No. 04

BASIC DESIGN STUDY REPORT
ON
THE EXPANSION PROJECT FOR FISHING BOAT REPAIRSHOP
IN
THE SOCIALIST REPUBLIC OF THE UNION OF BURMA

OCT. 1984

JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

In response to the request of the Government of the Socialist Republic of the Union of Burma, the Government of Japan decided to conduct a Basic Design Study on the Expansion Project for Fishing Boat Repairshop and entrusted the study to the Japan International Cooperation Agency (JICA). The JICA sent to Rangoon, Burma a study team headed by Mr. Junichi Fujita, Fishing Boat Inspector, Fishing Boat Div., Fisheries Agency, from June 10th to June 30th, 1984.

The team had discussions with the officials concerned of the Government of Burma and conducted a field survey in Rangoon area. 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 the officials concerned of the Government of the Socialist Republic of the Union of Burma for their close cooperation extended to the team.

October, 1984

Keisuke Arita
President
Japan International Cooperation Agency

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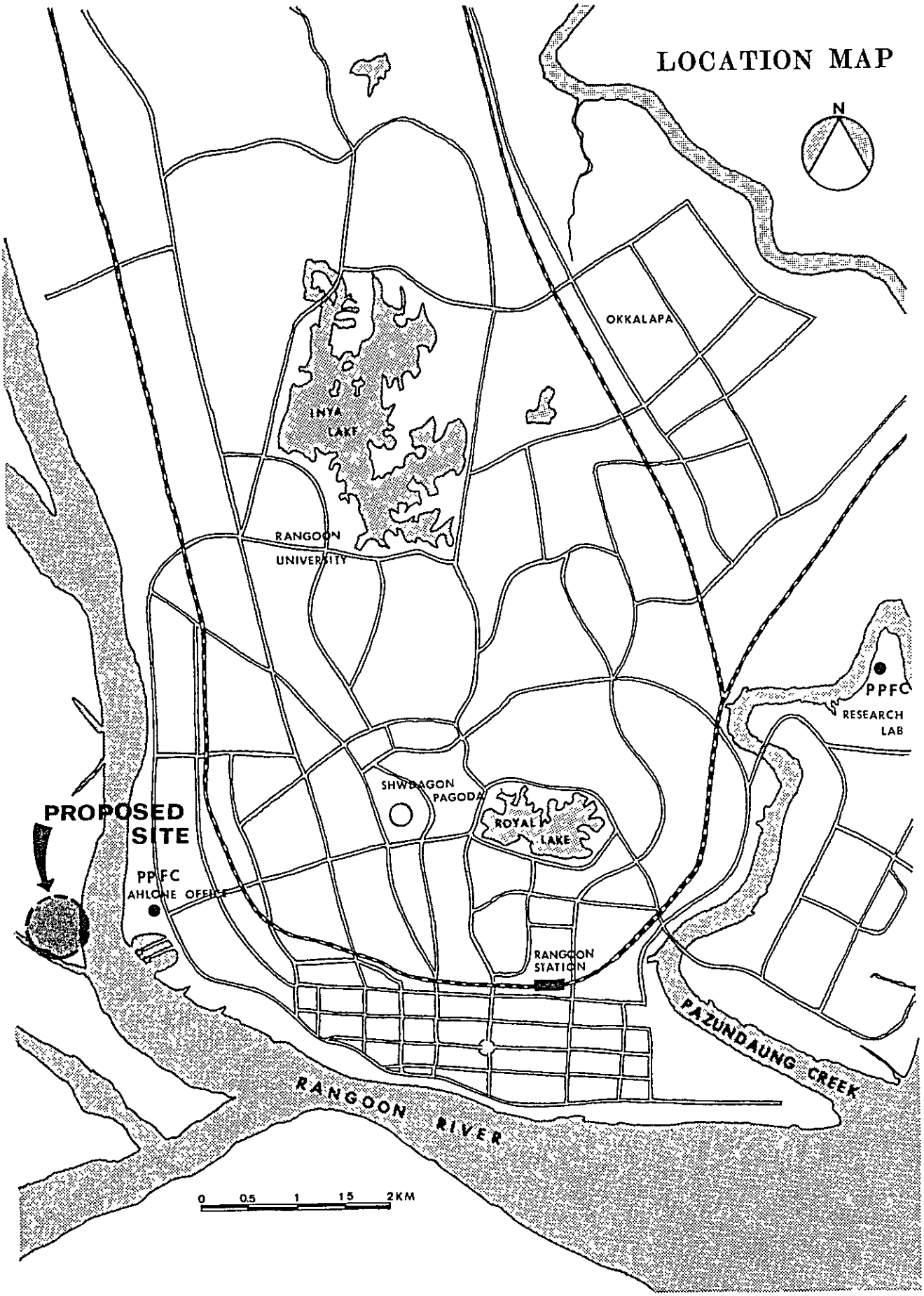

LOCATION MAP
N
OKKALAPA
INYA LAKE
RANGOON UNIVERSITY
PPFC RESEARCH LAB
SHWEDAGON PAGODA
ROYAL LAKE
PROPOSED SITE
PPFC AHLONE OFFICE
RANGOON STATION
PAZUNDAUNG CREEK
RANGOON RIVER
0 0.5 1 1.5 2KM

SUMMARY

The Socialist Republic of the Union of Burma has a coastline of some 2,800 km and a Continental Shelf area of some 215,000 km^2. 75% of its fish production is comprised of marine species.

The Government of Burma, in its Fourth Four-Year Plan (1982/83-1985/86), has placed a high priority on investments in export-related industries offering a high rate of return on investment over a short period of time. In this respect, the Government hopes to increase the production of such marine products as shrimp and fish species, which are considered to be the most promising export products. It is, therefore, making a considerable investment in the fishing fleet and distribution and processing facilities of the PPFC (The Peoples' Pearl and Fishery Corporation).

For the above reasons, the strength of the PPFC fleet has been increased by 87 vessels since 1977. However, while fish production too has been increasing, results have fallen far short of expectations, with actual production at no more than 50 – 70% of target values.

The major impediment to the raising of catch levels by PPFC has been the low operating rates of its fishing vessels, owing to the inadequacy of vessel repair facilities. PPFC has been able to carry out vessel inspection and repairs by utilizing the repair facilities of the BPC (Burma Ports Corporation) along with its own floating dock and slipway. However, in view of the fundamental shortage of facilities, the fact is that, present, only 70% of the fishing vessels owned by PPFC are being given even the regular inspections required by Burmese law. Thus, there is a pressing need in the immediate future to provide adequate vessel repair facilities.

The Burmese Government is planning, for this purpose, to expand the fishing boats repair center at Gyaung Waing, in which the existing facilities, such as the slipway, are owned by PPFC. In order to carry out this plan, the Government has requested the Government of Japan for a grant-in-aid.

Based on this request, the Government of Japan, through JICA (Japan International Cooperation Agency), dispatched a Basic Design Study Team to Burma. This Team conducted an on-the-spot survey of the building site and related facilities at the existing fishing boats repair center and also studied general conditions in the country's fisheries and vessel repair operations. It also exchanged views with concerned persons with the Government of Burma.

As a result of the field survey and discussions, the Team estimated that there was a requirement for a repair capacity of 100 vessels per year, including steel, F.R.P. and large wooden vessels. It concluded that, for this purpose, it would be most appropriate to build the necessary facilities at Gyaung Waing and to supply various items of related equipment.

Following is an outline of the facilities and equipment that would be donated by the Government of Japan under this plan:

1. <u>The Construction Project:</u>

1)	Dry Dock	60 (L) x 14 (W) x 7.5 (H) m
	500 ton capacity	
	Jib crane	2 tons x 35 m
2)	Repairing Jetty	60 (L) x 10 (W) m
	Pile construction	
	Access bridge	50 (L) x 4 (W) m
	Jib crane	2 tons x 30 m
3)	Improvement of the Existing Slipway	
	Jib crane	2 tons x 30 m

2. <u>The Buildings:</u>

1) <u>Iron Worker's Shop</u>

Steel construction	
Building area	about 360 sq.m
Overhead Travelling crane	2 tons

2) Machinery Repair Shop

Steel construction	
Building area	about 360
Overhead Travelling crane	2 tu

3) Generator House

Brick construction	
Building area	about 72 sq.m
Generators	2 units of 225 KVA each
Compressor	2 units of 7 cu.m/min.

4) Building for Showers and Lavatories

Brick construction	
Building area	about 42 sq.m

3. Attached Facilities:

1) Water supply facilities — with a 25 ton ground tank

2) Work area and access road for transporting materials — about 5,200 sq.m

4. Machinery

1) Tugboat

L x B x D	approx 18.7 x 5.8 x 2.5 m
Main engines	2 units of 300 PS each
Cruising speed	10 knots
Maximum bollard pull	approx 7.8 tons

2) Equipment for the Iron Worker's Shop

Electric welding equipment	
Gas welding equipment	
Lattice floor	100 m^2
Shearing unit	1
Press (200 tons)	1
Other tools and equipment	

3) Equipment for the Machine Shop

Lathe (4.0 m)	1 unit
Lathe (1.5 m)	1 unit
Milling machine	1 unit
Radial drilling machine 40 ϕ	1 unit
Drill Press 25 ϕ	1 unit
Other tools and equipment	

4) Equipment for the Engine Repair Facility

Measuring equipment
Diesel Test equipment
Other tools and equipment

5) Equipment for the Electrical Repair Shop

Measuring equipment
Drier
Other tools and equipment

6) Equipment for the Carpenter's Shop

7) Equipment for the Foundry

8) Painting equipment

9) Equipment for the F.R.P. Repair Shop

10) Transport vehicles

forklift	4 ton (1 unit)
forklift	2 ton (1 unit)

11) Parts and Equipment for Emergency Repair Use

With regard to the construction program, the only materials and equipment that can definitely be procured in Burma are items such as cement, brick, aggregate and windows; all the other materials will have to be brought in from Japan.

The construction period may be broken down into the following phases--

1) Detail design, costing, tenders, and contracts — 5 months

2) Procurement and shipment of the various equipment and materials together with the actual construction program

Jetty construction	11 months
Dry dock	16 months
Building construction	10 months
Supply of parts and equipment	9 months
Tugboat	9 months

Simulataneous implementation of the dry dock and repairing jetty phases would, from the standpoint of the construction machinery plan, lead to many redundancies. In addition, if the construction were to run into the rainy season, we can anticipate that serious problems would arise with respect to the dry dock works. Accordingly, the team feels it would be desirable to divide the construction phase into two parts, with the dry dock program to be implemented as a separate construction program during the second fiscal year.

The Vessel Repair Center would be operated by the Engineering Division of the PPFC Marine Fisheries Department. At present, this Division employs 551 people on shore, and so there should be no need to increase the staff even after completion of the expansion program. Since, at present, the funds now being expended for outside repair services will be reduced, we can anticipate a saving in annual operating costs in the order of 1,074,000 kyat.

The benefits that can be anticipated from the subject project for Burma's economy would include:

.... an increase in fish catches as a result of higher utilization rates for fishing vessels;

.... increased intake of proteins owing to the increased supply of fish products on the domestic market; and

.... an increase in fish and shrimp export.

If we analyze those benefits and costs that can be quantitatively measured, we obtain an IRR (Internal Rate of Return) of 27.36%.

This indicates that the implementation of the project would produce susbstantial benefits for the Burmese economy and that there would be considerable significance in the Government of Japan awarding the proposed grant-in-aid.

In order to more effectively utilize, in future years, the facilities planned under this program and to further develop PPFC's vessel repair operations, there is a need for a major effort to bring techniques, quality, and cost up to international levels, based on the efficient and planned used of the equipment in the repair center, the efficient and well-planned procurement of materials and interchangeable components for use in the repair operations; and, with a view to raising technical

levels, a move to rationalize factory administration and increase productivity. Also in order to develop a truly efficient vessel repair center it will be desirable to promote functional specialization based on the development of peripheral industries.

SECTION 1 INTRODUCTION

The Government of Burma, in its Fourth Four-Year Plan (1982/83 to 1985/86) sets continuing economic growth and the development and effective utilization of domestic resources as its main targets. In order to realize these goals, the Plan places high priority on investments in industries that will help foster export development. Among these export commodities, alongside the country's traditional products like rice and teak, high expectations are held for the future growth of fish exports, particularly freshwater and marine shrimps.

Accordingly, the Government of Burma has positioned fisheries as an industrial sector which promises a good return on investment over a short period of time and has been investing actively in a facilities modernization program for this industry centering around the PPFC. On the basis of these investments, the PPFC fishing fleet has grown by a total of 87 vessels since 1977. If we confine our analysis to steel and F.R.P. vessels only, the growth since 1977 has been in the order of 3.5 times.

However, despite this rapid expansion in fleet size, owing to the inadequacy of the PPFC's vessel repair facilities, there has been a serious decline in fishing vessel utilization. As a result, the growth in PPFC's fish production has failed to keep pace with the expansion of the fleet. The Government of Burma, therefore, is planning to upgrade and expand the PPFC fishing vessel repair facilities and, in order to carry out this plan, has requested the Government of Japan for a grant-in-aid.

In response to the request, the Government of Japan, through the JICA (Japan International Cooperation Agency), dispatched a Basic Design Study Team to Burma for a 21 day period from June 10-30, 1984.. The Team was led by Junichi Fujita, Fishing Boat Inspector, Fishing Boat Div., Fisheries Agency.

In order to validate the substance of the Burmese request for the fishing boat repair center and establish the appropriateness of this project as well as the functions and scope of the repair center, the Team undertook a field survey centering on the collection of data on the present status of Burma's fishing industry, the utilization pattern for the PPFC fishing fleet, the situation regarding fishing vessel repairs, and the maintenance and management plans of the repair center developed by the Burmese side.

The basic agreements that were reached between the Basic Design Study Team and the Burmese authorities on the basis of discussions during the field survey were incorporated in a Minutes of Discussions signed by both sides.

After returning to Japan, the Study Team conducted an analysis and examination of the survey findings and put together basic design for implementation of the planned program in the form of a Draft Basic Design Study Report. At that point, the Study Team, again led by Mr. Fujita, returned to Burma for another 12 day period (from August 31 to September 11) to explain its Report to the parties concerned with the project on the Burmese side.

As a result of this second visit, the full understanding of the Burmese authorities was obtained with regard to the contents of the Basic Design Study. Accordingly, in order to present the making in the form required under Japan's grant-in-aid program, we have prepared the subject report.

The names of the members of the Study Team, the itinerary, the names of the various discussants along with the Minutes of Discussions are shown following the body of the main report.

SECTION 2 BACKGROUND OF THE PLAN

2・1 The National Development Plan:

2・1・1 Present Socio-economic Conditions:

The Burmese economy, as shown by the fact that 29.4% of the GDP is accounted for by agriculture, may be characterized as having a monoculture structure, with its base in the production of primary products such as rice, teak, and beans.

There has been little change over the past 20 years in the proportion of primary products, particularly agricultural, in GDP; to the contrary, this share has actually been rising somewhat, from 26% in 1961/62 to 29.4% in 1982/83. Thus Burma is essentially an agricultural country.

Burma's economic development has been implemented on the basis of the "New 20 Year Plan" (1974/75 to 1993/94), as published in 1974. In this Plan, the country's abundant resources, such as agricultural and fishery products and minerals, have been positioned as the motive force behind economic growth. The basic objective is to move, based on a well-balanced economic development, from an agricultural country to an industrial nation based on agriculture.

In the Third Four Year Plan (1978/79 to 1981/82), the expansion of industrial production was to be supported by a rise in a agricultural productivity, an expansion of productive facilities, and increased imports of raw materials. With an announced real economic growth rate of 6.5% per annum, the target rate of 6.6% was almost achieved.

In the Fourth Four Year Plan (1982/83 – 1985/86), presently being implemented, in order to sustain the momentum of economic growth that had been built up during the Third Four Year Plan, the principal thrust has been placed on the maintenance of harmonious economic growth, increasing the efficiency of the existing production base, and the

development and effective utilization of domestic resources under a program of active public investment. As a result of this ambitious program, however, Burma's financial position has weakened considerably since 1978/79, with a chronic fiscal deficit having developed.

There has been a continual deficit in the country's balance of payments on current account, but these deficits have been covered through an increase in internal and foreign loans as well as grants-in-aid from other countries. Reflecting the recent dependence on foreign loans in particular, the country's debt-service ratio in 1981/82 is estimated to have reached 26.8%, based on a total overseas debt-repayment of $127 million in that year.

The total planned investment under the Fourth Four Year Plan of 37 billion kyat is 20% than that under the previous Four-Year Plan. Since the building up of exports will be necessary to permit increased repayment of foreign debt, the strategy will be, with a view to meeting these targets, to place top priority on projects promising a high return on investment over a short period of time.

In this context, investment will be focused on the development of export industries utilizing domestic resources. With regard to projects funded by foreign loans and grants as well, the Government of Burma has decided to give top priority to programs that will assist in generating this kind of export development.

2・1・2 Export Development:

The Government of Burma considers exports to be the determining factor between success and failure of the National Development Program and places export development just behind the goal of meeting domestic demand for rice and other agricultural products deemed necessary to the nation's livelihood.

Particular emphasis has been placed on expanding and diversifying exports as a means of improving the nation's financial situation. The export target for 1983/84 is 3,894.8 million kyat, an impressive 14.2% increase over the 3,410 million kyat of 1982/83.

Among export commodities, rice, as the country's leading export product, plays the most important role, but fishery products, though still small in actual value, have been accorded a growth rate second only to agricultural products under the plan. As a result, high hopes are held for the development of the fishery sector of the economy.

The most important export product in the fishery sector is shrimp, both freshwater and marine, which accounts for about 70% of total fishery exports.

The ratio of all fishery products to Burma's total exports has been growing year by year; it was 3.4% in 1981/82.

The catches by the country's marine fisheries are expanding, and marine fish resources are still felt to have considerable room for further development.

For these reasons, the Government of Burma has recognized the importance of the fishery industry as one which can contribute further to export development, based on an expansion in productivity and the development of fishery resources.

2・2 Profile of Burma's Fishing Industry:

2・2・1 Fish Production:

The ratio of the fishery and livestock industries to Burma's GDP was about 6.6% in 1982/83, of which the fishing industry alone is believed to have represented about 5%.

Burma's fishing industry is divided into inland fisheries and marine fisheries. The former is classified into fish culture, leasable fisheries, open fisheries, and flood fisheries; the latter into onshore fisheries, inshore fisheries, and offshore fisheries.

As a result of the country's well developed network of rivers and streams as well as its rich land and water environment, inland fisheries have been developed since ancient times.

However, as a result of the irrigation projects that have been carried out in recent years to expand agricultural production and the spraying of fertilizers and agricultural chemicals, inland fishery production has been subjected to increasing constraints, and as a consequence production has stagnated.

Marine fisheries, despite fluctuations in the production of the off-shore sector, have been growing year by year. With 1969/70 as a base, the production for marine fisheries has grown spectacularly to 146.8 in 1982/83, vs. only 124.7 for inland fisheries.

The onshore and inshore components of the marine fisheries are operated mainly by artisanal fishermen, using traditional fishing methods. About 100,000 persons in Burma are estimated to be engaged full-time in marine fisheries. Some 93% of the total marine catch is landed by artisanal fishermen, while the remaining 7% is produced by public corporations and cooperatives.

Overall catch data by species are not available for either inland or marine fisheries but, for reference purposes, the breakdown by species of the catch by PPFC were in the Appendix Ⅲ-7, 8.

2・2・2 Fish Resource:

The primary fishing grounds for the inland fisheries is the delta area of the country's three major river systems (Irrawady-Chindwin, Sittang and Salween), areas which are inundated for 4-5 months each year. This inundated area is estimated to cover 60,000 sq.km and to yield an average harvest of 20 kg/ha per year. Another important fishing area is Lake Inle and Lake Indawgyi, with a total lake area of 13,000 sq.km

In recent years, production by the lease fisheries, the most important of the inland fishery sectors, has been declining as a result of overfishing and changes in water flow as a result of the construction of irrigation channels. From the above, it can be seen that there are definite limits to inland fishery resources.

However, with regard to the fresh-water shrimp resources in the estuary of the Irrawady, which is believed to provide an annual catch of 2,000 tons, while comprehensive resource studies have not yet been attempted, the absence of any apparent decline in production indicates that there is still room for expansion of this resource.

With its roughly 2,800 km of coastline and some 215,000 sq.km of continental shelf, Burma is well endowed with marine fish resources. Based on a resource study using hydro-acoustic survey, carried out under a UNDP/FAO program, the Marine Research Division of PPFC has estimated the biomass of marine resources in Burma to be as follows:

Table 2-1 Marine Resources in Burma (in tons)

	Small Pelagic Resources	Demersal Resources	Total
Northern waters	175,000	125,000	300,000
Central waters	505,000	500,000	1,005,000
Southern waters	295,000	125,000	420,000
Total	975,000	750,000	1,725,000

(PPFC, 1984)

The Maximum Sustainable Yield (MSY) is estimated at between 700,000 and 960,000 tons.

The MSY for marine shrimp resources is estimated as follows:

Table 2-2 MSY for Marine Shrimp

Northern waters	4,000 tons
Central waters	2,000
Southern waters	4,000
Total	10,000

(PPFC, 1984)

However, these exploratory fishing and resource studies were conducted mostly in waters shallower than 40 m within the central and sourthern zones, so that a considerable area has not yet been studied or exploited.

Based on the good harvest during the experimental trawl operations by PPFC in 1983 in waters below 80 m depth in the northern section, off Arakan, we can perhaps conclude that Burma's marine fishery resources still leave ample room for development.

At the present time, the coastal fishermen, who comprise the bulk of the country's marine fishery production, rarely venture more than 12 miles offshore. Thus, considerable expectations are held for the future development of offshore fishing activities.

2・2・3 Fishermen; Fishing Vessels; Fishery Administration:

Burma's full-time fishing population is about 158,000 persons, representing about 1.1% (in 1981/82) of the country's estimated total labor force. Some 101,000 persons are engaged in marine fisheries and

some 204,000 in inland, including a portion working in both sectors. The number of fishing vessels in Burma totals 65,468 in the inland sector and 37,798 in the marine -- for a total of 103,266 vessels combined. Of these, 5,049 are motorized with the powered ratio at only 5.14%.

There is no breakdown of powered vessels as between the inland and marine sectors. However, with the average net tonnage of fishing vessel at 29 tons in the marine and only 1.5 tons in the inland sector, we may estimate that the powered ratio in the marine sector is certainly higher than in the inland.

Burma's fishery administration are made by three Ministries: Planning and Finance, Cooperatives, and Livestock Breeding and Fisheries.

The Ministry of Planning and Finance handles the collection of fishing fees for the leasable fisheries. The Ministry of Cooperatives has jurisdiction over the cooperative organizations that are all-pervasive in Burma's social structure. Fishing activity is undertaken by Townships Cooperatives, Village Tract Cooperatives, Pilot Cooperative Firms, and their associations.

The fishing activity undertaken by the various cooperatives is mainly centered in inland fisheries and fish culture.

However, there is a relatively great difference in the scale of operations from cooperatives engaged in marine fishery operations. This is believed to reflect the fact that, whereas virtually the only cooperative involved in marine fisheries is the Fish Producers' Cooperative, there are large number of cooperatives engaged in inland fisheries as a supplementary activity.

The area of fisheries directly under the aegis of the Ministry of Livestock Breeding and Fisheries relates to the activities of the Department of Fisheries and a public corporation known as the Peoples' Pearl and Fishery Corporation (PPFC).

The Department of Fisheries is divided into the following sections:

Fishery Statistics, Fish-Culture, Fisheries Research, Fisheries Extension Services, and Fisheries Education. The Department has 26 township offices and 15 fishery inspectors scattered around the country. Officially, the operations of this Department are supposed to embrace fishery research, administration, extension services and fishery management but, given the constraints in terms of budget and personnel, its activities are on a very low key, with research and extension services activities only negligible in scope.

2・2・4 The People's Pearl and Fishery Corporation (PPFC)

The PPFC was established in 1972 as the sole public fishery corporation in Burma in the area of commercial fishery development. PPFC falls under the jurisdiction of the Ministry of Livestock Breeding and Fisheries, and its activities include: Marine and inland fisheries, aquaculture, pearl culture (all handled directly by the Corporation) as well as processing, exports, domestic marketing, research, and the distribution of fishing nets and gear to small-scale fishermen.

The PPFC is divided into six Divisions, under the supervision of the Managing Director and Additional Managing Director. These Division include: Fresh Water Fish Production, Marine Fish Production, Pearl Culture, Marketing, Administration, Planning, Budgets and Finance. Permanent staffs total 1,422 persons, supplemented by about 3,000 temporary staffs and about 4,500 daily wages staffs. Based on an active program of facility investment, PPFC has been putting a considerable effort into fishery development, particularly offshore.

2・3 The Fishery Development Plan and PPFC:

2・3・1 The Fourth Four-Year Plan and Investments in Facility Modernization:

The Government of Burma, having positioned fisheries as a sector promising an early return on developmental investment and capable of

contributing significantly to export development, has been carrying out an active investment program, mainly through PPFC, to modernize the nation's fish production and processing facilities.

In the Fourth Four-Year Plan, the principal goals for the fishery sector have been set as follows:

1) to increase the production of fish species required for domestic consumption;
2) to increase the production of fish and crustaceans in order to expand exports.
3) to expand pearl culture for export;
4) and achieve an average annual growth rate of 8.2% in net production volume.

In concrete terms, by 1986, the Plan seeks to expand current fish catches by another 130,000 tons so as to be able to deliver to the Burmese people 20 kg of fish products per capita annually and increase shrimp exports to a level of 30,000 tons annually.

For this purpose, the Government of Burma, in its original 1982/1983 budget, allocated some 443 million kyat--5% of its total public investment program--to the live-stock and fishery sectors. PPFC itself has been engaged in a large-scale facilities modernization program involving investments of 155 million kyat in 1981/82, 59 million kyat in 1982/83, and 66.2 million kyat in 1983/84, primarily to build up its fishing fleet and its ice-making and refrigeration facilities.

2・3・2 Expansion of Fleet Capacity and Financial Deterioration:

Based on the above modernization program, PPFC has increased its fishing fleet from 43 vessels in 1976 to 153 in 1983. In steel and FRP vessels alone, the growth has been 5 fold over this period, from 14 to 91 vessels.

Along with the expansion in fleet size, there has been some growth also in PPFC's marine fish production, but results have failed to meet original expectations and, in the past 3 years, production has been no

more than 50-70% of target. The following table shows recent trends in actual vs. targeted fish production:

Table 2.3. Actual & Targeted Fish Production

	Targeted production	Actual Production	Ratio
1979/80	21,278 Ton	20,832 Ton	97.9%
80/81	34,886	17,264	49.5
81/82	40,281	23,996	59.6
82/83	36,844	25,290	68.6

(PPFC 1984)

As the primary cause of this disappointing catch performance, PPFC cites the drop in fishing vessel utilization for the reasons discussed below. Thus, the most critical problem facing the PPFC is how to solve these problems and raise fishing vessel utilization.

(Reasons cited by PPFC)

1) Shortage of vessel repairing facilities
2) Difficulties in obtaining fuel
3) Inadequate landing and supply facilities
4) Shortage of spare parts.

PPFC's operating budgets have been growing year by year in response to its facility investments to date. In view of the slow growth in fish production, however, sales have failed to grow apace, and so the Corporation's finances have been steadily deteriorating.

In the 1982/83 fiscal year, PPFC showed a profit of some 1,000,000 kyat, but, in 1983/84, will report a deficit of 1,400,000 kyat. The deteriorating trend in the Corporation's finances over the past few years is clearly evident from the following table:

Table 2.4. Financial Situation of PPFC

(Kyats in Million)

	1979/80	1980/81	1981/82	1982/83
Expenditure				
1. Materials	60	72	71	69
2. Wages & salaries	17	19	22	25
3. Depreciation	12	12	14	15
4. Taxes	18	20	25	26
5. Maintenance	5	8	9	10
6. Interest	11	34	19	24
7. Other expenses	56	48	108	124
Total	179	213	268	293
Income	193	225	274	294
Profit	14	12	6	1

(PPFC 1984)

In addition, PPFC operations are saddled with a considerable burden in the form of interest obligations on foreign loans. In 1981/82, these payments absorbed 18% of total expenditures, and this ratio rose to 23% in 1982/83, with continued increases anticipated in future years.

