THE SOCIALIST REPUBLIC OF THE UNION OF BURMA

REPORT ON GEOLOGICAL SURVEY OF THE MONYWA AREA

(FEASIBILITY REPORT ON THE MONYWA COPPER MINE)

PHASE Ⅳ
(VOL. Ⅴ)

July 1976

METAL MINING AGENCY

JAPAN INTERNATIONAL COOPERATION AGENCY

GOVERNMENT OF JAPAN

REPORT ON GEOLOGICAL SURVEY OF THE MONYWA AREA THE SOCIALIST REPUBLIC OF THE UNION OF BURMA PHASE Ⅳ (VOL. Ⅴ) METAL MINING AGENCY JAPAN INTERNATIONAL COOPERATI[ON] GOVERNMENT OF JAPAN

THE SOCIALIST REPUBLIC OF THE UNION OF BURMA

REPORT ON GEOLOGICAL SURVEY OF THE MONYWA AREA

(FEASIBILITY REPORT ON THE MONYWA COPPER MINE)

PHASE IV
(VOL. V)

July 1976

METAL MINING AGENCY

JAPAN INTERNATIONAL COOPERATION AGENCY

GOVERNMENT OF JAPAN

PREFACE

The Government of Japan, at the request of the Government of the Socialist Republic of the Union of Burma, decided to execute a series of field survey and studies on the fundamental articles, and also to establish a feasibility report, about the Monywa Copper Mine which is located on the western bank of the river Chindwin in central Burma.

Thus, the Japanese Government entrusted the Metal Mining Agency of Japan (MMAJ) to undertake and carry out the survey project aforementioned through the Japan International Cooperation Agency (JICA).

The scope activities of the survey project chiefly covered the following field activities:

Geological reconnaissance, Topographic survey, Geophysical survey, Core drilling, Overburden stripping, Tunneling, Concentrating test by a 50 t/d pilot plant, and the Infra-structural survey of the Monywa area, as well as a Feasibility Study of the copper project.

All of these miscellaneous surveys were successfully accomplished during the four fiscal years from 1972 to 1975 by the gratis technical cooperation of the Government of Japan with the support and cooperation of Myanma Mineral Development Corporation (MMDC, now called as No. 3 Mining Corporation) and other departments of the Government of Burma, together with the said Japanese agencies.

Through these preliminary activities, a probable ore reserve of about 94,000,000 ton with copper grade of 0.84% has been proved, and a suitable concentrating method for precise separation of the complicated ore, composed of minute particle of chalcocite and pyrite, has been nearly established, although this was originally considered to be difficult.

In addition, the mine has been found excellent particularly in regard to its natural and environmental situation, and also its economic viability has been clarified.

A report has been compiled of all these results with synthetic analysis and this contributes the feasibility report which will be presented to the Government of Burma. On this occasion of the completion of the feasibility report, it is sincerely hoped that the report will result in the development of the Monywa Copper Project, and will contribute to the economical evolution of the Socialist Republic of the Union of Burma, particularly to the region of which Monywa is considered to be the center.

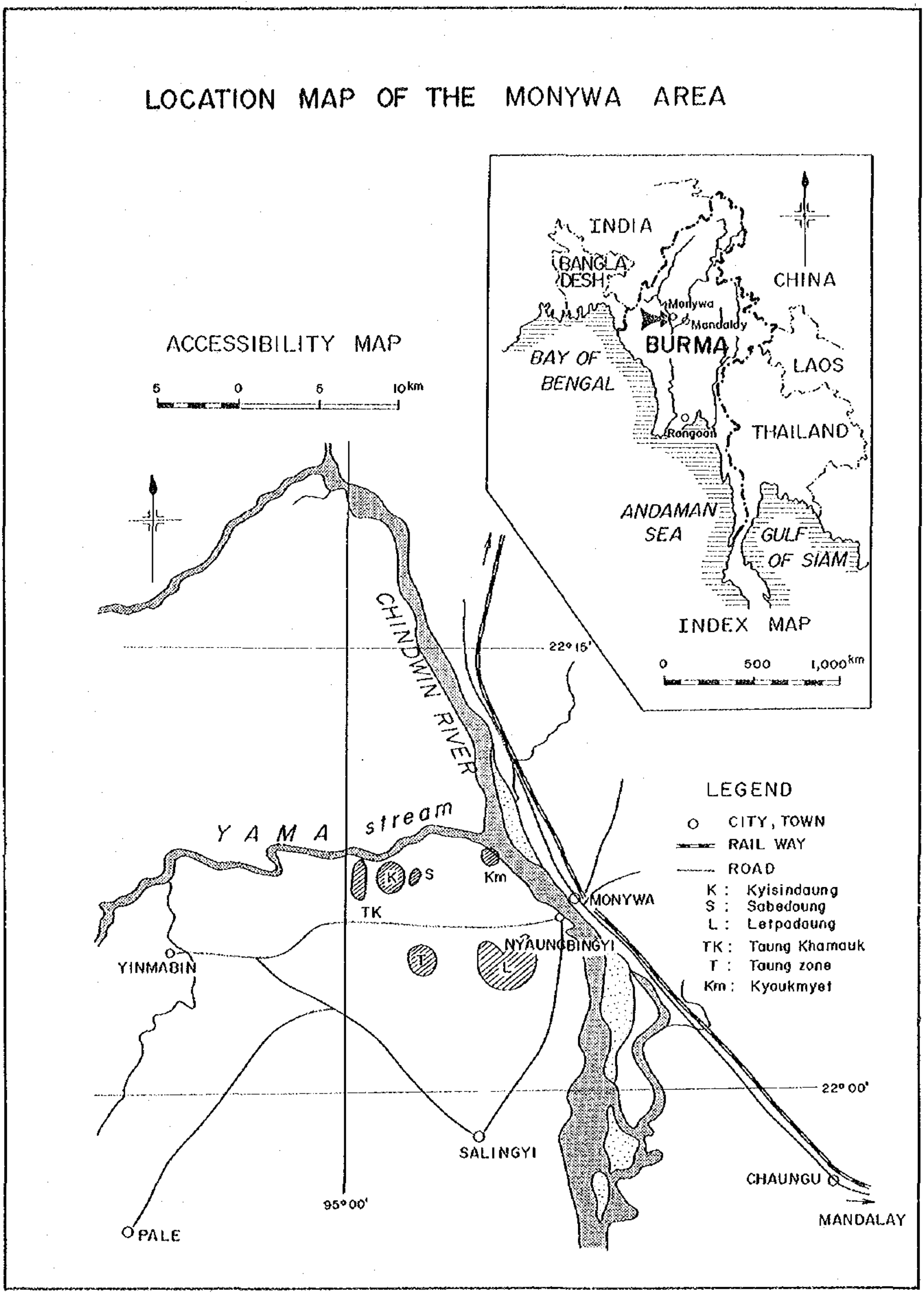
It is also fervently wished that the completed cooperative survey will further support the inseparable friendship between Burma and Japan.

In closing the preface, we would like to express our profound and heartfelt gratitude to the Government of the Socialist Republic of the Union of Burma and her authoritative corporations, as well as to the relevant authorities of the Ministries of Foreign Affairs, International Trade and Industry, and other Ministries concerned of the Government of Japan.

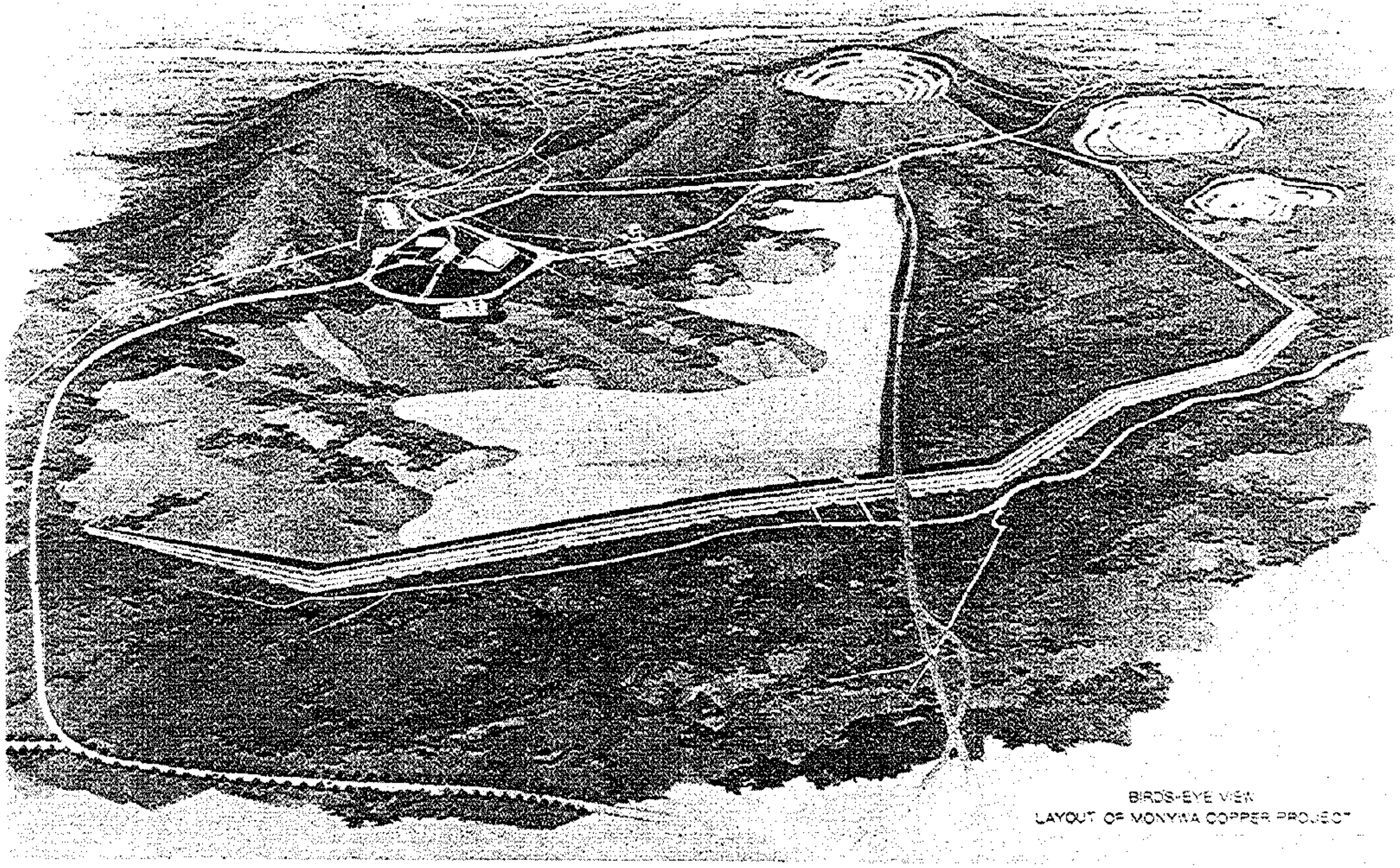
July, 1976

Shinsaku Hougen
President
Japan International Cooperation Agency

Yasuaki Hiratsuka
President
Metal Mining Agency of Japan



LOCATION MAP OF THE MONYWA AREA
INDIA
BANGLA DESH
CHINA
Monywa
Mandalay
BURMA
BAY OF BENGAL
LAOS
Rangoon
THAILAND
ANDAMAN SEA
GULF OF SIAM
INDEX MAP
0 500 1,000km
ACCESSIBILITY MAP
5 0 5 10km
CHINDWIN RIVER
22° 15'
YAMA stream
K
S
Km
TK
MONYWA
NYAUNGBINGYI
YINMABIN
T
L
22° 00'
SALINGYI
95° 00'
PALE
CHAUNGU
MANDALAY
LEGEND
CITY, TOWN
RAIL WAY
ROAD
K : Kyisindaung
S : Sabedaung
L : Letpadaung
TK : Taung Khamauk
T : Taung zone
Km : Kyaukmyet



BIRD'S EYE VIEW

PROPOSED LAYOUT OF MONYWA COPPER PROJECT

FEASIBILITY REPORT ON THE MONYWA COPPER PROJECT

CONTENTS

****

List of Figures

Chapter 1 INTRODUCTION

CHAPTER 1.　INTRODUCTION

Since 1972, the basic cooperative surveys for the development of the copper resources in the Monywa area of the Socialist Republic of the Union of Burma have been carried out during four fiscal years, under a bi-lateral agreement between the Governments of Burma and Japan.

The surveys have been organized by the cooperation of Myanma Mineral Development Corporation (hereafter as MMDC, though it is called No. 3 Mining Corporation now), Metal Mining Agency of Japan (MMAJ), and Japan International Cooperation Agency (JICA).

The survey were composed of a geological survey, a geophysical survey, core drilling, overburden stripping, tunneling, ore excavation, pilot mill construction, and concentrating test, as well as an infra-structural survey and a study to decide on the optimum scale and method of the exploitation of the mine.

There are 3 groupes of copper ore deposits know in the Monywa area; they are Sabedaung, Kyisindaung, and Letpadaung.

However, the feasibility report has been established only for Sabedaung and Kyisindaung.

The feasibility report may be regarded as the final summary of all the survey activities related to the Monywa copper project under the bi-Governmental agreement mentioned above.

In compiling the report, careful consideration has been given not only to the results of the said surveys but also to the ore reserves, ore grade, other natural conditions which affect the opening the mine, miscellaneous local factors, foreseeable demand and supply circumstances of world copper market, as well as the possible pollution problems not to be avoided in the development of the mine.

The scale of the ore deposits of Sabedaung and Kyisindaung, the two major areas of importance of the Monywa copper project, allow it to be ranked as one of the important and accessible projects for copper resources in the world. This is because it benefits fundamentally from the climate, water supply, transportation situation, power supply, labour supply, etc.

Particularly to be appreciated are the existence of big rivers, and also an urban community in its vicinity, together with the spaceous area available for the extension layout of the project. However, regarding the transportation facilities and the transmission line for power supply, some amount of supplementary investment in the existing installations will fulfill the relevant requirement without difficulty.

These factors are quite favourable for the opening and running of the mine. Annual production of 2,400,000 MT of crude ore is the planned scale of the mine, and this will permit the production of copper concentrate equivalent to an annual maximum of 20,000 MT of copper metal. The period necessary for the construction of the mine is planned at 4 years and the period of actual operation is scheduled to be 15 years.

The estimated amount of the initial investment needed for the development is $81,323,000, while the amount for the infrastructures has been calculated at $9,042,000. Of these amounts, the requirement of foreign exchange is $54,744,000 for the initial investment, and $6,023,000 for infrastructures, respectively.

The total of these amounts is $60,767,000, and is to be procured in 5 successive years. If in addition to the aforementioned funds sufficient support and cooperation are obtained from the Burmese government and other authorities for the following items, the mine will be satisfactorily established with a considerable amount of profit:

(1) Materialization of infrastructures.

(2) Exemption from Import duties on the machinery and materials for the project.

(3) Exemption from Income taxes for the incorporated association.

(4) Smooth supply of locally procurable materials.

Under these presumption, the critical price of copper on inventory is estimated at approximately 77¢/lb, and over 10.0% of internal return of interest can be expected for a copper price above 80¢/lb, with an interest rate of 7.5% for the funds procured for the project.

Out of the mineable ore deposits, Sabedaung deposit is the highest in ore grade with thinner overburden, thus it has a very advantageous natural condition.

On the other hand, Kyisindaung deposit is a little less advantageous on those points mentioned above. In the present report, it has been planned to work also a part of the Kyisindaung deposit for the sake of effective utilization of the resources. However, before the start of the exploitation of Kyisindaung, the prevailing financial circumstances, as well as the copper price and other fundamental factors should be much more carefully studied, to decide the further policy on its actual development.

At a later stage of the operation, should an increase in the copper price, or some other major change in the operational circumstances occur, the enlargement or expansion of the production should be discussed on the basis of the synthetic exploitation of Kyisindaung deposit, as well as the development of possible new deposits in the Monywa area.

At the same time, the greater the improvement in the local circumstances such as material flow and supply and the skill of the workers, in comparison with the initial assumptions, the more the technical or operational efficiency will be increased, thus ensuring the success of the project.

Along with the development of the mine, a strong effect can be expected from the mine on the economic activities of the surrounding community of the region.

In start, increase in employment, and other related effects on the regional economy will certainly be noticed.

In the present plan, the interest for the foreign exchange borrowed is also assumed at the same annual rate of 7.5% as that of the local funds. However, if the foreign exchange could be borrowed at the annual rate of 3.0%, then an annual amount of around $10,000,000 could be expected to be earned in foreign exchange in the early stage of the operation even with a copper price of 80¢/lb. The result of the said calculation is shown in the following table.

($1,000)

Item	Cu 70¢/lb	Cu 80¢/lb	Cu 90¢/lb	Remarks
Accumulation for 15 years				
[Income in Foreign Exchange]				
Copper Concentrate	247,614	289,662	331,709	1. Interest rate of Foreign Exchange being set at 3% per annum
[Expenditive in Foreign Exchange]				
Operation & Sales Cost	87,101	87,206	87,311	
Additional Investment	68,411	68,411	68,411	2. Interest rate of the Surplus Fund to be employed is not considered
Interest for Borrowed Maney	16,108	16,108	16,108	
Total	171,620	171,725	171,830	
Balance of Foreign Exchange	75,994	117,937	159,879	3. Local currency account is to be separately controled apart from the account on Foreign Currency. And the shortage of the former should not be conpensated by the latter.
Annual Income in Foreign Echange				
1 F.Y.	5,808	9,429	13,050	
2	9,778	13,511	17,244	
3	9,331	13,041	16,690	
4	9,216	12,865	16,514	
5	6,488	9,286	12,084	4. The returning of the Foreign Exchange is to be accomplished by the annual payment of what corresponds to the amount of Drepreciation and Amortization
6	6,141	8,939	11,737	
7	4,979	7,578	10,177	
8	△ 553	2,047	4,646	
9	3,597	6,186	8,776	
10	4,494	7,083	9,673	5. F.Y. stands for each fiscal year of the operation
11	3,091	5,620	8,150	
12	2,432	4,601	6,769	
13	2,415	4,584	6,753	
14	2,948	5,117	7,286	
15	5,769	8,050	10,330	

Chapter 2 OUTLINE

CHAPTER 2. OUTLINE

2-1 OUTLINE OF MONYWA COPPER MINE

2-1-1 Natural Circumstances

(1) Location and Traffic

The mine under the project is located at the northern most part of Salingyi Township, Sagain Division, in the Socialist Republic of the Union of Burma, about 150 km to the west of Mandalay city. In other words, it is located at 22°06'N in latitude and 95°08'E in longitude.

From Mandalay to Monywa city which lies approximately 135 km to the west, there is both a railway and a national road. After crossing the Chindwin river by ferry boat, the mine area can be reached by a road which runs along the western bank of the Chindwin to the north of the west bound national road.

There is also inland water transportation from Rangoon to Monywa city through the rivers Irrawaddy and Chindwin, utilizing various ships with shallow draft. (Fig. 2-1)

(2) Topography

The mine site is located in a flat area of Central Burma, the elevation of which is round about 75 m to 100 m ASL (above sea level) with regional gentle rolling hills. Furthermore, the area is characterized by occasional presence of prominent volcanic hills.

The hills in the area include Sabedaung, Kyisindaung, Letpadaung, Taungkhamauk, Chadwindaung, and Shwebontataung.

In the east of the area, the Chindwin river flows in a southerly direction while in the north the Yama stream runs towards the east and meets the Chindwin not so far from the mine site.

(3) Climate

The climate can be fundamentally divided into a dry season lasting from November to April and a rainy season lasting from May to October.

Of the dry season, the months between November and January may be considered as winter because of the comparatively low temperature.

The annual rainfall amounts to nearly 800 mm, and it falls mostly in rainy season. Thus the climate of the region can be classified as an arid one. The maximum and minimum temperatures have been recorded as 45.6°C and 8.9°C, respectively. Usually the daily change in temperature is remarkable, owing to the location far from the sea.

Hazardous storms have not been reported in the region. The monthly rainfall and temperature are shown in Table 2-1, according to the statistical records.

Table 2-1 Monthly Rainfall and Temperature

Item	Unit	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total / Average
Rainfall	mm	3	1	4	19	94	96	52	106	218	174	13	8	789
Max. Temperature	°C	28.5	31.6	36.3	40.0	37.8	34.8	34.6	33.8	33.4	32.4	30.4	27.8	33.5
Min. Temperature	°C	13.9	15.7	19.7	24.1	25.9	26.0	26.2	25.9	25.4	23.8	19.8	15.0	21.8

(4) Inhabitant , Facies of Animal and Vegetation

The urban area of Monywa, on the eastern bank of the Chindwin, has a population of approximately 200,000, while the population in the mine area is estimated at around 10,000, including the villages scattered in the vicinity. Some of the said villages are distributed either along the river banks or on the cultivated land along the national road. The villagers obtain their livelihood mainly from agriculture and animal breeding.

Other places are almost nothing but unused wild grounds.

Tall trees are rarely found except in the narrow zones along the rivers or in inhabited sectors. Sugar palm trees prevail in the lower plains where there is plenty of subsurface water. Away from the cultivated or planted sectors, the land is usually covered either with thinly grown shrub or with seasonal greenery. However, some areas are desert like wild land with very scarce vegetation because of the strongly alkaline surface soil. Wild animals are also rare in the region, except some poisonous snakes such as cobra, viper, etc.

2-1-2 Geology and Ore Deposit

The mine area occupies part of the local basin formed along the eastern periphery of the Salingyi Uplift Blick, which is located approximately at the center of a wide flat area of Central Burma.

It is supposed that the basin occurred as a result of regional subsidence caused by faults, and consequent or subsequent active volcanic activities. Various types of sedimentation are also observed to have taken place.

The Monywa copper deposits are chiefly composed of ore deposits which are well developed in the vicinity of the prominent volcanic hills scattered in the Monywa Basin as mentioned above. The deposits are largely classified into 3 groups, that is, Sabedaung, Kyisindaung, and Letpadaung.

The volcanic hills are, lava domes of the biotite porphyry, which were formed by the volcanism during oligocene in tertiary.

The ore deposits are defined as epithermal disseminated copper deposits accompanied by rhyolite dykes which intrude in or around the aforementioned lava domes. The major ore minerals are pyrite and the secondary mineral, chalcocite, where the latter has been enriched by meteorologic water reaction.

The deposits are generally distributed in horizontal, lenticular masses under the overlying oxidized leached zone of 10 m to 200 m in thickness.

Out of the 3 groups of the ore deposits mentioned above, it is scheduled that the Sabedaung and Kyisindaung deposits are to be exploited.

By means of geological reconnaissance, geophysical survey, and core drillings which have been carried out over the last years, the presence of the following amount of ore reserves has been clarified and shown in Table 2-2.

Table 2-2 Ore Reserves and Ore Grade

Name of Deposit	Ore Reserve (MT)	Copper Grade (%)
Sabedaung	25,717,000	1.01
Kyisindaung	66,538,000	0.77
Sabedaung South	2,158,000	0.77
Total	94,413,000	0.84

(Remarks) Cut-off Grade 0.30 %

2-2 OUTLINE OF DEVELOPMENT PROGRAM

2-2-1 Production Program

The copper concentrate is planned to be produced in the mineral beneficiation of the crude ore excavated by open pit mining from the ore deposits of Sabedaung, Sabedaung South, and a part of Kyisindaung in this order. The operational years and annual working days are to be set at 15 years and 300 days, respectively, while the production scale of the crude ore is planned at 8,000 MT per day.

Mineable ores, ore grades, volumes to be stripped, and the stripping ratio W/O of the deposits are respectively shown in Table 2-3. Furthermore, the yearly production of the deposits, etc. are listed in Table 2-4, respectively.

Table 2-3 Mineable Ores, Stripping Ratio, etc.

Item	Unit	Sabedaung	Kyisindaung	Sabedaung South	Total
Mineable Ores	10^3MT	24,000	10,000	2,000	36,000
Ore Grade	% Cu	0.915	0.711	0.777	0.851
Metal Content	MT	219,648	71,172	15,540	306,360
Volume to be stripped					
Preliminary stage	10^3MT	2,300	12,000	1,500	15,800
Operational stage	10^3MT	13,588	24,700	4,630	42,918
Total	10^3MT	13,588	36,700	6,130	58,718
Stripping Ratio					
Preliminary stage	~	0.096	1.200	0.750	0.439
Operational stage	~	0.566	2.470	2.315	1.192
Total	~	0.662	3.670	3.065	1.631

Table 2-4 Yearly Production, etc

Fiscal Year	Crude Ore	Crude Ore Grade	Amount of Concentrate	Grade of Concentrate	Metal Content	Concentrating Reconery	Volume Stripped
	10^3MT	%	DMT	%	MT	%	10^3MT
1	2,400	1.070	66,597	30.0	19,979	77.8	788
2	2,400	1.070	66,597	30.0	19,979	77.8	930
3	2,400	1.050	65,100	30.0	19,530	77.5	910
4	2,400	1.050	65,100	30.0	19,530	77.5	798
5	2,400	0.849	49,920	30.0	14,976	73.5	830
6	2,400	0.849	49,920	30.0	14,976	73.5	1,168
7	2,400	0.805	46,367	30.0	13,910	72.0	1,680
8	2,400	0.805	46,367	30.0	13,910	72.0	1,942
9	2,400	0.802	46,197	30.0	13,859	72.0	2,265
10	2,400	0.802	46,197	30.0	13,859	72.0	2,277
11	2,400	0.789	45,130	30.0	13,539	71.5	6,090
12	2,400	0.706	38,689	30.0	11,607	68.5	6,090
13	2,400	0.706	38,689	30.0	11,607	68.5	6,090
14	2,400	0.706	38,689	30.0	11,607	68.5	5,530
15	2,400	0.706	38,689	30.0	11,607	68.5	5,530

The schedule has been established in careful consideration of the yearly trends of the concentrate production and stripping volume, in order to achieve the best economical results.

The requirement of the personnel to be registered for the project is also estimated to be from 1,200 persons to 1,500 persons during the operational period, although the actual numbers will shift year by year.

2-2-2 Construction Schedule and Work Plan

(1) During the construction period of 4 years, the following projects are to be carried out;

a) Various detailed designs

b) Checking of the distribution of ore grade

c) Preliminary stripping at Sabedaung

d) Construction of the Concentrator and other facilities

e) Arrangement and Repairs of Jetties, Road, etc.

f) Education and Training of the employees

At the end of this period, the running test of the concentrator as well as an operation test are also to be planned. For the construction, the ballast crushing plant, butcher plant, heavy machinery and vehicles, etc. are also to be installed.

(2) Mining

Open pin mining is to be adopted. The volume to be stripped in the initial stage is estimated at 2,300,000 MT for Sabedaung, and at 13,500,000 MT for Sabedaung South and Kyisindaung respectively. The preliminary stripping at Sabedaung is to be done during the construction period while the preliminary stripping at Sabedaung South and Kyisindaung will be carried out much late, during the 8th to 10th fiscal years.

The pit slope in mining is to be set at 38 degree with each bench height of 10m, and later the final pit slope is to be set at between 40 to 45 degrees.

Drilling is to be done at 4 inches in diameter, and the blasting will be carried out using explosives, mostly of AN-FO. The broken ore and waste are to be mucked by 6m^3 class front end loaders to 32t class rear dump trucks, then transported to either the concentrator or to the waste dump area.

A waste dump area is to be provided in the open wasted land to the south of Sabedaung, with a total area of 118 ha and a capacity of 30,000,000 MT.

In addition, other equipments and facilities such as heavy machinery, vehicles, drainage pumps, lighting, magazine, and miscellaneous buildings are also to be installed, with relevant access roads as necessary.

(3) A concentrator with a maximum capacity of 8,800 MT is to be constructed at the southern foot of Taungkhamauk, together with primary, secondary and tertiary crushers, grinding mills, flotators, and a filtration plant for the concentrate.

The copper ore of Monywa is a mixed ore of minute particles of chalcocite coexisting with pyrite in a compact texture, thus a comminution into finer grains is essential to separate the chalcocite from the basal pyrite.

No washing facility is to be installed, for there is only a small amount of primary sline in the crude ore.

All slime copper flotation is to be introduced with a scavenger-cleaning circuit to produce copper concentrate. In this circuit the rougher froth concentrate is reground to -325 mesh to recover as much of the copper mineral as possible.

8,000 MT per day of crude ore is to be processed for the recovery of copper concentrate.

The waste tailing pulp is to be sent to the waste tailing pond which is to be built on open ground to the east of Taungkhamauk, in the south of Kyisindaung. The waste tailing pond is to be built with a total area of ca. 285 ha and a capacity of 32,349,000 m^3. It is to be encircled by stone block banking consisting mostly of the waste from the overburden stripping.

At the same time, a lime calcining plant, assay laboratory and metallurgical testing room are to be provided as facilities attached to the concentrator.

(4) Transportation

From the mine to the railway terminal north of Monywa, on the eastern bank of the Chindwin river, a new 13.7km length of main road is to be constructed. Other mine roads or lanes will also be constructed, while repairs to the existing national road for a length of 8.6km, as well as the construction of 2 jetties, railway service yards and other miscellaneous warehouses are to be carried out.

On the other hand, a 50t class landing craft, 8t class rear dump trucks and other handling machinery are to be provided for the transportation of the concentrate and materials between the mine site and Monywa city.

The transportation from Monywa to Rangoon is planned to be undertaken by the Burma National railway. However, in addition to this, a 300t class landing craft is also to be procured in order to provide an additional transportation route by river.

(5) Electric Power

The planned electric capacity of all the equipment and installations of the mine amounts to 14.2 MW, where the maximum electric power requirement is estimated at 9.2 MW.

The electric power is to be supplied by the Myanma Electric Power Corporation through a transmission line which is to be constructed as part of the infra-structural project.

After being received by the sub-station of 13 MVA in output capacity at the eastward of Taungkhamauk, the power is to be distributed to the miscellaneous installations of the mine.

The traverse length of the main distribution line is estimated at 9 km.

In parallel to the construction of these facilities, other installations such as delivery power lines, lighting and communication facilities are also to be provided for the project.

(6) Water supply

The maximum daily water supply requirement of the mine is expected to be 40,000 t. To the north east of Kyisindaung on the bank of the Yama stream, an in-take station is to be constructed with a tank, pond, pump and other water supply facilities. From the station, the water is to be pumped up through a pipe line to the head water tank on the eastern mountain side of Taungkhamauk, and then to being delivered to the concentrator and other facilities.

(7) Additional Facilities

In the vicinity of the concentrator, work shops for mechanical and electrical repairs, a saw mill or carpenters' work shop, and a motor pool are also to be provided, together with the machinery for processing and manufacturing at the mine site.

In addition, an administration office, ware-houses for materials, miscellaneous buildings, service yards, as well as a fuel supply station with storage tanks for kerosene and gasoline, are also to be constructed.

Furthermore, material handling and hauling machinery, common use devices, and also vehicles for general use are to be installed.

(8) Living Facilities

To the north of Taungkhamauk and Kyisindaung, on the hill slope toward the Yama stream, a mine town of 2,000 in overall population is to be constructed. It will have 271 mine houses, bachelors' dormitories, a guest house, as well as a school, medical clinic, shops, and other buildings. The mine town is to be installed on an area of 16.0 ha within the developed ground of about 32.8 ha.

At the same time, a commuting road, park, sports ground, water supply, sewage duct and other necessary facilities are also to be provided.

2-2-3 Infra-structure

Both the power supply facilities needed for the development of the mine, and the establishment of the transportation between the mine and Rangoon are to be ensured by other Governmental organizations, etc. These initial projects will be based on a separate account apart from the development of the mine, that is they will be included in the so-called "infra-structural program".

These two items mentioned above are indispensable for the development of the mine, thus they should be completed half a year in advance of the start of the operation of the mine. Outlines of these two projects are as follows;

(1) Construction of Transmission line

One transmission line of 132 kV in voltage is to be constructed for a length of 128 km, from the gas turbine power station at Kyunchaung to the sub-station at the mine.

Construction period is estimated at about 3 years.

(2) Railway and Related Facilities

For the transportation of the concentrate and other materials, an extension line of around 1.5 km is to be constructed along the eastern bank of the Chindwin to the north of Monywa city.

4 diesel engine locomotives with 93 freight cars of 18 ton loading capacity are to be installed for the aforementioned transportation.

(3) Construction and other costs

Transmission line, etc.	$ 3, 940, 000	(Foreign currency, $2, 090, 000 included)
Railway facilities	$ 5, 102, 000	(Foreign currency, $3, 933, 000 included)
Total	$ 9, 042, 000	(Foreign currency, $6, 023, 000 included)

2-2-4 Capital Investment

Initial investment has been estimated for the construction period of 4 years and also for a part of the first year of the operation period.

The respective amounts are as listed in Table 2-5.

Table 2-5 Initial Investment

(Unit : $ 1, 000)

Item	Total	-4	-3	-2	-1	1	Remarks
Miscellaneous Facilities, etc.	53, 163	4, 889	18, 527	15, 253	10, 945	3, 549	Preliminary Stripping at Sabedaung included
Contingency	2, 658	244	926	763	548	177	5% of various installation cost
Technical Fees	4, 962	489	1, 853	1, 525	1, 095		10% "
Opening Cost	9, 055	940	2, 639	2, 771	2, 705		Dispatch of experts, other training fee
Total	69, 838	6, 562	23, 945	20, 312	15, 293	3, 726	
(Foreign currency)	(54, 744)	(6, 029)	(20, 761)	(15, 137)	(9, 275)	(3, 524)	
(Local currency)	(15, 094)	(533)	(3, 184)	(5, 175)	(6, 018)	(184)	
Interest for Construction Period	9, 575	246	1, 048	3, 174	4, 747		[Assumption] Borrowing at middle of each year, at interest rate of 7. 5%
Running Fund	1, 910					1, 910	
Grand Total	81, 323	6, 808	25, 353	23, 486	20, 040	5, 636	
(Foreign currency)	(63, 752)	(6, 255)	(22, 009)	(17, 824)	(13, 079)	(4, 585)	
(Local currency)	(17, 571)	(553)	(3, 344)	(5, 662)	(6, 961)	(1, 051)	

In calculating the amount for the investment, the base for the commodity prices was chosen as the prices at the beginning of 1976.

Furthermore, an annual cost escalation of 5% was adopted year by year, and an interest rate of 7. 5% per annum was assumed for both local and foreign currencies.

It has been assumed that custom duty with not have to be paid on the imported machinery and materials to be used for the project.

Out of the said capital investment, throughout the operating period, some amount of additional investment will be needed for the preliminary over burden stripping at both Kyisindaung and Sabedaung South, for the enlargement of the waste tailing pond, and for the renewal of the machinery and equipment as required.

The additional investment is estimated to be as much as $16,871,000 accumulated, of which $13,667,000 is to be provided in foreign currencies.

2-2-5 Operation Cost

Though the production of the crude ore is to be fixed at a constant 8,000 t per day, the operating cost is estimated to shift from $3.07 to $3.72 per ton of crude ore, owing to fluctuations both of the volume to be stripped and the amount of the concentrate produced, etc.

For convevience, the destination of the concentrate is assumed to be Japan, and the procurement of all major machinery and equipment is assumed to be also from Japan, where no cost escalation has been considered.

The outline of the operating costs is as shown as in Table 2-6.

Table 2-6 Operating Costs (outline)

Item	unit	Average 1st to 4th Year	Average 5th to 10th Year	11th Year	Average 12th to 15th Year	Remarks
Direct Costs	$1,000	7,120	7,179	8,548	8,346	
Freight charges, etc	$1,000	2,208	1,605	1,525	1,322	
Total	$1,000	9,328	8,784	10,073	9,668	
Per ton of Crude ore						
Mining	$/MT	0.49	0.61	1.19	1.14	
Concentrating	$/MT	2.13	2.06	2.06	2.03	
Others	$/MT	0.35	0.32	0.31	0.31	
Direct Costs (Total)	$/MT	2.97	2.99	3.56	3.48	

2-2-6 Profitability and Funds

The results of the calculations of both the profitability during the operating period of 15 years and the foreseeable average funds required for each operating year, are shown separately, based on different copper prices, in Table 2-7.

In the above mentioned calculations, the following items were presumed;

(1) Ore Selling Terms

1.1 unit less, where the Treatment Charge is assumed at 17¢/lb, 18¢/lb and 19¢/lb for copper prices of 70¢/lb, 80¢/lb and 90¢/lb, respectively.

(2) Exemption from all Import and Export Customs Duties, as well as from Taxes on the incorporated association and the earnings of the mine, is assumed.

(3) Depreciation and Amortization are to be carried out in proportion to the production amount for 15 years, where the final value should be nil in book keeping.

(4) Interest is to be assumed at 7.5% for both local and foreign funds.

(5) Running of Funds is to be carried out as follows;

a) The fund from the depreciation and amortization is to be used for the repayment of the initial investment.

b) The fund from the earnings of the operation is to be paid back to compensate the running fund account.

c) Surplus funds after the completion of the repayment of the loan should be employed at the annual interest rate of 3.5%.

Table 2-7 Economic Balance and Cash Flow Estimation

(Unit : $ 1,000)

Assumption of Cu Price \ Item	Cu 70¢/lb	Cu 80¢/lb	Cu 90¢/lb
[Economic Balance]			
Total Income	16,508	19,311	22,114
Total Cost	19,870	17,615	16,244
Profit from Operation	△ 3,362	1,696	5,870
[Foreseeable Cash Flow]			
Profit from Operation	△ 3,362	1,696	5,870
Interest on Borrowed Fund	4,208	1,946	567
Depreciation & Amortization	6,419	6,419	6,419
Inventory Asset	127	127	127
Cash Flow Income in Total	7,392	10,188	12,983
Cash Flow Expenditure	5,908	5,908	5,908
Cash Flow Balance	1,484	4,280	7,075
Discounted Cash Flow	4.1%	10.0%	14.7%

On the other hand, the profitability is supposed to decrease after the start of the mining at Kyisindaung, because of the reduction of the crude ore grade, as well as the increase in the waste volume to be stripped. However, the economic balance is expected to be good during the exploitation period of the Sabedaung deposit.

Throughout the operating period, the critical copper price as regards profitability has been assumed to be around 77¢/lb. Therefore, even at a price of 80¢/lb, a considerable amount of profit can be expected from the mine.

The balance sheet on funds also shows a favourable background for the project.

In conclusion, the mine is to be considered as being sufficiently worthy of development, and can be expected to become of major importance among the copper mines of the world.

Chapter 3 GEOLOGY AND ORE RESERVES

CHAPTER 3. GEOLOGY AND ORE RESERVES

3-1 GEOLOGY

3-1-1 Stratigraphy

The Monywa area is underlain by the sequences of Cretaceous, Tertiary and Quaternary general sediments of which are summarized below. (Refer Table 3-1.)

(1) Basement Rocks

The basement of the Monywa area is composed of green rocks, being represented by diabases and altered porphyrites and correlated to upper Cretaceous, hornblende-quartz diorites which intrude into them. Granophyre dykes cut all of the above rocks. The basement rocks are exposed about 5 to 7 km west of Kyisindaung, but the thickness is uncertain.

(2) Tertiary System

The Tertiary system in this area is divided into two formations. The lower is Damapala Formation, correlated regionally to the Pegu Group while the upper has been named Magyigon Formation, and is in regional correlation to Irrawaddy Formation.

Damapala Formation

The period of sedimentation of the Damapala Formation is thought to be from Oligocene to Miocene. Overlying the basement rocks, Damapala Formation is comprised mostly of lavas and volcanic pyroclastic rocks originating from the andesitic activity and alternating with well-stratified sandstone and mudstone in its uppermost part. Total thickness of the Formation is over 300 meters, but the bottom of it has not been confirmed yet.

Magyigon Formation

The Damapala Formation is conformably overlain by the rocks of the Magyigon Formation, which is found broadly in the plain of the Monywa area. The Magyigon Formation is thought to have accumulated from Miocene to Pliocene and the thickness of it is approximately 800 meters.

Magyigon Formation is composed of a repetition of rocks derived from volcanism and sedimentation, in which the former is represented by the rhyolitic activity associating tuffs and succeeding activities of hornblende biotite porphyry and biotite porphyry. Especially during the last stage of the accumulation of the Magyigon Formation, volcanic activities culminated and some domes of biotite porphyry were formed.

Subsequent to formation of the domes, rhyolite dykes were seen to have intruded into the domes and their surroundings. The dykes have brought mineralization with them at Sabedaung, at Kyisindaung, at Letpadaung and so on.

Small hills of Shwebonthataung and Kyaukmyet were formed by the intrusion of rhyolite, with the preceding activities of tuff extrusion overlying sandstones and mudstones of the uppermost Magyigon Formation.

(3) Quaternary

Diluvium and alluvium are found in the Monywa Basin as Quaternary Sediments.

Diluvial Sediments

Covering uncomformably the basement and all the Tertiary formations, Quaternary diluvial sediments, named Kangon Formation are widely distributed in the plain of the Monywa area. They are composed of pebbly sands and mud, 30 to 50 meters thick, and are consolidated only to a certain low degree.

Aluvium

As the recent sediments, three levels of river terraces composed of red sandy soil are observed within about 20 meters above the river floor of the Chindwin River and of the Yama Stream.

Also, located about 8 km north-west of Kyisindaung, overlying the basement rocks and the Kangon Formation, there is an extrusion of olivine basalt, which forms a lava plateau of approximately 2 km in diameter. Olivine basalt is also seen in a depressive zone of the plain between the southern part of Kyisindaung swell and a hill to the south of Chadwindaung, in the form of two parallel dykes, 1 or 2 meters wide.

Table 3-1 Generalized Column of Monywa Area

Geological age		Formation	Columnar section	Rock facies	Structual movement	Igneous activity	Mineralization
QUATERNARY	RECENT	ALLUVIUM (10~20m)		sandy soil olivine basalt		Olivine (basalt)	
	PLEISTOCENE	KANGON F. (30 - 50m)		upper muddy member lower coarse s.s. member lower coarse sandstone	SUBSIDING MOVEMENT BY STEP-WISE FAULTING (MONYWA BASIN)		
TERTIARY	PLIOCENE	MAGYIGON F.		rhyolite dome with its pyroclastics		Rhyolite (dome)	
				upper s.s. and mudstone. rhyolite dyke and biot-porphyry and its pyroclastics		Hb-biot porphyry (lavadome) Biotite porphyry (dyke) Qz-Biot-porphyry Rhyolite (dyke)	COPPER MINERALIZATION (MONYWA AREA)
				s.s. and mudstone alternation			
		(IRRAWADDY F.)		upper Hb-biot porphyry with its pyroclastics			
				middle, s.s. and mudstone alternation			
	MIOCENE	(300 - 800m)		lower Hb-biot porphyry and its pyroclastics		Hb-biot porphyry	
				lower s.s. mudstone alternation and rhyolite dykes		Andesite, Rhyolite	
	MIOCENE	DAMAPALA F.		alternation of graded s.s. and laminated mudstone			
	OLIGOCENE	(PEGU-GROUP) (Over 300m)		andesite flow			
CRETACEOUS		BASEMENT		greenrocks hornblende diorite(+) granophyre dykes (x)			

s.s. - sandstone Hb - hornblende biot - biotite F. - formation ore body

mudstone sandstone tuff basalt rhyolite Hb-biot-porphyry andesite

3-1-2 Geological Structure and Volcanism

The Monywa area comprises a local geological basin formed along the eastern margin of the Salingyi Uplift, which develops widely in the central part of the vast Burma Plain. The formation of this geological basin was due to faulting movement of NE-SW trending, accompanied by intense volcanic activities in the process of the subsidence of the basin. The evidence of the volcanic activities is best exposed in the area of 225 km^2, 15 km in E-W and 15 km in N-S, to the west of the Chindwin River. According to the results of survey work, the Monywa Basin accompanies Silaung Basement to its north, and Salingyi Complex to its south.

The basement rocks are exposed in the areas to the north-west and to the west of the Monywa Basin, in the form of an arc opened to northeast. The inside of this arc is filled up by the Tertiary and the Quaternary formations in an order from west towards east.

Several faults of NE-SW trending and gentle foldings with E-W axes, plunging gently to the east, are recognized in the Tertiary system of this area. The former is considered to have been a major factor in the subsidence of the Monywa Basin.

The subsidence of Monywa Basin started in Oligocene, with the sedimentation of Damapala Formation overlying unconformably the basement rocks. This was followed by the culmination of the subsiding activity in Miocene to Pliocene, when Magyigon Formation accumulated to over 800 m in thickness. The sinking of the Basin went on, though fading away gradually, up to the deposition of Kangon Formation in Diluvial Epoch. The thickness of each formation of Tertiary and Quaternary accumulated in the Monywa Basin is given here;

Damapala Formation	over 300 m
Magyigon Formation	about 800 m
Kangon Formation	50 m
Total	over 1,150 m

These structural lines of NE-SW trending are considered to have taken part in the building up the Monywa Basin by composing step faults from the NW and SE margins toward the bottom of the basin. The faults of this trending are "syndepositional faults", which kept moving while the sediments were accumulated. The structure of this NE-SW trending controlled the volcanic activities too, and their faulting movement started at the same time as the beginning of the folding movement in the Damapala and Magyigon Formations.

NE-SW structure has wide ranges of influence on the form of sedimentation in this basin.

3-1-3 Porphyry Domes

The most remarkable volcanism observed in this Monywa Basin is the one represented by the hornblende-biotite porphyries during the period of the accumulation of Magyigon Formation. Two stages of activity are recognized in regard to this volcanism of hornblende-biotite porphyries. The evidence of the later stage extrusion is seen at the upper part of the Magyigon Formation, while the rocks belonging to the earlier stage are contained in the lower part of the Magyigon Formation.

As a lava flow of maximum 250 m in thickness, the rocks of the earlier stage are found at Taungzone, accompanying some preceding tuffs. The activity of the lava flow was followed by another extrusion of tuffs. The extrusion is recognized to have been at the early stage of the accumulation of the Magyigon Formation. The have flow was intruded into by the lenticular dykes of biotite-quartz porphyries trending NE-SW and NW-SE.

The volcanic activity of the hornblende-biotite porphyries recognized in the upper part of the Magyigon Formation is found at Kyisindaung and at Letpadaung. The succession of the extruded rocks so far observed is in the order of tuff-lava-tuff, as seen also at Taungzone. The distribution of the materials resulting from the volcanism is as extensive as 5 km x 5 km (an area of about 25 km^2) in each case at Kyisindaung and at Letpadaung, which denotes that this volcanism was the most remarkable in the Monywa Basin.

The volcanic activity represented by the hornblende-biotite porphyry was followed by the formation of domes of biotite-quartz porphyry, almost free from hornblende, at Kyisindaung and Letpadaung.

It is considered that the mineralization took place at the end of the intense volcanic activities which formed the domes of porphyry.

3-2 ORE DEPOSITS

3-2-1 General

Monywa copper ore deposits are those which are related to and distributed in the volcanic hills scattered in the Monywa Basin. They are divided into three ore deposits of Sabedaung, Kyisindaung and Letpadaung. These are epithermal copper deposits of the nature of network and dissemination related to the rhyolite dykes, intruding in and around the lava domes of biotite porphyry formed through the Pliocene volcanism.

Mineralization is observed to have spread like a halo around each rhyolite body. It can be said that these deposits lie in the highly silicified, alunitized and pyritized zones with many rhyolite dykes in the porphyry dome, surrounded by a argillized zone composed chiefly of kaolin minerals. Though the rocks on the surface are roughly oxidized and leached, evidence of silicification and alunitization is usually well preserved and the pyrite concentration is represented as iron gossans, as the result of hematitization and limonitization.

Along the bottom of this oxidized and leached zone, the secondary enriched zone, consisting mainly of pyrite and chalcocite, is produced and distributed almost horizontally, in a lenticular shape. The object of exploration and development is usually this secondary enrichment zone.

Remarkable mineralization and alteration are usually recognized along the rhyolite dykes, which were introduced through fissures trending NE-SW and rectangular NW-SE, developing in and around the porphyry domes.

In the vicinity of the brecciated rhyolite dykes containing breccias of biotite porphyries, subordinate N-S or E-W fissures are well developed, accompanying network fissilities and small dykes of the breccialed rhyolite of the same trendings.

The richness of the mineralization is controlled not only by the density of the rhyolite intrusion but also by the nature of the host rocks. Network fissures are developed more abundantly in biotite porphyries and hornblende biotite porphyries than in such rocks as tuffs and shales, and rich mineralization is found chiefly in porphyritic rocks. However, mineralization is observed to fade out remarkably in the tuffs, sandstones and shales.

Monywa ore deposits are composed of the following minerals, which have been identified under microscope, by X-ray refraction and by X-ray microanalyser:

(1) Ore Minerals;

Mainly pyrite, chalcopyrite and secondary chalcocite, with minor association of enargite, tetrahedrite, sphalerite, hematite and green copper-oxide minerals.

(2) Gangue Minerals;

Quartz and calcite.

(3) Clay Minerals;

Kaolin, sericite (or a mica-clay mineral with a peak at 10 Å in X-ray reflaction) and alunite.

