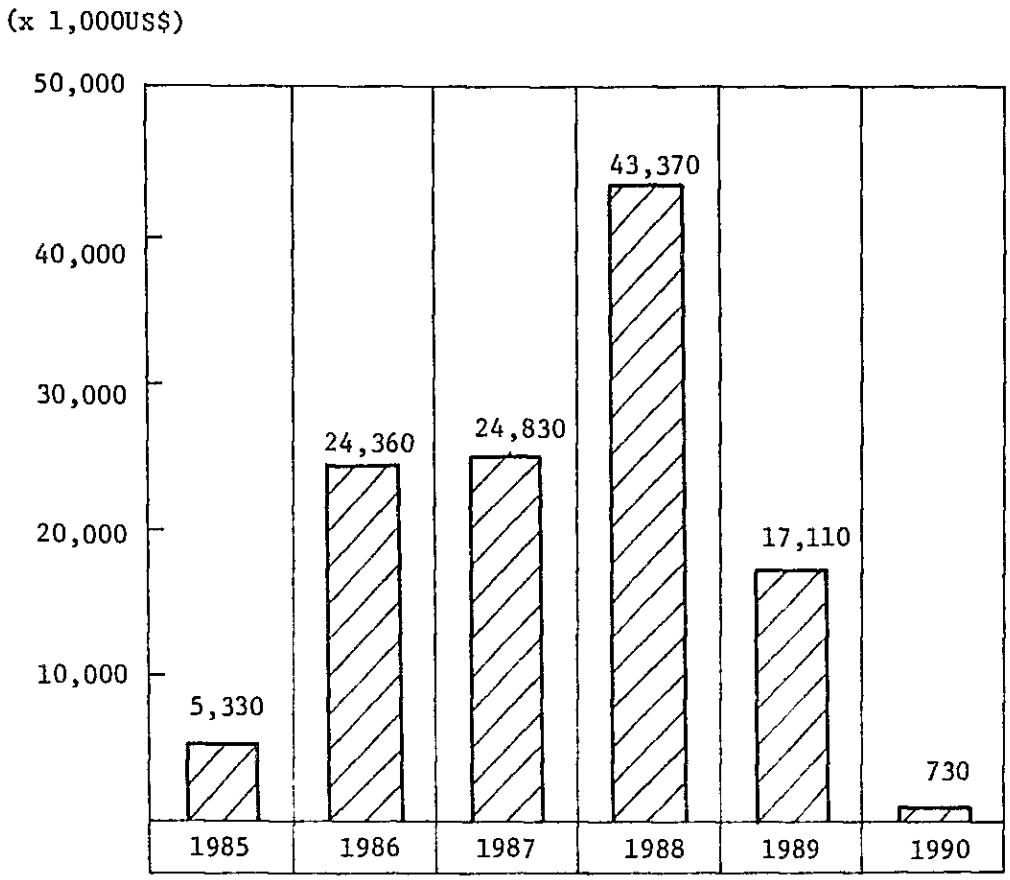
The shipbuilding industry (including ship repairing) compared with other industries, tends to promote a long-term projects, because of large investment costs and long-lived assets. In this analytical study, the project evaluation period is considered to be 30 years. It is conceivable, however, that some machinery and equipment may become useless, physically or economically, earlier than the end of the project period. In that case, reinvestment and additional investments for worn-out machinery and equipment is inevitable.

In this study, with regared to ships, vehicles, and shop machinery, the reinvestment and additional investments scheme has been worked out in consideration of individual length of durability for various machinery and in correlation with upkeep and improvements for well-balanced production capacity, as shown in Table III-6-3.

6-3. Cost Estimations

The estimation of costs during the 30 year project evaluation period is made on assumptions mentioned below and in accordance with the results of the aforementioned production and operation planning.

The estimated results can be seen in Table III-6-4.



(These figures are nominal price, including import tax.)

Fig. III-6-1 Estimated Capital Flow for Initial Investment

Table III-6-3 Estimation of Reinvestment

Items	Time of investment (year of operation)	Investment (1,000US$)	
		1983 price	Nominal price
Mobil cranes and transporters	10	450	900
	15	1,490	3,790
	20	450	1,470
Vessels	20	4,380	14,290
Shop machineries	15	2,260	5,760
	25	3,390	14,100

(These estimated figures include import tax)

(1) Personnel expenses

The average personnel expenses per head has been assumed at levels described below, making reference to the current BDC standard of salaries and wages.

Officers and Engineers	US$80/month
Direct Workers	US$40/month
Indirect Workers	US$40/month

The grounds for calculation of the personnel expenses are the above conditions and the man-power planning as previously mentioned. In this case, personnel expenses incurred prior to the start of operations have been taken into account. These costs, incurred from the payment of wages for preparation and education purposes prior to operations initiation, are assumed at 30% of the personnel expenses for the first year of operation. Increases in personnel expenses are assumed at 5% every year, based on the BDC wage system and the latest rise in prices in Burma.

(2) Social security costs

The social security costs, including medical service expenditures, are assumed at 6% of the personnel expenses in view of the current level of actual payment by BDC.

(3) Material costs

It is assumed that the annual costs of materials

for ship repair and other work, such as steel structures, come to the following:

For ship repair: 18% of the sales amount
For other works: 45% of the sales amount

The import ratio of materials to be procured by this dockyard is considered to decrease as follows, corresponding to the development of related industries in Burma.

Form the 1st through the 5th year : 90%
of operation

From the 6th through the 10th year: 80%
of operation

From the 11th through the 20th year: 70%
of operation

From the 21st through the 30th year: 60%
of operation

At the same time, in view of the time required for procuring the materials to be imported, the required inventory is estimated at one-year consumption, computable from the results of production planning.

(4) Direct expenses

The direct expenses including ship inspection charges are to increase in proportion to the amount of work. In this study, these expenses are considered equivalent to 6% of sales.

(5) Repair and maintenance costs

The repair and maintenance costs depend upon sizes of facilities, frequency of their employment, and their age. In this study, the repair and maintenance costs in the first year of operation are set down at 0.23% of construction investment (excluding the portions for engineering and educational services), and are increased at the same rate as the rise in sales in and after the second year of operation. To compensate for the aging of certain machinery, the aforementioned reinvestment has been taken into consideration.

