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FEASIBILITY STUDY REPORT FOR THE CONSTRUCTION OF THILAWA SHIPYARD (DRY-DOCK) IN THE SOCIALIST REPUBLIC OF THE UNION OF BURMA

July 1984

JAPAN INTERNATIONAL COOPERATION AGENCY

FEASIBILITY STUDY REPORT

FOR

THE CONSTRUCTION OF THILAWA SHIPYARD(DRY-DOCK)

IN

THE SOCIALIST REPUBLIC OF THE UNION OF BURMA

July 1984

JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

In response to the request of the Government of the Socialist Republic of the Union of Burma, the Japanese Government decided to conduct a feasibility study on the Construction of Dry Dock Project and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Burma a study team headed by Mr. Masayasu Takebayashi, the Overseas Shipbuilding Cooperation Centre several times during the period from August 1983 to March 1984, under the guidance of the Supervisory Committee chaired by Mr. Kenji Tokudome, the Ministry of Transport of the Japanese Government.

The team exchanged views on the Project with the officials concerned of the Government of Burma, including those of the Burma Dockyards Corporation and conducted field surveys and collected reference materials.

After the team returned to Japan, further studies were made and the present report has been prepared.

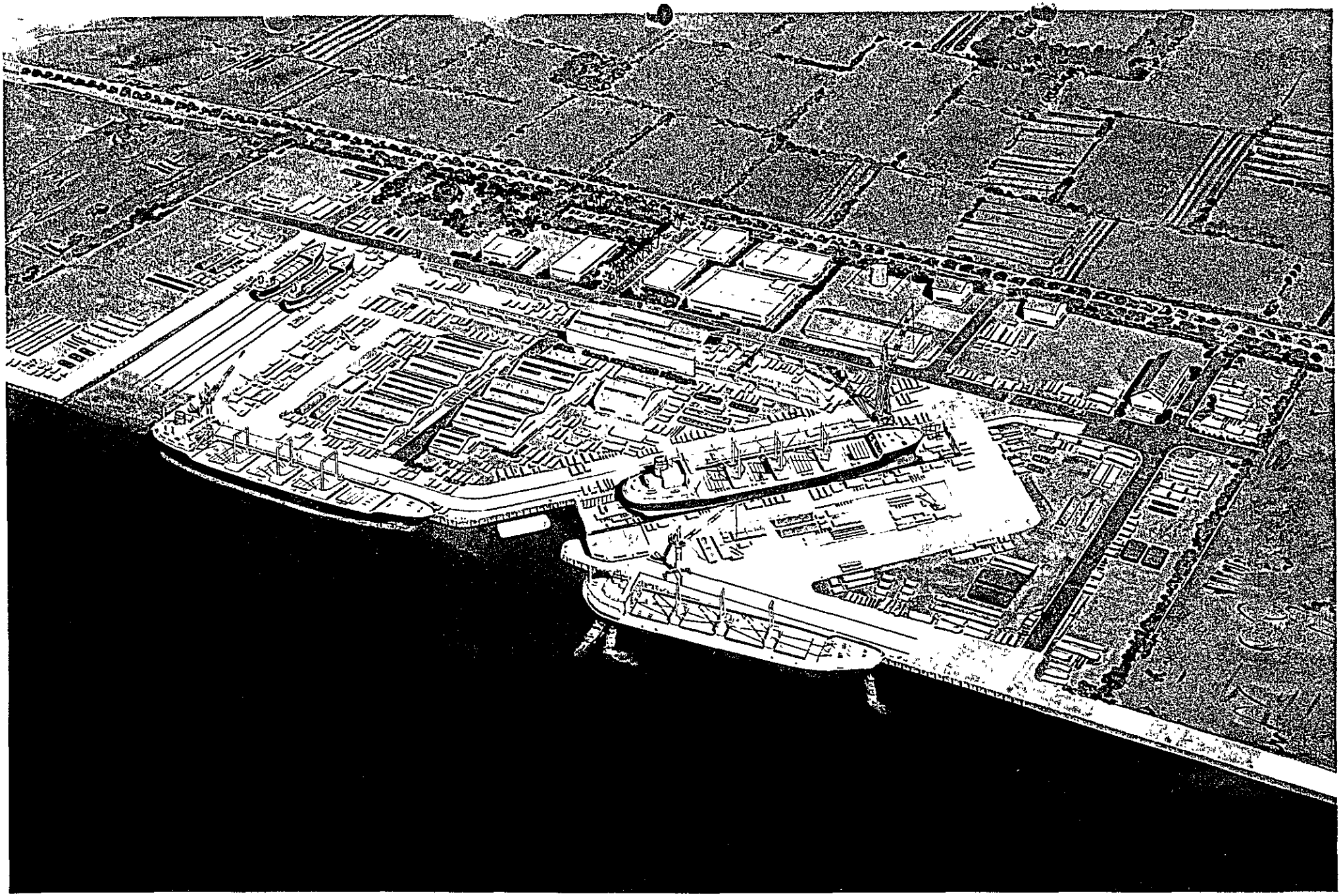
I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

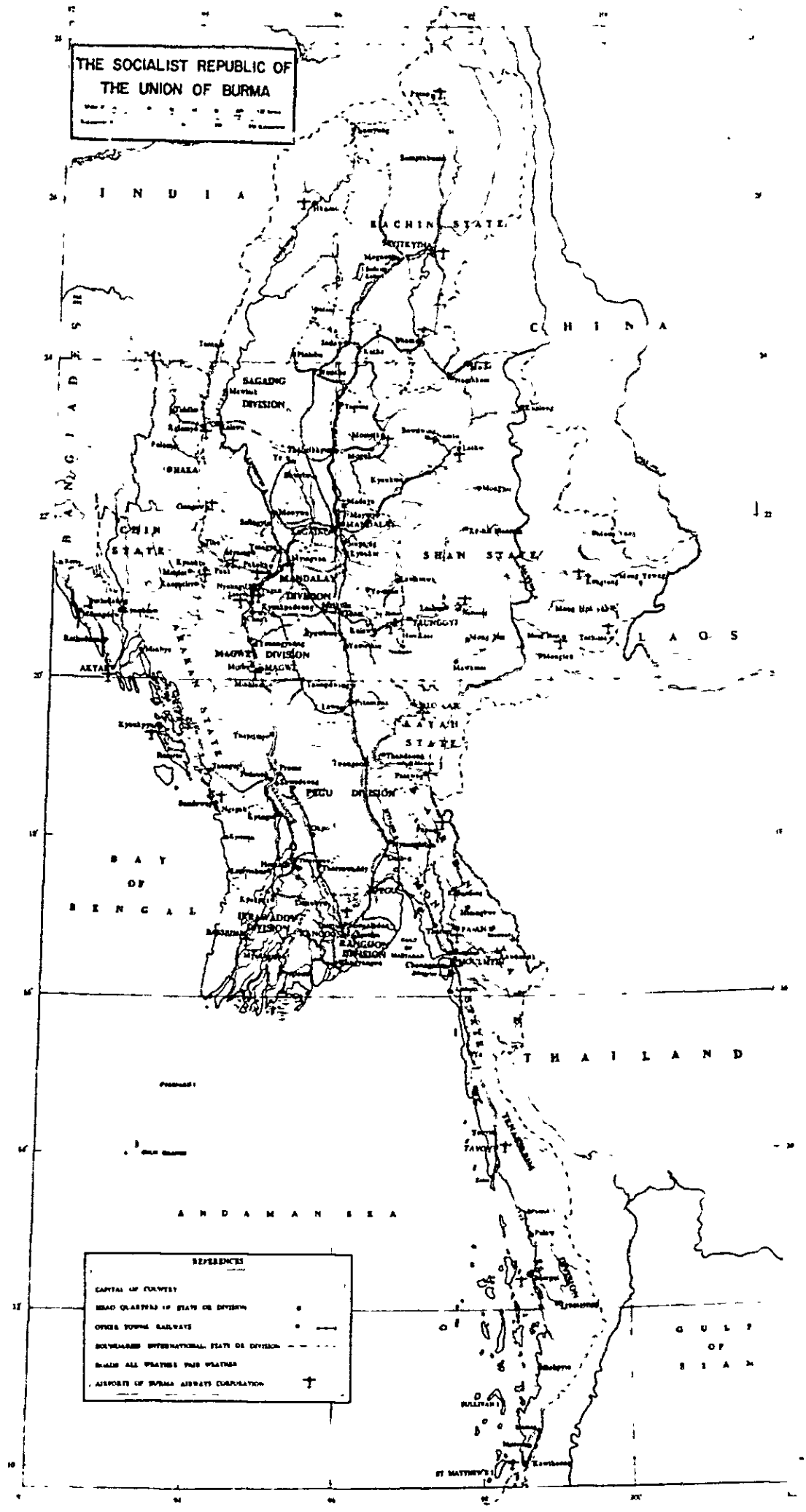
I wish to express my deep appreciation to all the officials concerned of the Government of the Socialist Republic of the Union of Burma for their close cooperation extended to the team.

July 1984

Keisuke Arita

Keisuke Arita
President
Japan International Cooperation Agency




THE SOCIALIST REPUBLIC OF THE UNION OF BURMA
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SAGAING DIVISION
CHIN STATE
SHAN STATE
MANDALAY DIVISION
MAGWE DIVISION
KAYAH STATE
PEGU DIVISION
RANGOON DIVISION
TAVOY
REFERENCES

Abbreviations used in this report

ABS	American Bureau of Shipping
ADB	Asian Development Bank
BDC	Burma Dockyards Corporation
BFSSC	Burma Five Star Shipping Corporation
BV	Bureau Veritas
CC	Construction Corporation
DWT	Dead Weight Tonnage
EC	European Community
GT	Gross Tonnage
IDA	International Development Association
IWTC	Inland Water Transport Corporation
LRS	Lloyd's Register of Shipping
NK	Nippon Kaiji Kyokai
OPEC	Organization of Petroleum Exporting Countries
TC	Time Charter
TFYP	Third FOUR-YEAR Plan
VC	Voyage Charter

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EXCHANGE RATE

The exchange rate of currency used in this report is as follows:

1 US$ = 230 YEN

I. SUMMARY AND RECOMMENDATIONS

I. SUMMARY AND RECOMMENDATIONS

The object of this project is the construction of a large-scale dockyard for ship repairing in Burma.

The study team stayed at the prospective project site for 3 months from August, 1983, to carry out various studies including geological investigations and surveys.

The maximum ship repairing capacity among the existing dockyards in Burma is 1,500 DWT. There were 14 Burmese flag ships exceeding the above DWT operating in 1983, and as the Fourth Four-Year Plan implies, five more new large ships are scheduled to enter service. As there is no repair dock available for large-sized ships in Burma at present, such repairs have been carried out in Singapore or elsewhere. Due to this, Burma has an urgent need for a large dockyard. This is necessary from the view-points of saving foreign exchange as well as of encouraging the ship repairing industry as part of the national industrialization scheme.

In keeping pace with the Rangoon New Port Project, the Burmese Government requested the Japanese Government to conduct a feasibility study for construction of a twin type dock capable of accommodating 20,000 DWT ships and 12,000 DWT ships at the same time.

In response to this request, the Japanese Government sent a study team to make studies on demand prediction, capital investment, economic analysis, etc., which, after several steps, resulted in a consolidated feasibility study on the construction of a dockyard capable of repairing 20,000 DWT ships.

Through a series of studies and analyses, we have reached the conclusion that this project will be "feasible" on condition that government policies are properly carried out and efforts of the executing agency are enthusiastically made as recommended. We have also concluded that this project should be given support by all means in view of its valuable contribution to the future development of the economy of Burma.

1. SUMMARY

1-1. Demand Forecast

The 30-year demand for ship repairing from 1989, the initial year of operation of the dockyard, to 2018 has been predicted.

(1) Prospective vessels for repair and expected docking demand

Ships to be accommodated consist of vessels owned by BFSSC and foreign ships calling at the port of Rangoon.

1) BFSSC-owned ships

Among BFSSC-owned ships, there are 14 (108,385 DWT) that exceed 1,500 DWT in size. In 1989 when the new repair dock begins operations, there will be 19 vessels (157,259 DWT), and this number will increase thereafter according to the growth of the volume of transportation, as shown in Table I-1-1. It is assumed that the annual average frequency of docking of these ships shall be once a year in view of their advanced age in the initial year of operations.

After that, the frequency of docking will decrease as the proportion of new ships increases, arriving at a fixed frequency of 3 times every 4 years in and after 2013. The predicted docking demand is also shown in Table I-1-1.

Table I-1-1 Annual Docking Demand (BFSSC-owned ships)

Year	Estimated Shipping Demand		Corresponding Annual Demand for Docking	
	No. of Vessels	Average D W T	No. of Vessels to be Docked	Total D.W.T. to be Docked
1989	19	8,120	19	154,200
1993	25	8,383	24	201,100
1998	31	8,724	28	244,200
2003	42	9,078	36	326,800
2008	51	9,447	41	387,300
2013	65	9,831	49	481,700
2018	79	10,231	59	603,600

2) Foreign ships

As regards foreign ships calling at the port of Rangoon,there were 437 vessels (3,607,000 DWT) of 1,500 DWT or over in 1982.

The number of incoming vessels to the port of Rangoon showed an average annual growth of 10.0% for the four years from 1978/79 to 1981/82. Judging from this and viewed from the topographical advantages of the new dockyard to be located near the same port, it is considered that foreign ships may more and more prefer docking at the new dockyard as its technical facilities are gradually improved and docking charges consequently reduced.

Therefore, in this study, it is assumed that an actual docking demand begins in the 5th year from initiation of operations, and that the number of ships to be repaired will increase year after year.

(2) Demand and supply forecast for docking

According to the results of the calculations, the annual docking capacity of this dockyard will be 200,000 DWT in 1989, and 500,000 DWT in 2018, in proportion to the productivity increase and so on.

Based upon the calculated annual docking capacity and the prediction of the docking demand as mentioned before, the demand-and-supply situation will be as shown in Fig. I-1-1.

Although the expected work load at the initial stage of operation is about 80% of the annual docking capacity, it is quite possible to look forward to a docking demand corresponding to 100% of the same capacity provided that measures, to be mentioned later, are taken.

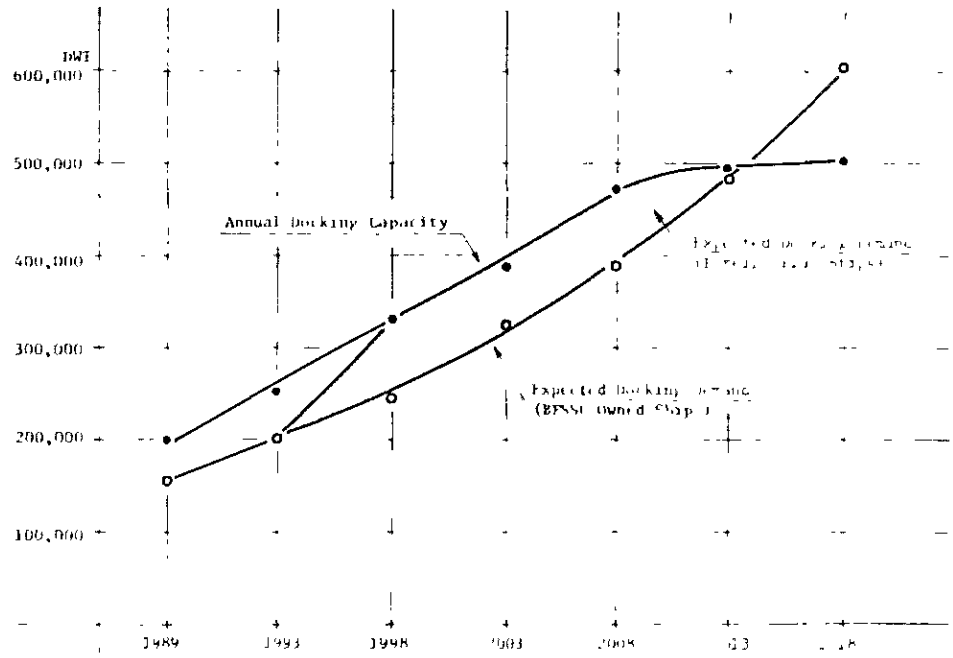


Fig. I-1-1. Demand and Supply Prediction for Docking

1-2. Outline of Project Site

The Thilawa area situated 32 km to the south of Rangoon, is being considered by the Burmese Government as the construction site for the dockyard. Adjacent to the above construction site, the new port of Rangoon is scheduled to be constructed in the future.

As a result of soil studies, it has been found that construction of a dockyard will be possible at the project site. However, the subsoil conditions are poor because of an underlying soft clay deposit of some 20m in thickness, a sand layer which can support pile foundations exists at a depth of 30m or deeper.

It will therefore be necessary to take these conditions into consideration in the design and construction work of the dockyard.

1-3. Facilities Planning

The principal particulars of facilities in the basic plan are shown as follows:

(1) Dockyard site: 210,000 M^2 (700M x 300M)

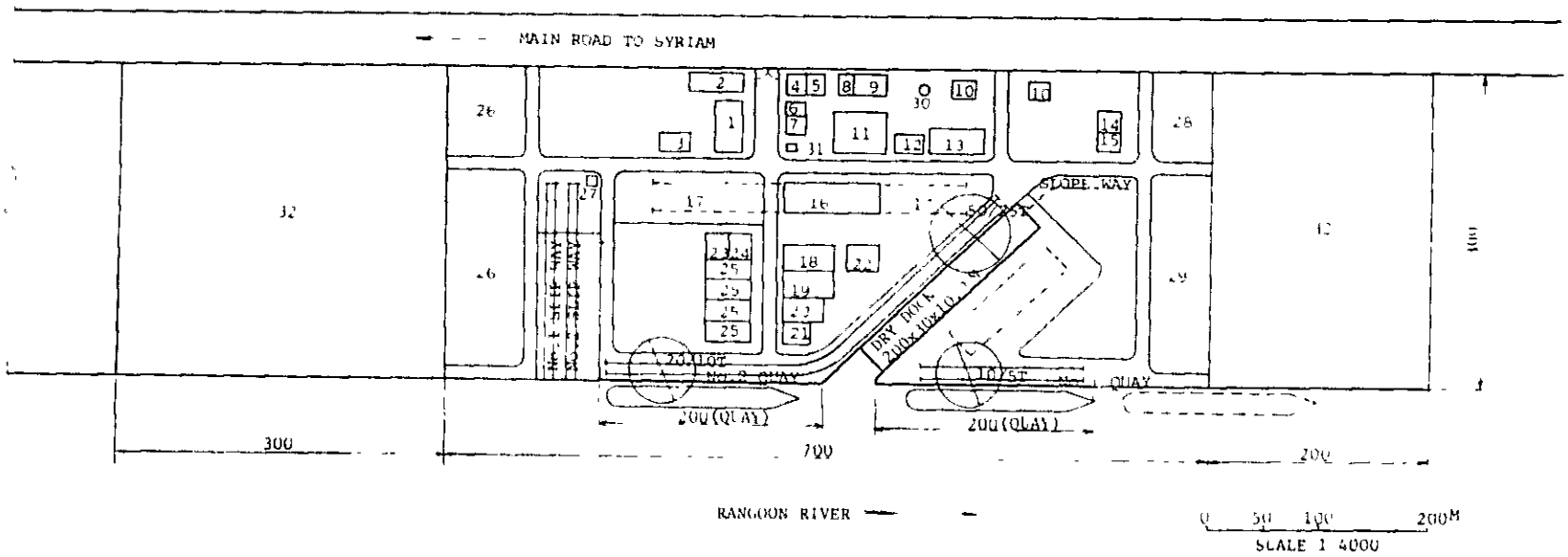
(2) Principal dimensions of dock:

Dock length = 200 M
Dock width = 30 M
Dock depth = 10.5 M

(3) Type of dock : Graving type

(4) Mooring quay : 200 M x 2

(5) Arrangement of ship repairing facilities
The arrangement of ship repairing facilities is illustrated in Fig. I-1-2.



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. I-1-2 Layout Plan

1-4. Construction Implementation Plan

(1) Progress planning

April 1986 Start of construction

April 1989 Start of operation

April 1990 Completion of construction

(2) Capital investment

The capital investment in this project is as shown in Table I-1-2. These figures are based on economic values as of 1983.

Table I-1-2 Capital Investment in Construction Project

As of 1983

	Foreign curr -ency portion (1000US$)	Local curr -ency portion (1000US$)	Total (1000US$)
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$ = 230yen

Import tax is not included in Total investment.

1-5. Production Planning

The production programme based upon the demand forecast of ship repair and other work is indicated in Table I-1-3.

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

Table I-1-3 Annual Production Programme

Year	Ship-repair in dock (DWT)		Ship-repair on slipway (DWT)	Production of steel struc-ture (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

1-6. Financial Evaluation

The Financial Internal Rate of Return (FIRR) of this project is calculated at 8.7%. From a financial point of view, this project is considered feasible.

This project requires 17 to 18 years for the recovery of initial investment. Considering the present situation of industrialization in Burma and the special characteristics of the ship repairing industry (e.g. large-scale investment, long-lived production facilities, etc.), this payback period is considered allowable.

Depending upon the availability of a long-term loan at a favorable interest rate, this project should be able to repay loans and to pay taxes without impairing its financial soundness.

1-7. Economic Evaluation

It is expected that this project will give not only stimulus to industrialization in Burma, but also bring about many economic benefits, as mentioned below, and will greatly contribute toward the economic and social development of the country.

Benefits

* Savings and acquisition of foreign currency
* Expansion of employment
* Development of related industries
* Increase of benefits to regional inhibitants

The Economic Internal Rate of Return (EIRR) of the project is calculated at 13.5% in consideration of saving and acquisition of foreign currency alone, which the Burmese Government regards as the greatest target in policy making. It can be concluded, in this respect, that this project is evaluated as highly significant.

2. RECOMMENDATIONS

For the efficient implementation and sound operation of the dockyard construction project, several supporting steps must be taken, such as preferential measures by the government, improvement of environmental conditions, and reinforcement of BDC, the executing agency of this project.

In other words, adequate measures have to be taken so that the dockyard may successfully compete in the fields of work quality, repair time, work price, etc., with neighbouring countries and so that it can secure a satisfactory work load out of the recent large demands for ship repair. Measures to be taken are as follows:

(1) Obligatory docking of BFSSC-owned ships:
Although it is most likely that the dockyard production system may be somewhat incomplete at the initial stage of dockyard operations, much difficulty can be expected in securing a sufficient work load to fully utilize its operation capacity at this time. Because of this, in order to assure the dockyard an ample work load until production gets well under way, the Government shall place the BFSSC's own ships and other Burmese vessels under an obligation to give this dockyard first priority for repair docking.