3-2-2 Sabedaung Ore Deposit

Being located about 5 km WSW of the junction of Yama Stream and Chindwin River, the Sabedaung ore deposit lies in the dome of biotite porphyry formed and penetrating the tuffs of the upper Magyigon Formation.

The sizes of the dome are as follows:

Width	(E-W)	approx.	400 m
Extension	(N-S)	approx.	600 m
Area		approx.	240, 000 m^2
Relative height to the plain level			80 m

Among the Monywa ore deposits and their surroundings the most appreciable progress has been made in the exploration work in this area. That is to say, 55 drill holes totalling 9, 955. 2 m have been completed for this Sabedaung ore deposit. 41 of the 55 holes were drilled by MMDC, totalling 7, 632. 8 m in length, and the remaining 14 holes were made by a Japanese survey team, with a total length of 2, 322. 4 m.

In 1973, 12 of the said 14 holes were drilled by a Japanese survey team on this deposit, for the purpose to check the continuity of the ore bodies and to collect samples for a mineral processing test. The results were remarkable in that the copper grades were almost equal to those obtained in the closest Burmese holes.

Based on this conclusion, the sizes of the deposit were confirmed as follows:

Average extension	approx.	500 m
Average width	approx.	350 m
Average thickness	approx.	60 m
Average thickness of the oxidized and leached zone	approx.	26 m

As is seen, the stripping ratio of the ore deposit should be under 1, and the condition for mining seems to be excellent.

Consequently in 1975, a drifting was carried out, at its south-western part, both to supply the ore to the pilot mill test and to study precisely the underground geology of the ore body. The ore is generally siliceous and rich in pyrite, supposedly about 10 % in weight. Pyrite is recognized from grains as fine as below 1 micron to coarse grains of 5 mm, but mostly at around 0. 1 to 1 mm. The copper mineral is principally chalcocite, irregular in shape and of very fine grains. About 15 % of the total copper content is soluble in acid.

3-2-3 Kyisindaung Ore Deposit

The dome of Kyisindaung is adjacent to the western side of the Sabedaung hill. The sizes of the Kyisindaung dome are given below;

Width	(E-W)	approx.	1, 000 m
Extension	(N-S)	approx.	1, 200 m
Area			1, 200, 000 m^2
Relative height to the plain level			190 m

The base of the dome is composed of hornblende-biotite porphyry, tuff, sandstone and mudstone of the upper part of the Magyigon Formation. So-called

Kyisindaung dome is, virtually, a composite dome composed of the three small domes. Intense alteration and mineralization are recognized in an area of 400,000m^2, approximately 1,000 m long and 400 m wide, including two of the three small domes, sitting in an alignment of NE to SW.

In and around the Kyisindaung ore deposit, drilling of 72 holes totalling 20,069.2 m in length was completed before the end of July, 1974. The breakdown is given below;

67 holes	total 18,563.1 m	by MMDC
5 holes	total 1,506.1 m	by Japanese survey team

Drillings are still continuously underway by MMDC.

In the Kyisindaung sector, a program for the drill grid with 100 m spacing was established over the area from the north-eastern hillfoot to the southern part of the dome, and the drilling has been carried out according to this programme from north to south.

In the Kyisindaung sector, chalcocite enrichment is observed in two zones horizontally, in the upper concentration zone of 100 - 150 m and in the lower concentration zone of 250 m to max. 400 m below surface. By field observation and by the data of the drilling, it has been confirmed that the Kyisindaung dome is bordered by two parallel faults of NE-SW trending, along which the dome itself slipped down and subsided against the surrounding country. It is inferred from the above that there had been some chalcopyrites left unleached at the time of this fault movement, and that they were leached, transported, redeposited and enriched to compose upper ore horizon, after the subsidence of the dome. According to the observation of drill cores, the nature of ore does not differ from that of the Sabedaung ore. Horizontal distribution of the mineralization zone is nearly the same, with an intense alteration zone on the surface.

Three ore zones of economical grade are recognized within the depth of 430 m below the surface, which are given as follows;

Table 3-2 Sizes of the Kyisindaung Orebodies

Orebody	Average Length	Average Width	Average Thickness	Remarks
A	800 m	400 m	65 m	Lower Orebody
B	300	120	45	Upper Orebody
C	300	120	15	Upper Orebody

The average depth of leached zone is about 70 m below the surface for the upper orebodies and 220 m for the lower orebody.

3-2-4 Mineralization at Letpadaung

Letpadaung sector is located at about 10 km south-east of Kyisindaung, and corresponds to the place where the oldest explorations in the Monywa area was carried out.

The sizes of the lava dome are as follows:

Distance across (E-W)	approx.	3,000 m
Width (N-S)	approx.	2,000 m
Area		6,000,000 m^2
Relative height to the plain level		240 m

The zone bearing intense mineralization and alteration is recognized to be in the north and in north-eastern parts of it, with a total area which is approximately 3,000,000 m^2. This zone is known to reveal high IP anomaly by the geophysical prospecting completed by the Japanese survey team in 1973, and is considered to be an area of high potential warranting further exploration.

In 1955, a Yugoslavian survey team carried out some exploration work by the self-potential method of electrical prospecting. Subsequently, in 1957, the Burmese government (MRDC) completed 25 holes by diamond drilling, mostly on the northern foot of the hill. As a result of the electrical survey then carried out, self-potential anomalies were detected in the area around the northern hillfoot of the dome, where sulphate minerals are locally concentrated.

3-2-5 Another Mineral Indications

(1) Sabedaung South Ore Deposit

This ore deposit was discovered by the diamond drilling performed in 1972. It is an IP anomaly caught around the rhyolite dykes intruding into the altered zone of the hornblende-biotite porphyry lavas, tuffs and sandstones. Since then, diamond drilling has been carried out in the grid system by MMDC, and 15 holes out of 21 holes performed have hit the ore.

Although rhyolite dykes are related to mineralization, this area seems to be an exceptional case compared with the others, because the mineralization has directly affected its Magyigon Formation without any dome of porphyry.

The scale of mineralization is presently recognized to be as follows;

Horizontal dimension	approx.	230m x 155 m
Average of thickness		29 m
Depth from surface	about	22 m

Although these dykes do not reach to the surface, boxworks of iron gossans are formed and some alunite is found on the surface above these subsurface dykes.

The nature of the ore does not differ from that of Sabedaung, according to observations of the drill cores.

(2) Others

Diamond drilling was performed at the places where the IP anomalies caught, in the plain area around the known deposits. However, they do not seem to have any direct relation to the mineralization.

3-3 SAMPLING AND ORE GRADE

3-3-1 Sampling of the Drill Cores

The cores drilled by the Japanese survey team during Phase II were examined geologically to compile the core logs of scale 1 to 300, from which the portions to be sampled for assay were determined. The cores picked out for assay were split into halves. Half of the split core was left in the core boxes, while the other half was collected to make samples of every 2 meters. These were crushed and rendered to quartering repeatedly to prepare assay samples of under 100 meshes in grain size.

The assay samples thus prepared were forwarded partly to Japan for assay, and were partly analyzed at the DGSE laboratory in Burma. The method of chemical analysis adopted by the Japanese laboratory was to add acid to the sample and to heat the whole solution, followed by the filtration. After this the copper content in the filtered solution was analysed by the atomic absorption method.

The method of chemical analysis employed by the Burmese laboratory was to add acid to the sample and to heat the whole solution, followed by the filtration. After this the copper content in the filtered solution was analysed by the tiltration method.

As stated below, no significant difference in assay results between the laboratories in Japan and Burma was found. Consequently, in and after the Phase II surveys, all the assay data obtained on the Burmese side have been used directly in the reports. The same sampling method has also been applied as in the Phase I.

3-3-2 Study of the Core Assays

Based upon the comparative study of assays, by both Japanese and Burmese analysis, on the drilled cores obtained by the Japanese survey team in the Phase II, the following correlations and a regression formula were obtained by plotting all the assay results of the 721 samples from the drill holes JS-1 to JS-12, in the Sabedaung area, in each range of every 0.25 % Cu.

(1) Regression formula for all the assay results

$$J = -0.0726 + 1.01760 \times B$$

(2) For the Burmese assay results of nil to 0.25 % Cu

$$J = 0.0460 + 0.60937 \times B$$

(3) For the Burmese assay results of 0.25 % to 1.90 % Cu

$$J = -0.0048 + 0.93146 \times B$$

(4) For the Burmese assay results of over 1.9 % Cu

$$J = -0.8143 + 1.17300 \times B$$

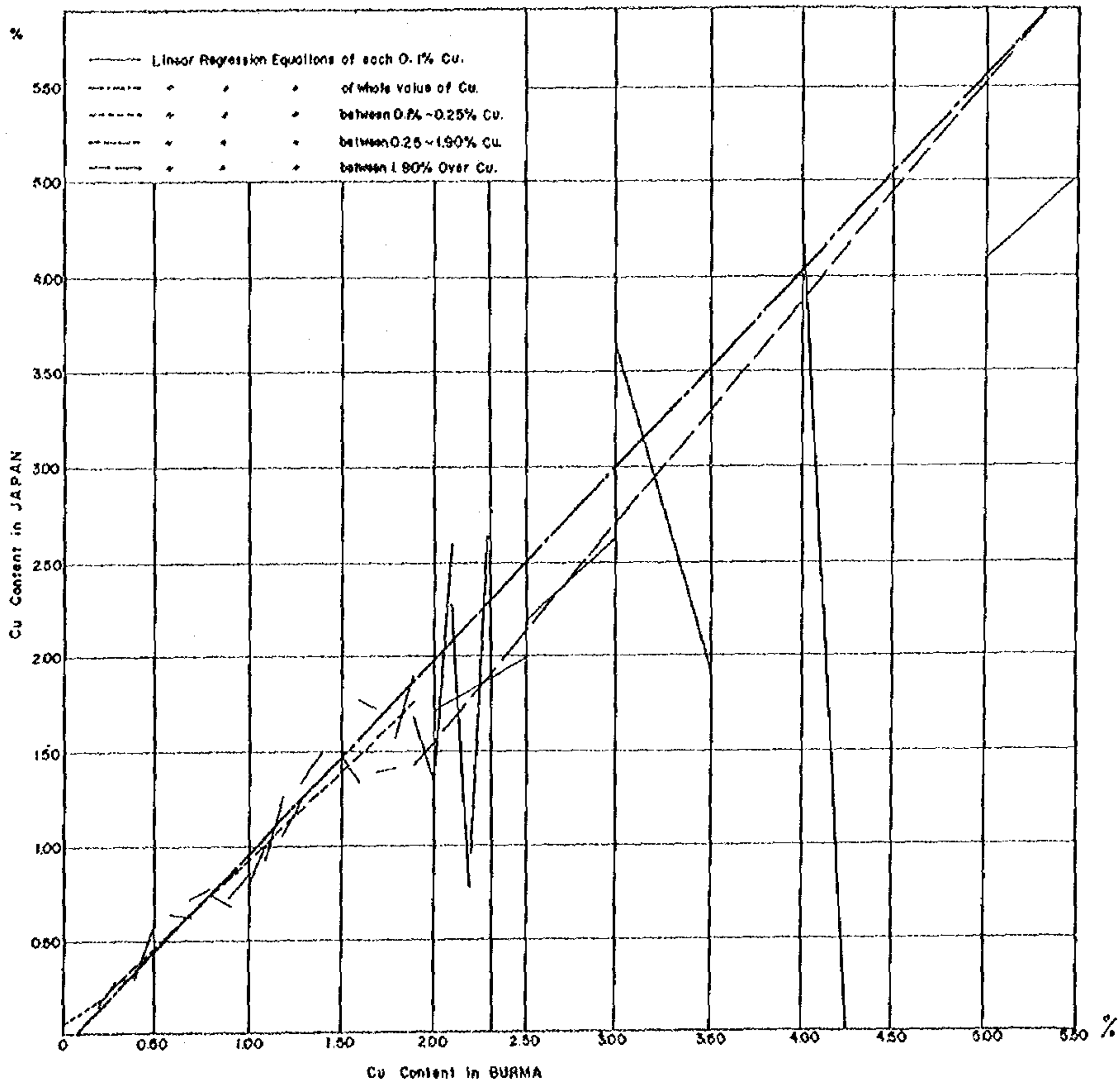
J : Assay results by Japanese B : Assay results by Burmese

By the above formulas it can be said that, compared with the Burmese assay results under 0.25 % Cu, the Japanese results are lower. For the Burmese assay results of 0.25 % to 1.9 % Cu, the Japanese assay results are obtained by multiplying the Burmese results by 0.93, and for the Burmese assay results between 1.9 % and 5 % Cu, the Japanese results are lower. However, in the range over 5 % Cu, Japanese results are higher, although the samples showing such high Cu grade according to only 3 percent of the total 710 samples.

In such type of ore deposit, the range of ore grade prevailing on the calculation of ore reserve, as well as in mining operations, is generally distributed between

0. 25 and 1. 9 %. No significant differences have been found between the two assay results within this assay range. Therefore, it was taken for granted that the Burmese assay result should be used for the calculation of ore reserve. (Refer Table 3-3.)

Table 3-3 Correlation of Assay Results of Copper (Total)



3-4 ORE RESERVES

3-4-1 Basis of Calculation

(1) Method of Calculation

Scaled cross sectional method is adopted.

The ore reserve of Sabedaung ore deposit was estimated by means of parallel sections of NW-SE, spaced 20 to 91 m from each other. The ore reserves of Kyisindaung ore deposit was estimated by means of parallel sections of NW-SE, spaced 42 to 100 m from each other, and the ore reserve of Sabedaung South ore deposit was estimated by using 7 parallel sections of NW-SE direction, spaced at 45 m from each other.

(2) Specific Gravity

According to the results of Burmese measurement.

The average of the specific gravity measurements of 2,922 samples from Sabedaung deposit is 2.5, which also applies to the Sabedaung South deposit. The average of the specific gravity measurements of 1,504 samples from Kyisindaung deposit is 2.6.

(3) Cut off Grade

0.3 % Cu by the Burmese assay results.

As the cut off grade of 0.3 % Cu had been taken as the base of the ore reserve calculation done in Burma, the same figure was employed here.

(4) Upper Limit of the Ore Grade

Burmese assay results over 5 % Cu are treated as 5 %, because only 3 % (22 samples) of the total 721 samples show a copper grade of over 5 %.

(5) Class of the Ore Reserve

As there is no part of the ore which has been proven regarding the continuity of the deposit by being directly trenched or tunnelled, and all the data except a small part of Sabedaung, are based on the drilling and surface geology, the ore reserves are classified as "Possible Ores", according to the Japanese Industrial Standard.

(6) Delineation of the Ore Deposit for the Calculation

Even in the case that, geologically the extension of the orebody is expected in the spherical zone, the extension taken was limited within the distance correspondent to the thickness of the ore zone encountered in the drill hole concerned. Although the continuity of the ore deposit between cross sections has not been proved, the estimation was accomplished on the assumption that the ore deposit is continuous.

(7) Ore Grade

Burmese assay results of the total copper content were used for the estimation, regardless of the fact that the soluble copper content and grade correction factor was not adopted.

However, in working mines, the grade correction factor is generally adopted for the sake of safety to prevent possible errors in assaying. Therefore, in the near future, this kind of safety factor should be considered to maintain a reasonable ore grade in the mining operations. Other valuable contents such as Au, Ag, S, Fe, etc. were neglected in this calculation, as very little of them are contained in the deposits.

(8) As for the Kyisindaung ore deposit, where exploration work is currently underway, the results of the exploration, including diamond drilling and assay results, used for this calculation of the ore reserves, were those obtained before August, 1974.

(9) Ore reserve of the Sabedaung South ore deposit has been calculated from the assay results of the ore samples obtained from 15 out of 21 holes, which were performed before the end of March, 1976.

3-4-2 Estimation of the Ore Reserves

The result of the estimation accomplished is given on the following Table 3-4.

The ore reserve of the Letpadaung ore deposit is not calculated in this report, as the deposit has not yet been well delineated, although it was partially proved by the drilling carried out by Burmese concerns in the past.

Table 3-4 Ore Reserve

Ore Deposit	Class	Extension in Average	Width in Average	Thickness in Average	Specific Gravity	Ore Reserve	Cu Grade
Sabedaung	Poss.	500 m	350 m	60 m	2.5	25,717,000 MT	1.01 %
Kyisindaung							
A-orebody	Poss.	800	400	65	2.6	60,851,000	0.77
B-orebody	poss.	300	120	45	2.6	4,383,000	0.81
C-orebody	Poss.	300	120	15	2.6	1,574,000	0.54
Subtotal						66,538,000	0.77
Sabedaung South	Poss.	230	155	29	2.5	2,158,000	0.77
Total						94,413,000	0.84

Poss. : Possible Ore Reserve

Chapter 4 MINING

CHAPTER 4. MINING

4-1 OUTLINE OF DEPOSIT AND MINING METHOD

4-1-1 Outline of Deposit

As previously mentioned in Chapter 3, there are three groups of ore deposit, that is, Sabedaung, Sabedaung South, and Kyisindaung.

They are summarized and shown in Table 4-1.

Table 4-1

Items \ Deposit	Unit	Sabedaung	Sabedaung South	Kyisindaung		
Relation to Topography		Inside of a prominent hill on plain	Under a gentle sloping hill	Deep under a large scale higher prominent hill on plain		
Highest Flevation	m	155	88	280		
Shape of Deposit	-	Compact and massive	Compact and massive	Massive, but dispersed in 3 sub-groups		
Size of Deposit				A	B	C
Average Length	m	500	230	800	300	300
" Width	m	350	155	400	120	120
" Thickness	m	60	29	65	45	15
Average Overburden Thickness	m	26	22	220	70	70
Ratio in Thickness Overburden/Deposit	-	0.43	0.76	3.38	1.56	2.14
Ore Reserve				60.581	4.383	1.574
in Subtotal	10^3MT	25.517	2.158	66.538		
Grade of Ore Reserve				0.77	0.81	0.54
in Average	% Cu	1.01	0.77	0.77		
Ground Specific Gravity	-	2.5	2.5	2.6		

From the table, it is clearly understood that Sabedaung deposit has the advantages of its higher ore grade, thin overburden, and its compactness.

On the other hand, Kyisindaung deposit has fundamentally inferior conditions because of the comparatively lower grade of the ore, thick overburden, and the fact that it is composed of 3 sub-groups though each of these is remarkably large in scale. Sabedaung South deposit is a small one with less advantages than Sabedaung deposit.

The real specific gravity of the ore deposits, and the surrounding rocks is estimated at 2.9, while the ratio of their water content is estimated at 3.0%.

4-1-2 Adopted Mining Method

Conventional open pit mining by bench cutting is to be adopted for all the deposits, because, despite some individual minor differences, each of them almost satisfies the following conditions:

(1) Comparatively shallow occurrence allows easy access to the ore bodies. The same favourable topography also permits easy access in each case.

(2) The horizontal length of the deposit is much more greater than its thickness.

(3) Massive production is required from large scale deposits with lower grade ore.

(4) Waste dump site is to be prepared at a location close to the pit.

(5) Pit design is possible with an economic stripping ratio, W/O.

(6) Annual rainfall amounts to only about 800 mm, and this is also favourable for open pit mining.

(7) There is no river in or close to the pit site.

4-2 OPERATION PLANNING

4-2-1 Assumptions for Planning

(1) Basic Conditions

Annual working days are to be set at 300 days in consideration of Burmese national holidays and other established working conditions there.

Though the mining operation may have to be run in 3 shifts a day as usual, 2 shift operation is to be adopted in the present planning on account of local circumstances such as the safety of work carried out at night, and the time required for repair and maintenance of machinery and vehicles.

8 hour shifts are to be adopted.

(2) Selection of Mining Machines and Vehicles

In selecting the kind, type, and size of those mining machine and vehicles, slightly smaller ones have been selected in comparison with those generally employed in the major open pit mines of the world.

This is because of the necessity for both increasing the numbers of machines and vehicles, in order to be prepared for any trouble which might unduly hinder the overall operations.

Smaller machines and vehicles will also ensure greater mobility at the mine site, as well as facilitating their transportation from Rangoon.

The difficulties in the supply of new and additional materials as they are required, as well as the after care service and maintenance by the manufacturers, have to be considered in the first priority.

The machines and vehicles are composed of mainly of crawler drills, 21 t class bulldezers, 6 m^3 class front end loaders, 32 t class rear dump trucks, etc.

(3) Dimensions on Pit Design

Dimensions of the size of bench, the inclinations of pit slope, etc. are to be set as shown in the following table 4-2.

Performances in test stripping, the results of strength tests on rock samples, information from other mines, the size and capability of the planned machinery or vehicles as well as other factors have to be carefully considered.

Table 4-2

Remarks	Unit	Sabedaung	Sabedaung South	Kyisindaung
Final pit slope (max.)	degree	45	45	40
Slope under operation (4 bench/set)	"	38	38	38
Inclination of bench	"	70	70	70
Height of bench	m	10. 0	10. 0	10. 0
Width " (operation)	m	16. 4	16. 4	16. 4
Width " (others, min.)	m	6. 4	6. 4	6. 4
Size of pit bottom (min.)	m	30 x 30	30 x 30	30 x 30

The final inclination of the pit of Kyisindaung is to be set lower than those of other deposits, because the final depth of the pit will make it the deepest of the three.

An example of a pit profile is shown in Fig. 4-1.

4-2-2 Setting of Operation Scale

The Sabedaung and Sabedaung South deposits are divided into 10 m dimensional cubes, while the Kyisindaung deposit is divided into 20 m cubes. These cubes, hereafter to be called blocks, have been given corresponding copper grades based on the results of core drilling, and respective computor calculations. The lowering of the ore grade, especially of the blocks in the marginal portions of the deposits to be caused by waste dilution has also been calculated by the grade of the enclosed waste portion.

At the same time, the production and investment amounts, running costs, copper price, depreciation period, etc., in other words the operational factors for accounting balance, have been tentatively assumed in order to estimate the economic value of each block.

After considering the systematic ore grade distribution of each ore deposit, as well as its overburden thickness distribution, optimum pit plans have been established by computor for all the deposits concerned. In these, the blocks with higher evaluation are to be successively excavated according to the pit specifications mentioned previously.

The result of those pit designs for the relevant deposits, in which maximum mineable ore tonnage obtainable respectively, is shown in Table 4-3.

Table 4-3

Name of Deposit	Minable Crude Ore	Grade	Copper Metal Content	Cut off Grade	Mining Recovery	Overburden to be Stripped	W/O Ratio
	10^3MT	%Cu	MT	%Cu	%	10^3MT	
Sabedaung	24,000	0.915	219,648	0.40	93.3	15,888	0.662
Kyisindaung	48,000	0.660	316,980	0.30	72.1	190,090	3.960
Sabedaung South	2,000	0.777	15,540	0.45	92.7	6,130	3.065
Total	74,000	0.746	552,168	-	83.7	212,108	2.866

If the operation period of the mine is assumed at 15 years in line with the expected life of the chief machinery of the mill, etc., 16,000 MT of daily crude ore production under 300 working days per annum may be thought reasonable. Thus, this amount could reasonably be selected as the normal production scale for working all of the mineable ore listed in Table 4-3.

However, in this feasibility report, 8,000 MT of daily production is proposed for the normal operation, though it is only half of the said scale.

The reasons are as follows:

(1) Consideration of the present situation of the world copper market, as well as the local circumstances.

(2) Necessity for further, more detailed studies on the fundamental conditions for capital costs, copper price, etc. especially for the development of Kyisindaung deposit. It would actually be economically disadvantageous to develop the Kyisindaung deposit because of its thick overburden and its comparatively low metal content.

In running the 8,000 t/d operation, the scale of production, including a possible change to 16,000 t/d, should be carefully studied after confirmation of both the normal stabilized operation and the future circumstances of the world copper market.

4-2-3 Mining Schedule

(1) Succession of Mining

Judging from the view point of the ore grades, overburden thickness, good consolidation of the deposit, it is planned to open Sabedaung deposit first, for it has the highest profitability. Then, the Sabedaung South and Kyisindaung deposits are to be excavated successively in this order.

By this arrangement, or order of mining, the comparatively large sum of initial investment will be more rapidly depreciated in the early stages of the development, to decrease the capital cost. This will enable the exploitation or working of the less profitable, low grade ore deposits.

(2) Preparation for Mining

Each deposit requires preliminary stripping in the preceding 3 to 4 years before the start of the mining, in order to arrange the exposed ore body to be mined in the following 4 months at maximum.

The waste produced from the work will mostly be used as banking materials at the waste tailing pond, with some being used for road and ground construction or as ballast material.

On the other hand, also before the start of the operation, a tunnel is planned to be driven for a total of 500 m on 80 m ASL at Sabedaung deposit. The tunnel is to clarify how deep towards the core of the deposit the leaching (caused by meteorologic water along fissures) has progressed, and its effect on reducing the ore grade. The tunnel is expected to offer important information for deciding in which succession the blocks should be mined.

(3) Final Pit Design

The total of the mined ore will amount to 36,000,000 MT on the basis of 8,000 t/d, 300 working days per annum, and 15 years of operation.

To fulfill the requirement mentioned above, Sabedaung, Sabedaung South will be mined in this order, and later necessary amounts of ore will also be supplied from the most favourable, selected portion of Kyisindaung.

Table 4-4 shows the result of the final pit design according to the above-mentioned mining plan.

Table 4-4

Item	Unit	Sabedaung	Kyisindaung	Sabedaung South	Total
Ore to be mined	10^3MT	24,000	10,000	2,000	36,000
Ore Grade	Cu%	0.915	0.711	0.777	0.851
Metal Content	MT	219,648	71,172	15,540	306,360
(Stripping)					
by Preliminary work	10^3MT	2,300	12,000	1,500	15,800
with Mining work	10^3MT	13,588	24,700	4,630	42,918
Total	10^3MT	15,888	36,700	6,130	58,718
(Stripping Ratio)					
by Preliminary work	-	0.096	1.200	0.750	0.439
with Mining work	-	0.566	2.470	2.315	1.192
Total		0.662	3.670	3.065	1.631

Periods necessary for recovering the planned ore are shown as follows:

Sabedaung	10.0 years	(1st to 10th year)
Sabedaung South	0.8 "	(A part of 11th year)
Kyisindaung	4.2 "	(Rest of 11th year to 15th year)
Total	15.0 years	

Amounts of ore and waste, on levels to be excavated inside the designed final pits, are shown in Table 4-5, 4-6, 4-7, respectively.

Table 4-5 Final Pit of Sabedaung Deposit

Level	Ore	Grade	Metal Content	Waste
M	MT	%Cu	MTCu	MT
160 ~ 150	-	-	-	-
150 ~ 140	-	-	-	105,000
140 ~ 130	-	-	-	347,500
130 ~ 120	52,500	0.424	222.6	730,000
120 ~ 110	230,000	0.802	1,845.0	1,032,500
110 ~ 100	582,500	0.814	4,741.6	1,660,000
100 ~ 90	1,090,000	1.002	10,921.8	2,510,000
90 ~ 80	1,712,500	1.038	17,775.8	3,025,000
80 ~ 70	3,300,000	1.013	33,429.0	2,477,500
70 ~ 60	3,712,000	0.950	35,264.0	1,223,000
60 ~ 50	3,392,500	0.942	31,972.6	755,000
50 ~ 40	2,990,000	0.881	26,341.9	507,500
40 ~ 30	2,290,000	0.851	19,489.3	402,500
30 ~ 20	1,672,500	0.833	13,939.7	402,000
20 ~ 10	997,500	0.825	8,229.4	292,500
10 ~ 0	742,500	0.843	6,259.0	197,500
0 ~ -10	520,000	0.813	4,227.6	132,500
-10 ~ -20	377,500	0.745	2,812.4	60,000
-20 ~ -30	240,000	0.659	1,581.6	25,000
-30 ~ -40	102,500	0.580	594.5	2,500
Total	24,004,500	0.915	219,647.8	15,887,500

Table 4-6 Final Pit of Sabedaung-South Deposit

Level	Ore	Grade	Metal Content	Waste
M	MT	%Cu	MTCu	MT
90 ~ 80	-	-	-	805,000
80 ~ 70	-	-	-	2,035,000
70 ~ 60	230,000	0.567	1,304.7	1,475,000
60 ~ 50	582,500	0.755	4,396.5	755,000
50 ~ 40	500,000	0.685	3,430.0	452,500
40 ~ 30	255,000	0.852	2,172.6	322,500
30 ~ 20	217,500	1.023	2,224.5	197,500
20 ~ 10	142,500	0.984	1,402.7	77,500
10 ~ 0	72,500	0.840	609.0	10,000
Total	2,000,000	0.777	15,540.0	6,130,000

Table 4-7 Final Pit of Kyisindaung Deposit

Level	Ore	Grade	Metal Content	Waste
M	MT	%Cu	MTCu	MT
280 ~ 260	-	-	-	20,000
260 ~ 240	-	-	-	1,120,000
240 ~ 220	-	-	-	4,220,000
220 ~ 200	-	-	-	5,740,000
200 ~ 180	40,000	0.440	176.0	6,380,000
180 ~ 160	730,000	0.602	4,397.0	5,560,000
160 ~ 140	1,440,000	0.720	10,364.0	4,640,000
140 ~ 120	1,550,000	0.650	10,075.0	3,860,000
120 ~ 100	1,990,000	0.662	13,174.0	2,220,000
100 ~ 80	1,110,000	0.680	7,548.0	1,940,000
80 ~ 60	1,140,000	0.676	7,712.0	880,000
60 ~ 40	1,140,000	0.939	10,706.0	120,000
40 ~ 20	660,000	0.801	5,284.0	-
20 ~ 0	200,000	0.868	1,736.0	-
Total	10,000,000	0.711	71,172.0	36,700,000

(4) Annual Production of Ore

The amounts of stripping, mining, together with the relevant ore grade, both in the foregoing four years of construction, and in the subsequent years of operation, are estimated to shift as shown in Table 4-8.

The average grade of the produced crude ore is designed to be high in the earlier years, gradually changing over to lower grades in the later stage, while it is planned to increase the stripping volume gradually.

The preliminary stripping both at Sabedaung South and Kyisindaung is planned to start in the 8th year after the start of the mining operation.

However, it will also be necessary to study the copper price and other factors further, and with great attention, before the start of the stripping mentioned above.

Table 4-8

Fiscal Year	Stripping Volume (10^3 MT)				Mined Ore (10^3 MT)				Grade Cu %	Running w/o Ratio	Remarks
	Sabe-daung	Kyisin-daung	Sabe. South	Total	Sabe-daung	Kyisin-daung	Sabe. South	Total			
-4	*300			300							
-3	*600			600							
-2	*700			700							
-1	*700			700							
1	788			788	2,400			2,400	1.070	0.328	*Stands for
2	930			930	2,400			2,400	1.070	0.388	preliminary
3	910			910	2,400			2,400	1.050	0.379	stripping
4	798			798	2,400			2,400	1.050	0.332	
5	830			830	2,400			2,400	0.849	0.346	
6	1,168			1,168	2,400			2,400	0.849	0.486	
7	1,680			1,680	2,400			2,400	0.805	0.700	
8	1,942	*3,000	*1,500	6,442	2,400			2,400	0.805	0.809	
9	2,265	*4,500		6,765	2,400			2,400	0.802	0.944	
10	2,277	*4,500		6,777	2,400			2,400	0.802	0.949	
11		1,460	4,630	6,090		400	2,000	2,400	0.789	2.538	
12		6,090		6,090		2,400		2,400	0.706	2.538	
13		6,090		6,090		2,400		2,400	0.706	2.538	
14		5,530		5,530		2,400		2,400	0.706	2.304	
15		5,530		5,530		2,400		2,400	0.706	2.304	
Total:	15,888	36,700	6,130	58,718	24,000	10,000	2,000	36,000	0.851	1.192	

4-3 INDIVIDUAL WORK PHASES

4-3-1 Drilling and Blasting

Major drilling in bench operation of either stripping or mining is planned to be carried out by the combination of a pneumatic crawler drill and a portable compressor, with rock bits of 4 inches in diameter. The drilling pattern is to be 3.7 m x 4.3 m, with drilling inclination of 70 degree, while the drilling length is planned to be chiefly 11.7 m in length with 1.1 m of toe hole.

The drilling speed is estimated at 0.38 m/min on average under the pneumatic pressure of 6 kg/cm^2. It is assumed that the ore, which is to be secondarily blasted, occupies 10 % of the primary ore blasted, and the secondary drilling is planned to be done by air leg drills

In blasting, AN-FO explosive mixed at the mine site is to be used mainly, whereas dynamite will be used mostly as priming explosive. It is planned that AN-FO will be charged by a special charger mounted on a small truck, and the remaining water in the hole is to be drained by means of small pumps.

Consumption of explosives, with those for secondary blasting, is estimated to be as much as 100 grams per broken ton.

Milli-second and non-delay electric detonators, as well as detonating fuses are to be used for initiating the explosion.

The drill hole arrangement is illustrated in Fig. 4-2.

4-3-2 Mucking and Haulage

The 6 m^3 class front end loader is planned to muck the broken ore or waste to the 32t class rear dump truck, which will haul the ore or waste to the concentrating mill or the waste dump, respectively. As for the auxiliary machinery, bulldozer, smaller mucking machine, or trucks are planned to be used, too.

The haulage distance, including the road inside of the pit, will change from time to time according to the location of the excavating site or the deposit itself. This in turn depends on the year under the schedule, in other words the length of haulage way inside the pit itself.

Thus, the hauling trip time required and the number of trucks can also not be defined as constant.

However, the haulage distance is estimated to shift between 3,300 m and 3,900 m for the ore, while the waste haulage is expected to fluctuate very much, depending on the case.

4-3-3 Removed Earth and Waste

After the completion of the preliminary stripping, subsequent stripping is planned to be carried out in parallel to the mining, in order to prepare each time sufficient exposed ore body on which mining can be continued for a maximum of four months without any further overburden removal.

Of the overburden, it is assumed that a 5 m thickness from the surface will be removed only by bulldozing and ripping, and the underlying portions are to be drilled and blasted as in mining.

The waste from stripping is intended to be used as much as possible as banking material for the waste tailing pond and also for other construction areas.

However, afterwards, when the mining of the Sabedaung and Sabedaung South deposits is completed, the waste produced in Kyisindaung will be put into those completely excavated pits.

The amounts of waste in production, usage, and the residual balance are shown in Table 4-9.

Table 4-9

(10³ MT)

Year	Waste Stripped	for Dam, etc.	Balance	Accum.
-4 ~ -1	2,300	1,611	689	689
1 ~ 10	27,088	3,076	24,012	24,701
11 ~ 15	29,330	1,607	27,723	52,424
Total	58,718	6,294	52,424	---

Possible amount of waste to be put into the goafs at both Sabedaung and Sabedaung South is estimated at 24,100,000 MT, and corresponds to 87% of the total surplus waste which is expected to be produced from 11th year to 15th year.

In grand total throughout the entire period, the surplus waste to be dumped at the proposed waste dump site will amount to 28,324,000 MT.

Thus, the necessary area for the dump site has been calculated to be as large as 118 hectare, with a banking height of 15 m and a apparent specific gravity of 1.60.

The said volume is planned to be piled in the open wild area, to the east of the waste tailing pond of the second stage. For piling and disposing of the dumped waste, bulldozers and road rollers are to be allocated to the dump site as required.

4-3-4 Road

As described in Chapter 7-1, roads which connect the pits with the mill, waste dump site, etc. are planned to be constructed. At the same time, roads in or around the pits will be built for mining activities, with good maintenance and repairs whenever necessary.

The access road inside of pit is designed to be over 6 m in width, with a maximum inclination of 8%. The condition of the truck haulage road greatly affects the costs on tyres and vehicle-repair. Therefore, for the better maintenance of the road, sprinkler truck, bulldozer, grader, road roller, small shovel loader, and other vehicles are to be available.

4-3-5 Other Works

(1) Drainage

Annual rainfall in the region amounts to about 800 mm, falling mainly during the rainy season from May to September.

In the early stages of stripping, the topography may allow natural drainage of the pit. However, it will be necessary to pump up the water in the pit during later stages of the operation.

Under the assumptions of a maximum hourly rainfall of 20 mm and that an equivalent amount of water will seap into the pit, necessary pumps are to be installed at the pit.

In the early stage of operations, higher head multi-staged pumps of 30 kw capacity are to be used, while pumps of 55 kw will be introduced for the deepened pit in the later stages.

Power for the pumps is to be fed from the main transformer station.

(2) Illumination

Regarding illumination for the night shifts, it is planned to set up a network of street lamps as required, and also for the housing areas.

However, for the pit illumination, a small truck equipped with both a small diesel generator and extendable lamps is to be available for the sake of mobility.

(3) Operation Control

To precisely control the conditions at the pit and to grasp the ore grades of benches, a team of experts for geology and toposurvey is to be stationed at the mine site.

In particular, analysis of cuttings from the pit drilling is planned to be carried out to collect data for grade checking of the ore to be mined. This is to be done in addition to the conventional pit sampling. With the results of these assay data, it is expected that daily control of the ore production can be accordingly carried out.

(4) Miscellaneous Transportation

Jeeps, small turcks, and other vehicles are to be available for the transportation of personnel, as well as materials, in order that all the operations can be smoothly carried out. In addition, such services as guard patrol, water supply for drilling, explosives delivery and control of explosives, bit and rod arrangement, bit grinding, office work, and other miscellaneous activities will also depend on the avalability of such transportation.

4-4 MACHINERY, EQUIPMENT AND REQUIREMENT OF MATERIALS

4-4-1 Requirement of Major Mining Machinery

Major mining machinery including that required for the preliminary work is shown in Table 4-10.

Each of those pieces of machinery or equipment is to be renewed at the time when its life expectancy has passed.

Table 4-10

Item	Spec.	-4 ~ -1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Bulldozer	21 t	2	3	3	3	3	3	4	5	15	14	13	11	11	11	10	10
Road Roller	10 t Macadam	1	1	1	1	1	1	2	2	5	5	5	4	4	3	3	3
Motor Grader	9.1 t width 3.1m	1	1	1	1	1	1	1	1	2	2	2	2	1	1	1	1
Front-end-loader	6.0 m^3	1	2	2	2	2	2	2	2	4	4	4	4	4	4	3	3
Front-end-loader	0.8 m^3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Back-hoe	0.7 m^3	1	1	1	1	1	1	1	1	2	2	2	1	1	1	1	1
Rear Dump Truck	32 t	3	9	10	10	11	11	12	13	23	25	24	20	22	19	19	19
Rear Dump Truck	8 t	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Service Truck	7 t	1	2	2	2	2	2	2	2	4	4	4	4	4	4	4	4
Service Truck	2 t	3	6	6	6	6	6	6	6	12	12	12	9	9	9	9	9
Jeep	-	4	10	10	10	10	10	10	10	13	13	13	10	10	10	10	10
Watering Cart	3,800 L	-	1	1	1	1	1	1	1	2	2	2	1	1	1	1	1
Crawler Drill	-	2	3	3	3	3	3	3	4	7	8	8	8	8	8	7	7
Drill	Drifter & Leg Drill	9	15	15	15	15	15	15	17	30	33	33	33	33	33	32	32
Air Compressor	170 ps	2	3	3	3	3	3	3	4	7	8	8	8	8	8	7	7
AN-FO Charger	8ps, 5KVA	2	2	2	2	2	2	2	3	5	5	5	5	5	5	5	5
Pump	30 KW	-	1	1	1	1	-	-	-	1	1	1	1	1	1	1	1
Pump	55 KW	-	-	-	-	-	1	1	1	1	1	1	1	1	1	1	1
Bit Sharpener	-	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3
Illumination Set	5 KVA	3	4	4	4	4	4	4	4	6	6	6	4	4	4	4	4

4-4-2 Attached Facilities

On the northern foot of Kyisindaung, an explosive magazine is planned to be constructed which can also be used as a storage of prilled ammonium nitrate. The magazine, which can accommodate the amount to be consumed in 3 months, is to be built of concrete with interior wooden finish and will be as large as 300 m^2 in total area. A spacious service yard encircled by a barrier fence is also to be arranged in the vicinity of the said magazine.

Furthermore, at the southern foot of Kyisindaung, a supervising office of 200 m^2 in area for mining operations is to be built of wood with slate sheet roofing. This office is also to be used for geological, topographical work, and at the same time it will offer a store room for tools and instruments.

Mechanical work shop, motor pool, wood sawmill, fuel storage, and oil service station are also planned to be installed. However, the details of these are described later in Chapter 7-4.

Electric service stations for the mining division, and their facilities are introduced in Chapter 7-2.

4-4-3 Requirement for Chief Consumables

The requirements of the chief consumables for the mining operation, during the entire period, are expected to shift from year to year as shown in Table 4-11.

Table 4-11

Year	Fuel Oil & Gasoline	Ammonium Nitrate	Dynamite	Detonator	Rock Bit	Tyre for big Truck & Loader	Explosives Sum of ANFO & Dy.
	kl	t	t		pcs	pcs	t
1	1,683	271	32	45	365	49	320
2	1,667	283	33	50	365	51	334
3	1,707	283	33	50	365	56	334
4	1,712	278	33	49	361	57	329
5	1,760	282	33	50	365	58	333
6	1,879	305	36	54	396	62	360
7	2,439	345	41	61	449	69	408
8	4,359	635	75	112	826	129	751
9	4,550	738	87	130	956	139	872
10	4,423	772	91	136	999	134	912
11	3,752	756	90	134	986	114	897
12	3,871	769	91	136	996	122	909
13	3,569	769	91	136	996	106	909
14	3,436	707	84	125	917	104	836
15	3,478	702	83	124	908	106	830

Chapter 5 CONCENTRATING

CHAPTER 5. CONCENTRATING

5-1 CONCENTRATING TEST

5-1-1 Laboratory Test

In 1974, about 2 tons of the drilled core, sampled at Sabedaung sector, was sent to Japan by air cargo, and was tested metallurgically using the testing facilities at the Central Research Laboratory of Mitsui Mining and Smelting Co., Ltd. (hereafter, MMS).

The sampled core was divided into three groups, ie. upper-zone ore, lower-zone ore, and lower grade ore. However, only the first two types of ore were tested at the laboratory. The metallurgical treatment of these types of ore cannot be considered easy if compared with other common types of copper ore, in which the chalcopyrite content prevails over other copper minerals. In the present study, the copper minerals have been found to be mostly chalcocite, with small associated amounts of chalcopyrite.

Furthermore, the particle size of the chalcocite is as fine as from 1 micron to 150 micron, and the major is between 10 and 40 micron.

It was felt necessary to finely grind the ore to minus 400 mesh by regrinding in order to recover the copper mineral better in flotation. The result of the locked flotation test is as shown as in Table 5-1, indicating a concentrate copper grade of 19.37% and a recovery rate of 78.3% for the upper zone ore, while the concentrate copper grade was 20.8% and the rate of recovery 80.2% for the lower zone ore.

Thus, the lower zone ore showed better results in the laboratory test.

Table 5-1 Result of Locked Test of the Sabedaung Core Sample

Ore	Assay, % Cu		
	Feed	Concentrate	Recovery % Cu
Upper zone	0.90	19.37	78.3
Lower zone	0.87	20.85	80.2

5-1-2 Pilot Plant Test

The aforementioned test merely gave us general information on the concentrating process of the copper ore. To obtain the indispensable designing criteria for the large scale mill, it became necessary for the ore to be tested, on a slightly larger scale, continuously using the actual ore mined from the ore deposit.

For this purpose, a 50 T/D capacity pilot plant was constructed on the north-eastern foot of Kyisindaung, and a series of concentrating tests was carried out on the crude ore produced from the prospecting tunnel at Sabedaung from November 11, 1975 to February 14, 1976.

During the test period, a total of 2,138 tons of crude ore, of which the average copper grade was 0.70%, was treated in order to confirm the foregoing laboratory test result, as well as to collect various data necessary for establishing this feasibility report.

The result of the locked test in 1974, using a grinding-flotation circuit, indicated the concentrate copper grade as 30% and recovery as 70.7% for the crude ore copper grade of 0.9%. However, by improving the circuit (regrinding of the flotation middling, and additional setting of recleaning facilities), the recovery rate was much improved, and confidence was gained that a recovery rate of 75% can be obtained.

The metallurgical estimation for each crude ore grade is shown in Table 5-2.

Table 5-2 Metallurgical Estimate

Grade of Crude Ore % Cu	Grade of Copper Conc. % Cu	Recovery % Cu
0.5	30	57.0
0.6	"	63.5
0.7	"	68.3
0.8	"	72.0
0.9	"	75.0
1.0	"	76.8
1.1	"	78.2

5-1-3 Designing Criteria learned from Experience with the Pilot Plant

Of the miscellaneous mill designing criteria obtained in the operating test at the pilot plant, the major findings can be summarized as follows:

(1) The amount of -200 mesh fine ore in the crude ore at Sabedaung is found as little as 1.2% on average, thus the washing of the feed is believed to be unnecessary.

(2) The Work Index of Sabedaung ore was measured by the ball mill, and found to be 12.5 on average. This figure shows a grinding resistance in the medium range.

(3) The optimum degree of grindings required for the flotation feed is found in -200 mesh passing ratio as from 75% to 82% for a roughing circuit, while the optimum flotation is found in the feed with -325 mesh passing ratio of over 95% for a cleaning circuit.

(4) 80% passing size of the copper concentrate is approximately 23 micron.

(5) The settling velocity of the concentrate and tailing is shown in Table 5-3.

Table 5-3 Results of the Settling Test

Feed	Copper Concentrate				Tailing
Pulp Density (% solid)	30	35	40	50	20
Settling Velocity (meter/hour)	0. 282	0. 215	0. 201	0. 182	0. 030

5-1-4 Chemical Analysis of Copper Concentrate

The average of the assay data of 5 concentrate samples produced both at the laboratory and at the pilot plant is shown in Table 5-4.

Table 5-4 Chemical Analysis of the Copper Concentrate (Average Value)

Element	Assay	Element	Assay
Cu	29. 5 %	Ni	0. 02 % less
Pb	0. 01 % less	MoS_2	0. 01 % less
Zn	0. 01 % less	SiO_2	1. 4 %
S	37. 7 %	Al_2O_3	0. 9 %
Fe	26. 2 %	Au	0. 9 g/t
As	0. 04 % less	Ag	23 g/t
Sb	0. 02 % less	Hg	0. 6 ppmless
Bi	0. 01 % less		

5-1-5 Filtration Test of Copper Concentrate

About 200 kg of the copper concentrate recovered at the pilot plant was sent to Japan for Filtration Tests. The result of the tests is shown in Table 5-5, and the moisture content of the cake of concentrate was successfully cut below 10% by means of a centrifuge.

However, the moisture content of the cake remained as high as from 12.8% to 18.5% when a vaccum filter was used. Thus, in this case, it was necessary for the cake to be secondarily treated by a drier to reduce the water content to below 10%.

Table 5-5 Result of the Filtration Test by Centrifuge

Basket Diameter of Tester : 375 mm

Permeability of Filter Cloth-Cotton #26 : 1.19cm^3/sec/cm^2

Pulp Density of Feed : 30 % solid

Basket Speed, rpm	1,650		2,000	
Centrifugal Force, G	571		838	
Time, Charging, min.	4-1/2		5-1/3	
" Dewatering min.	5	10	5	10
Cake, Weight, wet kg.	-	18.9	-	29.5
" Moisture, %	10.4	9.3	9.6	9.3
" Thickness, mm	-	44	-	59

5-2 DESIGN CRITERIA OF THE MILL

The following design criteria have been established based on the production schedule, laboratory data, pilot plant performance and other technical information from newly developed large scale mines throughout the world.