(6) Indirect and administrative expenses

The indirect and administrative expenses can be expressed as a function of sales, capacity of facilities, volume of manpower, etc. In this analysis, considering that the ratio of these expenses to the sales falls according to an increase in management efficiency, etc. in the indirect and administrative sections, these expenses have been set at 8% of sales for the first year of operation. This rate is assumed to decrease gradually to 6% by the 30th year of operation.

(7) Depreciation costs

The depreciation costs have been estimated on the basis of the depreciation rates of Burma defined by its assets. The results are shown in Table III-6-5.

Table III-6-4 Cost Estimation

(Unit in 1,000US$)

Items \ Year	-1 1988	1 1989	2 1990	3 1991	4 1992	5 1993	6 1994	7 1995	8 1996	9 1997	10 1998	11 1999	12 2000	13 2001	14 2002	15 2003
1 Personnel Expenses (engineers and officers)	29	103	108	114	119	125	131	138	145	153	160	168	176	185	195	204
2 " (direct and indirect workers)	78	271	287	306	324	344	361	379	398	418	439	463	488	515	543	573
3. Social Security Cost	6	22	24	25	27	28	30	31	33	34	36	38	40	42	44	47
4. Material Cost (Ship repairing)	943	1,100	1,241	1,396	1,564	1,976	2,235	2,514	2,813	3,140	3,499	3,864	4,259	4,684	5,140	5,625
5. " (other works)	336	392	463	540	621	711	799	891	992	1,098	1,216	1,346	1,476	1,622	1,779	1,948
6. Direct Expenses		350	397	448	504	629	710	797	892	994	1,108	1,220	1,348	1,482	1,624	1,780
7. Repair and Maintenance Cost		236	267	303	340	424	479	539	603	672	747	827	911	1,002	1,099	1,203
8. Indirect and Administrative Expenses	160	560	639	724	818	917	1,026	1,142	1,269	1,403	1,551	1,670	1,795	1,930	2,072	2,226
Total	1,552	3,034	3,426	3,856	4,317	5,154	5,771	6,431	7,145	7,912	8,756	9,596	10,493	11,462	12,496	13,606

Items \ Year	16 2004	17 2005	18 2006	19 2007	20 2008	21 2009	22 2010	23 2011	24 2012	25 2013	26 2014	27 2015	28 2016	29 2017	30 2018
1. Personnel Expenses (engineers and officers)	215	225	237	248	261	274	288	302	317	333	349	367	385	405	425
2 " (direct and indirect workers)	605	638	673	710	748	789	832	917	967	977	1,026	1,077	1,131	1,187	1,247
3. Social Security Cost	49	52	55	58	61	64	67	73	77	79	83	87	91	96	100
4. Material Cost (ship repairing)	6,088	6,582	7,104	7,669	8,277	8,761	9,293	9,857	10,440	11,069	11,704	12,393	13,113	13,873	14,673
5. " (other works)	2,126	2,317	2,519	2,738	2,973	3,229	3,498	3,791	4,095	4,433	4,786	5,165	5,563	5,994	6,453
6. Direct Expenses	1,928	2,086	2,254	2,435	2,631	2,795	2,972	3,160	3,355	3,570	3,785	4,016	4,263	4,523	4,793
7. Repair and Maintenance Cost	1,301	1,410	1,524	1,645	1,778	1,888	2,005	2,133	2,268	2,411	2,555	2,716	2,877	3,052	3,238
8. Indirect and Administrative Expenses	2,390	2,562	2,749	2,945	3,156	3,353	3,565	3,790	4,026	4,283	4,538	4,822	5,113	5,427	5,753
Total	14,702	15,872	17,115	18,448	19,885	21,153	22,520	24,023	25,545	27,155	28,826	30,643	32,536	34,557	36,682

Table III-6-5 Schedule of Depreciation

(Unit in 1,000US$)

Item	Rate of Depreciation per year	Depreciable Assets	1 1989	2 1990	3 1991	4 1992	5 1993	6 1994	7 1995	8 1996	9 1997	10 1998	11 1999	12 2000	13 2001	14 2002
A Initial Investment																
1 Buildings	3.0%	5,960	149	149	149	149	149	149	149	149	149	149	149	149	149	149
2 Dock and Slipways	2.5%	29,370	734	734	734	734	734	734	734	734	734	734	734	734	734	734
3 Wharves	5.0%	16,960	848	848	848	848	848	848	848	848	848	848	848	848	848	848
4 Roads, etc	5.0%	8,630	432	432	432	432	432	432	432	432	432	432	432	432	432	432
5 Electrical Instal	5.0%	4,960	248	248	248	248	248	248	248	248	248	248	248	248	248	248
6 Plants and Machineries	7.5%	24,900	1,868	1,868	1,868	1,868	1,868	1,868	1,868	1,868	1,868	1,868	1,868	1,868	1,868	616
Vessels	7.5%	5,180	389	389	389	389	389	389	389	389	389	389	389	389	389	1,4
8 Motor Vehicles, etc	15.0%	4,360	354	354	354	354	354	354	236							
9 Engineering and Training	20.0%	7,830	1,566	1,566	1,566	1,566	1,566									
Sub-total		110,140	6,588	6,588	6,588	6,588	6,588	5,022	4,904	4,663	4,663	4,663	4,663	4,663	4,663	1,150
B Reinvestment																
10 Plants and Machineries	7.5%	19,860														
11 Vessels	7.5%	14,290														
12 Motor Vehicles, etc	15.0%	6,160										135	135	135	135	135
Sub-total		40,310										135	135	135	135	135
Total			6,588	6,588	6,588	6,588	6,588	5,022	4,904	4,663	4,663	4,798	4,798	4,798	4,798	3,285