Table 2.5 Repayment to Foreign Loans

(Kyats in million)

Name of Lender	1981/82	1982/83	1983/84
ADB (Phase I)	5	5	5
ADB (Phase II)	—	—	13
Norwegian Loan	—	15	15
Australian Loan	10	13	12
Midland Bank Loan	22	23	31
Hong Kong Bank Loan	13	13	14
Total	50	69	90

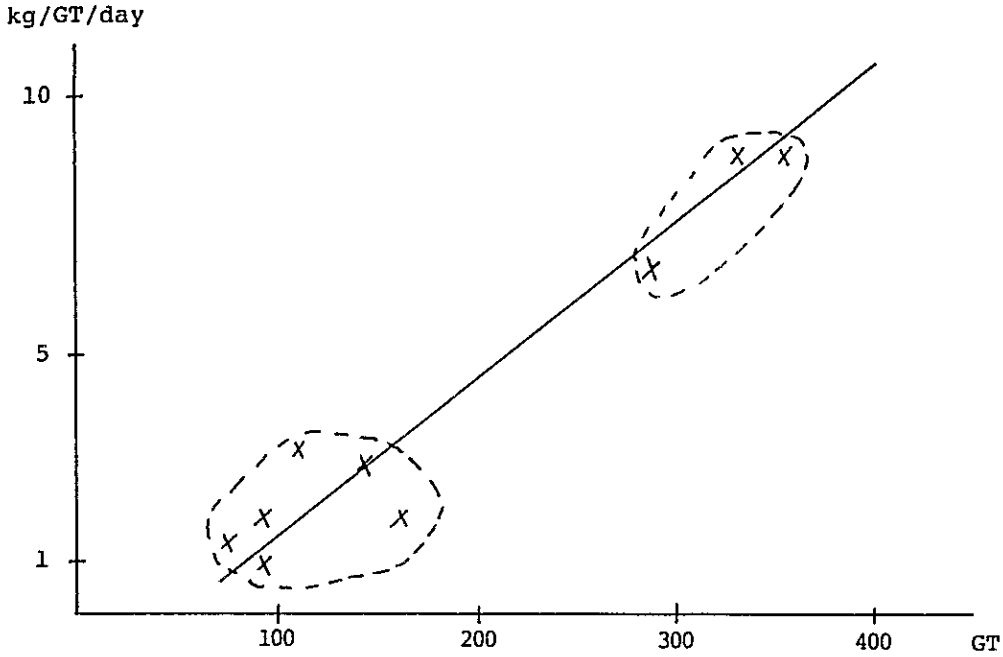
As shown above, when we consider the fact that the fishing industry is positioned in the National Development Plan as one promising a rapid return on investment as well as a major contribution to export earnings, and given PPFC's adverse financial performance owing to its past investment program and the future increases that will be required in payments on foreign loans, it is eminently clear that the enhancement of fishing productivity, keyed to an improvement in fishing vessel utilization ratios, is the major problem now facing the PPFC.

2・3・3 Fishing Vessels Utilization Patterns:

The table on the page 16 shows detailed operating data for PPFC's trawl fleet during 1983/84. As this table shows, if we focus on operating ratios, the number of fishing days was, on the whole, quite low, with the 48 days registered by the No. 4 group of 400-class vessels a source of particular disappointment.

Looking at catch volume per fishing day, even apart from the above 400 group, catch results were poor the No. 6, 7, 8, and 9 groups as well. Among all these groups, there was a relatively low average number of fishing days per trip (7-9). In addition, the relationship between gross tonnage and catch per GT day is shown in the following chart:

Chart 2.1 Gross Tonnage vs. Catch Per Day Per GT



As is clear from the chart, there is a clear disparity in catch per GT/day as between vessels of 200 GT or less and larger vessels.

Table 2.6 Operating Results for PPFC Fishing Vessels During 1983/84

	Vessel Number	Country of origin (year built)	Average gross tonnage	Total No. of trips	Total No. of fishing days	Catch (tons)	No. of trips per year per vessel	No. of fishing days peryear per vessel	Catch per vessel (tons)	Catch per vessel /day (tons)	Catch per GT/ day (kg)	Average No. of fishing days per trip
1	101, 103, 105, 107, 109, 111, 113, 115, 117, 119 (Total 10 vessels)	Korea (1977)	166	79	1,092	3,548.05	7.9	109.2	354.8	3.25	1.95	13.7
2	519, 521, 523 (Total 3 vessels)	"	284	19	306	1,729.56	6.3	102.0	576.5	5.65	6.63	16.0
3	*533, *535 (Total 2 vessels)	Japan 1982/83	332	8	131	779.08	4.0	65.5	389.5	5.95	8.96	16.5
4	405, 407, 409, 411, 413, 415, 417,421, 423 (Total 9 vessels)	Norway 1979	98	64	430	707.18	7.1	47.8	78.6	1.64	1.86	7.0
5	525, 527 (Total 2 vessels)	"	356	12	223	1,419.45	6.0	111.5	157.7	6.37	8.94	18.0
6	425, 427, 429, 431, 433, 435, 437, 439, 441, 443 (Total 10 vessels)	Australia 1979	97	111	869	762.67	11.1	86.9	76.3	0.88	0.90	7.9
7	473, 475, 477 (Total 3 vessels)	"	147	33	285	361.65	11.0	95.0	120.6	1.27	2.88	8.7
8	445, 447, 449, 451, 453, 455, 457, 459, 461, 463 (FRP) (Total 10 vessels)	U.K. 1980/81	75	123	998	999.01	12.3	99.8	99.9	1.00	1.33	8.3
9	465, 467, 469, 471 (Total 4 vessels)	Denmark 1979	113	50	413	573.25	12.5	103.3	143.3	1.39	3.07	8.8
	GRAND TOTAL (53 vessels)	–	–	499	4,747	10,879.9	9.4	89.6	205.3	2.29	–	–

NOTES: * Delivered in November, 1983
SOURCE: PPFC, 1984

The above situation presumably reflects that fact that relatively good fishing grounds are evidently found well offshore from fishing bases and that, since vesseles of a small size cannot stay out for long periods per trip, the usable gear is limited; thus lowing operations in favorable grounds. Nor can the vessel types be considered appropriate for ground conditions offshore. Nevertheless, more critical than any other single factor in preventing an increase in catch levels is the low level of fishing vessel utilization, as indicated by the small number of fishing days per vessel.

If we look at data from neighboring Thailand, we see that the catch per vessel day is almost identical to the PPFC average but that, since the Thai vessels record 3 times more fishing days per year, there are major differences from the PPFC patterns in annual catch per vessel.

In Thailand, we should note, owing to overfishing in recent years by trawl vessels, the depletion of demersal fish resources has become a serious problem, and this probably reflects the fact that fishing operations in that country are only viable on the basis of increased fishing effort. Nonetheless, when we consider that, against an 81% fishing vessel utilization ratio in Thailand, the PPFC rate is only 35%, this fact tells us that there must be considerable room for improvement in operation rates in Burma.

Table 2.7 Similar Fishing Vessels Activities in Thailand and Japan

	Fishing Vessels	Number of Fishing Vessels	No. of Trips	No. of Fishing Days	Catch Volume	No. of Fishing Days per Vessel	Catch (tons) per vessel	Catch (tons) per vessel day
Thailand	Otter trawlers (length: 25 m or more)	47	1,701	35,789	85,103	296	578.9	2.38
Japan	Off-shore trawlers (100–200 GT)	165	15,623	35,778	608,523	217	3,688	17.0

Sources: Thailand: Marine Fisheries Statistics (1980)/ Fishing Record of Thailand (1980)
Japan : Production Yearbook for Fisheries and Aquaculture (1981)

If we now summarize actual operating results for the PPFC fishing vessels during 1982/83, we see the following:

Table 2.8 Utilization of Fishing Boats

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Average (vessel)	Ratio (%)
Awaiting for docking	5	9	16	12	9	9	8	7	6	5	5	5	8	10.0
Under repair	27	26	26	26	21	21	26	20	19	23	28	22	23.8	29.7
On dock	3	5	5	6	7	4	5	2	2	2	2	1	3.7	4.6
Afloat	22	20	20	15	11	16	19	18	17	21	26	21	18.8	23.4
Awaiting Nautical Inspection	2	1	1	4	3	1	2	–	–	–	1	1	1.2	1.5
Awaiting for fuel	23	19	16	22	27	15	1	–	–	–	–	–	10.2	12.7
Awaiting to land catch	2	2	1	1	1	2	3	1	1	2	2	3	1.8	2.2
Preparing for sea	3	1	1	–	1	3	1	1	1	1	2	2	1.4	1.7
Waiting for ice	–	–	–	–	–	1	3	5	–	–	–	1	0.8	1.0
On operation	15	15	12	14	17	9	23	32	46	43	33	42	25.9	32.3
Fishery	11	11	8	7	10	11	16	23	37	37	27	35	19.4	24.2
Carrier	4	4	4	7	7	8	7	9	9	6	6	7	6.5	8.1
Others	2	4	5	5	4	10	10	15	8	9	12	7	7.6	9.5
Total	77	77	77	79	80	80	81	81	81	83	83	83	80.2	100.0

(PPFC 1984)

From the above chart, the average operating patterns for the PPFC fishing vessels reveal the following: that while some 32% of total time is used for actual operations, repairs (including waiting time) consume 40%, resupply 18%, and other factors 10%. We see that repairs and resupply consume inordinate amounts of time.

While waiting times for resupply are likely to persist, owing to the inadequacy of landing facilities, it may be noted that since November, 1982, there has been a distinct improvement in obtaining fuel supplies: since that time, no time has been lost for this reason.

With respect to repairs, while even the actual repair operations themselves are time-consuming, it is the waiting time for space at the repair facilities that accounts for the highest proportion of repair time. It is believed that the major cause of this situation is a shortage of vessel repair facilities and equipment.

Since vessel repair facilities do not relate directly to fish production, PPFC has invested very little to date in this area, the only concrete investments have been in a slipway by the ADB and a floating dock from Norway as parts of the projects. The result is that repair facilities have lagged seriously behind the expansion of fleet size.

2・4 The Present Situation Regarding Fishing Vessel Repair:

2・4・1 Present Status of Ship-building and Repair Facilities:

The ship-building industry in Burma is still in a developmental stage, so that the number of boat-building and repair facilities is still quite inadequate.

Table 2.9 Boat Building and repair facilities in Rangoon

Name of Yard	Organization	Capacity
Sinmalike Dockyard	Burma Dockyards Corporation (B.D.C)	Slipway 1 unit (1,700tons)
Dalla Dockyard	Inland Water Transport Corporation (I.W.T.C)	Slipway 14 units (400tons)
Ahlone Dockyard	"	Slipway 6 units (200tons)
Botataung Dockyard	Burma Ports Corporation (B.P.C)	Slipway 6 units (200tons)
Sat Sun Dockyard	"	Dry dock 1 unit
Ant Gyi Dockyard	"	Slipway 3 units (150tons)
Dawbon Dockyard	Marine Administration Department (M.A.D)	Slipway 5 units (100tons)

There are, in addition to the above, a few small privately owned facilities.

Of the above facilities, the Sinmalike Dockyard, built with aid from Yugoslavia, is the largest publicly owned shipyard, with facilities for both ship building and repairs. Following is a brief description of this dockyard:

Location	Sinmalike, on the east bank of the Hlaing River
Area	161.554 acres
Docking facilities	slipways (3) of 1500, 750, and 350 tons
Cranes	5 cranes of 35, 25, 15, 13, and 7 tons
Tugboat	40 tons
No. of workers	about 2,000

Excluding the above Sinmalike Dockyard of BPC, the other facilities operate repair facilities mainly for their own vessels and so, to the extent they lack reserve docking capacity for outside vessels, cannot be used by PPFC. Sinmalike devotes itself mainly to new ship building. While it has repair capacity for up to 80 vessels a year, under present conditions, it does not, in principle, accept any repair orders other than for emergency repair work arising shipwrecks.

As a consequence, it is exceedingly difficult for PPFC to rely on the above yards for the repair of its vessels.

2・4・2 PPFC's Fishing Vessel Repair Facilities:

PPFC owns 3 facilities for the repair of its fishing vessels: an 800 ton floating dock, the Gyaung Waing slipway, and a mud dock at Thaketa.

The floating dock is moored in the center of the Hlaing River upriver from the Sinmalike Dockyard. The main specifications of this facility are as follows:

Manufacturer	North West Engineering, Norway
Class	DnV + 1A1 (Det Norske Veritas)
Docking capacity	800 tons
Total length	61.7 m
Length of pontoon	55.0 m
Width of pontoon	15.0 m
Height	9.0 m
Main engines	250 KVA (2 units)
Auxiliary engine	61 KVA
Cranes	2 1/2 tons/18 meters x (2)

The Gyaung Waing slipway is on the shore opposite Ahlone and is equipped with a winch of 300 ton capacity. In addition to the slipway, a generator house, iron work shop, machine shop, carpenter shop, and warehouse are scattered over an area of about 10 hectares. However, there are no crane facilities here, while the supply of machine tools can hardly be described as adequate.

The Thaketa mud dock was built facing Paxundaung Creek, which flows in to the Pegu River east of Rangoon. Vessels are raised onto the dock for repairs, taking advantage of tidal variations, and the facility is used exclusively by wooden vessels.

The following table summarizes PPFC fishing vessel repair activity over the past 3 years at both its own repair facilities and elsewhere:

Table 2.10 Fishing Vessel Repair Activity

(number of vessel)

		81/82	82/83	83/84
P	Floating dock	31	36	27
P	Slipway	-	10	16
F	THAKETA mud dock	26	23	25
C	Sub-Total	57	69	68
DAWBON Slipway (DMA)		11	14	9
ANTGYI Slipway (BPC)		6	5	1
Private facilities		12	12	19
Sub-Total		29	31	29
Total		86	100	97

(PPFC 1984)

Among the above facilities, wooden vessels are handled at the Thaketa mud dock and the privately owned yards. Some 40-60 of PPFC's steel and F.R.P. vessels as well as 30-40 of its wooden vessels are regularly repaired each year at these facilities.

These figures show that some 30-40 steel and FRP and 20-30 wooden vessels in the PPFC fleet are unable to be satisfactorily accommodated for even the once a year regular inspection called for under the Burmese law. These other vessels get by by filing applications for extensions on these regular inspections, and some have now gone as long as 2 1/2 years without inspection.

From the above, it is clear that there is an urgent need for PPFC to provide adequate fishing vessel repair facilities of its own and shorten the time for proper repair operations, with a view to improving fishing vessel utilization.

2·4·3 Repair and Maintenance Structure:

The repair and maintenance of PPFC vessels are under the direction of the Engineering Division of the Marine Fisheries Department. This Engineering Division employs 1,041 workers, who are supervised by a chief engineer, 490 of these workers are engine room crews.

In the Shore Division, there are 551 workers, broken down : 51 permanent, 240 temporary, and 260 daily. The disproportionate number of temporary staffs reflects restrictions on the employment of permanent staff. Thus, there are many workers of long standing who still cannot break out of the "temporary" category.

We present below an organizational chart for the Engineering Division. The PPFC expense for vessel maintenance and repairs keeps increasing from year to year; in fact, over the past 1-2 years in particular, this expenditure has exceeded 6,000,000 kyat per annum.

Expenditure for the 4-year period 1979/80 through 1982/83 are shown below:

ORGANIZATION CHART OF ENGINEERING DIVISION
MARINE FISHERIES DEPARTMENT

STRENGTH OF ENGINEERING DEPARTMENT		
S. No.	DESCRIPTION	Q'TY
1.	PERMANENT STAFF	188
2.	TEMPARATRY STAFF	605
3.	DAILY WAGES STAFF	248
	TOTAL	1041

NOTE: The above strength includes engine room crews of 153 vessels.

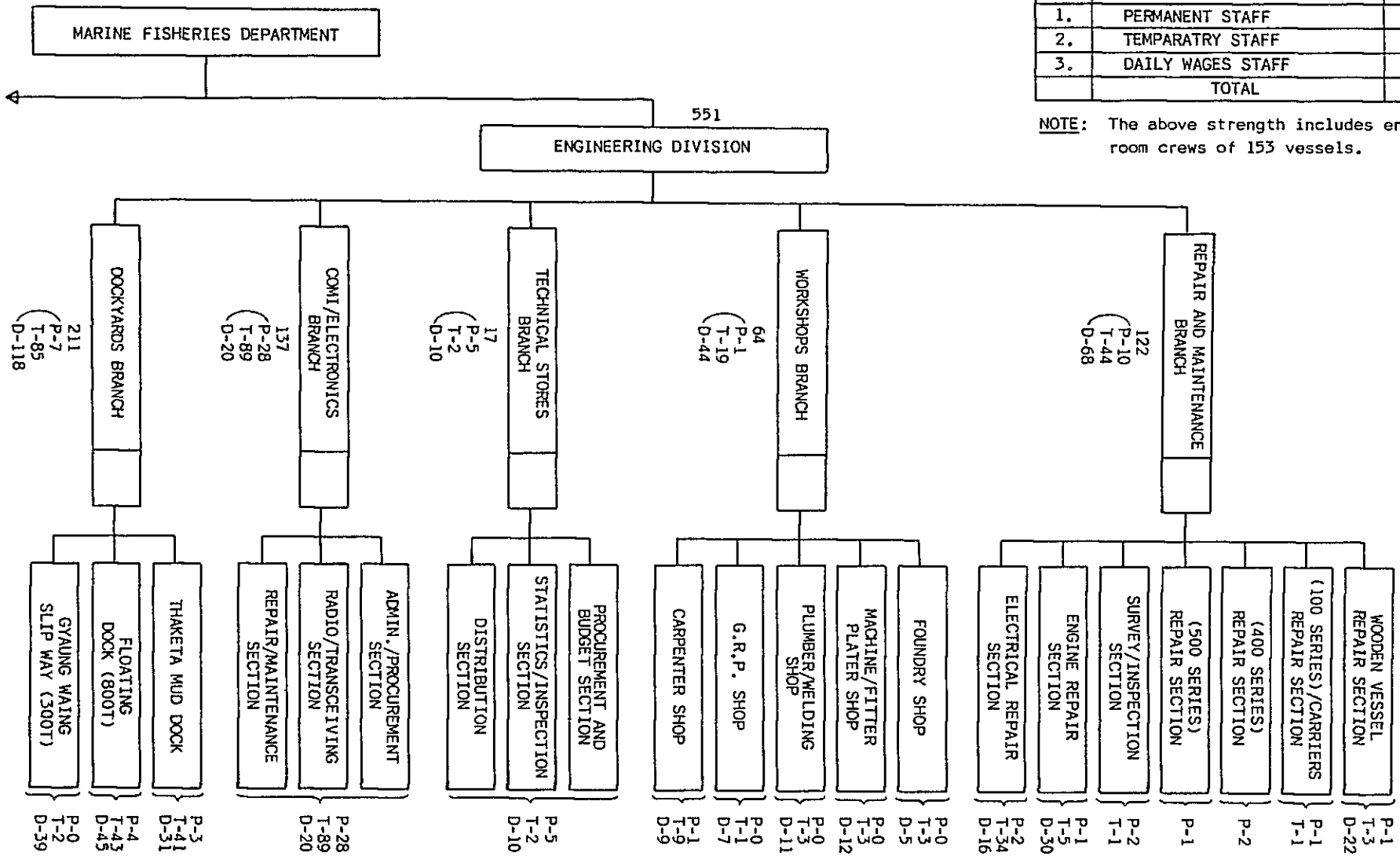


Table 2.11 Expenditure for Repair (in Thousand Kyats)

Project Name	Number of vessel	1979/80	1980/81	1981/82	1982/83	Per vessel 82/83
Off-shore fisheries	7	1,671	2,968	2,604	3,373	482
Off-shore fisheries (ADB Phase I)	13	169	483	1,404	1,014	78
Marine Prawn Development Project (Norway Loan)	14	37	415	1,369	355	25
Marine Prawn Development Project (Australian Loan)	13	-	392	140	615	47
Marine Prawn Development Project (U.K. Loan)	21	-	347	7	639	30
Fisheries Development Project (Danida Loan Phase II)	4	-	-	6	86	22
Lin Shue (U.K. Grant)	1	-	-	10	-	-
Coastal Fisheries	41	808	1,013	1,360	306	7
Total	114	2,685	5,618	6,900	6,388	56

(PPFC 1984)

In 1981/82, PPFC expended 6,900,000 kyat on vessel maintenance and repairs, distributed roughly as follows:

Table 2.12 Breakdown of maintenance and repairs cost

	Value (000 kyat)	Percent
Wages	300	4.3%
Outside contracting	3,500	50.7
Materials	1,200	17.4
Spare parts	1,500	21.7
Other	400	5.8
Total	6,900	100.0%

As seen above, PPFC is spending some 2,700,000 kyat a year on materials and parts and must rely on imports for almost all of its requirements in this area. Given Burma's present foreign exchange situation, these purchases are surely not easy.

The build-up of the PPFC fishing fleet can hardly be said to have reflected careful long-term planning. The fact that these vessels were procured from 10 different yards, the main and auxiliary engines from 33 different companies, the generators from 6 companies, and the electrical equipment from 7 companies has certainly made the procurement of spare parts as well as the maintenance and repair task even more difficult.

In addition, over 50% of the total expenditures on repairs and maintenance are spent on outside contracting, which constitutes a major burden for PPFC.

When we consider the difficult financial conditions that PPFC is expected to face in future years, we can only conclude that there would be great significance in increasing the share of maintenence and repair activity that can be done internally by providing suitable captive facilities, thereby reducing the amount of work that must be contracted to outside yards.

SECTION 3 PROJECT SITE CONDITIONS

3・1 Location and Topography of the Planned Site:

The planned site is bounded on the north by the Gyaung Waing Creek and Ngazing, a small residential village; on the west, to the rear of the property, by rice paddies; and on the east by the Hlaing River. The site extends about 430 m from north to south and about 230 m from east to west, covering a total area of some 10 hectares.

The site is almost flat, with the average ground level a marsh area about +5.7 - 6m above the Datum Level.

A stone dyke runs parallel to the Hlaing River, with an approximate height of +7m and a width of about 2 m. During periods of high tide, however, river water flows into the site from the Gyaung Waing Creek and drainage pipes on the side, causing flooding of up to 0.8 meter. The PPFC presently has fishing vessel repair facilities on this site which carry out about 30 inspections a year.

3・2 General Profile of the Existing Facilities:

The principal existing buildings and facilities on the subject site include the following:

1) A slipway of 300 tons (1)

2) Generating facilities

Building	single-story wooden (12 m x 30 m) (1)
Equipment	generators: 150 KVA (1)
	100 KVA (1)

3) Iron works shop

Building	single-story wooden (12 m x 30 m) (1)
Equipment	drilling press (1)
	arc welder (1)
	gas welder (1)
	press (50 ton) (1)

4) Machine and forging shop

Building	single-story wooden (12 m x 30 m) (1)
Equipment	lathes (3)--of which one is used for woodworking
	drill press (1)
	sawing machine (1)
	forging equipment (1)
	tool grinder (1)

5) Electrical and engine repair shop

Building	single-story wooden (12 m x 36 m) (1)
Equipment	battery charger
	motor drier

6) Carpenter shop

Building	single-story wooden (12 m x 36 m)
Equipment	planer (30 cm) (1)
	circular saw (400 mm dia.) (1)
	band saw (unusable) (1)

7) Mould loft

Building	single-story wooden (12 m x 39 m) (1)

8) Design room

Building	single-story wooden (12 m x 39 m) (1)

9) Warehouse and other

1. Warehouses for spare parts	19.2 x 36 m (2)
2. Warehouses for fishing gear	19.2 x 36 m (2)
3. Warehouse for lubricating oil	19.2 x 36 m (1)
4. Wooden boat yard	15 m x 45 m (1)
5. Communications shed	15 m x 45 m (1)

10) Administration building

RC construction; 2-story (1)

11) Engineering office

Single-story wooden (13.5 x 24 m) (1)

12) Slipway staff office

One-story wooden (10 m x 19 m) (1)

13) Fuel tank

Steel Tanks (100,000 + 200,000 = 300,000 gallons)

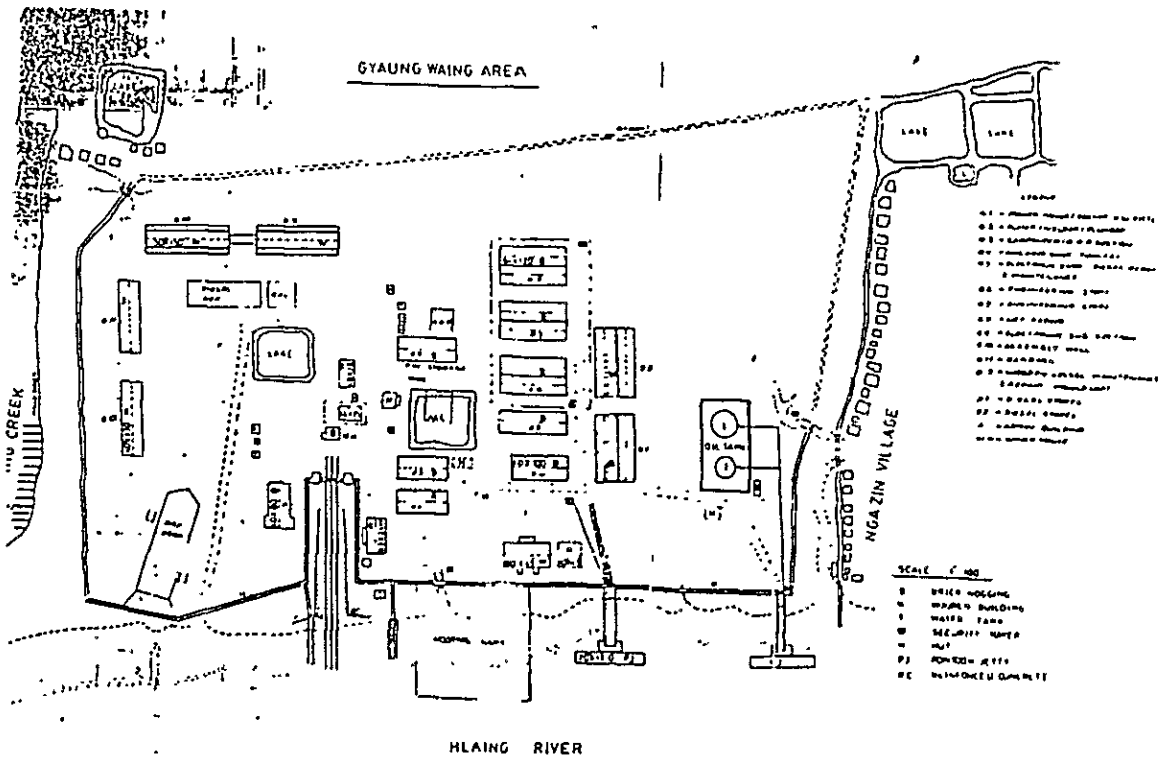
(2) tanks

14) Jetties

pontoon type (12 m x 43 m) (1)

(9 m x 30 m) (1)

The facilities for the repair of fishing vessels are deployed as follows:



3・3 Site Conditions:

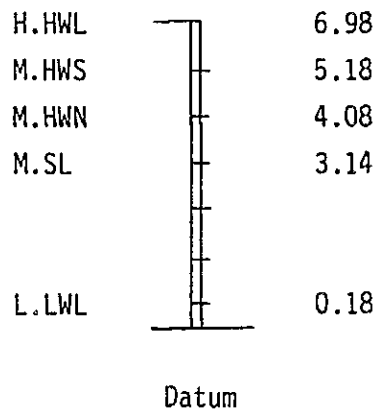
3・3・1 The Oceanographic Environment:

1) Tides

The river area in front of the planned site is a section of the Hlaing River and is incorporated in the Rangoon Port Area. Rangoon Port is situated about 45 km downstream on the Hlaing River from Gyaung Waing, which flows into Martaban Bay. However, the port is subjected to strong tide, with the tidal range reaching as high as 6 m.

Based on observation data for the period 1969-1979 taken at Monkey Point in Rangoon Port, the maximum tidal level over the period was 6.98 m (July, 1978) and the minimum 0.18 m (January, 1969). The tidal levels in Rangoon Port are as shown below:

Chart 3.1 Tidal Level in Rangoon Port



2) Current Speed and Direction

The river flow too is subject to strong tidal action. The current is strongest during spring tides following the monsoons. On August 17, 1981, at Hteedan Point in the vicinity of the planned site, a maximum flow of 3.86 m/s (7.72 Kt) was recorded.

The average maximum flow in the river area in the front of the planned site is 5-6 Kt, and current direction completely reverses during periods of rising and ebbing tide. This reverse flow phenomenon and the rapid current flow, which reaches 2.5 - 3m/second, are the primary causes of problems in vessel docking operations.

3・3・2 The Geology:

The area surrounding the planned site is situated in an alluvial delta region in which rivers and waterways have developed. While there are seasonal variations in the normal underground water level, this is quite shallow, ranging from 2-4m.

Judging from this sort of topography, the ground surface in the vicinity is subject to successive cycles of dryness and wetness during the alternating dry and rainy seasons. Thus, characteristically, the top surface layer has progressively hardened, owing to the drying effect, while the shallow alluvial layer directly below is exceedingly soft.

In the simple soil bearing tests we conducted with a cone penetrometer during our field survey, we derived a value of 7.5 - 17 tons/sq.m at 1 meter below surface, the planned design foundation level. (cf. Appendix Ⅲ-3)

And, based on the boring tests that were simultaneously conducted, there is a silt clay layer up to about 9 m below ground surface, with a silt and sand layer extending from that point down to about 18 m. (cf. Appendix Ⅲ-5)

3・4 Infrastructure Conditions:

3・4・1 Water Supply and Sewage:

(1) Waterworks:

The central part of Rangoon is equipped with a waterworks. However, water from this facility cannot be drunk from the tap but must first be

boiled and sterilized. During the dry season, there are frequent interruptions in water service, and countermeasures have to be improvised, such the installation of a reservoir tank or a private overhead tank. During the rainy season, on the other hand, the water becomes turbid.