5-2-1 Concentration Method

All Slime Copper Flotation

5-2-2 Operating Condition

Annual operating days 300

Number of daily shift

Primary crushing 2

Secondary, tertiary, and concentrator, etc. 3

Operating hours a day

Primary crushing 12

Secondary, tertiary crushing	21
Grinding, flotation, and filtration	24

5-2-3 Capacity in Design

Primary crushing	max. 8,800 t/d	1 unit
Secondary, tertiary crushing	max. 8,800 t/d	1 unit
Grinding, flotation	max. 4,400 t/d	2 units
Filtration of concentrate	max. 250 t/d	1 unit

5-2-4 Physical Properties of Crude Ore

Grade of copper	First year	1.070
Grade of copper	15th year	0.706
True specific gravity		2.9
Apparent specific gravity	Coarse crushed ore	1.85
	Fine crushed ore	1.68
Moisture content	Average in dry season	2.0
	Average in rainy season	6.0
Primary slime content (-200 mesh)	below	1.5%

5-2-5 Crushing

Crushing method	3 stages in open circuit	
Maximum feed size	540 x 800 x 1,260 mm	
Crushing product of 80% passing size	Primary	120 mm
	Secondary	38 "
	Tertiary	13 "

Effective capacity of storage

Primary crushed product	3,000 t

Secondary, intermediate hopper		30 t
Tertiary, intermediate hopper		30 t

5-2-6 Grinding

Grinding method	Rod ball mill	
Grinding circuit	Rod mill ---- open circuit	
	Ball mill ---- closed circuit	
Classification method	Wet cyclone	
Feed in 80% passing size		130 mm
Mill product in 80% passing size	Rod mill	0. 69 mm
	Ball mill	0. 074 mm
Operating Work Index (KWH/short ton)		13. 0
Cyclone circulating load (%) for new feed		300
Ball mill discharge pulp density (solid %)		68
Cyclone overflow pulp density (solid %)		28
Live capacity of fine ore storage		9, 000 t

5-2-7 Regrinding

Grinding method	Ball mill closed circuit	
Classification method	Wet cyclone	
Feed in 80% passing size		0. 074 mm
Mill product in 80% passing size		0. 020 mm
Operating Work Index (KWH/short ton)		17. 2
Cyclone circulating load (%) for new feed		200
Cyclone overflow pulp density (solid %)		25

5-2-8 Flotation

Pulp density (solid %)	Roughing circuit	28
	Scavenging circuit	25
	Cleaning circuit	25
Flotation time (minute)	Roughing circuit	15
	Scavenging circuit	15
	Cleaning circuit	22
PH value of pulp	In each circuit	11.5
Final concentrate copper grade (Cu %)		30.0
Recovery (Cu %)	In first year	77.8

5-2-9 Thickening of Concentrate

Thickening method	Thickener
Feed pulp density (solid %)	25.0
Underflow pulp density (solid %)	30.0
Settling velocity (m/hr)	0.215

5-2-10 Filtering of Concentrate

Filtering method	Centrifuge
Feed pulp density	30.0
Moisture content in filtered concentrate (water %)	10.0

5-2-11 Principal Unit Consumption (First year)

Grinding media (g/t)	Rod for rod mill	290
	Ball for primary grinding	725
	Ball for regrinding	174
	Liner for rod mill	44

Flotation reagent (g/t)	Slaked lime	5,500
	Sodium isopropyl xanthate (NaPX)	70
	Aerofloat 208	82
	Pine Oil	92
	Methyl Isobutyl Carbinol (MIBC)	16
	Electric power (KWH/t)	18.31
	Water supply (m^3/t)	4

5-3 CONCENTRATOR

The concentrator has been designed to recover copper concentrate by all slime flotation in annually treating 2,400,000 MT of crude ore, with 300 operating days per annum.

The mill is composed of primary crushing, secondary and tertiary crushing plants, grinding flotation, and filtration plants, together with lime slaking plant and a laboratory.

The capacity of the mill is designed nominally at 8,000 MT/d, but its maximum capacity has been set at 8,800 MT/d in consideration of some problems in treating wet and coarsely crushed ores during the rainy season, which may cause a reduction of grinding capacity. It will provide also a compensating faculty against unexpected stops or repairs of the facility.

Figures which are attached for reference on other volume are as follows:

Figure	5-1	Basic Flow Diagram
"	5-2	Flow sheet of Crushing Plant
"	5-3	Flow sheet of Concentrator
"	5-4	General Arrangement of Crushing Plant
"	5-5	General Arrangement of Concentrator

5-3-1 Location of Concentrator

The location of the concentrator was selected on the gentle slope at the southern foot of Taungkhamank in consideration of the topography, ground situation, and the distance to the mining pit, etc.

5-3-2 Primary Crushing

The crude ore hauled from the open pit is first to be crushed by a gyratory crusher of 42" x 65" (setting in 140 mm), then carried to the 3,000 ton coarse ore storage by belt conveyor.

The storage is to be located between the primary crushing plant and the secondary, tertiary crushing plants. The primary crushing plant to be operated in 2 shifts and the secondary, tertiary crushing plants in 3 shifts.

Thus the storage is to be used as a reserve supply in the flow of the crushed ore.

5-3-3 Secondary, Tertiary Crushing

The crushed ore from the 3,000 t storage is to be fed into the 30 t hopper for the secondary crushing by means of apron feeder and belt conveyors. It will then supplied to the double deck vibrating screen of 8 ft x 20 ft by a belt feeder.

The over size on the screen is fed to a 7 ft standard cone crusher, while the under size (-16 mm ore) is directly sent to the fine ore storage.

The ore crushed by the standard cone crusher is first hauled to another 30 t hopper for tertiary crushing, then fed to the 8' x 20' single deck vibrating screen through a belt feeder.

The oversize of the single deck screen is crushed by a 7 ft short head cone crusher, and mixed with the corresponding undersize. This finely crushed ore is then sent to the 9,000 t fine ore storage by means of a belt conveyor equipped with a tripper.

The final crushing product is planned to be usually 80% in 13 mm passing size, however in the rainy season the moisture content of the crude ore will inevitably increase, and the wet ore may cause choking of the cone crusher at its crushing head.

Accordingly the mesh of the vibrating screen will then be widened from 13 mm to 40 mm, so that the size of the final crushing product will be coarser during the rainy season.

5-3-4 Grinding

The crushed ore in the fine ore storage is fed to the 2 sets of the 12'ø x 15 ft 6 inch rod mill by means of a belt feeder and belt conveyors through a 25 t hopper, and is to be treated by wet grinding. The discharge of the rod mill is continuously treated in wet grinding in a closed circuit, composed of both 2 sets of 15 ft 6 inch ø x 21 ft ball mills and 16 sets of 20 inch ø cyclones.

The product is designed to consist to 80% of 0. 074 mm passing particle size with a pulp density of 28% in the solid state. This product is then to be fed for the subsequent flotation.

5-3-5 Regrinding

The froth of the roughing flotation, as well as from the scavenging flotation, is sent respectively to the 9 ft 6 inch ø x 19 ft 6 inch ball mill, and reground in a wet closed circuit in association with 8 sets of 6 inch ø cyclone.

Then, the product of finer particle size is sent to the subsequent cleaning process. The particle size of the reground product mentioned above is estimated to be as fine as 0. 02 mm in 80% passing size, while its pulp density is planned at 25% in the solid state.

5-3-6 Flotation

The flotation plant is designed to be established with 4 banks of DR 300 V rougher and scavenger, where one bank is composed of 8 cells of rougher and 12 cells of cleaner, together with 18 cells of Sub-A No. 24 rougher-cleaner and also 18 cells of Sub-A No. 24 scavenger-cleaner.

The finely ground ore of 0.074 mm in 80% passing size, obtained by means of the said ball mill of 15 ft 6 inch, is divided into four by a distributor and fed to the rougher-scavenger flotator.

Thus, both rougher froth and scavenger froth are recovered, and the residues become tailing pulp for the waste pond.

The froth recovered by the rougher and scavenger is to be reground, after it has been thickened by a thickener of 10.5 m in diameter. It is then treated to recover the final copper concentrate by means of either rougher-cleaner or scavenger-cleaner.

5-3-7 Concentrate Filtering

The copper concentrate recovered by the said rougher-cleaner and scavenger-cleaner is first thickened in the 15 mø thickener, then fed to the 10 sets of AT 48 type centrifuge to decrease the moisture content of the concentrate to 10%.

Finally, the concentrate cake is to be collected and hauled by a set of belt conveyors to the concentrate storage of 2,500 t capacity.

5-3-8 Tailing

After recovering the contained copper mineral, the final tailing is to be sent to the waste tailing pond in natural flow.

5-3-9 Flotation Reagents

It is proposed that the flotation reagents to be used will be slaked lime, sodium isopropyl xanthate, Aerofloat 208, pine oil, and MIBC.

It is planned to prepare the slaked lime at the proposed lime slaking plant, in the neighbourhood of the concentrator. There, the locally purchased quick lime will be slaked, thus milk of lime will be sent directly to the grinding plant.

Other flotation reagents are to be dissolved and adjusted into respective optimum densities, then sent to each discharging point according to pre-set plans.

5-3-10 Instrumentation

The following instrumentation facilities are to be installed for running the plant smoothly.

(1) Industrial Television (I. T. V.)

An I. T. V. system is to be installed for each ore storage area to control the circumstances of both the in flow and out flow of the feed.

(2) Metal Detector

Should some non-magnetic metal piece, which can not be excluded by the hanging magnet, accidentally be contained in the ore, the cone crusher may be in danger of being damaged. The feed conveyor to the cone crusher is therefore to be equipped with a set of metal detectors.

This device will automatically stop the feeder conveyor whenever it detects any piece of non-magnetic metal.

(3) Conveyor Weight Meter

To measure the amounts of crushed ore, ground ore, and concentrate continuously, conveyor weighers are to be installed.

By these weighers, both the instant rate and accumulated amount of respective ore flow can be read directly.

(4) Pulp Measuring Meters

To ascertain either the pulp density or the pulp amount in situ either at the grinding plant or in the flotators, several sets of density meter and flow meter are to be installed.

On the other hand, PH meters will be also be introduced to indicated continuously the PH of the pulp flows.

(5) Fluorescent X-ray Analyzer

To watch the copper grades of the flotation feed, intermediate rough concentrate, copper concentrate, and tailing at each stage, a set of fluorescent X-ray analyzers is to be used. These analyzers will measure the copper content of each sample concerned, one at a time. An automatic sampler will be used to send the samples successively to the analyzers according to the previous arrangement.

All of these instrumentations are to be controlled by trained technicians from an operations center.

No computerized control is planned to be applied for the mill.

5-3-11 Crane

The following overhead cranes are planned to be installed for the concentrator.

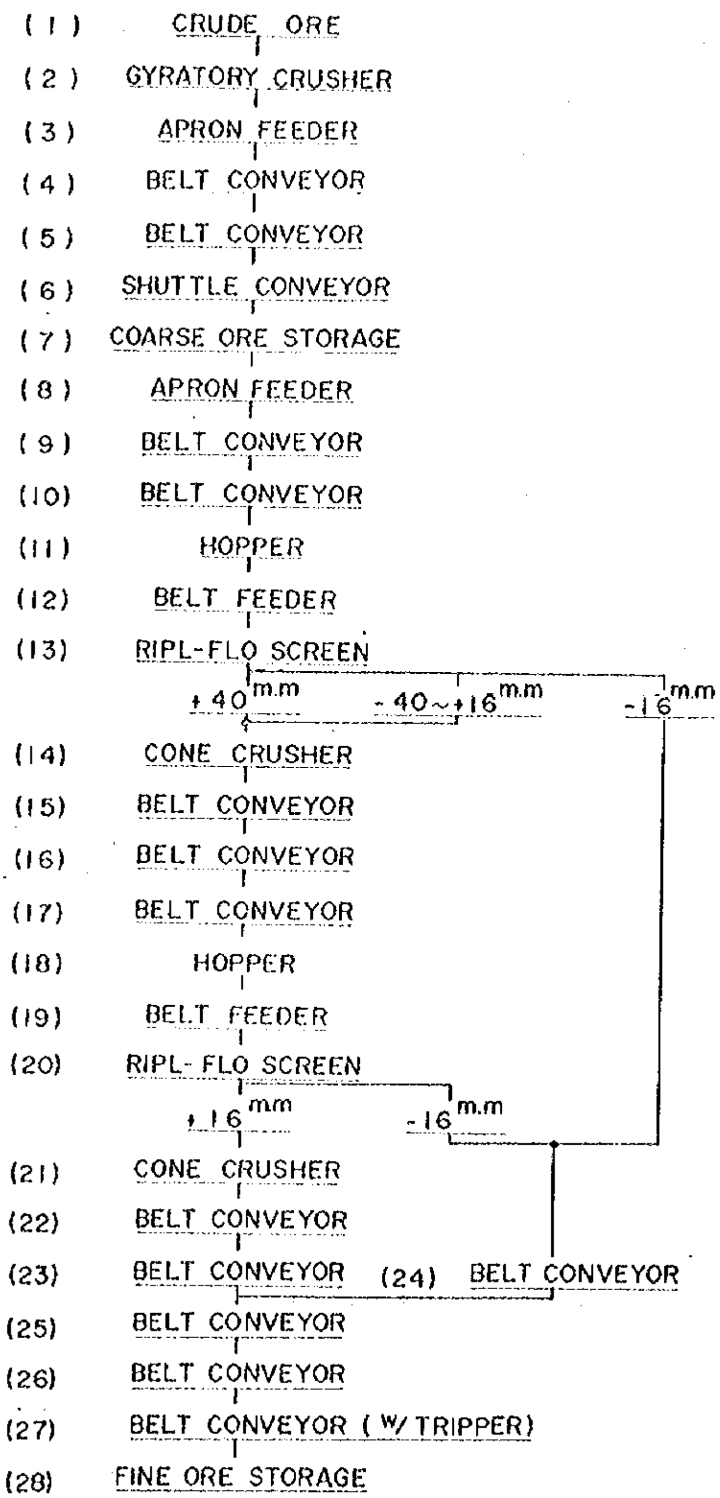
Primary crushing	75/15 ton
Secondary and tertiary crushing	30/5 ton
Grinding	50/15 ton
Flotation	5 ton

5-3-12 Flow Sheet and Main Machinery

The flow sheets are as shown below and the main machinery or equipment of the crushing plants and other facilities are mostly shown in Tables 5-6 and 5-7.

FLOW SHEET OF CRUSHING PLANT

CAPACITY 8,000 T/DAY



FLOW SHEET OF CONCENTRATOR

CAPACITY 8,000 TONS PER DAY

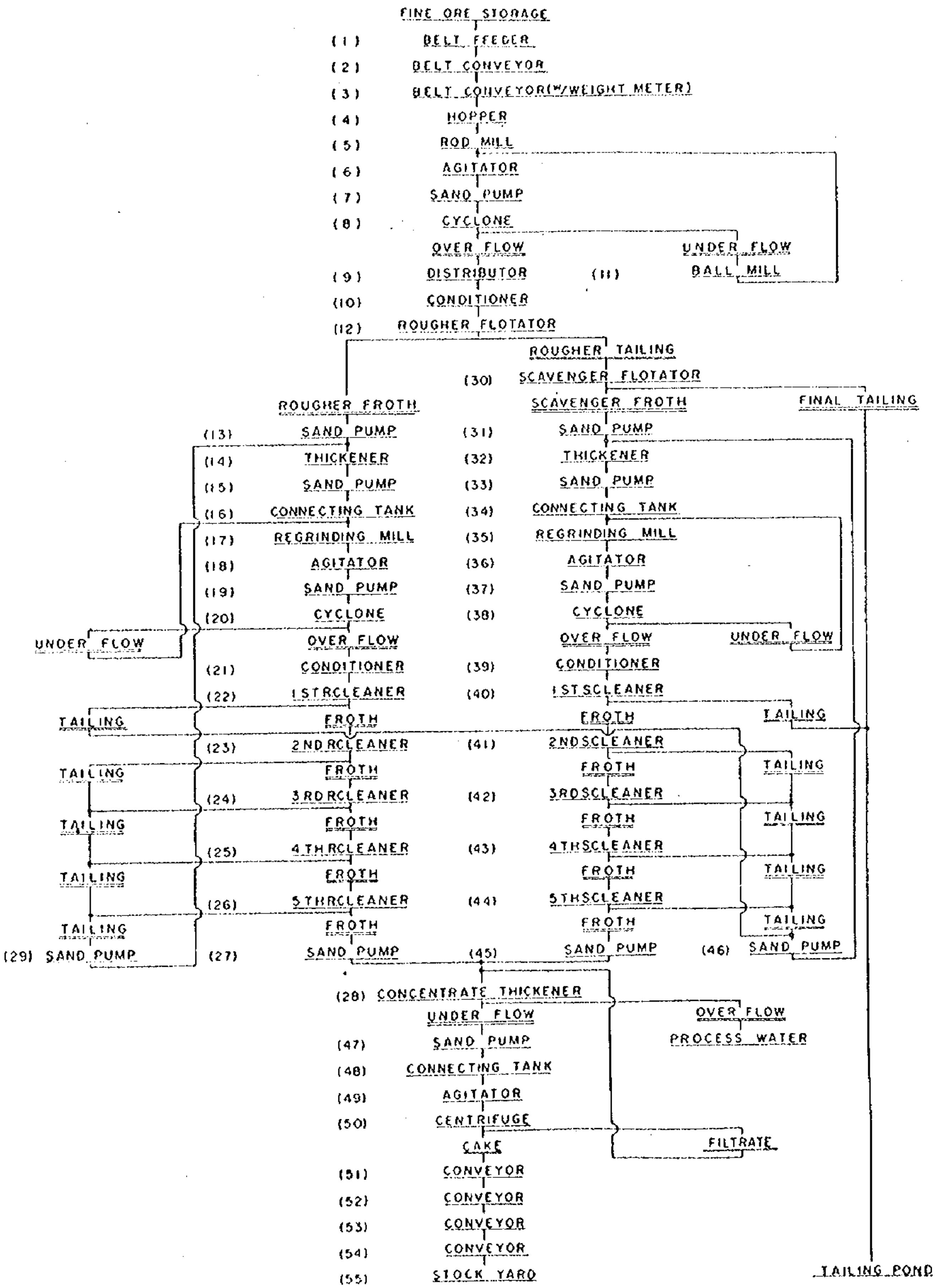


Table 5-6

EQUIPMENT FOR FLOW SHEET OF CRUSHING PLANT

CAPACITY 8,000 ^{T}/DAY

ITEM NO.	NO. OF SETS	I T E M	R E M A R K S
(1)		CRUDE ORE	8,000 ^{T}/DAY MAX. SIZE $536^{mm} \times 800^{mm} \times 1{,}256^{mm}$
(2)	1	GYRATORY CRUSHER	42 x 65 GYRATORY ECCENTRIC THROW 32^{mm}, 260^{kw}, 120^{MT}
(3)	1	APRON FEEDER	$1{,}800^{mm} \times 6^{m}$ VARIABLE SPEED 26^{kw}, 33.4^{MT}
(4)	1	BELT CONVEYOR	$1{,}000^{mm} \times 60^{m}$ 120 ^{m}/MIN. 15° INCLINED
(5)	1	BELT CONVEYOR	$1{,}000^{mm} \times 70^{m}$ 120 ^{m}/MIN. 15° INCLINED
(6)	1	SHUTTLE CONVEYOR	$1{,}200^{mm} \times 20^{m}$ HORIZONTAL
(7)	1	COARSE ORE STORAGE	OPEN TYPE CAPACITY $3{,}000^{MT}$
(8)	2	APRON FEEDER	$1{,}600^{mm} \times 8^{m}$ VARIABLE SPEED 20^{kw}, 37.6^{MT}
(9)	1	BELT CONVEYOR	$1{,}000^{mm} \times 24^{m}$ 120 ^{m}/MIN. HORIZONTAL
(10)	1	BELT CONVEYOR	$1{,}000^{mm} \times 100^{m}$ 120 ^{m}/MIN. 15° INCLINED
(11)	1	HOPPER	CAPACITY 30^{MT}
(12)	1	BELT FEEDER	$1{,}000^{mm} \times 8^{m}$ HORIZONTAL
(13)	1	RIPL-FLOW SCREEN	8'x 20' DOUBLE DECK (TOP 40^{mm} ROD, BOTTOM, 16^{mm} SLOTTED) 44^{kw}, 6.5^{MT}
(14)	1	CONE CRUSHER	$2{,}100^{mm}$ STANDARD C.C. 220^{kw}, 78^{MT}
(15)	1	BELT CONVEYOR	$1{,}000^{mm} \times 50^{m}$ 15° INCLINED
(16)	1	BELT CONVEYOR	$1{,}000^{mm} \times 12^{m}$ 15° INCLINED
(17)	1	BELT CONVEYOR	$1{,}000^{mm} \times 54^{m}$ 15° INCLINED
(18)	1	HOPPER	SAME AS (11)
(19)	1	BELT FEEDER	SAME AS (12)
(20)	1	RIPL-FLOW SCREEN	8'x 20' SH RIPL-FLOW SINGLE DECK 16^{mm} SLOTTED 30^{kw}, 2.5^{MT}
(21)	1	CONE CRUSHER	$2{,}100^{mm}$ SHORT HEAD C. S. H 220^{kw}, 81^{MT}
(22)	1	BELT CONVEYOR	$1{,}000^{mm} \times 11^{m}$ 15° INCLINED
(23)	1	BELT CONVEYOR	$1{,}000^{mm} \times 8^{m}$ 15° INCLINED
(24)	1	BELT CONVEYOR	$1{,}000^{mm} \times 31^{m}$ HORIZONTAL
(25)	1	BELT CONVEYOR	$1{,}000^{mm} \times 52^{m}$ 15° INCLINED
(26)	1	BELT CONVEYOR	$1{,}000^{mm} \times 36^{m}$ 15° INCLINED
(27)	1	BELT CONVEYOR W/TRIPPER	$1{,}000^{mm} \times 92^{m}$ HORIZONTAL
(28)	1	FINE ORE STORAGE	OPEN TYPE STORAGE CAPACITY $9{,}000^{MT}$

Table 5-7

EQUIPMENT FOR FLOW SHEET OF CONCENTRATOR CAPACITY 8,000 TONS PER DAY

ITEM NO	NO OF SETS	I T E M	R E M A R K S
(1)	6	BELT FEEDER	$700^{mm} \times 10^{m}$ $70^{m}/min$ HORIZONTAL W/CONTROL GATE
(2)	2	BELT CONVEYOR	$800^{mm} \times 40^{m}$ $70^{m}/min$ HORIZONTAL
(3)	2	BELT CONVEYOR W/WEIGHTMETER	$800^{mm} \times 52^{m}$ $70^{m}/min$ 15° INCLINED & MERRIC WEIGHTMER CAP 250～$400^{T}/Hr$
(4)	2	HOPPER	CAPACITY 25^{T}
(5)	2	ROD MILL	ϕ12'×15'-6" OVERFLOWTYPE 1,050 HP
(6)	2	AGITATOR	ϕ14'×14' DENVER TYPE SUPER AGITATOR 40 HP
(7)	4	SAND PUMP FOR CYCLONE	14"×12" DENVER TYPE SRL-C 360 HP
(8)	4	CYCLONE SEPARATOR	KREBS MODEL D-20B×8
(9)	1	DISTRIBUTOR	ϕ8'×8' DENVER TYPE 4 WAY 3 HP
(10)	4	CONDITIONER	ϕ12'×12' DENVER TYPE 40 HP
(11)	2	BALL MILL	ϕ15'-6"×21' MARCY OVER FLOW TYPE 2,600 HP
(12)	4	ROUGHER FLOTATOR	DENVER DR 300V 8 CELLS EACH BANK 30 HP PER CELL
(13)	4	SAND PUMP FOR ROUGHER FROTH	3"×3" DENVER TYPE SRL 5 HP 3SETS FOR RUNNING 1 SET FOR SPARE
(14)	1	THICKENER FOR ROUGHER FROTH	ϕ$10.5^{m} \times 3.7^{m}$ DORR TYPE 5 HP
(15)	1	SAND PUMP	SAME AS (13) FOR THICKENER DISCHARGE
(16)	1	CONNECTING TANK	ϕ$1,200^{mm} \times 1,200^{mm}$
(17)	1	REGRINDING MILL	ϕ9'-6"×19'-6" OVERFLOWTYPE 630 HP FOR UP-GRADING
(18)	1	AGITATOR	ϕ6'×6' DENVER TYPE SUPER AGITATOR
(19)	2	SAND PUMP FOR CYCLONE	8"×6" DENVER TYPE SRL-C 40 HP
(20)	2	CYCLONE SEPARATOR	KREBS MODEL D-6B×8
(21)	1	CONDITIONER	ϕ6'×6' DENVER TYPE 5 HP
(22)	1	1ST ROUGHER CLEANER	DENVER SUB-A TYPE 24" 8CELLS 15 HP PER 2 CELLS
(23)	1	2ND ROUGHER CLEANER	DENVER SUB-A TYPE 24" 3CELLS 15 HP PER 2 CELLS
(24)	1	3RD ROUGHER CLEANER	SAME AS ABOVE
(25)	1	4TH ROUGHER CLEANER	DENVER SUB-A TYPE 24" 2CELLS 15 HP PER 2CELLS
(26)	1	5TH ROUGHER CLEANER	SAME AS ABOVE
(27)	1	SAND PUMP	SAME AS (13) FOR ROUGHER CLEANER CONCENTRATE
(28)	1	CONCENTRATE THICKENER	ϕ$15^{m} \times 4^{m}$ DORR TYPE 5 HP
(29)	1	SAND PUMP	SAME AS (13) FOR 2^{ND}～5^{TH} ROUGHER CLEANER TAILING
(30)	4	SCAVENGER FLOTATOR	DENVER DR 300V 6 CELLS EACH BANK 30 HP PER CELL
(31)	4	SAND PUMP	SAME AS (13) FOR SCAVENGER FROTH
(32)	1	THICKENER	SAME AS (14) FOR SCAVENGER FROTH
(33)	1	SAND PUMP	SAME AS (13) FOR THICKENER DISCHARGE
(34)	1	CONNECTING TANK	SAME AS (16)
(35)	1	REGRINDING MILL	SAME AS (17) FOR SCAVENGER FROTH UP-GRADING
(36)	1	AGITATOR	SAME AS (18)
(37)	2	SAND PUMP FOR CYCLONE	SAME AS (19)
(38)	2	CYCLONE SEPARATOR	SAME AS (20)
(39)	1	CONDITIONER	SAME AS (21)
(40)	1	1ST SCAVENGER CLEANER	SAME AS (22)
(41)	1	2ND SCAVENGER CLEANER	SAME AS (23)
(42)	1	3RD SCAVENGER CLEANER	SAME AS (23)
(43)	1	4TH SCAVENGER CLEANER	SAME AS (25)
(44)	1	5TH SCAVENGER CLEANER	SAME AS (25)
(45)	1	SAND PUMP	SAME AS (13) FOR SCAVENGER CLEANER CONCENTRATE
(46)	1	SAND PUMP	SAME AS (13) FOR SCAVENGER CLEANER (NO.2-NO.5) TAILING
(47)	1	SAND PUMP	SAME AS (13) FOR DISCHARGE OF CONCENTRATE THICKENER
(48)	1	CONNECTING TANK	SAME AS (16)
(49)	1	AGITATOR	(16)
(50)	12	CENTRIFUGE	AT 48 TYPE 10 SETS FOR RUNNING, 2 SETS FOR SPARE
(51)	2	CONVEYOR	$400^{mm} \times 15^{m}$
(52)	2	CONVEYOR	$400^{mm} \times 5^{m}$
(53)	1	CONVEYOR W/WEIGHTMETER	$450^{mm} \times 15^{m}$ 15° INCLINED & MERRIC WEIGHTMETER CAP 6～$8^{T}/Hr$
(54)	1	CONVEYOR W/TRIPPER	$450^{mm} \times 30^{m}$ HORIZONTAL & TRIPPER
(55)	1	CONCENTRATE STOCK YARD	OPEN TYPE CAPACITY 2,500 TONS

5-4 LIME SLAKING PLANT

All the slaked lime to be used as flotation reagent at the concentrator is to be procured at the mine site and in its vicinity.

Thus, a lime slaking plant is to be built next to the concentrator, and quick lime obtained at lime stone quarries in the suburbs of Mandalay is probably to be used as the raw material.

5-4-1 Raw material

(1) Grade

The chemical analysis result on the quick lime calcined at both Ohn Chan and Zebingyi, to the east of Mandalay, showed that it had a high MgO content in comparison with the quick lime produced in Japan, as shown in Table 5-8.

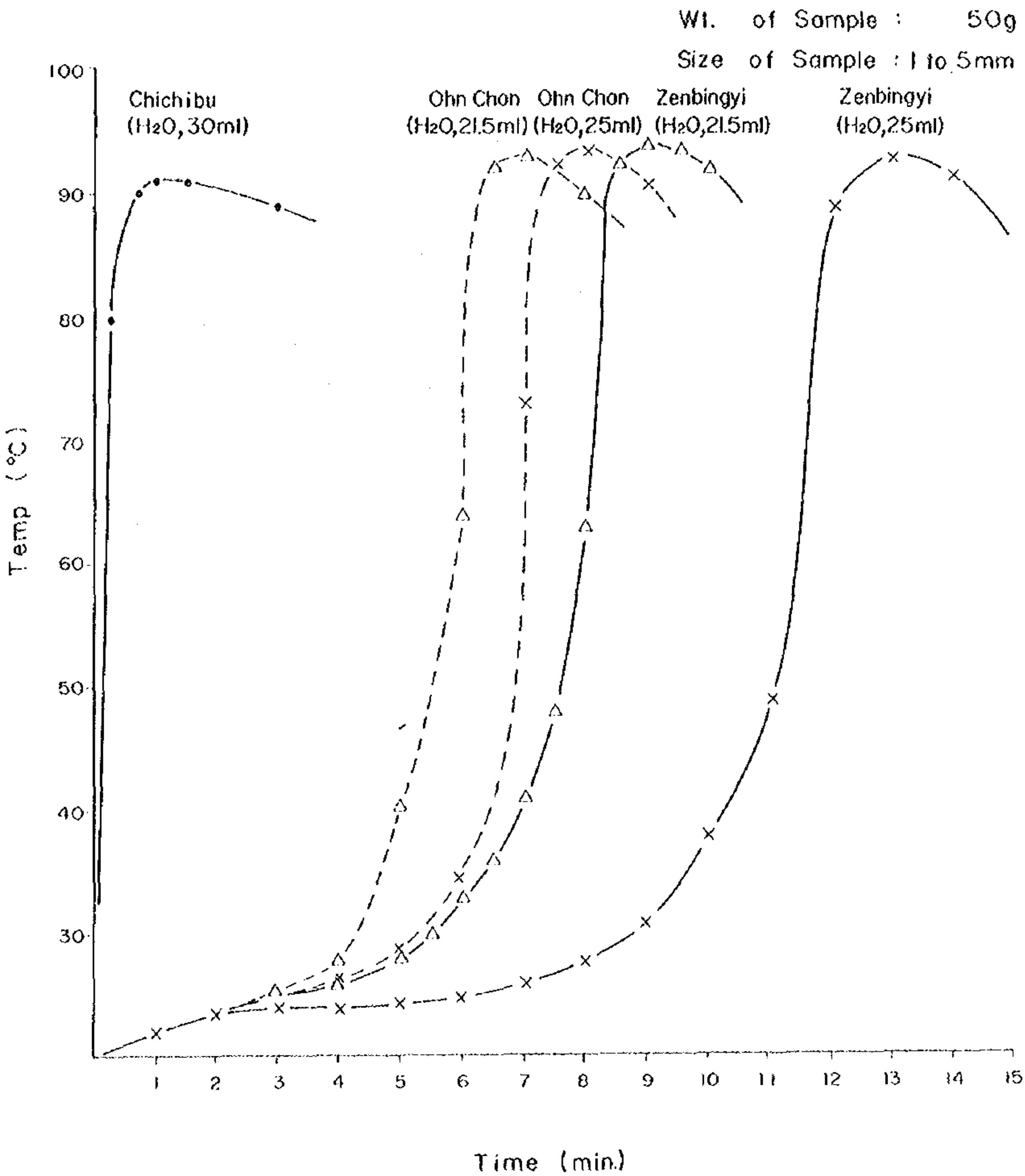
Table 5-8 Chemical Analyses of Quick Lime

Element	Assay, %		
	Ohn Chan	Zebingyi	Chichibu (Japan)
CaO	58.38	56.79	96.95
MgO	37.90	39.56	0.85
SiO_2	0.03	0.10	0.56
Al_2O_3	0.07	0.07	0.26
Fe_2O_3	0.02	0.02	0.11
Ignition Loss	3.20	3.41	0.93
CO_2	0.26	0.22	0.66

(2) Slaking Rate

The survey result of the measurements of the slaking rate of the quick lime made in Burma is shown in Table 5-9, and it is a remarkably slow rate if compared with that of the Japanese product. So, in slaking the lime, sufficient preliminary mixing of the quick lime with slaking water will be indispensable.

Table. 5-9 Slaking Rate of Quick Lime



(3) Fineness of the Slaked Material

Fineness of the slaked lime obtained in the test (2) mentioned above was also studied. The result is shown in Table 5-10.

Table 5-10　Fineness of Slaked Lime made from Slaking Rate Test

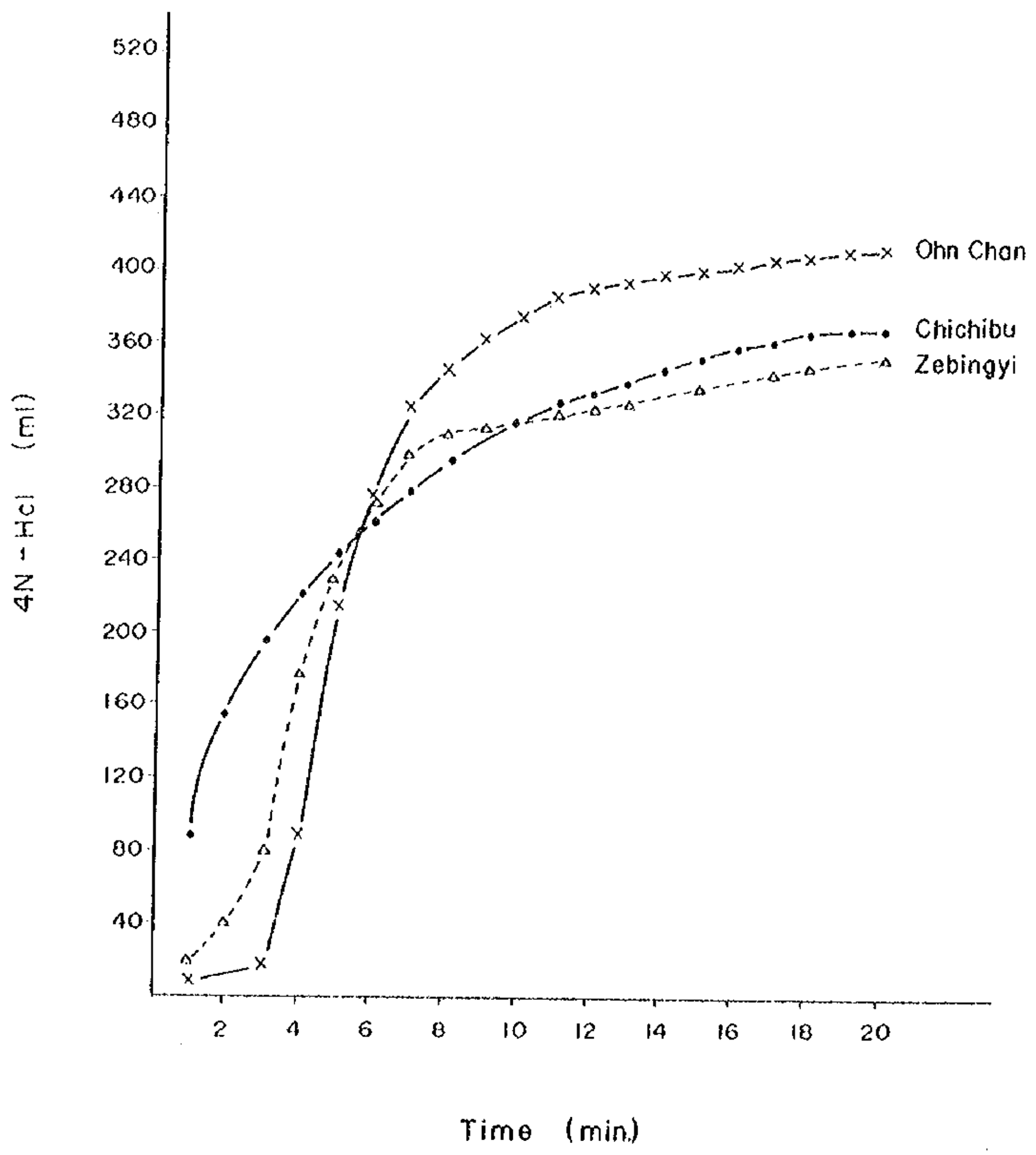
Fineness		Weight, %				
mm	mesh	Zenbingyi		Ohn Chan		Chichibu
		Adding water Ratio 50%	43	50	43	60
+0.25	+60	35.0	14.2	77.0	61.6	54.8
+0.149	+100	6.5	3.5	6.7	8.8	4.0
-0.149	-100	58.5	82.3	16.3	29.6	41.2
Total		100.0	100.0	100.0	100.0	100.0
Moisture, %		5.6	3.0	1.4	1.2	0.8

(4)　HCl-Reaction Rate

The result of the measurement of the HCl reaction rate is as shown as in Table 5-11.

Table. 5-11 Hcl - Reaction Rate of Quick Lime

Wt. of Sample : 50g
Size of Sample : 1 to 5mm
Vol. of Pure Water : 200ml
Temp. of Pure Water : 40°C
Agitation Speed : 350rpm
Reagent : 4N - Hcl
Titration Indicator : Phenolphthalein C2H14O4



5-4-2 Criteria of Design

The criteria of design for the slaked lime plant is as follows:

(1) Material

Material equivalent to that from Ohn Chan and Zebingyi as shown in Table 5-8.

(2) Operating Conditions

Annual operating days	300
Daily operating shifts	3
" " hours	24

(3) Slaking Facility

Type of facility	3 stage overflow
Capacity in design	Maximum 5 t/hr

5-4-3 Flow Sheet and Main Machinery

The flow sheet and the machinery required are shown in Table 5-12, while the relevant layout design is illustrated in Fig. 5-6.

Table 5-12 (1)

FLOW SHEET OF LIME SLAKING AND FEEDING

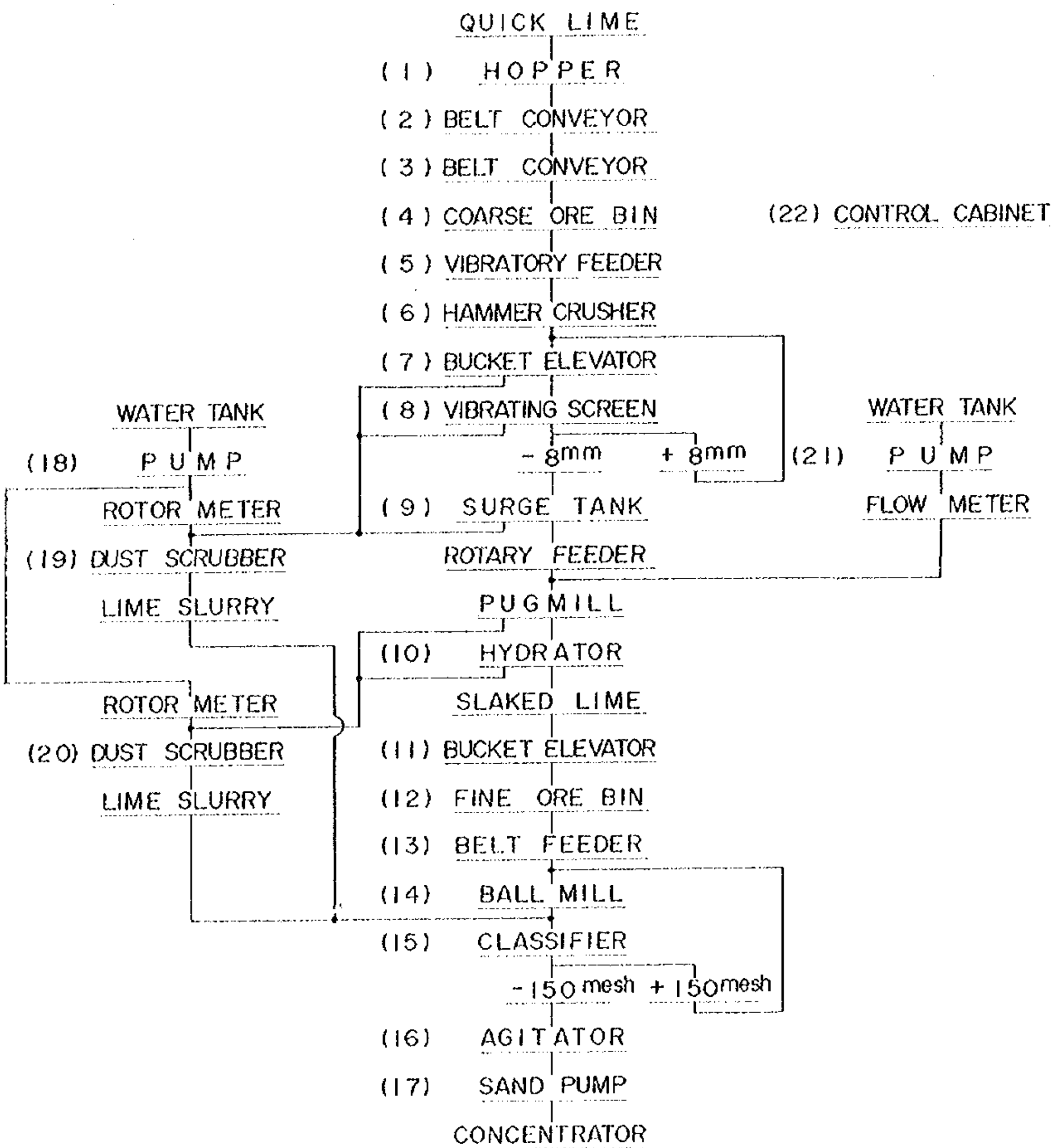


Table 5-12 (2)

EQUIPMENT FOR LIME FACILITIES

NO.	ITEM	REMARKS	
(1)	HOPPER	CAP. 4.5$^{m^3}$	
(2)	BELT CONVEYOR	500^{mm}x 3.50^{m} HORIZONTAL	0.75^{kw}
(3)	BELT CONVEYOR	500^{mm}x42.50^{m} 15° INCLINED	7.5^{kw}
(4)	COARSE ORE BIN	CAP. 100$^{m^3}$	
(5)	VIBRATORY FEEDER	EP-100 MAX. CAP. 8^{t}/Hr	0.4^{kw}
(6)	HAMMER CRUSHER	IMPELLER BREAKING TYPE CAP. 8^{t}/Hr	15.^{kw}
(7)	BUCKET ELEVATOR	600^{mm}W x 1,100^{mm}L x 13,500^{mm}H	2.2^{kw}
(8)	VIBRATING SCREEN	SD 90x180 8^{t}/Hr	1.5^{kw}
(9)	SURGE TANK	STEEL PLATE CAP. 8$^{m^3}$	
(10)	HYDRATOR	CSH-P-5 TYPE CAP. 5^{t}/Hr	
(11)	BUCKET ELEVATOR	SAME AS (7)	
(12)	FINE ORE BIN	FOR FINE SLAKED LIME CAP. 35$^{m^3}$	
(13)	BELT FEEDER	400^{mm}x 5.0^{m}	2.2^{kw}
(14)	BALL MILL	1,500$^{mm\phi}$ x 1,500^{mm}	37.^{kw}
(15)	CLASSIFIER	760$^{mm\phi}$ x 4,600^{mm}	2.2^{kw}
(16)	AGITATOR	1,800$^{mm\phi}$ x 1,800^{mm} SUPER TYPE	3.7^{kw}
(17)	SAND PUMP	3" x 2" 2 SETS (1-SPARE)	3.7^{kw}
(18)	PUMP	18$^{m^3}$/Hr 3^{kg}/cm^3 G	5.5^{kw} EACH
(19)	DUST SCRUBBER	MULTIVENTURI TYPE 80$^{m^3}$/min	11.^{kw} 0.75^{kw}
(20)	DUST SCRUBBER	MULTIVENTURI TYPE 120$^{m^3}$/min	15.^{kw} 0.75^{kw}
(21)	PUMP	18$^{m^3}$/Hr 3^{kg}/cm^3 G	1.5^{kw}
(22)	CONTROL CABINET	CUBICLE TYPE 1,200^{mm}W x 1,800^{mm}L x 2,000^{mm}H	

5-5 LABORATORIES

The laboratories consist of an assay laboratory and a metallurgical test laboratory.

5-5-1 Assay Laboratory

The assay laboratory is to deal with preparatory crushing and comminution of samples, chemical analysis and pyrometallurgical assay.

(1) Capacity of Analysis

Monthly serial numbers of analysis are estimated to amount to as many as 1,500 elements. The details are shown in Table 5-13.

Table 5-13 Estimated Amount of Assay on Element

Item	Element/Month								
	Cu		Au	Ag	S	Fe	CaO	SiO_2	Total
	Total	Acid Soluble							
(Geology)									
Crude ore	30	30	10	10	10	10	-	-	100
(Mining)									
Crude ore	300	100	-	-	-	-	-	-	400
(Milling)									
Feed	75	25	3	3	3	3	-	-	112
Copper concentrate	75	25	3	3	25	25	-	-	156
Waste tailing	75	25	3	3	-	-	-	-	106
Research	300	60	2	2	20	20	-	-	404
Laboratory test	100	20	1	1	5	5	-	-	132
Total	625	155	12	12	53	53	-	-	910
Contingency	50	-	-	-	-	-	20	20	90
Grand Total	1,005	285	22	22	63	63	20	20	1,500

(2) Main Facilities

The following is a list of the main facilities to be used at the assay laboratory.

Roll Jaw Crusher	75kg/hr	1
Sample Grinder	50kg/hr	1
Disc-type Vibrating Mill		1
Chemical Balance	100gr, Sensitivity 0.1mg	2
Assay Balance	1gr Sensitivity 0.005mg	1
Electric Melting Furnace	Max 1500℃, 12kW	1
Electric Cupellation Furnace	12kW	1
Absorption Spectrophotometer		1
Deionized Water Apparatus		1
Sand Bath	12 kW	2
Water Bath	3 kW	2

5-5-2 Metallurgical Test Laboratory

In the captioned laboratory attached at the concentrator, metallurgical bench scale test, screening test of mill products, and necessary microscope observations are to be carried out.

The following are the expected chief instruments to be required for the test laboratory.

Batch Flotation Test Machine	500g	1
〃	100g	1
Batch Grinding Mill	500g	1
Testing Sieve Set		1
Binocular Microscope		1
pH-meter		1
Sample Dryer	4kW	2

5-6 WASTE TAILING POND

The waste tailing is to be discharged from the concentrator at a discharging elevation of 110 m ASL (See Fig. 5-7), and will flow down by gravity to the tailing pond in a line of wooden launder with a descending gradient of 1/30 to 1/40.

However, after 5 years of normal operation, the tailing pulp is to be delivered to the same pond by means of a few sets of pumps.

After being discharged into the pond, the tailing pulp liberates the bigger solid materials which will settle gradually.

Finally, at the opposite end of the waste tailing pond, the clean top water, without solid particles will make a water reservoir. Then, the clean water mentioned above is to be allowed to flow out of the pond, through a releasing facility, to the river.

The location of the tailing pond has been selected in the basin-like waste land which is widely spread to the north of the national road in the southeast of Taungkha mauk. It may also be described as being to be the south of Sabedaung and Kyisindaung.

Total area required for the waste tailing pond is estimated to be as large as 285 hectare, and this is to be divided into two sectors, west and east. Both of them are to be arranged for necessary banking, culvert, water way, etc. gradually in 2 periods, from the west one to east one, and used for the dump of the waste tailing.

The chemical composition of the soil on the farm land, etc. in the vicinity of the mine has been also checked, and it was found that the soil contains small amounts of copper and other materials but not enough to be harmful to the health of the community.

The design of the tailing pond has been carried out carefully so as not to cause any unfavourable influence on the public during the long life of the mining operations.

5-6-1 Selection of Site on Topography and Soil Quality

(1) Selection of Site

The location of the said tailing pond has been selected for the following reasons;

a. Close to the concentrator.

b. Small in the upstream area.

c. Consideration given to the ground water level.
(Elevation about 85 m should be chosen)

d. Wide, with shallow sedimentation is preferable for both easier dehydration and consolidation of the tailing pulp, as well as for quicker evaporation and penetration of the pulp water.

e. No inhabitants or structures exist in the area, nor is there any river or stream at all.

f. Sandy soil, to be used as the filtering material, is obtainable in the pond area.

(2) Topography and Soil Quality

The topography may be considered as a basin contained within low hills, where the vegetation is only shrub and grass and there are few high trees.

The soil quality of the basal ground is a type of sandy soil with calcareous fragments, consisting partially also of loamy soil. The ground is considered strong enough to bear the banking and other structures, for it is of a rather solidified nature in general.

5-6-2 Type and Outline of Waste Tailing Pond

(1) The waste pond is to be encircled by a rock-earth dam, and it will be thickly coated with a sandy soil lining as a filter for the tailing pulp water.

The existing mine road passing from North to South in the area of the designed tailing pond is to be elevated by using banking materials in order to divide the said area into two zones, East and West. The western half of the area is to be used in the first period, while the eastern half is to be used subsequently in the second period.

The total area required is estimated at 2,584,000 m^2, while the capacity and the expected duration of use of each pond is as shown in Table 5-14.

The final elevation of the top of the tailing pile is expected to be 110 m.

Table 5-14 Capacity and Duration of Waste Tailing Pond
(Based on 8,000 MT per day crude ore production)

	Capacity in m^3	Durability in Years
First stage	12,094,300	5.66
Second stage	20,255,000	9.48
Total	32,349,300	15.14

(2) The Nature of the Waste Tailing to be dumped is presumed as follows:

Real specific gravity	2.77
Moisture content	30 - 35 %
Void ratio	1.1
Consistency (wet)	1.75
Consistency (dry)	1.30

5-6-3 Dam

First, a stone block dam is to be constructed by piling up waste rock of a suitable compaction.