Year / Item	15 2003	16 2004	17 2005	18 2006	19 2007	20 2008	21 2009	22 2010	23 2011	24 2012	25 2013	26 2014	27 2015	28 2016	29 2017	30 2018	Residual Value
A Initial Investment																	
1. Buildings	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	5,480
2 Dock and Slipways	734	734	734	734	734	734	734	734	734	734	734	734	734	734	734	734	7,350
3 Wharves	848	848	848	848	848	848											-
4 Roads, etc	432	432	432	432	432	432											-
5 Electrical Instal.	248	248	248	248	248	248											
Sub-total	2,411	2,411	2,411	2,411	2,411	2,411	883	883	883	883	883	883	883	883	883	88	12,830
B Reinvestment																	
10. Plants and Machineries	432	432	432	432	432	432	432	432	432	432	1,490	1,490	1,490	1,202	1,058	1,058	7,754
11. Vessels						1,072	1,072	1,072	1,072	1,072	1,072	1,072	1,072	1,072	1,072	1,072	2,498
12. Motor Vehicles, etc.	704	659	569	569	569	789	596	220	220	220	220	150					
Sub-total	1,136	1,091	1,001	1,001	1,001	2,293	2,100	1,724	1,724	1,724	2,782	2,712	2,562	2,274	2,130	2,130	10,250
Total	3,547	3,502	3,412	3,412	3,412	4,704	2,983	2,607	2,607	2,607	3,665	3,595	3,445	3,157	3,013	3,013	23,080

6-4. Financial Evaluation

6-4-1. Criteria for evaluation of project profitability

There are various methods for evaluating the profitability of a project. In the case of a long-term project or a project employing enormous amounts of capital, it is very important to look at its profitability in correlation with the timing of capital inflows and outflows in the project appraisal. From this point of view, and in serious consideration of time values, the Internal Rate of Return (IRR), a typical index for such evaluations, has been adopted as a critierion for evaluating the project profitability in this study. The IRR is a discounted rate which functions to reduce into zero the aggregate differences in net present value between the cash inflows and the cash outflows of the project.
This is expressed by the following equation:

$$\sum_{t=1}^{n} \frac{CIt - COt}{(1 + r)t} = 0$$

CIt = Cash Inflow in the "t"th year

COt = Cash Outflow in the "t"th year

r = IRR

The above equation implies that the equilibrium between income and expenditure of this project will be maintained by employing fund at a rate of interest equivalent to the IRR. In other words, the IRR will suggest a reasonable rate of interest in using individual fund. In the case where the IRR for a project is known beforehand, the financial feasibility of the project may more or less be regarded as verified only if the cost for raising funds stays at a lower level than the one of the IRR. The IRR appearing in the financial evaluation shall be called "Financial Internal Rate of Return (FIRR)" to distinguish it from the IRR to be used in the economic evaluation.

6-4-2. Estimation of cash flow

The cash flow of an enterprise may vary depending upon its business activities, which are susceptible to influences from external factors. It then follows, of course, that cash flow also may change under influences from economic, political, and social factors outside the enterprise. In this analysis, inflation has been taken into account as an external factor influencing cash flow. This is because the influence of inflation can not be ignored in financial analyses, especially in the case of such a long term project. Therefore, a reasonably-assumed rate of inflation is necessary for a practical financial evaluation. Table III-6-6 indicates the cash flows in this project on the basis of estimated results for

sales, invested-capital flows, and costs, as influenced by inflation in the way as previously mentioned.

Furthermore, to make clear the true nature of this project, for comparison's sake, cash flow has been estimated in the case where no price rises (and no income rises) are assumed to exist. The results can be seen in Table III-6-7.

There is an alternative calculation method that does not take into consideration tax payment (such as income taxes) in the cash flow analysis as a basis for calculating the FIRR. In this case, besides repayment of the principal and the interest for loans, payment of taxes shall be included in the cash flow. In this analysis, however, the Contribution-to-the State (applicable to corporations in Burma) equivalent to 30% of the profit after depreciation has been taken into account to study in- and out-flows of capital from the viewpoint of dockyard management.

In the case loans or other external funds are introduced to finance the project, payment of the interest thus incurred can be deducted from the profit account as a non-operating loss, and the profit before taxes decreases accordingly. As a result, payment of the Contribution-to-the State will decrease likewise. However, its influence upon the FIRR can be said to be minute in view of the nature of this project (profitless operation for the initial four or five years, depreciation cost accounting for a high percentage of the costs, etc.).

Table III-6-6 Cashflow Estimation (a reasonable inflation rate of 5%/year being considered)

(Unit in 1,000US$)

Items \ Year	-4 1985	-3 1986	-2 1987	-1 1988	1 1989	2 1990	3 1991	4 1992	5 1993	6 1994	7 1995	8 1996	9 1997	10 1998	11 1999	12 2000	13 2001
A. Income or Loss																	
(1) Sales					6,980	7,930	8,960	10,070	12,560	14,200	15,950	17,840	19,880	22,140	24,450	26,930	29,630
(2) Cost				1,553	3,034	3,426	3,856	4,317	5,154	5,771	6,431	7,145	7,912	8,756	9,596	10,493	11,463
(3) Depreciation					6,588	6,588	6,588	6,588	6,588	5,022	4,904	4,663	4,663	4,798	4,798	4,798	4,798
(4) Operating Income or Loss				-1,553	-2,642	-2,084	-1,484	-835	818	3,407	4,615	6,032	7,305	8,586	10,056	11,639	13,369
(5) Contribution to the State					-	-	-	-	245	1,022	1,385	1,810	2,192	2,576	3,017	3,492	4,011
(6) Net Income or Loss				-1,553	-2,642	-2,084	-1,484	-835	573	2,385	3,230	4,222	5,113	6,010	7,039	8,147	9,358
B. Cash in-flow																	
(3) + (6)				-1,553	3,946	4,504	5,104	5,753	7,161	7,407	8,134	8,885	9,776	10,808	11,837	12,945	14,156
C. Cash out-flow																	
Initial Investment	5,330	24,360	24,830	43,370	17,110	730											
Reinvestment														900			
D. Cashflow																	
B - C	-5,330	-24,360	-24,830	-44,923	-13,164	3,774	5,104	5,753	7,161	7,407	8,134	8,885	9,776	9,908	11,837	12,945	14,156