There are no waterworks in the vicinity of the planned site area. In the existing facilities, water for general use is drawn and distributed from a reservoir. Drinking water during the rainy season is obtained from rain water and, in the dry season, from supply vessels. There are deep wells in the site area, but there are problems with the water from these wells in terms of excessive salinity and iron content; the deep wells, therefore, are not presently utilized.

(2) Sewage:

As in the case of waterworks, the only sewage facilities are found in central Rangoon. Elsewhere, including the planned site area, such facilities are non-existent. In general, water for general use is either directly discharged or drained via evaporation and seepage. Thus, in principle, sewage first treated in a simple septic tank and then eliminated either by discharge or via evaporation and seepage.

In the existing repair facilities, water for general use is directly discharged into the river, while sewage is treated in a septic tank and then discharged into the river.

3・4・2 Other facilities:

(1) Telephones:

In central Rangoon, despite a slight shortage of circuits, the telephone system is relatively well developed. However, in the planned site area, there are no telephone facilities.

In the existing facilities, transceivers are used for communication with the PPFC Ahlone headquarters on the opposite bank.

(2) Fuel:

City gas and propane gas are not available. Power, kerosene, firewood, and charcoal are the principal fuel sources in the area.

SECTION 4 THE BASIC PLAN

4 • 1 Basic Policy:

The urgent priorities, in terms of expanding PPFC's fishery production and increasing exports, which is the near-term objective of the National Plan, call for an improvement in the operating efficiency of fishing vessels, based on an expansion and upgrading of the existing fishing boat repair facilities of PPFC.

The existing repair facilities of PPFC are, on the whole, totally inadequate in terms of capacity, owing to the low capacity of the slipway, the lack of proper machine tools, and the lack of an access road. As a result of this situation, it has not been possible to develop an organically integrated structure for these operations, and so we can only say that it has not been possible to demonstrate the functions of the complex to full advantage.

For this reason, based on a study of the overall set-up, including the existing facilities, and a consideration of how best to utilize these present facilities, we feel that it is necessary to draw up an effective facilities plan that would provide the capabilities of a new facility through the addition of new functions, facilities, and equipment.

The next point to be considered is the efficient flow of materials. An extremely large number of parts and accessories must be handled by the facility, with heavy items particularly numerous. Thus, the facilities must be located so that these materials and components are able to flow smoothly. While organically tying these materials to the functions of the facilities, it is also important to operate the complex efficiently and effectively by minimizing the area of movement for both materials and personnel.

Thirdly, the highest priority in the program must be placed on safety. Safe management, in its original sense, developed from a spirit of simply respecting human life. But, in modern factory management, it is axiomatic that no operation can afford to ignore safety considerations.

If a plant is maintained so as to assure proper safety and sanitation, the impact of the facilities goes beyond operating efficiency. For the impact of industrial accident can be vast in terms of the economic losses suffered by the injured parties, the losses suffered by the plant, and the socio-economic losses from the disaster. The link between production and safety if so strong that it would hardly be an exaggeration to say that a person who ignores safety considerations is totally unqualified to be involved with production operations.

It is vital, therefore, in considering the placement, types, and structure of the various facilities, that top priority should be assigned to both safety and sanitation.

Fourthly, it is also important to carefully consider capacity balance between the various plants and production stages. For, even if one chooses to strengthen the repair capability of one production stage, if the other production stages are allowed to lag behind, there can be no improvement in the productive efficiency of the complex as a whole. Only by establishing a balance between the productive capacity of the various processes and stages can the productive capability of the entire facility be adequately mobilized.

A ship-building yard is a prototype assembly industry. In Japan, a vessel is built by procuring over 200 different kinds of components from some 40 peripheral industries and/or sub-contractor plants. Of course, when comparing a facility for ship building with one dedicated to repair operations, there will be obvious differences in the components required and in the number of industrial classifications involved, but, in both cases, a large variety of components and materials are required.

In Burma, however, since peripheral industries are not yet developed, the bulk of the components and materials must be imported or fabricated within the complex. For this reason, even in the case of items whose manufacture in Japan would normally be contracted out, we will have to consider having at least the most critical items made within the complex.

Finally, in line with the future expansion of the productive capacity of the repair center, it will be necessary to leave some leeway for expansion in the various facilities and equipment. In drawing up this plan, our immediate concern was, of course, to maintain the required levels of productive capacity, but, in future years, we can certainly anticipate an expansion or a shift in the application of certain of the facilities on the basis of an increase in the scale of production or advances in manufacturing techniques.

We have, therefore, developed our plan in such manner as to hold to a minimum the costs of such expansion, should the need arise.

4・2 Plan Objectives and the Principal Dimensions of the Required Facilities:

4・2・1 Plan Objectives:

Of the 153 fishing vessels owned by PPFC, 67 are steel, 24 are F.R.P., and 62 are wooden.

Table 4.1 Vessels by Hull Material

	Steel Vessel	F.R.P. Boat	Wooden boat
Fishing vessels	60	21	31
Support crafts	7	3	31
Total	67	24	62

(PPFC - on 30, Aug. 1983)

If we break down the 91 steel and F.R.P. vessels by age, we see that 60 are less than 5 years old, 19 are 5-14 years old, and 12 and 15 years old or older.

Table 4.2 Vessels by Age

Age	Number of Vessels	Gross Tonnage
0 - 5	60	7,257.50
6 - 10	14	2,613.15
11 - 15	5	955.00
16 - 20	11	2,888.66
over 20	1	250.00
Total	91	13,964.31

(PPFC)

In principle, all steel and F.R.P. vessels make use of the docking facilities. However, 6 of the 12 vessels that are 15 years old or older are scheduled to be scrapped in the near future, and so these 6 vessels have not been included in this plan.

Wooden vessels are, generally speaking, repaired at mud docks which do not have specialized docking facilities. However, the 6 large wooden vessels, which are difficult to service at these mud docks, will also have to make use of the docking facilities.

Also, in the near future, there are plans to procure about 9 new fishing vessels. Totalling the above requirements, we estimate that about 100 vessels a year, excluding the small-medium size wooden vessels, will have to be accomodated by the PPFC repair complex.

4・2・2 Examination of Facility Requirements:

A total of 43 vessels were repaired at the PPFC docking facilities during 1983/84, broken down as follows:

... 27 vessels at the floating dock
... 16 vessels at the slipway

However, in the plans for the 1984/85 Fiscal Year, these totals would rise to 39 and 26 vessels, respectively, which is not an unreasonable goal. Thus, if all conditions are optimum, it is considered quite possible that a total of 65 vessels a year could be serviced at the existing facilities.

Accordingly, it is absolutely vital that there will be an expansion in the docking facilities to permit the servicing of an additional 35 PPFC vessels per year.

The fish catches of the PPFC show distinct differences as between vessels over and under 300 GT. In this sense, the main fishing vessels of the PPFC are those of the 400 to 500 GT class, and it is expected that, in the future, this class of vessel will be the principal type procured.

Since the existing slipway has a 300 GT capacity, it will clearly be necessary to provide new docking facilities capable of accommodating 300-500 GT vessels. With regard to mooring repairs as well, since there is at present no specialized repair jetty, the repair workers must go out to the moored vessel to do their work, causing a significant drop in operating efficiency, Thus, it will be necessary to construct a new repair jetty at which 4 of the PPFC's main vessels can simultaneously be berthed.

In order to effectively tow the repair vessel to the repair jetty and the docking facilities and maintain the position of the target vessel during docking and undocking, there will be a need for a suitable tugboat.

The normal functions of a shipyard are divided roughly into facilities for hull and that of rigging, while yard functions are broken down in detail on the basis of the various production functions. In the subject plan, however, rather than having the characteristics of a specialized repair facility, the repair center functions will have to include iron works, machinery repair, engine repair, electrical repairs,

carpentry work, F.R.P. repairs, and mould loft for wooden vessels.

For the iron works and machine repair shops, there will be a need for large-sized machine tools as well as for an overhead travelling crane to move heavy materials. But, from the standpoint of the structural nature and working efficiency of the buildings, it would be quite difficult to utilize the existing facilities, and so we have decided to construct new facilities for these operations.

The building site for this plan will be almost entirely inundated during high tide periods, and so communication between the various facilities must depend on a wooden passageway. This not only makes it inconvenient to move the general range of equipment and machinery but makes it quite impossible to move heavy equipment in particular. Thus, in the interest of efficient operations, it will be essential to construct a new connecting road along with an exterior work area to integrate these functions organically with the docking facilities, repair jetty, shops, warehouses, and other parts of the complex.

Another essential requirement will be to provide a power and water supply for the actual operation of the various facilities and equipment.

We have outlined above the main types of facilities that will be required under the proposed plan and have charted below a general profile of the subject facilities, classified by existing vs. new facilities, as well as of the other related facilities.

Table 4.3 General Profile of Fishing Boat Repair Center Facilities

	Facilities	Existing Facilities	New Facilities	Remarks
1.	Iron Work's Shop		Steel Frame Slate Roofing 12m x 30m = 360 m	Overhead Travelling Crane 2 ton
2.	Generator House	100 KVA 1 unit 150 KVA 1 unit	Brick structure 12m x 6m = 72 sq. m	225 KVA 2 unit Compressor 2 unit
3	Bldg for Showers & Lavoratories	–	Brick structure 10m x 3m = 30 sq. m	
4	Machine shop	–	Steel Frame, Slate Roofing 12m x 30m = 360 sq. m	Overhead Travelling Crane 2 ton
5	Water Supply Facilities	–	25 TON Tank	Pumping equipment
6	Dock Facilities	300 TON Slipway 1 unit 800 TON Floating Dock 1 unit	500 TON Dry Dock 1 unit	Fixed Crane Dry Dock 1 unit Slipway 1 unit
7	Repairing Jetty	–	60 m Fixed Pile Jetty Type	Fixed Crane
8	Engine Repair Shop	Wooden one-story 12m x 30m = 360 sq. m	(to be improved)	
9	Electrical Repair Shop	Wooden one-story 12m x 30m = 360 sq. m	(to be improved)	
10	1. FRR Repair Shop 2. Mould Loft	Wooden one story 12m x 39m = 468 sq. m	(to be improved)	
11	Carpenter Shop	Wooden one-story 12m x 36m = 432 sq. m	–	
12	Administration Office	RC Two-stories 26m x 12m x 2 = 624 sq. m	–	
13	Office	Wooden one story 10m x 19m = 190 sq. m	–	
14	Connection Road	–	Concrete paving 5,200 sq. m	

4・3 Layout :

4・3・1 The Rationale Behind the Layout :

The existing building facilities were formerly used as a training school and as a small factory. After an expanding these facilities through the addition of oil tanks for the docking facility, an administration building, and a mooring jetty, PPFC commenced repair and inspection operations in October, 1982. Thus, from the outset, the facility complex was not necessarily arranged in a desirable way for fishing vessel repair work.

In order to organically organize the complex, which is now scattered over the site, and permit it to function as an integrated repair facility, we have made the following provisions in the subject Plan.

(1) A Smooth Flow of Materials:

Shipbuilding is an industry built on small production runs many kinds of products. Numerous materials and components must be handled, while shapes too vary widely. Particularly in a repair facility, the production flow becomes quite complex indeed.

Based on very careful consideration, we have attempted to assure a reciprocal flow of products by using a flow deployment pattern for the shops and machinery. We have provided simple lines of movement in the interest of greater efficiency.

(2) Capacity Balance between the Various Stages:

In the case of a repair facility, the work is quite varied. Thus, the facility must be designed to be able to cope fully with a wide range of conditions. In order to eliminate redundancies in the process flow, careful consideration must be given to capacity balance among these stages. We have, therefore, established buffer areas between stages and have planned each process to be somewhat independent of the others. We have also examined that plan with a view toward consolidating similar plant function.

(3) Coping with Future Changes:

We have developed a facility that will be able to respond flexibly to any future changes in plans. The facilities have a character than can be altered in response to changes in production scale or advances in operating techniques. While assuming that the facilities are able to respond to such conditions, we have also provided a site for such expansion.

Based on the field study, we encountered the following problems:

1) With the existing slipway office and administration building located at the center of the layout plan, we had to find another site on which to build the dry dock, and mooring facilities.

2) Which specific buildings among the existing structures, in terms of building usefulness and location, can be served as active parts of the complex?

3) Based on a consideration of the reciprocal relationships between the existing facilities and slipway which must be actively utilized, where were we likely to find a suitable piece of land on which to build the necessary shore facilities?

With regard to these various problem areas, by classifying the facilities into docking, mooring, and shore-repair types and then further classifying the repair functions into those that require docking and those that can be performed even while a vessel is berthed, we have developed the basic concept for the layout plan.

4・3・2 Block Plan:

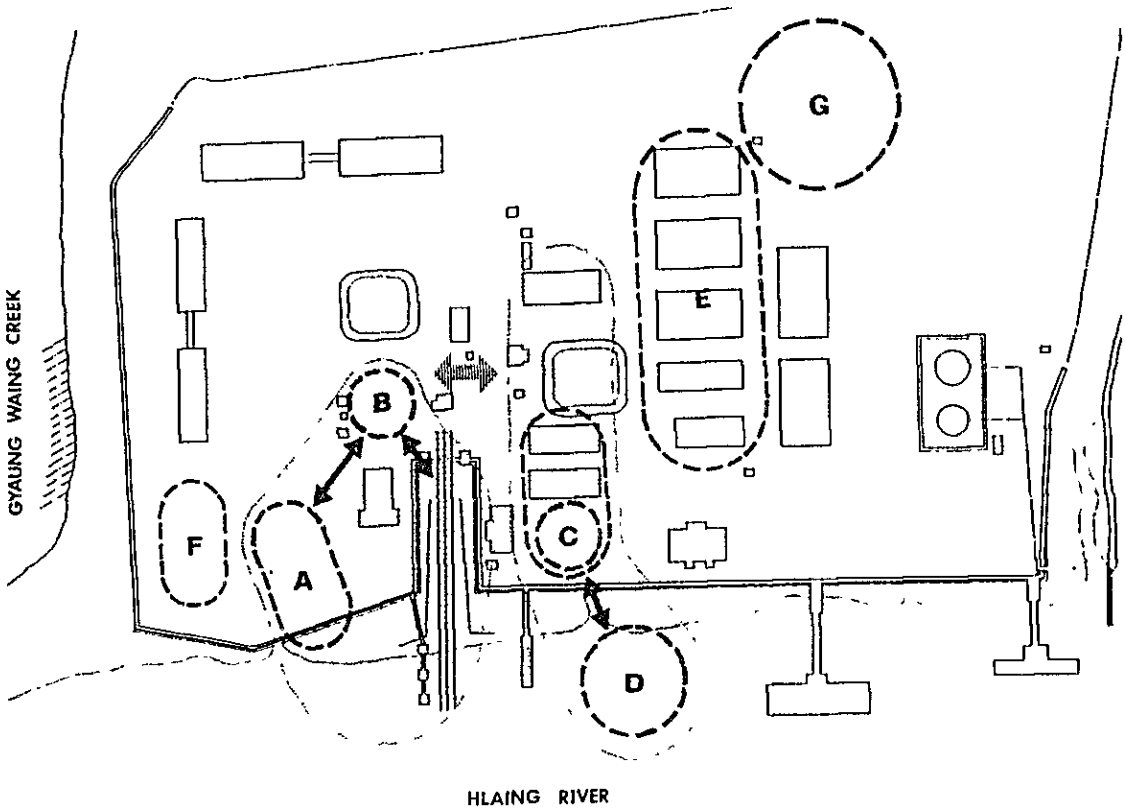


Chart 4.1 Block Plan

If we designate Area A, a relatively broad piece of available land along the Hlaing River, as the site for the dry dock, it becomes possible to locate the two docking facilities in parallel namely the existing slipway and dry dock in parallel alongside around the present Administration Building.

Adjacent Area B would be an ideal site for the iron works shop, which is to do exterior hull work that can only be performed at the docking facilities.

In the case of the machinery repair, engine repair, and electrical repair shops as well as other repair operations related to the vessel

engines which can be made during mooring, in order to keep the transportation for the many parts and materials as simple and as short as possible, the basic principle has been to site these facilities in the immediate vicinity of the repair jetty. If we locate this repair jetty in Area D between the existing pontoon jetty (1) and the fixed jetty, it will be possible to use the existing structures (2/3), which are relatively good quality buildings situated in the adjacent shore section (abutting Area D), as a part of the machinery repair facility.

If, in addition, we build a new machinery repair shop in Area C, which is directly in front of Area D, it will be possible to develop a facility complex that will permit organic functioning of the repair operations that can be performed without docking, such as those on the main and auxiliary engines, deck machinery, and fishing gear.

Area E can be dedicated, as at present, to the storage of repair parts and materials used for fishing operations.

By virtue of the above layout pattern, a basic structure has emerged for the functions of the new shops, in which the dry dock, slipway, mooring facilities, and the principal shore-based repair facilities are integrated around the Administration Building.

We have set aside Area F as a site for possible future expansion of the docking facilities or shops, while Area G has been targeted as a site for employee housing.

4・3・3 Facility Layout :

Chart 4.2 shows the overall facility layout plan. This plan organically joins the facility complex, with the addition of the carpentry and FRP repair operations, to the basic layout structure described above by means of an access road and an out-door work area and also includes energy-related facilities, such as those for power and water supply.

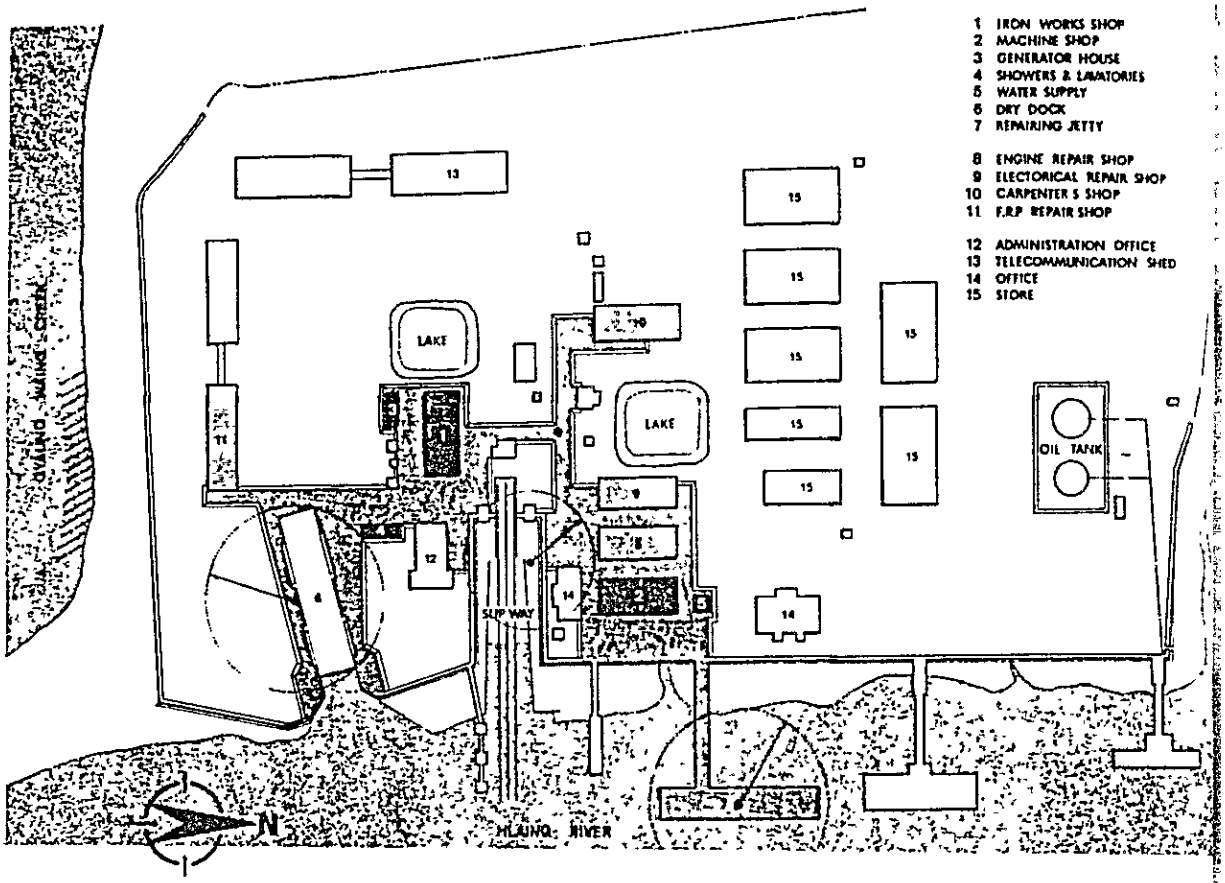


Chart 4.2 Layout Plan

4・4 Plans for the Dock and Repairing Facilities:

In this plan, the docking and repairing facilities are included in the waterfront construction works. The structural type and location of these facilities will have a major influence on workablity, maintenance, management, and the time and cost of construction.

In this Section, we have set the basic conditions for the facilities and carefully optimized the various alternative forms and structural types, selecting therefrom the most appropriate types for the implementation plan.

4・4・1 Docking Facilities :

The docking facilities are a vital and one of the most essential aspects of the repair complex. Various forms can be considered, depending on the logistics and the launching conditions of the vessels to be serviced, but in general the choice is among the dry dock, slipway, and floating dock types.

The floating type dock is not desirable from the standpoint of channel management, since the current flow in the planned site area is quite rapid, making mooring difficult, and is also a part of the navigating channel itself. It is for this reason that the present floating dock is moored several miles upstream, with a considerable effort required to move materials and manpower for the repair operations.

Since the floating dock is not suitable for the subject plan owing to the site conditions, it has been excluded from consideration.

Accordingly, the comparative analysis was confined to the dry dock and slipway type of facility. Evaluation of the dry dock and the slipway is shown in Table 4.4.

Table 4.4 Evaluation by Type of Docking Facilities

Type of Function		Dry Dock	Slipway
Docking & Undocking Operation	Safety	o	x
	Ease	o	x
Ship Repairing	Workability	o	Δ
	Safety	o	Δ
Running Cost		Δ	o
Maintenance	Siltation Problem	Δ	x
	Related Facility	Δ	o
Affection to Navigational Area		o	x
Construction	Cost	x	o
	Period	x	o

Note: 'o' and 'x' denote superiority and inferiority respectively between the two alternatives. In case of small difference, the 'Δ' mark is given.

While the dry dock is less advantageous than the slipway in terms of construction time and cost, it is distinctly superior in terms of docking and undocking operations and actual repair operations. The docking and undocking operations, in particular, must be carried out in a 5 knot current and so, with regard to the type of facility to be selected, we must clearly put priority on safety and ease of operation.

Also, in order to cater for the target vessels in the slipway, the extension of the slipway would be quite long, while, from the standpoint of facility arrangement in the repair yard, a considerable portion of the facility would protrude into the river channel. With the water fronting on the planned project site forming part of the navigating channel, the slipway type would not be desirable from the standpoint of channel management.

Based on the above analysis, we have selected the dry dock type as the docking facility to be employed in this project.

(1) Dry Dock:

We have planned the dry dock to cater for the larger vessels owned by PPFC, which are mainly in the 500 class, so that other PPFC vessels can be accommodated to the maximum extent possible.

1) Plan Conditions:

a) Vessels to be serviced:

The 533 and 535 vessel types, which are the representative fishing vessels in the 500 class, have the following particulars:

Gross Tonnage	331.63t
Net Tonnage	145.68t
Length O.A.	40.65m
Breadth	8.50m
Depth	3.70m
Draft (Full Load)	3.35m
Draft (Light weight, stem)	1.36m
Draft (Light weight, stern)	3.56m
Light Ship	392.96t

Among the vessels other than fishing vessels in the PPFC fleet, the largest, we believe, is the 801 class tanker, with the following particulars:

Gross Tonnage	500 t
Net Tonnage	275 t
Length O.A.	54.31m
Breadth	11.00m
Depth	4.10m
Draft (Full Load)	3.50m
Draft (Light weight, stem)	2.32m
Draft (Light weight, stern)	3.35m
Light Ship	404.4 t

Thus, if we gear the dry dock facility to these two vessel types, it will be possible to accommodate virtually the entire PPFC fleet.

b) Tidal Conditions:

The Hlaing River, which flows fast the planned dry dock site, is subject to considerable tidal variation, with the tidal range exceeding 6 m. Even if we assume that vessels will be docked and undocked only during periods of high tide, we nevertheless insuring vessel access without regard to tidal conditions make a design tide level low excessively.

However, if the design tide level is made low enough to permit 100% access, the cross-section becomes uneconomical. Accordingly, we have based our plans on the assumption that the design tide level to cater for the target vessels can be expected during at least 80% of the year.

Table 4.6 shows a number of days on which tide level exceeds an arbitrary height above the datum level. Tide level for the design of the dry dock is determined as 5.0 meters above the datum level which obtained on 316.5 days (87%) of the year.

Table 4.5 Number of days of low tide

Tide Level \ Month	1	2	3	4	5	6	7	8	9	10	11	12	Total	%
(m)	(day)													
0.5 >	9.5	9.0	8.5	2.0	0	0	0	0	0	0	3.0	3.0	32.0	9%
1.0 >	21.5	16.0	19.0	18.0	14.5	2.5	0	0	0	1.5	14.5	20.5	128.0	35%
1.5 >	26.5	22.5	25.5	24.5	24.5	21.0	12.5	5.5	10.0	16.5	23.5	31.0	243.5	67%
2.0 >	31.0	25.5	29.0	28.0	31.0	22.5	22.5	20.0	21.0	23.5	30.0	31.0	320.0	88%
2.5 >	31.0	28.0	31.0	30.0	31.0	30.0	27.5	26.5	26.5	27.5	30.0	31.0	350.0	96%
3.0 >	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0	365.0	100%

Recorded at Rangoon Port

Table 4.6 Number of days of high tide

Tide Level \ Month	1	2	3	4	5	6	7	8	9	10	11	12	Total	%
(m)														
4.0 <	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0	365	100%
4.5 <	29.5	24.5	28.5	27.5	31.0	30.0	31.0	31.0	30.0	31.0	29.5	30.0	353.5	97%
5.0 <	24.0	20.5	23.0	22.5	25.5	29.0	31.0	30.0	30.0	28.0	26.5	26.5	316.5	87%
5.5 <	16.5	15.0	17.5	16.5	21.0	21.0	24.5	25.5	29.5	23.5	19.5	18.5	247.5	68%
6.0 <	5.0	8.0	8.5	7.5	11.0	10.0	13.0	19.5	22.5	27.5	12.0	8.0	152.5	42%

Recorded at Rangoon Port

2) The Fundamentals of the Dry Dock Plan:

a) Dock Size:

The proposed size of the dry dock has been designed as follows, with a slight safety margin beyond the requirements of the 801 tanker vessel:

Length	60.00 m
Width	14.00 m

b) Crown Height:

This dimension has been set with a safety margin of 0.5 m to allow for the effect of wave action on the water level D.L. +6.98, which is the highest tidal level experienced at Monkey Point over the past 10 years:

Required Crown Height = 6.98 + 0.5 m = D.L. +7.50 m

Accordingly, the required crown height has been set at D.L. + 7.50 m.

c) Elevation of the Dock Floor:

The elevation of the dock floor has been calculated by subtracting the maximum draft of the target vessel, the keel block height, and a safety margin from the design tide level of D.L. + 5.0 m for docking and undocking.

The maximum draft in light weight condition has been set at 3.56 m for the 533/535 vessels, the keel block height at 1.20 m, and the reserve height at 0.20 m. On this basis, the dock elevation becomes:

Required dock elevation: 5.0 m - 3.56 m - 1.20 m - 0.20m ≒ D.L. ± 0.0 m

A tidal level used for the design can be expected on 87% of the days of the year. Thus, if docking and undocking operation is confined only to days of spring tide, there will be a considerable margin of safety.

d) Access Channel Depth:

The planned target site is in a swampy area formed by sediment provided from the many tributaries of the Irrawadi River. Particular after the monsoons, siltation caused by a large quantity of sediment can reach as high as 10 - 30 cm per year in high areas, in the certain area along the river basin. Elimination of this siltation is a very critical element in the maintenance and operation of the dry dock.

In our plan, we have attempted to provide a elevation of channel bottom which can be maintained and controlled by manpower only, without having to rely on machinery such as a dredger and a dredging pump.

The required bottom elevation of the access channel is calculated as follows.

5.0 m	-	3.56 m	-	0.6 m	-	0.3 m
(Design Tide Level)		(Design Maximum Draft)		(Design Maximum Sediment Deposition)		(Safety Margin)

= 0.54 m = D.L. + 0.5 m

Table 4.4 shows a number of days a year in which tide level become below an arbitrary elevation above the datum level. Frequency of a tide level less than 0.5 m occupies 9% of a year. Additionally, a tide level less than 1.0 m, which corresponds to 0.5 m water depth on the bottom of D.L. + 0.5

m, occurs 35% of a year. It means that sufficient workable days are available for a maintenance of the channel bottom by manpower only. Therefore, the bottom elevation of the access channel is determined as D.L. + 0.5 m.

e) Structural Type of the Dry Dock:

With respect to the foundation conditions in the area of the proposed construction site for the dry dock, the soft foundation layer, with a low N value, is distributed on the average over 12 m according to the bore hole test, so that the foundation conditions of subsoil are by no means good. Basically, two kinds of construction method are proposed to settle a soft soil problem, which are with and without an improvement of the soft soil.