(2) Favorable terms for the raising of funds:
The total investment in this project amounts to $94.75 million (at the 1983 price level, less import taxes). The results of the financial analyses suggest that use of a certain long-

term, low-interest loan for capital investment is indispensable to the sound development of this project in the future. At the same time, funds for inventory costs, including interests and expenses payable during the construction period, and the operating fund, shall be secured like-wise. Therefore, it is essential for this project to raise funds at a low interest rate. From this point of view, the Government is being strongly requested to give special assistance to the raising of funds, for capital investment as well as operations on the most favorable terms.

(3) Exemption from import taxes for material and equipment:

For improving the profitability of this project, it is a must to hold down capital investment as much as possible. From this viewpoint, it is desired that the Government will take favorable steps in taxation such as the reduction or exemption of import taxes on the materials and equipment to be used for the construction of the dockyard.

To maintain international competitiveness, continuing efforts for cost reduction are indispensable to the dockyard. This dockyard depends on foreign suppliers in the procurement of materials and equipment necessary for ship repair and other works. From this standpoint, the Government is further requested to consider the reduction of or exemption from import duties on the materials and equipment for ship repair and other works.

Furthermore, to promote smooth procurement of import articles, simplified importation proce-

dures and expedited customs-clearance procedures are to be studied likewise.

(4) Improvement of environmental conditions:
The access roads around the dockyard site, water and power supply systems, telephone and other communication facilities, etc., have to be improved as part of a national public undertaking, keeping ahead of, or at least abreast with, the progress of the construction of the dockyard.
Meanwhile, for the benefit of the 500 to 550 employees necessary for the normal operation of this dockyard, it is recommended that the construction of dwellings, improvement of transport facilities for commuting, etc., should be carried out by the Government swiftly.
In conclusion, the improvement of environmental conditions that may make this dockyard attractive to shipowners should be carried out for the early start of operations of the new port of Rangoon, this should be done along with the accelerated development of the commercial and industrial districts around the dockyard site.

(5) Promotion of sales activities:
It is presumed that the business activities of the dockyard should be done on a scale that can secure a workload matching the capacity of its production facilities. It is thus desired above all that efforts to create a new demand for work from shipowners may be made through direct contacts with them. This is because these efforts make it possible for the dockyard to succeed in receiving ship repair contracts from foreign as

well as domestic shipowners, thus assuring the lasting patronage of the shipowners.

(6) Establishment of management system:
One subject to be reckoned with concerning efficient operation of an enterprise and establishment of foundation suited for an enterprise having prospective future business activities is a well-established managerial administration system. For this purpose, it is necessary to give the cadre personnel a specific education that lays emphasis on mastery of modern management methods and also to provide practical guidance for a certain period through the instruction of relevant experts from abroad.

(7) Education and training of engineers and workers:
With commencement of dockyard operations, it will become necessary to conduct education and training to raise the level of engineers and to improve the skills of workers.
To meet the above, concrete measures should be taken as follows:

(i) Despatch of engineers and workers to advanced shipbuilding country:
Through technical collaboration with advanced shipbuilding country, 5 engineers and 32 foremen are scheduled to go to that country for the purpose of receiving specially arranged 6 to 8 month courses for specific education and training.

(ii) Engagement of experts from advanced shipbuilding country:
Concurrently with start of dockyard operations, 7 or 8 experts on ship repair from

advanced shipbuilding country will be engaged in accordance with the provisions of the technical collaboration agreement.
Their duty is to give technical guidance on practical matters until dockyard operations get well under way.
Apart from the above two aspects of an education and training system that places emphasis on practical guidance, the workers are to be trained at domestic training schools and also at the construction site in such a way as to take advantage of training opportunities arising during the dockyard construction period.

(8) Effective use of facilities:
To streamline dockyard operations, every item of the production facilities should be efficiently utilized. In other words, a system that enables both the production elements, human and mechanical to use their own capacities to the fullest extent should be established.
As for the human element, what is aimed at is mastery of production techniques through an adequate education and training system and improvement of productivity by cultivating multitrade craftmanship among the workers.
As for the mechanical element, it is essential to keep all the facilities in fully serviceable condition at all times through continuous efforts in maintenance and repair. It goes without saying that to promote effective use of the production facilities, a sufficient workload should be secured which will ensure the full operation

of principal workshops such as Hull Shop, Machinery Shop, etc. Leasing out of the dockyard's own tugboats, sales of yard generated acetylene gas, etc., are also necessary in relation to this. In short, it is most important, among other thing, that both the departments of sales and production, in close contact with each other jointly work out a master plan for sound operation of the dockyard.

II. BACKGROUND OF THE PROJECT

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1. DEVELOPMENT CIRCUMSTANCES OF THE PROJECT

1-1. Prologue

The Government of Burma has been carrying out the Fourth Four-Year-Plan (1982/83-1985/86) in which the construction project of the dockyard for ship repairing has been earmarked to begin operations in the fiscal year 1983/84.

In view of this national policy, the Government of Burma requested the Government of Japan, in August of 1981, to make a feasibility study for the project master plan which envisioned the over-all scheme on the dockyard.

In response to this request, the Government of Japan entrusted the Japan International Cooperation Agency (JICA) to undertake the study and, as a start, despatched a Preliminary Study Team to Burma in order to make completely clear the scope of work with reference to services to be rendered by the feasibility study team. This was done, in March/April, 1983, by means of discussions with the Burma Dockyards Corporation (BDC), the government appointed executing agency for this project.

In compliance with the Agreement concluded on April 8th, 1983, by the two parties, JICA sent a Feasibility Study Team to Burma, in August 1983, to execute market and demand analyses, technical analyses, financial analyses, economic analyses,

and a project implementation plan. The technical analysis was included a soil study and survey at Thilawa, the proposed project site located about 20 miles (32 km) downstream and to the south of the port of Rangoon. The study took a total of three months, finishing in November in 1983.

Following are the study results.

1-2. Members of the Teams

Supervisory Committee

Name	Assignment	
Mr. Kenji TOKUDOME	Chairman	Special Assistant to the Director Shipbuilding Div., Ship Bureau, Ministry of Transport MOT
Mr. Mitsunori NISHIMURA	Demand forecast	Chief, First Inspection Section, Supervision Div., Shipping Bureau, MOT
Mr. Toshiro KOTAKE	Ship repairing	Chief, International Affairs Section, Shipbuilding Div., Ship Bureau, MOT
Mr. Shigeo HIRATA	Dockyard planning	Chief, Supervision Section, Super vision Div., Ship Bureau, MOT

Name	Assignment	
Mr. Akira MURATA	Coordination	Deputy Head, 1st Department Survey Division, Social Development Cooperation Department, JICA
Mr. Takao KAIBARA	Coordination	1st Development Survey Division, Social Development Cooperation Department, JICA

Study team

	Name	Title	Assignment
1.	Mr. Masayasu TAKEBAYASHI	Team Leader: Naval Architect	Overall Team Management
2.	Mr. Kenichi NAKAO	Sub Leader: Operation Planner	Operation Planning
3.	Mr. Toshinori YAMASHITA	Member: Economist	Demand Forecast
4.	Mr. Kōjiro EMOTO	Member: Naval Architect	Dockyard Construction Planning
5.	Mr. Shinya HARADA	Member: Economist	Economic & Financial Analysis
6.	Mr. Masatoshi BABA	Member: Civil Engineer	Survey & Civil Work
7.	Mr. Katsutoshi SUZUKI	Member: Civil Engineer	Soil Investigation & Civil Work

	Name	Title	Assignemnt
8.	Mr. Ryoichi TAKAYAMA	Member: Mechanical Engineer	Facilities Planning

BDC

	Name	Title
1.	Comdr: Thein Tun	Managing Director
2.	U Nyana	Chief Engineer (Mechanical)
3.	U Kyin	Dy. Chief Engineer
4.	U Chit Oo	Chief Accountant
5.	U Myo Htut	Manager (Personnel & Admin)
6.	U Tha Hla	Store Officer
7.	U Chin Sein	Engineer (Naval Architect)
8.	U Tin Maung Nyunt	Engineer
9.	U Soe Thein	Engineer (Ship Construction) (Hull & Outfitting)
10.	U Aung	Engineer (Planning Engineer)
11.	U Aung Myat	Engineer (Liaison)
12.	U Kyaw Tun	Civil Engineer (Consultant of this project)
13.	U Han Kyi	Civil Engineer
14.	U Thet Han	Secretary to Managing Director

2. CURRENT SITUATION OF ECONOMY

2-1. General Trends

After being stagnant for about 15 years, the economy in Burma has been in an upward trend from the latter half of the 1970's. This is because of economic reforms introduced since 1975. The self-supporting system in commercial activities and the bonus system for the enhancement of laborers' will to work harder were introduced to improve the management of state enterprises. To execute the rice production increase plan, high yield variety crops and increased use of chemical fertilizers were extensively introduced.

Furthermore, public investment has been increasingly invited by means of introducing foreign loans and aid. These measures have lifted the Burmese economy toward attainment of its long-term goals with a growth rate of around 6% since 1976. The imports of raw materials, semi-finished goods, and capital goods have increased by dint of vigorous economic activities.

Table II-2-1 Value of Production of Goods and Services, Consumption and Investment

(At 1969/70 constant producers prices)

Particulars	Unit	1969/70	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	82/83
GDP	KYAT IN LAKHS	97,757	106,407	105,597	108,117	111,011	115,617	122,653	129,957	138,433	145,623	157,176	167,162	179,050
Total Imports(C.I.F.)		8,968	7,574	4,942	3,307	3,779	4,543	4,562	5,681	7,830	9,951	10,284	11,183	14,664
Total Exports(F.O.B.)		5,354	6,810	5,575	4,999	5,133	4,478	4,908	5,725	5,552	7,472	8,105	8,100	9,739
Net Output Available for use		101,371	107,171	104,744	106,425	109,677	115,682	122,287	129,916	140,711	148,102	159,355	170,245	183,975
Total Consumption	"	90,259	94,939	95,479	96,338	98,667	104,094	110,200	115,207	120,383	124,376	134,185	141,836	150,910
Total Investment		11,531	10,914	8,947	7,731	7,803	8,084	9,651	14,304	18,518	22,059	21,576	24,383	29,146
Stock Changes	"	+1,581	+1,318	+318	+2,356	+3,207	+3,504	+2,436	+405	+1,810	+1,667	+3,594	+4,026	+3,919
Total Imports + Exports/GDP	(%)	14.4	13 5	10.0	7 7	8.0	7 8	7.7	8 8	9 7	12 0	11.7	11.5	13 6
Total Investment/ GDP		11 8	10 3	8 5	7 2	7.0	7 0	7 9	11.0	13 4	15 1	13 7	14 6	16 3
Per Capita Output	KYAT	645	651	620	615	618	636	659	694	719	740	784	822	865
Per Capita Netoutput	"	369	377	365	366	368	375	389	408	425	437	461	479	502
Per Capita Income	"	382	379	363	361	364	375	388	408	432	445	468	488	516
Per Capita Consumption	"	334	336	331	326	327	338	350	362	370	373	394	407	423
Per Capita Investment	"	43	39	31	26	26	26	31	45	57	66	63	70	82
Output per Worker	"	1,604	1,643	1,568	1,561	1,570	1,618	1,678	1,749	1,811	1,867	1,977	2,079	2,176
Net Output per Worker	"	918	949	923	929	935	953	990	1,028	1,070	1,103	1,163	1,212	1,262

Source Report to the Pyithu Hluttaw

2-2. Finance

The scale of public finance had declined for about 10 years after 1966/67. A sign of revenue recovery was seen to begin around 1975/76. Revenues have shown steady growth since 1976/77 the balance is again in the black. The investment/ capital expenditure has been growing while the amount of foreign loans and aid has also been increasing.

Table II-2-2 Public Finance

(Unit: KYAT in LAKHS)

Particulars	1978/79	1979/80	1980/81	1981/82	1982/83
Part (1) State Administrative Organizations					
Receipts	45,527	54,516	59,387	70,327	62,557
1. Revenue from Taxes	31,830	36,082	37,106	42,569	41,340
2. Receipts from State Economic Enterprises	10,004	14,008	17,124	22,172	15,427
3. Others	3,693	4,426	5,157	5,586	5,790
Current Expenditure	34,828	37,185	40,807	46,665	48,742
Foreign Loans and Aids	5,918	7,883	9,220	8,543	11,257
Financial Account	(-)2,218	(-)1,998	(-)2,018	(-)808	(-)1,616
Amount Available for Investment	14,439	23,216	25,782	31,397	23,456
Investment	6,819	9,517	12,187	12,906	19,843
Surplus(+)/Deficit(-)	(+)7,620	(+)13,699	(+)13,595	(+)18,491	(+)3,613
Part (2) State Enterprises					
Current Revenue	136,132	154,279	179,656	196,770	217,011
Current Expenditure	139,932	153,103	181,216	202,532	221,657
Foreign Loans and Aids	13,809	21,502	14,060	21,529	27,077
Financial Account	(-)1,965	(-)4,274	(-)5,339	(-)6,285	(-)8,425
Volume of Capital Expenditure	32,004	45,061	40,139	51,420	63,861
Others	8,675	-	-	-	-
Bank Financing(+)/ Deposits(-)	(+)15,283	(+)26,657	(+)32,978	(+)41,938	(+)49,835
Part (3) Town and City Development Committees					
Current Revenue	1,416	1,486	1,654	2,029	2,177
Current Expenditure	948	1,112	1,290	1,429	1,726
Foreign Loans and Aids	233	103	208	79	218
Financial Account	-	-	-	(-)43	(-)43
Volume of Capital Expenditure	718	514	706	663	1,103
Bank Financing(+)/ Deposits(-)	(+)1	(+)17	(+)134	(+)27	(+)477

Source: Report to the Pyithu Hluttaw

2-3. Industries

The industrial structure in Burma was formulated during the age of British rule. The Burmese economy depends solely on agricultural production, related food processing industries, mining, and forestry (particularly teakwood production). The basic structure has remained unchanged even after indepedence, as shown in Fig. II-2-1.

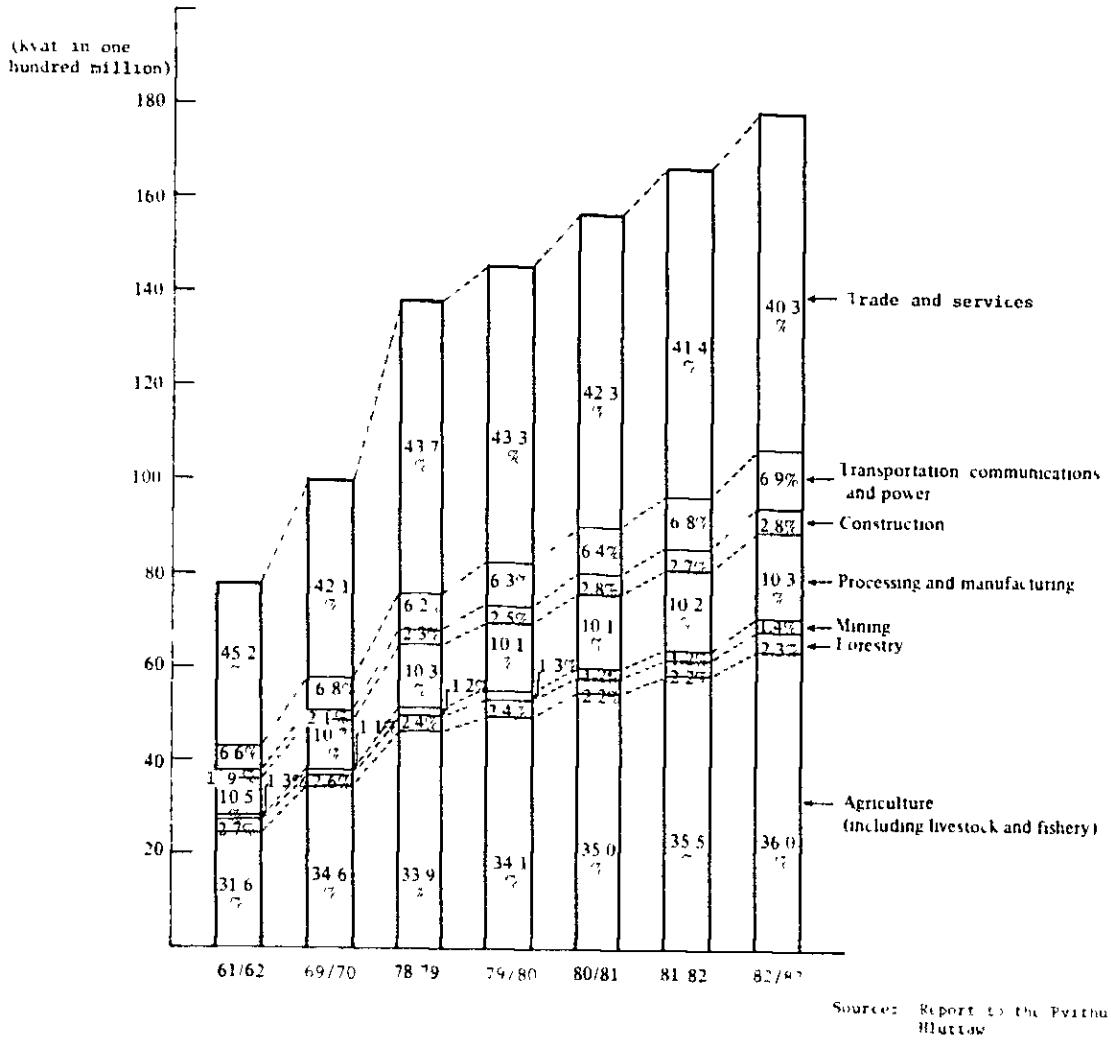


Fig. II-2-1 Changes of GDP Structure

The composition of the labour force of workers and peasants is as shown in Table II-2-3. This, similar to the industrial structure has also shown little change.

Table II-2-3 Active Labour Force of Workers and Peasants

(Unit: %)

Sector	1968/69	1976/77	1982/83
Agriculture	67.6	65.3	63.6
Livestock and Fishery	-	1.3	1.3
Forestry	1.0	1.2	1.3
Mining	0.3	0.5	0.6
Processing and Manufacturing	7.2	7.1	8.1
Power	0.1	0.1	0.1
Construction	0.9	1.3	1.5
Transport and Communications	3.2	3.4	3.2
Social Services	4.2	2.1	2.1
Administration		3.8	3.9
Trade	8.9	9.4	9.8
Others	6.6	4.5	4.5
Total	100.0	100.0	100.0

Source: Report to the Pyithu Hluttaw

The production of main commodities is as shown in Table II-2-4.

Table II-2-4 Production of Main Crops

Commodities	Unit	1969/70	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	82/83
Paddy	Thousand ton	7,859	9,172	9,313	10,362	10,283	13,107	13,923	14,525
Teak	Thousand cu ton	300	280	316	376	394	401	435	500
Hardwood	"	612	361	368	480	679	682	580	768
Tin	Ton	409	360	257	726	1,137	1,000	1,200	1,750
Tungsten	"	197	332	421	702	799	888	820	700
Lead	"	6,708	2,721	5,242	5,460	5,863	6,488	8,202	7,500
Zinc	"	6,978	3,860	4,170	5,255	6,270	6,992	9,015	9,000
Copper	"	217	86	164	119	129	236	306	170
Nickel	"	199	58	47	48	64	128	205	79
Coal	Million ton	11.0	19.2	28.3	12.0	13.6	11.0	18.0	40.0
Crude oil	Million barrels	5.85	8.58	9.56	9.99	11.02	10.11	10.45	10.55
Natural gas	Million cu feet	1,758	8,481	8,784	9,892	12,030	14,837	14,878	24,640

Source: Report to the Pyithu Hluttaw

2-4. Economic Development Plan

According to the basic policy in the 20-year plan made in 1974, each Four-Year Development Plans have been implemented. The basic policy mainly aims at doubling the national living standard (GDP in set at 5.9% growth), transforming the country from agricultural to industry while maintaining a high value on agriculture, and keeping favourable ratio of state enterprises and cooperative societies. As a strategy, expansion of the primary industries and an increase of exports was planned. The First Four-Year Plan, however, was not completed successfully because of poor exports and stagnant production. The Second Four-Year Plan failed to achieve goals because of stagnation in the agricultural sector, but the goal attainment ratio rose remarkably in the latter 2 years of the plan. As regards the Third Four-Year Plan, the overall target was attained because of successful achievements in primary industries.

Table II-2-5 Economic Growth Rates During Second/Third Four-Year Plan

(Unit: %)

	Second four-year plan				Third four-year plan				Fourth four-year plan
Year	1974/75	75/76	76/77	77/78	78/79	79/80	80/81	81/82	82/83
Plan	6.3	6.4	6.9	6.6	6.6	6.6	6.6	6.6	6.0
Actual	2.7	4.1	5.9	6.4	6.5	5.2	7.9	6.4	7.1

Source: Report to the Pyithu Hluttaw

Table II-2-6 Sectoral Economic Growth Rates During TFYP

Particulars	Annual Growth Rate				Average Annual Growth Rate	
	1978/79	1979/80	1980/81	1981/82	Plan	Actual
Goods	7 5	5 9	10 0	7 8		
Agriculture	7 7	5 2	12 7	8 7	5 8	
Livestock and Fishery	6 0	6 6	4 1	5 1		
Forestry	14 3	2.4	2 0	5 5		
Mining	7 7	16 0	3 3	2 9		
Processing and Manufacturing	2 5	3.9	7 5	7 8		
Power	4 1	9 9	14 1	24 8		
Construction	32 2	17.5	20 6	2 5		
Services	6 8	6 1	7 0	6 6		
Transportation	6 3	8 1	6 1	10 1	8 6	
Communication	0 9	15 2	17 1	26 6		
Financial Institutions	34 1	13 7	25 2	9 4	9 7	
Social and Administrative Services	4 2	4 5	3 5	5 1		
Rentals and Others	1 8	3 1	3.0	2 9	3 2	
Trade	4 2	2 7	4 4	2 6		
Total Net Output	6 5	5 2	7 9	6 4	6 6	

Source Report to the Pyithu Hluttaw

Table II-2-7 Sectoral Performance During TFYP

Particulars					
Goods					
Agriculture					
Livestock and Fishery					
Forestry					
Mining					
Processing and Manufacturing					
Power					
Construction					
Services					
Transportation					
Communication					
Financial Institutions					
Social and Administrative Services					
Rentals and Others					
Trade					
Total Net Output					

Source Report to the Pyithu Hluttaw

During the Fourth Four-Year Plan from 1982/83 to 1985/86, an annual economic growth rate of 6.0% was set as a target.