Item \ Year	14 2002	15 2003	16 2004	17 2005	18 2006	19 2007	20 2008	21 2009	22 2010	23 2011	24 2012	25 2013	26 2014	27 2015	28 2016	29 2017	30 2018
A. Income or Loss																	
(1) Sales	32,500	35,590	38,530	41,720	45,060	48,700	52,590	55,860	59,400	63,190	67,100	71,320	75,650	80,330	85,210	90,410	95,870
(2) Cost	12,496	13,606	14,702	15,872	17,115	18,448	19,885	21,153	22,520	24,023	25,545	27,155	28,826	30,643	32,536	34,557	36,682
(3) Depreciation	3,285	3,547	3,502	3,412	3,412	3,412	4,704	2,983	2,607	2,607	2,607	3,665	3,595	3,445	3,157	3,013	3,013
(4) Operating Income or Loss	16,719	18,437	20,326	22,436	24,533	26,840	28,001	31,724	34,273	36,560	38,948	40,500	43,229	46,242	49,517	52,840	56,175
(5) Contribution to the State	5,016	5,531	6,098	6,731	7,360	8,052	8,400	9,517	10,282	10,968	11,684	12,150	12,969	13,873	14,855	15,852	16,853
(6) Net Income or Loss	11,703	12,906	14,228	15,705	17,173	18,788	19,601	22,207	23,991	25,592	27,264	28,350	30,260	32,369	34,662	36,988	39,322
B. Cash in-flow																	
(3) + (6)	14,988	16,453	17,730	19,117	20,585	22,200	24,305	25,190	26,598	28,199	29,871	32,015	33,855	35,814	37,819	40,001	42,335
C. Cash out-flow																	
Reinvestment		9,550					15,760					14,100					
D. Cashflow																	(23,080)
B - C	14,988	6,903	17,730	19,117	20,585	22,200	8,545	25,190	26,598	28,199	29,871	17,915	33,855	35,814	37,819	40,001	65,415

Note: The figure in the bracket in 2018 is residual value.

Table III-6-7 Cashflow Estimation (at 1983 constant price)

(Unit in 1,000 US$)

Items \ Year	-4 1985	-3 1986	-2 1987	-1 1988	1 1989	2 1990	3 1991	4 1992	5 1993	6 1994	7 1995	8 1996	9 1997	10 1998	11 1999	12 2000	13 2001
A. Income or Loss																	
(1) Sales					5,210	5,630	6,060	6,490	7,710	8,300	8,880	9,460	10,040	10,650	11,200	11,750	12,310
(2) Cost				1,217	2,264	2,435	2,610	2,783	3,164	3,374	3,581	3,789	3,996	4,212	4,396	4,578	4,763
(3) Depreciation					5,731	5,731	5,731	5,731	5,731	4,347	4,248	4,050	4,050	4,118	4,118	4,118	4,118
(4) Operating Income or Loss				-1,217	-2,785	-2,536	-2,281	-2,024	-1,185	579	1,051	1,621	1,994	2,320	2,686	3,054	3,429
(5) Contribution to the State										174	313	486	598	696	806	916	1,029
(6) Net Income or Loss				-1,217	-2,785	-2,536	-2,281	-2,024	-1,185	405	738	1,135	1,396	1,624	1,880	2,138	2,400
B. Cash in-flow																	
(3) + (6)				-1,217	2,946	3,195	3,450	3,707	4,546	4,752	4,986	5,185	5,446	5,742	5,998	6,256	6,518
C. Cash out-flow																	
Initial Investment	4,930	21,230	21,640	37,800	14,920	660											
Reinvestment														450			
D. Cashflow																	
B - C	-4,930	-21,230	-21,640	-39,017	-11,974	2,535	3,450	3,707	4,546	4,752	4,986	5,185	5,446	5,292	5,998	6,256	6,518

Items \ Year	14 2002	15 2003	16 2004	17 2005	18 2006	19 2007	20 2008	21 2009	22 2010	23 2011	24 2012	25 2013	26 2014	27 2015	28 2016	29 2017	30 2018
A. Income or Loss																	
(1) Sales	12,860	13,410	13,830	14,260	14,670	15,100	15,530	15,710	15,910	16,120	16,300	16,510	16,670	16,860	17,030	17,210	17,380
(2) Cost	4,945	5,128	5,277	5,426	5,572	5,720	5,872	5,949	6,032	6,128	6,206	6,283	6,352	6,431	6,503	6,578	6,650
(3) Depreciation	2,834	2,581	2,581	2,513	2,513	2,513	2,910	1,493	1,347	1,347	1,347	1,601	1,575	1,533	1,413	1,363	1,363
(4) Operating Income or Loss	5,081	5,701	5,972	6,321	6,585	6,867	6,748	8,268	8,531	8,645	8,747	8,626	8,743	8,896	9,114	9,269	9,367
(5) Contribution to the State	1,524	1,710	1,792	1,896	1,976	2,060	2,024	2,480	2,559	2,594	2,624	2,588	2,623	2,669	2,734	2,781	2,810
(6) Net Income or Loss	3,557	3,991	4,180	4,425	4,609	4,807	4,724	5,788	5,972	6,051	6,123	6,038	6,038	6,227	6,380	6,488	6,557
B. Cash in-flow																	
(3) + (6)	6,391	6,572	6,761	6,938	7,122	7,320	7,634	7,281	7,319	7,398	7,470	7,639	7,695	7,760	7,793	7,851	7,920
C. Cash out-flow																	
Reinvestment	3,750						4,830					3,390					
D. Cashflow																	(14,061)
B - C	2,641	6,572	6,761	6,938	7,122	7,320	2,804	7,281	7,319	7,398	7,470	4,249	7,695	7,760	7,793	7,851	21,981

Note: The figure in the bracket in 2018 is residual value.

6-4-3. Financial internal rate of return (FIRR)

The FIRR is calculated on the basis of cash flows shown in Tables III-6-6 and III-6-7. The results are given below.

* FIRR with a reasonable inflation rate (5%/year) : 8.7%

* FIRR without inflation : 3.6%

6-4-4. Sensitivity analysis

In this study, a sensitivity analysis has been conducted by taking notice of the following two factors which, for all their influences on the project profitability, seem to have a rather high degree of uncertainty in the future.

(1) Workload and unit cost of sales

(2) Rate of rise in prices (such as unit prices of sales and material costs, etc.)