As a construction method involving improvement of the foundation, we may consider a method of soft soil replacement and a soil consolidation method which is represented by a preloading method, a sand-drain method, and a sand compaction method.

However, in all of these techniques, there are problems with cost, extended periods of construction, and local procurement of equipments. Thus, our plan chooses a structural shape that leaves the foundation unimproved.

As a structural type which can be employed without soil improvement, the pile type structure can be considered as being most suitable to the planned site. Under this method, the piles are driven down to a solid bearing foundation so as to eliminate any influence from the soft soil layer, with the overhead load then communicated to the foundation.

For a type of the dock wall, we have considered a L-shaped concrete walls and a sheet pile type wall. Regardless of the type employed, it will be necessary to place a sheet pile for cutting off ground water so as to reduce the up-lifting force

which acts to the dock. Therefore, the sheet pile type construction is more suitable to form the dock wall than the L-shaped concrete type.

From the standpoint of ease of construction cost and time, we feel that the sheet pile wall type would be advantageous. Accordingly, we have designated this type of construction for the dock walls.

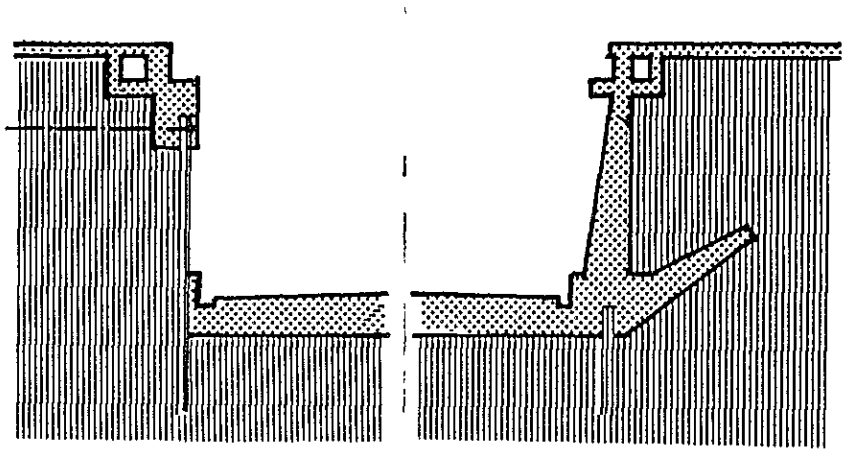


Chart 4.3 Sheet pile type wall L-shaped concrete wall

f) Structural Type of the Dock Gate:

The following three types of gates can be considered for use in the dry dock:

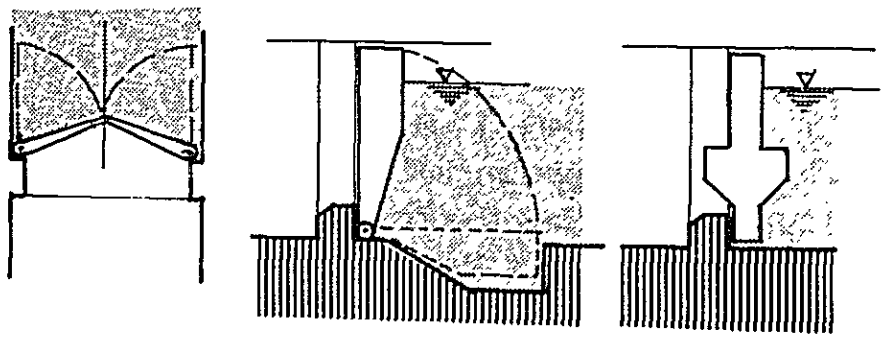


Chart 4.4 Miter gate Flap gate Floating gate

The floating gate has advantages relating to the unequal subsidance of the gate portion of the dry dock as well as the fact that it would have little impact on siltation. However, when we consider the big tidal range in the area and the matter of stability during low tides as well as the complexity and time-consuming operations associated with the floating gate, we feel that this type gate would be inappropriate.

The miter and flap gates have almost the same characteristics. . In the former, a synchronized mechanism is required for opening and closing operations because of the dual doors, while higher precision is called for in the construction of the hinge portion. In addition, in terms of the effect of the deposited sediment in front of the gate, this type would be more sensitive than the flap type. Accordingly, we have selected the flap gate with electrical and manual operation arrangement for this plan.

4・4・2 Repairing Facilities:

The repairing facility, like the docking facility, is a most important part of the repair complex. The type of repair facility, together with dimensions and other specifications, have been determined on the basis of careful consideration of the vessels to be accommodated, the site logistics, the conditions of the river bathymetry.

Generally speaking, two types of facility can be considered for our purposes: a pontoon type, which can adapt also to changes in tidal levels, and a fixed jetty type.

In an area like the subject area, subject to large changes in tide levels, one would assume that the pontoon type would be more advantageous. But, considering the problem of anchoring in a strong current as well as various maintenance operation, such as the ease or difficulty of restorative work after a disaster and the need for in-dock maintenance inspections every 1-2 years, we have determined that it would be better to use the fixed jetty type in the planned facility, owing to its relative ease of maintenance.

1) The Repairing Jetty:

The plan conditions, type, and dimensions of the jetty have been determined on the basis of the current vessel mooring patterns, the types of vessels owned, and the logistics at PPFC.

(1) Basic Conditions:

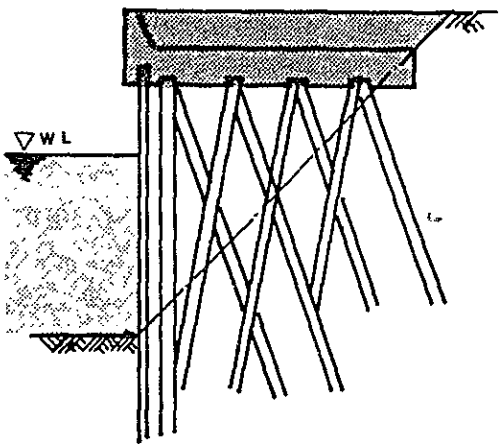
a) Target Vessels:

As in the case of the dry dock, the target vessels will be the 533/535 fishing vessels and the 801 tanker, the largest and widest vessel in the PPFC fleet.

b) Structural Type of the Facility:

Generally speaking, two structural types are used for fixed jetties: 1) the reclaimed type and 2) the pile jetty type. In the vicinity of the proposed construction site, there is, depending on the tide, a strong current of over 5 knots, so that, if a land-fill type were to be used, there is a strong likelihood that it would interfere with present flow patterns and also have an adverse impact on the bathymetry of the immediate area.

Accordingly, we have specified the pile jetty type out of consideration for the small impact it would have on current flow.



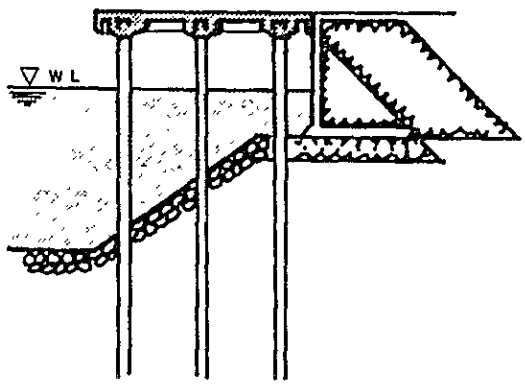


Chart 4.5 Reclaimed type Pile jetty type

(2) The Fundamentals of the Repairing Jetty Plan:

a) Required Jetty Length:

The total length of a jetty used for repairing should normally have a capability about double the repair capacity of the docking facility. There are planal constraints arising from the fact that the jetty is to be built between the existing slipway and pontoon, but we have provided for a jetty length of 60.0 m, which would be capable of accommodating either the largest fishing vessel in the PPFC fleet or the 801 tanker. This length would also be sufficient to accommodate simultaneously 2 of the 400-series fishing vessels.

If additional mooring space is considered offshore of moored vessels, capacity would be doubled, so that the required capacity conditions are almost fulfilled.

b) Required Jetty Width:

The conditions affecting the required jetty width include: repairing operations on the jetty, the tentative storage space for materials, and the movement patterns for transport vehicles.

Based on the operation of a forklift of 2-5 tons and a truck of 2 tons, the required width becomes:

1. Passing width:

1.5	+	2.0	+	1.0	+	(2 x 2)	=	8.5 m
(5 ton fork lift)		(2 ton truck)		(center safety margin)		(side safety margins)		

2. Minimum turning width:

(3 x 2)	+	(2 x 2)	= 10 m
(minimum turning radius for the truck)		(side safety margins)	

Accordingly, the width of the mooring repair jetty has been set at 10 m.

c) Required Jetty Depth:

Required Jetty Depth has been set at a sum of a draft in full load condition of the target vessel and safety margin.

Full load draft:	3.71 m
Safety margin:	0.30 m
Jetty depth:	D.L. - 4.0 m

d) Crown Height:

Based on the highest high water level and wave height in the last 10 years we have set the crown height of the jetty, as in the case of the crown height of the dry dock, at D.L. + 7.50 m.

e) Offshore Distance and an Access Bridge:

Since the water directly in front of the subject site is all part of the navigational channel, the distance of the jetty from shore must be held to a minimum, while the required depth should be obtainable with maintenance dredging.

Based on bathymetric charts for the area, we have set the distance from the revetment to the front of the jetty at 55 m. The jetty and shore are to be linked by an access bridge. The width of access bridge has been set at 4 m, after allowing for the operation of transport vehicles and the movement of the workers. The bridge will be of pile jetty construction, as in the case of the jetty itself.

4・5 Shore Facility Plan :

4・5・1 Basis of the Unit Plan:

The basic design plan for the various facilities has been drawn up on the basis of the following guidelines.

(1) Establishment of the Floor Plan:

With regard to the establishment of the floor plan, when this could be based on specific case studies or standards, we did so, but, when such cases or standards were not available, we made our determinations through trial placements taking into consideration such factors a machine parts to be accommodated in the repair facility unit, the size of materials to be fabricated from these parts, and the movement of both men and materials.

(2) Establishment of Cross-Section:

With regard to the heights of floors and roofs and other cross-sectional scope, we based our considerations on the specific operations, function and equipment to be handled at the facility, on the basis of material dimensions, as well as the customary height of ceilings in Burma.

(3) Establishment of Structural Types:

Structural types were established by incorporating the building performance required for the respective facility unit as well as the conditions in Burma regarding the materials. Another factor influencing our decision was the desire to shorten construction time for the project.

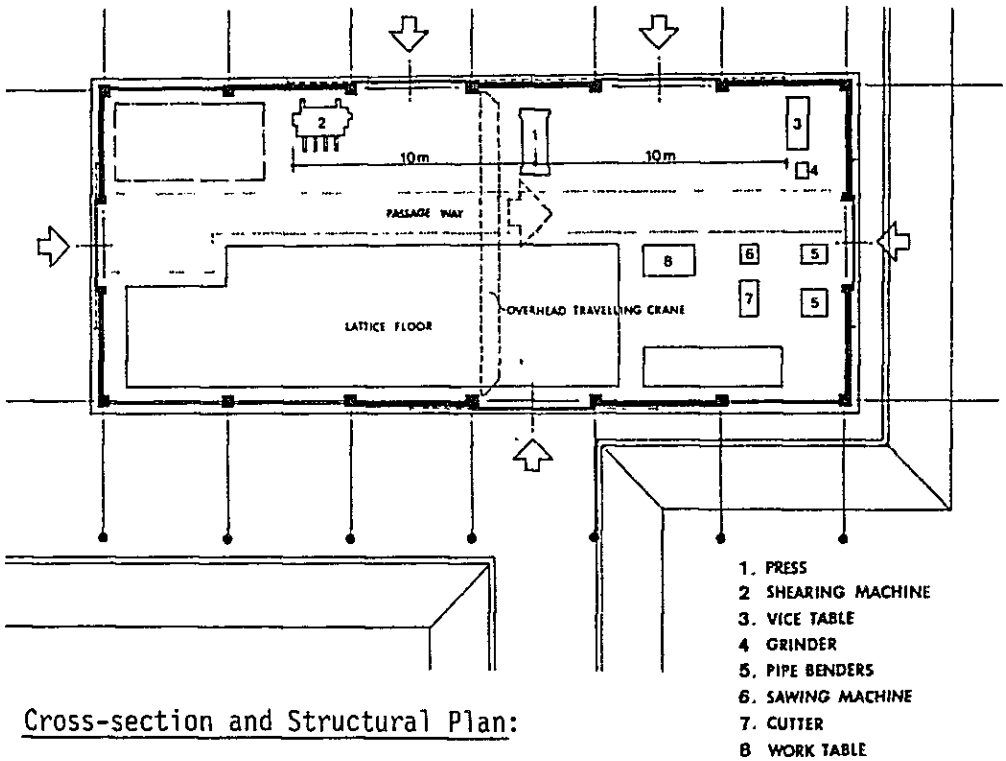
4・5・2 Iron Work's Shop:

Floor Plan

This facility is to have a combination of functions, including hull processing, assembly operations, and the fabrication of steel riggings. As a result, the main equipment will be hydraulic presses, shearings machine and a lattice floor.

With regard to the lattice floor, we shall consider the space used to mark, cut, and assemble 3 standard steel sheets of 1.5 x 6.0 m as one "unit" and make it possible for 3 such "units" to be combined for large-scale operations. On this basis, the dimensions of the lattice floor have been set at 5.0 m x 20.0 m.

With respect to the presses, based on the size of materials to be fabricated as well as the movement of personnel, we see the need for a space of about 10 m length for both sides of press machine. The shearing, sawing machine, drill press, and work tables will basically be arranged around the press and lattice floor. On this basis, we decided on a floor plan of 12 m x 30 m (360 sq.m)



Cross-section and Structural Plan:

There is a need for an overhead traveling crane capable of a relatively fast traveling speed in order to transport, sort and handle steel materials within the shop. Considering the size of these fabricated materials as well as the height of the installed fabricating equipment, we have set 5.0 m as the height from the floor to the lowest edge of the crane and 6.0 m as the ceiling height.

With respect to the type of structure, considering that it will be necessary to use a relatively long span of 12 m and that the above crane will be traveling overhead, a steel rigid frame construction would be optimum, and this type would also meet the constraints of an abbreviated construction time.

Sectional Plan:

In considering the plans for the various parts of the building, the natural and sociological conditions that must be borne in mind may be summarized as follows:

... There is a long period of hot, and high humidity weather.

... Sometimes a large amount of rainfall is concentrated in a very short period.

... There is a chronic shortage of key materials and a limited construction season.

Based on the above considerations, we shall now examine the building plan by section:

(1) Roof:

In our field survey, we saw almost no instances of flat roofs, most of the roofs were hipped or gable. Roofing materials comprise 3 main types: thatched, as seen in many private homes; asbestos slate, as seen in numerous buildings; and corrugated steel sheets, which were found common.

In the subject plan, after giving due consideration to heat resistance, durability, and the characteristics of the shop building, we have specified the use of asbestos slate, which is relatively easy to procure locally. However, with this material, special care must be taken to provide proper ventilation through ceiling.

(2) Exterior Walls:

With regard to the exterior walls, brick walls, which were the predominant type seen in our field survey, are not only well adapted to the natural environment but are relatively easy to obtain locally.

For these reasons, this type of brick wall has been specified liberally in the plan facilities. However, since the subject building has a high height of eaves, there would be serious structural problems in laying brick up to a height of some 6 m. In addition, given the wide brick area, there is a possibility that this type of wall might create time pressures in terms of the short building season. For these reasons, we have decided to use brick only for the dado (from ground level to about 1.5 m), with asbestos slate ply to be used for the upper sections.

(3) Openings:

Most workshops tend to shut themselves off from the surrounding areas to the maximum extent possible. The openings is kept as small as possible, while the loading side of the building is opened.

In the present structure as well, the loading entrance will be left as open as possible through the use of a sliding steel door.

As to the windows, given the factory-type functions of the building, we have specified jalousie windows. At the same time, from the standpoint of sunlight, which is another element in window design, we have tried our best to maximize the use of natural sun-light. In this plan, therefore, we have obtained a 20% area ratio with the side walls and a 30% ratio with the roof top-light.

(4) Floors and Interior Finishing:

With respect to the floors, from the standpoint of the type of operation to be performed, we have specified mortar steel trowel, with concrete slab as the foundation.

As to interior materials, these will be unnecessary, for the roof, while, for interior walls, cement mortar steel trowel finish will be sufficient for dado portion.

(5) Ventilation:

The electrical welding, gas cutting, and heat bending operations will give rise to noxious fumes and dust within the shop.

The ventilating system must eliminate these noxious elements and permit the work to be carried out safely and efficiently.

There are two basic types of ventilation system: natural and forced ventilation. Since the subject building will be well endowed with top windows, side windows, door openings and a roof fan have selected the natural ventilating method, utilizing on differences in air pressure and temperature.

4・5・3 Machine Shop:

Floor Plan:

The Machine Shop will be equipped with the following types of equipment.

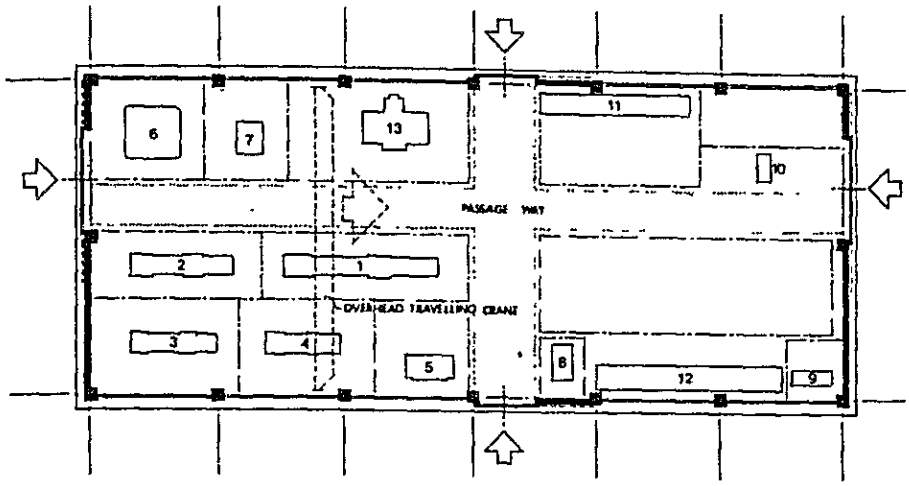
1.	Lathe (4.0 M.)	1 unit
2.	" (1.5 M.)	1 unit
3.	" (1.5 M. present available)	1 unit
4.	" (2.0 M. " ")	1 unit
5.	Tool Grinding Machine	1 unit
6.	Radial Drilling Machine	1 unit
7.	Shaping Machine	1 unit
8.	Drill Press	1 unit
9.	Grinder	1 unit
10.	Sawing Machine	1 unit
11.	Tools & Tools Shelves	1 unit
12.	Vice	1 unit
13.	Milling Machine	1 unit

The operations in this plant will include primarily the fabrication of components related to the equipment for vessel processing partial fabrication of riggings, and the making of such other items as bolts, pins, and flanges.

The main emphasis will be on the fabrication of heavy items, such as large components related to the shaft propeller, stern frame and repairs on pipe fittings.

We have calculated the working space requirements for each of the above items and have placed the machines on both sides, in consideration of the movement of material and a path of flow in a lengthwise direction. At the same time, since this facility will be reciprocally linked to the engine repair and electrical repair shop buildings, we will plan a path of flow in the short direction and will set aside a working tables and a store of various hand tools.

The layout plan will be as shown in the following diagram. We have calculated the required floor area as 12.0 m x30.0 m(360 sq.m) the same as for the iron work's shop.



1 LATHE
2 LATHE
3 LATHE
4 LATHE
5 TOOL GRINDER
6 RADIAL DRILLING MACHINE
7 SHAPER
8. DRILL PRESS
9. GRINDER
10 SAWING MACHINE
11 TOOL & TOOL SHELVES
12 VICE TABLE
13 MILLING MACHINE

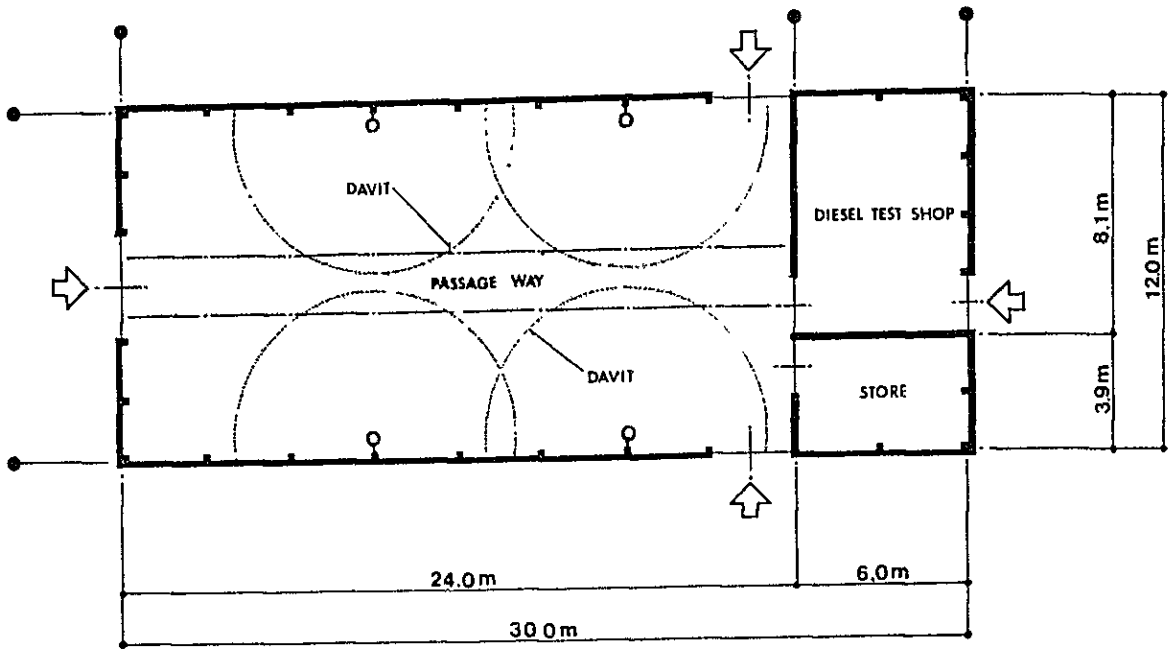
4・5・4 Engine Repair Shop:

We have examined the functions and size of existing building (2), as shown in Section 4.3.2, with a view to dedicating this for use as the engine repair shop and have established that this structure will be quite adequate for this purpose from both a space and performance standpoint.

We present below a general outline of the facilities surveyed, with a plan for partial modifications in certain areas of the building.

As per the attached diagram, the required area is 30 m x 12.2 m (366 sq.m). There are 10 spans of 3 m each lengthwise and 5 spans widthwise of which the center span is about 4 m and delivery and shipment of components are via both entrances.

The building is wooden structure, with brick walls. The floor is concrete slab, the roof, made of wooden trusses, is gable style with asbestos slate ply, while ceiling height is 5 m.



ENGINE REPAIR SHOP

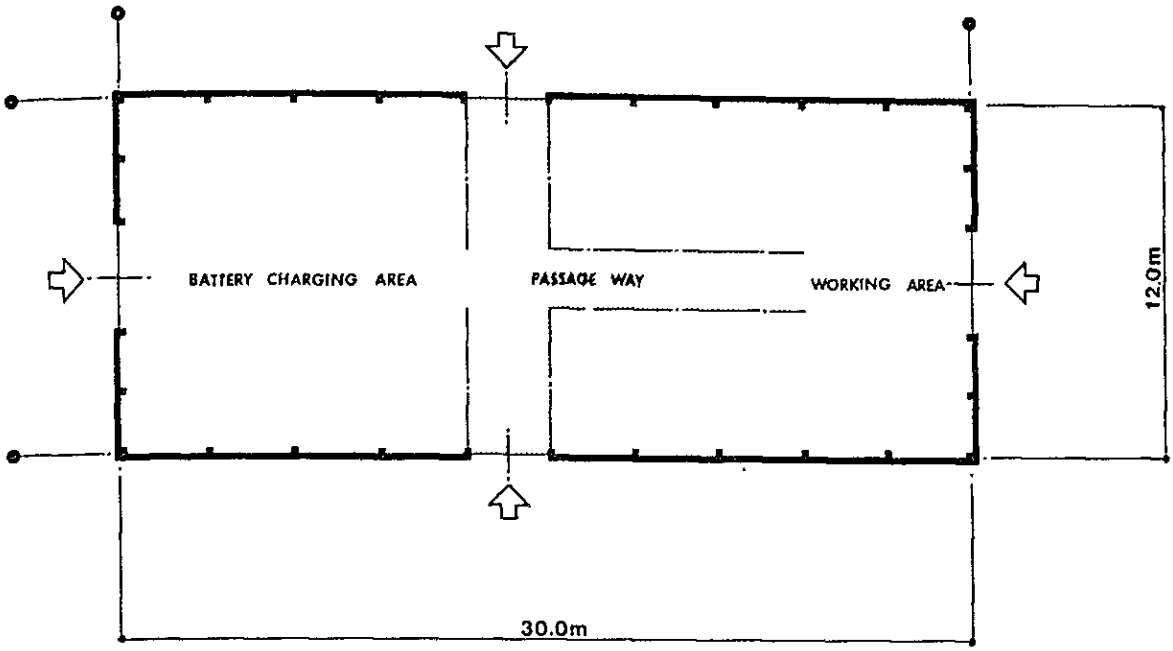
This existing building can be utilized as the engine repair area by prividing small handling and repair equipment in an area of 24 m x 12.2 m (≒ 290 sq.m)

By partioning off 2 spans on the right side, we have created a 6 m x 8.1 m (48.6 sq.m) area to be used for diesel test shop with air-conditioner and a 4.1 x 6 m (24.6 sq.m) to serve as a warehouse.

4・5・5 Electrical Repair Shop:

Existing building (3) would be used for the electrical repair shop. This building has specifications almost identical to those of Building (2), and an examination confirmed that it has adequate space to serve as an engine repair facility.

The plan is to allocate the entire floor of this building for electrical work. The main activities will be the wiring and rewinding of cables on electrical motors and the recharging of batteries. The floor plan is shown below.



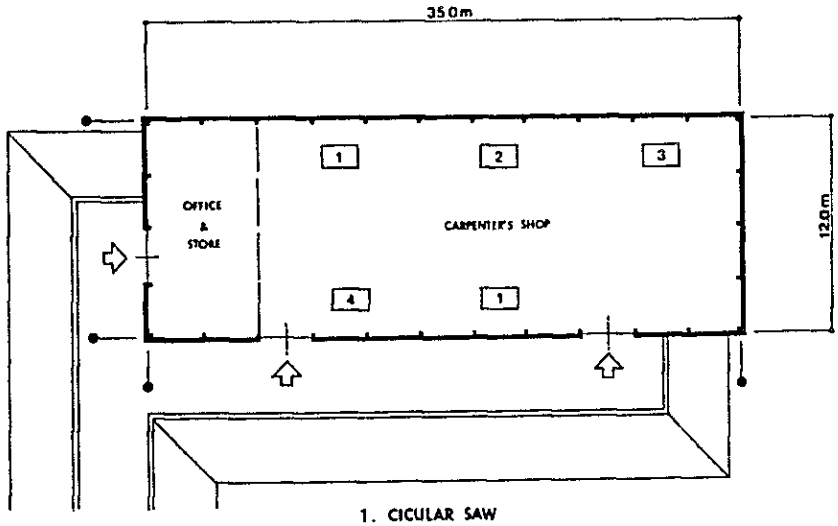
ELECTRICAL REPAIR SHOP

4・5・6 Carpenter Shop:

The plan is to use Building (4) (cf. Section 4.3.2) as the carpenter shop.

This building is already being used for this purpose and has ample space of 12 m x 36 m (432 sq.m). Accordingly, if the required equipment is provided, it can function superbly for this purpose without modification.

The floor plan is as shown below.



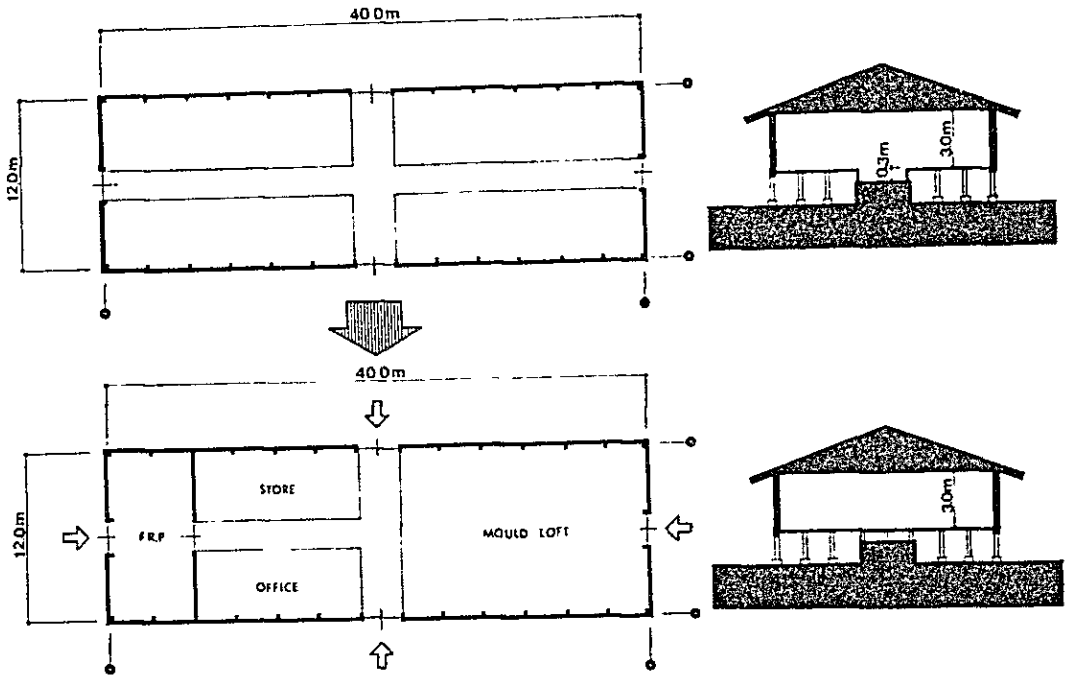
1. CICULAR SAW
2 LATHE
3 TENONING MACHINE
4. PLANER

CARPENTER'S SHOP

4・5・7 The F.R.P. Repair Shop and the Mould Loft:

Existing building (5) would be used as the F.R.P. repair shop and the mould loft.