The following four items have been given priority:

(1) Expansion of public investment (annual rate of 13.5%) in expectation of foreign loans and aid of 550 million US Dollars.

(2) Increase of exports (16.1% per year while keeping the import increase ratio at 12.5% per year).

(3) Employment of development projects able to produce benefits quickly.

(4) Improvement of the transportation sector, which is causing current bottlenecks in economic development.

The average annual sectoral growth rates are as shown in Table II-2-8 and Table II-2-9. Electric power supply, communications, and mining are being given high priority in public investment.

Table II-2-8 Targets of Forth Four-Year Plan

(Unit: Kyat in million)

	1981/82	1985/86	Average annual growth rates (%)	Average annual growth rates of the guidelines (%)
At 1969/70 prices				
GDP	16,698	21,278	6.2	6.0
Investiment	2,467	3,420	8.5	13.5
Exports	1,102	1,851	13.8	16.1
Imports	1,311	1,919	10.0	12.5

Source: Five-Year Development Programme

Table II-2-9 Sectoral Distribution of Public Investment and Average Annual Growth Rates

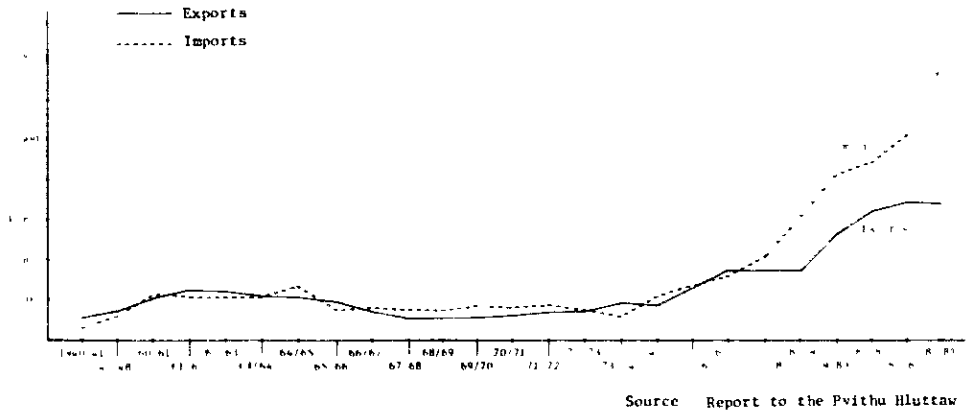
(1982/83 ∿ 85/86)

Sectors	Amount (KYAT IN LAKHS)	Per cent (%)	Average Annual Growth Rates (%)
Agriculture	4,590	12.4	5.4
Livestock and Fishery	1,678	4.5	8.2
Forestry	1,540	4.2	5.0
Mining	3,911	10.5	12.8
Processing and Manufacturing	11,181	30.1	8.4
Power	2,648	7.1	18.2
Construction	1,127	3.0	4.4
Transportation	4,116	11.1	6.9
Communication			16.4
Financial Institutions	6,314	17.1	5.3
Social and Administrative Services			5.4
Trade			5.7
Others			3.1
Total	37,105	100.0	

Source: Five-Year Development Programme.

2-5. Exports and Imports

After the introduction of foreign loans and aid in the mid-1970's, both exports and imports have been markedly increasing.



Source Report to the Pyithu Hluttaw

Fig. II-2-2 Changes of Exports and Imports
(Unit: Kyat in million)

The increase of imports has been much higher than that of exports, resulting in the balance of trade being in the red.

Table II-2-10 Exports by Type of Commodity

		77/78	78/79	79/80	80/81	81/82
Quantity (Thousand Ton, Thousand cu ton)	Rice (Incl. Rice Products)	470	510	783	703	711
	Other Agricultural Product	147	168	179	224	193
	Fish and Fish Product	3	2	4	6	8
	Base Metal and Ores	10	15	11	16	17
	Cement	91	109	124	72	98
	Teak	84	163	103	136	144
	Hardwood	30	57	32	58	57
Amount (Kyat in Million)	Rice (Incl. Rice Products)	867	288	1,213	1,355	1,509
	Other Agricultural Product	93	157	321	398	424
	Fish and Fish Product	33	48	66	82	116
	Base Metal and Ores	8	163	240	189	264
	Cement	4	24	30	24	37
	Teak	389	747	483	703	707
	Hardwood		106	67	71	65
	Others	155	167	326	386	330
	Total	1,756	1,852	2,676	3,225	3,452

Source Selected monthly economic indicators

Export items are mostly primary products consisting mainly of rice (including processed rice products) and timber. By commodity type, Asian countries account for over 50% of export destinations followed by EC countries. Exports to Asian countries (especially to Japan and Sri Lanka) have been growing steadily and growth of exports to African countries has been quite remarkable.

Table II-2-11 Exports by Country

(Unit: KYAT in Million)

Area	1978/79	77/80	80/81	81/82	81/82 Per cent (%)
South East Asian Countries	459	844	822	828	24.0
Other Asian Countries	692	897	987	1,170	33.9
People's Republic of China	3	78	40	29	0.8
Sri Lanka	94	124	153	183	5.3
India	7	26	54	57	1.7
Japan	222	188	257	329	9.5
Pakistan	50	32	34	43	1.2
Bangladesh	23	225	21	92	2.7
Others	293	224	428	437	12.7
Middle East Countries	54	29	123	82	2.4
North American Countries	15	20	65	13	0.4
South American Countries	-	91	224	-	-
European Economic Community	333	234	397	302	8.7
Other North-West European Countries	34	22	50	19	0.6
Other South European Countries	9	-	-	-	-
East European Countries	20	23	87	153	4.4
American Countries	41	395	354	844	24.4
Australia, New Zealand and other Countries in the Pacific	-	37	12	-	-
Others*	195	104	104	41	1.2
Total	1,852	2,696	3,225	3,452	100.0

Source Report to the Pyithu Hluttaw.

On the other hands, import items are mainly consisting of capital goods, raw materials and parts for home industry use.

Table II-2-12 Imports by Commodity

(Unit. KYAT in Million)

Commodity	1977/78	1978/79	1979/80	1980/81	81/82
Capital goods	991	1,922	2,673	2,129	2,541
Construction materials	254	265	451	512	483
Machinery and equipment	495	1,349	1,847	1,368	1,488
Transport equipment	200	244	303	143	[illegible]
Other capital goods	42	64	72	106	130
Raw materials and spares for inter-industry use	865	1,075	1,323	2,036	2,034
Raw materials	635	765	839	1,308	1,379
Fuel	20	0	5	0	18
Tools and spares	226	310	479	728	637
Consumer goods	217	213	188	285	427
Durable goods	32	64	49	107	118
Foodstuff	43	65	45	57	88
Textiles	68	16	8	23	54
Medicines and pharmaceuticals	46	55	54	79	112
Other consumer goods	28	13	32	19	55
Others	13	13	16	14	55
Total	2,086	3,223	4,200	4,464	5,057

Source: Report to the Pyithu Hluttaw

The countries of origin are quite different from export destinations. Major countries of origin are Japan and EC countries, accounting for 60%.

Table II-2-13 Imports by Country

(Unit KYAT in Million)

Area	1978/79	79/80	80/81	81/82	81/82 Per cent (%)
South East Asian Countries	226	218	524	363	7.2
Other Asian Countries	1,618	2,102	2,145	2,245	44.4
People's Republic of China	119	119	223	168	3.3
Sri Lanka	-	-	-	-	-
India	97	37	25	44	0.9
Japan	1,263	1,832	1,745	1,801	35.6
Pakistan	-	-	-	-	-
Bangladesh	45	59	63	34	0.7
Others	94	55	89	198	3.9
Middle East Countries	5	-	14	1	-
North American Countries	343	366	350	281	5.6
South American Countries	-	-	-	-	-
European Economic Community	823	1,026	982	1,327	26.2
Other North-West European Countries	57	202	130	227	4.5
Other South European Countries	2	-	7	3	0.1
East European Countries	79	131	215	393	7.8
African Countries	28	78	1	119	2.4
Australia, New Zealand and Other Countries in the Pacific	35	71	87	82	1.6
Others*	7	6	9	16	0.2
Total	3,223	4,200	4,464	5,057	100.0

2-6. Balance of Payments

The balance of payments is unfavourable because of the chronic balance of trade in the red.
Foreign exchange reserves are shown in Table II-2-15. The Government was rather reluctant to accept foreign loans and aid in the past. However, from 1973 it later accepted such from IDA, ADB, and others. The acceptance of foreign loans

Table II-2-14 Balance of Payments

(Unit: KYAT in LAKHS)

	1978/79	79/80	80/81	81/83	82/83
Main Account	Δ19,273	Δ13,229	Δ8,759	Δ22,844	Δ32,862
Balance of Trade	Δ21,831	Δ16,361	Δ14,227	Δ24,893	Δ34,100
Exports	16,322	26,340	31,800	34,621	31,400
Imports	Δ38,153	Δ42,701	Δ46,027	Δ57,514	Δ65,500
Balance of Invisible Trade	Δ1,485	Δ1,172	Δ1,126	Δ2,236	Δ4,923
Grants	4,043	4,304	6,374	4,285	6,161
Financial Account	21,319	19,253	11,141	19,762	23,708
Long-term Loans and Repayment	18,073	19,454	11,081	18,428	23,830
Loans	19,975	23,745	15,645	24,654	29,766
Repayment	Δ1,902	Δ4,291	Δ4,564	Δ6,226	Δ5,936
Short-term Loans and Repayment	2,093	411	Δ412	499	Δ79
Others	1,153	Δ612	472	835	Δ43
Total	2,046	6,024	2,182	Δ3,082	Δ9,154

Source: Report to the Pyithu Hluttaw

Table II-2-15 Foreign Exchange Reserves

(Unit. KYAT in LAKHS)

1962	65	73	74	75	76	77	78	79	80	81	82	82
end/Sept.	→	→	end/ March	→	→	→	→	→	→	→	→	end/ Sept
8,210	8,190	4,525	6,017	10,782	8,933	7,590	8,696	10,741	16,765	18,947	19,865	7,818

Source: Report to the Pyithu Hluttaw

and aid for the implementation of various development projects has increased since 1974. The main sources of loans and aid are Japan, West Germany, IDA, ADB, and so on.

Table II-2-16 Foreign Loans and Aids by Country

(Unit: US$ in Million)

	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	Total	Per cent (%)
Australia	-	-	-	[illegible]	[illegible]	-	8.8	0.4
Austria	-			-	-	37.8	[illegible]	[illegible]
Canada	-	[illegible]	-			-	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
Czechoslovakia	-		[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]
Denmark		-	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
France		[illegible]	[illegible]		-	[illegible]	[illegible]	3.1
W. Germany		[illegible]	[illegible]	[illegible]	209.4	[illegible]	[illegible]	[illegible]
Japan	1.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N. Korea		-	-	-	[illegible]		[illegible]	[illegible]
Netherlands	-	9.1	-		-	[illegible]	[illegible]	[illegible]
Norway	-	-	[illegible]			[illegible]	[illegible]	[illegible]
England	-	-		-	[illegible]	[illegible]	[illegible]	[illegible]
ADB	[illegible]	[illegible]	[illegible]	39	[illegible]	[illegible]	[illegible]	11.6
IDA	[illegible]	[illegible]	[illegible]	34	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	-			-	[illegible]	-	[illegible]	[illegible]
	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Commercial Bank	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	100

Source: Ministry of Planning and Finance

3. CURRENT SITUATION OF SHIPPING

3-1. Port Conditions

Burma's main ports are Rangoon, Akyab, Bassein, Moulmein, Mergui, Kyaukpyu, Sandoway, Tavoy, and Kawthoung. Rangoon, the largest port in Burma, and the other eight ports are called "outports" (international ports). Rangoon handled 88% of exports, 100% of imports and 44% of internal trade for all of Burma in 1982/83.

Table II-3-1 Volume of Handling Service

		1961/62	71/72	[illegible]	[illegible]	[illegible]	[illegible]	78/79	79/80	80/81	81/82	82/83
Rangoon	Export	2,224	1,436	745	61	48	1,040	926	1,428	1,485	1,360	1,482
	Import	1,175	798	908	614	619	553	841	704	747	1,148	915
	Coastal export	176	173	342	138	136	146	130	161	17	27	185
	Coastal import	121	87	80	6	79	76	73	54	9	48	128
	Total	3,696	2,494	1,875	1,819	1,882	1,815	1,967	2,347	2,258	2,781	2,648
Outports	Export	Data not available	166	74	134	134	243	69	148	102	138	191
	Import	"	-	-	-	-	-	-	-	-	-	-
	Coastal export	"	130	114	105	107	94	111	112	144	136	155
	Coastal import	"	218	164	164	167	168	167	206	247	265	240
	Total	"	514	349	377	428	411	347	475	498	539	603
Total	Export	2,224	1,602	819	935	1,114	1,283	995	1,576	1,587	1,503	1,673
	Import	1,175	798	908	614	619	553	841	704	747	1,148	915
	Coastal export	176	303	253	243	245	240	241	282	324	306	340
	Coastal import	121	305	244	236	246	238	240	287	337	363	368
	Total	3,696	2,828	2,224	2,028	2,224	2,270	2,317	3,049	2,995	3,320	3,296

Source Report to the Pyithu Hluttaw

The number of vessels arriving at Rangoon is as shown in Table II-3-2. An increase in vessels under 2000 GT and over 8000 GT is noticeable.

Table II-3-2 No. of Vessels by G/T Arriving at Rangoon (Excl. Coastal schooners)

(Unit: vessel)

G/T	1977/78	78/79	79/80	80/81	81/82	1977/78 ∿ 81/82 Average annual growth rate (%)
Up to 1000	229	363	401	332	420	16.4
1001-2000	32	24	76	139	170	51.8
2001-3000	97	65	42	43	47	▲ 16.6
3001-4000	47	62	67	53	57	4.9
4001-5000	45	23	32	28	23	▲ 15.4
5001-6000	34	37	40	33	34	0.0
6001-7000	30	26	27	28	34	3.2
7001-8000	37	34	33	44	42	3.2
8001-9000	17	23	30	36	38	22.3
9001-10000	25	38	40	32	46	16.5
Above 10000	4	18	29	22	36	73.2
Total	597	713	817	790	947	12.2

Source: Burma Dockyards Corporation

The number of arriving vessels at the Port of Rangoon classified by the country (port of departure) is as shown in Table II-3-3.

Table II-3-3 Number of Arriving Vessels

	1978/79		79/80		80/81		81/82	
	No. of vessel	Average G/T	No of vessel	Average G/T	No. of vessel	Average G/T	No. of vessel	Average G/T
South East Asian Countries	161	3,560	148	4,210	148	4,209	147	3,907
Singapore	119	3,396	105	4,066	112	4,273	116	3,593
Malaysia	27	4,386	34	4,370	27	3,923	18	5,466
Thailand	5	6,137	5	5,959	1	6,700	4	6,244
Indonesia	5	3,574	3	4,364	7	4,528	9	3,799
Others	5		1		1		-	
Other Asian Countries	158	5,971	208	5,463	202	5,556	195	5,978
People's Republic of China	-	-	-	-	2	4,167	2	8,716
Sri Lanka	17	5,028	40	6,200	38	6,163	25	5,948
India	43	7,043	31	6,623	49	5,855	43	6,581
Japan	34	6,745	50	5,633	27	5,587	32	6,772
Pakistan	-	-	7	6,149	1	6,174	2	6,205
Bangladesh	56	4,966	79	4,459	67	4,612	63	4,756
Others	8		1		18		28	
Middle East Countries	8	5,959	-	-	5	7,391	-	-
North American Countries	-	-	-	-	-	-	1	9,982
South American Countries	-	-	-	-	-	-	-	-
European Economic Community	12	7,508	11	7,933	9	6,486	4	4,884
Other North-West European Countries	-	-	3	5,606	-	-	1	696
Other South European Countries	-	-	-	-	-	-	-	-
East European Countries	4	8,126	4	7,401	6	10,308	10	9,809
African Countries	6	7,761	24	6,370	14	6,775	62	6,684
Australia, New Zealand and Other Countries in the Pacific	1	9,334	2	291	8	2,566	3	147
Others	18		1		3		1	
Foreign Country Total	368	4,962	401	5,105	395	5,148	424	5,405
Burmese Ports Total	345	574	(416)	(594)	405	773	523	804
Total	713	2,819	817	2,695	800	2,933	947	2,864

Source: Burma Dockyards Corporation

The largest vessel capable of entering to the port of Rangoon is 167 m in length and 9 m in draft (equivalent to a vessel of about 20,000 DWT). As regards incoming vessels from foreign countries, vessels from African countries have been increasing greatly, which contributes to an increase in the total number of incoming vessels. Vessel size has been increasing at an average rate of 2.8%. The growth of Burmese vessels is also great at an annual average of 14.9% in number and 11.2% in size.

Table II-3-4 No. of Foreign Vessels Arriving at Rangoon

	1978/79	79/80	80/81	81/82	Average annual growth rate (%)
No. of vessel	329	365	369	437	10.$\frac{0}{-}$
Average G/T	5,066	5,435	5,441	5,503	2.$\frac{8}{-}$

Source: Burma Dockyards Corporation

The characteristics of Burmese ports are that major ports are river or estuary ports and port facilities are super-annuated. River ports face the problems of siltation and water level variation. Constant dredging is therefore necessary for port maintenance.

River ports: Rangoon, Bassein, Moulmein and Tavoy
Burma ports: Akyab, Kyaukpyu, Sandoway, Mergui and Kawthoung

The Burma Ports Corporation responsible for ports administration has been taking care of the siltation problems, in addition to the effective use of ports and their development. The maintenance of facilities, repairs and purchase of dredgers,

renewal of loading equipment, etc. have all been carried out by the Burma Ports Corporation. Development projects include, among others, container-terminal construction at Rangoon and construction of the new Rangoon Port.

3-2. Current Shipping Situation

3-2-1. General

The shipping business in Burma developed in the prewar days by putting its priority on transportation on major rivers such as the Irrawaddy, Chindwin, Sittaung, and Salween.

The Government has been promoting the shipping industry after independence.

Before independence, foreign shipping was under the control of British shipping companies.

Inland shipping was almost monopolized by Irrawaddy Flotilla Co., Ltd. of the U.K.

At the time of independence in 1948, Burma had no oceangoing vessels at all. As regards inland shipping, Burma nationalized the Irrawaddy Flotilla Co., Ltd., and established and managed the Inland Water Transportation Corporation (IWTC), with about 300 vessels. As of march, 1983, the number of vessels almost doubled to 648.

The number of vessels for inland shipping owned by cooperative societies and private firms totals a little over 2,200, holding a large share of the inland shipping business.

Furthermore, the Petrochemical Industry Corporation, the People's Pearl & Fishery Corporation, the Heavy Industry Corporation, and the

Burma Ports Corporation have their own barges and tug boats for inland shipping.
As regards foreign shipping, the Burma Five Star Shipping Corporation was founded in 1959 as a state-owned shipping corporation.
According to the Lloyd's Register of shipping, vessels at 100 GT and above total 109 vessels (87,972 GT) as of July, 1982. (See Table II-3-5)

Table II-3-5 Fleet by Type

	1978		79		80		81		82	
	No. of vessel	G/T	No of vessel	G/T	No. of vessel	G/T	No of vessel	G/T	No of vessel	G/T
Oil tanker	12	6,528	13	7,246	13	7,256	4	2,986	4	2,986
Cargo vessel	13	51,254	13	43,224	20	65,084	26	65,987	37	67,883
Others	48	13,066	52	13,970	57	15,179	66	16,466	68	17,103
Total	73	70,848 (78,508 D/W)	78	64,440 (71,877 D/W)	90	87,519 (100,927 D/W)	96	85,439 (100,141 D/W)	109	87,972 (101,762 D/W)

3-2-2. Burma Five Star Shipping Corporation (BFSSC)

This is a solely state-owned shipping corporation in Burma which owns oceangoing vessels. BFSSC was initially managed with the help of Zim Israel Line, but later became independent in 1964.
The fleet as of September, 1983 consists of 29 vessels (121,069 DWT). A breakdown shows 14 oceangoing vessels (108,385 DWT), 10 coastal vessels (6,369 DWT), and 5 coastal tankers (6,315 DWT). (See Table II-3-6).
The fleet has been increasing steadily. The number of oceangoing vessels has increased by 40.0% (49.0% in DWT) in 10 years. The number of coastal vessels has increased by 275% (233% in DWT). According to the Fourth Four-Year Plan,

Table II-3-6 Details of Fleet as of Sept. 1983

NAME OF VESSEL	TYPE	D/W	G/T	BUILT	SHIPBUILDER	ASSIGNED TRADE
1. PAGO	MULTI-PURPOSE	13,105	10,097	1983	A.G. WESER, SEEBECKWERFT WEST GERMANY	EUROPE
2. MANDALAY	"	13,105	10,097	1983	A.G. WESER, SEEBECKWERFT WEST GERMANY	"
3 MAW LA MYAING	"	11,660	7,567.11	1979	FLENSBURGER SOBIFFSBAU-GESELISCHAFT WEST GERMANY	FAR EAST
4. SITTWAY	"	11,660	7,567.11	1980	"	"
5. AVA	"	10,120	7,435	1963	A.G WESER SEEBECKWERFT WEST GERMANY	EUROPE
6. BASSEIN	"	10,120	7,435	1963	"	"
7. MERGUI	"	10,075	7,458	1963	URAGE SHIPYARD JAPAN	"
8. PINYA	"	10,010	7,423	1963	HITACHI SAKURAJIMA JAPAN	"
9. MYOMA YWA	"	7,083	5,496	1961	A.G. WESER SEEBECKWERFT WEST GERMANY	BAY OF BENGAL
10. HTAN TAW YWA	"	4,000	2,749	1961	PAUL LINDENAU NORWAY	"
11. PA-GAN	"	2,076	1,619.8	1979	KRISTIANS AND MEK VERKSTED A.S., NORWAY	"
12. PA-AN	"	2,076	1,619.8	1979	"	"
13. HTONE XWA	"	1,720	944	1961	HEINRICH BRANK KG SHIFFSERFT WEST GERMANY	"
14. PHA SHWE GYAW XWA	"	1,575	780.27	1964	AARHUS FLYOEDOCKOG MASKINKOMPANI DENMARK	"
Total		108,385				

four oceangoing vessels and one coastal vessel are to be newly commissioned in two years. (See Table II-3-7).