Item (1) consists of factors directly influencing the sales amount. First, the workload may vastly fluctuate depending upon economic growth and the trend of foreign trade for Burma. It may also depend upon, to some extent, the demand for ship repairs from foreign ships (already mentioned in "demand forecast"). Secondly, as mentioned before, the unit price of sales for respective works is susceptible to influences of the type and age of the ship, the

nature of the repair work, the world shipping market, etc. These two factors have a great influence on the sales amounts. A sensitivity analysis has been conducted for the case where sales may fluctuate by ±10% due to the influences of the above two factors.

As for item (2), the rate of rise in prices has been assumed at 5% per annum in this study.

This value was decided in comprehensive consideration of the future rising trends of prices in Burma and other Southeast Asian countries, and especially, in Japan which may supposedly have a great influence upon the sales amounts and the import costs of materials and equipment in Burma.

Analyses have also been attempted regarding the influences of the rising rates of 4% and 6% per annum on the FIRR, the results of which can be seen in Table III-6-8.

Table III-6-8 Result of Sensitivity Analysis

Factors to be changed	Variation	FIRR
Sales amount	10% increase	9.7%
	Base case	8.7%
	10% decrease	7.5%
Rate of rise in price	6%/year	9.6%
	5%/year (Base case)	8.7%
	4%/year	7.8%

6-4-5. Fund plan

It seems to be indispensable in the implementation of this project to obtain long-term loans as sources of funds for capital investment. In this case, loans have to be repaid within definite periods of time, and a study of repayment plans will become very important for looking at business activities in the future.
Furthermore, granting that it becomes possible to repay the long-term loans within the scheduled periods of time, any shortage of operating funds resulting from financial difculties will perhaps hinder the continuance of business activities.
Particularly, it is essential for every enterprise to secure sufficient operating funds for reasons of the continuation of productive activities and the maintenance of financial soundness worthy of public confidence.
For the purpose of having the production activities start smoothly, certain funds have to be secured to cover inventory costs including interests and expenses payable during the construction. In this section, a repayment scheme for long-term loans based on the following assumptions for a certain representative case will be described, and an example of calculations of a required amount of operating funds (a short-term loan) and inventory costs will also be given for the sake of reference.

(1) In view of the current financial situation in Burma, the foreign currency portion of the investment capital shall depend upon long-term loans from abroad. Interest rates of 3% and 5% per annum, both for the repayment period of 30 years (including a 10-year grace period) are assumed. In these cases, the time of the loan is inferred from the flow of investment capital as previously predicted.

(2) As for the local currency portion, one half shall depend upon the equity capital, while the other half shall be raised by a long-term loan obtained domestically. The interest rate is assumed at 5% per annum in the light of the current level of interest rates applicable to government enterprises in Burma, and the repayment period is hypothetically taken as 8 years (including a 3-year grace period). In addition, a similar study in the case where the whole local currency portion is to be covered by the equity capital will be considered.

(3) The interest rate of a short-term loan (of one year) is assumed at 8% per annum in light of the existing level applicable to government enterprises in Burma.

(4) The inventory costs including interest and expenses payable during the construction period shall be paid off in amortization within 5 years after the beginning of operations.

In this study, the raising of funds is considered to occur in the middle of the year.
The results of this analysis are summarized in Table III-6-9.
Of the three cases shown in Table III-6-9, the fund statements of Case 1 and Case 2 are shown in Table III-6-10 and III-6-11 respectively.

Table III-6-9 Summary of Fund Plan

	Case 1	Case 2	Case 3
Interest rate for the foreign currency portion	3%	5%	5%
Ratio of equity capital of the local currency portion	50%	50%	100%
Necessary amount of inventory cost	US$ 4.26 million	US$ 6.70 million	US$ 6.44 million
Peak of short term loan	US$ 5.54 million in a year previous to operation	US$ 15.82 million in 6th year of operation	US$ 8.64 million in 2nd year of operation
Recovery of initial investment (Payback period)	16.8 years	18.5 years	18.0 years

Table III-6-10 Fund Statement - Case 1 - (1/2)

* Interest rate for the foreign currency portion . 3% P.A
* Ratio of equity capital of the local currency portion : 50%

(Unit in 1,000 US$)

Items \ Year	-4 1985	-3 1986	-2 1987	-1 1988	1 1989	2 1990	3 1991	4 1992	5 1993	6 1994	7 1995	8 1996
Profit and Loss Statement												
Sales					6,980	7,920	8,960	10,070	12,560	14,200	15,950	17,840
Cost				1,279	3,034	3,426	3,856	4,317	5,154	5,771	6,431	7,145
Depreciation					6,588	6,588	6,588	6,588	6,588	5,022	4,904	4,663
Amortization					509	509	509	509	509			
Interest												
long term loan (A)	[72]	[472]	[1,051]	[1,730]	2,325	2,502	2,512	2,512	2,512	2,512	2,512	2,508
" (B)				[250]	649	799	801	751	621	461	302	142
short term loan	[3]	[26]	[92]	[291]	422	367	273	200	151	57		
Profit and loss				-1,279	-6,547	-6,271	-5,579	-4,807	-2,975	377	1,801	3,382
Contribution to the state					-	-	-	-	-	113	540	1,015
Net Profit and loss				-1,279	-6,547	-6,271	-5,579	-4,807	-2,975	264	1,261	2,367
Fund Statement												
1 Funds sources												
Depreciation					6,588	6,588	6,588	6,588	6,588	5,022	4,904	4,663
Amortization					509	509	509	509	509			
Equity capital	520	2,520	8,020	4,920								
Long term loan (A)	4,810	21,840	16,810	28,470	11,170	660						
" (B)				9,980	5,940	70						
Short term loan	75	573	1,716	5,539	4,989	4,163	2,645	2,351	1,413			
Total	5,405	24,933	26,546	48,909	29,196	11,990	9,742	9,441	8,510	5,022	4,904	4,663
2. Fund expenditure												
Initial investment	5,330	24,360	24,830	43,370	17,110	730						
Reinvestment												
Inventory cost	75	498	1,143	2,544								
Repayment of loan												
long term loan (A)												240
" (B)								1,996	3,184	3,198	3,198	3,198
short term loan		75	573	1,716	5,539	4,989	4,163	2,645	2,351	1,413		
Total	5,405	24,933	26,546	47,630	22,649	5,719	4,163	4,641	5,535	4,611	3,198	3,438
Cash balance										675	2,967	3,592
(Cumulative cash balance)											(3,642)	(7,234)
Balance of long term loan												
(A)	4,810	26,650	43,460	71,930	83,100	83,760	83,760	83,760	83,760	83,760	83,760	83,520
(B)				9,980	15,920	15,990	15,990	13,994	10,810	7,612	4,414	1,216

Notes: 1. As regards long-term loan, (A) is for the foreign currency portion and (B) for a port of the local currency portion.