This structure is not used very much at present PPFC has a plan to use the creek in the rear of the building as a site for a mud dock for small wooden vessels. A logical standpoint, the building is situated very close to the main shop building cluster to the south, and with its characteristics that is, this structure could, we feel, with partial remodeling, provide ample space and capabilities for use as a facility to store F.R.P. materials and treat minor parts and as a space for wooden boat's mould loft.



MOULD LOFT & FRP REPAIR SHOP

The present condition of the subject building is as shown in the upper diagram. In the center are concrete slab pathways crossing. There is a wooden floor raised about 0.3 m. This is a one-story wooden building with a ceiling height of 3.0 m above the wooden floor, with a partitioned area made from the two spans of 6.0mx 12.0m(72.0 sq.m) on the left side. This patitioned area will be used as the F.R.P. repair area and, as shown in the cross-sectional diagram, we have planned wooden floors, with all rooms to be at the same level, with lumber posts on the concrete slab.

However, the high temperature and humidity in this partitioned room make it inappropriate for use as an F.R.P. repair shop in view of the characteristics of F.R.P. We will, therefore, use air-tight windows and doors and avoid direct sunlight. Insulation repairs will be made on the walls and ceilings, and air conditioning will be installed so as to hold the temperature to no more than 20 degrees C and the humnidity to no more than 60 per cent.

Most of the F.R.P. repairs will be done on or alongside the vessel. This area will involve light processing activity, including such items as hatch covers, plates, and other-similar small components. It will also serve as a storage area for repair tools and materials.

There will be another partitioned area on the right of 18.0 m x 12.0 m (216.0 sq.m), which will have a level-floor with lumber posts. This area will be used as the mould loft for the small wooden vessels.

The width of the mould loft area is normally slightly larger than the height from baseline to the top of the bow chock. Even when servicing the largest 500 GT class vessels,

8.5 m	+	1.5 x 2 m	=	11.5 m
(height)		(margin)		

Accordingly, if we allow 12 m, a layout becomes possible. This figure should be more than enough, since the area will be geared to accommodate the small wooden vessels.

The required length will be 0.5 m by two over vessel width and should permit fairing operations, for lines and shear plans at stem and stern along with a margin. However, in the case of a design 1/2 the above size would be adequate. Accordingly, the required length for the largest 500 GT class vessel can be calculated as:

(8.6m	+	0.5 x 2 + 2m	+ 14.1m	+	7.8m	+ 2m)	x1/2
(width)		(margin)	(stern)		(stem)	(margin)	

=17.75 m

Accordingly, a length of 18 m would be quite sufficient.

With regard to the rest of the space, as shown in the plan, it would be appropriate to use this for offices and warehouses along the entrances and passageway.

4・5・8 Generator House:

This facility will contain the generator and compressor. since the area will furnish compressed air and power through the piping and wiring to the various shops, dry dock, repairing jetty, and other main facilities, we wish to locate this facility close to these other facilities. On the other hand, this facility will be quite noisy and, for this reason, should properly be isolated from the other facilities.

The layout plan was determined on the basis of a careful consideration of these seemingly conflicting conditions. For planning the building, we have put priority on noise suppression and insulation and have specified an asbestos slate roof with brick walls and reinforced concrete structure construction.

As the plan, we have arranged the 2 new generators and the 2 existing generators (4 units in all) in parallel within a 6 m width. Including repair and inspection space, the total space allocation is 6m x 9m(54.0 sq.m). There is an additional requirement for 6m x 3m (18.0 sq.m) room to house the 2 compressors and 2 reserve tanks.

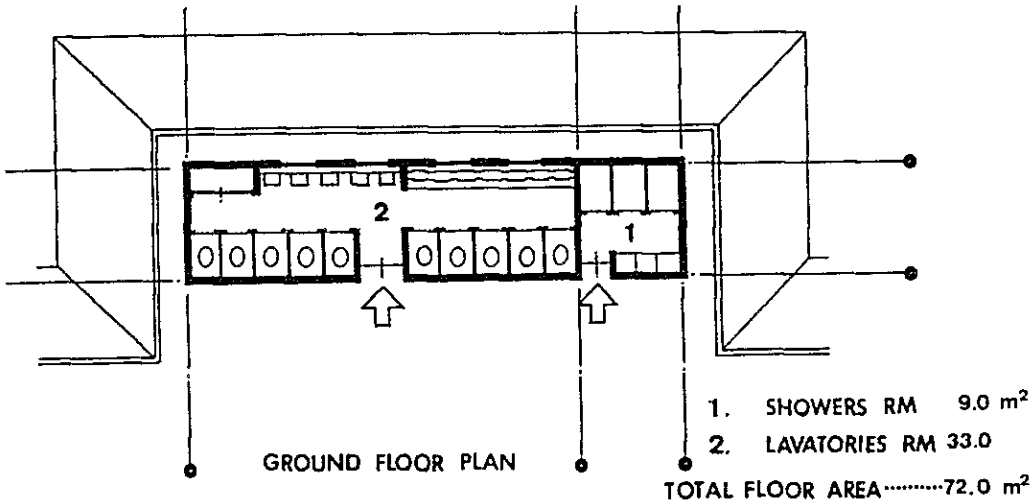
The total building area is set as 12.0m x 6.0m (72.0 sq.m).

4・5・9 Shower and Lavatory Building:

The total number of employees in the planned complex will total 550 persons, of which 51 will be permanent staffs, 240 temparatory staffs, and 260 dairy wages staff. With the bulk of the staff to be composed of dairy wages staff, the split between males and females will constantly fluctuate.

Accordingly, taking into account comparable field surveys we have done as well as typical factory ratios, we have set the male-female ratio for this complex at 8-2 respectively. Pursuant to this decision, and based on the Architectural Planning Information edited by the Nippon Kenchiku Gakkai (Japan Architects Society), we calculate that, for the 440 males, we will need 5 urinals and 5 toilets and, for the 111 females, 5 toilets. In addition, we will provide 5 communal wash basins for use by both sexes.

After adding auxiliary shower rooms, we obtain the total area shown below. We have specified an asbestos slate roof on a brick wall, with light steel members.



Even when completing this facility, it has been established that the present staff should be capable of operating the new complex. Thus, the 4 toilets and 2 urinals in the present office building would meet the needs of the very small number of office workers and visitors. There are a small number of additional toilets presently scattered over the other facilities but we should not that the installations in the present facilities have not been included in the above requirements.

4・5・10 Connecting Road:

As previously discussed, almost all of the building site is innundated during high tide, making it difficult to provide an adequate connection between the buildings. This would be a major obstacle to the efficient functioning of the complex.

There is, therefore, a requirement for a connecting road tying together the facility complex and for an exterior work space in the vicinity of the facilities to raise the foundation level of the buildings and their surrounding areas by + 7.5 m from the D.L. (i.e., +1.2 m above the average ground level).

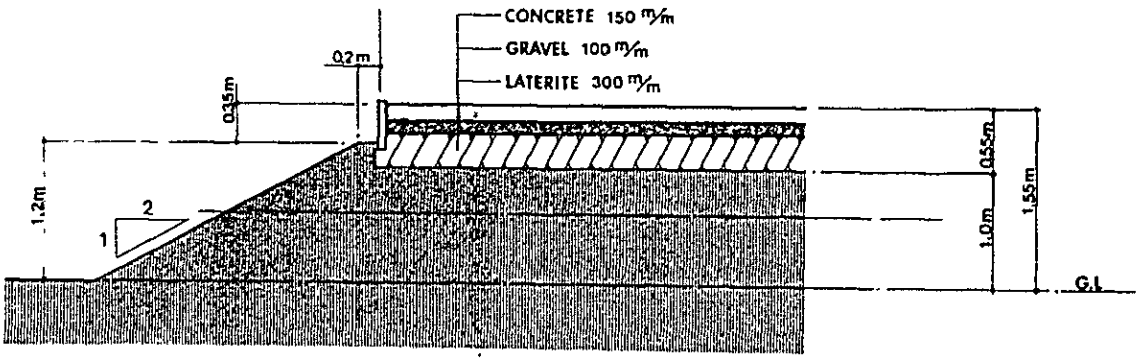
The work space along the connecting road will also have to be paved to permit transport vehicles to operate smoothly.

The total area to be filled is 5,100sq.m. Of this total, 4.500 sq.m will be paved and this area is to be raised +1.0 m from the present average ground level, and upon this ground to be placed a roughly 0.3 m thickness with laterite.

After adequately compacting 1.0 m of gravel on top of this laterite surface, concrete paving will be applied in a thickness of 150 mm.

The remaining area of about 600 sq.m will be raised about 1.2 m, with a particular need for adequate compacting in the banked section.

Following is a summary of the cross section filling and paving requirements.



4・6 Structural Design:

4・6・1 Applicable Standards:

In Burma, there are no specific structural standards other than those covering anti-earthquake design. In general, the country follows British standards, but these are no compulsory. The applicable standards in this plan have been left to our responsibility and judgement.

As a result, in this Plan, we have, in principle, used Japanese standards governing design methods and load factors. Specifications for construction materials follow, for the most part, British standards. Concrete stress tests, in particularly, are generally 180 kg/sq.cm, with 28-day strength; the 210 kg/sq.cm standard is only rarely used. The Construction Corporation has established the following basic values for long-term tolerance:

Compressive unit stress in bending	750 psi (54.0 kg/sq.cm)
Compressive unit stress	570 psi (41.0 kg/sq.cm)
Shearing unit stress	75 psi (5.4 kg/sq.cm)
Average bond unit stress	90 psi (6.5 kg/sq.cm)
Local bond unit stress	135 psi (9.7 kg/sq.cm)

4・6・2 Earthquake Intensity:

International standards are only now being developed in Burma for seismology and earthquake resistance. In 1970, as a result of a major earthquake resistance. In 1970, as a result of a major earthquake in the Rangoon area, which caused extensive damage, the Burmese Government asked the Government of Japan to dispatch experts in seismology and earthquake resistance. In response to this request, a Japanese seismological mission was sent, which produced a report designed to encourage the development of earthquake science in Burma. But the fact remains that governing standards have not yet been established on a national basis.

We feel it would be most appropriate for earthquake design for the subject facility to follow the anti-earthquake standards laid down in

the report by the 1970 Japanese mission. This report may be summarized as follows:

Draft Earthquake Standards for Burma (Extract)

Anti-earthquake design coefficient (design earthquake intensity)

1. Horizontal design earthquake intensity is determined by the following formula:

   $KH = n_1 \cdot n_2 \cdot n_3 \cdot k$

   where:

   KH = design earthquake intensity

   n_1 = earthquake area coefficient (shown in the area on the following chart)

   n_2 = basic type coefficient (as shown in the following chart)

   n_3 = weight (use) coefficient (cf. table)

   k = standard design earthquake intensity (= 0.1)

2. Generally, vertical earthquake intensity can be ignored.

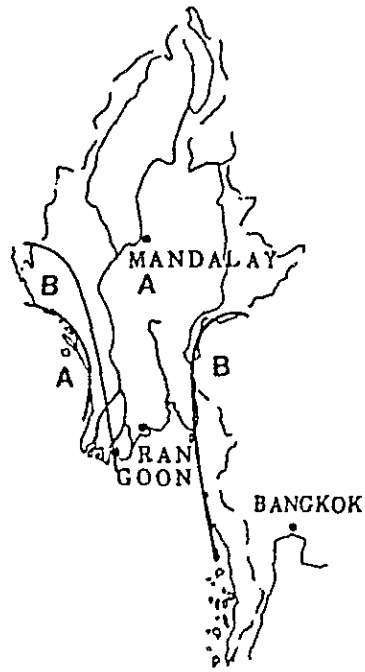
Coefficient by Foundation

Classification	Condition of Foundation	n_2
1	(1) Tertiary or older stratum (stone foundation) (2) Oiluvium of 10m or less thickness over rock base	0.9
2	(1) Oiluvium of 10m or over thickness over rock base (2) Alluvium of 10m or less thickness over rock base	1.0
3	Alluvium of a thickness of 10m or less	1.1
4	Other stratum	1.2

Eatehquake coefficient
by sector

Sector	n_1
A	1.0
B	0.7

Earthquake area
breakdown



Coefficient of Importance

Type of Structure		n_3
Public buildings		1.3
	Reinforced concrete	1.0
	Brick structure	0.5
	Wood structure	0
Dams		1.5
Bridge		1.0
Port and harbor structures		1.0

The design earthquake intensity for the subject facility may be derived from the above formula.

With $n_1 = 1.0$ (Section A)

$n_2 = 1.2$ (Group 4)

$n_3 = 1.3$ (Public buildings)

~

1.0 (Port facilities)

$KH = n_1 \times n_2 \times n_3 \times k$

$= 1.0 \times 1.2 \times (1.3 - 1.0) \times 0.1 = 0.15 - 0.12$

$= 1.0 \times 1.2 \times (1.3 - 1.0) \times 0.1 = 0.15 - 0.12$

Thus, the design earthquake intensity = 0.15 - 0.12.

4・6・3 Soil Bearing Capacity:

Considering the size of the buildings involved in the subject plan, we have determined that a spread foundation would be appropriate. In our field survey, we conducted simple soil bearing capacity tests at the 7 points shown in Appendix Ⅲ-3. Based on the results of these tests, we obtained values of 9.3 t/sq.m - 20.8 t/sq.m for the expected foundation elevation 1 - 1.5 m below the actual ground level. However, through the boring tests that were performed supplementally to these soil bearings tests, it became clear that, from about 4 - 12 m, the ground is composed of very soft silt layers.

When the plan is actually implemented, there will be a need to obtain accurate values through loading tests but, for the purpose of the Basic Plan, we have stipulated a soil bearing capacity, after building in a safety factor, of 7 t/sq.m. The findings of the boring tests are given in Appendix Ⅲ-5, 6.

4・6・4 Design Conditions for the Dry Dock and the Repairing Jetty:

The structural dimensions of the dry dock and repairing jetty will vary, depending on the design conditions. These design conditions are shown below:

1) Design Conditions for the Dry Dock:

(1) Assumptions:

(a) The target vessels are to be fishing vessels of the 533 and 535 which represent the 500 series vessel and a tanker of the number 801 as contained within the existing PPFC fleet.

(b) Size of facility:

Dock length	:	60.0 m
Dock width	:	14.0 m
Crown height	:	D.L. + 7.5 m
Dock floor height	:	D.L. + 0.0 m
Dock gate	:	Flap type

(c) Structural conditions:

The dry dock is to have a sheet pile type wall, with a pile support foundation.

(2) Natural Conditions:

(a) Tidal levels:

H.H.W.L.	:	D.L. + 6.98 m
H.W.L.	:	D.L. + 6.74 m
L.W.L.	:	D.L. + 0.00 m
W.L.	:	D.L. + 5.00 m (when docking or undocking)

Residual tide level : D.L. + 4.50 m

(b) Design seismic force:

Kh = 0.1
kv = 0.0

(c) Conditions for the foundation subsoil:

- The depth of the bearing layer is D.L. - 9.3 m (G.L. -15.0 m)

- The N value between the ground surface and the bearing layer is a 0 - 4, comprising a soft clay layer.

- Soft soil layer:

Internal friction angle	0°
Cohesion	0.6 t/sq.m
Bulk density	1.8 t/cu.m (in air)
Bulk density	1.0 t/cu.m (in water)
N value	1
Permeability coefficient	5.5×10^{-7} cm/sec.

- Foundation layer:

Internal friction angle	40°
Cohesion	0 t/sq.m
Bulk density	1.8 t/cu.m (in air)
Bulk density	1.0 t/cu.m (in water)
N value	42
Permeability coefficient	5.5×10^{-3} cm/sec.

(3) Material Conditions:

(a) Bulk density:

Steel	7.85 t/cu.m (in air)
Ready mixed concrete	2.45 t/cu.m (in air)
Sea water	1.03 t/cu.m

(b) Allowable stress of concrete:

Standard design strength	σ ck = 240 kg/sq.m
Allowable bending compressive stress	σ ca = 80 kg/sq.m
Allowable shearing stress	9 kg/sq.cm
Allowable bond stress	7 kg/sq.cm

(c) Allowable stress of steel allowable:

- Table 4.6 and 4.7 show the allowable stress for steel piles and steel sheet piles.

Corrosion Rates of Steel are as follows.

Inside	0.2 mm/year
Land side	0.02mm/year

Table 4.6 Allowable Stresses of Steel Pile (kg/sq.cm)

Kind of Stress \ Kind of Steel	STK 41
Axial Tensile Stress (Per Net Sectional Area)	1,400
Axial Compressive Stress (Per Gross Sectional Area)	$\frac{\ell}{\gamma} \leqq 20$ 1,400 $20 < \frac{\ell}{\gamma} < 93$ $(1,400 - 8.4 (\frac{\ell}{\gamma} - 20)$ $\frac{\ell}{\gamma} \geqq 93$ $\frac{12,000,000}{6700 + (\ell/\gamma)^2}$
Bending Tensile Stress (Per Net Sectional Area)	1,400
Bending Compressive Stress (Per Gross Sectional Area)	1,400

Member Which Receives Combined Axial and Bending Stresses	(1) In case of the axial tensile stress $\sigma_t+\sigma_{bt} \leqq \sigma_{ta}$ and $-\sigma_e+\sigma_{bc} \leqq \sigma_{ba}$ (2) In case of the axial compressive stress $\frac{\sigma_c}{\sigma_{ca}} + \frac{\sigma_{bc}}{\sigma_{ba}} \leqq 1.0$
Shearing Stress (Per Gross Sectional Area)	800

ℓ : Effective buckling length of the member (cm)

γ : Radius of gyration of area for the cross sectional area of the member (cm)

σ_e, σ_c: Tensile stress by axial tensile force and compressive stress by axial compressive force acting on the section (kg/cm^2)

σ_{bt}, σ_{bc}: Maximum tensile stress and maximum compressive stress by the bending moment acting on the section (kg/cm^2)

σ_{ta}, σ_{ca}: Allowable tensile stress and allowable axial compressive stress on the axis with smallest moment of inertia (kg/cm^2)

σ_{ba}: Allowable bending compressive stress (kg/cm^2)

Table 4.7 Allowable Stress of Steel Sheet Piles

Kind of Steel / Kind of Stress	SY30
Bending Tensil Stress (Per Net Sectional Area)	1,800
Bending Compressive Stress (Per Gross Sectional Area)	1,800
Shearing Stress (Per Gross Sectional Area)	1,000

2) Design Conditions for the Repairing Jetty:

1) Assumptions:

a. Target vessels are to be the same as for the dry dock.

b. Size of facility

Jetty length	:	60.0 m
Jetty width	:	10.0 m
Length of access bridge	:	45.0 m
Width of access bridge	:	4.0 m
Crown height	:	D.L. + 7.5 m
Design bottom depth	:	D.L. - 4.5 m

c. Conditions for the Structure:

The approach speed of the target vessel is to be set at 0.3 m/sec. Live load of the Jetty have been set at 1.0 t/sq.m. A fixed crane (2 ton/30 m) is planned to be installed on the center of the Jetty.

2) Design Conditions:

Design conditions of the Repairing Jetty has been set as in the case of the dry dock.

4・7 Installation Plan

The installation Plan comprises four areas: water supply and draingage, electrical facilities, air supply and conditioning facilities, and transport and handling equipment.

The existing fishing boat repair facilities are, on the whole, provided with water supply and drainage and electrical power, but do not include air supply facilities.

The subject plan does not then constitute a completely new complex but rather one to extend and upgrade the existing facilities.

While the existing facilities are in relatively good condition, they are not necessarily all functional or efficient. In the course of our discussions with PPFC personnel, we reached agreement on the need to improve certain portions of the complex.

We have developed the rationale for these improvements on the basis of both external and internal factors. We assume that the external factors are to be solved by the independent efforts of the Burmese side. With respect to the internal factors, the basis of this Plan is to eliminate the problems and upgrade the complex into a fully functional and efficient facility.

After a technical evaluation, piping and wiring networks that are both efficient and capable of responding flexibly to future plans as well as the selection of appropriate equipment would be established. It also seeks to develop a facility complex that will be effective yet simple from a management and operational standpoint -- one that will minimize operating loss.

Giving due consideration to maintenance and repairs, the equipment are to be standard items that can be readily obtained and will be capable of accommodating any future repair requirements, expansion, or changes in usage patterns.

We have avoided the use of equipment that would require a high technical skill in handling or maintenance.

4・7・1 Water Supply and Drainage Plan:

(1) Water Supply:

1) Drinking Water and Sewage:

In the subject Plan, we are not planning an entirely new system for drinking water and sewage but will utilize the existing system in its present form. The existing drinking water set-up relies mainly, in the rainy season, on rain-water and, during the dry season, on replenishment by vessels. All water is drunk only after boiling and sterilization.

The sewage system draws its water, during the rainy season, mainly from rain-water sotred in reservoirs and during the dry season, from water taken in from the Hlaing River, which flows directly in front of the property. In addition, water is pumped up to an overhead tank and supplied by a gravity-type system to the various facility. Deep wells have been dug on the grounds of these facilities in an effort to obtain water supply, but this water is not being used, since it is unsuitable as drinking water, owing to its high salinity and iron content.

The existing drinking water and sewage are not necessarily ideal from either a quality or quantity standpoint but, given the past experience and the replenishing system that has been established and the fact that, under present conditions, there are no viable alternatives, we have decided that it would be appropriate to use the existing set-up for this project.

2) Water for Cleaning the Hulls:

At present, the cleaning of hulls and the removal of seaweed are being done by hand, using brushes. The washing of the sub-paint surfaces is an extremely important operational stage intended to maintain, as per specifications, the anti-corrosive properties of the paints. It is, therefore, desirable that this operation would be carried out with more reliable method.

In order to effectively carry out the hull washing operation in the slipway and dry dock facilities under this Plan, we have provided for high-pressure washing equipment.

As water for washing, we shall use fresh water, but such water cannot be obtained in quantity from the existing facilities. In this plan, therefore, we shall construct a new water supply system for the high-pressure washing equipment which will include a reservoir tank to store water, water distribution pipes, and suction pits. We have calculated the required volume as shown below and have selected equipment of appropriate scale.

a) Calculation of the Required Volume:

If we set the average target vessel as being of the 350 GT class, the approximate area to be washed can be predicated at about 30% over the wetted surface and so may be determined by the following equation:

$$S = K \sqrt{\Delta \times L\,(ft)} \times \underset{(1)}{0.0929} \times 1.3$$

Where:

S = Shell plate area

K = the coefficient determined on the basis of the ratios of the midship section coefficient, width, and draft, which has been set here at 15.5

Δ = displacement

GT x 1.6 = 350 x 1.6 = 560

L = 34.5m = 116 f.

(1) = conversion rate from sq.ft to sq.m

$$S = 15.5 \sqrt{560 \times 116} \times 0.0929 \times 1.3 \fallingdotseq 477 \text{ sq.m}$$

If we assume the delivery pressure to be for the washing of the hull and the removal of seaweed than about 70 kg/sq.cm are required. ..... (1)

When the delivery pressure is constant, the greater the delivery volume, the higher the washing capacity. Giving consideration here to operation costs and efficiency, if we postulate completion of the washing operation in about 1 hour, the required washing capacity becomes:

477 sq.m ÷ 60 minutes = 7.95 ≒ 8 sq.m/min

With regard to the selection of the washing equipment, taking into account simultaneous washing from both sides, and in the event of an accident, we have provided for 2 units with a capacity of 4 cu.m/min each. ...(2)

The delivery volume, as derived from (1) and (2) above may be estimated in the range of 150 lit/min - 200 lit/min. Accordingly, the volume of water required for a single washing works out to:
150-200 liters x 2 units x 60 min = 18,000 -- 24,000 liters

6) Scale of Facilities:

The reservoir tank will be filled, on the average, once a week. In the case of the docking period is about 1 week, washing will be carried out two times per week at most.
Thus, the required capacity for the reservoir tank becomes:

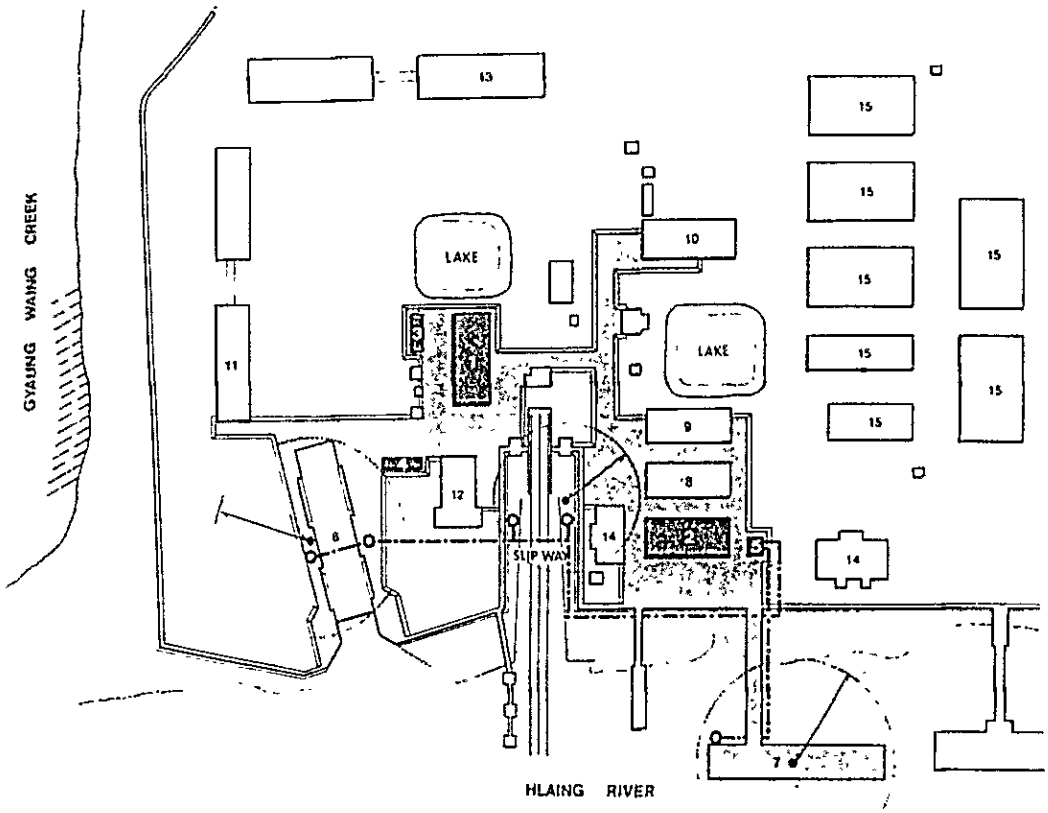
24 cu.m x 2 = 48 cu.m

The water for washing is to be sent to the suction pit by gravity through distribution pipes. After the water is sucked from the pit by means of a high-pressure wash pump, it is discharged.

If we assume that simultaneous washing is not done at 2 locations in the docking facilities, the amount of water used per unit time becomes 400 lit/min.

Assuming that PVC is used for the distribution pipes, the standard value of the design flow speed within the pipes, based on a radius of 75-150m/m, will be 0.7 - 1.0 m/sec. Using Table Ⅲ-9, at ϕ 100 m/m, this works out to 0.32 - 0.46 m/sec and, at ϕ 125 m/m, to 0.5 - 0.72 m/sec.

Allowing a safety margin for secular distortion, we have elected to use ϕ 125 m/m.



PIPING PLAN (WATER)

(2) Drainage Plan:

The drainage system will be a 4-way branch flow system for waste water sewage, dirty water, plant drainage, and dry dock drainage.

As waste water will not be discharged from the new facility, there is no need to build a new drainage facility. For drainage from the existing facility, we will use, as in the past, the existing system based on a direct flow system into the river.

Plant drainage will be newly discharged from the iron work's and engine repair shops. The drainage will pass through the water collection channel and grease trap pit and then evaporate and seepage.

Discharge from the dry dock will generally be directly into the river fronting on the site, using a lift pump, via water collection pit at the base of the dock. The shorter the elapsed time of discharge within the interval from high to low tide, the more efficient will be the operation.