NAME OF VESSEL	TYPE	D/W	G/T	BUILT	SHIPBUILDER	ASSIGNED TRADE
1. LOIXAW	LINER	800	498.69	1978	BURMA DOCKYARD CORPORATION, BURMA	COASTAL
2. NGWAY PALEI	"	750	541.64	1981	RICHARDS SHIP BUILDER U.K.	"
3. LASHIO	"	700	299.99	1973	A.S NORDSOVALRF TEI RING KOBING DENMARK	"
4. SHWAY PALEI	"	357	363.51	1979	STORVIK MGK VERKSTED A/S NORWAY	"
5. KYI-THA (1)	OCEAN TUG	184	-	1981	BURMA DOCKYARD CORPORATION BURMA	
6. KYI-THA (2)	"	184	-	"	"	
7. HAKA	LINER	948	1,403.16	1979	KRISTIAN SANDS MEK VERKSTED A.S. NORWAY	COASTAL
8. MYIT KYEE NAR	"	948	1,403.16	1979	LANSTEIN SLIP OG BATBYGGERI NORWAY	"
9. TAUNG GYEE	"	948	1,403.16	1980	BOISONFS VERFT NORWAY	"
10. AUNG ZEYA	"	550	754.46	1960	UJINA SHIP BUILDING JAPAN	"
11. MAHN	TANKER	1,440	998	1979	WISLA SHIPYARD POLAND	"
12. P Y I	"	1,430	997.56	1980	"	"
13. MYAN AUNG	"	1,195	498.04	1965	ANKERLOKKAN VERFT A/S NORWAY	"
14. SHWE PYI	"	1,125	498.04	1976	BURMA DOCKYARD CORPORATION, BURMA	"
15. SHWAY PYI THA	"	1,125	498.04	1980	"	"
Total		12,684				
Total		121,069				

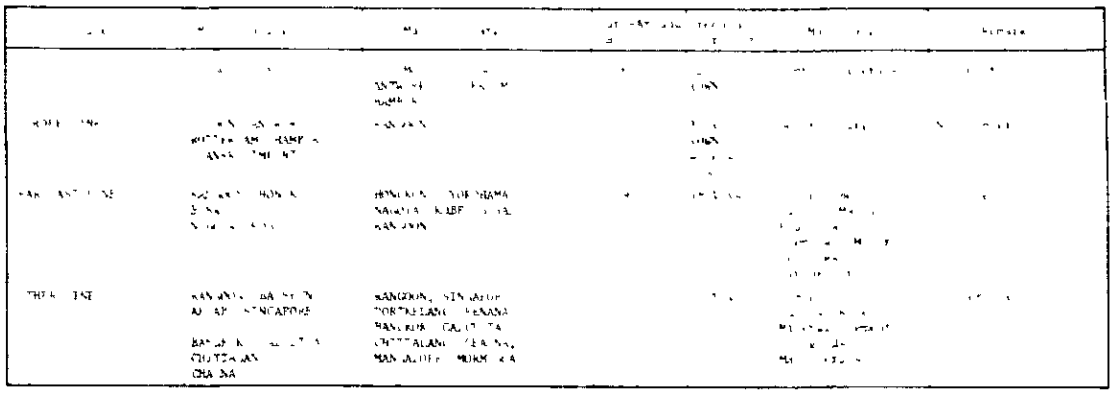
Table II-3-7 Changes and Forecast for Fleet

		1973/74		74/75		75/76		76/77		77/78		78/79		79/80		80/81		81/82		82/83		83/84		84/85		85/86	
		NO	D/W	NO	D/W	NO	D/W	NO	D/W	NO	D/W	NO	D/W	NO	D/W	NO	D/W	NO	D/W	NO	D/W	NO	D/W	NO	D/W	NO	D/W
Ocean going vessel	Conventional	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Multi-purpose	10	72754	10	72754	9	63746	9	63746	8	54703	11	70515	12	82175	12	82175	12	82175	14	108385	16	133385	18	158385	18	158385
	Tramper	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Tanker	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	10	72754	10	72754	9	63746	9	63746	8	54703	11	70515	12	82175	12	82175	12	82175	14	108385	16	133385	18	158385	18	158385
Coastal vessel	Conventional	2	1705	2	1705	2	1705	2	1705	4	2877	6	3975	7	4923	9	5291	9	5619	10	6369	11	6869	11	6869	11	6869
	Tramper	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Tanker	2	2104	2	2104	3	3229	3	3229	4	4354	5	5494	6	7224	5	6315	5	6315	5	6315	5	6315	5	6315	5	6315
	Total	4	3809	4	3809	5	4934	5	4934	8	7231	11	9469	13	12147	14	11606	14	11934	15	12684	16	13184	16	13184	16	13184
Total		14	76563	14	76563	14	68680	14	68680	16	61934	22	80284	25	94317	26	93781	26	94109	29	121069	32	146569	34	171569	34	171569

Source: BFSSC

The major assigned lines of oceangoing vessels are between Burma and Europe, the Far East, and the Bay of Bengal. Except for the Europe line, assignments have been made by participation in a Shipping Conference. The main discharging ports, main cargoes, and service frequencies are shown in Table II-3-8.

Table II-3-8 Assigned Line of BFSSC



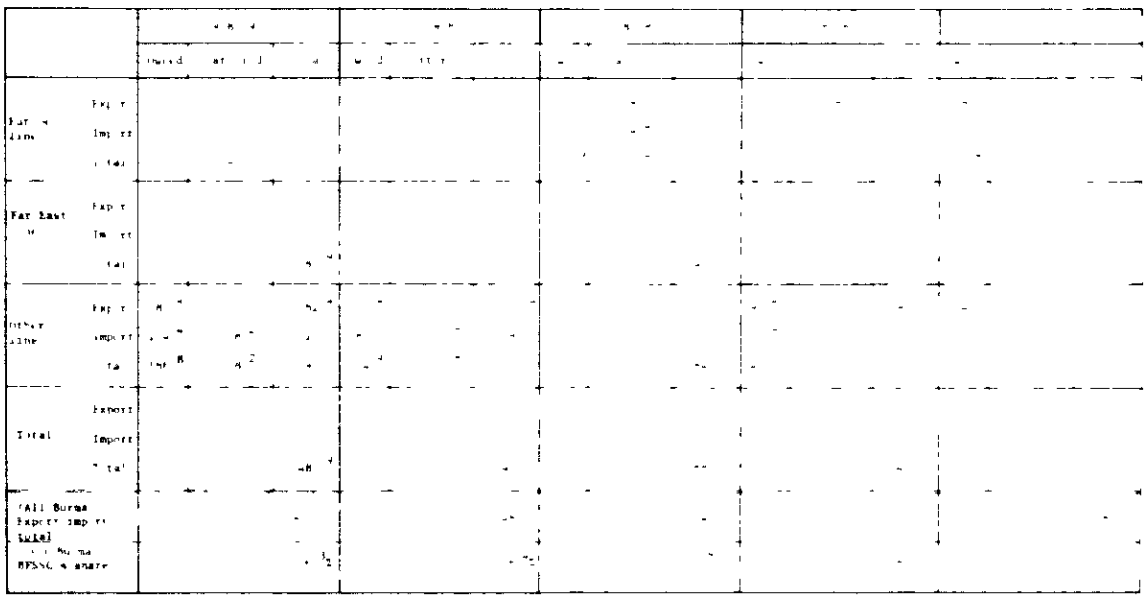
At present, BFSSC participates in various conferences with regard to assigned lines between Burma and the Far East as well as the Bay of Bengal. BFSSC, at present, is a participant in the following:

(1) Bay of Bengal/Japan/Bay of Bengal Conference
(2) Japan/Hongkong and Japan/Straits Freight Agreement
(3) Hongkong/Japan Freight Agreement
(4) Straits/Calcutta/Bangladesh Agreement
(5) Straits/Rangoon Rate Agreement
(6) Hongkong/Straits Freight Agreement
(7) Straits/East Asia Rate Agreement

Concerning actual transportation results, a

growth of as much as 72.5% from the preceding year was recorded in 1980/81 when BFSSC re-started service between Europe and Burma.
Transportation results have remained almost unchanged since then. The transportation volume of BFSSC has accounted for about 30% of the total since 1980/81. (See Table II-3-9).

Table II-3-9 Lifting Result



Source: BFSSC and Permit to the Pathu Hlutlaw

The number of chartered vessels increased to 34 in 1981/82 and 42 in 1982/83. BFSSC has mainly chartered vessels from Europe and Far East (Japan) on a one-way trip basis.
It seems that BFSSC has also chartered many trampers (T/C and V/C) for the transportation of phosphate, etc. (See Table II-3-10).
As regards the loading shares of owned and chartered vessels, over 50% is loaded on owned vessels as seen from the operating D/W per day in Table II-3-11.
In other words, 15% to 20% of the export and

import volume of Burma is transported by its own fleet.

Table II-3-10 Result of Chartering (including V/C)

	1981/82				82/83			
	No. of vessel	Average D/W	Average charter period	D/W per day	No. of vessel	Average D/W	Average charter period	D/W per day
Europe line	10	15,310	71	29,569	14	14,80[illegible]	69	39,433
Far East line	8	11,304	46	11,334	8	10,066	45	10,070
Others (including tramper)	16	14,832	55	37,591	20	14,891	45	38,628
Total	34	14,142	58	78,494	42	13,945	55	88,231

Source: BESS[illegible]

Table II-3-11 Comparison of D/W per Day between Owned Vessel and Chartered Vessel

	1981 82				82 83			
	Owned D/W	Chartered D/W	Total D/W	Share of owned D/W	Owned D/W	Chartered D/W	Total D/W	Share of owned D/W
Europe line	40,325	29,569	69,894	57.7	166,333	39,433	[illegible]	6[illegible]
Far East line	23,320	11,334	34,654	67.3	23,3[illegible]	10,[illegible]	33,390	69.8
Others (including tramper)	18,330	37,591	56,121	33.[illegible]	1[illegible],330	38,[illegible]	[illegible],358	3[illegible]
Total	82,175	78,494	160,669	51.1	108,383	88,[illegible]	[illegible],[illegible]	55.[illegible]

Coastal vessels are mostly assigned to shipments to Rangoon and surrounding areas. The transport volume corresponds to about 20% of the total shipping volume in Burma.

Table II-3-12 Assigned Lines as of Sept., 1983

Line	Loading Ports	Discharging Ports	Turn-Around Days	Frequency (Per year)	Remarks
COASTAL LINE					
HAICA	RANGOON, MERGUI	MERGUI, RANGOON	23	8 VOYS	RICE & RUBBER
MYITKYEENAH	RGN AKB/KET/SDY	SDY/KPU/AKB/RGN	17	8 VOYS	GENERAL CARGO
TAUNGYEE	SDY				
ALNGZAYA	RGN NGI KAWTHAUNG	KTE MGI/RGN	23	22 VOYS	FI GENERAL CARGO RUBBER
LAIKAW	RGN TVY, MGI	MGI, TVY, RGN,	14	16 VOYS	PKE, RUBBER & TN
TASHIO	RGN, AKB	SDY KPU AKB RGN	18	8 VOYS	GENERAL CARGO

Source: BPSS

Table II-3-13 Lifting Results

(Unit: 1,000 M/T)

	1978/79	1979/80	1980/81	1981/82	1982/83
Conventional	30	42	94	72	54
Tramper	-	-	-	-	8
Tanker	36	40	47	62	67
Total	66	82	141	134	129

According to the Five-Year Development Programme (1983/84 - 1987/88) issued by the Ministry of Planning and Finance, the construction of two multipurpose cargo vessels (15,000 DWT), the purchase of two second-hand cargo vessels (10,000 DWT), and the purchase of one second-hand coastal cargo vessel (800 DWT) are planned as top priority projects. The construction and purchase of another five vessels are also planned as priority project. The five vessels in the top priority project can be considered as replacements for existing vessels.

Table II-3-14 Project for BFSSC

(Unit: Kyat in million)

Name of project	Total project cost
(Top priority)	
Construction of (2) 15000 D/W Multi-purpose Cargo Vessel Project.	445
Purchase of (2) 10000 D/W Second-hand Cargo Vessel Project.	116
Purchase of (1) 800 D/W Second-hand Coastal Cargo Vessel Project.	5
	566
(Priority)	
Purchase of (2) 10000 D/W Second-hand Cargo Vessel Project.	177
Construction of (2) 4000 D/W Cargo Vessels Project.	354
Construction of (1) 15000 D/W Multi-purpose Cargo Vessel Project.	265
	796
Total	1,362
Project for Transport and Communications	6,617
Total Project in Burma	45,499

Source: Five-Year Development Programme

3-2-3. Inland Water Transport Corporation

This is the state-owned enterprise engaged in inland waterways transportation.
Cooperatives and private firms are also operating in this field with partial shares shown in Table II-3-15. The breakdown by age of various vessels of the Inland Water Transport Corporation is shown in Table II-3-16.

Table II-3-15 Coastal Vessel by Sector

(Unit: Vessel)

	1978/79	79/80	80/81	81/82	82/83
IWTC	588	616	618	646	648
Passenger CUM Cargo	169	170	173	173	172
Cargo Barges	47	48	48	48	49
Tug & Cargo Boat	43	45	45	58	58
Barges	193	218	218	237	238
Station Pontoons	84	83	81	77	77
Tugs	37	37	37	37	38
Oil Barges	15	15	16	16	18
Co-Operative	1,195	1,328	1,358	1,349	1,324
Powered Barges	214	226	245	256	255
Non-Powered Barges	852	941	804	785	782
Cargo Vessels	129	161	309	308	287
Private	760	779	703	775	916
Total	2,543	2,723	2,679	2,770	2,893

Source: IWTC and Report to the [illegible]

Table II-3-16 Fleet by Vessel's Age as of Mar., 1983

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Source: IWT

Vessels exceeding the age 21 years account for 71%. Only 13.1% of all vessels are less than 10 years in age.

The fleet by vessel DWT is shown in Table II-3-17. Vessels less than 200 DWT account for 78.1%, and IWTC so far does not own any vessel over 1000 DWT.

Table II-3-17 Fleet by Vessel's DWT

	Passenger CTM Cargo	Cargo Barges	Tug & Cargo Boat	Barges	Station Pontoons	Tugs	Oil Barges	Total	(D/W)	Ratio
- 100 D/W	27	3	-	96	10	37	3	183	(10,142)	28 3
101 - 200	114	24	49	104	32	-	-	323	(40,390)	49.8
201 - 300	19	7	-	21	12	1	7	67	(16,524)	10 3
301 - 500	12	15	2	4	3	-	6	42	(16,616)	6 5
501 - 1,000	-	-	-	13	18	-	2	33	(21,587)	5 1
1,001 -	-	-	-	-	-	-	-	-	(-)	-
Total	172	49	58	238	75	38	18	648	(105,259)	100 0

The DWT per vessel has remained almost the same for each vessel type for the past 5 years. (See Table II-3-18). On the other hand, the transportation volume has increased by 84.1% in cargo (ton-mile) and 45.3% in passengers in those five years. This means that much improvement has been made in transportation efficiency. (See Table II-3-19).

Table II-3-18 No. of Fleet and DWT per Vessel

	Pass & f CTM ar	Carg Carg	Tug & Carg Boat	Barges	Station P	Tugs	Oil Barges	Total	(D/W)
Fleet	78 79			93	241	36	37	15	588	(98,633)
	82 83			49	54	238	35	38	18	648	(105,259)
	Growth Rate (%)	4 5	-	34 9	23 3	18	2	26	1	(6 -)
wt per Vessel	78 79	1.8	24.	1.7	.32	267	73	237	168	
	82 83	1.1	.5	1.3	138	275	2	245	162	

Source IWTC

Table II-3-19 Lifting Results

	78 79	79/80	80/81	81/82	82/83
Cargo (Ton/mile)	1,015,671	[illegible]	1,413,678	1,594,805	1,869,835
Passenger (number)	13,169	13,467	14,209	17,933	19,134

Source IWTC

3-2-4. People's Pearl & Fishery Corporation

This Corporation owns fishing vessels and is engaged in coastal fishery. The fleet consists of many new steel vessels. 74.6% of these vessels are not older than 10 years, showing that many vessels have been put into use quite recently. The fleet has increased from 28 to 67 vessels in this four year period at an average annual increase rate of 24.4%. However, vessel sizes are small and 67.2% of the vessels are 200 DWT or less. (See Table II-3-20 ~ 22).

Table II-3-20 Fleet

	1978/79		79 80		[illegible]/81		81 8		8[illegible] 83	
	No of vessel	DWT								
Steel vessel	28	4,596	56	7,790	58	7,892	65	9,366	67	9,86[illegible]
Others	-	-	-	-	22	550	24	563	24	[illegible]
Total	28	4,596	57	7,790	80	8,442	89	9,929	91	[illegible]

Table II-3-21 Fleet by Vessel Age

(1982/83)

Age	No. of vessel	DWT
0 - 5	36	4,877
6 - 10	14	1,885
11 - 15	5	782
16 - 20	11	2,189
21 -	1	127
Total	67	9,860

Table II-3-22 Fleet by Vessel DWT

(1982/83)

DWT	No. of vessel	DWT
- 50	-	
51 - 100	25	1,583
101 - 200	20	2,215
201 -	22	6,062
Total	67	9,860

4. CURRENT SITUATION OF SHIPBUILDING AND SHIP REPAIRING INDUSTRIES

4-1. General Description

The shipbuilding industry in Burma has been displaying activity mostly in building and repairing the small fishing boats and small coastal vessels of shallow draft that are used on domestic routes. Thus, shipbuilding is a well developed industry but may well be considered to still be in its infancy.

1,000 GT ships are the largest types domestically built, so oceangoing ships of larger sizes are imported mainly from Japan, West Germany, Norway, Denmark, and others.

Concerning ship repairing, the Sinmalike Dockyard of the Burma Dockyards Corporation is one facility that is substantial in size. However, its repairing capacity (the maximum ship weight capable of being transferred on-shore) is limited, so repair work for larger ships of Burmese registry is done in Singapore, Malaysia, Japan and European countries.

A specific feature of the shipbuilding industry in Burma is the so-called vertical division system dominant throughout the industry. This tendency is prevailing among various other industries in Burma, and the shipbuilding industry is not an exception. Each dockyard belongs either to a governmental agency or to a corporation and is engaged in building and repairing ships mostly in the possession of individual parent organizations. The Burma Dockyards Corporation belongs to

the Ministry of Transport and Communications, and the People's Pearl and Fishery Corporation, the Burma Ports Corporation, the Inland Water Transport Corporation, the Marine Administration Department, etc., have their own dockyards carrying out shipbuilding and ship repairing jobs on ships in their possession. Among them, only the Burma Dockyards Corporation can undertake the building and repairing of oceangoing vessels on a commercial basis.

Most dockyards, being situated along rivers, are small and have only a few small slipways as production facilities. Various items of equipment including cranes, etc. have already become obsolete, presumably being unable to perform to capacities and at a satisfactory level. This is one reason that improvement in working efficiency and productivity is needed. However, one merit is easily obtainable abundant cheap labor, and accordingly, each dockyard has rather too many employees at present.

Shipbuilding-related industries in Burma have not fully been developed yet. Steel, main and auxiliary engines, propellers, etc., for marine use, are 100% imported from abroad. As there exist no outside workshops specializing in fabricating materials and components, all dockyards are obliged to have their own required workshops. Because there does not exist the practice of lending or exchanging materials and equipment among different shipyards, nor any communal facilities available for such purposes, every dockyard has to maintain all required facilities on its own.

This is one of the factors to which high manhour consumption and low productivity can be attributed.

4-2. Principal Dockyards

4-2-1. Burma Dockyards Corporation (BDC)

The Burma Dockyards Corporation has the Sinmalike Dockyard, (largest in Burma), which was completed in 1970. This is the only dockyard in Burma that can undertake shipbuilding and ship repairing jobs on a commercial basis. Sinmalike Dockyard is located about 5 Km to the north of the port of Rangoon, occupying a site of some 500,000 m^2 as the dockyard premises. It has a slipway capable of transferring onshore a ship of 1,700 tons sidewise for its repair on land, which enables 12 ships to be accommodated at the same time (building or repairing). Today, Sinmalike Dockyard is able to undertake the building and repairing of various types of ships such as tankers, dry cargo ships, tugboats, and barges. The biggest ships ever built are tankers of 1,100 DWT completed in 1976 and in 1980. The building records for the last five years are shown in Table II-4-1.

Table II-4-1 Shipbuilding Record at BDC

	Tanker		Bulk Carrier		General Cargo		Others		Total	
	NO.	DWT	NO.	DWT	NO.	DWT	NO.	DWT	NO.	DWT
1978							13	6,500	13	6,500
1979					1	550	10	4,560	11	5,110
1980	1	1,100					9	690	10	1,790
1981							15	2,405	15	2,405
1982							14	3,110	14	3,110
Total	1	1,100	-	-	1	550	61	17,625	63	18,915

The ship repairing capacity is 80 vessels (max.) per annum and is now working almost at full capacity.

4-2-2. Inland Water Transport Corporation (IWTC)

This corporation has its own small dockyards in Rangoon, Ahlone, Akyab, Moulmein and Mandalay. These dockyards are engaged in the building and repairing mainly of small-size vessels owned by IWTC.

The principal dockyard among them is Dalla Dockyard which has 14 slipways capable of accommodating onshore ships up to 400 tons in weight. This dockyard also extends technical guidance services to the other dockyards under IWTC management.

4-2-3. Burma Ports Corporation (BPC)

This corporation is in possession of 3 dockyards in Rangoon and also slipways for small boats located at various river-side places.

The leading dockyard is Botataung Dockyard in Rangoon with 6 slipways capable of drawing on-shore ships of about 200 tons.

4-2-4. Marine Administration Department (MAD)

This department has Dawbon Dockyard in Rangoon which can undertake the repairing of some 100 small vessels (110 GT) per annum.

The above descriptions of leading dockyards are summarized in Table II-4-2.