Then, a shielding zone of sandy soil collected in the area is to be plastered on the inside of the dam to form a layer about 10 m thick.

The banking is to be gradually continued to keep pace with the rise of the pond surface. Though the final height of the dam is planned at 20 m on average, a 115 m long portion of the dam is to be constructed to a height of 29 m.

The specification and design criteria are to be as follows:

(1) Structural specification (Fig. 5-9 and Fig. 5-10)

Crest of dam	minimum 8.0 m
Gradient of front slope	1 : 1.5
	For every 7.5 to 13.0 m in height, a 5.0 m wide step is to be built
Gradient of back slope	1 : 1.5
	- ditto -

(2) Banking length and Earth Volume Required

Table 5-15(1) Banking Length and Earth Volume Required

Height of Banking (m)	Length of Banking First Stage (m)	Length of Banking Second Stage (m)
28.5	-	115
26.0	-	340
23.0	-	270
21.0	20	835
18.5	45	530
16.0	1,100	365
13.5	675	20
11.0	350	10
8.5	140	30
6.0	170	30
3.5	300	20
1.0	290	10
Total	3,090 m	2,575 m
(Earth Required)		
Block Stone for Banking	1,113,000 m^3	2,396,600 m^3
Sandy Soil for Filter	310,000 m^3	495,000 m^3
Total	1,423,000 m^3	2,891,600 m^3

(3) Foundation

The basal ground at the proposed dam site looks well consolidated with mixed fragments of limestone, and also has sufficient bearing capacity. However, at the lower site below 85.0 m ASL, where the subsurface water level is near the surface, the surfacial earth is to be removed and replaced by hard, waste rock, hauled from the pit, to farm a stable, strong foundation.

The earth volume to be excavated at the foundations concerned is as follows:

First stage	184,000 m^3
Second stage	236,000 m^3
Total	420,000 m^3

The test result of the ground at the foundations, and the location of sampling for soil quality are respectively shown in Table 5-16 and Fig. 5-11.

Table 5-16 Soil Analysis (Base Ground of Monywa Copper Project Plant)

	Sample No.	1-1	1-2	3-1	6-1	"	6-2	"	8-3	10-3	11-3	12-2	12-3	15-3	R-1	R-3	T-3
	Sample Condition	Dis.	Dis.	Dis.	Dis.		Dis.		Dis.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.	Dis.
	Specific Gravity	2.78	2.75	2.74	2.68		2.73		2.74	2.68	2.70	2.69	2.71	2.69	2.75	2.73	2.82
Grading	Gravel	73	0	44	0		27		49	3	41	51	57	83	76	78	54
	Sand	6	32	14	78		44		28	75	39	16	36	9	6	7	24
	Silt	12	53	21	11		17		11	10	5	25	3	4	9	8	12
	Clay	9	15	21	11		12		9	12	15	8	4	4	9	7	10
	Max. Diameter	38.1	4.76	19.1	2.0		19.1		38.1	25.4	19.1	25.4	19.1	38.1	38.1	50.8	25.4
	60% Finer by Weight	1.5	0.053	2.7	0.22		0.42		3.2	0.27	2.3	7.0	3.8	16.0	9.5	15.0	3.6
	10% Finer by Weight	0.006	-	-	0.003		0.003		0.006	-	-	0.007	0.13	0.14	0.007	0.017	0.006
Classification	At Sight																
	Triangular Classification																
	Japan Standard Soil Classification	G-M	M-L	G-C	S-M		S-M		G-M	S-M	G-C	G-M	G-C	G-C	G-C	G-M	G-M
Natural Condition	Moisture Content (%)	7.4	14.0	4.4	1.4	1.4	1.6	1.6	1.5	1.9	6.1	2.6	1.2	8.4	0.9	1.2	3.7
	Void Ratio					0.913		0.736									
	Wet Density (g/cm3)					1.421		1.598									
	Degree of Saturation					4.1		5.9									
	Coefficient of Permeability					6.38×10^{-4}		5.27×10^{-4}									

(4) Banking Materials

Chief items concerned are shown in Table 5-17.

Table 5-17 Specifications of Banking Materials

Item	Unit	Waste Rock	Loam with breccia for filter
Weight per Unit Volume	t/m^3	1.80	1.60
Internal Angle of Friction	degree	37	12
Cohesive Strength	t/m^2	-	1.20
Permeability	cm/sec	-	6.0×10^{-4}

(5) Others

The seepage line in the bank body has been designed not to reach the back slope end of the stone block banking, thus the line is to be sharply lowered in the stone bank body after passing through the attached earth filter.

The thickness of the dam has been well designed to fulfill this requirement.

Though the region is almost free from earthquakes, an anti-earthquake factor of 0.05 has been adopted in the calculation for the sake of better safety.

Based on all of these presumptions, the stabilization was calculated by a slice method. The result has been found to be as follows:

Safety factor (Normal)	1.68
Safety factor (Earthquake conditions)	1.48

These figures show that a sufficient degree of safety has been obtained.

Table 5-18 Calculation of Banking Stabilization : Waste Tailing Pond

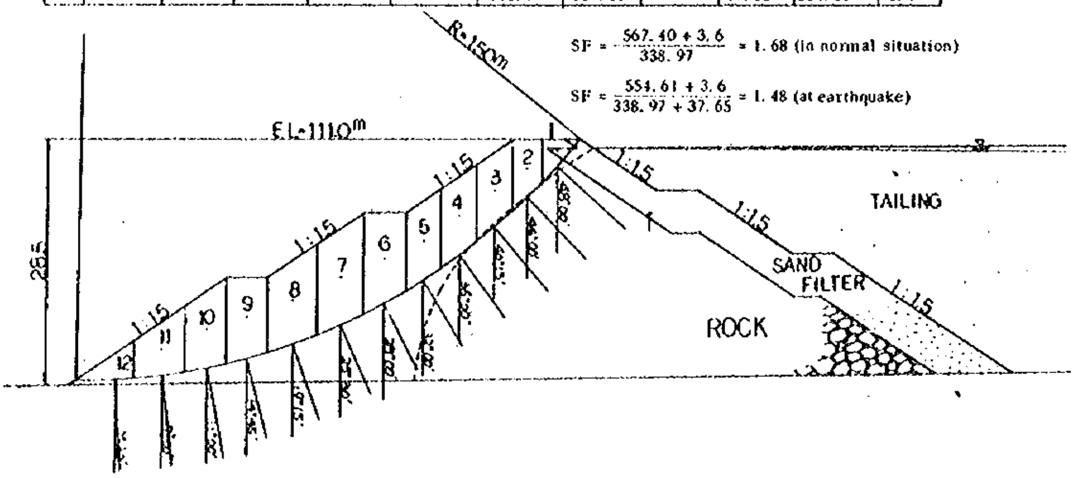
No.	θ	A	W	Sin θ	Cos θ	WSin θ	Wcos θ x tanφ	WKsinθ	WKcosθ	(Wcosθ - WKsin θ) x tanφ	Cl.
1	48°00'	12.5	22.50	0.7431	0.6691	16.72	11.34	0.84	0.75	10.72	3.6
2	44 00'	23.6	42.48	0.6946	0.7193	29.51	23.04	1.48	1.53	21.91	
3	40 15'	37.4	67.32	0.6461	0.7632	43.50	38.72	2.18	2.57	37.07	
4	36 00'	39.5	71.10	0.5878	0.8090	41.79	43.34	2.09	2.88	41.77	
5	32 00'	40.0	72.00	0.5299	0.8480	38.15	46.01	1.91	3.05	44.57	
6	28 00'	53.2	95.76	0.4695	0.8829	44.96	63.71	2.25	4.23	62.02	
7	23 30	62.4	112.32	0.3987	0.9171	44.79	77.62	2.24	5.15	75.93	
8	19 15	56.1	100.98	0.3297	0.9441	33.29	71.84	1.66	4.77	70.58	
9	14 45'	47.2	84.96	0.2546	0.9670	21.63	61.91	1.08	4.11	61.10	
10	11 00'	44.8	80.64	0.1908	0.9816	15.39	59.65	0.77	3.96	59.07	
11	7 00'	36.6	65.98	0.1219	0.9925	8.03	49.35	0.40	3.27	49.05	
12	2 30'	15.4	27.72	0.0436	0.9990	1.21	20.87	0.06	1.38	20.82	
Σ						338.97	567.40		37.65	554.61	3.6

Rock
C = 0
φ = 37°
r_t = 1.8 t/m³

Coefficient for Earth Quake
K = 0.05

$$SF = \frac{567.40 + 3.6}{338.97} = 1.68 \text{ (in normal situation)}$$

$$SF = \frac{554.61 + 3.6}{338.97 + 37.65} = 1.48 \text{ (at earthquake)}$$



5-6-4 Drainage Facility

In comparison with the large pond area of 247 ha, the outer drainage occupies only the extremely small area of 11 ha. This is because the outer drainage water is to be gathered only on the northern side by a drainage channel and discharged onto the lower land from the bank body. (Fig. 5-12)

On the other hand, all of the rain water directly received by the pond is to be collected by the drainage tower installed at the lowest site of the pond, then discharged away to the nearby stream bed. (Fig. 5-13)

In addition, an emergency channel is planned to be built along the bank body to prepare for emergencies. This channel is to have its elevation adjusted to meet with the rise of the piled waste tailing. For this purpose, it is to be removed by and by so as to be always on the top of the bank body.

The emergency channel is to be guided from the top of the bank into the underlying decant culvert via a passage burried in the bank body, and will be led to the outside of the pond. (Fig. 5-14)

The decant culvert is to be a cylindrical ferro-concrete structure of 2 m in diameter, while the decant tower will be a two faced type ferro-concrete structure with 2 m openings.

The design criteria and work involved in the drainage facility are shown as follows;

(1) Design Criteria

Rainfall intensity	20 mm/hr
Catchment area	258 ha
Coefficient of discharge	1. 0
Amount of water in tailing pulp	0. 267 m^3/sec

Coefficient of roughness of waterway	0.015
Depth of overflow at decant tower	2.5cm, Max. 40.0cm
" " at Emergency channel	Max. 50.0 cm
Maximum capacity of decant culvert	5 m^3/sec

(2) Planned Work and General Specifications

The captioned work and specifications are shown in Table 5-19.

Table 5-19 Outline of Drainage Facility

Name of Facility	Specifications	Designed Works 1st stage	2nd stage
Decant tower	4m x 4m, 2 facial gate	final H 18 m,	final H 28 m
Decant culvert	Cylindrical, 2m I. D.	total L 90 m,	total L 120 m
Emergency open channel	1m x 18m , 1m x 2.5m	" 30 m,	" 35 m
" spillway	2.5m x 2.5m	" 5 m,	" 28 m
" culvert	3m x 2m	" 50 m,	" 65 m

5-6-5 Tailing Pond Construction Schedule

Before the start of the operation, some of the essential parts of the first stage work should be completed. Other work is to be carried out by and by in parallel to the progress of the operation.

The detailed schedules are shown in Table 5-20 and Table 5-21.

Table 5-20 Pond Capacity and Banking Volume Diagram

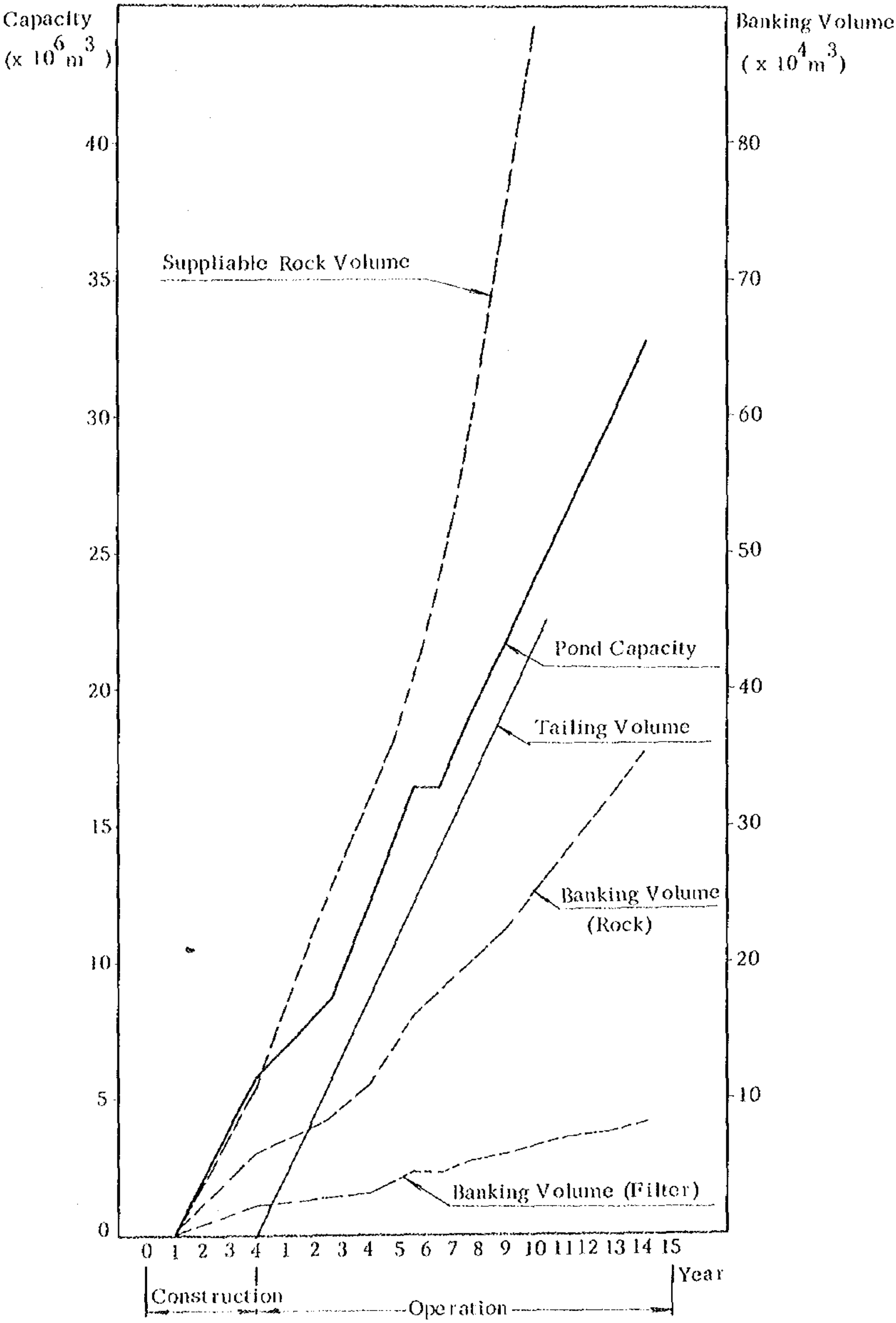
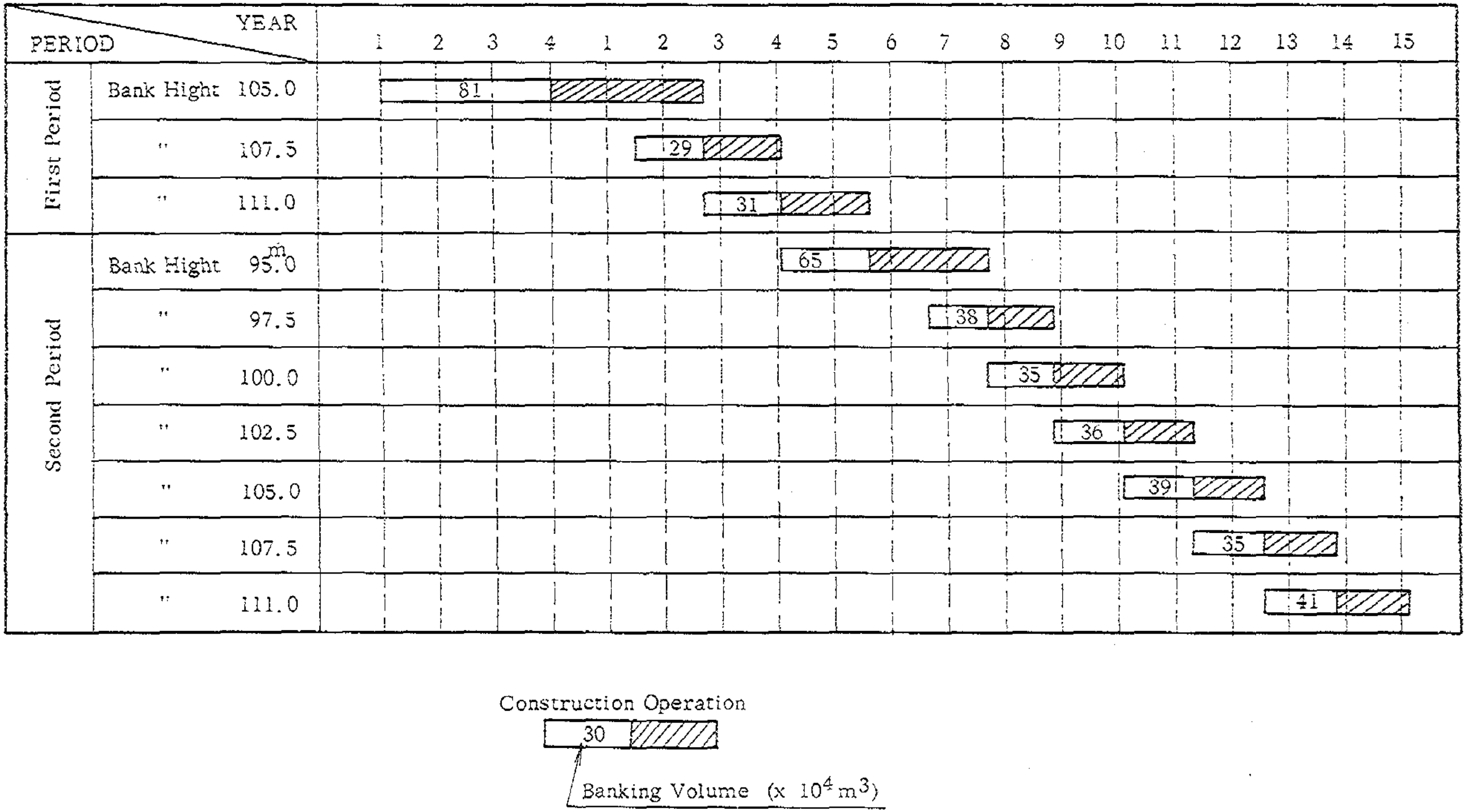


Table 5-21 Tailing Disposal Pond Construction and Operation Plan



Chapter 6 TRANSPORTATION

CHAPTER 6. TRANSPORTATION

6-1 OUTLINE

6-1-1 Transportation from Mine to Railway

The route of the concentrate from the mine to the proposed railway service yard, on the eastern bank of Chindwin river to the north of Monywa city, and the transportation work are decided as follows:

(1) Mucking

The concentrate will be mucked by front end loaders of 0.8 m^3 class to 8 t rear dump trucks, and then weighed at the concentrate storage area of the mill.

(2) Truck Haulage

Truck haulage of the concentrate is planned for a distance of 14.1 km from the mill to Oma jetty, which is located on the western bank of the Chindwin river, via the present national road and the proposed access road at Oma.

(3) Crossing the Chindwin River

From Oma jetty, two 8 t rear dump trucks with full loads of concentrate will be loaded together onto 50 t class landing craft, and will then cross the Chindwin for 3 km to the planned north port on the Monywa city side.

(4) Truck Haulage

After landing, the trucks will proceed for 1.4 km to the proposed service yard which is located at the extended terminus of the national railway.

(5) Unloading and Storage

At the service yard, the concentrate will be unloaded from the truck and kept in a storage facility.

(6) Loading to Freight Cars

The concentrate is to be mucked onto 18 t freight cars by a 0.8 m^3 class front end loader. After unloading the concentrate, the trucks come back to the mill using the same route carrying any materials which are required for the mine.

The haulage distance mentioned above is 18.5 km one way and the time necessary for a round trip including the river crossing by ferry is estimated as follows:

with freight on return trip	191.4 min/trip
without freight on return trip	136.4 min/trip

The flow-speed of Chindwin river is assumed at 1 knot. A system of 2 shifts a day on an 8 hour/shift basis is to be adopted so that night transportation can be avoided for the sake of security.

In establishing the said route, the following points were considered:

1. To avoid passing through densely populated areas.
2. To choose locations where there is no worry about flooding in the rainy season.
3. Deeper passage on the Chindwin river to avoid trouble due to sand banks.
4. Easy access on both banks of Chindwin for the proposed ferry transportation.
5. To use the existing road as much as possible, and at the same time to make every effort to shorten the total distance.

In the dry season, the water level of the Chindwin river goes down remarkably, thus a flat, shallow bottomed ferry boat, which can afford sufficient loading capacity, has been selected in the plan. Furthermore, the size of the truck has been decided according to the dimensions of the said boat.

6-1-2 Railway Transportation

Concentrate is planned to be transported by the national railway from the loading yard at the north of Monywa city to Rangoon port.

The haulage distance is shown as follows:

Monywa to Myohaung	101 km
Myohaung to Rangoon	616 "
Total	716 km

The freight trains is to be composed of a diesel locomotive and 20 freight cars, each of 18 ton capacity. Four trains, namely 4 locomotives with 93 freight cars (18 tons each, additional 13 spare cars included), are to be provided. Furthermore, it is planned that an extended branch of track of 1 km in length and other auxiliary side tracks will be installed or constructed as part of the infrastructure investment. When the normal cruising speed is set at 25 km/hr, one round trip of train haulage is estimated to take 6 days, including the loading and unloading time required at both terminals.

The concentrate unloaded at the warehouse at Rangoon port will have to wait for their shipment.

The freight charges and wharf storage fee are to be imposed at the rate which has been decided by the corporation concerned.

6-1-3 River Transportation

Though most of the required machinery are planned to be sent by rail transportation to the mine site, some of the larger machinery, equipment, and auxiliary parts may have to be sent by means of river transportation.

Those materials, such as cement, procured along the Irrawaddy river will also be transported through the water ways because of the inconvenience of the land traffic in the area. The distance of the route from Rangoon to Oma jetty through Irrawaddy and Chindwin is 908 km.

The water level of those rivers shifts as much as 10 m from season to season, and some part of the Chindwin becomes as shallow as 1 m, thus making the river transportation difficult in the midst of the dry season, usually in March and April.

For the river transportation, a shallow draught landing craft of 300 t class is to be provided for the project.

A round trip on the river is expected to take 18 days in all, with 10 hours of daily cruising.

6-2 ANNUAL TRANSPORTATION

The amount of annual transportation of concentrate and machinery, as well as the number of trips to be made by the trucks, is shown in Table 6-1, where the water content of concentrate is assumed at 8 %. The major subsequent supply materials are quick lime, P. O. L. , the ball and rod for the mill, reagents and various explosives.

Table 6-1 Annual Amount to be transported

Year	Concentrate		Materials, etc.	
	Amount	Trip No	Amount	Trip No.
	WMT	Trip/Yr.	MT	Trip/Yr.
1	71,925	8,991	22,889	2,861
2	71,925	8,991	23,033	2,879
3	70,308	8,788	23,089	2,886
4	70,308	8,788	23,091	2,886
5	53,914	6,740	21,774	2,722
6	53,914	6,740	21,996	2,750
7	50,076	6,260	22,898	2,862
8	50,076	6,260	26,307	3,289
9	49,873	6,234	26,750	3,345
10	49,873	6,234	26,602	3,326
11	48,740	6,093	25,482	3,185
12	41,784	5,223	25,692	3,211
13	41,784	5,223	25,221	3,153
14	41,784	5,223	24,925	3,116
15	41,784	5,223	24,983	3,123

6-3 MACHINERY AND FACILITIES

6-3-1 Requirements of Machinery

Requirements of the major transportation machinery to be delivered for the mine site, for both jetties on the Chindwin river, and for the railway service yard is as shown in Table 6-2.

Renewal is to be applied for each machine or vehicle depending on its life expectancy, while the cranes will be used continuously for the operation after their performance in the construction process.

Table 6-2

Item	Spec.	-4 ~-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Rear Dump Truck	8 t	2	9	9	9	9	8	8	7	7	7	7	7	7	7	7	7
Front-end-loader	0. 8m^3	-	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Fork Lift	3 t	1	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Landing Craft	50DWT	1	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2
Landing Craft	300DWT	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Crane	30 t	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Crane	15 t	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Truck Scale	25 t	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

6-3-2 Attached Facilities

The roads connecting the mine site with Oma jetty, as well as Monywa north jetty with the railway service yard, will be firmly established as far as possible by repairing the existing roads wherever they are available on the route.

Both jetties on Chindwin river will be equipped with concrete slip ways down to the river. Furthermore, at Oma jetty additional facilities such as a yard for material handling, etc. are to be installed.

On the other side of the river facilities will also be constructed, for example concentrate storage area, warehouses for material handling, and other service yards, etc.

These installations and facilities for the transportation are described afterwards in detail in Chapter 7-1.

Chapter 7 COMMON FACILITIES

CHAPTER 7. COMMON FACILITIES

7-1 TRANSPORTATION FACILITIES

7-1-1 Road

The roads can be divided functionally into mine road, general transportation road, waste haulage road, commuting lane, pedestrian pathway, etc. Some of them are to be newly constructed, and others are to be arranged by repairing the available existing passages.

(1) Mine Road

These passages between Sabedaung and Kyisindaung, as well as those connecting branch offices, workshops and motor pool with the concentrating mill, are to be constructed in two lanes with a width of 8.0 m. Accompanying side lanes of 3.0 m in width will also be constructed.

The road is to be established in the form of a loop surrounding the mill. Street lamps are to be installed along the mine road.

(2) General Transportation Road

The general transportation road consists of 3 sectors, that is, the first one from the southern foot of Taungkamauk to the national road along the ridge of the local topography, the second one from the north of Letpadaung to the Oma jetty, and the third one from the proposed new jetty on the east bank of the Chindwin to the projected service yard at the terminal of the extension of the railway. These roads are to be of 2 lanes with a total width of 6.5m

(3) Waste Haulage Road

The main purpose of the waste haulage road is to haul the removed overburden, as well as the filtering materials to be used at the waste tailing pond. It is planned that the existing mine road, between the mine site and the national road, should be widened into a 2 lane road of 6.5 m in width by heightening it with the overburden earth. Branch roads will be constructed whenever it is felt necessary.

(4) Commuting Lane and Pedestrian Pathway

In sectors such as the Yama stream side, Kyisindaung and in the northern periphery of Kyadwindaung, the captioned lane is to be constructed to connect the mine town, water supply facilities, and main electric service station with the mill. It will then be extended to the national road. The width of the lane is to be 5.0 m.

(5) Improvement of National Road

Concentrate and materials are planned to be transported partly through the present national road of which the effective width is 3.5 m. This narrow road may cause trouble both for public and mine transportation, and therefore the necessary portions are to be improved by increasing the width to 6.5 m, thus forming a 2 lane road. In carrying out the important work, 6 bridges are to be newly built, and 3 are to be repaired.

The road is fundamentally to be made of the transported overburden earth and other waste, and it will be completed through compaction using a road roller, and will have concrete pavement in parts. The specifications of the roads to be newly built or repaired are shown in Table 7-1.

The approximate locations of these roads are shown in Fig. 7-1 and 7-2, and their typical profiles in Fig. 7-3, while an example of the bridge construction is shown in Fig. 7-4.

Table 7-1

Items	Mine Road	General Transportation			Waste Haulage Road	Attending and Public use lane	Improvement of National Road
		(1)	(2)	(3)			
Localities Concerned	Pit → Facilities Concerned → Mill	Mill → National Road	National Road North of Letpadaung → Oma Jetty	Monywa North Jetty → Railway Service Yard	Pit → Waste Tailing Pond → National Road	Mill → Elec. Service Station & Mine Town → Water Intake	Taungkamank South → North of Letpadaung
Length	3,200 m	2,500 m	2,950 m	1,400 m	2,450 m	1,900 m	8,600 m
Width	8.0 + 3.0 m	6.5 m	6.5 m	6.5 m	Min.6.5 m	5.0 m	from 3.5 to 6.5m
Maximum Inclination	6 %	8 %	8 %	8 %	7 %	6 %	6 %
Profile Inclination	2 %	2 %	2 %	2 %	2 %	2 %	2 %
Minumum Curvature in Radius	30 m	50 m	50 m	50 m	50 m	15 m	50 m
Surface of Road	With pavement	With pavement	With pavement	With pavement	Rolled Gravel	Partial pavement	With pavement & 9 bridges

7-1-2 Jetties and Facilities

On both banks of Chindwin river, two ferry points, Oma and Monywa North, are to be constructed for the 50 t class landing craft, which will be planned to ferry the trucks carrying the materials and concentrate accross the river.

Oma jetty is also to be used as a river port for the planned 300 t class landing craft which will directly connect Monywa with Rangoon and other localities along the rivers.

A type of concrete made slipway is to be adopted to cope with the changes of water level easily, for the difference of the water level of the Chindwin annually can be as much as 9 m. The outline of the subjects is shown in Table 7-2, and the subsequent Fig. 7-5.

Table 7-2

Remarks	Oma Jetty	Monywa North Jetty
Length of Slipway	50 m	45 m
Width	4 m	4 m
Inclination of Slipway	12 degree	14 degree
Surface Treatment	Concrete	Concrete

At Oma jetty, a large service yard of 500 m^2 in area, paved with concrete, is to be prepared for the storage and handling of the materials Furthermore, at Monywa North, a bigger service yard of 1,000 m^2 with partial concrete pavement is to be built for both material storage and temporary rest for boarding the ferry boat.

To maintain the security of the said jetty and service yards, wired barrier fences and guard rooms are to be installed around them.

7-1-3 Railway Loading Station

At the terminal of the planned extension of the railway, the following facilities are to be constructed:

(1) Concentrate Storage

2,100 m^2 in area, Iron structure with slate roofing.

(2) Warehouse

1,000 m^2 in area, Wooden structure with slate roofing.

(3) Service Yard

5,000 m^2 in total area, surrounded by barrier wires with guard rooms. 2,000 m^2 of it is to be paved with concrete pavement and the residual part to be left as rolled gravel ground.

Outline of those facilities are shown in Fig. 7-6.

7-2 ELECTRIC FACILITIES

7-2-1 Required Electric Power

The annual requirement of electric energy for both the facilities for the production of 8,000 MT/day of crude ore and other miscellaneous installations, including the living accommodation and facilities is estimated at about 52,000 MWH as shown in Table 7-3. 89 % of the said electric power is required for the mill operation.

The maximum electric power required is estimated at about 9,000 Kw, and the details are shown in Table 7-4.

Table 7-3 Annual Electric Power Requirement

Items	Capacity installed KW	Power used KWH/d	Operating days	Annual consumption MWH
Mining	125	922	300	277
Milling (Tailing disposal not included)	12,242	146,530	300	43,960
Mechanical Work	460	1,036	300	310
Water Supply	660	8,904	300	2,670
Waste Tailing Pond	150	1,848	300	554
Living Accommodation and Facilities	250	2,160	365	788
Others	300	2,590	365	945
Total		-	-	49,504
Distribution loss				2,475
Grand Total				51,979

Table 7-4 Maximum Electric Power Required

Items	Installed capacity KW	Maximum requirement DF x KW	Average elec. power LF x KW	Operating hours H	Elec. power KWH	Elec. power per tonnage KWH/MT
Mining						
Machinery	100	0.70/ 70	0.80/ 56	14	784	
Illumination	25	0.90/ 23	1.00/ 23	6	138	
Total	125	0.74/ 93	0.87/ 81		922	0.11
Milling						
Primary crushing	419	0.55/ 230	0.70/ 161	14	2,254	0.28
Secondary crushing	880	0.60/ 528	0.80/ 422	24	10,128	1.27
Grinding	6,157	0.65/4,002	0.80/3,201	24	76,824	9.60
Flotation	4,113	0.65/2,673	0.80/2,138	24	51,312	6.41
Dewatering	370	0.55/ 203	0.65/ 131	24	3,144	0.40
Illumination	203	0.90/ 182	0.60/ 109	24	2,616	0.32
Others	100	0.50/ 50	0.72/ 36	7	252	0.03
Total	12,242	0.64/7,858	0.79/6,198		146,530	18.31
Mechanical Work						
Power	430	0.50/ 215	0.60/ 129	7	903	
Illumination	30	0.90/ 27	0.70/ 19	7	133	
Total	460	0.52/ 242	0.61/ 148		1,036	0.13
Water Supply						
Power	650	0.80/ 520	0.70/ 364	24	8,736	
Illumination	10	0.90/ 9	0.80/ 7	24	168	
Total	660	0.80/ 529	0.70/ 371		8,904	1.11
Waste Tailing Pond						
Powers	100	0.70/ 70	0.80/ 56	24	1,344	
Illumination	50	0.70/ 35	0.60/ 21	24	504	
Total	150	0.70/ 105	0.73/ 77		1,848	0.23
Living Accommodation and Facilities	250	0.60/ 150	0.60/ 90		2,160	0.27
Miscellaneous	300	0.60/ 180	0.60/ 108		2,592	0.32
Total	14,187	9,157	7,073		163,992	20.50
Diversity factor/ Max. composited power		1.05/8,720				
Distribution loss		5% / 436			5%/8,199	1.02
Grand total		9,156			172,191	21.52

7-2-2 Transmission Line and Voltage

The electric power necessary for the project is planned to be supplied from the Kyunchaung gas turbine power station, which is located 128 km to the south of the mine site.

A transmission line is to be constructed from the aforementioned power station to the substation at the mine site as part of the infrastructural investment. The specification of the line is as follows:

Transmission Distance	128 km (80 miles)
" Voltage	132 kv
No. of circuit	1 cct
Grounding	by overhead conductor

Thus, it will be necessary to prepare for both trial charging and receiving at least 9 month before the start of the normal operations.

The electric power is first to be received by the substation at the mine site, then to be dropped down to the distribution voltage of 6 kv for the following reasons:

(1) Direct Supply of Power for the High Voltage Motors without secondary transformers.

(2) Diminution of Transmission Power Loss.

(3) Economical Design of Transmission line, etc.

The lower delivery voltage is to be selected at 220 V for illumination and measurement, and at 440 V for universal motors in consideration of the practical circumstances in Burma.

For the bigger motors over 150 kw in capacity, the high tension voltage of 6 kv is to be used directly, while those motors below 150 kw are to be supplied with the lower voltage of 440 V.

7-2-3 Receiving Facility at Mine Site

(1) Selection of Location

The east-facing slope of the valley between Taungkamauk and Kyadwindaung has been selected for the location of the substation.

The location is good as regards the basal ground condition, and is close to the center of the load. It is also convenient as regards traffic connections with the other facilities.

The transmission line, which comes from south across the national road, is to be stretched along the new road to the southern foot of Taungkhamauk. It will then turn to the western skirt of Taungkhamauk across the top of the proposed mill to the receiving facility.

(2) Capacity of Substation and Circuit Breaker

The maximum requirement of electric power is estimated at about 9,000 kw, equivalent to about 10,000 KVA when the power factor is considered.

In conclusion, the capacity of the substation is to be fixed at 13,000 KVA with 30 % surplus for future expansion of the project.

The frequency of the current is to be set at 50 Hz. On the other hand, the capacity of the circuit breaker has been decided by the assumed value of the total capacity of all the generators concerned on the same Rangoon circuit.

(3) Housing and Major Equipment (Fig. 7-7, 7-8)

Substation	:	Iron structure with slate roofing, where the control room is to be of ferro-concrete
Transformer	:	13 MVA 1 set High resistance grounding system, outdoor type 132 kv/6 kv

Primary circuit breaker	:	Air-blast circuit breaker, 168 kv, 3,500 MVA, 2,000 A	1 set
Secondary circuit breaker	:	Vacuum circuit breaker 7.2 kv, 250 MVA, 2,000 A	1 set
		Vacuum circuit breaker 7.2 kv, 150 MVA, 600 A	5 sets
		Vacuum circuit breaker 7.2 kv, 50 MVA, 400 A	1 set
Condenser	:	1,000 KVA	1 set

7-2-4 Distribution Line

Distribution line at the mine site is to be divided into the following feeders:

(1) Sub-line for Mining (Approx. 1.5 km)

By aerial wire method, with the support of either antiseptic wooden poles, concrete poles, or steel pipe poles. The electric power for the drainage pumps installed in the pit is also to be delivered from the subline.

(2) Sub-line for Milling (Approx. 0.5 km)

By cable, either in aerial or elevated cable duct system.

(3) Sub-line for Water Supply Pumps (Approx. 1.5 km)

By aerial wire, with support of either antiseptic wooden poles, concrete poles, or steel pipe poles.

(4) Sub-line for Living Accommodation and Facilities (Approx. 3.0 km)

By aerial wire, in lower voltage for all requirements by means of transformers on posts.

(5) Sub-line for Common Use

By aerial wire, for miscellaneous installations used in the common facilities.

The voltage is to be dropped at the distributing room of the mechanical work-shop for the workshop itself, the motor pool, wood saw mill, etc., while the voltage is to be dropped at the outdoor cubicle near the administration office, and also by outdoor transformers for the waste tailing pond. In the cases mentioned above, the current is to be tertiarily supplied in the lower voltage of 220 V.

The street lamps are to be maintained by automatic flickering system.

Table 7-5 Distrbution Line

Line	Maximum Requirement (kw)	Elec. Power (KWH/Yr.)	Length of Line (km)	Specifcation
Mine Site	93	277,000	2.0	Aerial Line 38mm^2
Mill Site	7,858	43,960,000	0.5	Aerial Polyethylene Cable 250mm^2 x 2
Water Supply	529	2,670,000	1.5	Aerial Line 38mm^2
Mine Town	150	788,000	2.0	-ditto-
Others	527	1,809,000	3.0	-ditto-, partially CV cable
	9,157	49,504,000	9.0	
Max. Composited Power	8,720			
Loss	436	2,475,200		
Total	9,156	51,976,200		

7-2-5 Communication Facilities

(1) Wire Telegraphy

A telephone system is to be installed for all the sectors and divisions of the mine in order to run all the functions smoothly and efficiently. A telephone ex-change room with a switch board is to be built in the administration office, and is to be connected with each facility by cable wires.

Outline of the telephone system is as follows:

i) Switch board

Capacity 300 circuits, of which 200 circuits are to be used at the start by a cross-bar type autoexchanger. Of these circuits, 30 circuits are to be prepared for future external usage.

ii) Telephone

50 sets for installations at the working sites.

50 sets for living area and others.

iii) Telephone line

By aerial wires supported by either wood or concrete poles.

(2) Radio Communication

A radio communication facility of 500 W in capacity by short medium waves is planned to be installed for the purpose of direct communication between the mine site, Rangoon, Mandalay, and Monywa.

The outline of the facility is:

Short medium wave 500 W

Transmitter - Receiver	3 sets
3 MHZ - 21 MHZ	1 band
Aerial wire	4 setting
Power supply	3 unit

(3) Loud Speaker System

For public notification, instructions, and emergency calls, a loud speaker system is to be installed with a proper distribution of loud speakers in and around the community, including the various working sites.

The outline of the system is as follows:

500 W Amplifier, etc.	1 set
20 W Trumpet Speaker	10 sets
5 W Trumpet Speaker	20 sets

7-3 INDUSTRIAL WATER SUPPLY

7-3-1 Planned Amount of Supply

Water consumption per ton of treated crude ore is assumed at 4 m^3 for mill operation, and at 1 m^3 for other miscellaneous installations. In total the water consumption is to be assumed at 5 m^3/t.

Since the daily production of crude ore is being planned at 8,000 MT, 40,000 m^3 of water will be needed for operations each day. This amount is equivalent to a consumption ratio of 0.462 m^3 per second.

7-3-2 Water Source in Amount and Quality

(1) Yama stream has been selected for the water source of the project, for it is the closest source with sufficient capacity. The intake is to be set on the bank of Yama to the north of Kyadwindaung.

(2) Annual rainfall in the region is reported to be around 800 mm, which falls mainly in rainy season. Thus, the water level of the stream becomes very low in the dry season. The difference of the level is estimated at about 3.0 m. However, the result of measurements made in the dry season is favourable, as follows:

December, 1975	8.35 m^3/sec
February, 1976	4.74 m^3/sec

These figures allow sufficient intake of water for the project. (Fig. 7-9)

In the neighbourhood of the planned intake, there is a fairly extended sand bar, and the subsurface water level has been observed to be nearly equal to that of the stream.

All these facts assure the presence of a quantitative amount of underground current water.

(3) The quality of the Yama river water has shown no specific problem. The muddiness of the water is around 300 ppm in the dry season, and over 1,000 ppm in the rainy season. Thus, it is recommended to pump up the subsurface water during the rainy season instead of the said muddy water of Yama stream.

The muddy river water, after 48 hours for settlement, becomes almost clear in appearance, however the use of lime and flocculent chemicals will certainly shorten the time necessary for the settlement.

The results of the Settling Test is shown in Table 7-6.

Table 7-6 Settling Test of Yama Stream Water

1975. 12

No.	Additional Reagent	Sample Volume	Reagent Quantity	Sediment Volume	Hourly Condition	Esti- mation
1	Sample only	500ml	-	-	After 24 hours, slightly clear	-
2	"	"	-	10ml= 2%	After 48 hours, water is as clear as dry season	-
3						
4	Sulfuric Band	500ml	4 ppm	-	After 2 minutes, no sediment	B
5	"	"	44	-	After 20 minutes, slightly clear	B
6	Sunfloc	"	1	25ml= 5%	After 2 minutes, mud settle and supernatant water is as clear as dry season	C
7	Sunfloc + Sulfuric Band	"	1 + 4	30ml= 6%	After 2 minutes, mud settle and supernatant water is more clear	C
8	Accofloc (C-577)	"	1	75ml=15%	After 1 minutes, mud settle and supernatant water is quite clear	A
9	Accofloc (C-521)	"	2	35ml= 7%	After 4 minutes, mud settle but supernatant water is muddy	D
10	Konan-Floc (ZH-750-S)	"	1	-	After 1 minute, No sediment	D
11	" "	"	2	35ml= 7%	After 3 minutes, mud settle but supernatant water is muddy	C
12	Konan Floc (ZH-860)	"	1	25ml= 5%	After 1 minute, mud settle and supernatant water is slightly clear	B
13	Sulfuric Band + Limestone (3 min. after)	1,000ml	1 + 1,000	-	After 20 minutes, no sediment	B
14	Sulfuric Band + Limestone (2 min. after)	"	2 + 250	-	After 15 minutes, mud settle and supernatant water is quite clear	B

7-3-3 Facilities (Fig. 7-10, 7-11)

(1) On the southern bank of Yama stream, a large ditch of 200 m long and 6 to 7 m deep is to be dug to bury a set of rock filled culverts in order to take in the subsurface water during the rainy season. An intake pond is to be installed in the center of the culverts to gather the seaped, cleaned water. In the dry season the river water is to be pumped up directly.

In the latter case, Yama stream is to be connected directly with the intake pond through another culvert and a gate. Thus the necessary amount of water can be supplied without trouble caused by the changing.

(2) From the said intake pond, the water is to be sent to the settling pond by pump, and the suspending mud, etc. will be allowed to settle.

(3) The settled water will then be pumped up to the head tank on the eastern hill side of Taungkhamauk above the mill site. The water is to be distributed for the plant and other requirements by natural flow through delivery pipes.

(4) General specifications concerned are shown in Table 7-7, 7-8 and 7-9.

Table 7-7 Pumps

Classification	Capacity	Total Head	Motor	No. of Running Pumps
Intake	0. 50 m^3/min	22 m	150 kw	2
Pumping	0. 24 "	75 m	250 kw	3

Table 7-8 Pipe Line (Major portion)

Classification	Dia. of Pipe	Length
Intake pond to Settling pond	600 mm	100 m x 1 line
Settling pond to Head Tank	400 "	1, 600 m x 2 line
Cleaning water pipe	75 "	2, 000 m
Head Tank to Mill	500 "	500 m

Table 7-9 Water Reservoir

Classification	Capacity	Elevation	Structure
Intake pond	300 m^3	80 m	Ferro-concrete
Settling pond	3,600 "	90 "	Iron plate (Square)
Head Tank	12,288 "	140 "	Iron plate (Circle)

7-4 MISCELLANEOUS SERVICES

In the vicinity of the mill, a combination of mechanical workshop, wood workshop, motor car repair shop is to be arranged with manufacturing machinery installed to maintain a repairing and processing faculty at the mine site. (Fig. 7-12)
An Oil Service Station equipped with diesel oil and gasoline tanks is also to be installed.

7-4-1 Machine & Electricity Repair Shop

The captioned shop is to be a maintenance and repair shop for all machinery and equipment used in the project. In addition to the manufacturing of castings and special part-wares, the shop is expected to manufacture or process whatever the daily work of the mine requires Thus, the basic minimum of required machinery, instruments, and tools is to be provided and installed at the shop.

The shop requires a total area of 5,370 m^3 to accommodate the buildings, on outdoor working corner, electricity receiving facility, and the attached warehouses, etc. to permit passage of the various vehicles. The details of the shop are shown in Table 7-10.

Table 7-10 Required Space for Installations of Repair Shop

(1)	Building (Fig. 7-13, 7-14)		
	Mechanical Workshop for Machinery		200 m^2
	Plate Working shop	Space for Setting	50 "
		" " Marking-off	100 "
		" " Plate working	150 "
	Finishing Workshop	Space for Mechanical Work	50 "
		" " Overhauling	150 "
	Electrical Workshop		200 "
	Store Room for Tools		100 "
	Indoor Passage		200 "
	Total of Buildings		1,200 m^2
(2)	Outdoor Working Corner	20 m x 50 m	1,000 m^2
(3)	Outdoor Working Passage	6.5 m x 200 mL	1,300 m^2
(4)	Supervising office with drawing room, rest room, etc.		470 m^2
(5)	Attached Installations		
	Electricity Receiving, outdoor		100 m^2
	Secondary Warehouse	Capacity 1,000 MT, with ceiling crane	600 "
	Total of Attached Installations		700 m^2
(6)	Others for future use		700 m^2
	Grand Total		5,370 m^2

The chief machinery and equipment to be installed for the shop mentioned above is shown in Table 7-11.

Table 7-11 Chief Machinery and Equipment of the Repair Shop

Name of Machinery	Quantity	Specification	Motor output
Small High-speed Lathe	1	Swing Max. 240mm Center Distanel 390mm	kw 2.2
Medium Duty Engine Lathe	1	Swing Over Bed 460 mm Center Distance 1,500 mm	kw 5.5
Heavy Duty Engine Lathe	1	Swing Over Bed 533 mm Center Distance 2,500 mm	7.5
Heavy Duty Face Lathe	1	Swing Over Gap 2,500 mm Center Distance 2,000 mm	22.0
Shaper	1	Max. Stroke 700 mm Table Size 590 x 400 x 430 mm	3.7
Universal Milling Machine	1	Max. Moving Distance Side 800 mm Front & Rear 300 mm Up & Down 400 mm	10.0
Vertical Drilling Machine	2	Swing 600 mm Max. Drill Hole 50 mm	2.2
Radial Drilling Machine	1	Max. Distance bet. Column Face & Spindle Center 1,500 mm	7.5
Universal Grinding Machine	1	-	10.0
Hydraulic Press Brake	1	Length of Table 3,000 mm Power 300 t Open Height 350 mm	10.0
Plate Shearing Machine	1	Shearing Capacity 12 mm	7.5
Bending Roll	1	Width 1.5 m, Thickness 12 mm	7.5
[Transportation Facility] Over Head Crane	1	Cap. 5 t, Span 12 m	22.0
Over Head Hoist Crane	2	Cap. 1 t, Span 5.5 m	3.7
Fork Lift	1	1.35 t	
Truck	2	7 t	
Jeep	2		

7-4-2 Saw Mill

A saw mill is to be constructed, in which original logs of less than 3 feet in diameter can be treated mostly for use in buildings and other structures. (Fig. 7-15)

The required space both for the site and building of the saw mill is shown in Table 7-12, while the chief machinery required is listed in Table 7-13.

Table 7-12 Required Space for the Saw Mill

Installations	Area (in m^2)
(1) Building	
Space for Installed Machinery	100 m^2
Space for Working and Temporary Deposit	100 "
Total area of Building	200 "
(2) Outdoor Log Store Yard	400 "
Grand Total	600 m^2

Table 7-13 Chief Machinery for the Saw Mill

Machinery	No.	General Specification	Output of Motor
Band Saw Mill	1Set	Max. Log Dia. in Center Cat 915mm Cutting Speed 46m/min	30.0kw
Circular Saw	1	Max. Thickness to be cut 110mm Arbor Speed 3,600rpm	2.2
Surface Planer	1	Max. Width a Thick. 600x150mm Feed Speed 6-11-15m/min	5.5
Fork Lift	1	Cap. 2t	
Dust Collector	1Set	Cyclone	30.0

7-4-3 Motorcar Repair Shop

A repair shop is to be installed for the overhauling and repairing of vehicles and heavy machinery which will be used in the Mining division and in other divisions of the project. (Fig. 7-16) Although, repairs on the heavy machinery are expected to be carried out at each working site, the shop is planned to be sufficiently large to cope with repairs on 3 vehicles or pieces of heavy machinery at a time.