In the target plan area, the interval between high and low tide is 5 to 6 hours, and we have set this as the maximum discharge time. The required amount of water to be discharged is the amount of water in the dock minus the amount of water displaced by the target vessel.

Assuming, for safety sake, that the target vessel will be in the 400 GT class, the volume of water to be discharge will be:

60m(L) x 14m(W) x 6m(H) - 200cu.m = 4,840 cu.m

If this volume were, say, to be discharged in one hour, we would obtain a volume of:

4,840 ÷ 60 = 80 cu.m/min;

and, if this operation were to be done in 6 hours, the volume would become 13.4 cu.m/min.

A discharge volume of 80 cu.m/min would be quite large and, even if using among several pump units, would create problems in terms of running costs, maintenance and repairs, and investment effectiveness. On the other hand, with a volume of 14 cu.m/min, the discharge operation would be too time-consuming.

In this Plan, therefore, we have set an intermediate discharge time of 3 hours which, converted to drainage volume, becomes:

4,840 ÷ 60 x 3 = 26.8 cu.m

We feel that this would be an appropriate figure.

As to the lift pumps, with a view to spreading the risk in the event of a breakdown, we have provided for 3 units with a capacity of 10 cu.m per min. each.

We have also provided an auxiliary discharge pump in the dry dock, but this is to handle water leakage from the gate, rainfall, and hull washing, and so the volume to be discharged here has been set at 400 lit./min, the same as that for the hull washing operation. If it is converted in terms of rainfall, it would be 30 mm/hr. so that this volume should be quite adequate. When rainfall exceeds this level, the main pump will be used.

4・7・2 Electrical Facilities:

The electrical system for the subject Plan is to be controlled via a common system to incorporate the new facilities and equipment in addition to the existing facilities and equipment.

Power supply will be provided entirely from self-generating facilities on the site, and the generators will be of a daily use type.

From the standpoint of the characteristics of the facilities, there will be considerable fluctuation in power loads. With a view to preventing operation under low load conditions and to economize on fuel, the capacity needs can be met by two generators, equipped with a synchronizing generating system to permit automatic start-up and turn-off.

Maximum use will be made of the present power-supply grid and equipment, but the Plan will provide for new or remodeled facilities where required.

(1) Calculation of power loads:

In calculating power loads, we have assumed that the dry dock and slipway will not operate at the same time out of manpower and other considerations.

The power loads for the respective facilities are shown below:

1) Machine tools --- 166.95 x 0.3 = 50 kVA (1)
(load) (simultaneous use factor)
lathe, drill press, saw, cutter,
200 ton press, shaper, other equipment

2) Heavy machinery ---

		Load		No. of units		Usage Factor		Total
a)	Compressor	46 kw	x	2	x	0.5	=	46
b)	Jib crane (A)	25 kw	x	1	x	0.3	=	7.5
	" (B)	19 kw	x	2	x	0.3	=	11.4
c)	Winch (slipway)	37.34 kw	x	1	x	0 1/	=	0
d)	Winch (dry dock gate)	10.2 kw	x	1	x	0 2/	=	0
e)	Main discharge pumps (dry dock)	37.34 kw	x	3	x	1	=	112
f)	Auxiliary discharge pump (dry dock)	5 kw	x	1	x	0 2/	=	0
g)	High-pressure cleaning pump	30 kw	x	2	x	1	=	60
h)	Overhead travelling crane	4.4 kw	x	2	x	0.6	=	2.6
i)	Welding unit	24 kw	x	15	x	0.6 x 0.4 (Simultaneous arc factor)	=	86.4
j)	Compressor for tube well	3.75 kw	x	1	x	0	=	0
k)	Capstains	3.7 kw	x	3	x	0	=	0
		in total				325.9 KVA		(2)

3) Lighting outlets

Lights	20 x 0.5	=	10
Sockets	6 x 0.5	=	3
Cooler	2.5 x 4	=	10
			23 KVA (3)

TOTAL (1) - (3) 398.7 KVA

NOTES:

1/ We have assumed that the slipway winch will not operate together with the main discharge pump in the dry dock.

2/ There is to be no simultaneous operation of the dry dock winch and the main discharge pump in the dry dock.

2) The Generators:

From the preceding section, the power requirements come to 398.9 kVA, of this, the main discharge pump (dry dock), the high-pressure wash pump, and the other docking equipment will be used at a frequency of once or twice a week. Accordingly, the peak frequency, based on the stipulated use factor, will occur 2-3 times/month, with the ordinary operating load at:

398.9	-	(112	+	60)	=	226.9 kVA
(power load)		(main discharge pump)		(high pressure wash pump)		

We have provided 2 generators of 225 kVA, each of which will have a capacity close to the ordinary generating load. Through the incorporation of a synchro-alignment board, when the requirements exceed the capacity of one generator unit, the units will be automatically operated in tandem. The generating capacity then becomes:

225 kVA	x	2	x	0.9	=	405 kVA
(capacity of each generator)		(No. of units)		(power factor)		

(3) Trunk Line:

Power will be distributed from the distribution board in the generator house to the power and lighting distribution boards in each facility. The trunk line will basically be applied by a mid-air wiring system as well as the existing facilities. However, the operating radious of the jib crane will, as a safety precaution, be via cable in underground pipes.

(4) Lighting; Outlets:

In the existing repair center, night-time operations are rarely

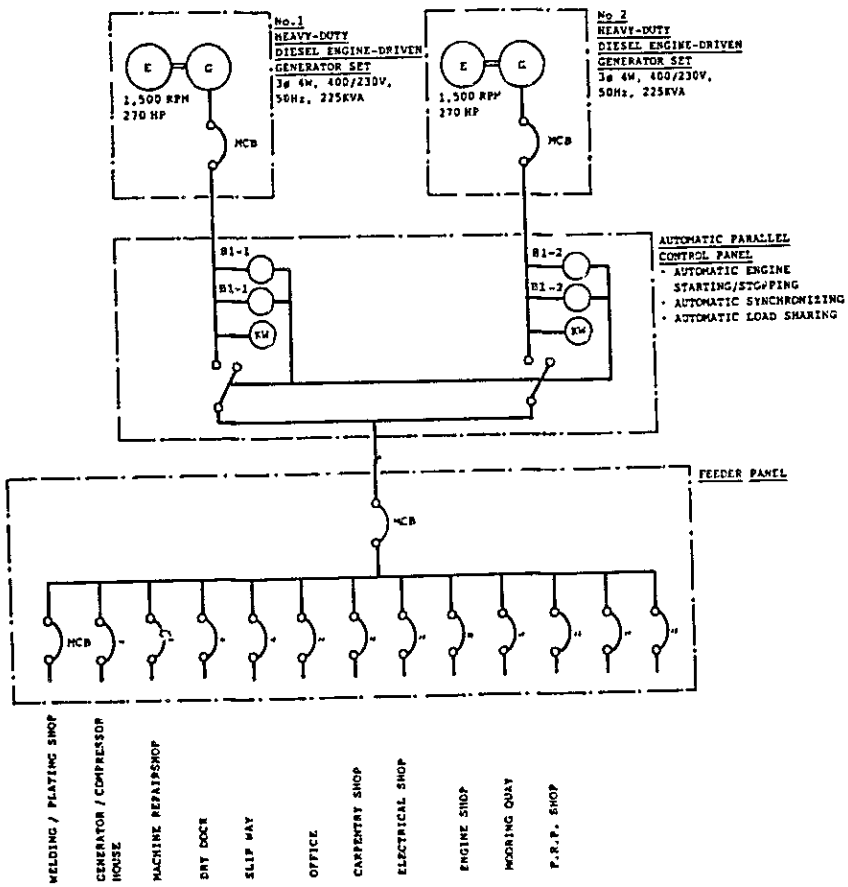
undertaken. In the subject Plan too, there will ordinarily be no night operations in the shop sections, and so the lighting requirements can be set on the basis of emergency and security use. However, since operating hours for the slipway, dry dock, and other docking facilities are dependent on natural conditions, such as waiting for tides, they may well carry over into nocturnal hours. Thus, from the standpoint of operational safety as well, we have specified adequate lighting for these facilities.

All outlets for general use, hand tools, ventilating fans and the like will be on independent circuits.

For maintenance, control, and ease of handling of lighting and outlets at the terminal equipment, we have specified items that can readily be procured locally.

Following is the proposed power distribution diagram for the facility complex.

POWER SUPPLY DIAGRAM



(5) Lightning Arrestors:

During the rainy season in the vicinity of the Plan area, there is frequent lightning which causes considerable damage, and in the existing facilities, lightning arrestors have been installed of buildings and tanks.

To prevent lightning-related accidents, lightning arrestors will be mounted on shop buildings, cranes, and overhead tanks.

4・7・3 Air Conditioning and Air Supply Equipment:

(1) Air Conditioning:

While air conditioning usage has been on a rising trend in Burma in recent years, natural ventilation and mechanical ventilation by ceiling or other fans are still most common. In the subject facilities as well, we shall rely mainly on natural ventilation, supplemented by the use of ventilating equipment. However, in the case of the engine test room in which precision equipment is to be installed, and the FRP storage, in which high temperature and humidity must be avoided, air conditioning will be installed to control temperature and humidity in accordance with the particular conditions.

(2) Air Supply Equipment:

In the docking facilities and various shops, compressed air will be used for drilling, air gouging, ventilation, cleaning, small grinding units and various other purposes. This compressed air will be distributed to the various facilities through the distribution pipes by means of compressors to be installed in the generator house.

1) Compressors:

Air pressure has been set at 7 kg/sq.cm for the equipment that will be used. The volume of air to be distributed will depend

on the total air requirements of the consuming equipment but, in reality, it is also necessary to consider such factors as disruptions in equipment use, pipe leakage, efficiency, and reserve capacity for other equipment. Thus, in computing the required volume, we have allowed a safety factor of about 30% over the capacity computed solely on the basis of usage. We have based our computations on the number of pieces of equipment requiring air, as follows:

Computation of Requiremented Air Volume

	No. of Unit s		Amount used(cu.m/min)		
Grinding tools (grinders, sanders, etc.)	30	x	0.7	=	21
Chipping tools	5	x	0.5	=	2.5
Cleaning & painting equipment	10	x	0.2	=	1.0
Gouging	5	x	0.5	=	2.5
	26	x	1.3 (safety factor)	=	33.8 cu.m/min.

According, the required air volume works out to 33.8 m/min. If we assume a joint-use factor of about 40%, we arrive at:

36.4 x 40% = 13.52 cu.m

Allowing for standby equipment, providing two compressors with a delivery volume of 7 cu.m/min. and a delivery pressure of 7 kg/sq.cm, which will be operated alternatively. And, by way of a reservoir, they will switch on and off automatically by means of a pressure switch.

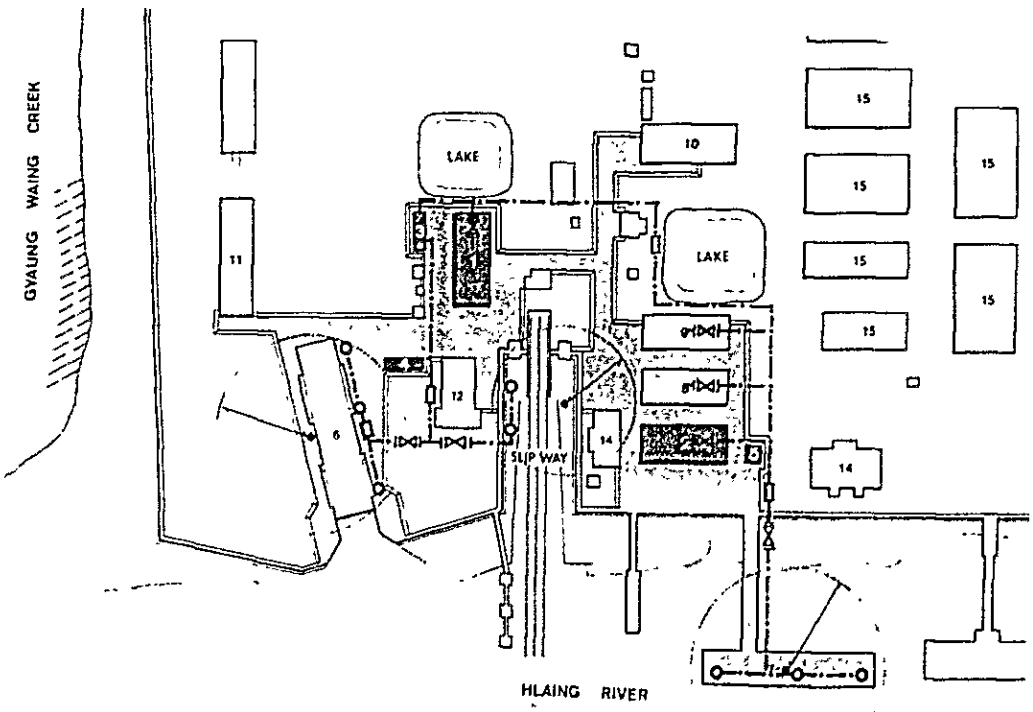
2) Piping:

The piping plan gave consideration to the contours of the piping areas, the safety of the road pipes, and the relative ease of construction and was planned as an efficient piping system with curved sections. In principle exposed piping is to be used whenever possible.

The number of headers has been set from the standpoint of use patterns, convenience, and usage frequency. As a general rule, the intervals between headers will be 10-15 m, with 5 to 6 pcs outlets. A stop valve will definitely be installed on each header.

The oil or air content in the compressed air will be eliminated by means of the condenser, but we have also provided a drain tank mid-way in the pipes to permit elimination at appropriate times.

An outline of the piping grid is shown below:



PIPING PLAN (AIR)

4・7・4 Transport Facility Plan:

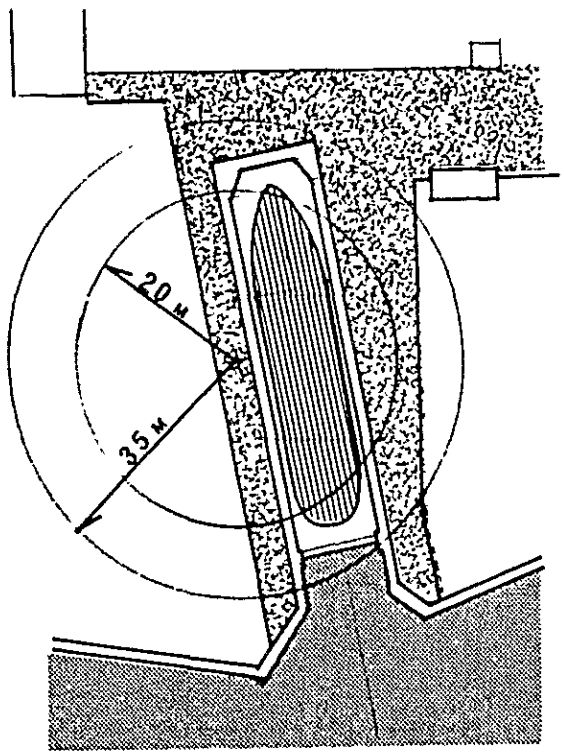
The items to be transported include steel materials, blocks, riggings, engines, and temporary materials. We have specified the transport equipment on the basis of a careful examination of the number, size, weight and movement frequency of the various materials involved in the complex.

In a ship-building facility, transport equipment accounts for a goodly share of accidents. Thus, in addition to ease of use and efficiency, we have given careful consideration to safety precautions as well.

Let us now consider the transport equipment to be used at each of the planned facilities:

1) Dry Dock:

The target facility in this area will be the crane, which is to be used to load and land the materials for repair operations. The following chart is based on a standard 500 GT class fishing vessel in dry dock.



We first considered the possibility of a fixed crane. Then, if problems turned up, we would move on to a traveling crane and a gantry crane. Within the 20 m line, the target points are those related to the generators, engine and machine rooms and those related to the fishing gear (such as trawl winches). The maximum weight is encountered in the engine components, which weigh about 4 tons.

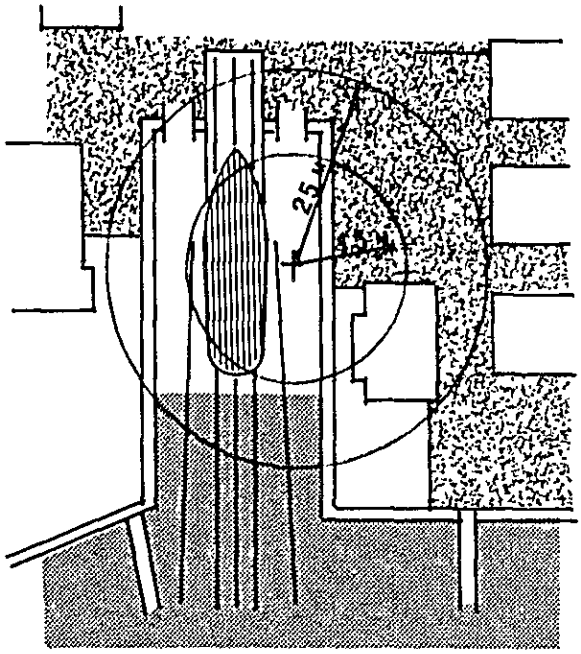
At the 35 m line, the target objects are the rudder, propeller, shaft, anchor, chains, windlass, otter board, and temporary materials, with a maximum weight of about 2 tons.

Accordingly, we shall require a capacity of 2 ton — 35m. This is a working radius within which a fixed crane can easily operate.

We have, therefore, chosen to use a level duffing crane which has the advantage of load shift horizontally according to radius variation and of speedy movement, with only a modest amount of power required to elevate the jib.

2) Slipway:

The following chart is based on a 150 GT class fishing vessel entering the slipway. Following the analytical pattern of the previous section, we have assumed a weight of 4 tons or over at 15 m and 2 tons or over at 25 m, but sufficient receiving space cannot be secured on the shore side within a 15 m range. As a consequence, we have specified a required capacity of 4 tons at a maximum radius of 20 m. Based on the same considerations as in the previous section, we have selected a level duffing crane.



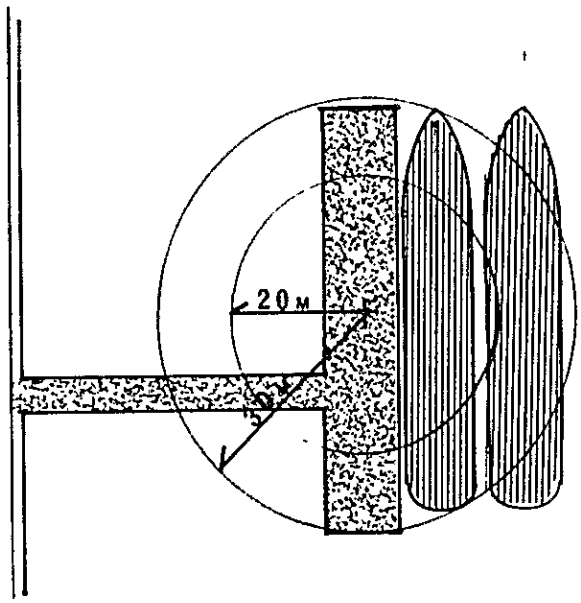
3) Repairing Jetty:

This facility poses about the same conditions as the dry dock. However, in place of the rudder, propeller, shaft, anchor, chains and the like, a function is added involving a landing crane for bringing in materials.

We may anticipate that the heaviest materials to be landed will be 2 ton pieces of standard steel materials. After building in a safety factor, the capacity becomes:

2 tons — 30m.

As in the previous sections, we have selected a fixed level duffing crane.



4) Machine and Iron Work's Shops:

The commonly used traveling crane would be appropriate for use in the machinery and iron works shops.

In the machinery shop, the principal operations will involve the shifting, arranging, and transporting of the fabricated materials. In the iron work's shop, the main operations will be the arrangement of the steel materials in the shop and the sorting, arrangement, and transporting of cut materials.

About 2 units will be provided per 1,000 sq.m, with one unit to be installed per shop. The maximum weight of the various repair components and steel materials will be about 1-2 tons and so, allowing a safety margin, we have established the capacity at 2.5 tons.

5) Engine Repair Shop:

For the engine repair shop, an overhead traveling crane, capable of handling about a ton of engine parts, would, ordinarily speaking, be appropriate. However, given the structural limitations of the existing structure, this type cannot be used.

We will provide, therefore, four davits in the shop and connect this with a movable chain block as the method for moving repair parts. Transportation will be accomplished with trucks and forklifts.

6) Connecting Transport Facility:

This is a facility to connect the various sections of the complex. There will be a need for a forklift and small trucks but, in the subject Plan, we have targeted 2 ton and 4 ton forklifts.

4・8 Machinery Plan

4・8・1 Tugboat:

(1) Vessels to be towed and Operating Conditions:

The largest vessel owned by the PPFC is the tanker of the number 801. The tugboat, therefore, must be able to tow this size of vessel.

The main particulars of the 801 vessel are as follows:

Length	54.30 m
Length between perpendiculars	50.00 m
Design width	11.00 m
Design depth	4.10 m
Draft	3.50 m
Gross tonnage	500 tons
Net tonnage	275 tons

Dead weight tonnage	887.19 tons
Main engine	1025 Hp
Light load displacement	404.4 ton
Full load displacement	1291.59 tons
Fuel oil tank	1000 cu m3
Speed	11.5 knots

The strongest current flow seen in the Hlaing River is 7.72 knots. However, since, at normal high tide, the 6 knot level is rarely exceeded, 6 knots has been established as the fastest current flow in which the largest vessel would be towed.

If we then add a 1.0 knot log speed, which is, from a practical standpoint, the minimum required speed, 7.0 knots becomes the maximum speed when towing a vessel with a light load displacement of some 400 tons. From the output curves in Figures 4.1 and 4.2, we see that:

BHP = 450 PS.

(2) Selection of the Propeller and the Main Engine Horsepower:

At an economic output of 450 PS, the maximum rated output is set at:

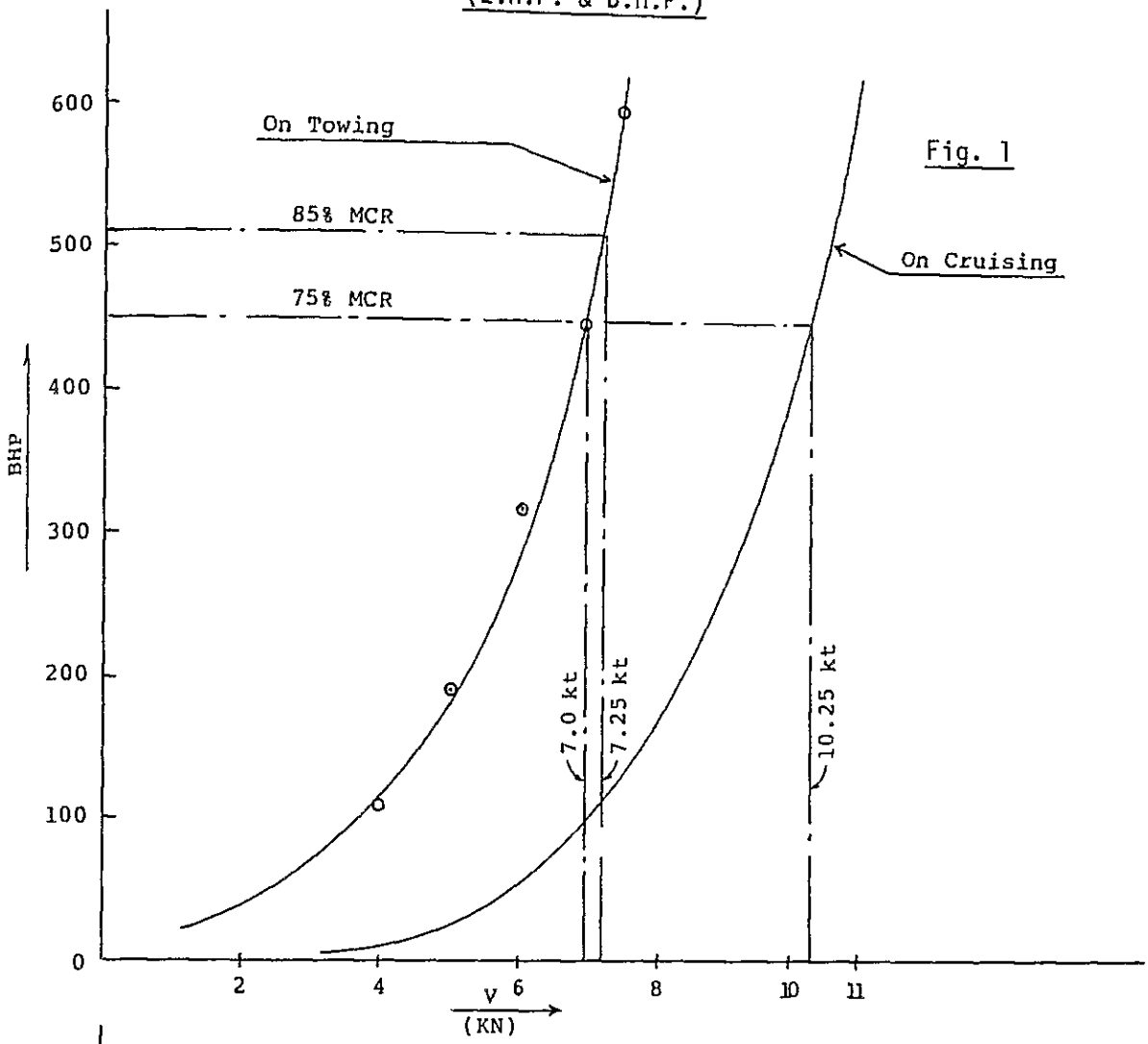
450 PS ÷ 0.75 = 600 PS.

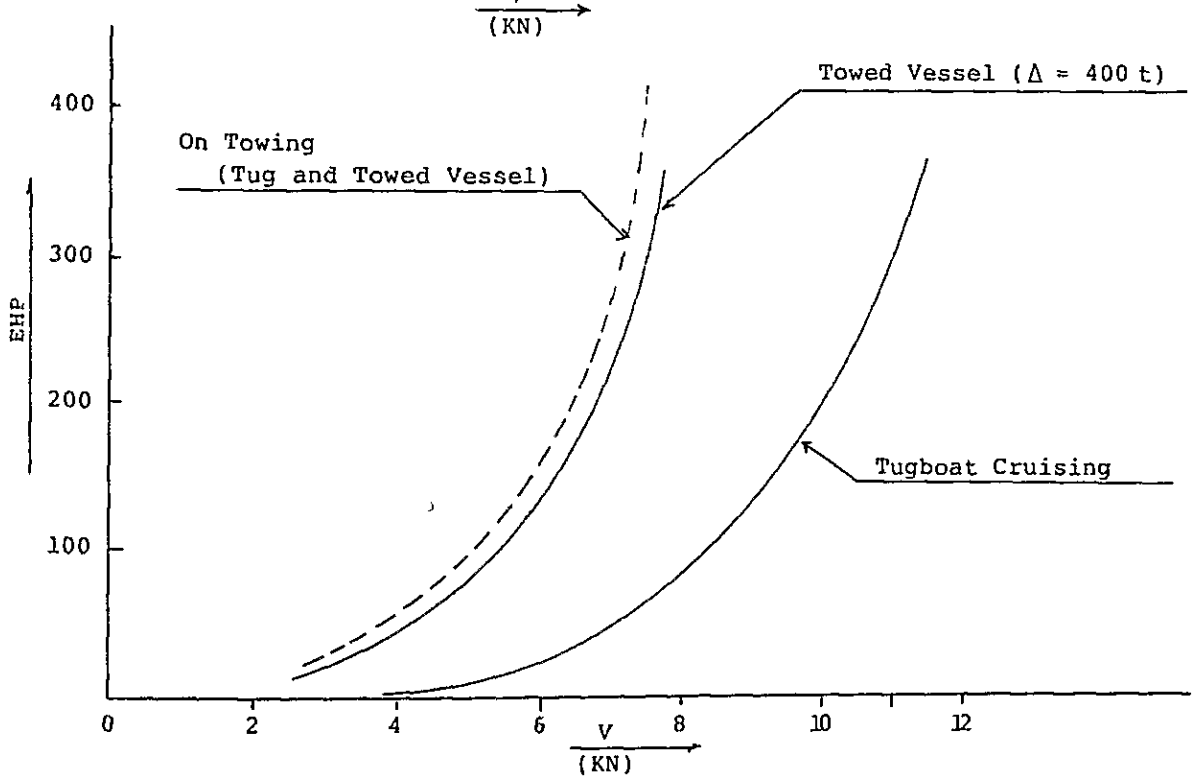
We have selected double propeller type accordingly, we have specified two engines with a maximum rated power of 300 PS.

As the tugboat propellers, we can use a propeller with Kort nozzle, a Voith Schneider, or a variable-pitch propeller, each of which has its own special characteristics. The variable pitch propeller, which permits a change in pitch, is efficient in terms of both cruising and towing performance and is also economical on fuel. Moreover, as a tugboat, the propeller must be designed with a high priority on thrust so as to maximize towing strength vis-a-vis a particular towing speed.. Accordingly, the propeller diameter must be as large as possible within the permissible parameters of the draft, and a pitch must be selected that is appropriate to this. For this reason, when cruising, we cannot ignore the fault that the revolutions of this type propeller are too high relative to output, thereby reducing speed.

Engine Output

(E.H.P. & B.H.P.)