Table II-4-2 Outline of Leading Dockyards

Dockyard	location	Facilities, etc.	Capacity	Employees
Burma Dockyards Corporation (BDC)		Sidewise slipway (1 unit)	Annual shipbuilding capacity = 4,000 DWT (12 vessels)	
Sinmalike Dockyard	Rangoon	12 vessels can be repaired at the same time.	Annual ship repairing capacity = abt. 80 vessels	Abt. 2,020 persons
			Max. onshore transferring capacity = 1,700 tons	
Inland Water Transport Corporation (IWTC)				
Dalla dockyard	Rangoon	Slipways (14 units) 22 vessels can be repaired simultaneously.	Max onshore transferring capacity = 400 tons	Abt. 1,850 persons
Ahlone dockyard	Rangoon	Slipways (6 units) 13 vessels can be repaired simultaneously	Max. onshore transferring capacity = 200 tons	Abt. 750 persons
Akyab dockyard	Akyab	Slipway (1 unit) and side slipways (3 units) 5 vessels can be repaired simultaneously.	Max. onshore transferring capacity = 200 tons	Abt 150 persons
Moulmein dockyard	Moulmein	Slipways (4 units)	Max. onshore transferring capacity = 200 tons	Abt. 160 persons
Mandalay dockyard	Mandalay	Neither slipways nor docks. Only welding shop and paint shop are available; the dockyard exclusive -ly for repair jobs.		Abt. 200 persons
Burma Ports Corporation (BPC)				
Botataung dockyard	Rangoon	Slipways (6 units) 6 vessels to be accommodated at the same time	Max. onshore transferring capacity = 200 tons	Abt. 1,430 persons
Sat sun dockyard	Rangoon	Gearing dock (1 unit) Max size of ship L x B x D = 70M x 11.6M x 7.6M		
Ant gyi dockyard	Rangoon	Slipways (3 units)	Max. onshore transferring capacity = 150 tons	
Marine Administration (MAD) Department				
Dawbon dockyard	Rangoon	Slipways (5 units)	Max. size of ship=1000T or 27.5M in L	Abt. 810 persons

Source BDC

4-3. Shipbuilding and Ship Repairng Capacities and Performances

As previously mentioned, the shipbuilding and ship repairing industry in Burma is mainly composed of repair jobs on small coastal vessels, with the exception of certain shipbuilding jobs that are being carried out by BDC.

Apart from the government-owned dockyards, there exist a number of private ones operating on a small scale which can undertake small-scale shipbuilding and repairing (mostly non-power-driven type).

Tables II-4-3 and II-4-4 refer to shipbuilding and ship repairing facilities in Burma.

Table II-4-3 Shipbuilding Facilities by Ship Sizes in Burma

D.W.T.	0 - 100	100 - 500	500 - 1000	1000- 5000	over 5000	Total
Building Berth	200	6	4	2	0	212
Total DWT	10,000	2,000	3,000	4,000	0	19,000

Source: BDC

Table II-4-4 Ship Repairing Facilities by Ship Sizes in Burma

D.W.T.	0 - 100	100 - 500	500 - 1000	1000- 5000	over 5000	Total
Dock & Slipway	200	80	6	2	0	288
Total DWT	10,000	24,000	4,000	4,000	0	42,000

Source: BDC

The average amount of shipbuilding per year is around 8,000 DWT, while ship repairing is around 160,000 DWT. The actual figures for shipbuilding and ship repairing by the government-owned dockyards are shown in Table II-4-5.

Table II-4-5 Shipbuilding & Ship Repairing Performance by Government-Owned Dockyards

Year	No. of Newly Built Ships	No. of Repaired Ships
1978	19	3,680
1979	15	3,632
1980	54	3,620
1981	42	3,171
1982	35	2,879
Total	165	16,982

Source: BDC

4-4. Current Situation of Facilities, Techniques, and Labour Force

4-4-1. Facilities

Sinmalike Dockyard and another two or three leading dockyards have comparatively modern facilities. The rest of the dockyards in general, however, are handicapped by rather obsolete facilities, most of which stand in need of repair or replacement. They require facility modernization in order to improve productivity.

4-4-2. Shipbuilding Techniques

For wooden vessel construction, conventional methods and techniques are still employed, although signs of introducing mechanical innovations have gradually been appearing.
Construction of steel ships started in 1950 after independence, and the shipbuilding industry is still in its infancy as is often the case in developing countries.
As for ship repairing, some techniques and experience have accumulated from work done at Sinmalike Dockyard in the past 13 years (since founding), and at other dockyards.
However, to cope with the shortage of engineers required in shipbuilding and repairing, some engineers and technicians have been sent abroad to study up-to-date technology.
The modernized production system and higher productivity as an overall assembly industry will be the most important matter for the development of the shipbuilding industry in Burma.

4-4-3. Labor Force

Although the labor force required for the shipbuilding industry can easily be recruited in abundance, skilled workers and naval architects are in short supply. Especially, specialists in naval architecture, ship design, electrical engineering and electronics, welding, metallurgy, and quality control are not sufficient in number, and skilled workers in erection and welding are in short supply. Table II-4-6 gives the number of employees engaged in shipbuilding.

Table II-4-6 Employees in Dockyards

Job Rank	No. of Persons
Managers	50
Engineers	200
Technicians	100
Foremen	400
Workers	5,000
Administration	300
Total	6,050

Source: BDC

4-5. Industries Related to Shipbuilding

The industries related to shipbuilding in Burma are now in the course of developing. Machinery and equipment for small ships are privately manufactured by the minor-scale enterprises, but the same for 100 DW ton or bigger vessels are 100% imported. Table II-4-7 indicates the proportion of domestic and international material procurement at Sinmalike Dockyard, BDC.

Table II-4-7 Domestic and International Procurement

	Imports (%)	Domestics (%)
1 Material steel (plates, shapes, etc.)	99	1
2 Main and auxiliary engines	100	0
3 Electric materials and equipment	100	0
4 Fuel oils, lubricants, etc.	5	95
5 Electrodes	100	0
6 Paints	100	0
7 Other materials	95	5

* Steel:

The No. 3 Mining Corporation produced pig iron amounting to about 13,000 tons in 1982-83.

The steels domestically obtainable are limited to round bars, flat bars, and equal angles, all in small sizes. Since these items are unsuitable for marine use, all steel material needs have to rely upon imports from abroad for the time being.

* Electrode:

The Heavy Industry Corporation produces the electrodes for manual welding of mild steel. When production increases to a certain level in the future, it can be expected that home-made electrodes may come to be extensively used in the industry.

The development of the steel industry and the machine industry are of great importance to the shipbuilding industry. How to foster all the industries related to shipbuilding will continue to be a great topic in Burma is future aims at national industrialization.

4-6. Training and Education

The Government has been trying hard to promulgate education and now the national literacy rate is as high as 70%; this may rank very high among the Asian countries.

The Engineering Institute trains professional engineers and several other vocational education schools train technicians and artisans, but none of them specializing in shipbuilding engineering. The vocational education schools have training courses for welders, which are usually supplemented by on-the-job training at respective dockyards to further proficiency required in shipbuilding and ship repairing. The education of shipbuilding engineers depends upon despatching them abroad for higher education there.

III. FEASIBILITY STUDY OF THE PROJECT

III. FEASIBILITY STUDY OF THE PROJECT

1. DEMAND FORECAST

1-1. Demand Forecast

The 30-year demand forecast for ship repairing until 2018, assuming 1989 as the initial year of operation, has been obtained on the basis of the results and forecasts of the Third Four-Year Plan, Fourth Four-Year Plan, and Five-Year Plan, while taking into account the recent economic situation, shipping volume, and current fleet situation. The following indicators were selected:

(1) Economic growth rate

Growth has been at 5.2% to 7.9% since 1976/77, and 6.0% growth, the target of the Fourth Four Year Plan, is expected to be sufficiently attained if oil continues to be domestically supplied as at present. Therefore, 6.0% has been set for the period until 1989/90, which is considered to be the first year of dockyard operations, and for the subsequent 15 years (1989/90 to 2003/04), assuming a similar growth rate of 5.0% to 7.0%.

For the succeeding 15 years (2004/05 to 2018/19), a 5.0% target has been set, assuming a growth rate of 4.0 to 6.0%.

(2) Volume of trade

The average annual growth rate of international trade from 1978/79 to 1982/83, in terms of value, was 15.1% for exports, 17.0% for imports, and 16.2% in total. Judging from past trade trends and the recent economic situation in Burma, the target annual growth rate of 16.1% for exports and 12.5% for imports in the Five Year Development Programme (1982/83-1986/87) is considered attainable.

The volume of trade increased at 9.0%/year in total from 1978/79 to 1982/83. According to the Ministry of Transport and Communications, the annual volume growth rate of trade from 1982/83 to 1986/87 is estimated at 7.0%, which is also considered reasonable.

In this study, therefore, this growth rate is adopted in forecasting the trade volume until 1986/87.

A trade forecast from 1986/87 to 2018/19 is made by using an elasticity coefficient of the growth rate of trade volume to that of GDP.

The elasticity coefficient during the period from 1982/83 to 1986/87 is estimated at 1.16.

Based on this elasticity coefficient and the estimated growth rate of GDP mentioned above, the growth rate of trade volume is forecast at 7.0%/year from 1986/87 to 2003/04 and 5.8%/year from 2004/05 to 2018/19.

(3) Volume of transportation of BFSSC

The average annual growth rate in 1978/79 to 1982/83 was 9.0% which was equal to that of the volume of trade; its target in 1982/83 - 1986/87

is set at 6.4%/year by BFSSC. If the lifting share of BFSSC is the same in the future, annual growth rate can be set at 6.4% for the initial 15 years, and 5.3% for the succeeding 15 years, according to the elasticity coefficient of the growth rate of trade to that of GDP. The ratio of transport by vessels owned by BFSSC to the total volume of transport is assumed to increase. Vessel size is classified into three types (including trade pattern), considering the maximum vessel size that can enter the port of Rangoon: 0 to 5000 DWT, 5001/ to 10000 DWT and 10001/ to 20000 DWT.

Considering that the annual average increase of DWT per vessel in the past nine years (1974/75 to 1982/83) in BFSSC was 0.8%, future growth is set at the same value.

(4) Prospective vessels using the new dockyard

Prospective vessel sizes have been forecast as being from 1,501 to 20,000 DWT, judging from the fact that the current repair capacity of the BDC is 1500 DWT, and that each corporation has its own repair dock. In other words, only oceangoing vessels owned by BFSSC will become large customers in Burma. As regards foreign vessels, an increase in incoming vessels will ensure sufficient demand. To lure such vessels to the new dockyard, however, international competitiveness is indispensable. The improvement of technical capacities (work time and work quality) and low repair costs are necessary.

Table III-1-1 Results and Forecasts of Annual Growth Rates

(Unit %)

	(Result) 1978/79~82/83	(Forecast) 82/83~86/87	(Forecast) 86/87~89/90	(Forecast) 89/90~2003/04	(Forecast) 2003/04~17/18
GDP	6.6	6.0	6.0	6.0	5.0
Amount of export/import	16.2	(13.9)	(13.9)	(13.9)	(11.6)
Export	15.1	16.1			
Import	17.0	12.5			
Volume of Export/import	(1974/75~82/83) 9.0 (5.2)	7.0	7.0	7.0	5.8
Export	13.9				
Import	2.1				
Volume transported by BFSSC (including chartered)	9.0	6.4	6.4	6.4	5.1
BFSSC's owned fleet (DWT)	11.3 (5.1)	6.4	6.4	6.4	5.3

The demand of the fleet of BFSSC is forecast in Table III-1-2.

Table III-1-2 Forecast of BFSSC Fleet

	1,501~5,000 DWT			5,001~10,000 DWT			10,001~20,000 DWT			Total		
	No. of vessel	Average DWT	DWT	No. of vessel	Average DWT	DWT	No. of vessel	Average DWT	DWT	No. of vessel	Average DWT	DWT
1983	5	2,289	11,447	1	7,083	7,083	8	11,232	84,855	14	7,742	108,385
1989	7	2,401	16,809	1	7,431	7,276	11	11,783	130,374	19	8,320	157,459
1990	7	2,420	17,672	2	7,490	10,934	12	11,877	138,718	21	8,185	167,324
1991	8	2,439	18,803	2	7,550	11,634	12	11,972	147,596	22	8,250	178,033
1992	8	2,459	20,006	2	7,610	12,379	13	12,068	157,042	23	8,316	189,427
1993	9	2,479	21,286	2	7,671	13,171	14	12,165	167,093	25	8,383	201,550
1994	9	2,499	22,648	2	7,732	14,014	14	12,262	177,787	25	8,450	214,449
1995	10	2,519	24,097	2	7,794	14,911	15	12,360	189,165	27	8,518	228,173
1996	10	2,539	25,639	2	7,856	15,865	16	12,459	201,272	28	8,586	242,776
1997	11	2,559	27,280	2	7,919	16,880	17	12,559	214,153	30	8,655	258,313
1998	11	2,579	29,027	2	7,982	17,960	18	12,659	227,859	31	8,724	274,845
1999	12	2,600	30,884	2	8,046	19,109	19	12,760	242,442	33	8,794	292,435
2000	13	2,631	32,861	3	8,100	20,332	20	12,862	257,958	36	8,864	331,151
2001	13	2,642	34,964	3	8,175	21,663	21	12,965	274,467	37	8,935	331,064
2002	14	2,663	37,202	3	8,240	23,018	22	13,069	292,033	39	9,006	352,253
2003	15	2,684	39,583	3	8,306	24,491	24	13,174	310,723	42	9,078	374,797
2004	15	2,705	41,681	3	8,372	25,789	25	13,279	327,191	43	9,151	394,661
2005	16	2,727	43,890	3	8,439	27,156	26	13,385	344,532	45	9,224	415,578
2006	17	2,749	46,216	3	8,507	28,595	27	13,492	362,792	47	9,298	437,603
2007	18	2,771	48,665	4	8,575	30,111	28	13,600	382,020	50	9,372	460,796
2008	18	2,793	51,244	4	8,644	31,707	29	13,709	402,267	51	9,447	485,318
2009	19	2,815	53,960	4	8,713	33,387	31	13,819	423,587	54	9,523	510,934
2010	20	2,838	56,820	4	8,783	35,157	32	13,930	446,037	56	9,599	538,014
2011	21	2,861	59,831	4	8,853	37,020	33	14,041	469,677	58	9,676	566,528
2012	22	2,884	63,002	4	8,924	38,982	35	14,153	494,560	61	9,753	596,554
2013	23	2,907	68,341	5	8,995	41,048	37	14,266	520,782	65	9,831	628,171
2014	24	2,930	69,857	5	9,067	43,224	38	14,380	548,383	67	9,910	661,464
2015	25	2,953	73,559	5	9,140	45,515	40	14,495	577,477	70	9,909	696,521
2016	26	2,977	77,458	5	9,213	47,927	42	14,611	608,052	73	10,069	733,347
2017	27	3,001	91,563	5	9,287	50,467	43	14,728	640,279	75	10,150	772,309
2018	28	3,025	85,886	6	9,361	53,142	45	14,846	674,214	79	10,231	813,342

The number of incoming vessels to Rangoon showed an average annual growth of 10.0% in the four years between 1978/79 and 1981/82.

The average annual growth rates in total DWT and DWT per vessel in the same period were 13.0% and 2.8%, respectively. Since the ratio of the volume of transport by BFSSC is assumed to remain the same, the growth rate of incoming foreign vessels has been set at 6.4% for the intial 15 years and 5.3% for the succeeding 15 years; these figures are similar to those for BFSSC.

As regards vessel size, a 2.8% increase has been observed in the past four years. This trend was due to the sharp increase of vessels bound for African countries, therefore a growth rate of 1.8% in size has been adopted by excluding vessels bound for African countries.

Table III-1-3 Increase Trend of Coming Vessels

	No. of vessel	Average DWT	(Thou-sand ton)		No. of vessel	Average DWT	(Thou-sand ton)
(1982)	437	8,255	3,607				
1989	595	9,353	5,569	2004	1,143	12,242	13,973
1990	622	9,521	5,925	2005	1,183	12,442	14,714
1991	650	9,692	6,304	2006	1,223	12,666	15,494
1992	680	9,866	6,707	2007	1,265	12,894	16,315
1993	710	10,044	7,136	2008	1,309	13,126	17,180
1994	743	10,225	7,593	2009	1,354	13,362	18,091
1995	776	10,409	8,079	2010	1,400	13,603	19,050
1996	811	10,596	8,596	2011	1,449	13,848	20,060
1997	848	10,787	9,146	2012	1,498	14,097	21,123
1998	886	10,981	9,731	2013	1,550	14,351	22,243
1999	926	11,179	10,354	2014	1,603	14,609	23,422
2000	968	11,380	11,017	2015	1,658	14,872	24,663
2001	1,012	11,585	11,722	2016	1,715	15,140	25,970
2002	1,057	11,794	12,472	2017	1,774	15,413	27,346
2003	1,105	12,006	13,270	2018	1,835	15,690	28,795

1-2. Estimations of Demands for Ship Repairing

The ships to be accommodated in this repair dock consist of the vessels owned by BFSSC, and, foreign ships entering the port of Rangoon. These ships shall be kept under safe and satisfactory conditions at all times so that the safety of lives and goods is ensured and that all risks at sea are prevented. From this point of view, the government has enacted various laws and regulations. In compliance with the safety laws of the country and the rules and regulations of Classification Societies, ships are legally obliged to be periodically subjected to surveys by relevant authorities. These surveys are categorized into Annual Survey (once a year) and Special Survey (once every four years), and about 90% of all ships to be repaired undergo these inspections.

Based upon the aforementioned prediction of demand and taking into account the current technical level and future work efficiency in Burma, an annual docking demand for the new repair dock and its annual docking capacity are estimated in the following sections.

1-2-1. Expected Docking Demands of BFSSC Owned Ships

The shipping demand for BFSSC-owned ships is predicted in Table III-1-4. In 1989 when the new repair dock is inaugurated, there will be 19 vessels that exceed 1,500 DWT, and this number is expected to increase gradually thereafter. It is assumed that the annual average frequency of docking of these ships shall be

once a year in view of their advanced age. After that, the frequency of docking will decrease as the proportion of new ships increases, arriving at a fixed frequency of 3 times every 4 years in and after 2013.
The predicted docking demand for the new repair dock is also shown in Table III-1-4.

Table III-1-4 Annual Docking Demand at New Repair Dock

Year	Estimated Shipping Demand		Corresponding Annual Demand for Docking	
	No. of Vessels	Average D.W.T.	No. of Vessels to be Docked	Total D.W.T. to be Docked
1989	19	8,120	19	154,200
1993	25	8,383	24	201,100
1998	31	8,724	28	244,200
2003	42	9,078	36	326,800
2008	51	9,447	41	387,300
2013	65	9,831	49	481,700
2018	79	10,231	59	603,600

1-2-2. Expected Docking Demands of Foreign Ships

Viewing topographical advantages of the new dockyard located near the port of Rangoon, the possibilities of foreign ships entering the same port and preferring to dock for repair at this dockyard will be high. To attract foreign ships to this dockyard, however, it should be competitive with neighbouring countries in work quality, repair time, and prices. Although

Burma has the advantage of inexpensive labor, the country is handicapped by its insufficient experience and technical level in repair work for large-sized ships.
So that foreign ships may be tempted to receive repairing services at this dockyard, once the dock goes into operation, it will be absolutely essential for the dockyard to make efforts at productivity increases by improving its techniques. Viewed from this, an actual docking demand can be assumed to begin in the 5th year from the start of operations, and the volume can be expected to increase year after year, finally attaining the full capacity level in and after the 10th year from the start of operations.

1-2-3. Annual Docking Capacity of the New Dockyard

The annual docking capacity can be calculated from a dock occupancy ratio (the ratio of average ship size actually docked to nominal dock capacity) and an average number of days in dock for repairs: the calculation procedure is indicated in Fig. III-1-1.

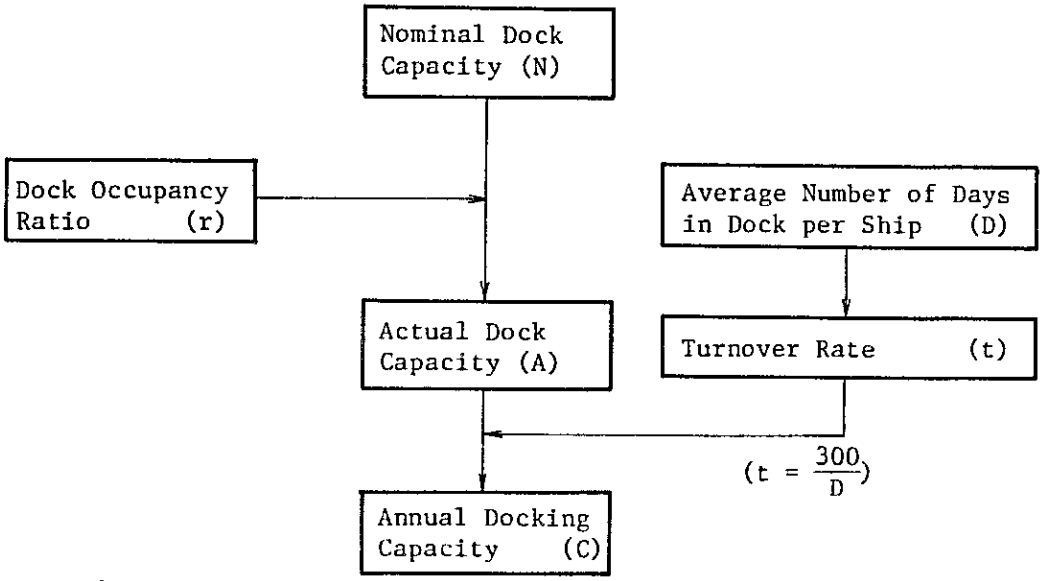


Fig. III-1-1 Calculation Procedure of Annual Docking Capacity

* Nominal Dock Capacity is defined as 20,000 DWT (this is the maximum ship size able to navigate in the Rangoon River).

* Dock Occupancy Ratio is assumed at 40-50% on the basis of the average DWT of BFSSC owned ships and the operating conditions of repair docks in Japan.

* Average Per Ship Number of Days in Dock is assumed at 12 days in the initial stage of operations and at a gradully-decreasing number of days afterward.

Turnover Rate is calculated from Annual Operating Days of the repair dock (= 300 days) and the Average Per Ship Number of Days in Dock.

$$\text{Turnover Rate (t)} = \frac{\text{Annual Operating Days of Dock}}{\text{Average Per Ship Number of Days in Dock}}$$

Based upon the above calculations, Annual Docking Capacity can be estimated as shown in Table III-1-5.