2. Interest payable of long- and short-term loan in [ ] and expenses during the construction period are appropriated as inventory cost in fund expenditure.

Table III-6-10 Fund Statement - Case 1 - (2/2)

(Unit in 1,000 US$)

Year / Items	9 1997	10 1998	11 1999	12 2000	13 2001	14 2002	15 2003	16 2004	17 2005	18 2006	19 2007	20 2008
Profit and loss statement												
Sales	19,880	22,140	24,450	26,930	29,630	32,500	35,590	38,530	41,7[illegible]	45,060	48,700	52,590
Cost	7,912	8,756	9,596	10,493	11,462	12,496	13,606	14,702	15,872	17,115	18,448	19,885
Depreciation	4,663	4,798	4,798	4,798	4,798	3,285	3,547	3,502	3,41[illegible]	3,412	3,412	4,704
Amortization												
Interest												
long term loan (A)	2,485	2,432	2,345	2,230	2,103	1,977	1,851	1,725	1,598	1,472	1,346	1,221
" (B)	33											
short term loan												
Profit and loss	4,787	6,154	7,711	9,409	11,267	14,742	16,586	18,601	20,838	23,061	25,494	26,780
Contribution to the state	1,436	1,846	2,313	2,823	3,380	4,423	4,976	5,580	6,251	6,918	7,648	8,034
Net Profit and loss	3,351	4,308	5,398	6,586	7,887	10,319	11,610	13,021	14,587	16,143	17,846	18,746
Fund Statement												
1 Funds sources												
Depreciation	4,663	4,798	4,798	4,798	4,798	3,285	3,547	3,502	3,41[illegible]	3,412	3,412	4,703
Amortization												
Equity capital												
Long term loan (A)												
" (B)												
Short term loan												
Total	4,663	4,798	4,798	4,798	4,798	3,285	3,547	3,50[illegible]	3,41[illegible]	3,412	3,412	4,703
2 Fund expenditure												
Initial investment												
[illegible] cost		900					9,550					15,760
Inventory cost												
Repayment of loan												
long term loan (A)	1,334	1,272	3,595	4,153	4,186	4,186	4,186	4,186	4,186	4,187	4,187	4,148
" (B)	1,204	14										
Short term loan												
Total	2,538	3,086	3,595	4,153	4,186	4,186	13,736	4,186	4,186	4,187	4,187	19,908
Cash balance	5,480	6,020	6,601	7,231	8,499	9,418	1,421	12,337	13,813	15,368	17,071	3,501
(umulative cash balance)	(12,714)	(18,734)	(25,335)	(32,566)	(41,065)	(50,483)	(51,904)	(64,241)	(78,054)	(93,422)	(110,493)	(113,994)
Balance of long term loan												
(A)	82,188	80,016	76,421	72,268	68,082	63,896	59,710	55,524	51,338	47,152	42,966	38,780
(B)	14	0										

Notes 1 As regards long-term loan, (A) is for the foreign currency portion and (B) for a port of the local currency portion.

Table III-6-11 Fund Statement - Case 2 - (1/2)

* Interest rate for the foreign currency portion 5% P.A
* Ratio of equity capital of the local currency portion 50%

(Unit in 1,000 US$)

Items \ Year	-4 1985	-3 1986	-2 1987	-1 1988	1 1989	2 1990	3 1991	4 1992	5 1993	6 1994	7 1995	8 1996
Profit and loss Statement												
Sales					6,980	7,920	8,960	10,070	12,560	14,200	15,950	17,840
Cost				1,279	3,034	3,426	3,856	4,317	5,154	5,771	6,431	7,145
Depreciation					6,588	6,588	6,588	6,588	6,588	5,022	4,904	4,663
Amortization					1,340	1,340	1,340	1,340	1,340			
Interest												
long term loan (A	[120]	[787]	[1,752]	[2,883]	3,875	4,170	4,187	4,187	4,187	4,187	4,187	4,180
" (B)				[250]	649	799	801	751	621	461	304	142
short term loan	5]	[43]	[152]	[433]	689	790	871	988	1,144	1,240	1,242	1,154
Profit and loss				-1,279	-9,195	-9,193	-8,683	-8,101	-6,474	-2,481	-1,116	556
Contribution to the state					-	-	-	-	-	-	-	167
Net Profit and loss				-1,279	-9,195	-9,193	-8,683	-8,101	-6,474	-2,481	-1,116	389
Fund Statement												
I Funds sources												
Depreciation					6,588	6,588	6,588	6,588	6,588	5,022	4,904	4,663
Amortization					1,340	1,340	1,340	1,340	1,340			
Equity capital	520	1,520	8,020	4,920								
Long term loan (A)	4,810	21,840	16,810	28,470	11,170	660						
" (B)				9,980	5,940	70						
Short term loan	125	955	2,859	7,977	9,244	10,509	11,264	13,433	15,163	15,820	15,230	13,616
Total	5,455	25,315	27,689	51,347	34,282	19,167	19,192	21,361	23,091	20,842	20,134	18,279
II Fund expenditure												
Initial investment	5,330	24,360	24,830	43,370	17,110	730						
Additional investment												
Inventory cost	125	830	1,904	3,839								
Repayment of loan												
long term loan (A)												240
" (B)								3,996	3,184	3,198	3,198	3,198
short term loan		125	955	2,859	7,977	9,244	10,509	11,264	13,433	15,163	15,820	15,230
Total	5,455	25,315	27,689	50,068	25,087	9,974	10,509	13,260	16,617	18,361	19,018	18,668
Cash balance												
(Cumulative cash balance)												
Balance of long term loan												
(A)	4,810	26,650	43,460	[illegible]	83,100	83,760	83,760	83,760	83,760	83,760	83,760	83,520
(B)				9,980	15,920	15,990	15,990	13,994	10,810	7,612	4,414	1,216

Notes 1. As regards long-term loan, (A) is for the foreign currency portion and (B) for a part of the local currency portion

2 Interest payable of long-and short-term loan in [ ] and expenses during the construction period are appropriated as inventory cost in fund expenditure.