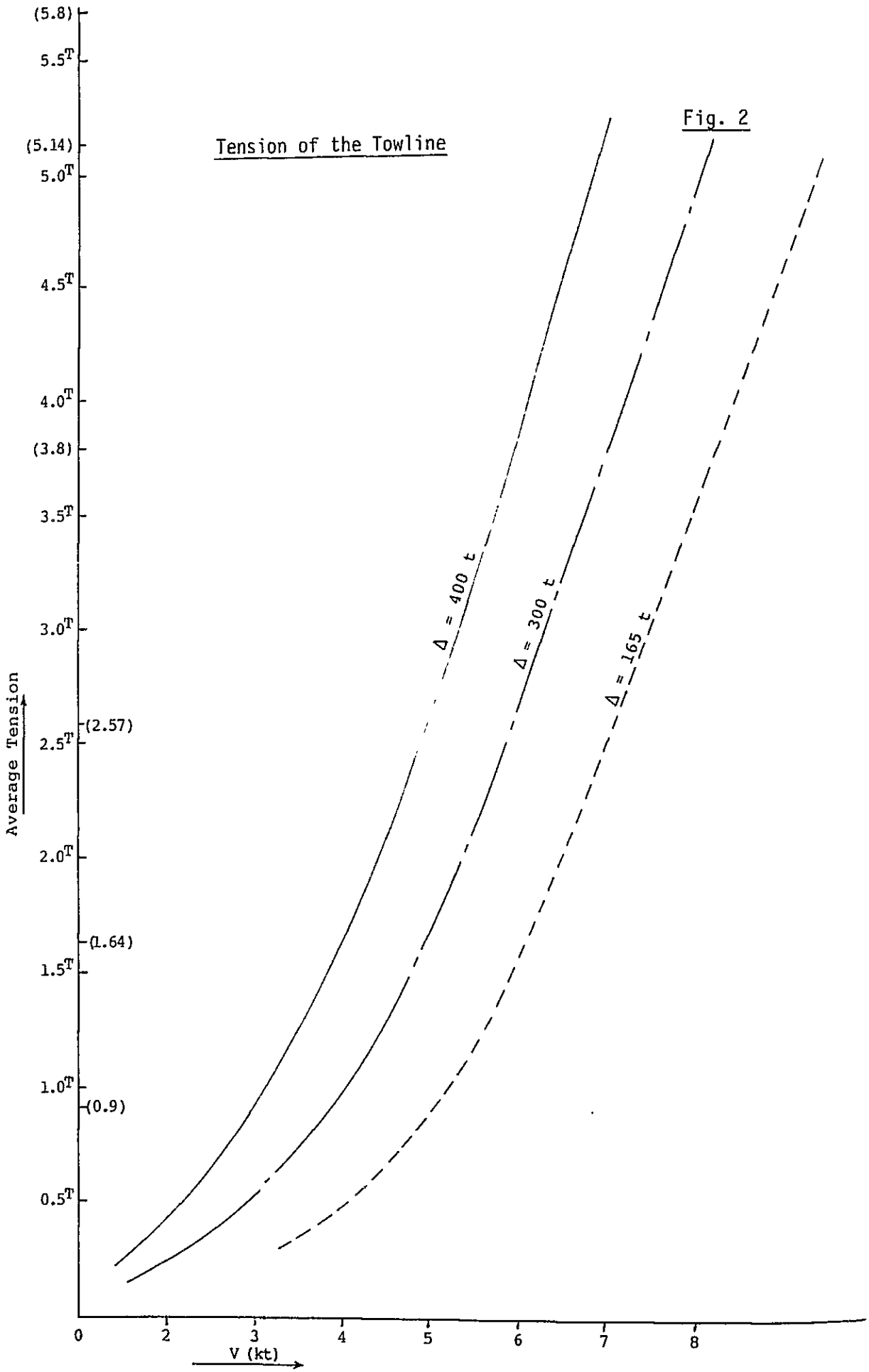


Fig. 2
Tension of the Towline
(5.8)
5.5T
(5.14)
5.0T
4.5T
4.0T
(3.8)
3.5T
3.0T
(2.57)
2.5T
2.0T
(1.64)
1.5T
1.0T
(0.9)
0.5T
Average Tension
Δ = 400 t
Δ = 300 t
Δ = 165 t
0
2
3
4
5
6
7
8
V (kt)

When the vessel is equipped with a Kort nozzle efficiency is excellent, and there is a boost of 40-50 percent in towing power at times of zero speed. However, towing power gradually declines with increases in speed, and, at or above a certain speed, this towing power may actually fall below obtained when a nozzle is not fitted.

Also, with the Voith Schneider propeller, no rudder is required and, during stops and while reversing, the vessel can be freely turned.

As the above summary has shown, the variable pitch propeller is highly efficient but, since the tugboat for this project is to operate only within the harbor, there is not need to consider long-distance cruising. If, then, we consider only its efficiency as a tugboat purpose, it would be advantageous to use a fixed pitch propeller with a Kort nozzle attached.

In addition, maintenance and repairs on the variable pitch propeller require special skills, requiring the services of specialists from abroad. For this reason too, we have elected to use a fixed pitch propeller, whereby towing strength can be increased by means of the Kort nozzle and there is considerable reserve engine strength, with no inconvenience vis-a-vis maintenance operations.

The maximum bollard pull varies considerably in response to the output of the main engine and the speed of the revolutions but, generally speaking, this can be set at 1 - 1.5 ton/100 p.s. However, when fitted with a Kort nozzle, a peak of 1.6 times is possible.

If we use 1.3 tons/100 PS, the Max Bollard Pull becomes:

600 PS/100 PS x 1.3 t = 7.8 tons

Accordingly, after a suitable safety allowance, the vessel should be fitted with a towing hook of 8.0 to 10.0 tons.

(3) Determination of the Principal Particulars:

The size ratios for a tugboat designed for harbor and river use are:

L/D = 6.0 - 8.0
L/B = 3.0 - 4.0
B/D = 1.8 - 2.3
d/D = 0.75 - 0.85

Referring, for comparison purposes, to a similar vessel with:

L/D = 7.28
L/B = 3.13
B/D = 2.32
d/D = 0.76

then:

Lpp (length between perpendiculars) = 18.7 m
BMLD = 5.8 m
DMLD = 2.5 m
d max = 1.9 m

With regard to the determination of the planned full-load displacement, based on the paper by Matsutaro Namba, the block coefficient and mid ship section coefficient become:

Cb (block coefficient) = 0.55 - 0.67
C (mid ship section coefficient) = 0.90 - 0.93

Applying the above data to a comparable vessel, where
B_b = 0.58 and C = 0.9,
Δ full (design full-load displacement) = 18.7 m x 5.8 m x 1.9 m x 0.58
=119.5 t ≒ 120 t

The specific gravity of water here is assumed to be 1.0.

(4) Economic Speed When Cruising:

Based on the formula developed by D.A. Arggriads,

$$VK\ max\ (max.\ speed) = 3.35\ (L - \frac{\Delta}{A})^{1/2} = 8.6\ knots$$

$$VK\ serve.\ (economic\ speed\ ) = 3.08\ (L - \frac{\Delta}{A})^{1/2} = 7.9\ knots$$

However, since the log speed in cruising must for practical purposes, be set at no less than 2 knots vis-a-vis the maximum current flow,
VK serv. (economic speed) = 7.9 + 2 = 9.9 knots

Based on the output curve in Chart 4.1, with BHP = 450 ps, a speed of about 10.25 knots is attainable, which should be ample to meet the above requirement.

(5) Equipment and Auxiliary Engine:

1) Windlass	2T x 12 m/min x 5.5 KW x 1 unit
2) Capstan	1.0 T x 13 m/min x 2.2 kW x 1 unit
3) Steering unit	1.5 T-M x 2.2 kW x 1 unit
4) Ventilating fan	150 cu.m/min x 30 mm Aq x 1.5 kW x 1 unit
5) Lighting	2 kW x 1, 0.5 kW x 2; others--a total of 4 kW
6) Navigating instruments	Wireless telephone x 1 unit
7) Generator	

With total power consumption at 15.4kW, the generator output will be:
15 kW x 1.25 = 19.25 KVA
≒ 20 KVA

We have specified 2 generators of 20 KVA each, judging from requirement of the rule of the classification society.

(6) Principal Particulars:

LPP	18.70 m
B MLD	5.80 m
D MLD	2.50 m
d max	1.90 m
Δ max	120 tons (approx)
Main engine	300 PS x 1200 rpm x 2
Trial max. speed	11.0 knots (approx)
Cruising speed	10.0 knots (approx)
Cruising range	about 650 miles
Complement	3 (plus temporary crew of 12)
F.O. tank	7 cu.m
Fresh water tank	2 cu.m
Towing hook	Approx. 8 tons
Applicable regulations	Vessel Safety Law of Japanese Government
Class	NK, NS* (Smooth Water Service) MNS*

4・8・2 Equipment for the Iron Works Shop:

This facility will primarily work and fabricate steel products for repairing and replacing the main structures. We have also deployed necessary equipment as necessary for the production and repair of pipes, riggings, and hardware. The following table summarizes the operations to be performed at this facility together with the required equipment and materials for each:

Operation	Equipment & Materials		
1) Marking of steel materials	Lattice floor		100 sq.m
2) Steel cutting	Shearing machine		(1)
3) Steel bending operations	Press	200 T	(1)
4) Steel assembly	Lattice floor		
5) Steel welding	Lattice floor		
6) Pipe cuttings	High-speed cutter		(1)
	Sawing machine (already available)		

7) Pipe bending	Pipe benders	(2)
8) Pipe flange work	Grinder	(1)
9) Movement of materials	Overhead travelling crane 2 T	(1)

In the interest of gas conservation, we have selected a shearing machine that would be capable of cutting in one operation steel panels of 6 mm depth.

In the interest of gas conservation, we have selected a shearing machine of 6 mm x 1200 mm that would be capable of cutting in one operation steel panels of 6 mm or less up to lengths of 1200 mm.

Following is a listing of the electrical welding equipment required to make repairs on the PPFC vessels:

1) AC arc welders (400 A)	15
2) Holders	30
3) Hand shields	30
4) Leather gloves	60
5) Cap tire cords 60 m/m x 25 m	60
6) Earth cord	30
7) AC/DC welder	1
8) Welding rod drier 50 Kg	1
9) Portable fans	4
10) Duct fans for the above	20

Following is a list of the gas cutting and welding equipment:

1) Model A gas cutters	25
2) Nozzles for above	50
3) Model A3 gas welders	5
4) Nozzles for above	10
5) Oxygen hoses (30 m)	60
6) Acetylene hoses (30m)	60
7) Oxygen cylinders	18
8) Acetylene cylinders	12
9) Oxygen regulators	6
10) Acetylene regulators	6

4・8・3 Equipment for the Machine Shop:

Among the components to be landed on shore for repair, those items required for cutting adjustment operations are to be carried out in this facility. The following machine tools will be installed in this facility. In addition, a portion of the shop will be used as a storage area for universal hand tools.

The following chart summarizes the principal operations to be carried out at this facility along with the equipment required for each:

Operation	Equipment to be Provided		
1) Rudder, rudder axle			
a) Replacement of sleeves and bushes; key trough fabrication	Lathe	(1.5 m)	(1)
	Milling Machine		(1)
	Shaper (already available)		(1)
2) Shafting			
a) Adjustment of propeller shaft sleeve	Lathe	(4.0 m)	(1)
b) Adjustment of coupling surface	Lathe	(4.0 m)	
c) Sleeve replacement	Lathe (already installed)		(1)
d) Key seating	Milling Machine, Shaper		

3) Main engine, auxiliary engine, freezer

a) Adjustment of packing sheet on cylinder covers and liners	Lathe (already installed)	(1)
b) Modification of: Crank pin metal, Piston pin metal, Journal bearings	Lathe	
c) Valve sheets; valve mount adjustment	Lathe	

4) Other equipment:

a) Modification of metal, valves, pistons, and liners	Lathe	
b) Modification of pump shafts, bearings, impellers, rings, and couplings	Lathe	
c) Manufacture and modification of parts and components	Lathe	
	Milling machine	
	Radial drilling machine	40ϕ(1)
	Drill Press	25ϕ(1)

5) Deck and fishing equipment

a) Manufacture and modification of shafts and bearings	Lathe	
	Milling machine	
	Radial drilling machine	
	Drill press	
b) Production and modification of various wheels	Lathe	
c) Production and modification of various brakes	Lathe	
d) Key seating	Milling machine	
	Shaper	
e) Production and modification of parts and components	Lathe	
	Milling machine	
	Radial drilling machine	
	Drill press.	

6) Cutting and grinding of raw materials	Sawing machine	(1)
	High-speed cutter	(1)
	Grinder	(1)
7) Grinding of cutting tools	Tool grinder(already available)	(1)
	Grinder	
8) Various drilling operations	Radial drilling machine	
	Drill press	
9) Transport of parts	Overhead travelling crane 2T	(1)

For the lathe, there is a need for 4 meters distance between centers so as to be able to make propeller shafts in lengths of 3700 mm for use in the vessel number 801, the largest in the present PPFC fleet.

With regard to component of a complex shape (approximately 1400 mm long x 600 mm wide), with the exception of such long and large-sized items as cylinder cases, cylinder columns, and beds for the main and auxiliary engines of the PPFC vessels, there is a requirement for an universal milling machine capable of flattening and key seating.

The following group of hand tools will be needed:

(1) Electric Drill		12
(2) Circular Saw		3
(3) Electric Planer		2
(4) Zig Saw		2
(5) Reciprocating Saw		2
(6) Nibbling Machine		2
(7) Hand Shear		2
(8) Chain Block	1/2 T	2
	1 T	2
	2 T	4
	5 T	4

(9)	Jet multiple chisel		5
(10)	Air Grinder		15
(11)	Torque Wrench	1.6 – 5.6	2
		2.5 – 7	2
(12)	Jack	10 T	2
		15 T	2
(13)	Gear Puller		3
(14)	Scraper	6"	6
		8"	6
(15)	Tap & Dies	1/4" – 1"	4 Sets
		6 m/m – 24 m/m	4 Sets
(16)	Assorted files		198 Pcs
(17)	Pipe Wrench	10"	2
		12"	2
		18"	2
		24"	2
(18)	Chain pipe wrench	4"	1
(19)	Vice		10
(20)	Hand traction machine		5
(21)	Journal Jack		5
(22)	Siren horn		1
(23)	Cabtyre Cord 100M		1
(24)	Air hose 20M		50 Sets
(25)	Cord reel		10 Sets

4・8・4 The Engine Repair Shop:

The following items of equipment are to be installed in the existing building for the dismantling, washing, measurement, inspection, and assembly of the engines (including freezers) for repair operations:

Operation	Equipment	
1) Movement of equipment	Small materials handling unit 150 kg	1
2) Dismantling of equipment	Small materials handling unit 150 kg	1
3) Washing of equipment	Portable air compressor (15 kg/cm^2, 5 HP)	1
4) Equipment measurement		1
5) Equipment inspection	Portable Vacuum pump	1
6) Assembly	Small handling unit	

Following is a listing of the measuring devices needed in connection with repair and servicing of the machinery and electrical equipment:

(1) Digital Hand Tachometer		1
(2) Contact Tip and Circumferential speed rings		8
(3) Extension shaft		2
(4) Photo electric hand tachometer		1
(5) Tachometer for Diesel Engine		1
(6) Magnet Box 40 x 50 x 50		2
(7) Dial Indicator		2
(8) Thermometers Thermistor	-40°C – +40°C	5
(9) Thermometers (Remote)	-40°C – +40°C	3
(10) Thermometers		2
(11) Freon/Ammonia Gas Detector		2

The servicing and inspection of the fuel injection pump will require special equipment, and so we have provided an independent measuring room in a section of the existing building. This room will contain the following types of equipment:

(1)	Diesel Fuel Pump Test Stand	1
(2)	Diesel Injection Pump Tool set	1
(3)	Diesel Nozzle Tester	1
(4)	Seal Peel Tank	1
(5)	Diesel Injection Pump Stand	1
(6)	Parts Washer	1
(7)	Air compressor 3P 3.7 KW, 5PS 220 L	1
(8)	Air hoser & hose	1
(9)	Press Stand (10t) & hydraulic jack	1
(10)	Surface Plate	1
(11)	Torque Wrench	1
(12)	Tool set	1
(13)	Bearing Puller Attachment	1
(14)	Parts washing stand	1
(15)	Inner pipe inspection equipment	1
(16)	Precision valve grinding machine	1

4・8・5 The Electrical Repair Shop:

Since this shop is principally engaged in the repair and servicing of heavy electrical equipment, such as generators and motors, the equipment required for these operations is to be installed in the existing structure.

The following chart summarizes the various operations to be performed at this facility and the equipment required for each:

1) Locating the cause of electrical breakdowns:

Circuit Tester	3
Clamp Tester	1
Frequency Indicator	1
Powerfactor Indicator	1
Watt meter	1
Volt meter	1
Megohm meter	1
Tester	1
Grounding Resistor	1

2) Dismantling and servicing of electrical equipment

Coil winding machine	1
Battery Charger	1
Grinder	1
Drill Press	1
Drier	1

3) Inspection following equipment servicing

Circuit tester	3
Clamp tester	1
Frequency Indicator	1
Power-factor Indicator	1
Watt meter	1
Volt meter	1
Megohm meter	1

4・8・6 Other Equipment:

1) Carpenter Shop:

The following equipment is to be installed in the existing building to construct and repair wooden vessels:

Planer (already available)	1
Circular Saw (already available)	1
Circular Saw 600 mm ϕ	1
Mortising machine	1
Wood lathe	1

2) The Foundry:

The existing foundry has hardly any equipment at present. The following items will be provided:

(1) Casting equipment

Crucible Tilting Furnace		1
Alminum	34 Kg	
Bronze	114 Kg	
Cast Iron	80 Kg	
Spare Crucible	8 pcs	

(2) Forging Equipment

Cast Iron Anvil	1
Cast Iron Swage Block	1
Furnace w/Blower ϕ 2'	2

3) Painting Equipment

The following equipment is required to improve the efficiency of the painting operation and improve the quality of the paints:

1)	Jet Cleaning machine	2
2)	Hose for the above 20M	8
3)	Coupling 1/4"	10
4)	Gun	2
5)	Nozzle	20
6)	Hydraulic oil 20 lit	1
7)	Disc Sander	20
8)	Rubber Pat	10
9)	Retaining Bolt	10

10)	Retaining bolt for Brush	10
11)	Bevel Brush	200
12)	Disc paper	2,000
13)	Rubber Hose 9 m/m x 20M	5
14)	High-coupler	60
15)	Hose clip	100
16)	Airless Spray Unit	3
17)	Hose for the above 20M	20
18)	Gun Swivel	10
19)	Spray Gun	10
20)	Tip Filter	50
21)	Tip	20
22)	Spare parts kit	5
23)	Suction hose	6
24)	Air hose 9 m/m x 200M	3

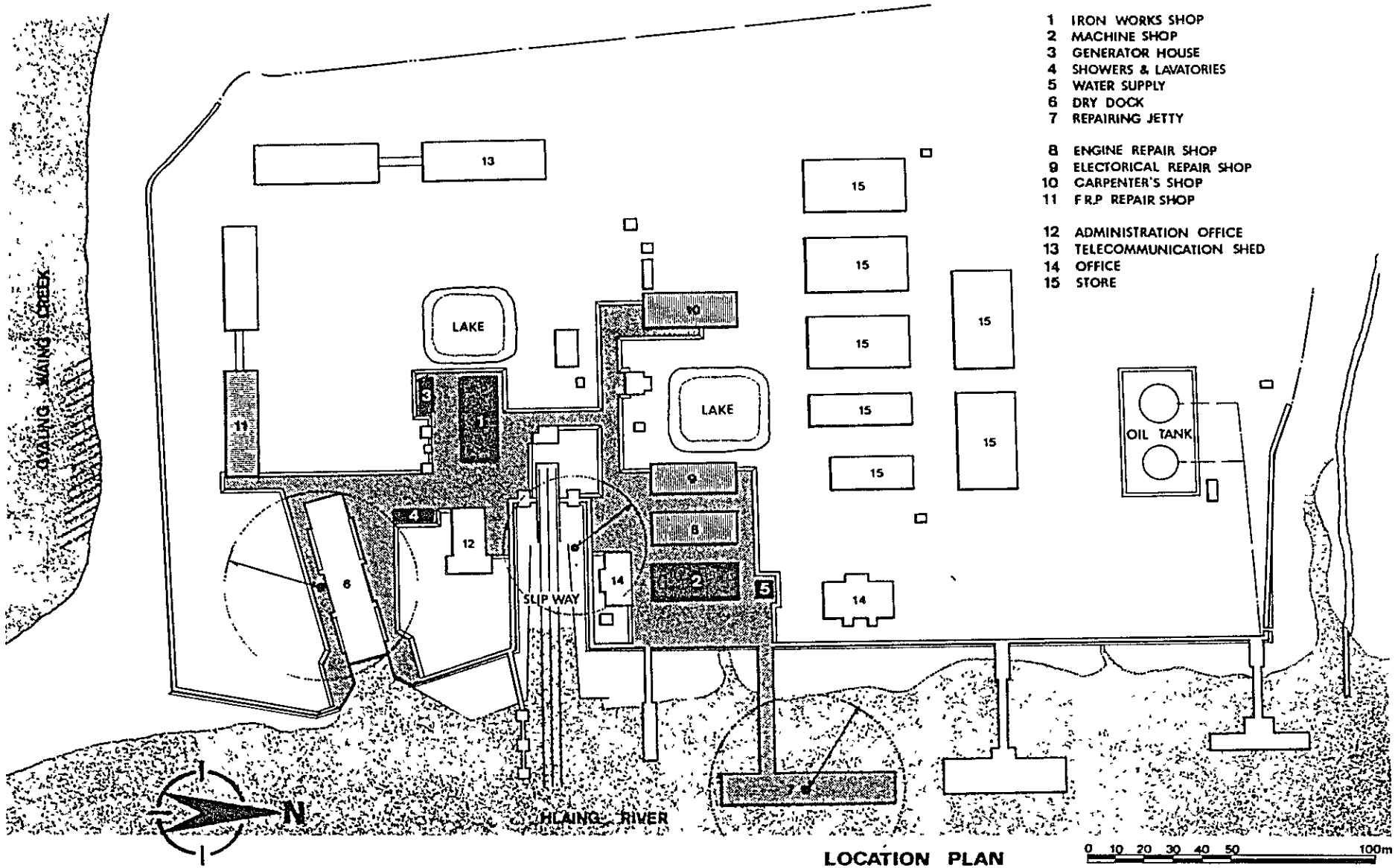
4) F.R.P. Repair Shop:

Equipment is required for use in repairing the PPFC's F.R.P. vessel.

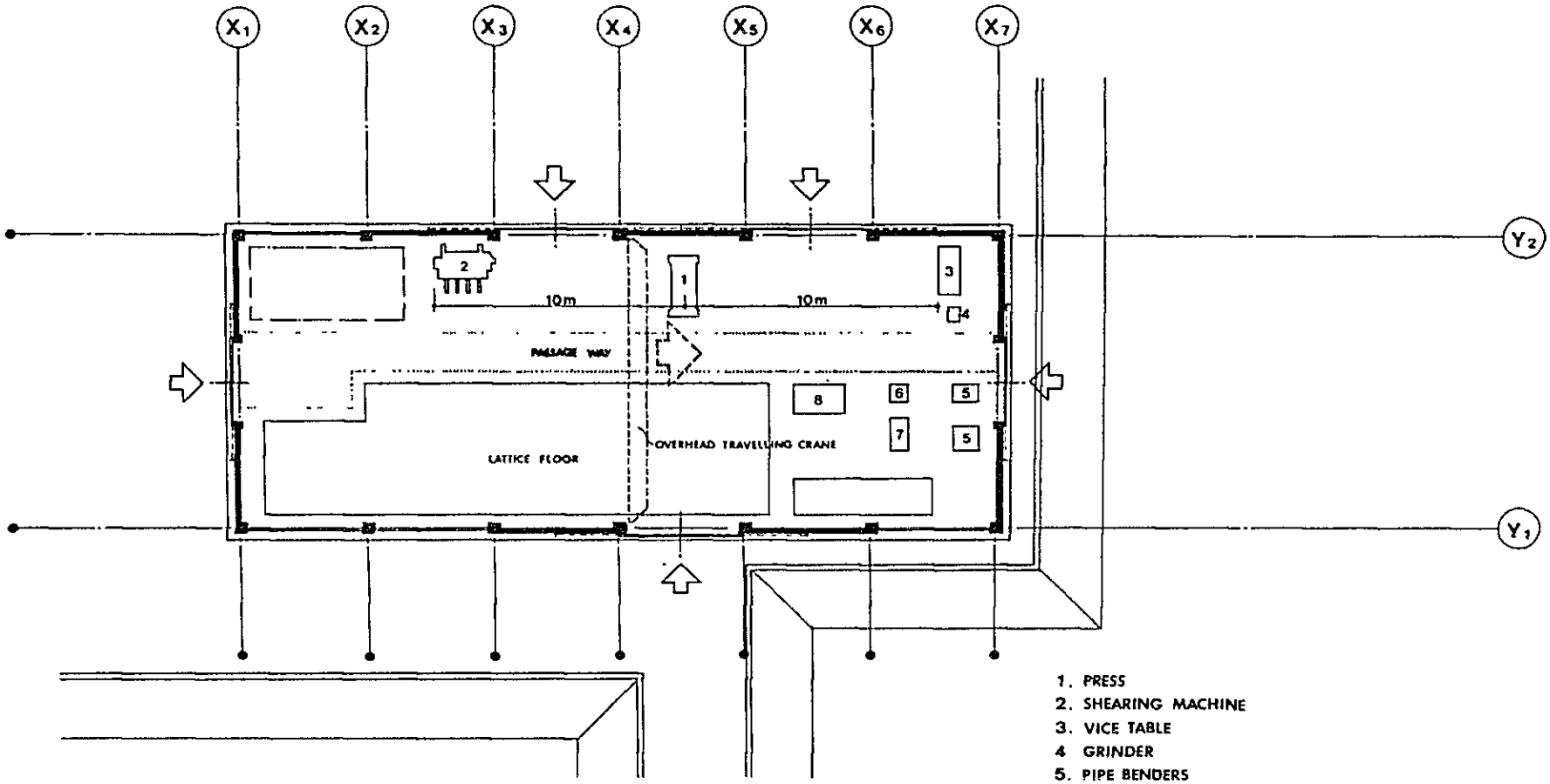
5) Parts and Materials for Emergency Repairs:

We have provided a minimum selection of spare parts and materials that are difficult to obtain locally for use in making emergency repairs on the PPFC vessels.