Table III-1-5 Annual Docking Capacity of New Dock

Year	Nominal Dock Capacity (DWT)	Dock Occupancy Ratio (%)	Actual Dock Capacity (DWT)	No. of Days Per Ship in Dock	Turnover Rate	Annual Docking Capacity (DWT)
1989	20,000	40	8,000	12	25	200,000
1993	20,000	42	8,400	10	30	252,000
1998	20,000	44	8,800	8	37.5	330,000
2003	20,000	45	9,000	7	42.9	386,100
2008	20,000	47	9,400	6	50	470,000
2013	20,000	49	9,800	6	50	490,000
2018	20,000	50	10,000	6	50	500,000

1-2-4. Demand and Supply Forecast for Docking

Based upon the prediction of the docking demand (Table III-1-4) and also upon the calculated Annual Docking capacity (Table III-1-5), the demand-and-supply situation will be as shown in Fig. III-1-2.

Although the expected workload is about 80% of the Annual Docking Capacity in the initial stage of operations, it is quite possible to look forward to docking demand of 100% of capacity by making efforts to attract foreign flag ships.

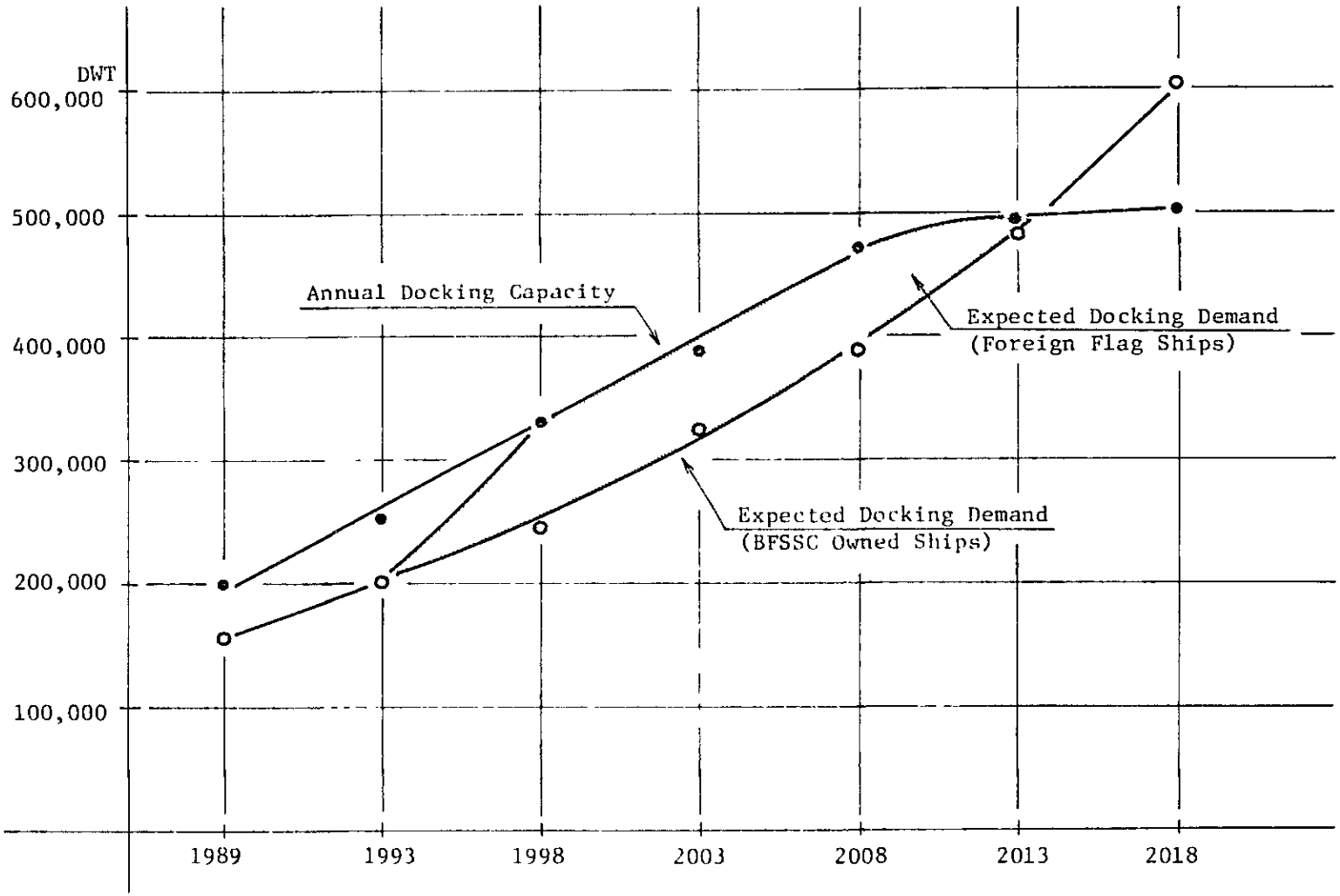


Fig. III-1-2 Demand and Supply Forecast for Docking

2. OUTLINE OF PROJECT SITE

2-1. General Description

As the planned construction site for the dockyard, the northern part of Chokey Palm along the Rangoon River in the Thilawa area, situated 32 Km to the south of Rangoon, is being considered by the Burmese side. Adjacent to the above construction site, the new port of Rangoon is projected to be constructed in the future (Port IV Project: a feasibility study will start in 1984).

In short, the new repair dock project is to be executed as a link in the chain of the Rangoon New Port Development Project. Rangoon is the biggest port at present, but because of its riverside location, it is handicapped by heavy siltation blocking ship routes; this restricts the draft of incoming ships.

Moreover, there remains little space for expanding the port area. For such reasons, various facilities annexed to the port such as a repair dockyard and a container yard, are being confronted with many problems in the implementation of their expansion programs. Under these circumstances, it is evident that the existing port facilities can never cope with the increasing volume of marine transportation related to economic development now under way.

In view of all these factors, the new port plan for Rangoon has been drafted for the Thilawa area, including the proposed site where a repair dockyard is to be constructed.

There is a plan to develop the Thilawa area into an industrial complex by constructing new factories in addition to the existing ones around the new port area and by improving all infrastructures concerned.

The site for these projects has already been earmarked in coordination with the various Government departments concerned. In order to secure a site for the dockyard, 720,000 m^2 has been allotted for first stage construction and an additional lot of 520,000 m^2 has been reserved for future expansion. An investigation was carried out on environmental and other factors to find out whether the proposed site is suited to construction of the dockyard. The results is described in the following articles. The details more than those in the articles are compiled in the report titled "SUPPLEMENTARY DATA 1. SURVEYING, 2. SOIL INVESTIGATION".

2-2. Topographical Conditions

Fig. III-2-1 shows the project area location. The project area is located approximately 32 km downstream from Rangoon City and some 18 km upstream from the mouth of the Rangoon River.

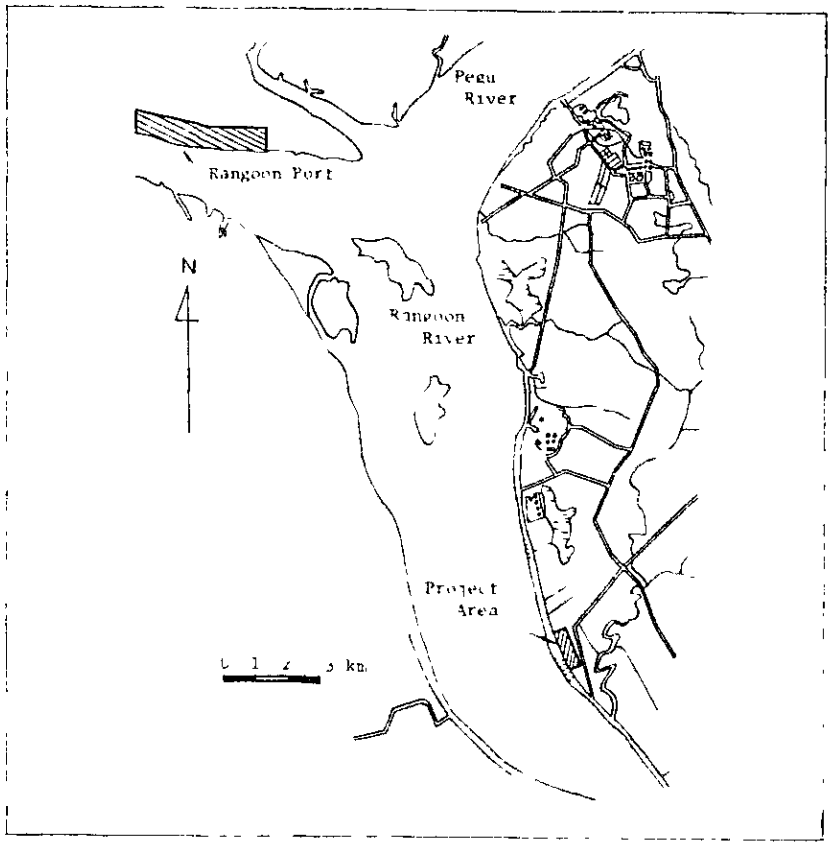


Fig III-2-1 Location of Project Area

Geographically, the site lies in a low, wet alluvial plain. At present the major portion of the project area is being used as rice fields; however, a strip extending between 50 and 100 m along the Rangoon River consists of bush. Fig. III-2-2 shows a survey map of the area based on the results of the topographic survey and sounding.

SURVEY MAP

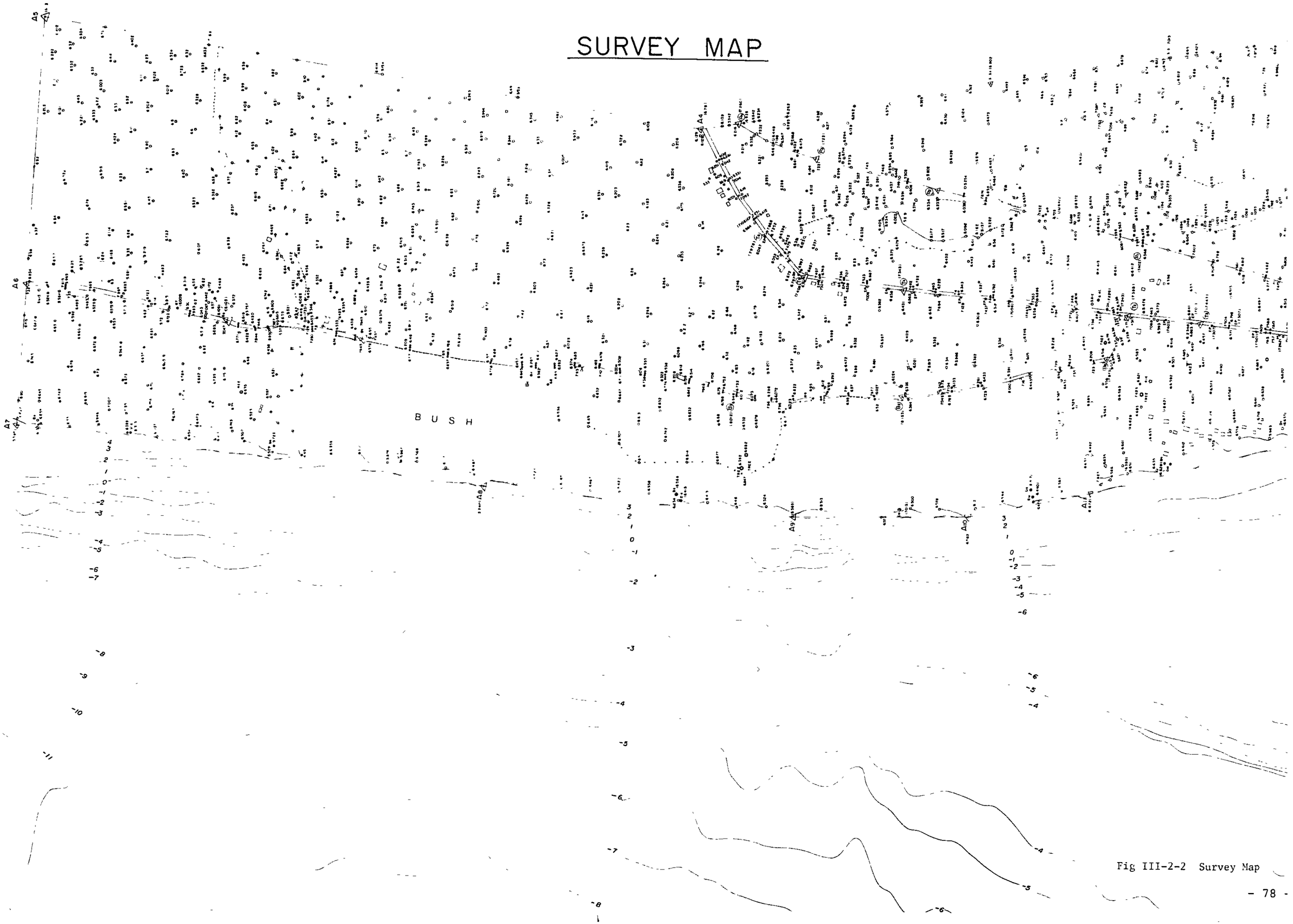


Fig III-2-2 Survey Map

SURVEY MAP

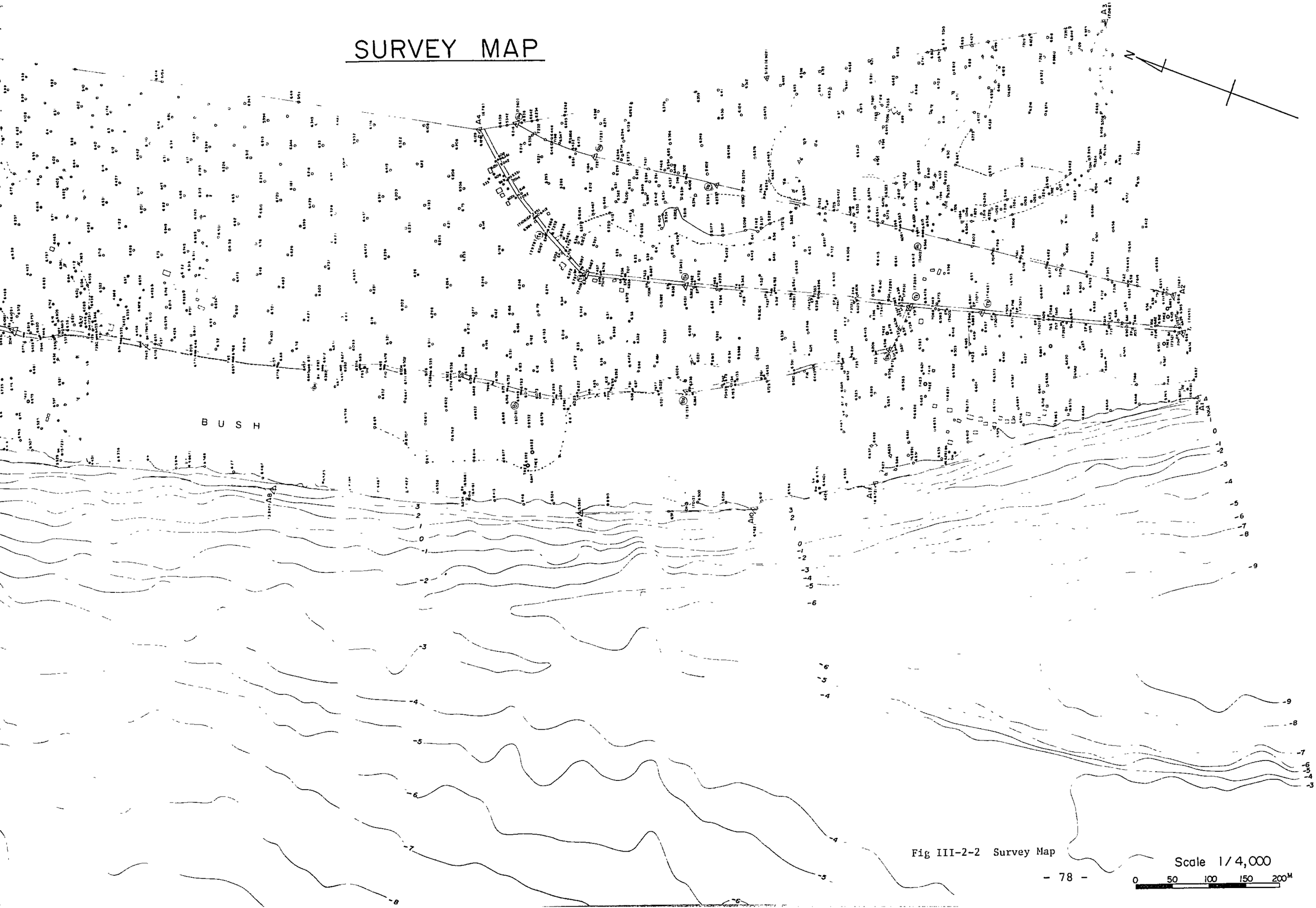


Fig III-2-2 Survey Map

The Rangoon River has 4 tidal guage points; one of these points, viz. Chokey Point, lies within the project site. Elevation values shown on the survey map represent the heights relative to datum zero (the lowest low water level) at Chokey Point. The datum zero at Chokey Point is 0.216 m lower than that for the Brooking Street Wharf Point in Rangoon.

2-3. Meteorological Conditions

(1) Rainfall

The rainy season in Rangoon lasts from May through October; the dry season, from November through April. These seasons are clearly divided: that is, whereas during the rainy season the average monthly rainfall exceeds 500 mm, in the dry season almost no rain falls whatsoever. Fig. III-2-3 shows the average monthly rainfall for the past 13 years.

(2) Temperature

Average monthly temperatures are shown in Fig. III-2-4. Temperatures are especially high between March and May; they are relatively low between October and December. The minimum daily temperature during the cool season is approx. 15°C.

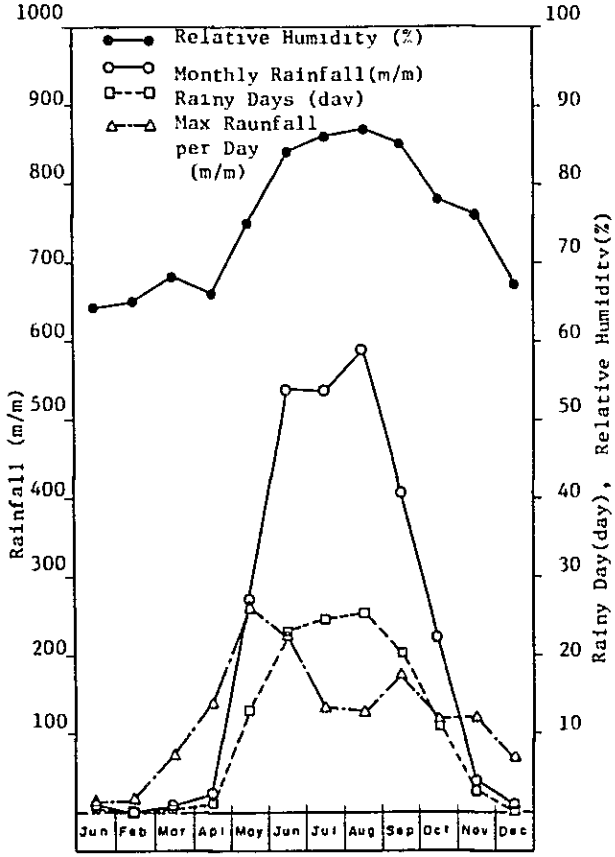


Fig III-2-3 Average Monthly Rainfall

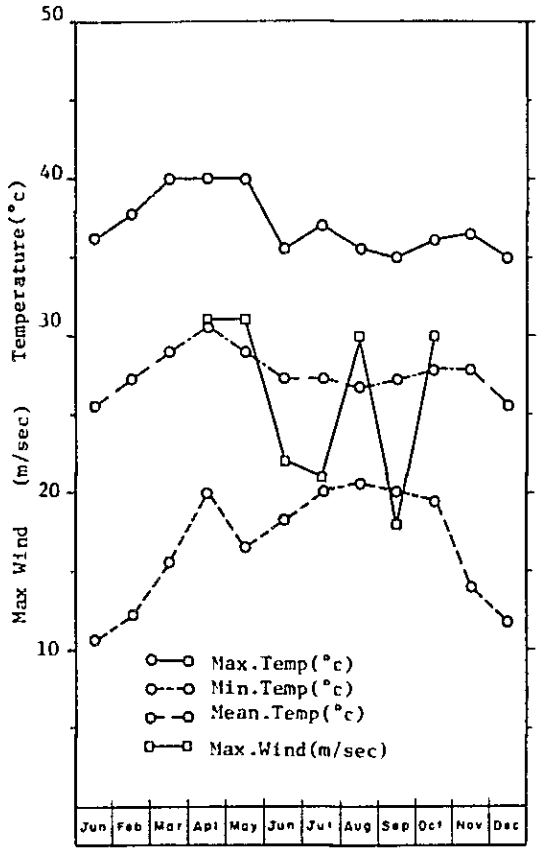


Fig III-2-4 Average Monthly Temperature

* Heaviest Rainfall in 361 mm/day in 20 Apr. 1934
* Max Intensity of Rinfall in 91 4 mm/hr. on 14 Jun 1953
* Annual Rainfall 2,682 m/m
* Annual Rainfall 123 days

(3) Storms

According to local records, 644 cyclones were experienced in the Bay of Bengal between 1891 and 1940, including 36 which touched land in Burma. More recently, a major cyclone went ashore at Gwa in May 1982. The maximum wind velocities recorded during this storm were 24m/sec in Rangoon and 30m/sec in Mingaladon, the site of Rangoon International Airport.

(4) Earthquakes

Based on local records, between 1884 and 1980 four major earthquakes, registering 6.9 or above on the Richter scale, occurred in Burma. In particular, a major quake which hit the city of Pegu in 1930 caused as many as 50 deaths even in Rangoon.

Although the frequency of seismic occurrences is relatively low, resistance to earthquakes must be considered in the structural design.

2-4. Subsoil Conditions

The subsoil conditions in the project area are poor, owing to the presence of a soft clay deposit with a thickness of approximately 20 to 25 m. In preparing a preliminary design, it will therefore be necessary to take this unfavorable deposit into consideration. It should also be noted that construction of the dockyard on such a poor foundation generally involves higher construction costs, as compared with dockyard construction on a favorable foundation.

(1) Subsoil Profile

A sketch of the subsoil structure in the project area is shown in Fig. III-2-5.