Manufacturing and processing of spare parts is to be carried out at the repair shop. Required area of both the site and the actual repair shop building is shown in Table 7-14, and the relevant major facilities to be installed are listed in Table 7-15.

Table 7-14 Required Area of Site and Motorcar Repair Shop Building

Installation	Area
(1) Building	300 m^2
(2) Outdoor Repair Corner	300 "
Total	600 m^2

Table 7-15 Major Facilities of Motorcar Repair Shop

Installation	No.	General Specification	Output of Motor
Steam Boiler	1	250 kg/H	3. 0 kw
Electric Charger	3	-	-
Motorized Hoist	3	2 T	-
Compressor	1	750 L/min, max. 14 kg/cm^2	5. 5 "
Hydraulic Jack	3	30 T	-
Fork Lift	1	1. 35 T	-

7-4-4 Oil Service Station

An oil service station is to be constructed to store and supply the fuel for the vehicles, as well as the heavy machinery in use at the mine site. The station will also supply other oil and lubricants. (Fig. 7-17, 7-18)
Its distribution capacity is designed at 5,000 kl p. a. for light oil, and 4,000 kl p. a. for gasoline, respectively.

The fuel and oil are to be collected in drums and transported by truck, then transferred to the subsurface mother tank in the storage yard.

The supply of fuel is to be done first by pumping up the fuel from the mother tank to the buried service tank, then delivery is to be made through a set of scaling meters. In addition, tank lorrys are to be available for the fuel supply of the heavy machinery at the operating sites.

The required area of ground for the oil service station is shown in Table 7-16, while the chief equipment to be installed is listed in Table 7-17.

Table 7-16 Required Area for Oil Service Station

Item	Area
(1) Store yard for drums and mother tank area	6,400 m^2
(2) Service Stand area	1,200 "
Total	7,600 m^2

Table 7-17 Chief Equipment of Oil Service Station

Equipment	No.	General Specification	Output of Motor
(Oil Storage)			
Mother tank for light oil	2	U/G type, 80 kl, 3. 2mø x 10m	3. 7 kw
" " gasoline	2	" 10 " 1.44 x 6. 1	3. 7 "
Service tank for light oil	1	" 10 " 1.44 x 6. 1	
" " gasoline	1	" 10 " 1.44 x 6. 1	
Feed meter	2	For light oil	1. 5 kw
" "	2	For gasoline	0. 7 "
Drum Container	2, 300		
(Transportation Facility)			
Tank Lorry	2	8, 000 L	
Drum Carrier	10		
(Building)			
Service crews' room	1	48 m^2, concrete made	
Lubricant Storage	1	48 m^2, concrete made	

7-5 LIVING ACCOMMODATION AND FACILITIES

A mine town is designed to be constructed for staff members, skilled workers (25 % of all labourers), and their families, as well as other personnel employed for the public services. Not only the living accommodations but also other public facilities such as roads or lanes, water supply, sewage system and planted greenery are to be suitably arranged.

In addition, such social and public installations as school, clinic, shopping center, as well as a supermarket, are to be prepared for the convenience of the inhabitants. (Fig. 7-19)

The population, together with these people engaged in regional services, is estimated at between 2, 000 and 2, 400, though it may shift from year to year. The mine town requires an area of 16 ha according to the plan.

7-5-1 Selection of Locality

The widely open terrace, located between 85 and 90 m ASL, on the southern bank of Yama stream to the north of Taungkamauk and Kyadwindaung, is proposed as the site of the mine town. The site is located approximately 1.3 km to the north of the mill, on a gentle slope of 4 to 5 % in average gradient.

The site is comparatively close to the operation facilities, and yet owing to its separation from the other location it is not directly affected by the noise, dust, and other nuisances caused by the mine operations.

Water supply is very convenient, because the location is near to the Yama stre stream. The scenery is also good, with a cultivated lower flat area along the stream and surrounding rich vegetation.

The terrace is quite safe from any flood even in the rainy season, and the site can be enlarged easily in future should the necessity arise. In considering all of these factors, the proposed site has been selected as the living area.

7-5-2 Population

The population of the mine town has been estimated as shown in Table 7-18.

Table 7-18 Estimation of Population

Item	1 - 7th Year		8 - 15th Year		Remarks
	Staff	Worker	Staff	Worker	
Average of Registered Personnel	111	1,005	114	1,255	
Personnel for Mine Housing	111	251	114	314	For skilled workers only (25%)
(Single --------- 25 %)	28	63	29	79	
(With Family --- 75 %)	83	188	85	235	
Family members	249	564	255	705	Assumed at 3 person/family
Mine Housing Population	360	815	369	1,019	
	1,175		1,388		
Population for Services	783		925		Assumed at 2/3 of the above
Grand Total	1,958		2,313		

Unskilled workers are to be employed from the neighbouring villages, directly from their homes. Temporary housing, originally used during the construction period, can also be used continuously as provisional living facilities, if necessary.

7-5-3 Mine Housing and Dormitory

(1) Mine Housing

For the registered staff members and skilled workers, especially for the those who are living together with their families, mine housing is to be prepared. This housing is to be built in three categories, ie. for the senior officers, general staff members, and the skilled workers respectively. Each of these categories is to be combined together as a block of houses.

All the houses are to be built independently as flat, wooden structures with slate roofing, and equipped with running water, sewage duct, lighting, and simple purifier tank for sanitary use.

The relevant number of houses and their internal area is demonstrated in

Table 7-19, Fig. 7-20 and Fig. 7-21.

Table 7-19 Number and Accommodation provided in the Mine Housing

	Senior Officer	General Staff	Skilled Worker
No. to be constructed	15	68	188
Accommodation/house			
Bed room	(3) 39.2 m^2	(2) 24.5	(2) 22.8
Living and Dining room	28.0	28.0	19.7
Kitchen	12.0	9.0	7.5
Shower & Toilet	6.3	7.5	6.7
Balcony	8.0	9.0	6.3
Other Utility	14.5	8.0	5.0
Total	108.0	86.0	68.0

(2) Dormitory

Dormitories are to be provided for single persons of the registered personnel of either staff or skilled workers, who are living apart from their families. One man one room is the rule to be principally applied, and 12 rooms will make up one unit. For 3 units of 36 rooms, another building is designed to join them to provide a common utility area, including dining room, kitchen, and other public area. Thus four buildings make up a composite dormitory. (Fig. 7-22)

The structures are also to be made of wood with slate roofing together with the same interior installations as the above described mine housing. However, shower and toilet facilities are to be arranged for every 3 rooms, and a washing corner for every 6 rooms.

The number of buildings, and the accommodation area of the dormitories concerned are shown in Table 7-20.

Table 7-20 Building and Accommodation Area of Dormitories

Item	For Staff	For Worker
No. of Building	1 compound, 3 houses	2 compound, 6 houses
No. of Rooms	36	72
Living Rooms (area)	$9m^2$/room, $108m^2$/house,	$324m^2$/compound
Balcony, Corridor	96 " ,	288 "
Dining Room		40 "
Kitchen & Utility		45.5 "
Total		697.5m^2/compound

7-5-4 Community Facilities

(1) Guest House

Lodging facilities for guests of 250 m^2 in housing area will be provided. This will be a flat wooden structure with 8 rooms available for guests. Each room will be fitted with the necessary equipment and utensils.

(2) Club House

A club house will be built for the use of staff members as a meeting hall, etc. This will be a flat wooden structure of 300 m^2 in area equipped with necessities for holding meetings, etc.

(3) Primary School/Kindergarten

A flat wooden building of 240 m^2 in area is to be arranged for 150 pupils of primary school and 50 children of kindergarten. 4 class-rooms with a teachers room are planned to be included and provided with the necessary educational installations.

(4) Clinic

A medical clinic is to be constructed chiefly for the sake of the mine personnel, at the same time it is expected to be a medical center for the neighbouring villagers.

The clinic to be built will be a flat wooden structure of 175 m^2, and will be equipped with 7 beds, medical instruments and medical supplies.

(5) Canteen

For the daily convenience of the inhabitants of the mine town regarding food and other living necessities, a canteen will be installed.

A flat building of 100 m^2 in area is to be built. On the other hand, a large area of 500 m^2 is to be kept free in order that the merchants from outside can open a market.

(6) Fire Guard

To cope with misfires in the project, as well as for the safety of the community, a fire station for the fire engine and a mans room with pump storages will be required.

A flat wooden structure of 100 m^2 in area is to be built for the above purpose.

(7) Others

General installations for community use are to be arranged as shown in Table 7-21.

Table 7-21

Facility	Total Area	Remarks
Play Ground	10,000 m^2	One ground
Park	40,000 "	Divided in 2 places
Green Belt	20,000 "	Encircling each housing group
Road	44,000 "	Trunk road of 10 m in width along the center line of blocks & branches

7-5-5 Water Supply and Sewage Disposal

(1) Water Supply

Water supply is to be taken from the subsurface current on the bank of Yama stream through 3 wells which will be drilled, and the water is to be pumped up to a high elevation tank, then delivered to each facility by natural flow.

The water supply is being planned for a population of 2,400, and under the assumption that the daily requirement per person is 300 L, with delivery loss of 15 %, the total amount needed per day will be 830 m^3.

(2) Sewage Disposal

Maximum volume of sewage per man-day has been assumed at 200 L.

The sewage is to be collected, settled, and filtered separately from the rain water. Then, the clean water after treatment is to be released.

7-5-6 Area of Mine Town

Area required for the town is as follows:

For Housing, etc.	4. 3 ha.	Houses, dormitories, club, etc.
" Attached Facilities	1. 2 "	School, clinic, canteen, etc.
" Others	10. 5 "	Road, park, ground, etc.
Total	16. 0 ha.	

7-6 OTHER COMMON FACILITIES

To provide general services for the community, as well as for supporting all the operations correctly, the following facilities and buildings are to be installed concerning the mine administration, including procurement, accounting, etc.

7-6-1 Instruments and Vehicles

Miscellaneous instruments, fittings for the office work, a fire engine, microbuses to be used for daily transportation of mine personnel and jeeps are to be provided.

Some of the jeeps are to be engaged in routine transportation between the mine and Mandalay. Such requirements will be as follows:

Table 7-22 Instruments and Vehicles

Item	No.	Remarks
Office Utensils	1 set	Calculators, typewriters, others
Fire Engine	1	Delivery 8. 5 kg/cm^2, 2 m^3/min, stationed at Mine Town
Micro Bus	3	Accommodation 29 person, in 8th year additional one joins
Jeep	8	

7-6-2 Buildings

In the vicinity of the proposed servicing workshops, an administration office is to be constructed as the center of all the project activities at the mine site. (Fig. 7-12, 7-23, 7-24)

The said office is to be used and will be fitted with the necessary equipment and instruments to accommodate almost all of the senior staff and clerk members and some of the personnel from the technical divisions.

However, a warehouse for materials is to be constructed adjacent to the servicing work shops. (Fig. 7-2) The warehouse will also be used to store various materials and spare parts.

Other buildings, such as guard rooms, workers' rest house, etc. , are to be built at the various locations as required.

Outline of the buildings is as follows:

Table 7-23

Item	No. of ridge	Area	Structure	Remarks
Administration office	1	400 m^2	Concrete, flat	Water, sewage installations included
Warehouse	1	1,200 "	Iron structure with slate roofing, flat	
Others	10	740 "	Wooden structure with slate roofing flat	Guard, rest room temporary storage, etc.

Chapter 8 PRODUCTION PLAN AND PERSONNEL

CHAPTER 8. PRODUCTION PLAN AND PERSONNEL

8-1 PRODUCTION PLAN

According to the plan, annually 2,400,000 MT of crude ore, in other words daily 8,000 MT, is to be produced.

Of the operational period of 15 years, the first 10 years are to be spent on the mining at Sabedaung, a part of 11th year at Sabedaung South, and the remaining years for Kyisindaung.

The average copper grade of the produced crude ore is expected to fluctuate from 1.070 % to 0.706 %. The grade will gradually go down year by year. And the stripping volume, which has to keep pace with the mining operation, is estimated to increase year after year from 788,000 MT to 6,090,000 MT per annum.

On the other hand in the ore beneficiation, all of the crude ore mined is to be treated to produce copper concentrate. The amount of the said concentrate of 30 % in copper content is estimated to decrease from 66,597 DMT to 38,689 DMT year by year because of the decreasing trend of the crude ore grade mentioned above.

Furthermore, the copper concentrate is expected to contain neither valuable metals nor harmful impurities, which would require either economical or technical consideration.

Table 8-1 shows the estimated yearly trend of both the various productions and the chief materials required for the operations.

Table 8-1 Estimated Trend of Productions and Chief Materials Required

Item	Unit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Remarks
Preliminary Stripping	10^3DMT	-	-	-	-	-	-	-	4,500	4,500	4,500	-	-	-	-	-	
Operational Stripping	10^3DMT	738	930	910	798	830	1,168	1,168	1,942	2,265	2,277	6,090	6,090	6,090	5,530	5,530	
Operational Stripping Ratio w/o	1 :	0.328	0.388	0.379	0.333	0.346	0.487	0.700	0.809	0.944	0.949	2.538	2.538	2.538	2.304	2.304	
Crude Ore produced	10^3DMT	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	
Crude Ore Grade	% Cu	1,070	1,070	1,050	1,050	0,849	0,849	0,805	0,805	0,802	0,802	0,789	0,706	0,706	0,706	0,706	
Metal Content of Crude Ore	DMT	25,680	25,680	25,200	25,200	20,376	20,376	19,320	19,320	19,248	19,248	18,936	16,944	16,944	16,944	16,944	
Copper Concentrate	DMT	66,597	66,597	65,100	65,100	49,920	49,920	46,367	46,367	46,197	46,197	45,130	38,689	38,689	38,689	38,689	30% Cu
Concentrate Grade	% Cu	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	
Metal Content of Concentrate	DMT	19,979	19,979	19,530	19,530	14,976	14,976	13,910	13,910	13,859	13,859	13,539	11,607	11,607	11,607	11,607	
Mill Recovery	%	77.8	77.8	77.5	77.5	73.5	73.5	72.0	72.0	72.0	72.0	71.5	68.5	68.5	68.5	68.5	
Explosives	MT	320	334	334	329	333	360	408	751	872	912	897	909	909	836	830	Mostly of AN-FO
Detonators	1,000 pcs	45	50	50	49	50	54	61	112	130	136	134	136	136	125	124	
Rock Bit	pcs	365	365	365	361	365	396	449	826	950	999	986	996	996	917	908	
Big Tyres	pcs	49	51	56	57	58	62	69	129	139	134	114	122	106	104	106	For dump cars and shovels
Slaked Lime	MT	13,200	13,200	13,200	13,200	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	
Reagents	MT	624	624	624	624	588	588	588	588	588	588	588	562	562	562	562	
Mill Rod	MT	696	696	696	696	696	696	696	696	696	696	696	696	696	696	696	
Mill Ball	MT	2,158	2,158	2,158	2,158	2,117	2,117	2,117	2,117	2,117	2,117	2,117	2,117	2,117	2,117	2,117	
Liner	MT	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106	
Electric Power	MWH	2,122	2,122	2,122	2,122	2,122	2,122	2,122	2,122	2,122	2,122	2,122	2,122	2,122	2,122	2,122	Average
Water Supply	1,000MT	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	Maximum
P. O. L.	kl	2,600	2,697	2,744	2,750	2,808	2,952	3,618	5,897	6,117	5,963	5,158	5,299	4,937	4,780	4,833	

8-2 ORGANIZATION AND PERSONNEL

One general superintendent and two acting general superintendents, heading the departments dealing with technical and clerical work, are respectively, to be assigned at the mine site.

In Rangoon and Mandalay, branch offices are to be established to cope with communication, liaison, material supply, concentrate transportation and other necessary activities. In each department, one or two vice superintendents are to be appointed together with the necessary staff members, and workers.

In estimating the number of personnel required, the following points were carefully considered.

(1) Average attending rate of workers is to be set at 70 %, namely 210 total working days per annum on average.

(2) 25 % of all the workers are assumed to be skilled ones.

(3) In principle, all activities are to be run by the employees, both staff members and workers. Thus, no contractor system is to be introduced for the operations in the mine.

(4) Foreign experts are to be employed only during the construction period.

(5) During the construction period, preliminary training is to be carried out for the staff personnel listed in the plan.

(6) All of the departments in the construction period, as well as those departments in the operational period, are planned to included some additional personnel needed for undertaking initial supplementary work related to the project.

The organization and required personnel are shown in the tables shown below;

Mine Organization	Table 8-2
Required Personnel (Summary)	" 8-3
Required Workers	" 8-4
Staff Members Required	" 8-5

Table 8-2 Mine Organization

General Superintendent

- Non-regular Experts
- Acting General Superintendent (Technical)
- Acting General Superintendent (Clerical)

Technical Service Department	Mining Department	Milling Department	Mechanical & Electric Service Department	Civil Engineering Department	Procurement Department	Administration Department	Accounting Department	Rangoon Branch Office	Mandalay Branch Office
Geology Survey Assay and Scaling Various Tests Designing Others	Mining Stripping Ore Haulage Waste Haulage Others	Crushing Grinding Flotation Dewatering General Maintenance Lime Shop Others	Mechanical Repair Electric Repair Saw Mill Car Repair Sub-Station Electric Services Others	Waste Tailing Disposal Road Repair Waste Supply Constructions Others	Concentrate Transportation Material " Materials Oil Supply Others	General & Personnel Affairs Communication Housing Dormitory Shopping Services General Services Guard, Fire Brigade Jeep, Bus Others	Accounting Cashier Wage, Salary Others	Communication Materials Liaison Handling of Concentrate Others	Communication Materials Liaison Others
Staff 11 Worker 54	Staff 19 Worker 225	Staff 11 Worker 173	Staff 24 Worker 145	Staff 9 Worker 119	Staff 17 Worker 184	Staff 10 Worker 141	Staff 3 Worker 20	Staff 2 Worker 8	Staff 2 Worker 3

(Remarks) Numbers of Personnel required stand for those at the first operational year.

Table 8-3 Required Personnel (Summary)

Item	Unit	-4	-3	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
(Worker)																				
Mining	man	105	97	96	90	225	223	225	224	228	242	265	560	566	553	459	462	439	423	426
Milling	"	-	-	-	173	173	173	173	173	173	173	173	173	173	173	173	173	173	173	173
Study and Survey	"	-	-	-	28	54	54	54	54	54	54	54	61	61	61	54	54	54	54	54
Mechanical and Electric	"	30	132	195	225	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145
Civil Engineering	"	108	257	435	398	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119
Procurement	"	31	31	31	43	184	184	183	183	174	174	157	161	163	163	157	157	156	156	156
Others	"	17	34	34	34	172	172	172	172	172	172	172	173	173	173	173	173	173	173	173
Total	"	291	551	791	991	1.072	1.070	1.071	1.070	1.065	1,079	1,085	1.392	1.400	1.387	1.280	1.283	1.259	1.243	1.246
(Staff)																				
Senior Staff	man	2	2	2	2	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Mining	"	7	7	7	7	17	17	17	17	17	17	17	22	22	22	22	22	22	22	22
Milling	"	-	2	2	7	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Study and Survey	"	-	-	-	2	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Mechanical and Electric	"	13	23	29	37	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
Civil Engineering	"	12	28	48	44	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Procurement	"	1	1	1	2	15	15	15	15	15	15	15	13	13	13	13	13	13	13	13
Others	"	22	24	24	5	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
Total	"	57	87	113	106	111	111	111	111	111	111	111	114	114	114	114	114	114	114	114
Foreign Experts	man	20	60	60	60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 8-4 (1) Required Workers

Item	Unit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Remarks
Mining Department																	
Drilling, Blasting	man	39	36	36	35	35	38	43	80	93	97	96	97	97	89	88	
Mucking	〃	22	24	23	22	22	26	31	90	86	83	69	68	68	64	64	
Main Haulage	〃	49	53	56	58	60	63	69	127	138	133	111	120	102	100	103	
Auxiliary Machine and Vehicle	〃	45	46	47	48	49	50	53	115	111	108	87	83	78	77	77	
Other Services	〃	70	64	63	61	62	65	69	148	138	132	96	94	94	93	94	
Total	〃	225	223	225	224	228	242	265	560	566	553	459	462	439	423	426	
Milling Department																	
Crushing	〃	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	
Grinding	〃	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	
Flotation	〃	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	
Dewatering	〃	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
Maintenance	〃	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	
Lime Shop	〃	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	
Control and others	〃	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	
Total	〃	173	173	173	173	173	173	173	173	173	173	173	173	173	173	173	
Technical Service Dept.																	
Geology and Survey	〃	20	20	20	20	20	20	20	27	27	27	20	20	20	20	20	
Assay	〃	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	
Testing Laboratory	〃	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	
Designing, etc.	〃	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	
Total	〃	54	54	54	54	54	54	54	61	61	61	54	54	54	54	54	
Mechanical and Electric Service Department																	
Mechanical Workshop	〃	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	

(continued)

Table 8-4 (2)

Item	Unit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Remarks
Electric Workshop	man	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	
Saw Mill	"	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	
Vehicle Workshop	"	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	
Sub-Station	"	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	
Electric Patrol	"	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	
Total	"	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145	
Civil Engineering																	
Waste Tailing Pond	"	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	
Road Repair	"	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	
Water Supply	"	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	
Construction Services	"	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	
Total	"	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119	
Procurement																	
Car Transportation	"	44	44	43	43	34	34	33	33	33	33	33	29	29	29	29	
Ferry Services	"	69	69	69	69	69	69	51	51	51	51	51	51	51	51	51	
Loading	"	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	
Storage and Services	"	36	36	36	36	36	36	38	42	44	44	38	42	41	41	41	
Oil Supply	"	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	
Total	"	184	184	183	183	174	174	157	161	163	163	157	157	156	156	156	
Administration																	
General and Personnel Affairs	"	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	
Communication	"	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	
Mine Housing Dormitory	"	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	
Shopping Services and Distribution	"	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	

(continued)

Table 8-4 (3)

Item	Unit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Remarks
Clinic	man	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	
Club and Guest House	"	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
Servicing Facilities	"	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	
Guard and Fire Brigade	"	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	
Jeep and Bus etc.	"	8	8	8	8	8	8	8	9	9	9	9	9	9	9	9	
Others	"	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	
Total	"	141	141	141	141	141	141	141	142	142	142	142	142	142	142	142	
Accounting Department																	
General Accounting	"	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	
Salary and Wage in charge	"	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	
Total	"	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	
Rangoon Branch																	
Branch Office	"	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
Rangoon Port	"	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
Total	"	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	
Mandalay Branch	"	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
Grand Total	man	1.072	1.070	1.071	1.070	1.065	1.079	1.085	1.392	1.400	1.387	1.280	1.283	1.259	1.243	1.246	
(Living out of the mine though included in total)	(")	(68)	(68)	(68)	(68)	(68)	(68)	(56)	(56)	(56)	(56)	(56)	(56)	(56)	(56)	(56)	including Monywa city

Table 8-5 (1)   Staff Members Required

Item	Unit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Remarks
General Supervision																	
General Superintendent	man	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Vice Superintendent	"	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
Total	"	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
Mining Department																	
Chief	"	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Acting Chief	"	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Senior Officer	"	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
Officer	"	14	14	14	14	14	14	14	19	19	19	19	19	19	19	19	
Total	"	19	19	19	19	19	19	19	24	24	24	24	24	24	24	24	
Milling Department																	
Chief	"	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Acting Chief	"	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Senior Officer	"	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
Officer	"	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
Total	"	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	
Technical Service Dept.																	
Chief	"	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Senior Officer	"	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
Officer	"	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	
Total	"	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	
Mechanical and Electric Service Department																	
Chief	"	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Acting Chief	"	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	

(continued)

Table 8-5 (2)

Item	Unit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Remarks
Senior Officer	man	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	
Officer	"	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	
Total	"	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	
Civil Engineering Dept.																	
Chief	"	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Acting Chief	"	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Senior Officer	"	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
Officer	"	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
Total	"	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	
Procurement																	
Chief	"	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Acting Chief	"	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Senior Officer	"	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
Officer	"	11	11	11	11	11	11	11	9	9	9	9	9	9	9	9	
Total	"	17	17	17	17	17	17	17	15	15	15	15	15	15	15	15	
Administration																	
Chief	"	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Acting Chief	"	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	
Senior Officer	"	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
Officer	"	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	
Total	"	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
Accounting Department																	
Chief	"	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Senior Officer	"	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Officer	"	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Total	"	3	3	3	3	3	3	3	3	3	3	3	[illegible]	3	3	3	

(continued)

Table 8-5 (3)

Item	Unit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Remarks
Rangoon Branch																	
Chief	man	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Acting Chief	"	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Total	"	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
Mandalay Branch																	
Acting Chief	"	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Officer	"	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Total	"	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
(Grand Total)																	
Acting Chief and Senior	"	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	
Senior Officer	"	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	
Officer	"	69	69	69	69	69	69	69	72	72	72	72	72	72	72	72	
Grand Total	"	111	111	111	111	111	111	111	114	114	114	114	114	114	114	114	
(Included in Grand Total. living out of mine site)	(")	(8)	(8)	(8)	(8)	(8)	(8)	(8)	(8)	(8)	(8)	(8)	(8)	(8)	(8)	(8)	Monywa City included

Chapter 9 DEVELOPMENT SCHEDULE AND CONSTRUCTION WORK

CHAPTER 9. DEVELOPMENT SCHEDULE AND CONSTRUCTION WORKS

9-1 DEVELOPMENT SCHEDULE

The construction period is to be set at 4 years. During this period the preliminary stripping work, etc. of Sabedaung deposit is to be carried out.

At the same time, the required construction work is planned to be carried out roughly according to the following schedule;

Table 9-1 Outline of Development Schedule

Fiscal Year	Scope of Works	Remarks
-4	Detailed design, Quotation, Orders, Procurement and Transportation of Materials* Arrangement of Necessary Staff, Workers, and the land needed. Preparatory plant setting and works, Transportation of some heavy machinery Ground preparation mostly for the mill, and others.	*Desirably these should be done before the -4th Fiscal Year.
-3	Transportation of heavy machinery, etc. Construction of Mill and Waste Tailing Pond Starting the construction of Substation and Water supply installations, and others	
-2	Construction of Roads Transportation of heavy machinery Construction of Mill, Setting of Machinery Construction of Waste Disposal Pond Ground formation for various buildings Sub-station, Water Supply facilities Starting the construction of Housing facilities and others	
-1	Completion of Mine road construction Finishing the transportation of heavy machinery Completion of Jetties, Railway Service facilities ** Construction of Waste Tailing Pond In the first 6 months, Mill, Water Supply Substation, delivery facilities being completed	** In the earlier half of Fiscal -1 Year, Infrastructure facilities are to be established.

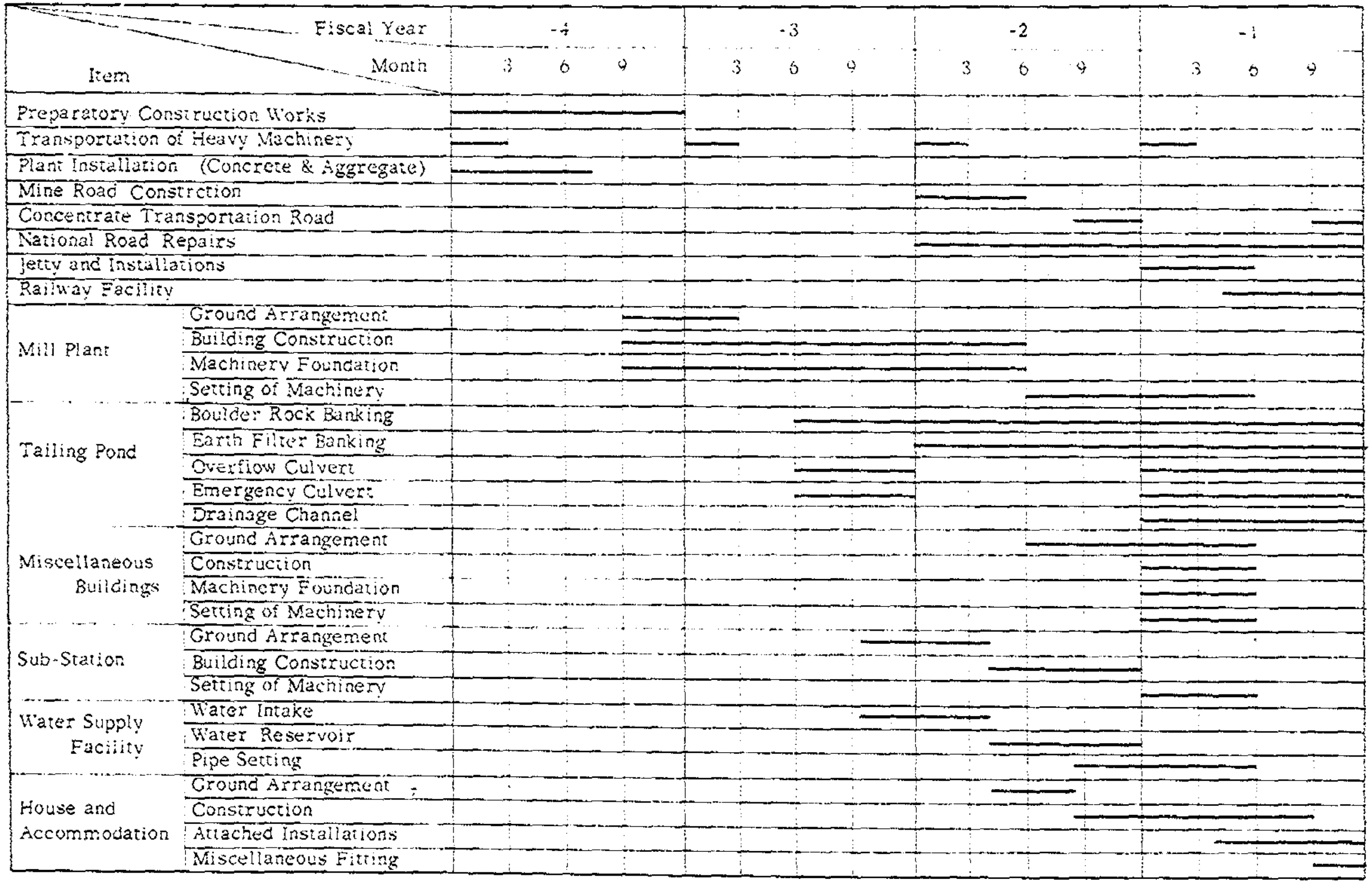
	Completion of various buildings, Housing facilities, and the setting of machinery Electricity Distribution fittings, Test transmission, and Actual Use of Electricity in full capacity in the second 6 months** Running Test of Mill, and Test Operation for the last 3 months, and others.

As explained in the said table, the Infrastructural Installation work on both the transmission line and the railway related facilities are expected to be completed by the middle of the fourth year of the construction period. The mill is planned to be completed in the first 6 months of the last year of the construction phase, together with the substation and relevant distribution facilities. Then, subsequently, no load and with-load running tests are to be carried out.

In the last 3 months of the construction period, a test of the normal running operations will be essential. Thus, right on schedule and from the beginning of the first step of the operation period, crude ore production, and treatment can be realized without any trouble at a daily rate of 8,000 MT.

The Schedule of the Construction Work is shown in Table 9-2.

Table 9-2 Construction Schedule



9-2 CONSTRUCTION WORK

9-2-1 Outline of Construction Works

(1) The construction work is to be carried out in the preliminary four years, right on the development schedule mentioned previously.

During this period, various facilities, installations necessary for the mine town are also to be constructed. For this purpose miscellaneous preparatory work, such as earth quality study, topographic survey, procurement and transportation of various pieces of machinery for the construction, building and operating of plants for both ballast crushing and concrete mixing, and also of the temporary housing or accommodations for the constructing teams, etc., is to be carried out smoothly.

(2) As for materials, fuel, oil, lubricant, cement, ballast, sand, wood, slate sheet and other materials are to be procured, as far as possibly locally, while all heavy machinery, equipment, steel fabrics, and miscellaneous other materials are to be imported from abroad.

(3) The transportation of the said materials is to be dependent on Burma National Railway, Inland Waterway Corporation, and other corporations concerned. After arrival at the relevant terminal in Monywa, the handling and transportation at or to the mine site are to be carried out by the machinery and vehicle which are already available. Public ferry is also to be utilized whenever it is necessary and available.

(4) The personnel requirement needed for the construction period is shown in Table 8-3.

Labourers are to be employed from the local inhabitants in the neighbouring community, except for well trained skilled workers. At the same time, during the first 3 years, from -4 to -2 fiscal year, 20 selected staff members annually are to be sent to the participating countries to be trained technically in regard to the job and items.

During the same period training of the workers is also planned to be carried out in parallel with the construction works. Thus over 250 skilled workers from every department are expected to be well trained by the first year of the operation period.

During the construction period, foreign experts are to be employed from the participating countries to cooperate on all the contruction activities, as well as to give technical training and guidance. The number of foreign experts in expected to be 20 in the -4 fiscal year and will increase to 60 in the subsequent 3 years from -3 to -1 fiscal year.

9-2-2 Ground Area, Earth Quality Test, Topo-survey

(1) The area of ground needed for the mine construction, excluding the planned pit mining area, is estimated as shown in Table 9-3.

Table 9-3 Requirement of Ground Area

Item	Area in Hectare
Mill Site	8.0
Waste Tailing Pond	258.0
Waste Dump Site	118.0
Water Supply Facility	2.0
Ballast crushing and Concrete Mixing Plant	9.0
Mine Road	14.0
New Road Construction and National Road Enlargement	16.6
Jetties and Attached Facilities	0.1
Railway Service Yard	1.0
Miscellaneous installations, Workshops, etc.	10.0
Living Facilities	16.0
Total	479.7

This ground area is to be expropriated by the Burmese Government for the use of the project.

(2) Earth Quality Test and Topographic Survey

Topographic survey, earth quality test, and material strength test are to be undertaken to enable the design, performance and supervision of all the construction work go smoothly and on schedule.

The procedure to be in carrying out the work is demonstrated in outline below;

Table 9-4 Outline of Earth Quality Test and Toposurvey

Fiscal Year	Scope of Activities
(Topo survey)	
-4 F. Y.	Mill, Waste Tailing Pond, Road, Water Supply Facility, Inhabitation Facilities, etc.
-3 F. Y.	Rest of Tailing Pond and Road, other Installations
(Earth Test)	
-4 F. Y.	Loading Test of Ground at each Site, Bearability Test and Permeability Test of the banking of Waste Tailing Pond. Material Test for Road construction, Concrete and Ballast Strength Test.
-3 F. Y.	Ground Bearability and Permeability Tests for Water Supply, Living Facilities, Attached Workshops, Road, and Foundations of other Facilities.
-2 F. Y.	Supplementary study and tests

9-2-3 Heavy Machinery and Equipment for Construction Work

The machinery and equipment captioned above is to be imported one piece at a time to the project site and used according to the yearly construction program. As previously mentioned, spare parts for one year of maintenance are to be brought in together with each machine or vehicle, and afterwards additional procurement should be arranged separately as necessary.

Some of the machines or vehicles are of the same types as those used in the mining activities, thus they can be used for both purposes. All machinery originally used for the construction is to be continuously used for each operation until the end of their life expectancy.

Table 9-5 lists the Major Heavy Machinery and other mechanical facilities to be used in the construction work.

Table 9-5 Major Machinery and Equipment for Construction Works

Name of Machinery and Equipment	Numbers	Specification
Bulldozer	7	21 T class
Front End Loader	5	0. 8 M^3
Rear Dump Truck	9	8 T
Road Roller	4	Macadam 10 T class
Motor Grader	2	9. 1 T class, Blade width 3. 1 M
Back Hoe	1	0. 7 M^3 class
Truck	6	7 T
Truck	3	2 T
Jeep	5	-
Piling Hammer	1	391 kg
Concrete Finisher	5	6. 5 M Engine type
Rummer	10	-
Portable Conveyor	45	10 M in length
Hopper	25	6 M^3
Mixer Car	10	4 M^3
Hand Cart	40	0. 085 M^3
Vibrator	21	-
Concrete Pump	3	60 M^3/H
Ballast Crushing Plant	1 set	30 M^3/H cf. 9-2-4
Concrete Mixing Plant	1 set	60 M^3/H cf. 9-2-4
Compressor	2	75 HP
High Speed Cutter	5	5. 5 kw
Welding Machine	30	Electric (200A) 20 set, Gas (400A) 10 set
Beam Lamp	35	2 kw
Material Testing Machine	1 set	-
Earth Quality Tester	1 set	-
Crane	2	30 T, Boom length 30 M
Crane	1	15 T, Boom length 30 M
Fork Lift	7	2 T class
Diesel Generator	2	250 KVA
Transformer	4	50 KVA

9-2-4 Ballast Crushing and Concrete Mixing Plants

In order to supply materials and concrete needed for the construction work, a ballast crushing plant and a concrete mixing plant are to be built on the southern slope of Kyisindaung to the west of the mill construction site. (Fig. 7-2)

Of the materials required, the coarser and finer materials are to be obtained by making use of some of the waste overburden excavated in the preliminary stripping. While some finer materials are to be collected from the river beds in nearly localities.

The requirement of aggregate and concrete during the construction period is summarized and shown in Table 9-6.

Table 9-6 Aggregate and Concrete Needed

Item	Unit	-4 FY	-3 FY	-2 FY	-1 FY	Total
Aggregate	MT	7,404	14,355	15,701	7,366	44,826
Concrete	m^3	12,470	24,176	26,444	12,406	75,496
Waste stripped	10^3 MT	300	600	700	700	2,300

The capacity of the crushing plant is designed at 30 T/H, and the products are to be arranged in 3 sizes as follows;

40 - 0 mm
25 - 5 "
5 - 0 "

The crushing process is to be arranged approximately as follows:

Coarse crushing	:	2 stages in open circuit
Fine crushing	:	By a rod mill in closed circuit
Screening	:	3 stages in wet separation and classification by a spiral classifier.

The capacity of the concrete mixing plant is to be approximately 60 T/H.

9-2-5 Other Preliminary Construction Work

In the early stage of the construction period, to be exact in the first half of the -4 fiscal year, the following preliminary construction work is to be undertaken to promote the smooth progress of the project.

(1) Temporary Housing for Construction Teams

The captioned housing is to be built at the northern foot of Kyisindaung (Fig. 7-2). The area of the site is to be 2,500 m^2, while the area of the building themselves will be 500 m^2, with an accommodation capacity of 100 persons. This accommodation will be mainly for the use of staff members for the construction and foreign experts. The buildings are to be equipped with illuminations, water supply, sewage disposal, and other services.

(2) Temporary Road for Transportation of Machinery and Materials

The road is planned to connect major points on the mine site and will have a width of over 4 meter and gravel pavement. It is estimated to be about 2,500 m in total length.

(3) Others

2 set of diesel generators of 250 KVA are to be installed as a temporary electric power service, together with wire setting and other miscellaneous fittings. On the other hand, the temporary water supply system is to be arranged by using both the existing water pipe line from Yama stream to the top of Kyisindaung hill, and the newly drilled water tube wells to the east of the 50 t/d pilot plant.

Chapter 10 INITIAL COST AND OPERATING COST

CHAPTER 10. INITIAL COST AND OPERATING COST

10-1 INITIAL CAPITAL INVESTMENT

Initial investment is planned to be made mostly in the 4 year construction period, and partly in the subsequent initial year of the operation period.

The amount required for the investment is estimated and summarized as follows;

Total Amount	$69,838,000
(of which, Foreign Currency)	($54,744,000)
(Local Currency)	($15,094,000)

When the interest incurred during the construction period and the running fund needed are considered, the sum of the investment increases as follows;

Ground Total of Investment	$81,323,000
(of which, Foreign Currency)	($63,752,000)
(Local Currency)	($17,571,000)

In calculating the investment amount, the commodity prices in early 1976 have been adopted as the basis of the calculation. A yearly rate of 5 % has been assumed as cost escalation rate, while the interest rate has been set at 7.5 %, both in local currency and foreign currency.

In the present report it has been assumed that no customs duty will be applied on the importation of machinery and equipment.

For the convenience of the calculation, it is supposed that such machinery and equipment will be chiefly imported from Japan, and their prices include all the expenses incurred in their transportation from Japan to the mine site. In addition to the prices of the heavy machinery for civil engineering work, vehicles, and other machinery, the cost of spare parts sufficient for one year of use have been included together with the earlier ship cargos.

Table 10-1 gives a summary of the initial investment.

Table 10-1 Contents of Initial Investment

(Unit : 1,000$)

Item	Total	-4	-3	-2	-1	1	Remarks
Mining							
Heavy Machinery and Vehicle	3,080	840	69	323	-	1,848	Refer to Attached Table 4-11
Stripping	971	116	244	298	313	-	2,300,000 t at Sabedaung
Others	500	96	81	200	47	76	Buildings, Tools, Grade-checking
Total	4,551	1,052	394	821	360	1,924	
Milling							
Crushing Facility	3,238	348	1,802	1,020	68	-	Crushing Plants for 3 stages
Dressing Facility	12,651	420	9,258	2,520	453	-	Grinding, Flotation, Dewatering
Attached Facility	3,048	-	481	1,240	1,327	-	Lime, Reagent, Assay, Laboratory and Piping, etc.
Electric Works	2,949	128	438	1,684	699	-	Wire Setting, Various Fittings
Construction Works	3,811	-	1,604	1,647	560	-	Ground Arrangement, Machine Foundation, Buildings
Test Operation	742	-	-	-	742	-	For 3 months after Running Test
Total	26,439	896	13,583	8,111	3,849	-	
Transportation							
Heavy Machinery and Vehicle	3,102	568	1,020	-	56	1,458	Refer to Table 6-2
Buildings and Jetty	620	-	-	-	620	-	- ditto -
Material Haulage	103	17	18	19	49	-	Services offered during construction period
Total	3,825	585	1,038	19	725	1,458	
Mechanical Services							
Mechanical and Electric Workshop	782	409	359	14	-	-	Various manufacturing Machine, Buildings, Service Yards.
Saw Mill	136	102	27	7	-	-	Various Saw Mill Machine, Buildings, Yards.
Car Repair Shop	101	23	76	2	-	-	Oil jack, etc. Buildings, Yards
Oil Storage	321	155	144	22	-	-	Tank Lorry, Oil Reservoir, Oil Service Station
Attached Facility	226	51	127	2	46	-	Transportation Passages, Foundations, etc.
Total	1,566	740	733	47	46	-	
Electric Services							
Sub-station Facility	1,492	50	105	1,003	334	-	Main Transformer, 13 KVA, Circuit Breaker, etc.
Distribution Services	1,243	55	187	663	338	-	Mill Plant Excluded, Communication Facility included
Supply Facility for Housings	52	-	9	23	20	-	Total Length of Supply Wire Line in Mine Site, Approx. 9 km.
Total	2,787	105	301	1,689	692	-	
Water Supply							
Water In-take	387	-	-	125	262	-	Sand Settling Pond 3,000 T, etc.
Pumping Facility	400	-	-	-	400	-	Pumps, Delivery Pipes
Head Tank	856	-	-	99	757	-	10,000 T

Table 10-1 (2)

(Unit : 1,000$)

Item	Total	-4	-3	-2	-1	1	Remarks
Water Delivery etc.	129	-	-	20	109	-	
Total	1,772	-	-	244	1,528	-	
Waste Tailing Disposal							
Foundation Digging	82	-	40	42	-	-	Partial Construction of Waste Disposal Pond of 1st Stage
Stone Boulder Banking	400	-	94	200	106	-	- ditto -
Earth Filter Works	219	-	-	107	112	-	- ditto -
Water Passages	286	-	-	37	249	-	Various Drainage, Culvert, etc.
Total	987	-	134	386	467	-	
Road							
Crude Ore Haulage Road	383	-	91	191	101	-	3.2 KM, 9 M in Width
Other Roads	1,178	-	79	325	774	-	10.5 KM, 6.5 M in Width
National Road Repair	400	-	62	65	273	-	8.6 KM Enlarge and Repair
Bridges	153	-	49	104	-	-	New Bridges 6 Sites, Repairs 3 Sites
Total	2,114	-	281	685	1,148	-	
Common Preparations							
Heavy Machinery, Vehicles	3,775	880	1,373	1,362	160	-	Refer to Table 9-5
Buildings, etc.	571	443	-	-	128	-	Temporary Lodging, etc.
Preliminary Works	1,787	143	536	701	407	-	Maintenance Costs for Heavy Machinery included
Total	6,133	1,466	1,909	2,063	695	-	
General Services							
Cars, Installations	195	28	-	-	-	167	Fire Engine, Micro-bus, Large Ferry
Buildings	307	-	120	-	187	-	Administration office, etc.
Others	125	17	34	36	38	-	Liaison and other miscellaneous expenditures
Total	627	45	154	36	225	167	
Mine Town							
Living Installations	1,517	-	-	740	777	-	271 Houses, 2 Dormitories, 1 Guest House
Attached Buildings	123	-	-	60	63	-	School, Clinic, Shopping Center, etc.
Other Facilities	722	-	-	352	370	-	Sports Ground, Yards, Parks, etc.
Total	2,362	-	-	1,152	1,210	-	
Total of All Dept.	53,163	4,889	18,527	15,253	10,945	3,549	
Contingency	2,658	244	926	763	548	177	5% of the total amount of all the departments
Technical Fee	4,962	489	1,853	1,525	1,095	-	10% of the total amount of all the departments
Inaugulation Fee	9,055	940	2,639	2,771	2,705	-	Mobilization and Education of personnel concerned
Sub-Grand Total	69,838	6,562	23,945	20,312	15,293	3,726	

Table 10-1 (3)

(Unit: 1,000$)

Item	Total	-4	-3	-2	-1	1	Remarks
(of which, Foreign Exchange)	(54,744)	(6,029)	(20,761)	(15,137)	(9,275)	(3,542)	
(of which, Domestic Currency)	(15,094)	(533)	(3,184)	(5,175)	(6,018)	(184)	
Monetory Interest to be paid for Construction Period	9,575	246	1,408	3,174	4,747	-	Borrowing at 7.5% rate per annum (mid-year counting)
Running Fund	1,910	-	-	-	-	1,910	
Grand Total	81,323	6,808	25,353	23,486	20,040	5,636	
(of which, Foreign Exchange)	63,752	6,255	22,009	17,824	13,079	4,585	
(of which, Domestic Currency)	17,571	553	3,344	5,662	6,961	1,051	

10-2 ADDITIONAL CAPITAL INVESTMENT

Throughout the operation period, such additional investments as will be required for the preliminary stripping both in Kyisindaung and Sabedaung South, the enlargement of the Waste Tailing Pond, and the renewal of the machinery and equipment must indispensable to be considered.

The amount of additional investment necessary can be summarized as follows;

Total Amount	\$16,871,000
(of which, Foreign Exchange)	(\$13,667,000)
(Local Currency)	(\$ 3,204,000)

The investments concerned are as follows;

10-3 OPERATING COST

Though the crude ore production is fixed in the plan, the operating cost of the mine is expected to fluctuate a little year by year, because of changes in the stripping volume, concentrate produced, etc.

The operating cost per ton of crude ore is calculated to shift yearly between \$3.07 and \$3.72, where the possible cost escalation has not been considered at all. The said cost covers all the expenses, including the transportation charges to Rangoon Port.

In the cost calculation mentioned above, the following presumptions have been made;

(1) The price of the imported machinery includes all the transportation charges upto the mine site, but it has been assumed that no customs duty will be applied.

(2) Regarding local materials or supplies, the prevailing prices based on the official procurement are to be universally adopted.

(3) Wages and Salaries are also to be set according to the rates which have been defined by the Burmese Government.

(4) The supply of electric power is to be arranged at 0.15 Kyat/KWH, which is the official charge for factories of over 200 kw in consumption rate under the Rangoon System.

(5) Freight charges and port facility charges are also to be imposed respectively at the rates set by the corporations concerned.

The yearly operating cost is estimated to shift as shown in Table 10-4, while the details of the said cost are displayed in Table 10-5.