Table III-6-11 Fund Statement - Case 2 - (2/2)

(Unit in 1,000 US$)

Items \ Year	9 1997	10 1998	11 1999	12 2000	13 2001	14 2002	15 2003	16 2004	17 2005	18 2006	19 2007	20 2008
Profit and Loss Statement												
Sales	19,880	22,140	24,450	26,930	29,630	32,500	35,590	38,530	41,720	45,060	48,700	52,590
Cost	7,912	8,756	9,596	10,493	11,462	12,496	13,606	14,702	15,872	17,115	18,448	19,885
Depreciation	4,663	4,798	4,798	4,798	4,798	3,285	3,547	3,502	3,412	3,412	3,412	4,704
Amortization												
Interest												
long term loan (A)	4,142	4,053	3,908	3,717	3,505	3,295	3,085	2,875	2,663	[illegible]	[illegible]	2,035
" (B)	33											
short term loan	943	618	226	6								
Profit and loss	2,187	3,915	5,922	7,916	9,865	13,424	15,352	17,451	19,773	22,080	24,597	25,966
Contribution to the state	656	1,174	1,777	2,375	2,960	4,027	4,606	5,235	5,932	6,624	7,379	7,790
Net Profit and loss	1,531	2,741	4,145	5,541	6,905	9,397	10,746	12,216	13,841	15,456	17,218	18,176
Fund Statement												
1 Funds sources												
Depreciation	4,663	4,798	4,798	4,798	4,798	3,285	3,547	3,502	3,412	3,412	3,412	4,703
Amortization												
Equity capital												
Long term loan (A)												
" (B)												
Short term loan	9,956	5,503	155									
Total	14,619	10,301	4,953	4,798	4,798	3,285	3,547	3,502	3,412	3,412	3,412	4,703
2 Fund expenditure												
Initial investment												
Reinvestment		900					9,550					15,760
Inventory cost												
Repayment of loan												
long term loan (A)	1,332	2,172	3,595	4,153	4,186	4,186	4,186	4,186	4,186	4,187	4,187	4,188
" (B)	1,702	14										
short term loan	13,616	9,956	5,503	155								
Total	16,150	13,042	9,098	4,308	4,186	4,186	13,736	4,186	4,186	4,187	4,187	19,948
Cash balance				6,031	7,517	8,496	557	11,532	13,067	14,681	16,443	2,931
(Cumulative cash balance)				(6,031)	(13,548)	(22,044)	(22,601)	(34,133)	(47,200)	(61,881)	(78,324)	(81,255)
Balance of long term loan												
(A)	82,188	80,016	76,421	72,268	68,082	63,896	59,710	55,524	51,338	47,152	42,966	38,780
(B)	14	0										

Notes 1 As regards long-term loan, (A) is for the foreign currency portion and (B) for a port of the local currency portion.

6-4-6. Evaluation

The Financial Internal Rate of Return (FIRR) of this project is estimated at 8.7% with a reasonable rise in prices (5%/year) being considered. From this, it can be concluded that this project is feasible from a financial point of view.

This project will not only contribute to industrialization in Burma, but will also bring about various other effects on the Burmese economy. Therefore, profitability should not be a decisive factor in evaluating the project.

By studying the fund statement of this project, the payback period of the initial investment will take 17-18 years. This period is considered allowable, considering the specific features of this project (namely, large amounts of investment, relatively long life of facilities, etc.).

It is necessary for this project to secure inventory cost and operating funds. To keep these costs and funds down, the raising of long-term funds with low interest rates is essential for initial investments.

Furthermore, the availability of a long-term loan at a favorable interest rate will allow the repayment of debts and payment of taxes while maintaining financial soundness.

7. ECONOMIC ANALYSIS

7-1. Economic Effects of The Project

It is expected that the implementation of this project will play an important role in developing the Burmese economy and improving standards of living. Following are some expected effects of this project for Burma's national economy.

(1) Saving and acquisition of foreign currency

The implementation of this project will make it possible to save foreign currency since it will prevent capital outflow which would occur when Burmese vessels have to be repaired in foreign shipyards. Likewise, the capability of manufacturing steelworks at this dockyard will basically perform a function of saving foreign currency. In the meantime, the revenue earned by repairing foreign vessels will help Burma acquire foreign currency. It is thought, therefore, that the balance between gross earnings and the payments for imported materials and equipment is equivalent to foreign currency saved and acquired from this project. It is also thought that the stay of foreign vessel crews will promote the foreign currency earnings. Saving and acquisition of foreign currency, thus, are expected to improve the balance of international payments for Burma.

A detailed economic analysis of this project, in terms of the saving and acquisition of foreign currency, is to be made later in this section.

(2) Expansion of employment

About 550 Burmese workers are scheduled to be employed in the operations of this dockyard, which means that this project will create this new amount of job opportunities. Furthermore, taking the multiplier effect into consideration, it is estimated that the implementation of this project will produce a job creation effect of several times as many job opportunities as mentioned above, including opportunities in related industries and the services sector.

In other words, the sales of this dockyard will provide the employees and related industries with their primary incremental income. Those individuals having this income, in turn, will appropriate part of it for purchasing consumers' goods, capital goods, and services.

Consequently, such disbursement will create a secondary incremental income in the goods and services sectors. Thus, the income increment process will be repeated except for savings and expenditures for imported goods, which will not contribute to an increase in the domestic income level and will lead to further increase in the national income and more job opportunities.

(3) Development of related industries

It is expected that the implementation of this project will contribute to development of and progress in domestic related industries dealing with various materials and equipment goods

required for the dockyard. Applying the material import ratio earlier discussed, the proceeds of domestic related industries brought on by this project are estimated at US$700,000 in the 10th year of operation, and at US$1,370,000 in the 20th year (both in 1983 prices). Taking the multiplier effect into account, it is considered that the repercussion effect on the domestic industries will be extremely remarkable.

(4) Others

This project will induce investment for infrastructure such as roads, water-supply, etc., in the Thilawa area. The improvement of the infrastructure will eventually cause the entry of new industries and contribute to the development of the area. It is also expected that the consolidation of the infrastructure, including schools, hospitals, and facilities for public welfare, will confer considerable benefits on the residents of this area.