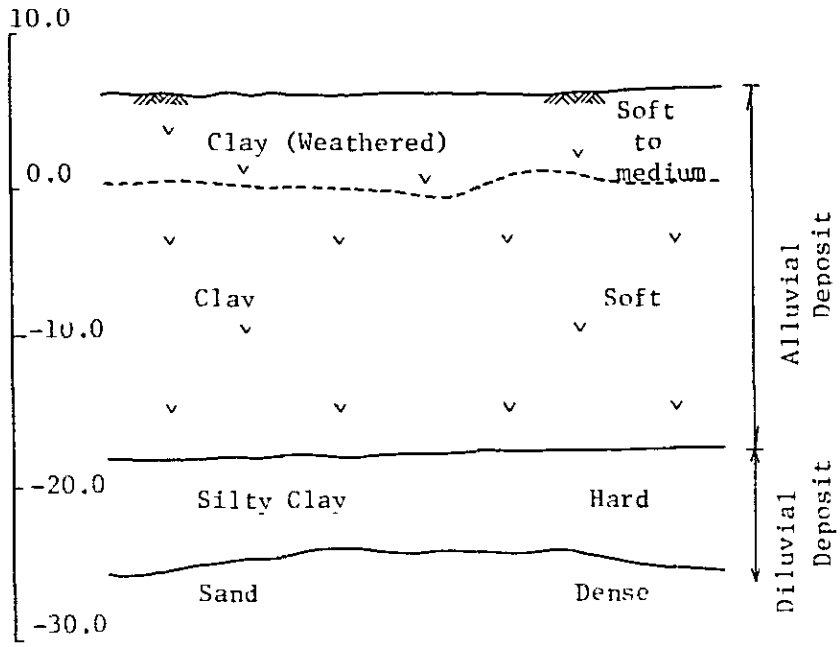
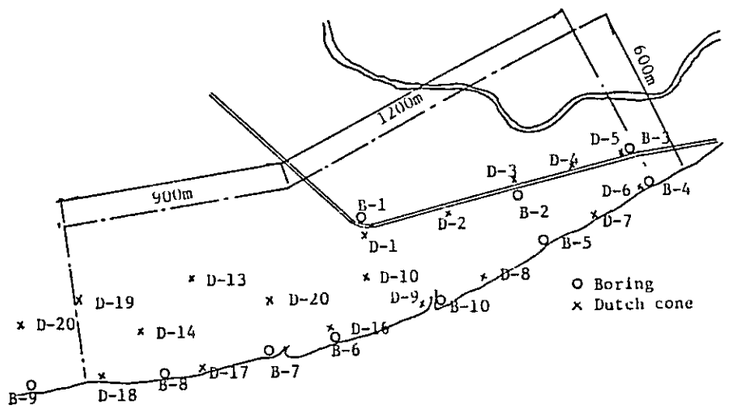


Fig III-2-5 Sketch of Sub Soil Structure

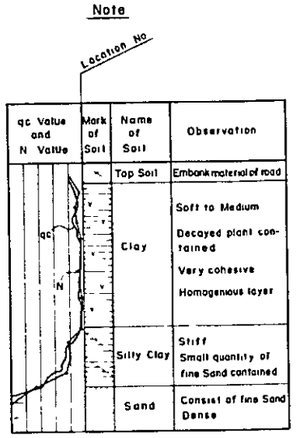
Fig. III-2-6 shows a soil profile of the project area based on the results of boring and Dutch Cone Sounding. The subsoil of the project area comprises, from the top, a clay layer, silty clay layer, and sand layer.

1) Clay layer

A clay layer deposit is found at a depth of 20 to 25 m from the ground surface. The soil of this layer consists of clay featuring high plasticity and cohesiveness.
A small amount of decayed plant (humus) is also found. A very thin layer of fine sand



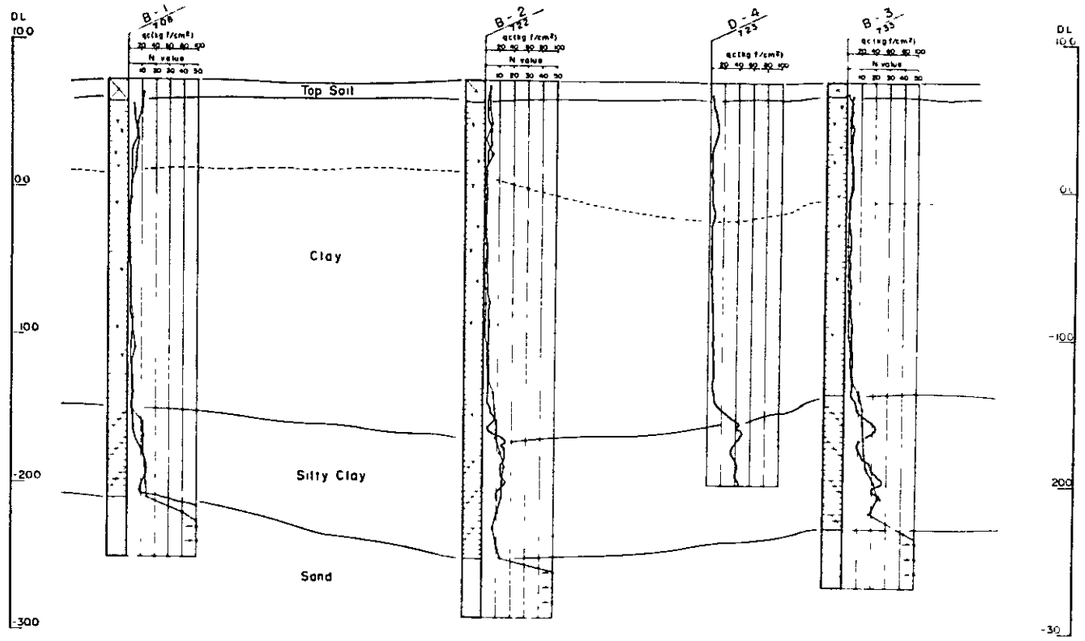
Note



N value Result of Standard Penetration Test

qc Result of Dutch Cone Sounding

Road Line



To Rangoon

River Coast Line

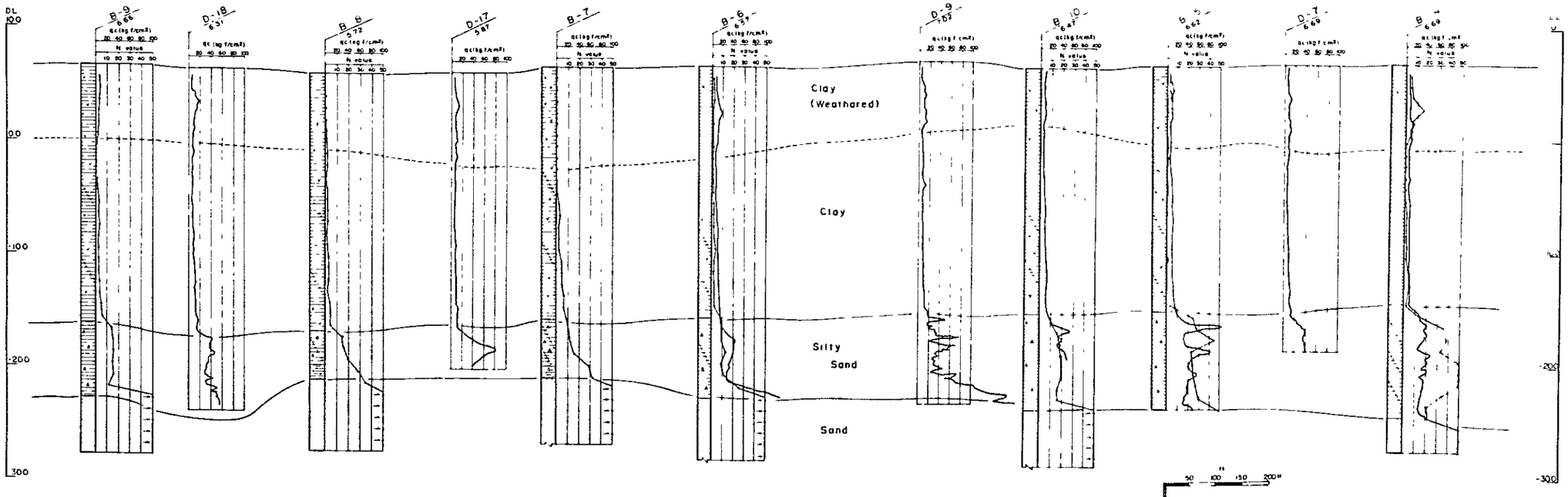


Fig III-2-6 Soil Profile

lies at the lower part of this layer. No shell fragments are detected in this layer. The soil layer is homogeneously composed of uniform clay, and the horizontal continuance of the soil layer is extremely good, thereby indicating that this may be a marine or aqueous deposit layer from the alluvial era. The uppermost portion of this layer is assumed to be a weathered layer to a depth of approximately 7 m. While the material comprising this layer is identical to that of the lower portion, it is relatively harder. Based on the Standard Penetration Test (SPT) the N value of the weathered upper layer is 2 to 5, while that of the lower part is 0 to 4, showing it as soft or medium soft.

2) Silty clay layer

A relatively hard clay-like soil layer, with a thickness ranging from 5 to 10 m, is found below the clay layer described above, throughout the project area. A small amount of fine sand is mixed in with this layer, and the layer is uniform. The color of this soil is gray or milky-white. The upper portion of subsoil is reddish brown owing to the influence of weathering, thus indicating that this layer at one time formed the ground surface.

The N value of this layer ranges from 10 to 20, and this is relatively hard for a clay-like layer. However, it does not have enough strength to support the pile foundations of heavier structures.

3) Sand layer

The sand layer exists at a depth of approximately 30 m from the ground surface. This layer is composed of fine to medium sand, with a small amount of silt mixed in. The soil particles are uniform.

The N value of this layer exceeds 50, and thus it possesses sufficient strength to serve as a bearing layer for pile foundations.

(2) Soil properties

Table III-2-1 indicates soil properties and indexes comprising each layer. Fig. III-2-7 shows a comparative chart on the basis of the compiled results of soil tests.

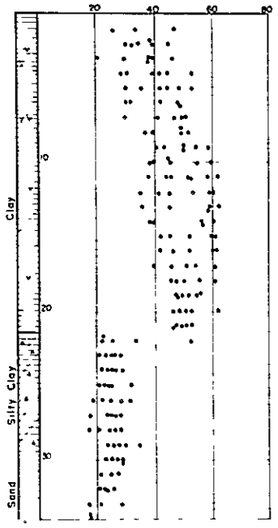
Table III-2-1 Soil Properties

Soil layer				Clay	Silty clay	Sand
Depth				0-25 m	25-30 m	Under 30 m
Physical property	Consistency	Wn	%	30-60	20-30	-
		LL	%	50-70	40-50	-
		PL	%	20-30	20-30	-
	Fraction content	Sand	%	2	5	63
		Silt	%	43	43	37
		Clay	%	55	47	-
		Gs	-	2.60	2.60	-
Mechanical property		qu	kg/cm^2	0.3-0.6	-	-
		qc	kg/cm^2	5.0-15.0	20-40	200>
	Consolidation	Cv	cm^2/min	0.06-0.03	-	-
		mv	kg/cm^2	0.04-0.01	-	-
		py	kg/cm^2	1.0-3.0	-	-

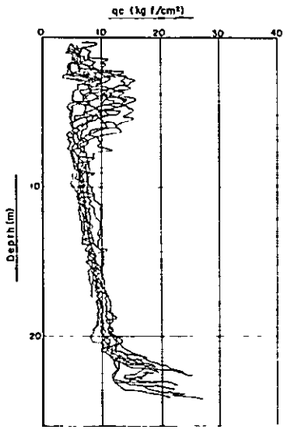
Wn: Natural moisture content
LL: Liquid limit
PL: Plastic limit
Gs: Specific gravity
qu: Unconfined compressive strength
qc: Bearing capacity of cone
Cv: Coefficient of consolidation
mv: Coefficient of volume change
py: Consolidation yield stress

Depth Distribution of Soil Property

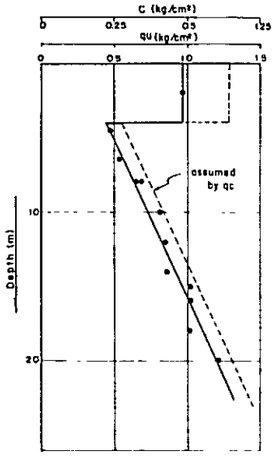
Depth Distribution of Water Content



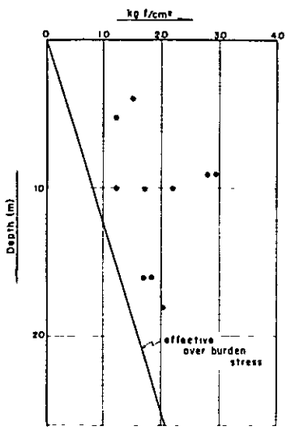
Depth Distribution of qc



Depth Distribution of C, qu



Consolidation Yield Stress

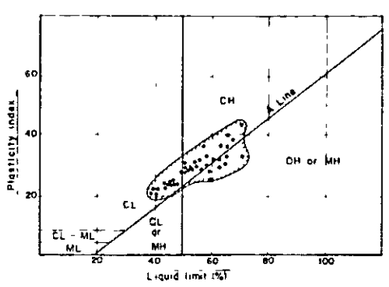


qc Bearing Capcity of Cone (by dutch cone)

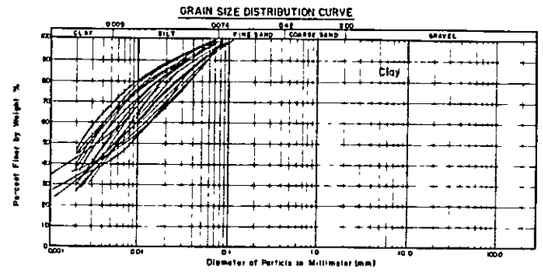
C Cohesion

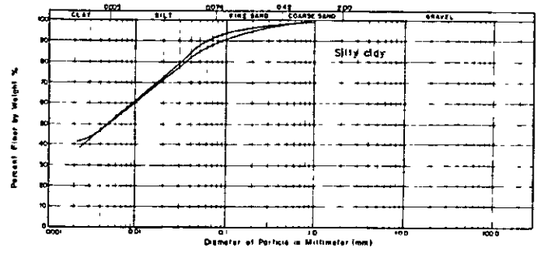
qu Unconfined Compresive Strength

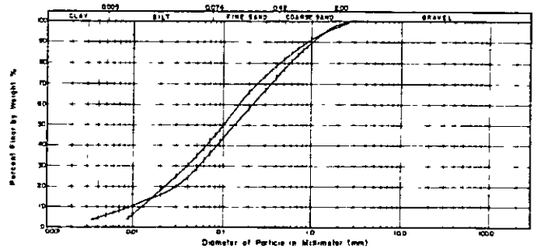
Plasticity Chart

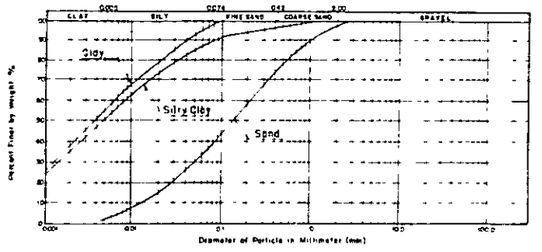


GRAIN SIZE DISTRIBUTION CURVE





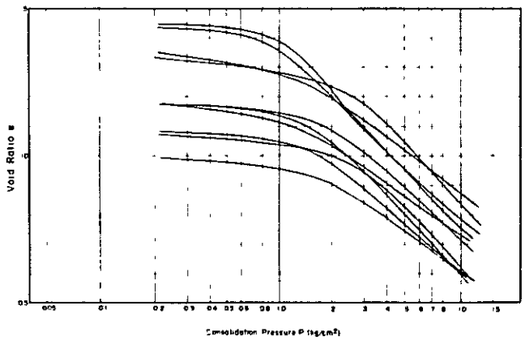




Soil Name	% Gravel	% Coarse Sand	% Fine Sand	% Silt	% Clay	% Colloid	Effect. Diameter mm	Uniformity Coefficient Uc	% 2.00mm Under	% 0.42mm Under	% 0.074mm Under
Clay	-	0	2	43	55	25	0.003	0.074	-	100	98
Silty Clay	-	3	4	43	47	25	0	0.009	-	96	90
Sand	3	23	37	24	3	-	3.0	0.2	0.074	3	97	77	40

Results of Consolidation Test

e ~ log P Curve



log P ~ log mv , log Cv

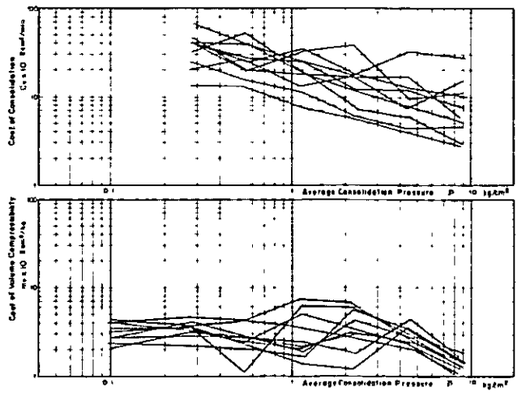


Fig III-2-7 Comparative Chart of Soil Properties

2-5. Environmental Conditions

In the Thilawa area, the proposed site for dockyard construction, several plants such as a glass factory, a petroleum product storage yard, and a tin smelting plant are already in operation. As mentioned previously, a plan for constructing a new Port of Rangoon adjoining the dockyard site is being considered. This is based upon the idea that not only industrial development but also the commercial growth of the trade port should be accelerated by constructing new plants such as a textile factory and rice mill in the new Port of Rangoon.

2-5-1. Access roads

In driving from Rangoon to the Thilawa area the Pegu River has to be crossed. There exists only one bridge across the said river, which is located in Pegu city, an upstream town about 60 Km north of Rangoon. It is a four- or five-hour drive from Rangoon to Thilawa through Pegu city. Thanks to Chinese assistance, planning for the construction of a rail and traffic compound bridge between the Thaketa and Syriam areas which face each other across the river is now in progress. This bridge construction project will commence in March 1984 and is aimed at completion within the term of the Fourth Four-Year Development Plan (1982-1985). Pier construction seems to be more time-consuming than initially calculated because of the soft soil. Upon completion of this bridge, it will take only one-hour or less to drive from

Rangoon to the Thilawa area, undoubtedly assisting smooth construction of the dockyard and better transportation of materials, components, and personnel, during the start-up stage of dockyard operations.

2-5-2. Waterways

Water transport was developed as a pivotal means of transportation in Burma since ancient times. The Rangoon River is quite navigable because of its gentle winds and current. It takes about one hour to go by water from Rangoon city to the Thilawa area, though the time may vary depending upon current conditions. Accordingly, it is presumed that water transport has to be fully relied upon at least until the Syriam Bridge is completed.

2-5-3. Electricity

The power generation capacity in Burma is around 740 MW, consisting of hydroelectricity (30%), and other forms of power (70%) such as thermal power electricity, and diesel- or turbine-generated electricity.

Electricity is supplied mainly through the Electric Power Corporation, and the Fourth Four-Year Development Plan includes an expansion program for power plants and transmission lines as well. The electricity consumption in 1982-83 was about 1.1 billion KWH, of which about 55% was for industrial use, 28% for

household use, and 17% for hospital, office, and school uses.

The glass factory already operating in the Thilawa area is being supplied with electricity by the Electric Power Corporation. The repair dockyard will also be supplied thus. Power rates are based on a graded system, imposing 17 Pyas (about 5 yen) per KWH for the first 40 KWH/month and reducing in steps as the amount of power consumed exceeds the above basic value. In comparison with power rates in Japan, the above rates represent only one-fourth or one-fifth of the Japanese rate.

2-5-4. Water Supply

(1) Drinking Water:

According to the water supply project of Rangoon municipal authorities, the Pugyi water dam sited about 50 km north of Rangoon is scheduled to start supply of drinking water to the Thilawa area in 1984-85.

(2) Industrial Water:

The Rangoon River may be made the water supply source. It is difficult, however, to use this water for industry use because of contaminating sea water admixture and high silt content. From the view point of expense and consumption rate (240 tons/day), it may be better to drill some wells in the vicinity of the dockyard.

2-5-5. Gases, Oxygen, Etc.

(1) Acetylene Gas:

Acetylene gas is widely used for flame cutting at dockyards in Burma. In the case of Sinmalike Dockyard, there is an acetylene generator (10 m^3/Hr) and a dispensing station, selling extra gas (beyond on-site demand) to outside customers. The new dockyard shall install a similar generator of sufficient capacity.

(2) Oxygen:

Oxygen is obtainable from the Paper & Chemical Industry Corporation and Burma Railways Corporation. Because of the long travel distance involved, it is advisable for the dockyard to construct an oxygen plant for its own use.

2-5-6. Tugboats, Etc.

(1) Tugboats:

The Burma Ports Corporation and other corporations have their own tugboats to serve incoming and out-going ships. There is no company specializing in chartering tugboat services, and a supply of tugboats from outsiders appears to be unobtainable.

Therefore, the proper tugboats should be obtained for individual purposes.

(2) Floating Cranes:

There are some serviceable light duty floating cranes only but cranes with capacity ample for the intended dockyard construction and operations are not available.

(3) Mobile Cranes:

As is the case with tugboats, there is no leasing company dealing in mobile cranes and the like; their acquisition should be arranged by the dockyard itself.

2-5-7. Communications Systems

It is difficult to say that communications systems in Burma are complete. Telephone, telegraph, and telex services are being domestically and internationally operated of microwave transmission. The short distance from Rangoon to the dockyard site should make it easy to provide the necessary communications systems.

2-5-8. Miscellaneous

(1) Dwellings

As for housing for employees, the drafting of the housing project plans for the Thilawa industrial estate is now in progress, and presumably the project will have been completed by the time dockyard operations begin.

(2) Vessel Classification Societies, etc.

All repair work conducted at this dockyard shall be subject to inspection by various vessel Classification Societies as well as by the Burmese Government. At present, societies such as N.K., A.B.S., L.R.S. and B.V. have branch offices in Rangoon. Government inspections are being carried out by the Department of Marine Administration. There will be no problems hindering inspections and surveys.

(3) Legal restrictions

There are no specific laws or regulations to restrict dockyard construction and operation.