Table 10-4 Yearly Operating Costs (Summary)

Item	Unit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Remarks
Mining	1,000$	1.141	1.187	1.203	1.196	1.223	1.312	1.473	1.528	1.640	1,624	2.859	2.913	2,793	2.639	2.649	
Milling	"	5.116	5.116	5.114	5.114	4.965	4,965	4.952	4.952	4.950	4.950	4.939	4.871	4,871	4.871	4.871	
Transportation	"	303	303	298	298	241	241	226	229	228	228	223	199	199	199	199	
Mechanical Services	"	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	
Electric Services	"	10	9	11	11	11	11	12	12	12	12	13	13	13	13	13	
Water Supply	"	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
Waste Tailing Pond	"	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	
Civil Engineering	"	127	127	127	127	127	127	127	127	127	127	127	127	127	127	127	
General Services	"	167	167	167	167	167	167	167	169	169	169	169	169	169	169	169	
Total	"	7,082	7.127	7.138	7.131	6.952	7.041	7,175	7.235	7.344	7.328	8.548	8.510	8.390	8.236	8.246	
Railway Freight	"	557	557	544	544	420	420	391	391	389	389	380	328	328	328	328	Ware House charges included
Total	1,000$	7.639	7.684	7.682	7.675	7.372	7.461	7.566	7.626	7.733	7.717	8.928	8.838	8,718	8.564	8.574	
Cost per Ton of Crude Ore	($/t)	(3.18)	(3.20)	(3.20)	(3.20)	(3.07)	(3.11)	(3.15)	(3.18)	(3.22)	(3.22)	(3.72)	(3.68)	(3.63)	(3.57)	(3.57)	
(Foreign Exchange)	1,000$	4,176	4.206	4.214	4.208	4.116	4.180	4.281	4.322	4.398	4.386	5.261	5.233	5.157	5.043	5.047	
(Local Currency)	"	3.463	3.478	3.468	3.467	3.256	3.281	3.285	3.304	3.335	3.331	3.667	3.605	3.561	3.521	3.527	

Table 10-5 (1) Yearly Operation Cost (Detail)

Item	Unit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Remarks
Mining																	
Stripping	10^3\$	209	223	224	205	218	299	432	486	570	561	1.544	1.626	1.548	1.412	1.416	
Mining	"	679	701	713	727	736	729	728	714	722	716	728	713	682	690	694	
Access Road	"	9	14	16	19	20	19	19	17	18	15	33	23	14	16	16	
Civil Engineering Work	"	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	
Waste Disposal	"	21	25	24	21	22	31	45	52	60	60	162	162	162	147	147	
Illumination and Drainage	"	27	28	29	31	33	31	33	34	36	38	42	39	39	40	42	
Servicing Haulage	"	61	60	59	58	59	62	67	70	73	73	112	112	112	106	106	
Servey and Geology	"	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	
Supervising, maintenance and others	"	107	108	110	107	107	113	121	127	133	133	210	210	208	200	200	
Total	"	1.141	1.187	1.203	1.196	1.223	1.312	1.473	1.528	1.640	1.624	2.859	2.913	2.793	2.639	2.649	
(Foreign Exchange)	(")	742	772	783	770	793	857	969	1.010	1.086	1.074	1.953	1.991	1.915	1.801	1.805	
(Local Currency)	(")	399	415	420	419	430	455	504	518	554	550	906	922	878	838	844	
Per Ton of Crude Ore	S/T	0.48	0.49	0.50	0.50	0.51	0.55	0.61	0.64	0.68	0.68	1.19	1.21	1.16	1.10	1.10	
Milling																	
Crushing	10^3\$	222	222	222	222	222	222	222	222	222	222	222	222	222	222	222	
Grinding	"	2.616	2.616	2.614	2.614	2.581	2.581	2.577	2.577	2.577	2.577	2.576	2.556	2.556	2.556	2.556	
Flotation	"	1.807	1.807	1.806	1.806	1.698	1.698	1.694	1.694	1.694	1.694	1.693	1.650	1.650	1.650	1.650	
Dewatering	"	77	77	77	77	65	65	65	65	65	65	65	52	52	52	52	
Lime Shop	"	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	
Supervising and maintenance	"	325	325	326	326	330	330	325	325	323	323	314	322	322	322	322	
Assay and Laboratory	"	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	
Total	"	5.116	5.116	5.114	5.114	4.965	4.965	4.952	4.952	4.950	4.950	4.939	4.871	4.871	4.871	4.871	
(Foreign Exchange)	(")	3.234	3.234	3.234	3.234	3.148	3.148	3.143	3.143	3.143	3.143	3.141	3.085	3.085	3.085	3.085	

(continued)

Table 10-5 (2) Yearly Operation Cost (Detail)

Item	Unit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Remarks
(Local Currency)	(10^3\$)	1,882	1,882	1,880	1,880	1,817	1,817	1,809	1,809	1,807	1,807	1,798	1,786	1,786	1,786	1,786	
Per Ton of Crude Ore	\$/T	2.13	2.13	2.13	2.13	2.07	2.07	2.06	2.06	2.06	2.06	2.06	2.03	2.03	2.03	2.03	
Transportation																	
Truck Haulage	10^3\$	57	57	56	56	43	43	41	41	41	41	40	35	35	35	35	
Ferry Boat	"	172	172	168	168	129	129	120	120	119	119	117	100	100	100	100	
Handling	"	11	11	11	11	10	10	10	10	10	10	10	9	9	9	9	
Jetty Services	"	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	
Miscellaneous charges in Rangoon	"	16	16	16	16	13	13	12	12	12	12	12	10	10	10	10	
Others	"	30	30	30	30	29	29	26	26	29	29	27	28	28	28	28	
Total	"	303	303	298	298	241	241	226	229	228	228	223	199	199	199	199	
(Foreign Exchange)	(")	114	114	111	111	89	89	83	83	83	83	81	71	71	71	71	
(Local Currency)	(")	189	189	187	187	152	152	143	146	145	145	142	128	128	128	128	
Per Ton of Crude Ore	\$/T	0.13	0.13	0.12	0.12	0.10	0.10	0.09	0.10	0.10	0.10	0.09	0.08	0.08	0.08	0.08	
Mechanical, Electric and Oil Supply Services																	
Labour Cost	10^3\$	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	
Electric Power Cost	"	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
Materials, etc.	"	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	
Total	"	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	
(Foreign Exchange)	(")	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
(Local Currency)	(")	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67	
Electric Power Supply																	
Substation Running, etc.	10^3\$	10	9	11	11	11	11	12	12	12	12	13	13	13	13	13	
(Foreign Exchange)	(")	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
(Local Currency)	(")	10	9	11	11	11	11	12	12	12	12	13	13	13	13	13	

(continued)

Table 10-5 (3) Yearly Operating Cost (Detail)

Item	Unit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Remarks
Water Supply, Civil Services																	
Industrial Water	10^3\$	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
Waste Tailing Pond	"	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	
Road	"	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	
Inhabitations	"	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	
Maintenance of Construction Machinery	"	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67	
Total	"	271	271	271	271	271	271	271	271	271	271	271	271	271	271	271	
(Foreign Exchange)	(")	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	
(Local Currency)	(")	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	
General Services																	
Fire Brigade and Guard	10^3\$	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	
Traffic Services	"	21	21	21	21	21	21	21	23	23	23	23	23	23	23	23	
Senior Staff and Clerical Labour Cost	"	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	
Material Cost, etc.	"	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	
Total	"	167	167	167	167	167	167	167	169	169	169	169	169	169	169	169	
(Foreign Exchange)	(")	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	
(Local Currency)	(")	144	144	144	144	144	144	144	146	146	146	146	146	146	146	146	
Freight and Warehouse																	
Transportation of Concentrate	10^3\$	557	557	544	544	420	420	391	391	389	389	380	328	328	328	328	
(Foreign Exchange)	(")	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
(Local Currency)	(")	557	557	544	544	420	420	391	391	389	389	380	328	328	328	328	
Grand Total	10^3\$	7,639	7,684	7,682	7,675	7,372	7,461	7,566	7,626	7,733	7,717	8,928	8,838	8,718	8,564	8,574	
(Foreign Exchange)	(")	4,176	4,206	4,214	4,208	4,116	4,180	4,281	4,322	4,398	4,386	5,261	5,233	5,157	5,043	5,047	
(Local Currency)	(")	3,463	3,478	3,468	3,467	3,256	3,281	3,285	3,304	3,335	3,331	3,667	3,605	3,561	3,521	3,527	
Per Ton of Crude Ore	\$/T	3.18	3.20	3.20	3.20	3.07	3.11	3.15	3.18	3.22	3.22	3.72	3.68	3.63	3.57	3.57	

Chapter 11 ECONOMIC EVALUATION

CHAPTER 11. ECONOMIC EVALUATION

There are several serious problems now in the economic foundation and structure, particularly under the present unstable world economy which was once initiated by the so-called "resource problems" for mineral resources at the beginning of this decade. It may still take a long time for a stablized economic regime to be re-established.

The shift of the copper marketing price is to be understood as nothing other than a symbol of the unstable situation of the world economy.

The extreme fluctuation of LME prices, and the remarkable unbalance between the demand and supply of metals have led to the diminution or closing of numerous working mines, all over the world. On the other hand, they have caused almost all of the new mine development programs to be revised or even abandoned. Because of the present uneasy economic situation, it is undoubtedly very difficult for any economist to precisely evaluate the financial risks involved in the development and the operation of a copper mine during the next decades. Accordingly, investment in a copper mine may inevitably encounter unexpected economic risks. This kind of aspect should be clearly emphasized.

However, from the long-term view point, both the scarcity of copper resources and the promotion of industrialization in various countries can be expected to lead to an improved copper demand situation, with possible higher prices. Furthermore, the international disputes on mineral resources may be suitably settled sooner or later, so that the stabilization of the copper price can be expected.

Although the situation is still obscure with a number of as yet undetermined factors, the significance of developing a new copper mine has not been lost or diminished at all.

11-1 D.C.F. (DISCOUNTED CASH FLOW)

Because of the extreme difficulty in foreseeing various factors in economical evaluations, the following calculation has been carried out on the basis of numerous assumptions. Thus, changes in the assumptions made will greatly affect the economy of the project.

If conditions are associated too freely, the presumed case studies can be countlessly increased.

So, in the present calculation, for the sake of simplification, only the copper price has been assumed separately at ¢70/lb, ¢80/lb and ¢90/lb, and other items or factors have all been presumed to be the same. This is because the copper price is by far the most important factor for the economical evaluation.

All the prices and values in the report are expressed in US dollars.

The Internal Rate of Return using the Discounted Cash Flow (in short, D.C.F.) method for the total sum of the investment, has been calculated respectively, and the results are shown as follows;

Copper price at ¢70/lb	4.1 %
Copper price at ¢80/lb	10.0 %
Copper price at ¢90/lb	14.7 %

11-2 COPPER CONCENTRATE PRODUCED

The following conditions have been presumed under the assumption that all the copper concentrate produced is to be exported.

(1) The treatment charge is to be assumed at each copper price as follows;

1) Copper price at ¢70/lb, ¢17/lb

2) Copper price at ¢80/lb, ¢18/lb

3) Copper price at ¢90/lb, ¢19/lb

The treatment charge for the copper concentrate shifts in general, depending on the relation between its supply and demand at the time of selling of the concentrate. In addition, in these days of world scale inflation, a part from the said price scale, some escalation terms are usually included in the price scale to compensate for increases in wages, fuel costs, power costs, and other factors of smelting country.

(2) Recovery in smelting is to be assumed at 1.1 unit less, where the said recovery usually also shifts in the same way as the treatment charge does.

(3) According to the assay results of the Monywa copper concentrate, no valuable metals such as gold, silver, etc. exist in economical amounts to be recovered as by-products. Furthermore no impurities have been recognized in such amounts as to cause penalties.

The following assay values are the average of 5 sets of results from, between 1974 and 1976.

Table 11-1

Content	Assay Grade	Content	Assay Grade
Cu	29.5 %	Ni	0.01 %
Pb	below 0.01 "	MoS_2	0.01 "
Zn	below 0.01 "	SiO_2	1.5 "
S	37.7 "	Al_2O_3	0.9 "
Fe	26.2 "	Au	0.9 g/t
As	below 0.04 "	Ag	23 g/t
Sb	below 0.02 "	Hg	0.6 ppm
Bi	below 0.01 "	F	tr.

11-3 COST

(1) The capital cost is respectively composed of the initial investment, interest for the initial investment during the construction period, and additional investment.

(cost of inauguration not included)

Initial investment	\$60,783,000
Interest for the initial investment during the construction period	\$ 9,575,000
Additional investment	\$16,871,000
Total	\$87,229,000

For the construction period under the initial investment, an annual escalation rate of 5 % has been assumed, while for the additional investment, the highest accumulated rate at the end of the construction period has been adopted.

(2) The opening costs are estimated at \$9,055,000 in total, and this is to be used to pay for the employment of foreign experts, the educational training expenditures for the Burmese staff and technicians, as well as for other miscellaneous expenses involved in the opening of the mine.

(3) It is considered reasonable for the project to adopt the Production Method as a means of depreciation to cope with any remarkable change in the annual production of concentrate caused by shifting grades of the crude ore produced.

With regard to the mining division, Sabedaung and Kyisindaung are to be calculated separately. On the other hand in book keeping, the final remaining value of the assets is assumed to be nil.

The amortization of the opening cost is to be treated in a similar way to the initial investment.

Table 11-2 Yearly Trend of Amortization

(Unit: 1,000$)

Fiscal Year	Amortization		Total
	Initial Investment	Inaugulation Cost	
1	7,037	730	7,767
2	7,037	730	7,767
3	6,879	714	7,593
4	6,879	714	7,593
5	5,275	548	5,823
6	5,275	548	5,823
7	4,899	509	5,408
8	4,899	509	5,408
9	4,881	507	5,388
10	4,882	507	5,389
11	6,613	687	7,300
12	5,668	588	6,256
13	5,668	588	6,256
14	5,668	588	6,256
15	5,669	588	6,257
Total	87,229	9,055	96,284

(4) No escalation has been considered in the calculation of running cost, where all the prices are fixed at the level in 1976.

(5) Loan interest of 7.5 % per annum is to be adopted in both funds, for installations and for running.

The influence of the interest rate on the economy viability of the project is tremendous, thus the introduction of a lower interest rate will contribute greatly to the promotion and success of the project.

(6) It is assumed that no customs duty will have to be paid on the imported machinery and materials for the national project.

(7) It is also assumed that no local taxes will be paid on earnings from the project.

(8) Regarding shipping freight charges, the amount necessary for shipment to Japan has been adopted for convenience in the present calculation. The freight charge rate is presumed to be $22. 50 for a wet metric ton of the concentrate ore. It has also been assumed that units of 8,000 t of the concentrate will be shipped by 10,000 t class liner sailing from Rangoon port.

The maritime insurance rate of 0. 25 % is to be applied.

(9) Inland Freight Charges

Freight transportation between Monywa and Rangoon is to be carried out by Burma National Railway, and the official charge rate is to be applied for the freight.

(10) For the copper concentrate stored at Rangoon port prior to the shipment, the warehouse charge rate of the Port Corporation is to be imposed.

11-4 FUNDS

(1) It is assumed that all the necessary funds for both the installations and running of the project will have to be borrowed.

It is further supposed that the sources of the funds will be unified by local financing organizations, such as the Central Bank of Burma, Industrial Bank of Burma, etc.

However, the nomination of the currencies should be unified in US dollars for convenience, and the exchange rate for the project is to be assumed as US$1 equivalent to 6. 5 Kyats.

(2) Funds of local as well as foreign origin needed for the construction period are shown in Table 11-3.

Table 11-3 Rezuired Fund During Construction Period ($1,000)

Item	-4	-3	-2	-1	1	Total
Foreign Currency						
Installation Cost	4,442	15,671	10,510	5,376	3,374	39,373
Contingency	222	787	526	269	168	1,968
Technical Fee	489	1,853	1,525	1,095	-	4,962
Inaugulation	876	2,453	2,576	2,535	-	8,440
Interest for Construction Period	226	1,248	2,687	3,804	-	7,965
Running Fund	-	-	-	-	1,910	1,910
Total	6,255	22,008	17,824	13,079	5,452	64.618
Local Currency						
Installation Cost	447	2,856	4,743	5,569	175	13,790
Contingency	22	143	237	279	9	690
Technical Fee	-	-	-	-	-	-
Inaugulation	64	186	195	170	-	615
Interest for Construction Period	20	160	487	943	-	1,610
Running Fund	-	-	-	-	-	-
Total	553	3,345	5,662	6,961	184	16,705
Foreign Currency + Local Currency						
Installation Cost	4,889	18,527	15,253	10,945	3,549	53,163
Contingency	244	926	763	548	177	2,658
Technical Fee	489	1,853	1,525	1,095	-	4,962
Inaugulation	940	2,639	2,771	2,705	-	9,055
Interest for Construction Period	246	1,408	3,174	4,747	-	9,575
Running Fund	-	-	-	-	1,910	1,910
Total	6,808	25,353	23,486	20,040	5,636	81,323
Infrastructare						
Foreign Currency						6,023
Local Currency						3,019
Total						9,042
Grand Total						
Foreign Currency						70,641
Local Currency						19, 724
Total						90,365

The fund needed for the additional investment of $16,871,000 (of which, foreign exchange is estimated at $13,667,000) is most probably expected to be procured from the planned surplus fund, produced by the income obtained through the operation of the project.

Thus, unless some unexpected charge should occur to allow the above presumptions, such "additional fund" may be excluded from the loan program.

(3) As for the repayment of the invested funds, no definite plan has been established yet. However, some of the earnings which are equivalent to depreciation and amortization should be allocated for the repayment.

(4) Running funds needed for operation are estimated to be the same amount as the operating costs for 3 months (excluding the amortization cost and interest). On the other hand, 2,000 tons of copper concentrate produced should be considered and kept for the necessary reserve supply.

Thus a basal running fund is also required for maintaining the operation which covers the said reserve supply of concentrate at the mill. However, this is also expected to be achieved by using the sales income from the products of the operation.

(5) All of the surplus fund obtained from the operational profit should also be paid back, as repayment of the borrowed running fund.

(6) The surplus fund obtained after paying back all the loan is to be efficiently employed at the annual interest of 3.5 %.

11-5 *PROFITABILITY AND EVALUATION*

The results of the calculation on profitability under the above-mentioned presumption and terms are shown in the Tables 11-4 to 11-7, based on assumed copper prices of ¢70/lb, ¢80/lb, and ¢90/lb, respectively.

The critical copper price as regards profitability has been found to be about ¢77/lb, thus with the price of ¢80/lb, a considerable amount of profit can be anticipated.

In this case at ¢80/lb, D. C. F. also becomes 10.0 %, and the development and exploitation of the mine can be evaluated as economically worthwhile.

Table 11-4

ANNUAL PROFIT (LOSS) AND DISCOUNTED CASH FLOW (COPPER PRICE BASIS)

Showing the average value of the operational 15 years

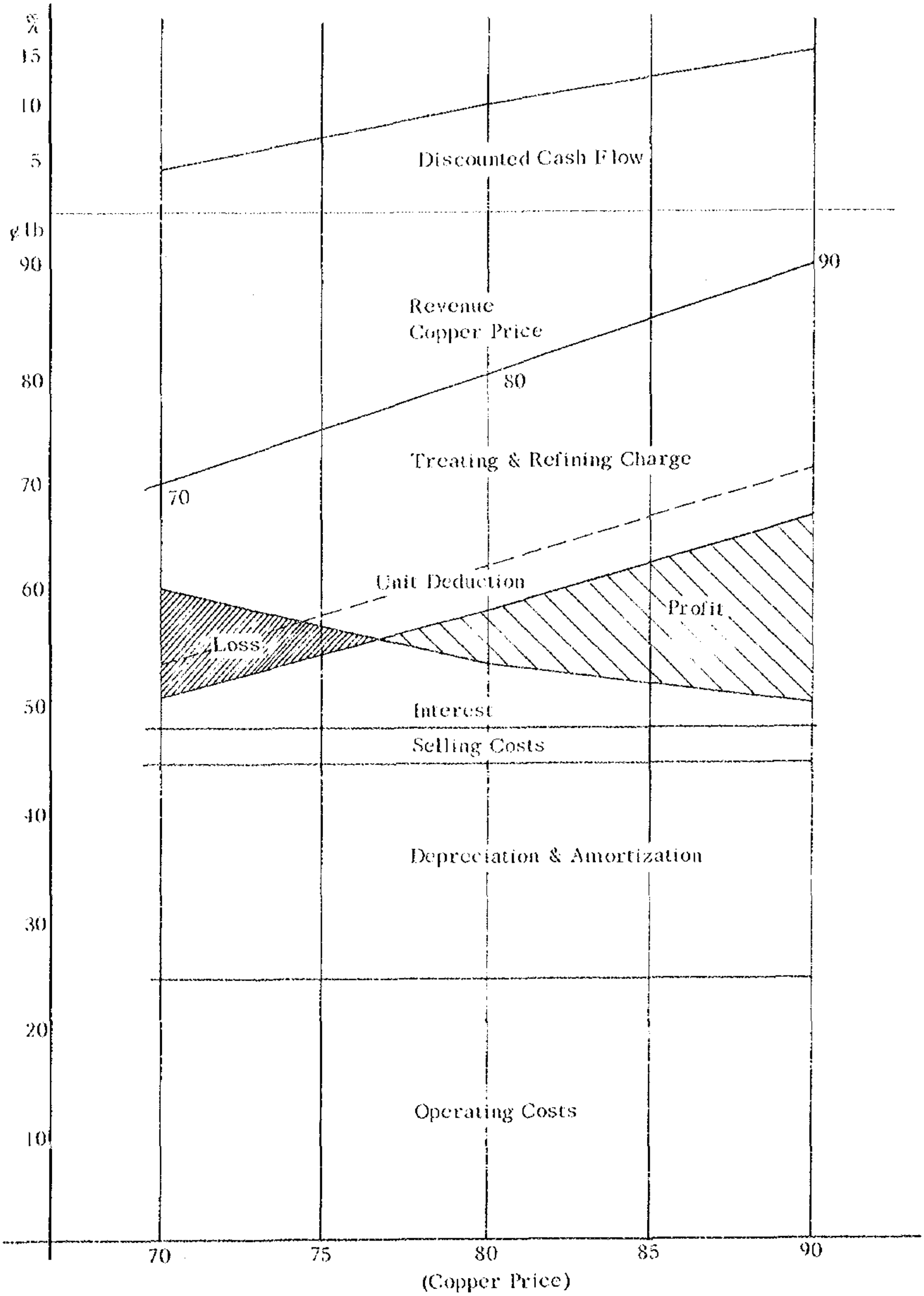


Table 11-5 Annual Profit (Loss) and Cash Flow (Copper Price Basis 70¢/lb)

Items	Unit	f/year 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
(Income Statement)																	lb
Revenue																	577,355,630
Copper Conc. Q'ty. for Sale	DMT	64,597	66,597	65,100	65,100	49,920	49,920	46,367	46,367	46,197	46,197	45,130	38,689	38,689	38,689	40,689	748,248
Unit Price of Copper Conc.	$	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331
Revenue	10^3\$	21,377	22,039	21,543	21,543	16,520	16,520	15,344	15,344	15,288	15,288	14,935	12,803	12,803	12,803	13,464	247,614
Costs																	
Production Costs	"	7,639	7,684	7,682	7,675	7,372	7,461	7,566	7,626	7,733	7,717	8,928	8,838	8,718	8,564	8,574	119,777
Conc. at the beginning of the year	"	-	229	231	236	236	295	299	326	329	335	334	396	457	451	443	-
Conc. at the end of the year	"	△229	△231	△236	△236	△295	△299	△326	△329	△335	△334	△396	△457	△451	△443	-	-
Depreciation and Amortization	"	7,767	7,767	7,593	7,593	5,823	5,823	5,408	5,408	5,388	5,389	7,300	6,256	6,256	6,256	6,257	96,284
Interest	"	5,820	5,628	5,122	4,638	4,142	3,879	3,627	3,479	3,794	3,817	3,780	3,750	3,816	3,892	3,939	63,123
Selling Expenditure	"	1,629	1,680	1,642	1,642	1,259	1,259	1,170	1,170	1,165	1,165	1,138	976	976	976	1,026	18,873
Total Costs	"	22,626	22,757	22,034	21,548	18,537	18,418	17,744	17,680	18,074	18,089	21,084	19,759	19,772	19,696	20,239	298,057
Profit and Loss	"	△1,249	△718	△491	△5	△2,017	△1,898	△2,400	△2,336	△2,786	△2,801	△6,149	△6,956	△6,969	△6,893	△6,775	△50,443
(Cash Flow Statement)																	
Receipts																	
Profit	10^3\$	△1,249	△718	△491	△5	△2,017	△1,898	△2,400	△2,336	△2,786	△2,801	△6,149	△6,956	△6,969	△6,893	△6,775	△50,443
Interest	"	5,820	5,628	5,122	4,638	4,142	3,879	3,627	3,479	3,794	3,817	3,780	3,750	3,816	3,892	3,939	63,123
Depreciation and Amortization	"	7,767	7,767	7,593	7,593	5,823	5,823	5,408	5,408	5,388	5,389	7,300	6,256	6,256	6,256	6,257	96,284
Inventory Variation	"	△229	△13	△5	2	16	△26	△54	△18	△33	5	△364	△39	36	46	2,584	1,908
Total	"	12,109	12.664	12,219	12,228	7,964	7,778	6,581	6,533	6,363,	6,410	4,567	3,011	3,139	3,301	6,005	110,872
Payment																	
Revolving Fund		1,910															
Installations and Equipments		66,112															
Before Production		68,022															
Initial Investment	"	3,726	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,726
Additional Investment	"	-	298	637	990	292	564	966	7,257	2,874	2,100	396	138	336	23	-	16,871
(Before Production)	"	(68,022)															
Total Payments		3,726	298	637	990	292	564	966	7,257	2,874	2,100	396	138	336	23	-	20,597
(Before Production)	"	(△68,022)															(△68,022)
Cash Flow	"	8,383	12,366	11,582	11,238	7,672	7,214	5,615	△724	3,489	4,310	4,171	2,873	2,803	3,278	6,005	22,253

Table 11-6 Annual Profit (Loss) and Cash Flow (Copper Price Basis 80¢/lb)

Items	Unit	f/year 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
(Income Statement)																	
Revenue																	
Copper Conc. Q'ty. for Sale	DMT	64,597	66,597	65,100	65,100	49,920	49,920	46,367	46,367	46,197	46,197	45,130	38,689	38,689	38,689	40,689	748,248
Unit Price of Copper Conc.	$	387	387	387	387	387	387	387	387	387	387	387	387	387	387	387	387
Revenue	$10^3$$	25,007	25,781	25,202	25,202	19,325	19,325	17,949	17,949	17,884	17,884	17,471	14,977	14,977	14,977	15,752	289,662
Costs																	
Production Costs	"	7,639	7,684	7,682	7,675	7,372	7,461	7,566	7,626	7,733	7,717	8,928	8,838	8,718	8,564	8,574	119,777
Conc. at the beginning of the year	"	-	229	231	236	236	295	299	326	329	335	334	396	457	451	443	-
Conc. at the end of the year	"	△ 229	△ 231	△ 236	△ 236	△ 295	△ 299	△ 326	△ 329	△ 335	△ 334	△ 396	△ 457	△ 451	△ 443	-	-
Depreciation and Amortization	"	7,767	7,767	7,593	7,593	5,823	5,823	5,408	5,408	5,388	5,389	7,300	6,256	6,256	6,256	6,257	96,284
Interest	"	5,820	5,357	4,550	3,750	2,913	2,348	1,772	1,289	1,245	882	431	18	195	376	580	29,188
Selling Expenditure	"	1,638	1,689	1,651	1,651	1,266	1,266	1,176	1,176	1,172	1,172	1,145	981	981	981	1,033	18,978
Total Costs	"	22,635	22,495	21,471	20,669	17,315	16,894	15,895	15,496	15,532	15,161	17,742	15,996	15,766	15,433	15,727	264,227
Profit and Loss	"	2,372	3,286	3,731	4,533	2,010	2,431	2,054	2,453	2,352	2,723	△ 271	△1,019	△789	△456	25	25,435
(Cash Flow Statement)																	
Receipts																	
Profit	$10^3$$	2,372	3,286	3,731	4,533	2,010	2,431	2,054	2,453	2,352	2,723	△ 271	△1,019	△789	△456	25	25,435
Interest	"	5,820	5,357	4,550	3,750	2,913	2,348	1,772	1,289	1,245	882	431	△ 18	△ 195	△376	△ 580	29,188
Depreciation and Amortization	"	7,767	7,767	7,593	7,593	5,823	5,823	5,408	5,408	5,388	5,389	7,300	6,256	6,256	6,256	6,257	96,284
Inventory Variation	"	△ 229	△ 13	△ 5	2	16	△ 26	△ 54	△ 18	△ 33	5	△ 364	△ 39	36	46	2,584	1,908
Total	"	15,730	16,397	15,869	15,878	10,762	10,576	9,180	9,132	8,952	8,999	7,096	5,180	5,308	5,470	8,286	152,815
Payment																	
Revolving Fund		1,910															
Installations and Equipments		66,112															
Before Production		68,022															
Initial Investment	"	3,726	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,726
Additional Investment	"	-	298	637	990	292	564	966	7,257	2,874	2,100	396	138	336	23	-	16,871
(Before Production)	"	(68,022)															
Total Payments		3,726	298	637	990	292	564	966	7,257	2,874	2,100	396	138	336	23	-	20,597
(Before Production)	"	(△68,022)															(△68,022)
Cash Flow	"	12,004	16,099	15,232	14,888	10,470	10,012	8,214	1,875	6,078	6,899	6,700	5,042	4,972	5,447	8,286	64,196

Table 11-7 Annual Profit (Loss) and Cash Flow (Copper Price Basis 90¢/lb)

Items	Unit	f/year 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
(Income Statement)																	
Revenue																	
Copper Conc. Q'ty. for Sale	DMT	64,597	66,597	65,100	65,100	49,920	49,920	46,367	46,367	46,197	46,197	45,130	38,689	38,689	38,689	40,689	748,248
Unit Price of Copper Conc.	$	443	443	443	443	443	443	443	443	443	443	443	443	443	443	443	443
Revenue	$10^3$$	28,637	29,523	28,860	28,860	22,130	22,130	20,555	20,555	20,480	20,480	20,007	17,151	17,151	17,151	18,039	331,709
Costs																	
Production Costs	"	7,639	7,684	7,682	7,675	7,372	7,461	7,566	7,626	7,733	7,717	8,928	8,838	8,718	8,564	8,574	119,777
Conc. at the beginning of the year	"	-	229	231	236	236	295	299	326	329	335	334	396	457	451	443	-
Conc. at the end of the year	"	△229	△231	△236	△236	△295	△299	△326	△329	△335	△334	△396	△457	△451	△443	-	-
Depreciation and Amortization	"	7,767	7,767	7,593	7,593	5,823	5,823	5,408	5,408	5,388	5,389	7,300	6,256	6,256	6,256	6,257	96,284
Interest	"	5,820	5,085	3,978	2,861	1,685	817	△40	△419	△590	△914	△1,278	△1,646	△1,956	△2,275	△2,619	8,509
Selling Expenditure	"	1,647	1,698	1,660	1,660	1,273	1,273	1,183	1,183	1,178	1,178	1,151	987	987	987	1,038	19,083
Total Costs	"	22,644	22,232	20,908	19,789	16,094	15,370	14,090	13,795	13,703	13,371	16,039	14,374	14,011	13,540	13,693	243,653
Profit and Loss	"	5,993	7,291	7,952	9,071	6,036	6,760	6,465	6,760	6,777	7,109	3,968	2,777	3,140	3,611	4,346	88,056
(Cash Flow Statement)																	
Receipts																	
Profit	$10^3$$	5,993	7,291	7,952	9,071	6,036	6,760	6,465	6,760	6,777	7,109	3,968	2,777	3,140	3,611	4,346	88,056
Interest	"	5,820	5,085	3,978	2,861	1,685	817	△40	△419	△590	△914	△1,278	△1,646	△1,956	△2,275	△2,619	8,509
Depreciation and Amortization	"	7,767	7,767	7,593	7,593	5,823	5,823	5,408	5,408	5,388	5,389	7,300	6,256	6,256	6,256	6,257	96,284
Inventory Variation	"	△229	△13	△5	2	16	△26	△54	△18	△33	5	△364	△39	36	46	2,584	1,908
Total	"	19,351	20,130	19,518	19,527	13,560	13,374	11,779	11,731	11,542	11,589	9,626	7,348	7,476	7,638	10,568	194,757
Payment																	
Revolving Fund		1,910															
Installations and Equipments		66,112															
Before Production		68,022															
Initial Investment	"	3,726	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,726
Additional Investment	"	-	298	637	990	292	564	966	7,257	2,874	2,100	396	138	336	23	-	16,871
(Before Production)	"	(68,022)															
Total Payments		3,726	298	637	990	292	564	966	7,257	2,874	2,100	396	138	336	23	-	20,597
(Before Production)	"	(△68,022)															(△68,022)
Cash Flow	"	15,625	19,832	18,881	18,537	13,268	12,810	10,813	4,474	8,668	9,489	9,230	7,210	7,140	7,615	10,568	106,138

ATTACHED FIGURES

List of Figures

Fig. 2-1

LOCATION MAP OF THE MONYWA AREA

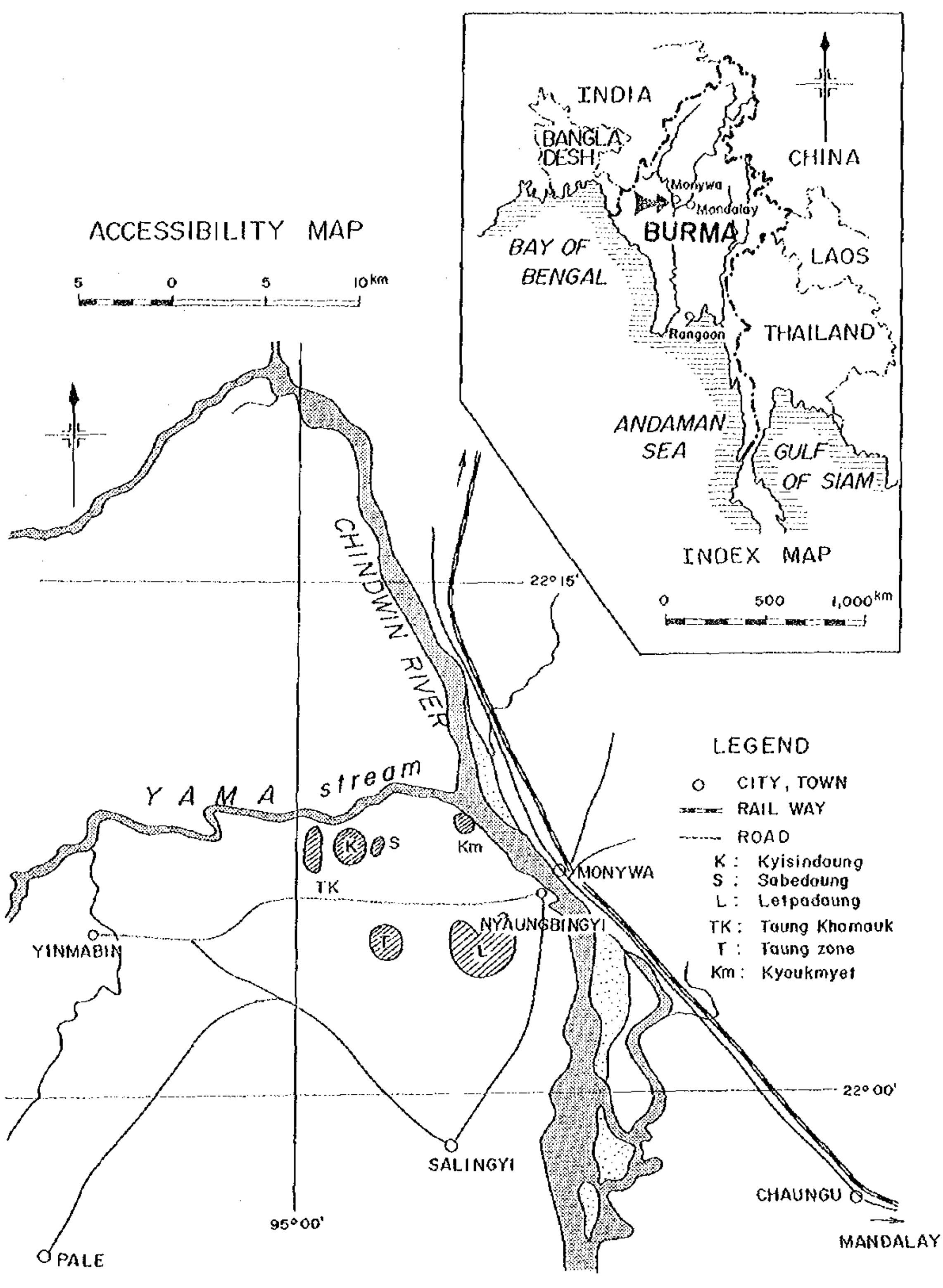


Fig. 3-1 GENERALIZED STRUCTURAL MAP OF MONYWA AREA

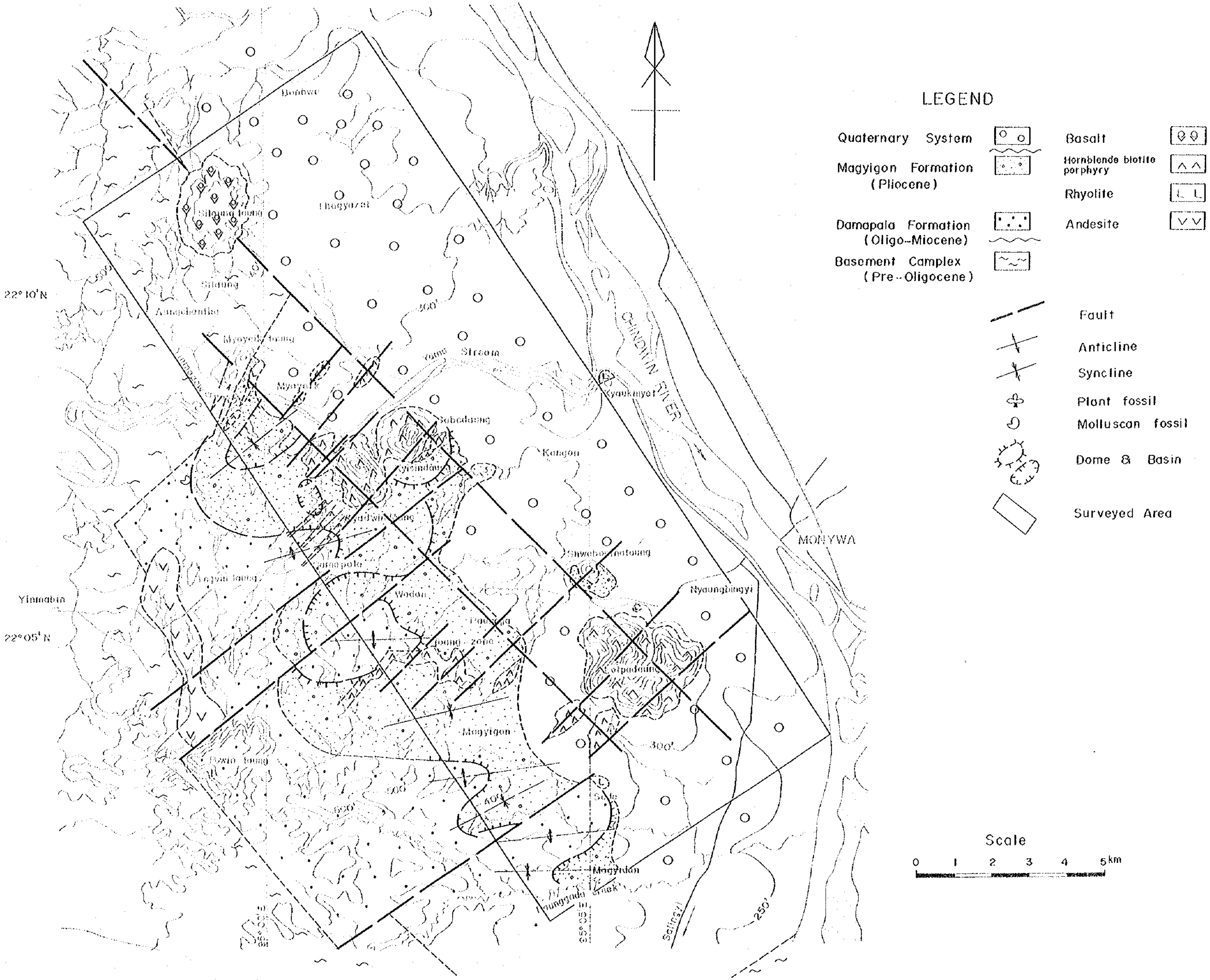
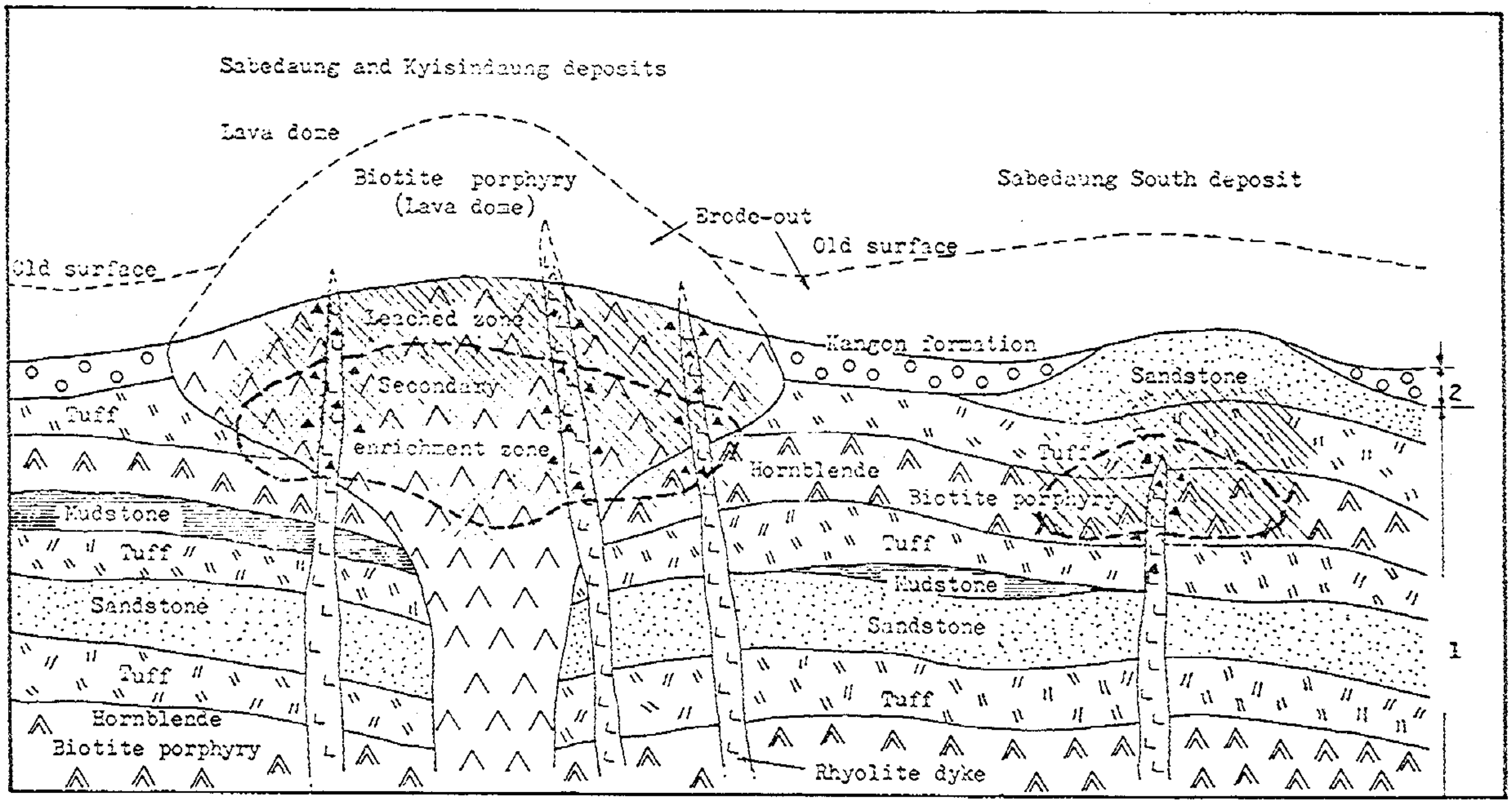


Fig. 3-2 Schematic Explanation of Ore Deposits



▲ Brecciated structure   2 Kangon formation   1 Magyigon formation

Network and Disseminations zone

FIG.4-1 PROFILE OF THE PIT FOR SABEDAUNG DEPOSIT

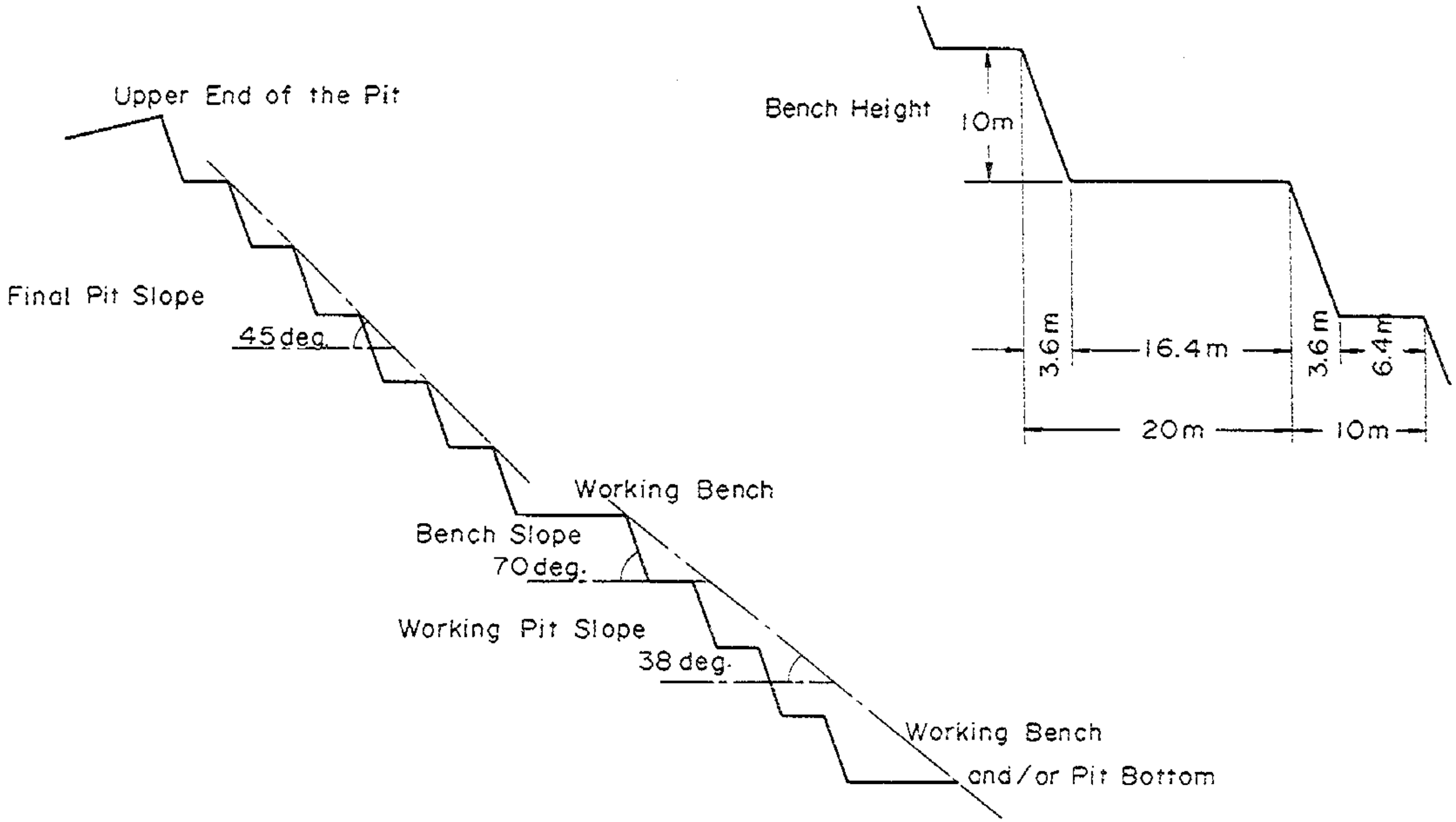
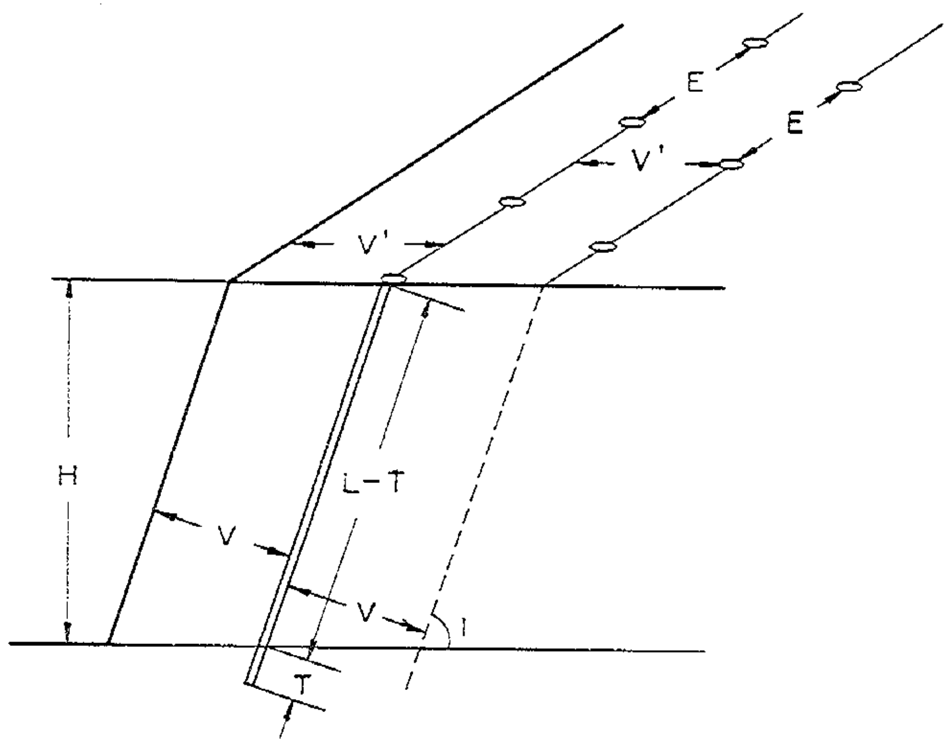


FIG.4-2 DESIGN OF THE OPEN-CUT DRILLING



Hole Diameter		100mm	(4")
Burden	V	3.5 m	
Burden on Bench	V'	3.7 m	
Spacing	E	4.3 m	
Hole Length	L	11.7 m	
Toe Overdrilling	T	1.1 m	(0.3V)
Hole Inclination	I	70 deg.	
Bench Height	H	10.0m	

EVH = 150.5 cubic meters of rock will be blasted by 1 drilled hole.