7-2. Economic Evaluation

As described so far, the implementation of this project is expected to produce many economic benefits and effects. Among them, attention is particularly focused on the effects of savings and acquisition of foreign currency, which is one of the most important policies of the Burmese Government, in order to make a quantitative analysis of this project from the national economic point of view.

7-2-1. Criteria for evaluation

The Economic Internal Rate of Return (EIRR) is adopted as a criterion for making an evaluation of this project. Since the benefits and the cost of a project should be viewed over a long term, a consideration of time value is indispensable for evaluation of the project. EIRR is a discounted rate calculated by equalizing the sum of present value of the benefits to that of costs, as shown in the following formula, and represents the efficiency and profitability of the project from the national economic point of view.

$$\sum_{t=1}^{n} \frac{Bt - Ct}{(1+r)^t} = 0$$

Bt: Benefits in the 't'th year
Ct: Cost in the 't'th year
r: EIRR

In this analysis, the values of benefits and costs are calculated by the following formula:

Benefits = Sales of vessel repairs + Sales of other works - Outflow of foreign currency

Costs = Initial investment + Reinvestment - Residual value

As regards the outflow of foreign currency, not only payment for imported materials required for repairing vessels and other works, but also 20% of the expenses for the repair and maintenance of the dockyard is taken into account, these are assumed to come under the category of imported goods. The import duties and income taxes contributed to the State are, of course, excluded from this economic analysis because they are regarded as transfer income and transfer payments within the domestic economy of Burma.

7-2-2. Economic internal rate of return

Table III-7-1 shows the estimated result of benefits and costs in the case that savings and acquisition of foreign currency would be the only economic benefit brought by this project. EIRR of this project, calculated on the basis of Table III-7-1, is as follows:

EIRR = 13.5%

Table III-7-1 Estimation of Economic Benefit and Cost

(Unit in 1,000 US$)

Items \ Year	-4 1985	-3 1986	-2 1987	-1 1988	1 1989	2 1990	3 1991	4 1992	5 1993	6 1994	7 1995	8 1996	9 1997	10 1998	11 1999	12 2000	13 2001
A. Economic Benefit																	
(1) In-flow (Sales)					6,980	7,930	8,960	10,070	12,560	14,200	15,950	17,840	19,880	22,140	24,450	26,930	29,630
(2) Out-flow (Imported Material)				1,320	1,390	1,590	1,800	2,050	2,500	2,530	2,830	3,170	3,520	3,920	3,810	4,200	4,620
Total (1) - (2)				-1,320	5,590	6,340	7,160	8,020	10,060	11,670	13,120	14,670	16,360	18,220	20,640	22,730	25,010
B. Economic Cost																	
Initial Investment	5,330	23,670	23,830	37,620	17,110	730											
Re-investment														800			
C. Net Benefit																	
A - B	-5,330	-23,670	-23,830	-38,940	-11,520	5,610	7,160	8,020	10,060	11,670	13,120	14,670	16,360	17,420	20,640	22,730	25,010

Items \ Year	14 2002	15 2003	16 2004	17 2005	18 2006	19 2007	20 2008	21 2009	22 2010	23 2011	24 2012	25 2013	26 2014	27 2015	28 2016	29 2017	30 2018
A. Economic Benefit																	
(1) In-flow (Sales)	32,500	35,590	38,530	41,720	45,060	48,700	52,590	55,860	59,400	63,190	67,100	71,320	75,650	80,330	85,210	90,410	95,870
(2) Out-flow(Imported Material)	5,060	5,540	5,190	5,620	6,080	6,580	7,100	6,370	6,800	7,250	7,720	8,230	8,750	9,320	9,910	10,550	11,210
Total (1) - (2)	27,440	30,050	33,340	36,100	38,980	42,120	45,490	49,490	52,600	55,940	59,380	63,090	66,900	71,010	75,300	79,860	84,660
B. Economic Cost																	
Re-investment	8,450						14,130					12,400					
C. Net Benefit																	(21,220)
A - B	18,990	30,050	33,340	36,100	38,980	42,120	31,360	49,490	52,600	55,940	59,380	50,690	66,900	71,010	75,300	79,860	105,880

Note: The figure in the bracket in 2018 is residual value.

7-2-3. Sensitivity analysis

Of all the conditions and assumptions involved in this analysis, we have conducted a sensitivity analysis by selecting two factors in particular which may greatly affect the level of savings and acquisition of foreign currency.

(1) Sales of vessel repairs and other works
(2) The ratio of imported materials

A sensitivity analysis concerning (1), following the sensitivity analysis method used in the financial evaluation, is conducted to observe how the value of EIRR would be affected by a variation ranging from -10% to +10% of sales.

As for (2), in consideration of economic development and advancement in Burma in the future, the ratio of imported material to the total material costs is assumed to decrease from 90% to 60% as mentioned in "Cost estimation (III-6-2)".

A sensitivity analysis is also attempted in the case where the ratio of imported materials would fluctuate by $\pm$10%.

Table III-7-2 shows the result of the sensitivity analysis.

Table III-7-2 Result of Sensitivity Analysis

Factors to be changed	Variation	EIRR
Sales amount	10% increase	14.2%
	Base case	13.5%
	10% decrease	12.5%
Ratio of imported materials	10% decrease	13.6%
	Base case	13.5%
	10% increase	13.3%

7-2-4. Evaluation

Many economic and social benefits will be brought by this project, as mentioned before. The Economic Internal Rate of Return has been presented focusing on the aspects of savings and acquisition of foreign currency, which is a primary goal for Burma in making an analytical evaluation of this project from the national economic point of view. The estimated value of EIRR is 13.5%. Two of the significant factors which may greatly influence the level of savings and acquisition of foreign currency are: (1) Sales and (2) the ratio of imported materials. The sensitivity analysis centering on these two factors within a certain range has resulted in the EIRR values of 12.5% - 14.2%. These figures are higher than the ratio of the opportunity costs of capital for industrial projects in low-income economies, being 8 to 10% (classified by the World Bank). It can be concluded, in this respect as well, that this project is evaluated as highly significant.

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