3. FACILITIES PLANNING

3-1. Basic Principle

(1) In view of the fact that a ship repairing dockyard needs huge capital investment and investment recovery takes a long time, the study was conducted with an aim to keep the initial investment at the lowest possible level.

(2) As an enterprise exclusive for ship repairing, the dockyard should not only secure the necessary labor force and facilities to cope with peak loads, but also be able to deal with idle periods of time. Such idleness is liable to occur due to fluctuations in workload which are natural to the industry. To counter this, a plan for equalizing the overall workload in the dockyard has to be worked out, adopting construction of facilities for small vessel repairs and the development of new work other than the ship repairing (such as the steel structure manufacturing).

(3) The shipbuilding-related industries have not yet developed sufficiently, and special services are not easily obtainable from outside. Due to this, the necessary workshops are to be set up so as to enable urgent jobs, such as the repair of damaged ships, to be done immediately. Utility services indispensable to production are also to be planned on a self-sufficiency basis.

(4) Planning for all the facilities has been optimized in consideration of the survey results on geological conditions at the site, water level of the Rangoon River, atmospheric, oceanographic, and other natural conditions.

(5) Special attention has been paid to the preservation of unused space for future expansion in order to cope with an anticipated increase in production.

(6) Anti-pollution measures have been adopted in view of the fact that the waters neighbouring the dockyard site happen to be good fishing waters.

3-2. Outline of Facilities and Installations

3-2-1. Basic Planning

(1) Dockyard Premises

The dockyard premises occupy 210,000 M^2 (700M x 300M) and about 300,000 M^3 earth for reclamation is to be moved into the site from nearby hills. Ground level has been set at 7.8M above the datum line in consideration of seasonal fluctuations in the tide level (the highest level at the port of Rangoon in the past was 6.74M above the datum line) and rain water drainage conditions.

(2) Principal Dimensions of the Dock

The principal dimensions of the repair dock are based upon the dimensions of a dry-cargo ship of 20,000 DWT (L = 180M, B = 24M).

Dock Length = 200M
Dock Width = 30M
Dock Depth = 10.5M

Each dimension has been selected a bit larger than those of an ordinary 20,000 DWT ship dock for the following reasons.

1) Dock Length:

The overall length (LOA) of a 20,000 DWT cargo ship is generally 180M or less. In order to allow the necessary space for removal of parts such as rudders and plopellers and a margin for docking and undocking operations, a dock length of 200M has been decided on.

2) Dock Width:

The molded breadth (Bmld) of a 20,000 DWT cargo ship is generally 24M or less. A dock width of 30M has been decided on taking into account a space for docking and undocking operations and the necessary clearance for outboard work on both sides of a ship.

3) Dock Depth:

The governing factors of the dock depth are

ship draft, height of keel blocks or sill height (whichever is greater) from the dock bottom, ground level height above the highest high-water level at spring tide, clearance between the ship bottom and the top of keel blocks, and the range of water levels suitable for docking.

In this case, especially, the maximum difference between high and low tides in the Rangoon River is as large as 6M, so it has been made a rule to perform docking and undocking of ships exclusively at full tide in order to reduce the necessary dock depth as much as possible. Performing this operation at full tide is also required from the viewpoint of preventing the dock bottom from suffering siltation. Fig. III-3-1 indicates the rise and fall of tides in the Rangoon River (based on the tide table), and Fig. III-3-2 exhibits correlations among various factors governing the dock depth.

(3) Type of Dock

There are two types of ship repairing docks: floating, graving. The Burmese side prefers a graving dock. The selection of the study is also a graving type dock for the following reasons.

1) Because of insufficient depth of the Rangoon River, a great deal of dredging work is

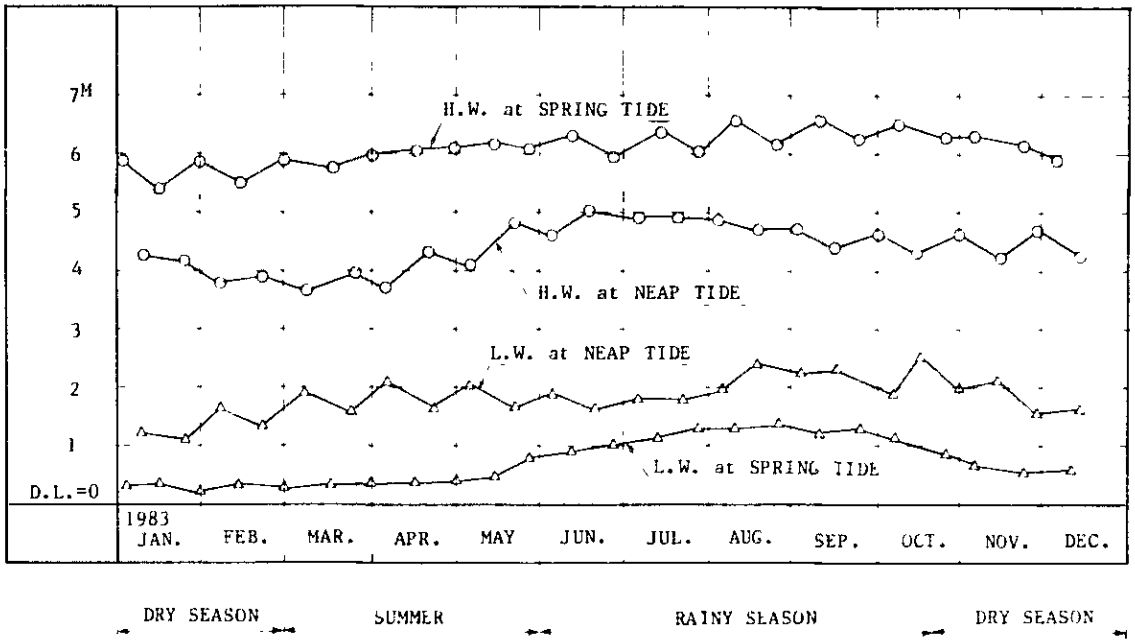


Fig. III-3-1 Tide for the Rangoon River at Sule Pagoda Wharf 1983

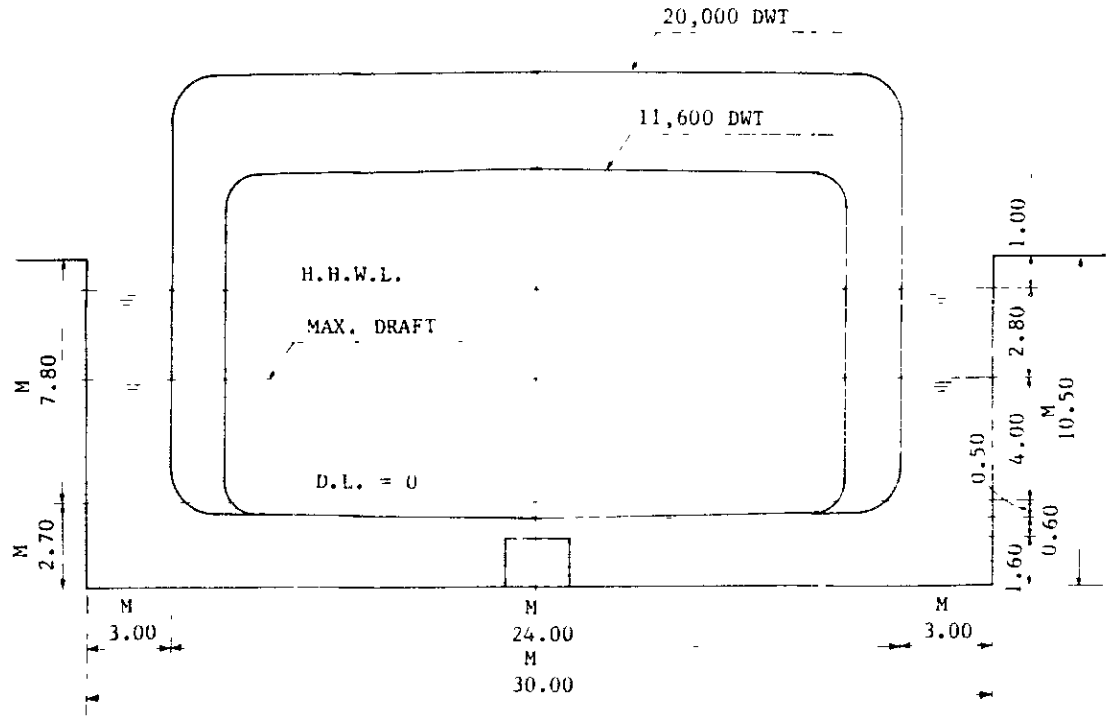


Fig. III-3-2 Correlation among Various Factors Governing the Dock Depth

required for the safe operation of a floating dock, and its maintenance is rather difficult.

2) The difference between ebb and high tides is as much as 6M at spring tide, which is dis-advantageous for a floating dock in terms of mooring, etc.

3) The current speed of the Rangoon River is 5 to 6 knots; this is too rapid to allow free operation of a floating dock. It is especially difficult to lead a ship into the right position at docking.

4) Although the construction cost for a graving dock is higher than that for a floating dock, longer life and easier operation and maintenance will eventually make a graving dock economically more advantageous than a floating dock in the long run.

5) As the river in front of the dockyard is the navigational route to and from the port of Rangoon, it is considered difficult to obtain a suitable position for mooring the floating dock.

6) The geological conditions of the construction site are not as perfect as desired, but no serious problems seem to exist for constructing a graving dock.

(4) Dock Gate

A shorter work period is always desirable for ship repairing in a dock. A flap type dock gate has been adopted; it can be operated easily and quickly.

To prevent the dock gate operation from suffering siltation, a desilting water-jet type apparatus has been decided on. However, it is necessary to study more about the siltation and river-bed conditions at the site for the final selection of the most suitable type of dock gate. For efficient use of the dock, an intermediate gate is to be installed.

(5) Main Draining Pump of the Dock

Factors for defining the capacity (Q) of a main draining pump consist of the required draining time (T), the required drainage quantity (W) and the number of pumps (N).

Thye are correlated by the following equation.

$$Q = \frac{W/T}{N}$$

Because docking and undocking are to be done at high tide, by making use of tidal variations in the Rangoon River for draining purposes, the required pump capacity can be reduced, and accordingly, the construction and maintenance costs of the draining system can be lowered. However, it takes a considerable amount of time, if relying upon natural draining action; this is

not desirable for completion of work in a short time.

In many recent cases, the draining time (T) of a ship repairing dock is set at 2 to 4 hours. Assuming the draining time (T) at 2.5 hours and the number of pumps (N) at 2 units, and calculating the quantity of drainage based upon the water volume as shown in Fig. III-3-2, the pump capacity (Q) is determined as follows:

$$W = 200M \times 30M \times (2.7M + 6.0M)$$
$$= 52,200M^3$$

$$Q = \frac{W/T}{N} = \frac{52,200/2.5}{2} = 10,440M^3/Hr/unit$$

(6) Dockside Crane

It is a usual practice to determine the crane capacity required for ship repair jobs on the basis of propeller weight, etc. Because of the unavailability of a floating crane in this case, a level luffing crane of 50T type has been adopted so that it may be used for engine replacement, hull remodelling, etc., as well as periodical survey repair.

(7) Mooring Quay

Mooring quays are arranged at both the upstream and downstream ends of the dock, situating the dock such that 2 ships of 20,000 DWT type may moor at the same time. Each mooring quay is

served by a level luffing crane (upstream-20T type, downstream-10T type).

(8) Dredging

It is a must to secure the required depth of water in front of the dockyard for ship maneuvering and docking, and also for floating repairs while the ship is alongside the quay.

The dredging area is intended to cover 700M along the quay and extend 400M offshore; it will have a depth of 5M below datum line.

After the commencement of dockyard operations, it will be necessary to repeat dredging periodically to prevent siltation from the upper parts of the river.

(9) Utilities

1) Electricity:

Electric power is to be supplied from outside at 6.6kV, 50Hz, and substation will be constructed on the premises. The power will be supplied to drydock, quays various workshops and so on at 420V or 220V through transformer stations arranged in the yard locally. Necessary number of shore power supply connection boxes and various distribution boards will be arranged within the yard considering power consumption and suitable location. An emergency diesel generator will be installed for use in case of power supply failure.

2) Compressed Air:

Compressed air is distributed from the compressor station to various workshops through a piping network.

3) Water

As for drinking water, an outside supply is available. Once stored in the reservoirs in the dockyard, this water is to be distributed to each shop and ships under repair as well.

Wells dug in the vicinity of the dockyard will supply industrial water through reservoirs and piping.

4) Oxygen and Acetylene:

These gases are rather hard to obtain from outside mainly because of transportation problems. Generating plants are to be provided in the dockyard, distributing these materials to workshops through their respective piping systems.

(10) Facilities for repairing of small size ships.

There are several kinds of systems for this purpose. In this study, the following two systems are considered.
There are advantages or otherwise in each system;

a) the operation by a ship-lift system can be done easily.

b) a ship-lift system is suitable for many small size shiprepairing simultaneously.

c) the construction cost of a slipway system is lower than of a ship-lift system.

d) a slipway system has a longer life-time, and it's maintenance fee is smaller compared with a ship-lift system.

The slipway system is recommendable by taking priority of the lower construction cost. However, the ship-lift system as one of alternatives is also worth studying in further examination considering the existing hydrographical conditions at the site.

3-2-2. Outline of Facilities and Installations

The outline of main facilities are shown in Table III-3-1

Table III-3-1 Outline of Main Facilities and Installations

Item	Unit	Main Particulars
1. Yard area		700x300^{M}=210,000M^2
2. Drydock	1	200x30x10.5^{M} Graving type
Dock gate	1	Flap type
Winch for dock gate	1	10Tx20M/MIN.
Desilting arrangement at dock gate	1	Water jet system
Intermediate gate	1	Floating type
Main pump	2	10,000M^3/HRx9M
Aux. pump	1	1,000M^3/HRx14M
Ballast and aux. pump	2	250M^3/HRx40M
Keel block	200	150T
Side block	100	100T
Hauling winch	4	10Tx20M/MIN.
Carrier and rail	2	
Access tower	1	4x5x15M
Shore ladder	4	6 - 10M
Rubber fender	2	Dock entrance
Level luffing crane	1	50/25TX35/45MX40M
3. Quay	2	200M
Mooring winch	4	10Tx20M/MIN.

Item	Unit	Main Particulars
Rubber fender	84	
Bitt	20	Dia 0.3 - 0.5 M
Shore ladder	3	8 - 12 M
Level luffing crane	1	20/10Tx30/50Mx40M
Level luffing crane	1	10/5Tx30/50Mx40M
4. Hull shop	1	90x30M
Honeycomb floor	1	135M^2
Lattice floor	1	1,200M^2
Hydraulic press	1	500T
Flame planner	1	Cutting floor area 5.5x25M
Bending roller	1	12.5MM x 2,500MM
Shearing machine	1	16MMx3,100MM
Overhead crane	2	30Tx 1 20Tx1
5. Machine shop	1	50Mx25M
Lathe	1	12M
Lathe	2	6M
Lathe	3	3M
Lathe	4	1.5M
Horizontal boring machine	2	2.5M, 1.5M
Vertical boring machine	1	Propeller dia. abt 4.5M
Horizontal milling machine	1	Large size
Vertical milling machine	1	Large size

Item	Unit	Main Particulars
Radial boring machine	1	Large size
Shaping machine	2	Stroke 0.75Mxl 0.45Mxl
Planner machine	1	Stroke 5M
Cylindrical grinding machine	1	Stroke 1.1M
Universal tool grinding machine	3	
Plane grinding machine	1	Magnetic chuck dia. 0.5M
Working bed	1	2Mx3M
Slotter	1	Stroke 0.31M
Bench drilling machine	3	
Bench grinder	2	
Grinding cutter	1	
Contour machine	1	
Tool cabinet	1	
Balancing machine	1	Capacity dia. 1.5M
Arc remetalizing machine	1	
Portable boring machine	1	Boring dia. max. 0.5M
Surface grinder	1	
Lapping machine	1	
Universal hobbing machine	1	0.4 module to 2 module
Hack saw machine	1	Stroke 0.6M

Item	Unit	Main Particulars
Hydraulic press	1	5 to 10T
Propeller balancing machine	1	Dia. 4.2M static balancing
Overhead crane	2	20Tx1 10Tx1
6. Electrical shop	1	40Mx25M
Varnish treatment tank	2	1.5x1.5M 0.5x0.5M
Coil winding machine	1	
Test pannel	1	440V, 220V, 110V
Charging and discharging pannel	1	0.5KVA - 1KVA
Meter calibrator	1	
Electric heater	2	120°C with thermocouple
Magnetic particle tester	1	
Ultra sonic detector	1	
X-ray apparatus	1	
Overhead crane	1	10T
7. Foundry shop	1	20Mx20M
Induction furnace	1	2TON/HR Steel casting
Induction furnace	1	1 TON/HR Steel casting
Crucible tilting furnace	1	0.5 TON/HR Non ferrous
Moulding and core sand prepairing plant and M/C	1	

Item	Unit	Main Particulars
Shot blast machine	1	Table 5TONx2.5MØ
Heating furnace	2	900°C, 1200°C
Pattern finishing M/C	1	Grinding M/C, High speed cutter etc.
Laboratory equipment	1	
Hydraulic press	1	500TON
Remetaling equipment	1	Tank capacity 2x1.5x1M
Overhead crane	1	10T
8. Galvanizing shop	1	20Mx20M
Tub	7	6x2x2M
Galvanizing furnace	1	
Anti-pollution apparatus	1	
Overhead crane	1	5T
9. Carpenter shop	1	40x25M (Include mold loft shop)
Circular saw	1	
Planing machine	1	
Hollow chisel mortiser	1	
Hand vise	1	
10. Engine repair shop and pipe shop	1	50x25M
Lattice floor	3	$90M^2$x2, $60M^2$x1
Hydraulic pipe bender	1	150 A Automatic

Item	Unit	Main Particulars
Hydraulic pipe bender	1	50A
Thread rolling machine	1	
Pipe cutter	1	
Bench drilling machine	1	
Bench grinder	4	
Hand vise	6	
Overhead crane	2	20T x 1, 10T x 1
11. Painting shop	1	30Mx25M
High pressure cleaning pump	5	55 - 85 KG/CM^2 260 L/MIN.
Sand blast machine	12	
Vacuum air blast machine	1	
Airless spray	20	
Humidity eliminator	1	4500M^3/HR
Dust collector	4	Bag filter type 100M^3/MIN.
Vacuum cleaner	1	3 T/H
Grit burner	1	
Belt conveyer	5	15 M
Grit tank	1	300 T
Ventilating fan	30	10 HP x 20, 5 HP x 10
Spot cooler	5	
Overhead crane	1	5 T

Item	Unit	Main Particulars
12. Mobil crane and transporter		
150 T crawler crane	1	
Mobil crane	2	20 T
Trailer	1	20 T
Truck	6	16 T x 1, 6 T x 1, 2 T x 4
Fork lift	6	3 T x 4, 2 T x 2
Motor truck	7	1 T
Travelling stage	4	5 - 12 M
Travelling stage	3	15 - 20 M
Fire engine	3	
Ambulance car	1	
Business car	2	
13. Vesels		
Tug boat	3	2,000 HP x 1 1,000 HP x 1 500 HP x 1
Work boat	1	150 HP
Fresh water barge	1	25 x 10 x 3 M
Oil barge	1	12 x 5 x 3 M
Ferry boat	1	150 HP
14. Pollution preventive eqipment		
Incinerator	2	
Oil fence	1,000M	

Item	Unit	Main Particulars
Dock sweeper	1	
Shovel car	1	
15. Welding machine		
A/C arc welder	150	500A
A/C arc welder	50	300A
Mig arc welder	2	300 - 500A
Tig arc welder	1	500A
Submerged arc welder	2	1,500A
Arc air gouging	8	600A
Engine gen. welder	5	D.C. 70 - 500A
16. Slip way	2	190M
Diesel engine driven winch	1	85HP x 14M/min.
Carriage	16	5 x 10M
Sheave and wire		
Wooden block		
17. Service utilities		
Air compressor	3	$84M^3/MIN.x7KG/CM^2$
Acetylene gas generator	1	$10M^3/HR$
Oxygen generator	1	$50M^3/HR$
Drinking water supply system	-	Tank $350M^3x1$ Transfer pump $20M^3/HR$
Industrial water supply system	-	Well Tank $1000M^3x1$ Transfer pump $125M^3/HR$

Item	Unit	Main Particulars
Fire fighting system	-	Pump $50M^3/HR$ x 2
Portable air compressor	2	$21.2M^3/MIN.x7kG/CM^2$
Portable transformer	2	
Water resistance	3	
Reactor	3	
Dry-ice generator	1	
18. Piping		
Drinking water line	-	
Industrial water line	-	
Sea water line	-	
Compressed air line	-	
Oxygen line	-	
Acetylene gas line	-	
19. Electric work		
Substation	1	4,000 kVA x 2 (6.6 kV)
Transformer station	12	6.6 kV/420V or 220V
Motor generator for ship's shore power supply	3	440V 60Hz and 380V 50Hz
Distribution board (Lighting, welder and power)	172	

Item	Unit	Main Particulars
Emergency diesel generator	1	1,500 kVA
Lights for drydock and slipway	110	
Cable		
20. Tools		
Hand tools	-	Hammer, Chisel, Center punch, Electrical hand tools, etc.
Measuring tools	-	Dial gauge, Micrometer, Pressure gauge, Torque wrench, Vernier caliper, Level, etc.
Lifting tools	-	Journal jack, Chain block, Turnbuckle Steel wire rope, Nylon sling belt, etc.
Pneumatic tools	-	Air drill, Air grinder, Screw driver Air hammer, Impact wrench, Jet chisel, etc.
Electrical tools	-	Electric drill, Disc grinder, etc.
Gas cutting tools	-	Gas cutter, Heating torch, Semi-auto cutting M/C, 02&C2H2 hose, etc.
Welding tools	-	Drying oven for electrode, Holder, Cabtire, Auto-conductor, Wire brush etc.
Protectors	-	Helmet, Glove, Gas mask, etc.
Fire fighting and safety appliances	-	Portable fire extin-guisher, Gas detector, Life buoy, etc.

Item	Unit	Main Particulars
Scaffoldings	-	Work stage, Safety net, Hand rail, etc.
Others	-	Tool box, Tool cabinet, Pipe vise, Hand truck, Airless spray gun, Magnetic V block, Extractor (puller) Draftmans hand tools, Tool set, Etc.