4・9 Basic Design Plans



LOCATION PLAN



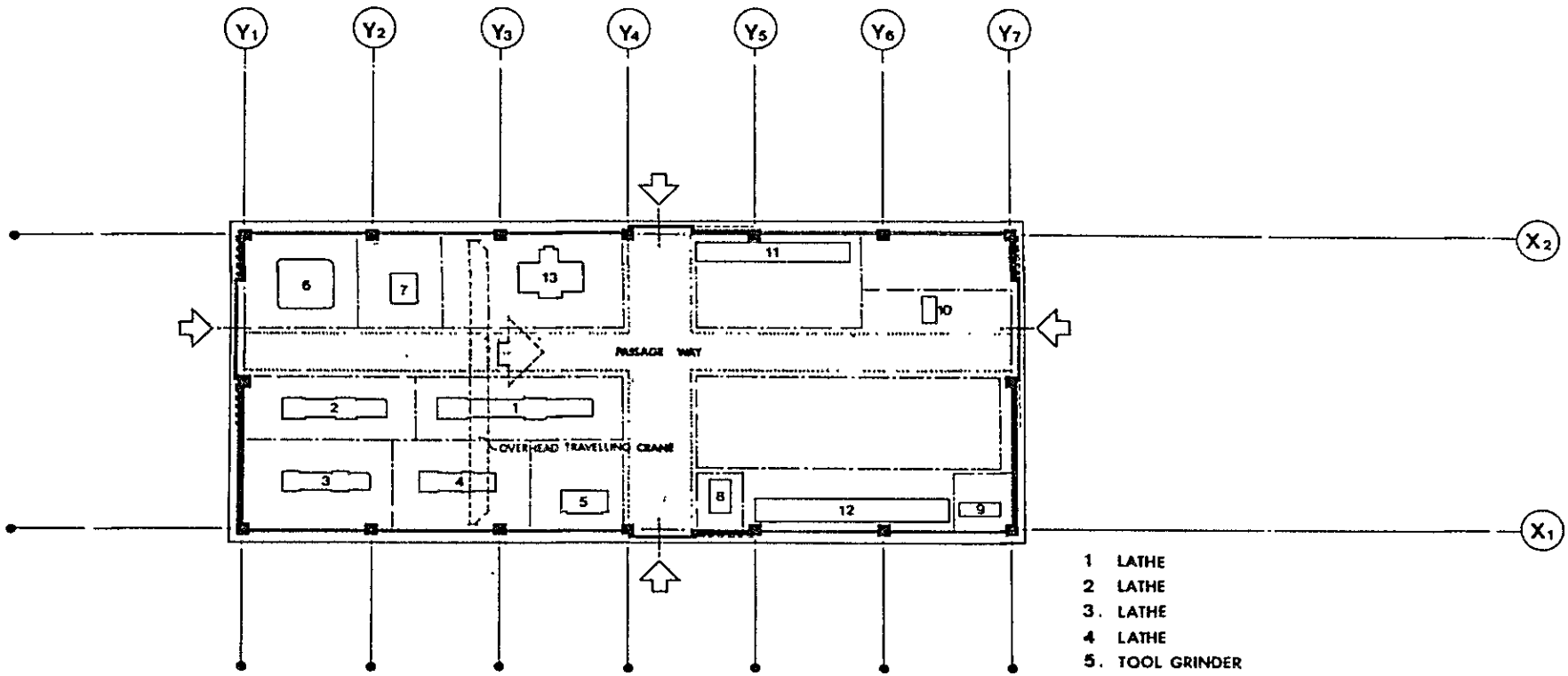
1. PRESS
2. SHEARING MACHINE
3. VICE TABLE
4 GRINDER
5. PIPE BENDERS
6. SAWING MACHINE
7 CUTTER
8. WORK TABLE

TOTAL FLOOR AREA ..... 360.0 m²

N

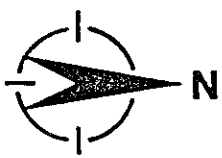
IRON WORKS SHOP FLOOR PLAN

0 1 2 3 4 5 10m

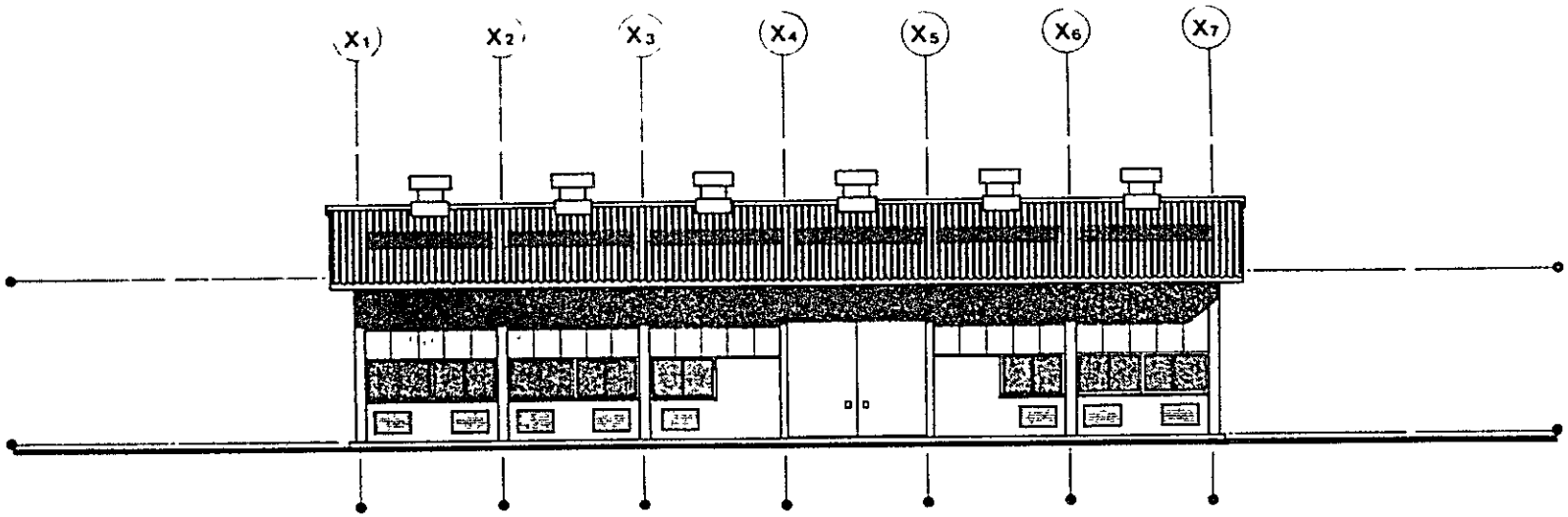


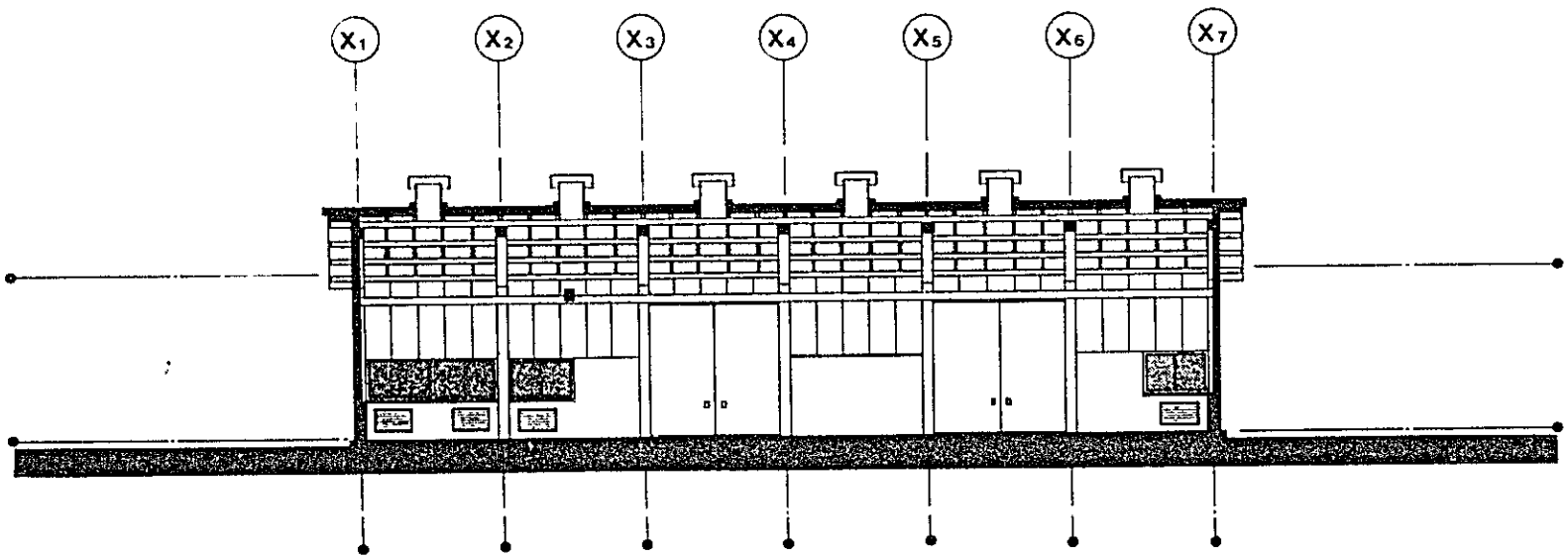
1 LATHE
2 LATHE
3. LATHE
4 LATHE
5. TOOL GRINDER
6. RADIAL DRILLING MACHINE
7. SHAPER
8. DRILL PRESS
9. GRINDER
10. SAWING MACHINE
11. TOOL & TOOL SHELVES
12. VICE TABLE
13. MILLING MACHINE

TOTAL FLOOR AREA ..... 360.0 m²



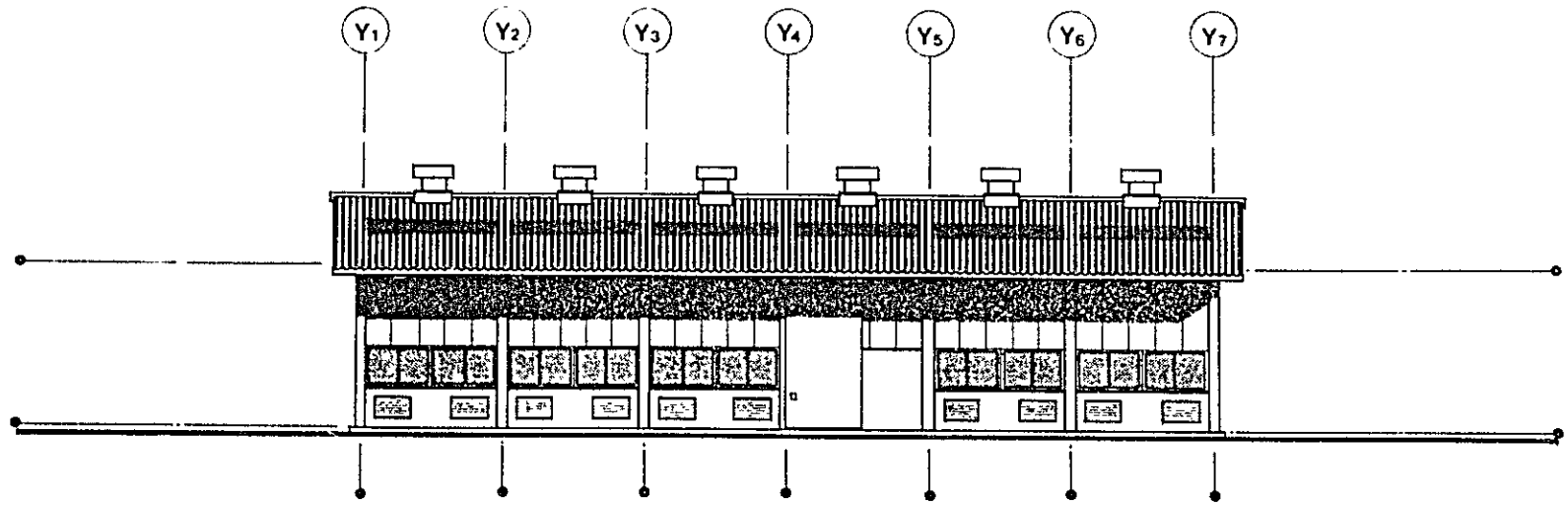
MACHINE SHOP FLOOR PLAN

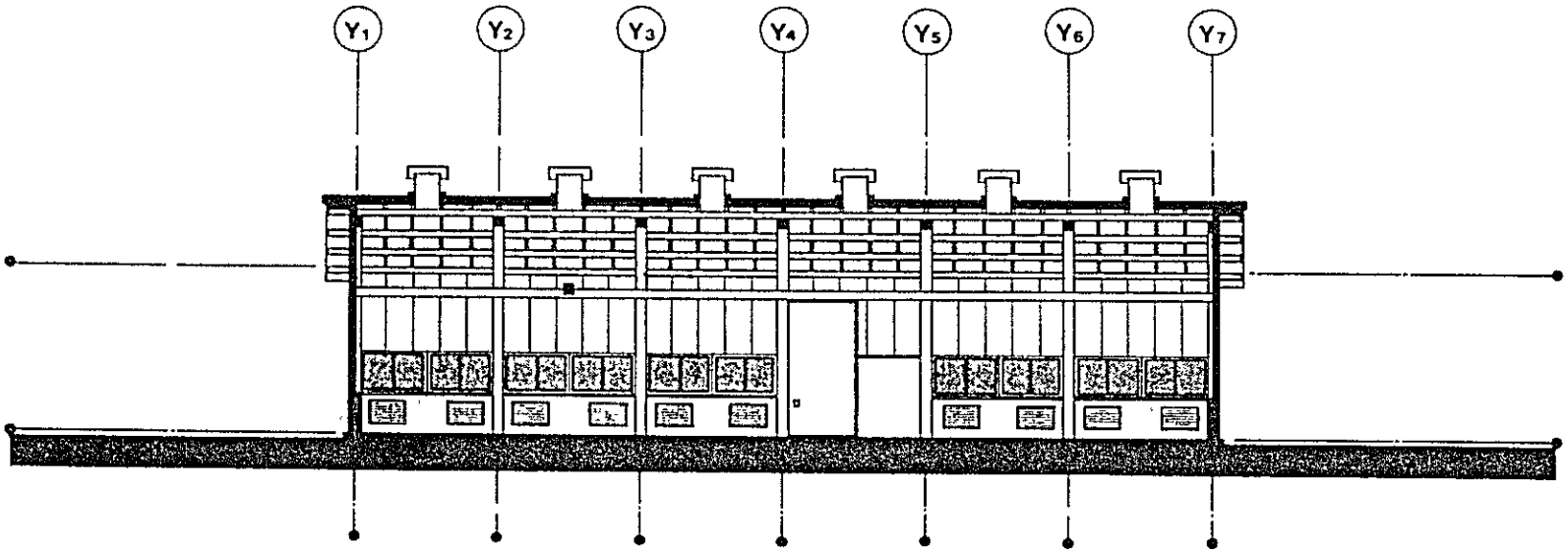




IRON WORKS SHOP ELEVATION & SECTION

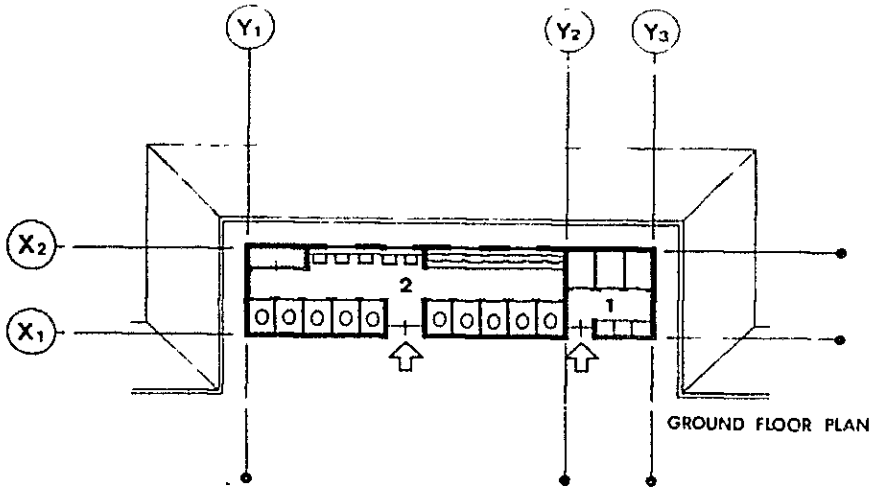
0 1 2 3 4 5 10m



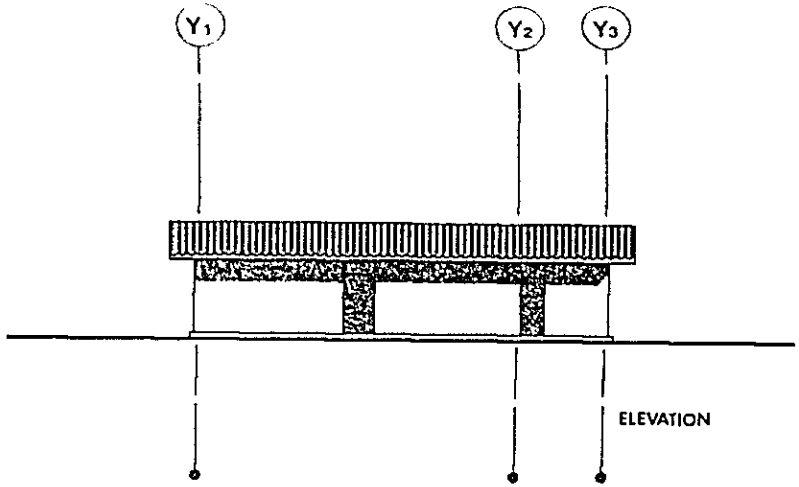


MACHINE SHOP ELEVATION & SECTION

0 1 2 3 4 5 10m

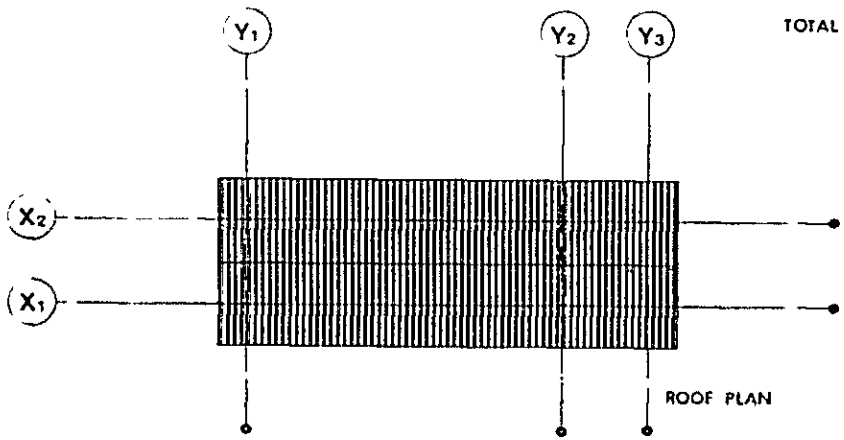


GROUND FLOOR PLAN

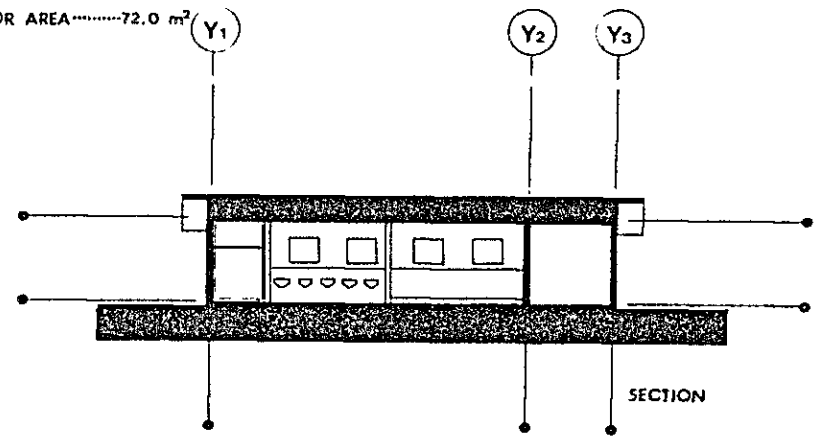


ELEVATION

1 SHOWERS RM 9 0 m²
2. LAVATORIES RM 33 0
TOTAL FLOOR AREA·····72.0 m²



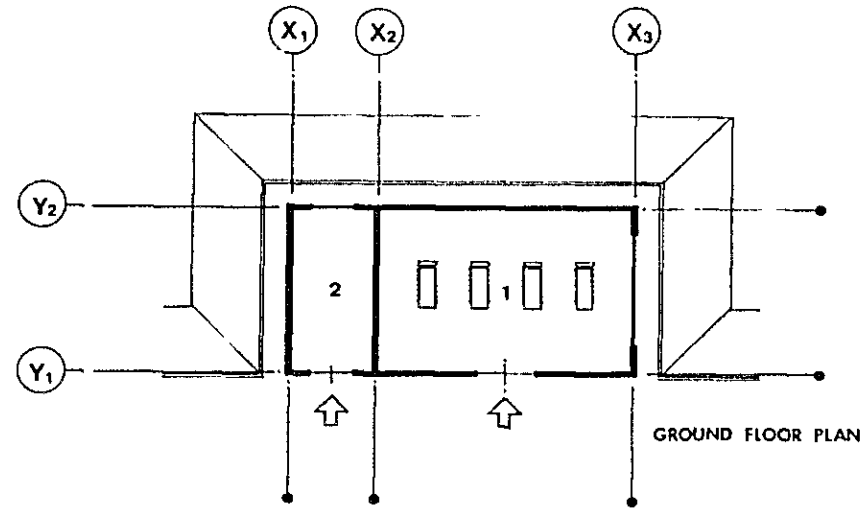
ROOF PLAN

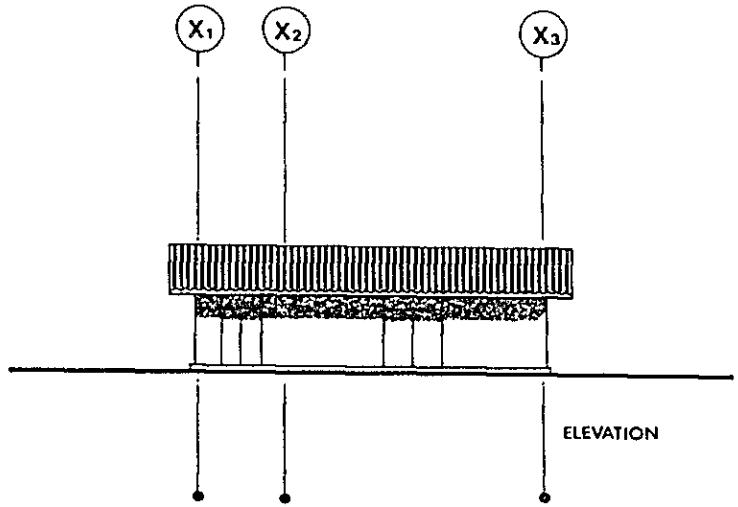


SECTION

BUILDING FOR SHOWERS & LAVATORIES FLOOR PLAN , ELEVATION & SECTION

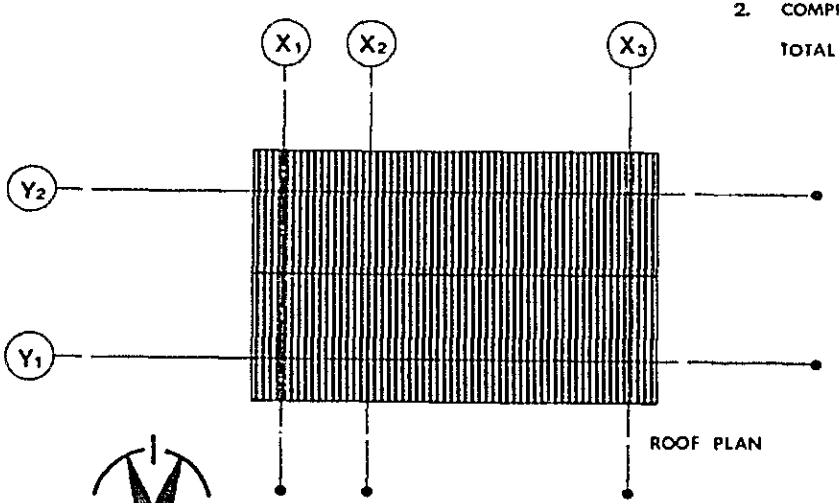
0 1 2 3 4 5 10m

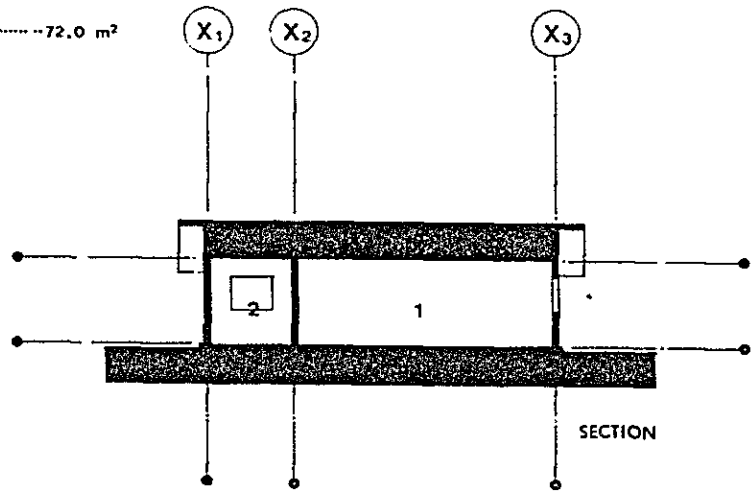


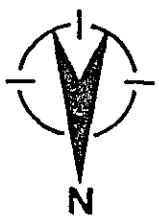


1. GENERATOR RM 54.0 m²
2. COMPRESSOR RM 18.0

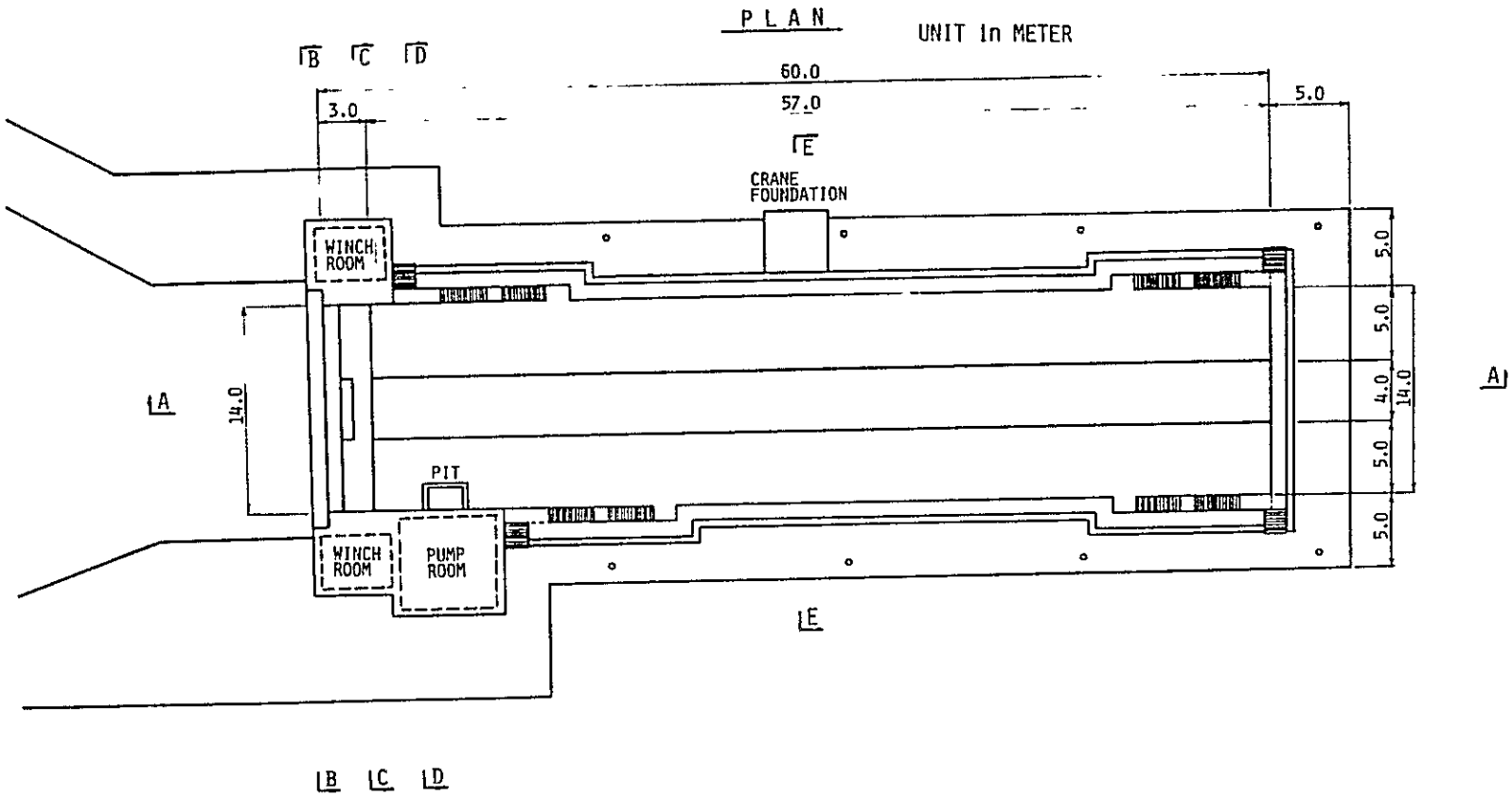
TOTAL FLOOR AREA ..... 72.0 m²



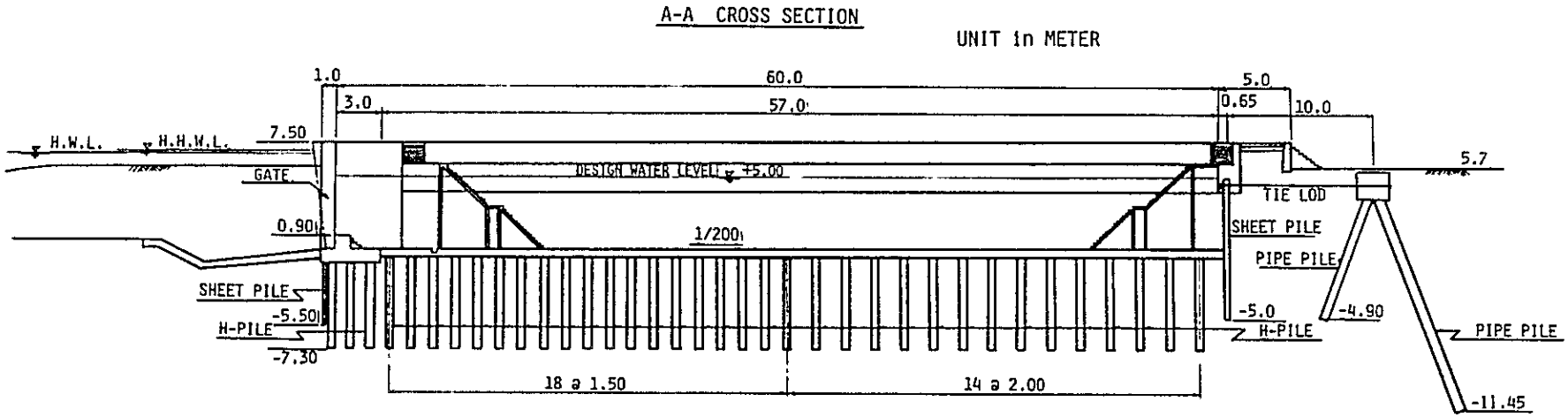




GENERATOR HOUSE FLOOR PLAN , ELEVATION & SECTION



DRY DOCK PLAN



DRY DOCK, SECTION (1)