If the specific gravity of the rock is 2.5, about 376 tons of blasted rock will come out by 1 hole.

N.B. 560/L = 47.5 ton/m of hole

Fig. 4-3 LONGITUDINAL SECTION OF OPEN PIT OF SABEDAUNG ORE DEPOSIT

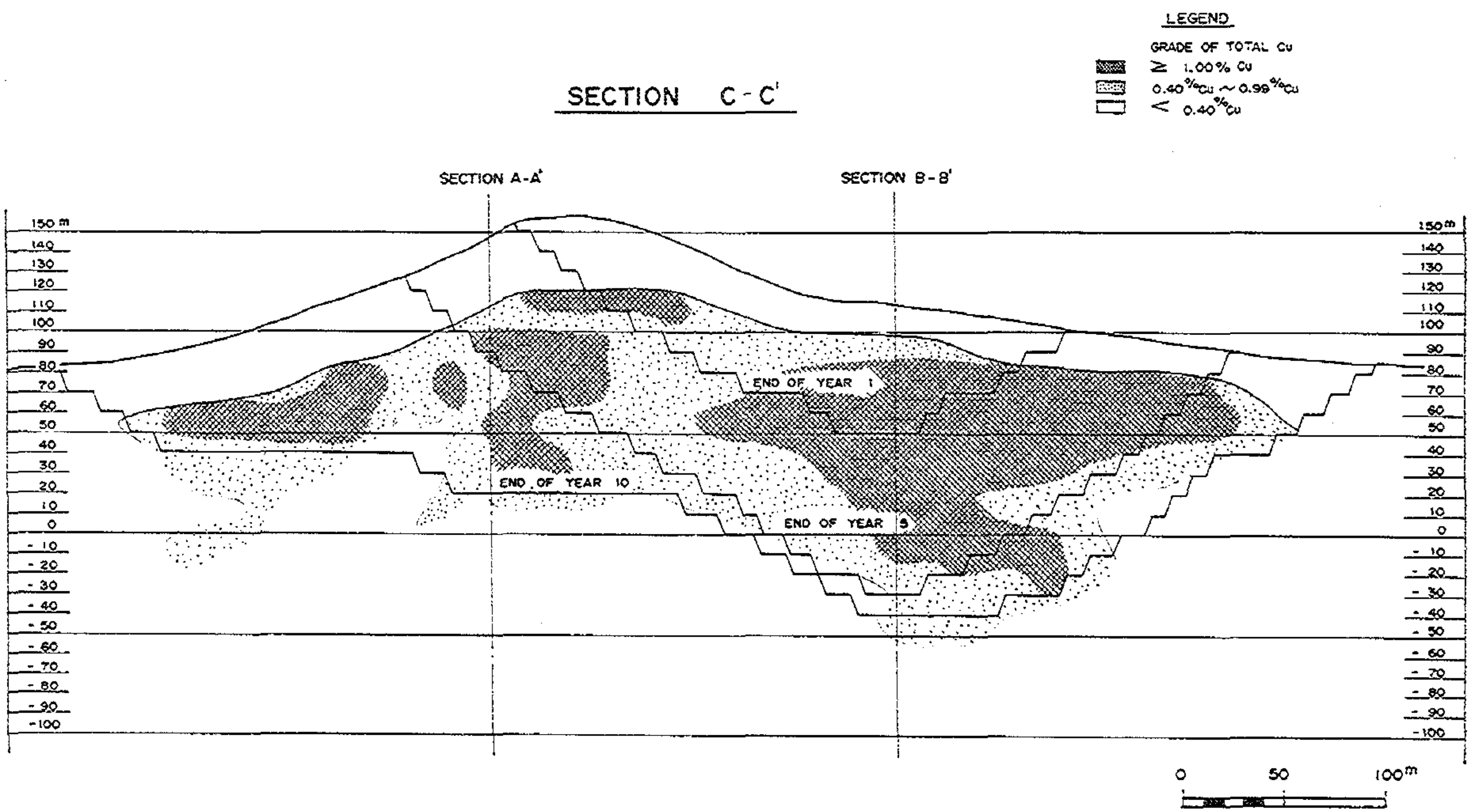


Fig. 4-4

CROSS SECTION OF OPEN PIT OF SABEDAUNG ORE DEPOSIT

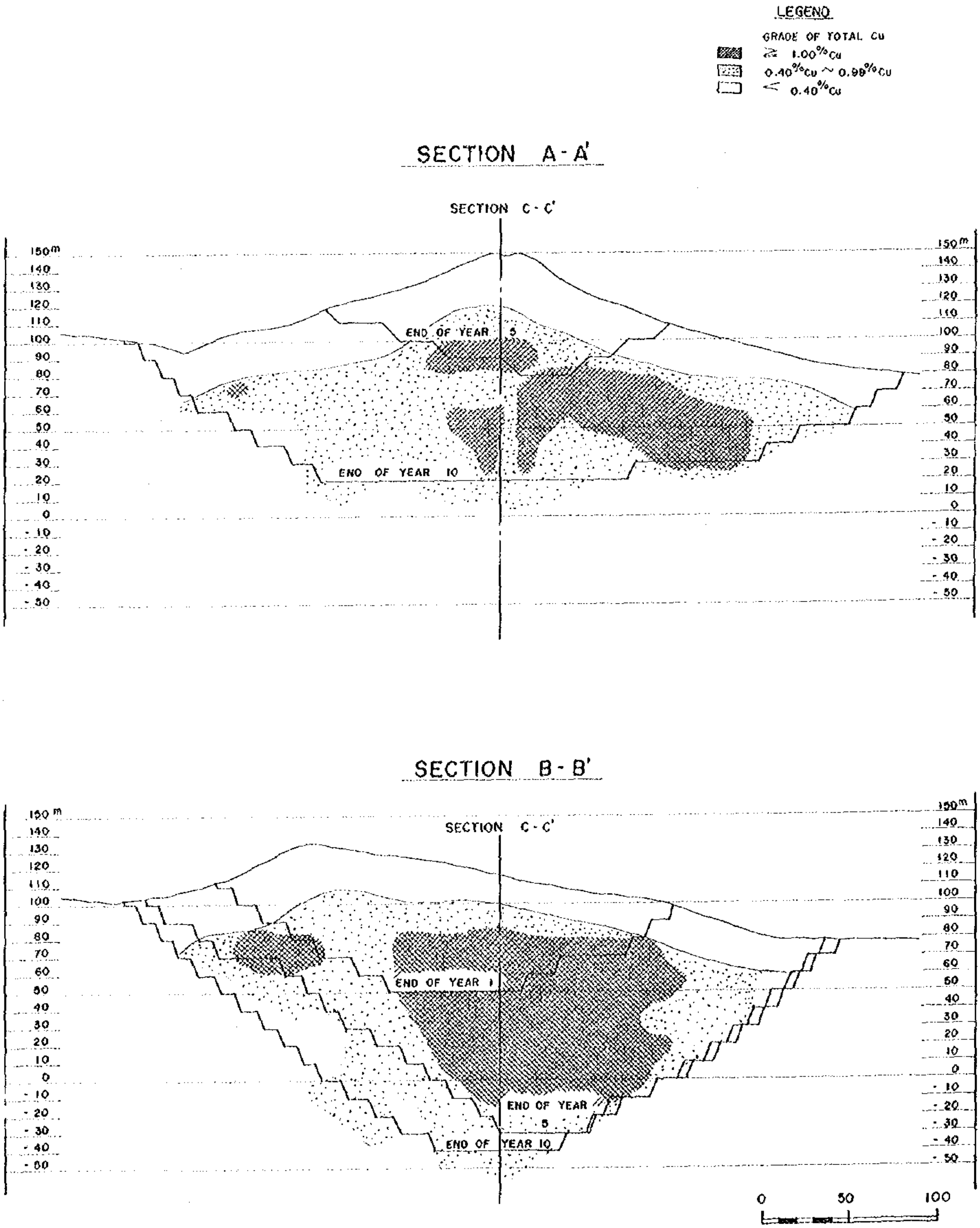


Fig. 4-5

SECTION OF OPEN PIT OF SABEDAUNG SOUTH ORE DEPOSIT

LEGEND
AREA OF THE OREBODY ON THE SECTION
33 DRILL HOLE

CROSS SECTION A-A'

LONGITUDINAL SECTION B-B'

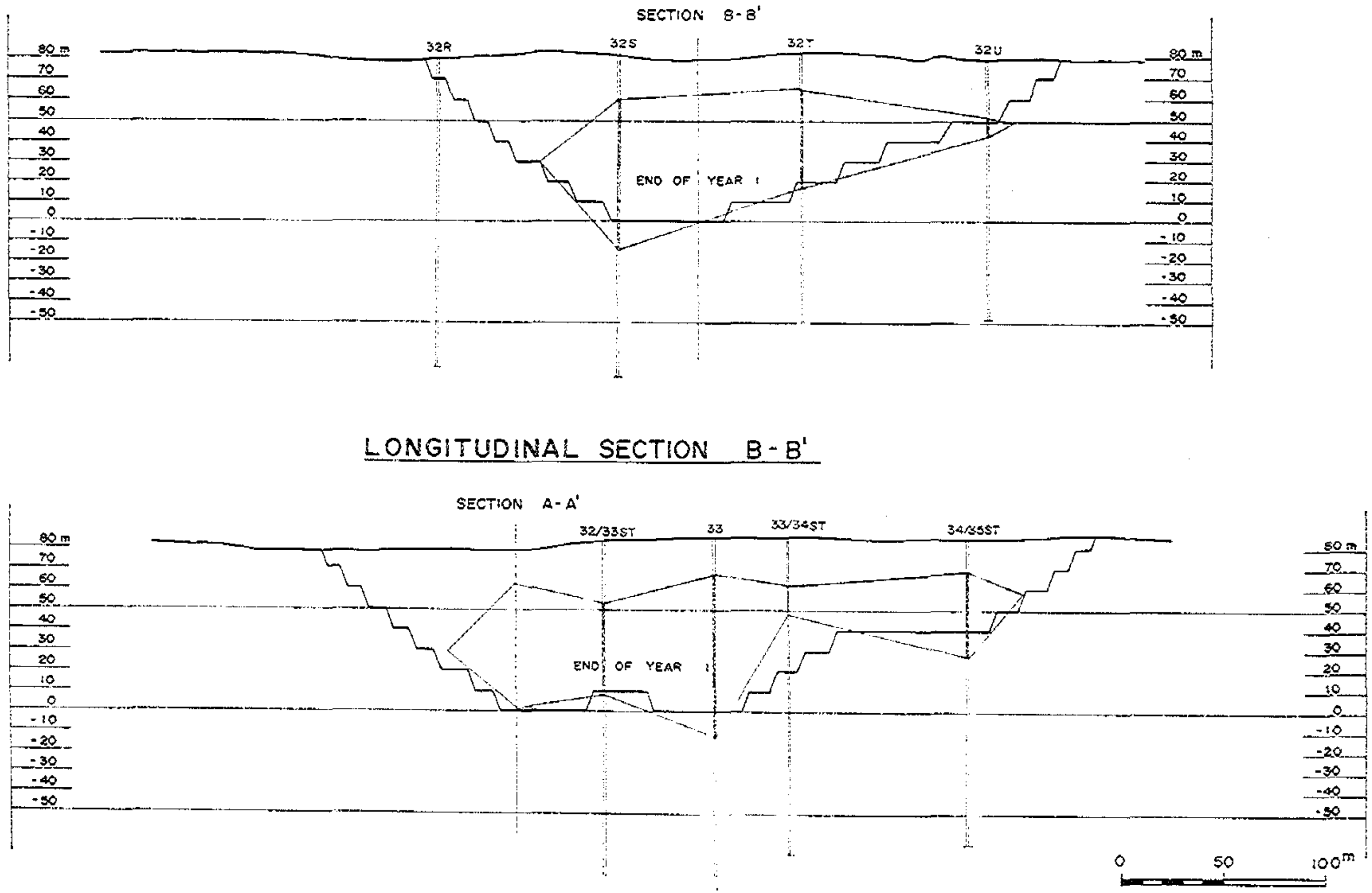
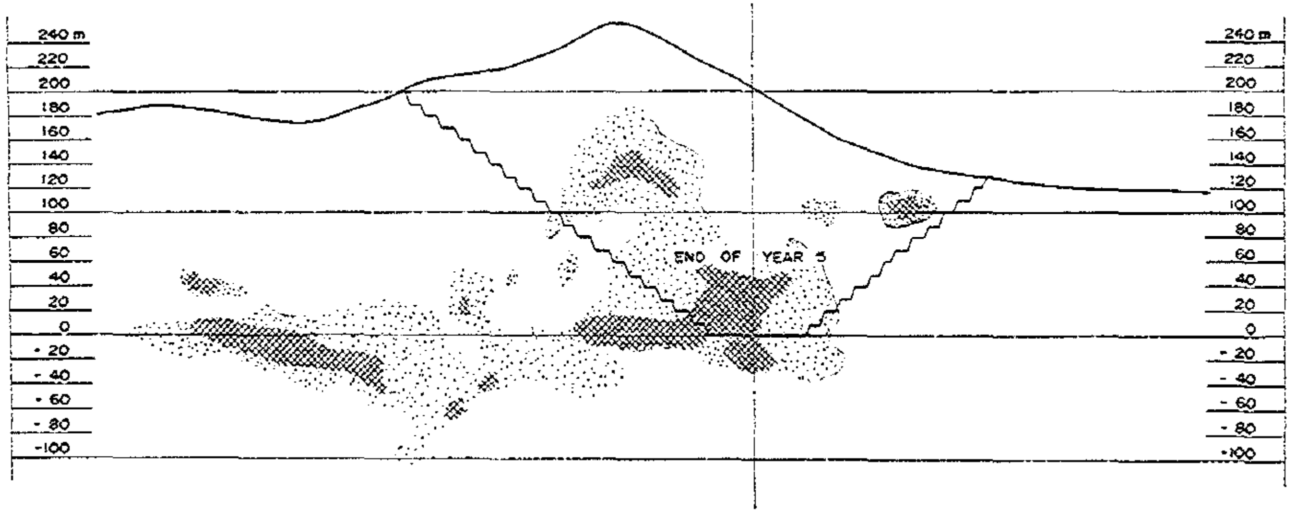
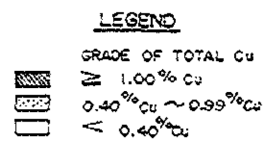


Fig. 4-6

SECTION OF OPEN PIT OF KYISINDAUNG ORE DEPOSIT

CROSS SECTION A-A'





LONGITUDINAL SECTION B-B'

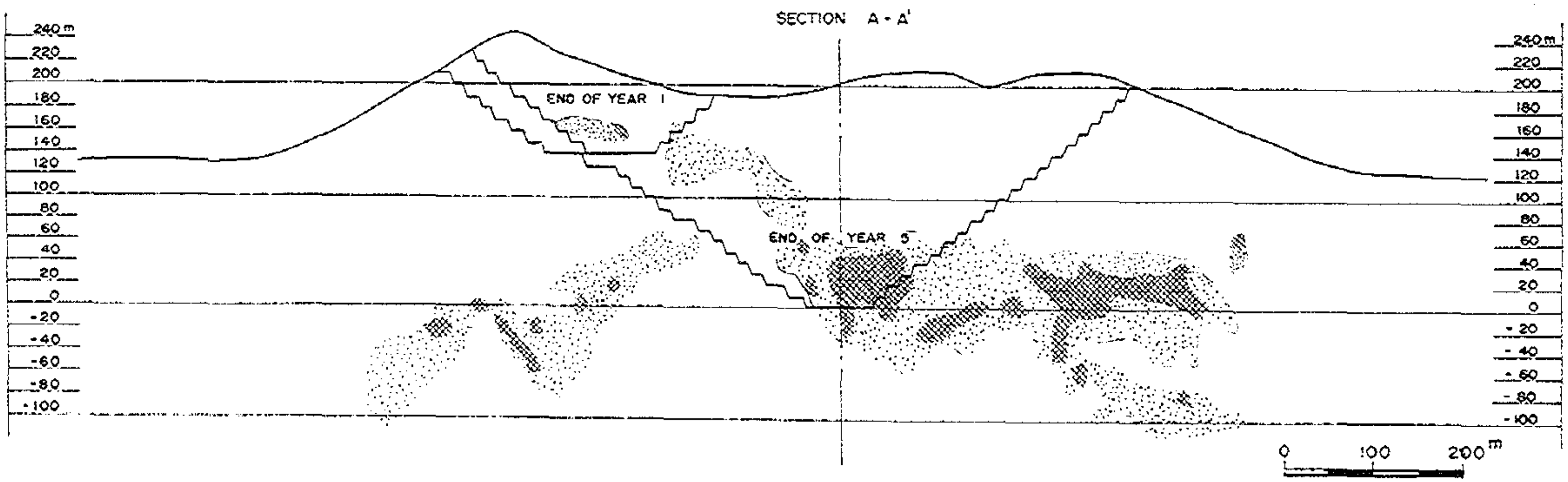


Fig. 4-7

OPEN PIT PLAN OF SABEDAUNG ORE DEPOSIT AT THE END OF YEAR I

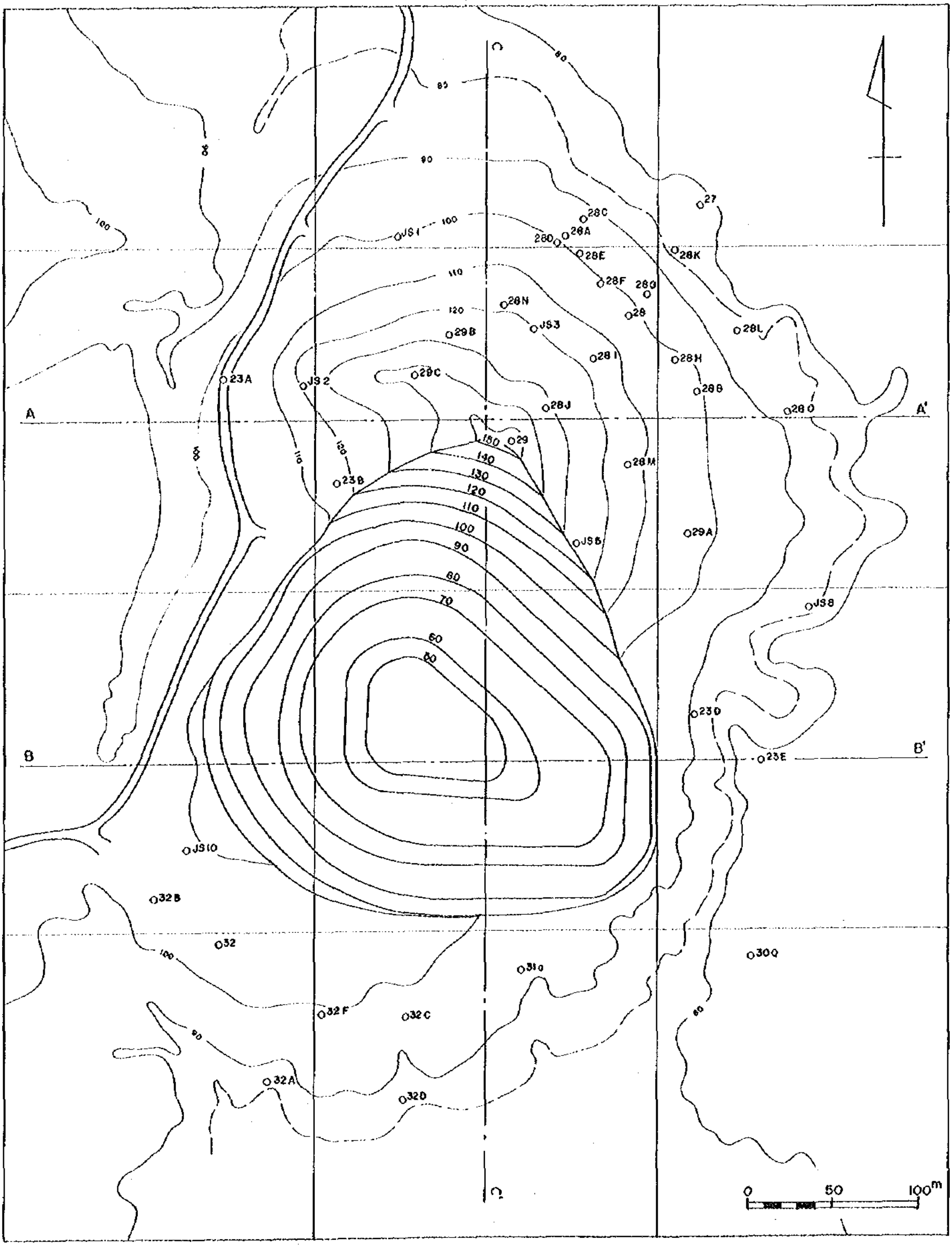


Fig. 4 - 6

OPEN PIT PLAN OF SABEDAUNG ORE DEPOSIT

AT THE END OF YEAR 5

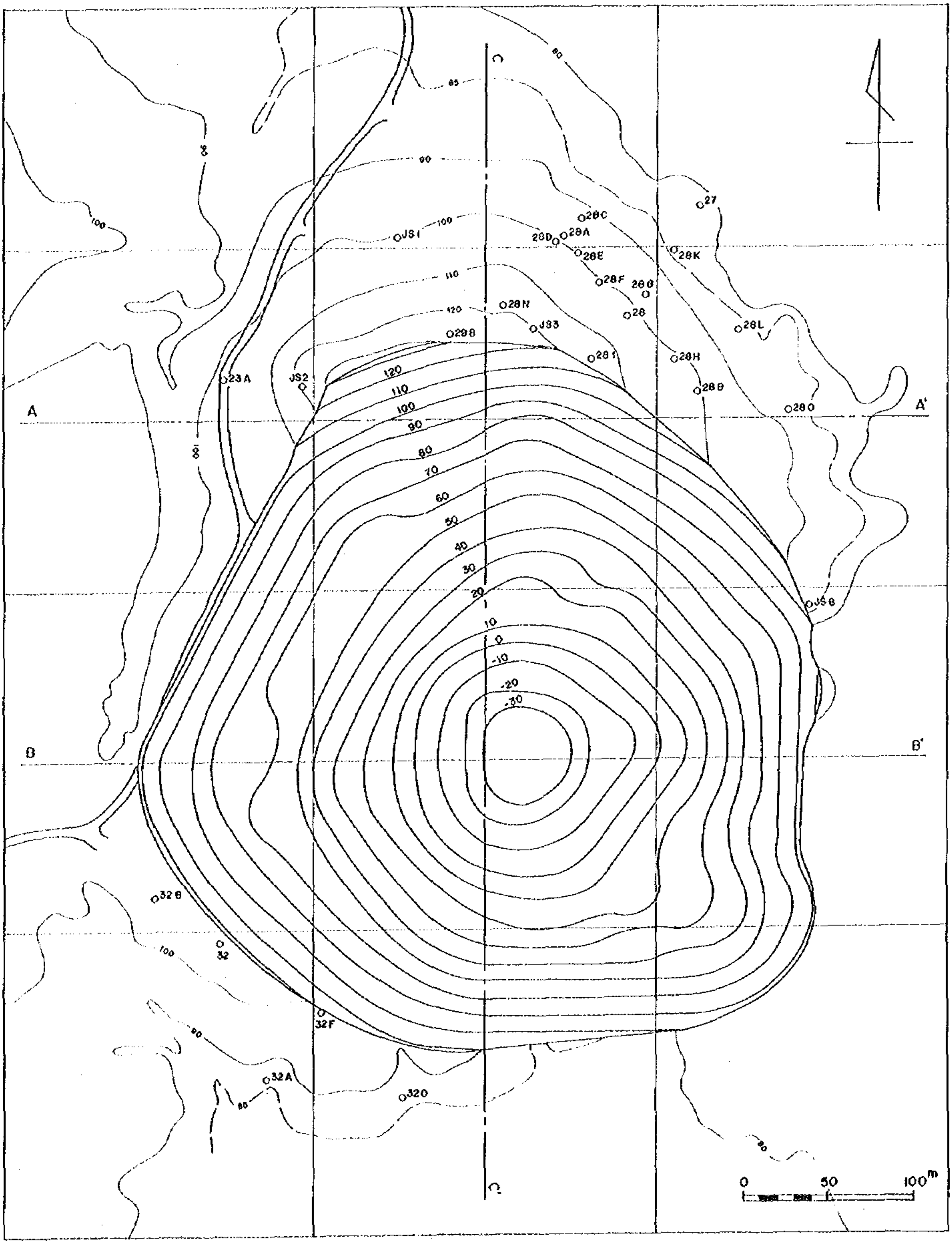


Fig. 4-9

OPEN PIT PLAN OF SABEDAUNG ORE DEPOSIT AT THE END OF YEAR 10

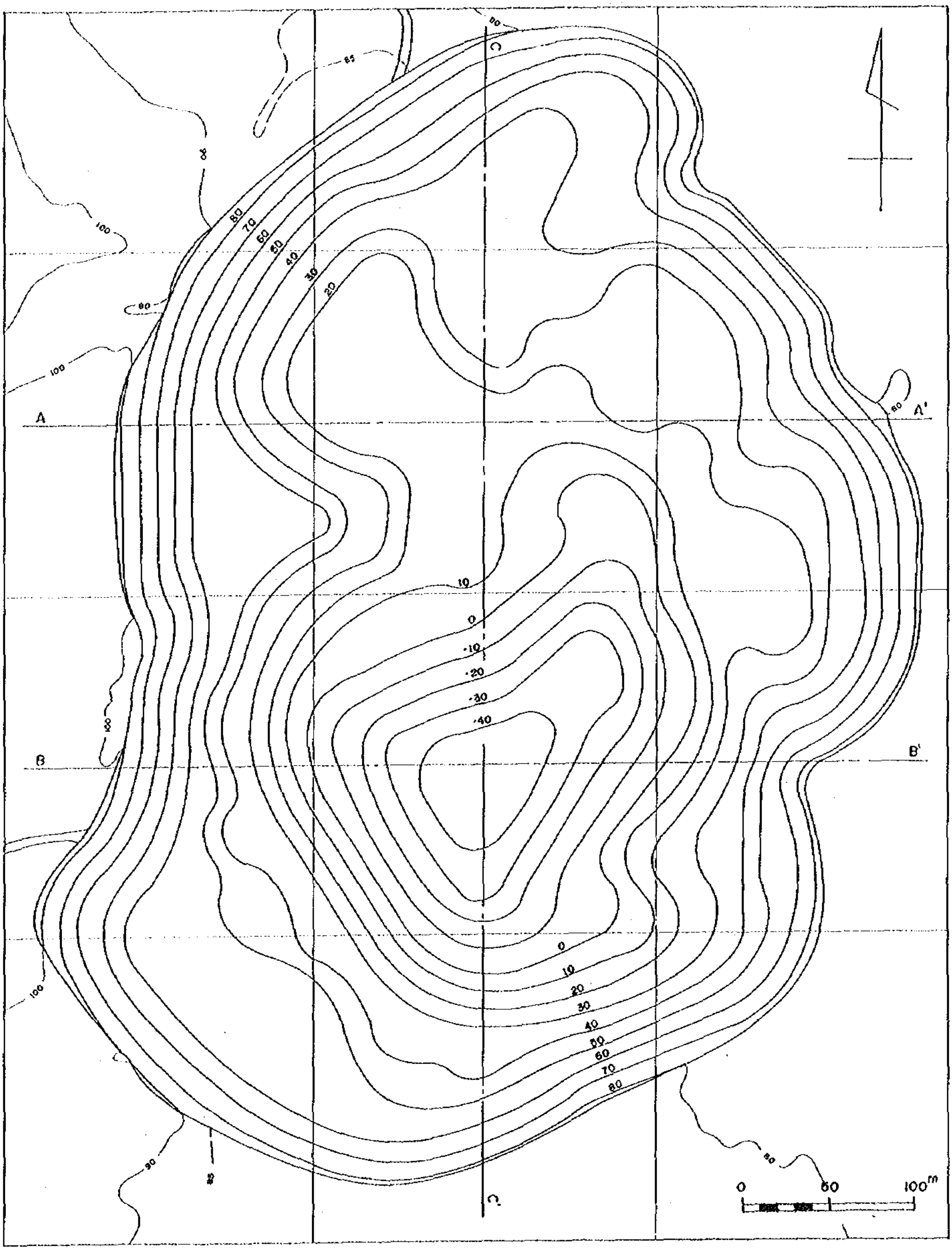


Fig. 4-10

OPEN PIT PLAN OF SABEDAUNG SOUTH ORE DEPOSIT
AT THE END OF YEAR 1

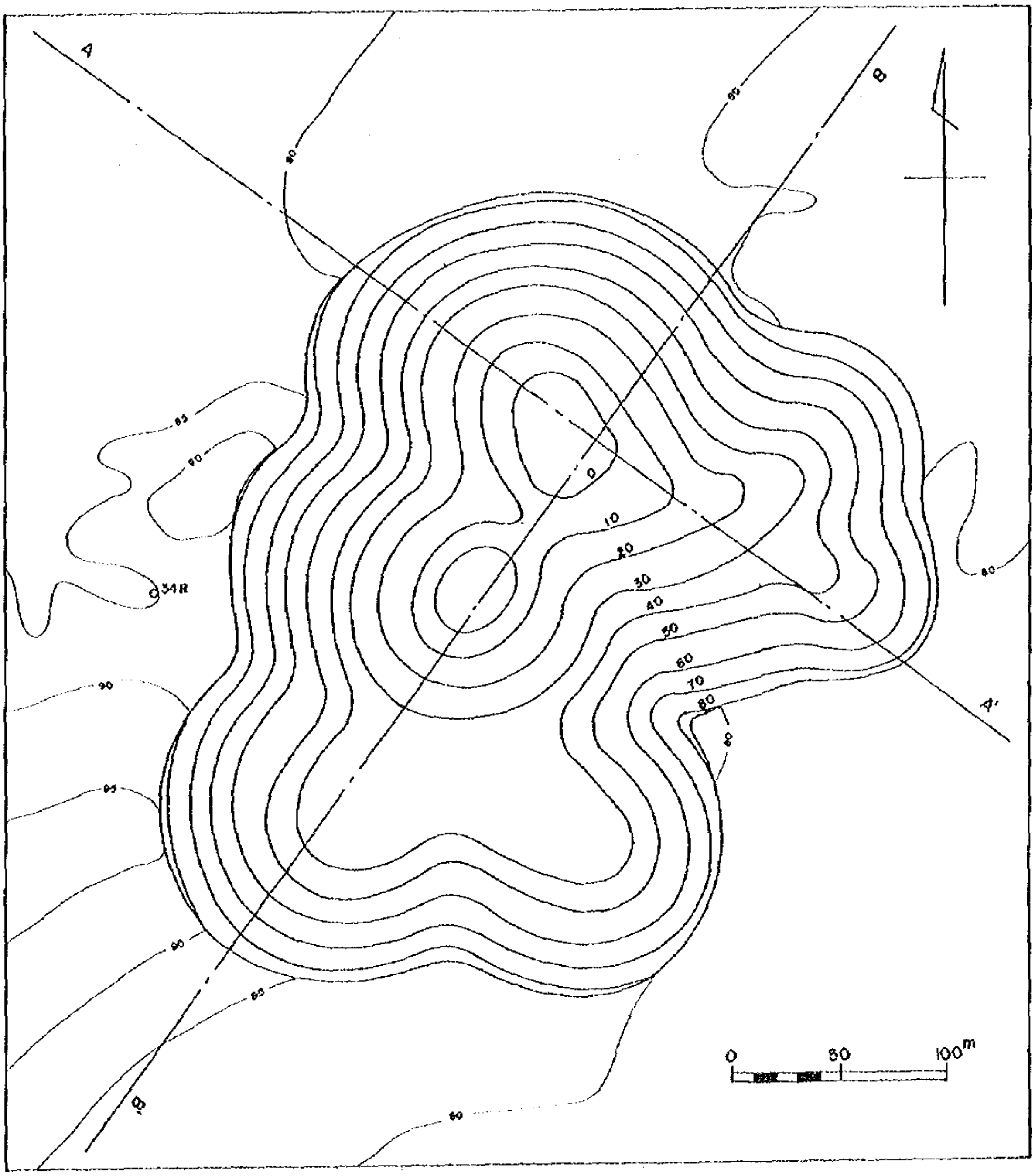


Fig. 4-11

OPEN PIT PLAN OF KYISINDAUNG ORE DEPOSIT
AT THE END OF YEAR I

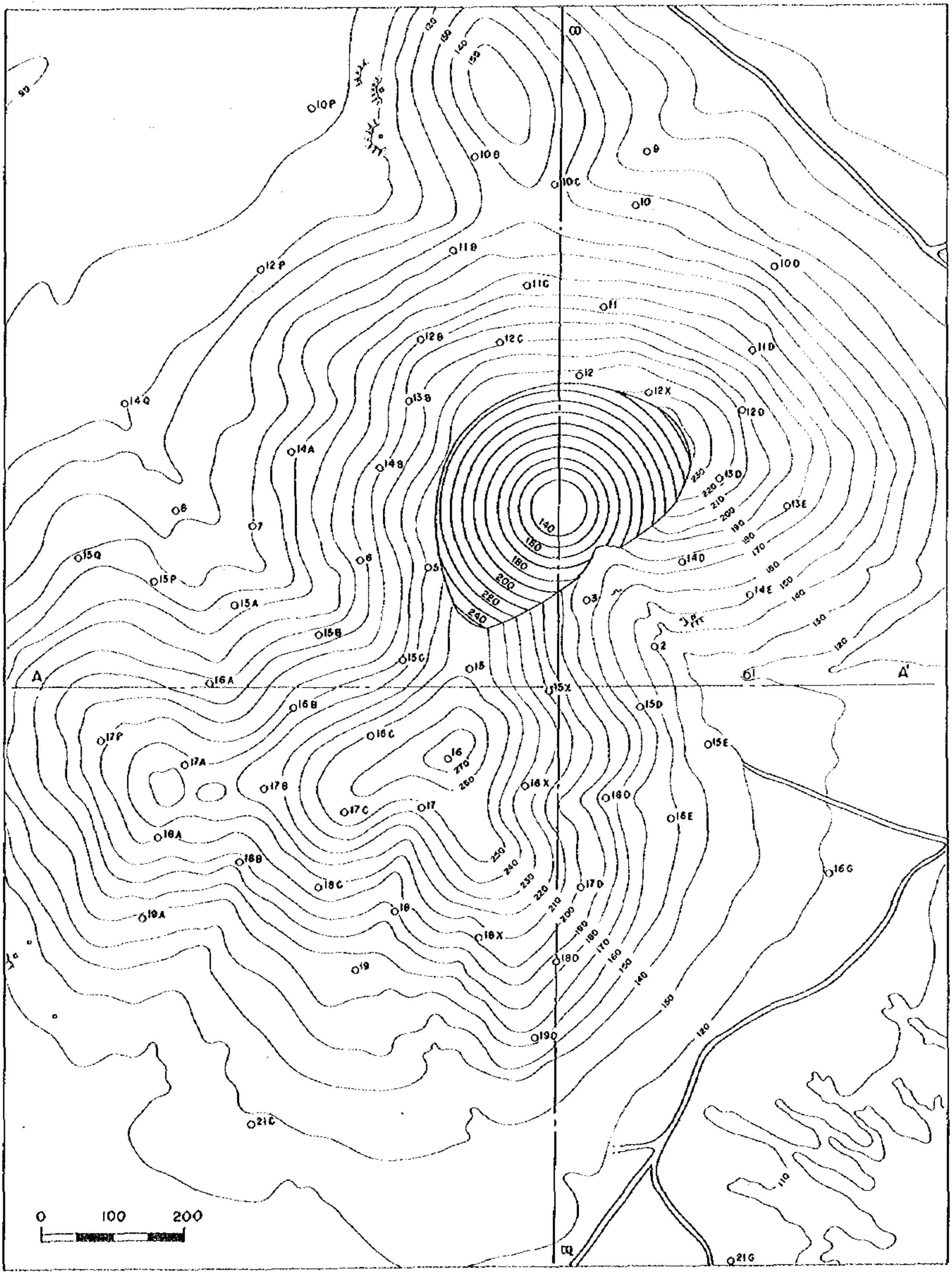


Fig. 4-12

OPEN PIT PLAN OF KYISINDAUNG ORE DEPOSIT
AT THE END OF YEAR 5

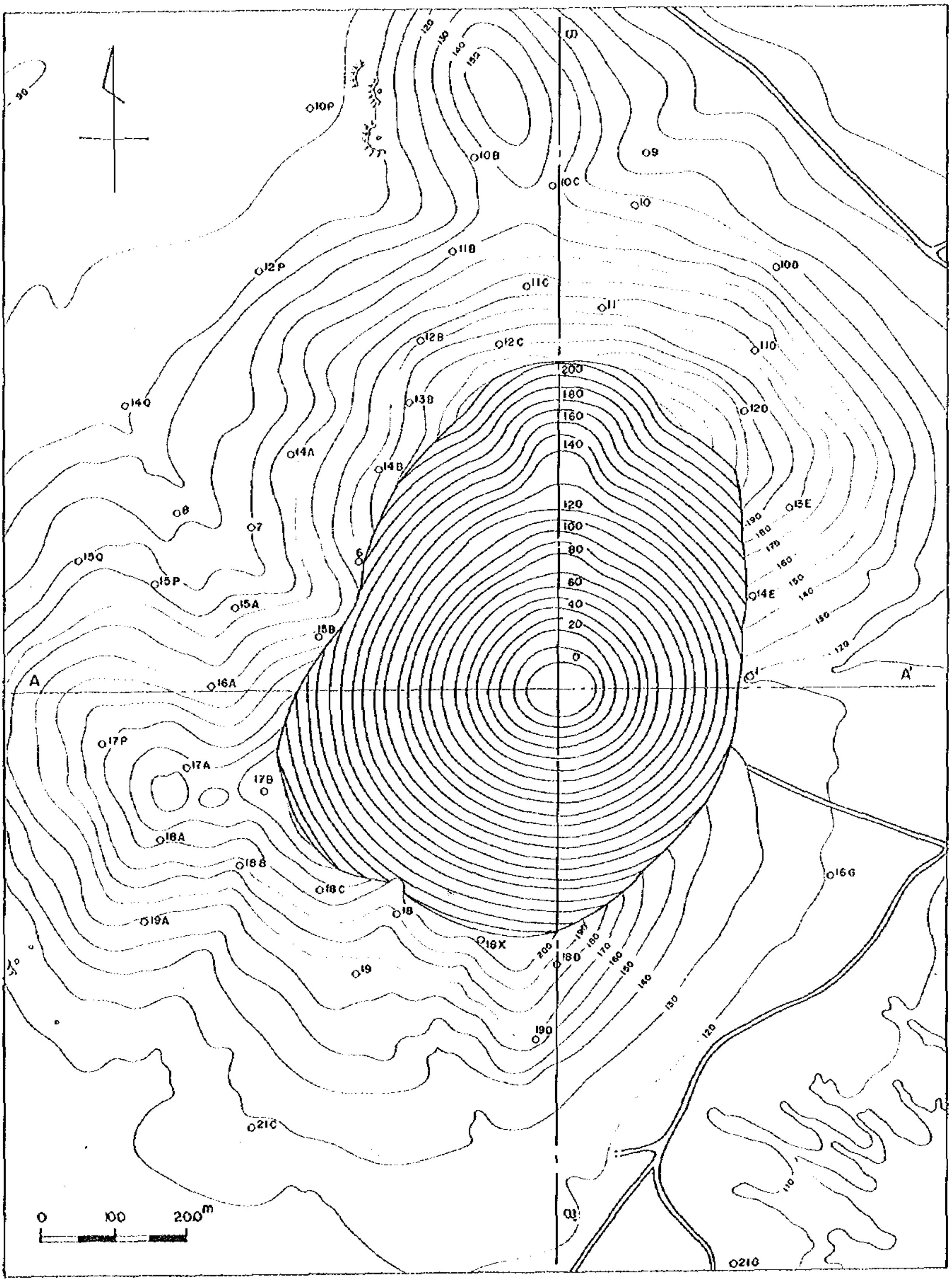


Fig.5-1 BASIC FLOW DIAGRAM

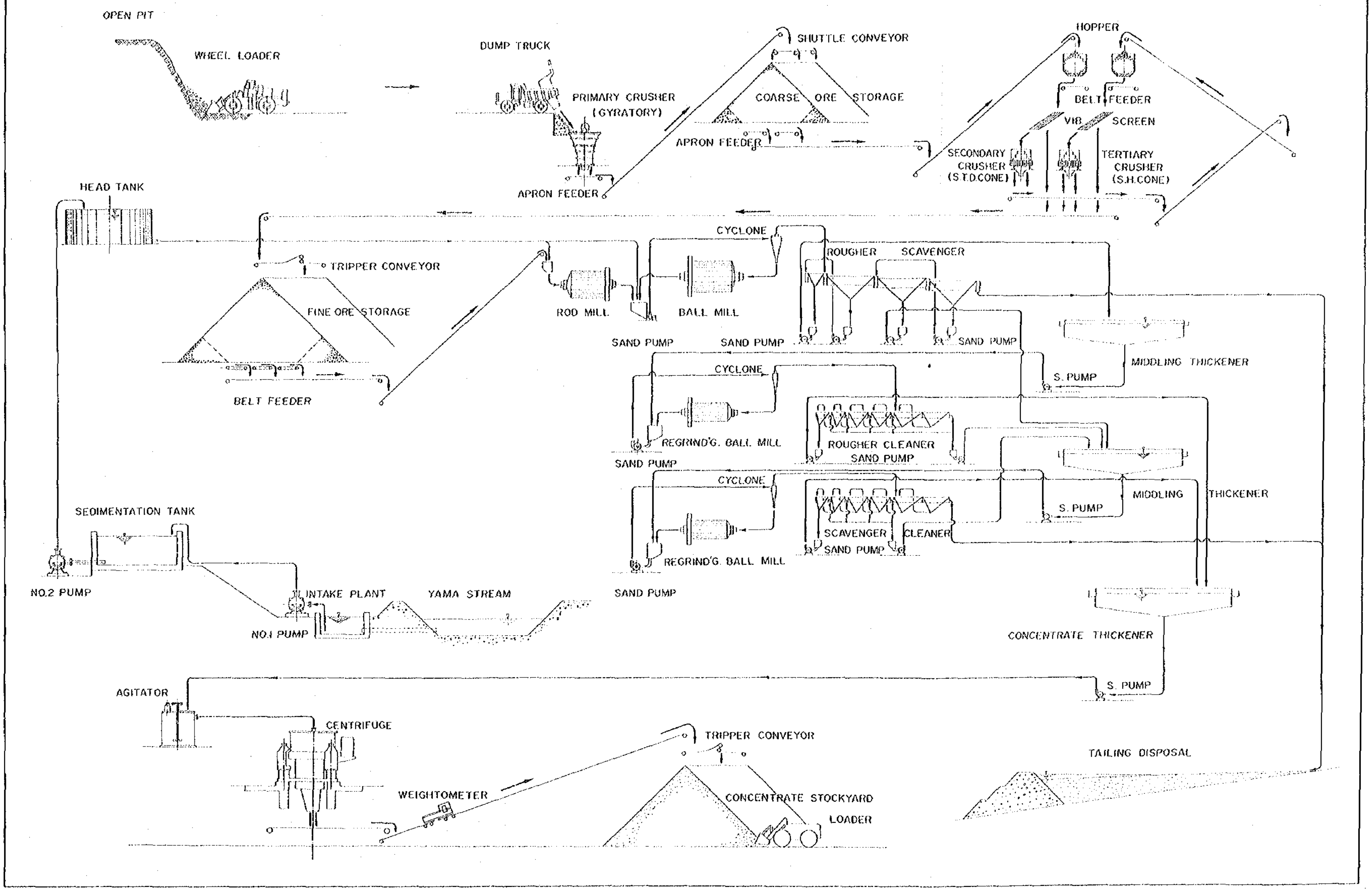


Fig. 5-2 FLOW SHEET OF CRUSHING PLANT

CAPACITY 8,000 T/DAY

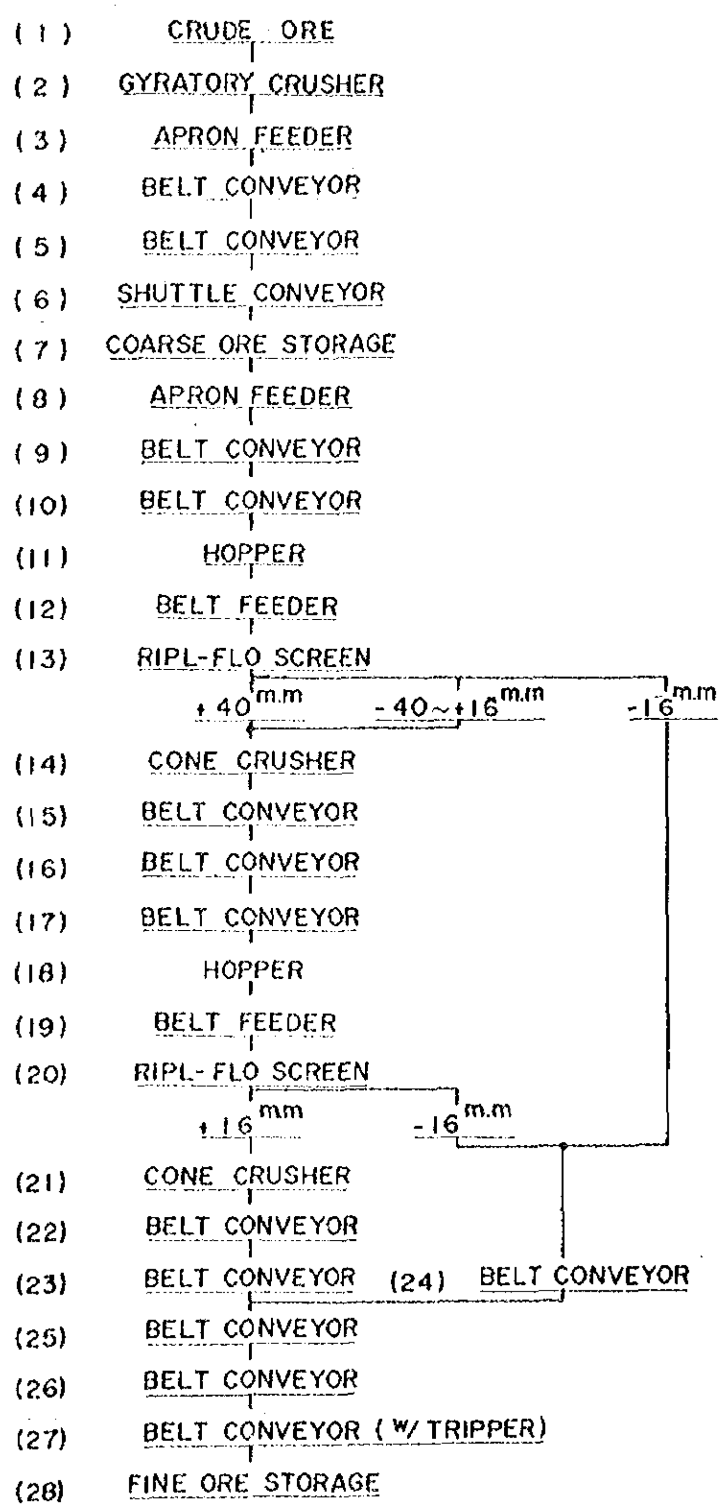


Fig.5-3 FLOW SHEET OF CONCENTRATOR

CAPACITY 8,000 TONS PER DAY

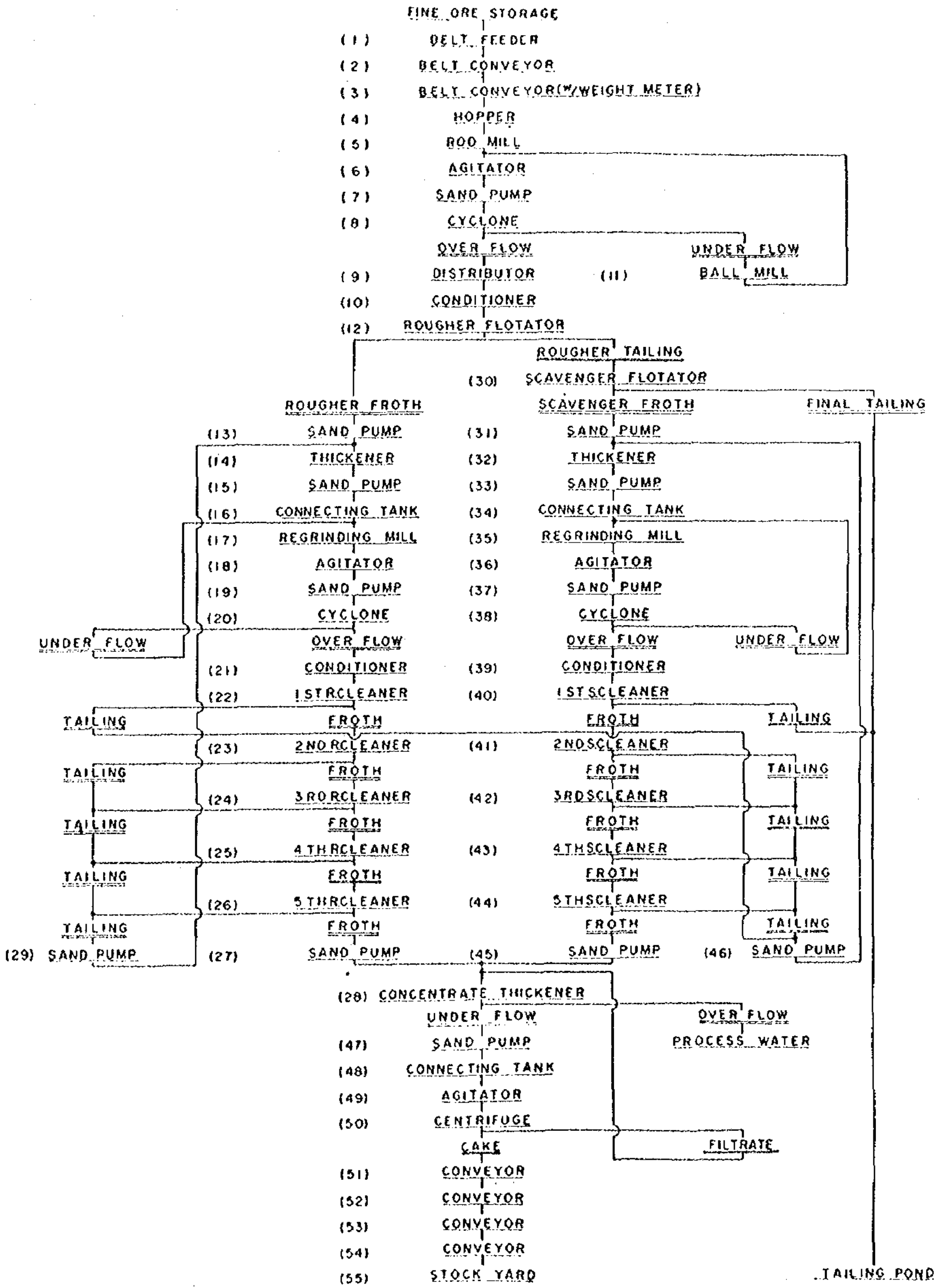


Fig.5-4 GENERAL ARRANGEMENT OF CRUSHING PLANT

(CAPACITY ; 8,000 TONS PER DAY) SCALE 1:800

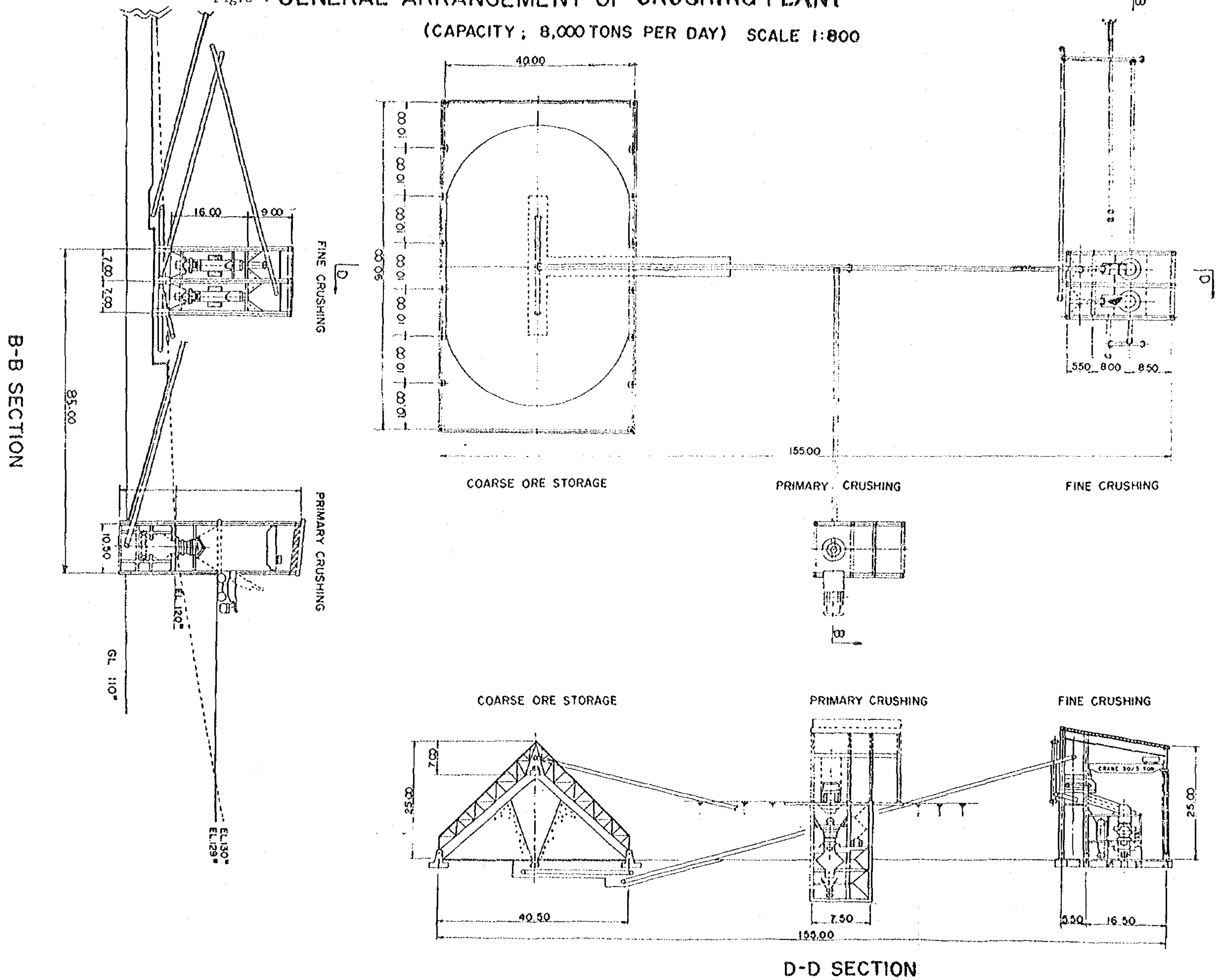


Fig. 5-5 GENERAL ARRANGEMENT OF CONCENTRATOR

(CAPACITY ; 8,000 TONS PER DAY) SCALE 1:500

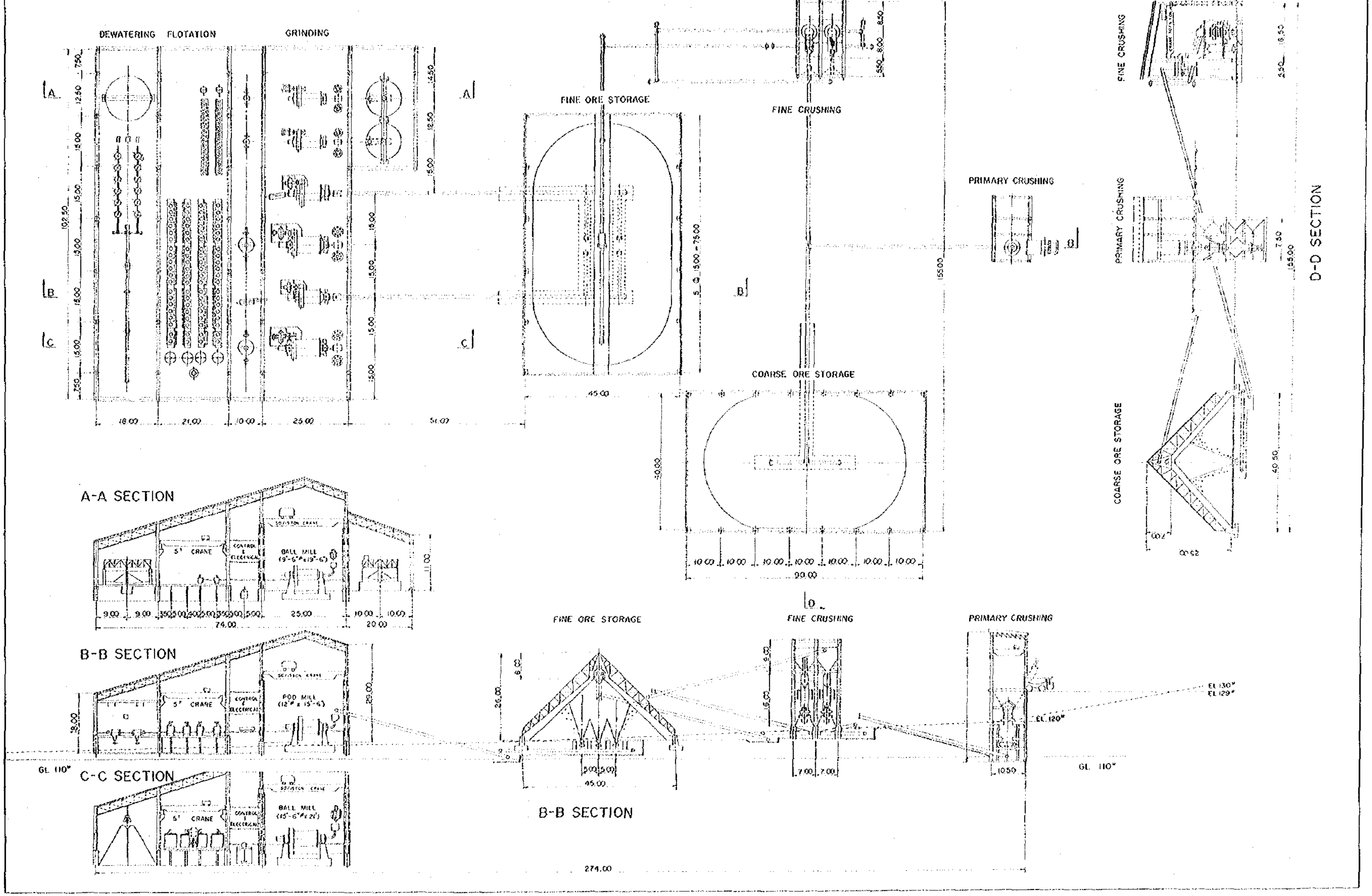


Fig.5-6 GENERAL LAYOUT OF LIME SLAKING AND FEEDING FACILITIES

CAPACITY 100 TONS PER DAY SCALE 1:100

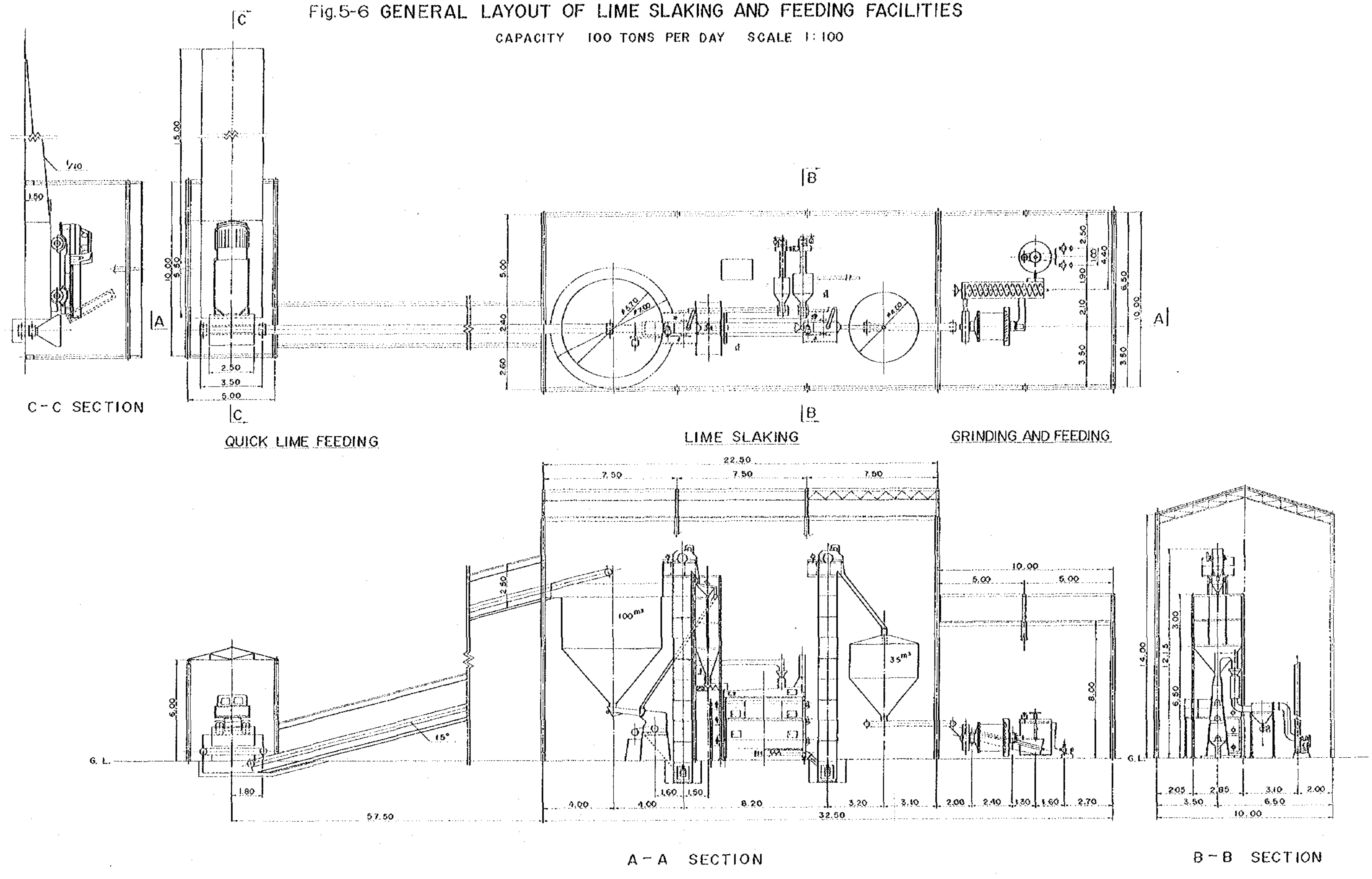
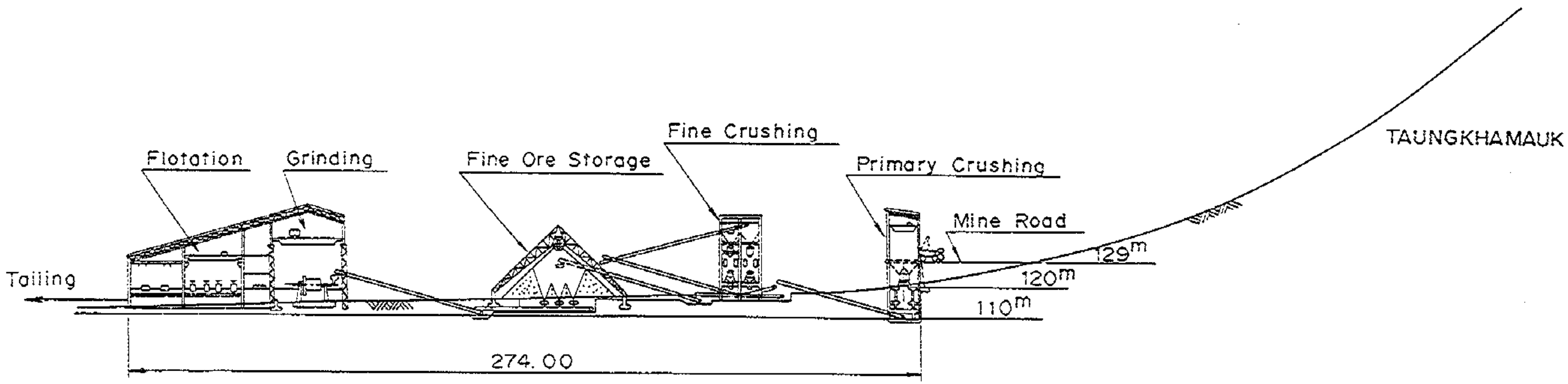


Fig. 5-7 GENERAL SECTION OF CONCENTRATOR



Max. hight of tailing pond : 110m

Fig. 5-8
PLAN OF TAILING DISPOSAL POND

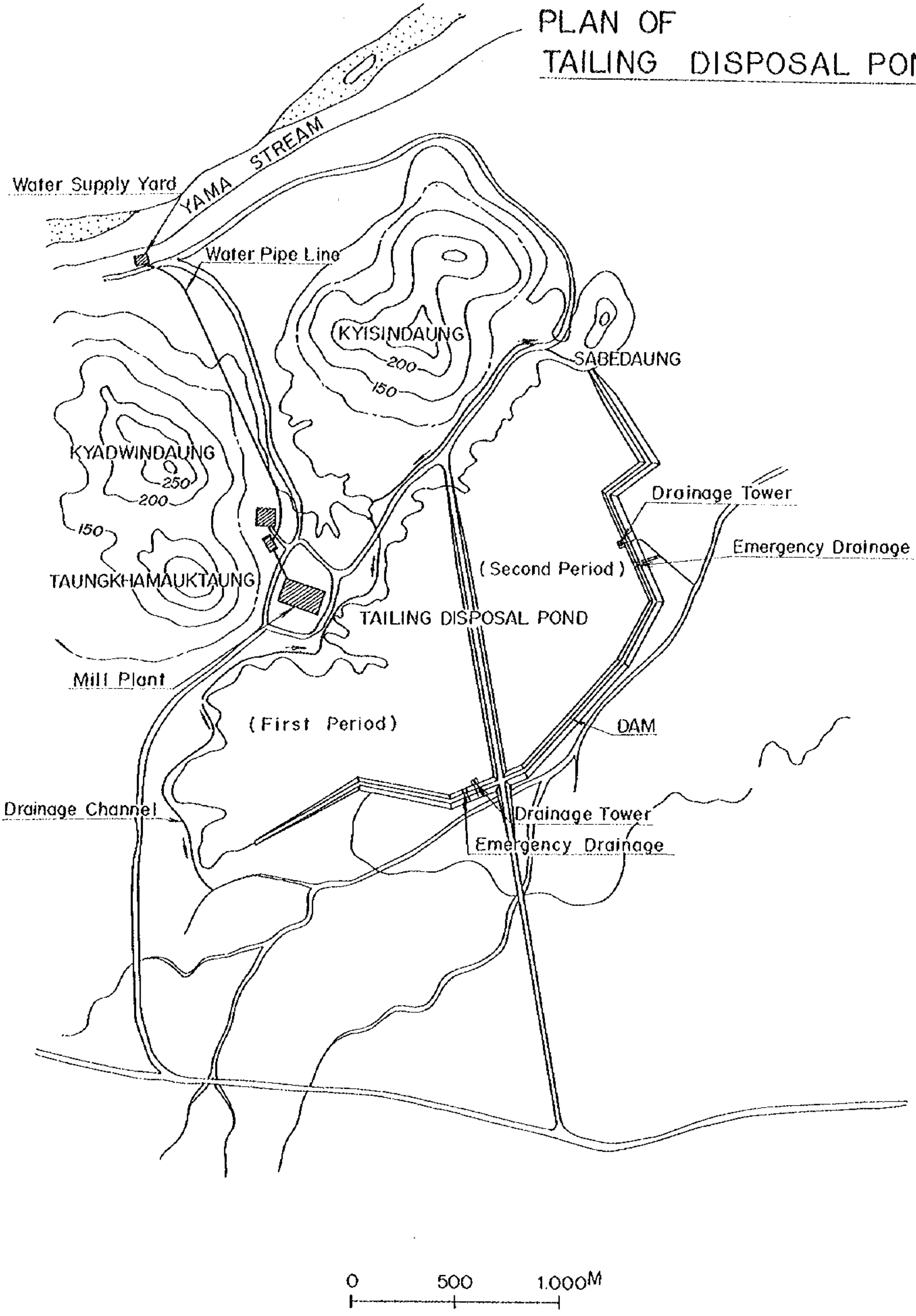


Fig. 5-9 Standard Section of Dam (First Period)

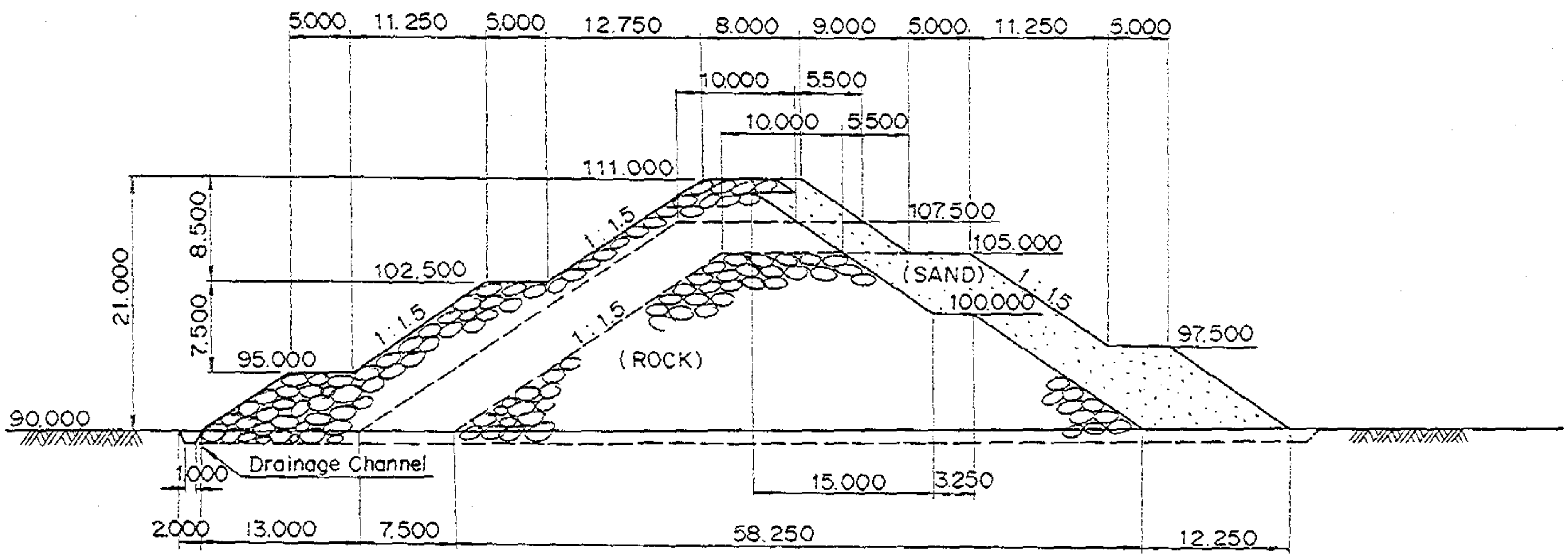


Fig. 5-10 Standard Section of Dam (Second Period)

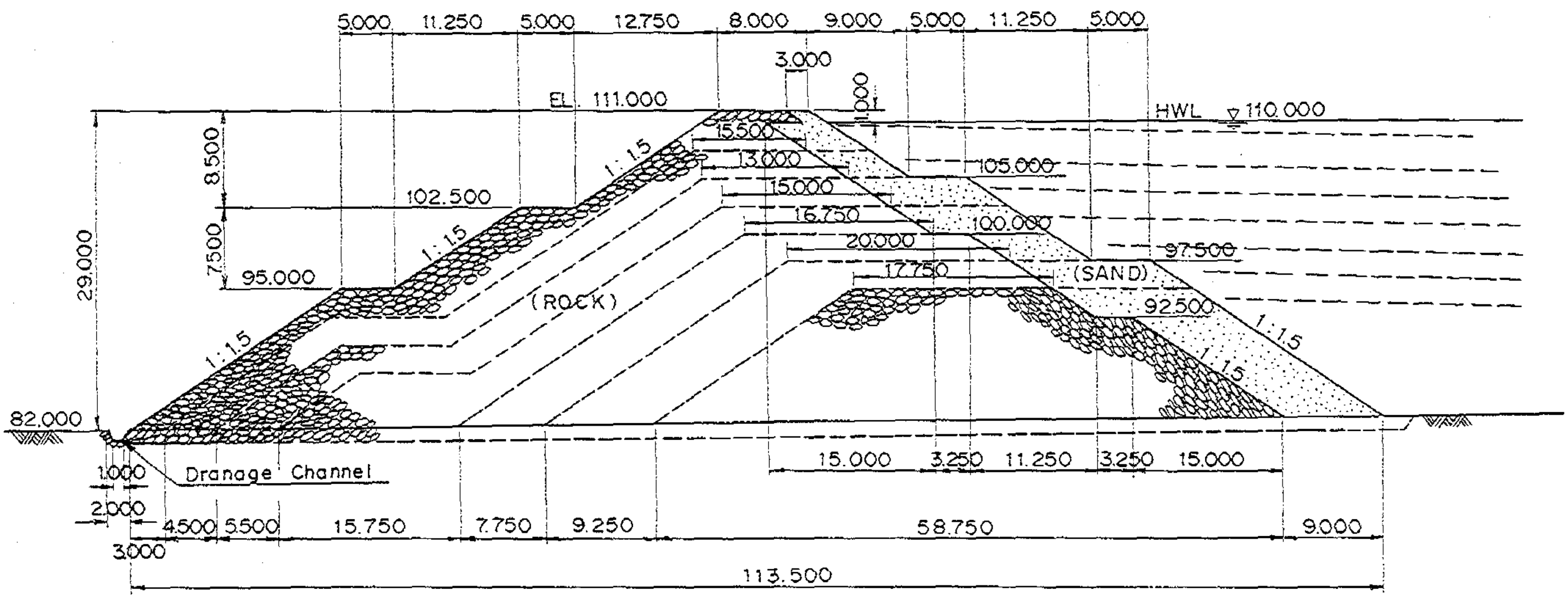


Fig. 5-11

BORING SITE FOR EARTH TEST

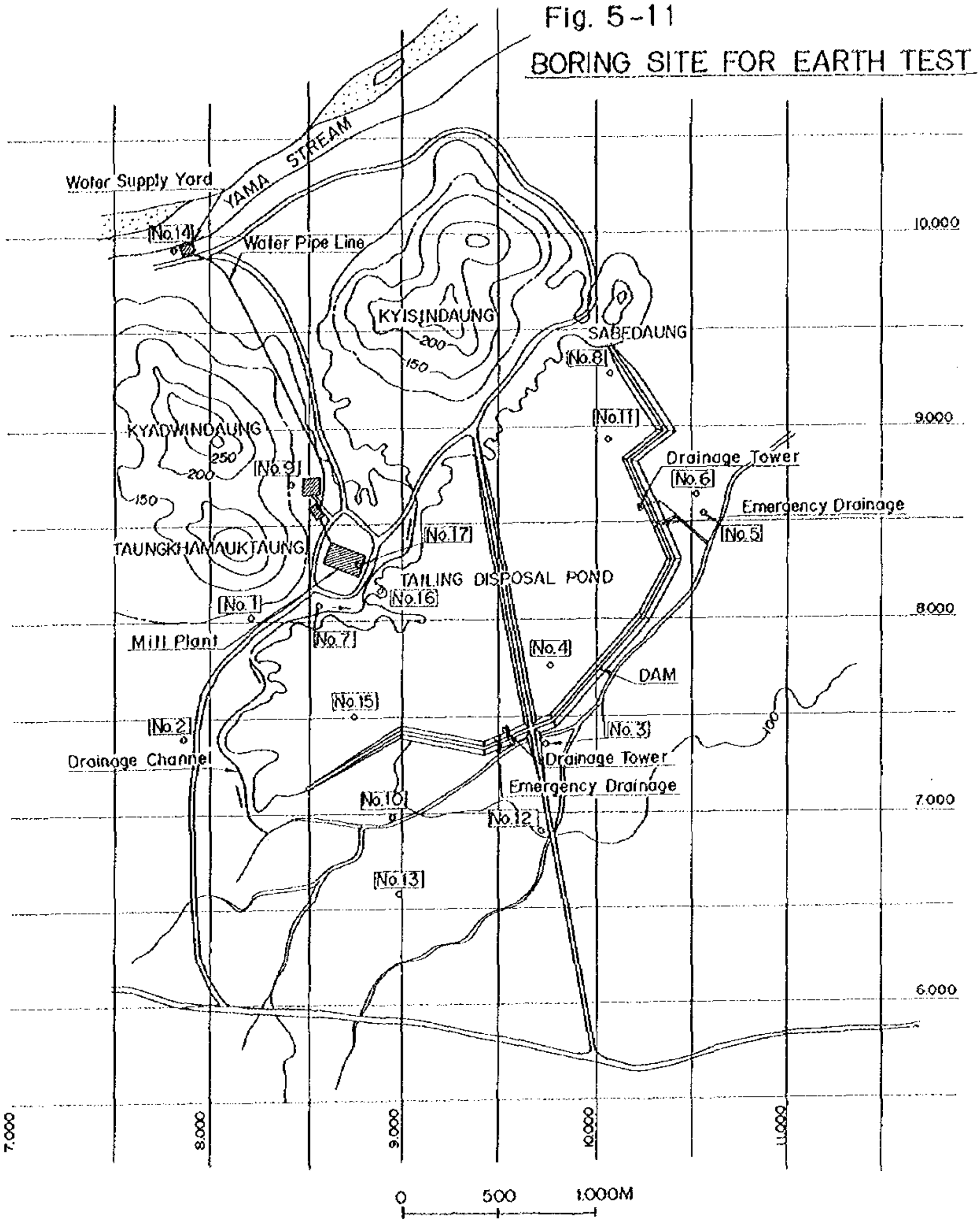
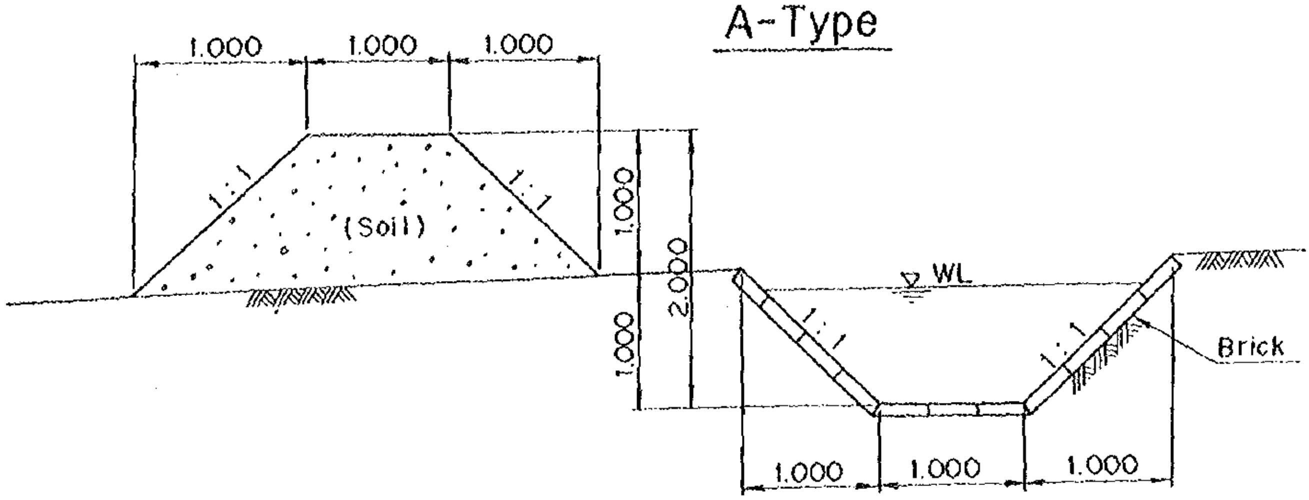
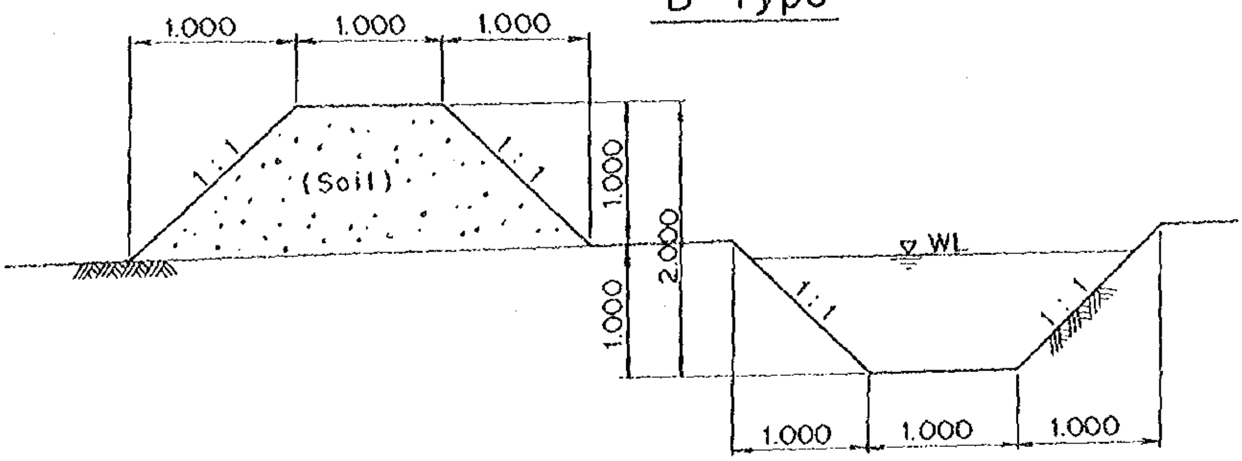


Fig. 5-12 Drainage Channel

A-Type



B-Type



C-Type

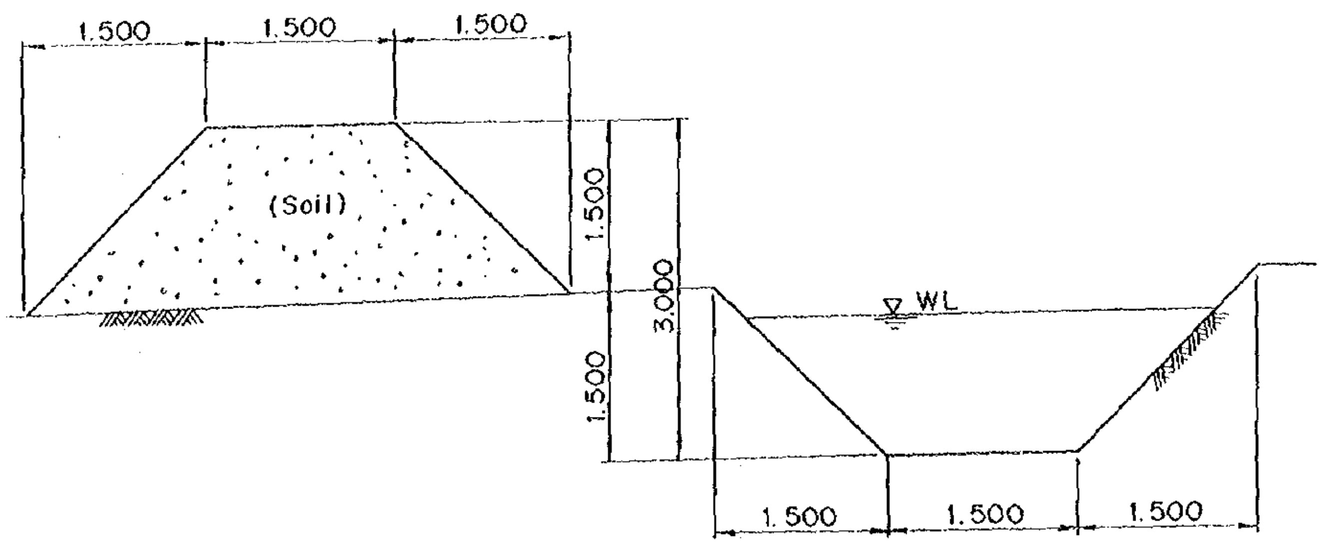


Fig. 5-13 Decant Drainage Tower and Culvert

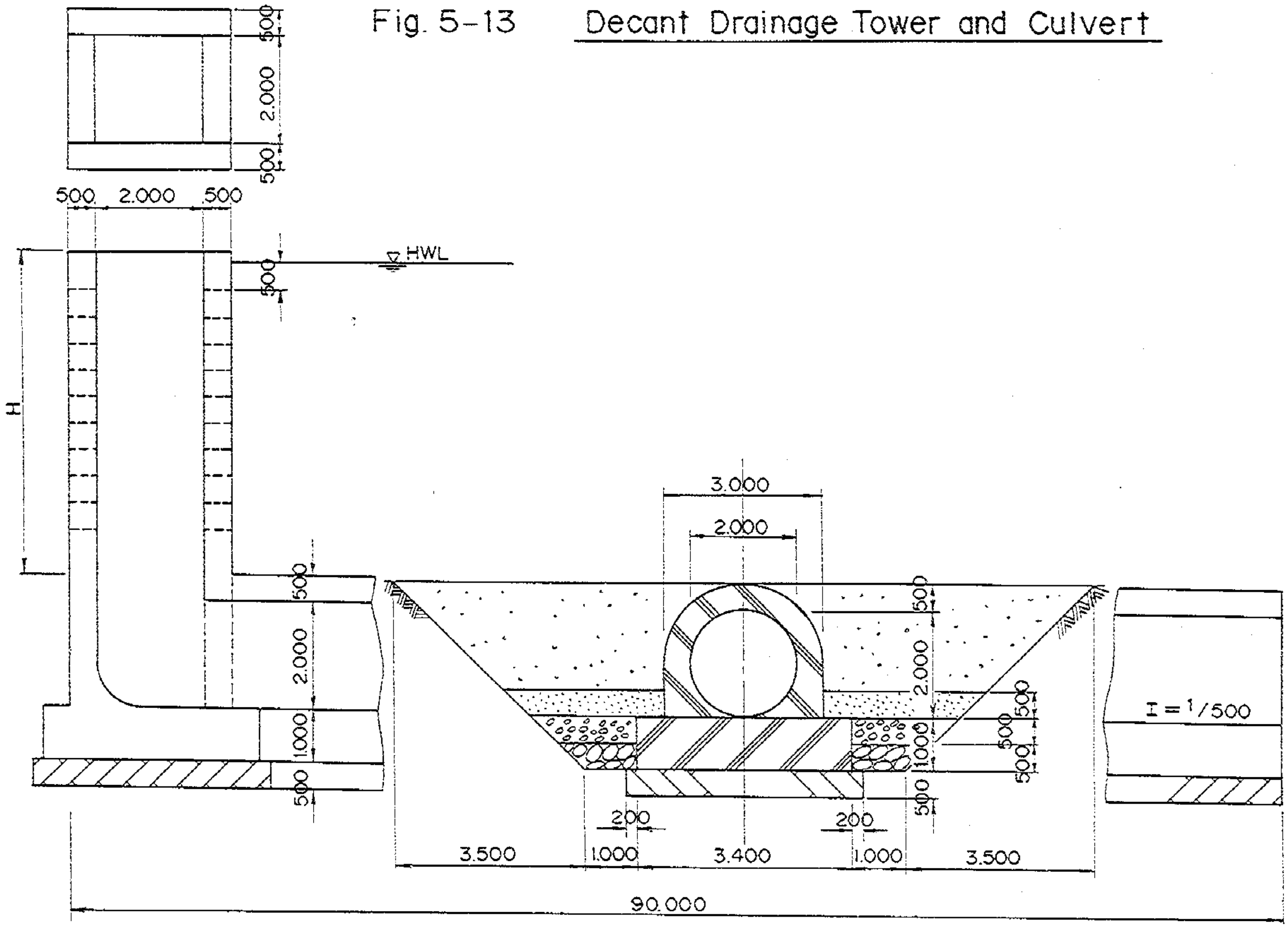


Fig. 5-14 Emergency Drainage

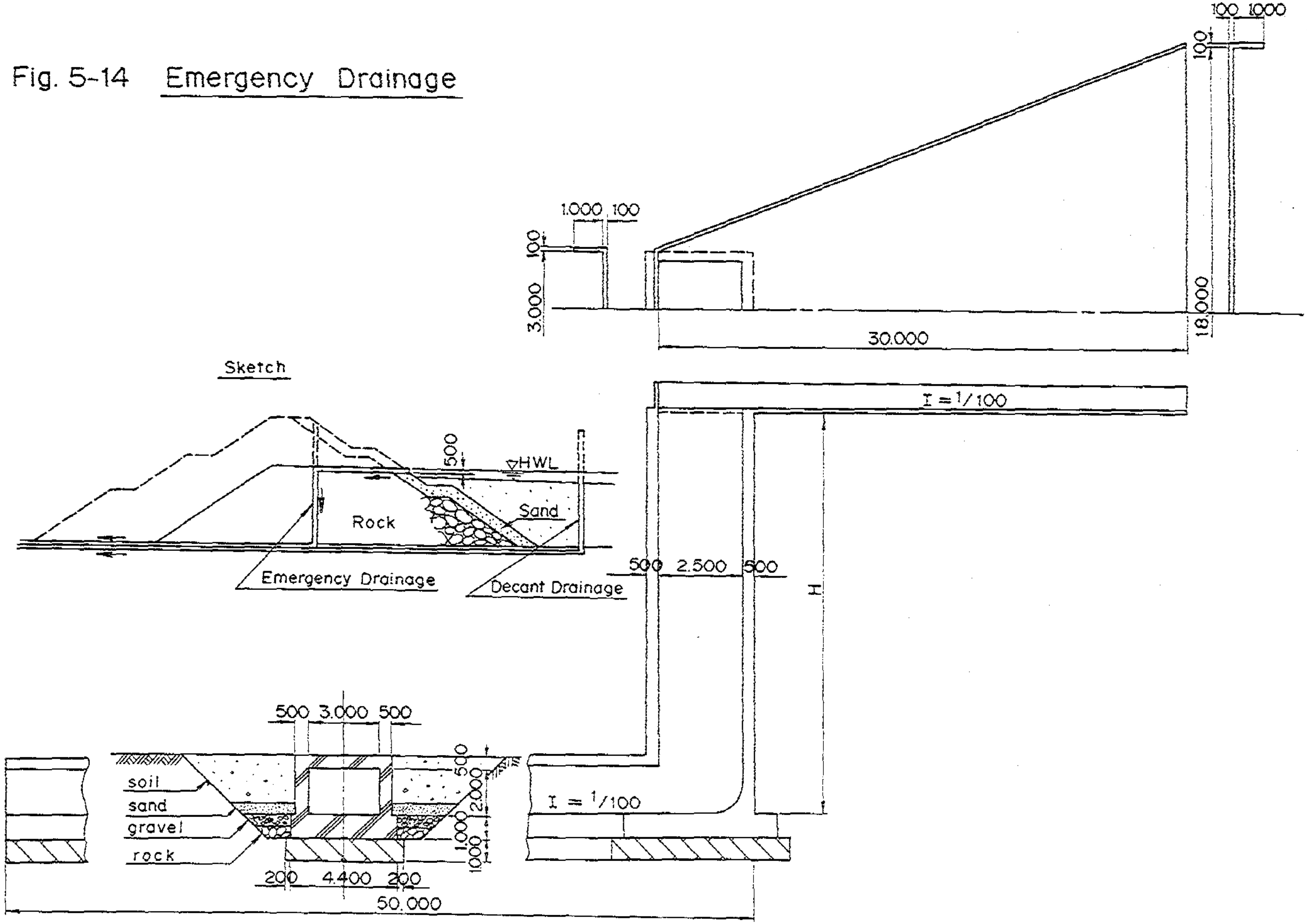
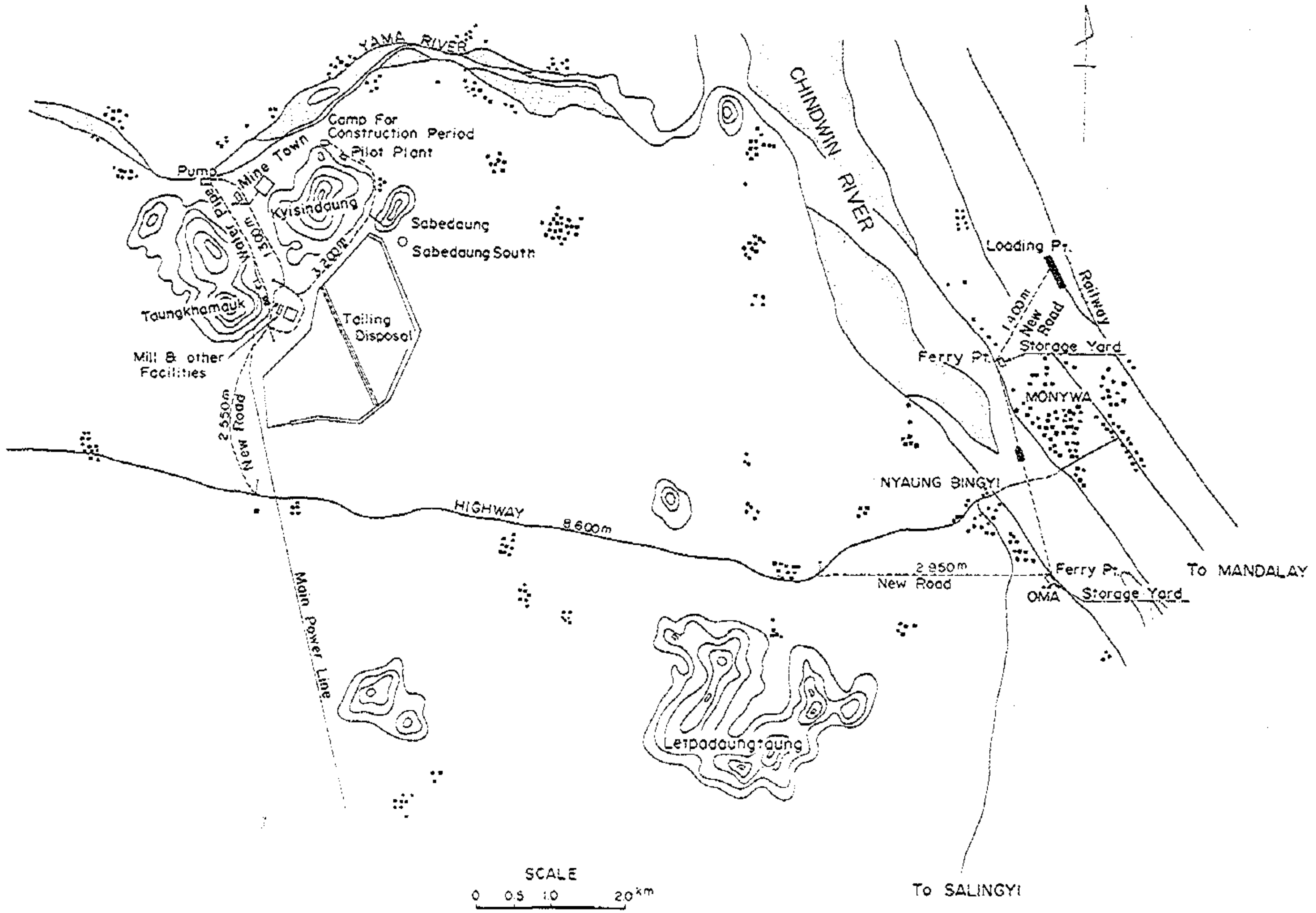


Fig. 7-1

GENERAL LAYOUT



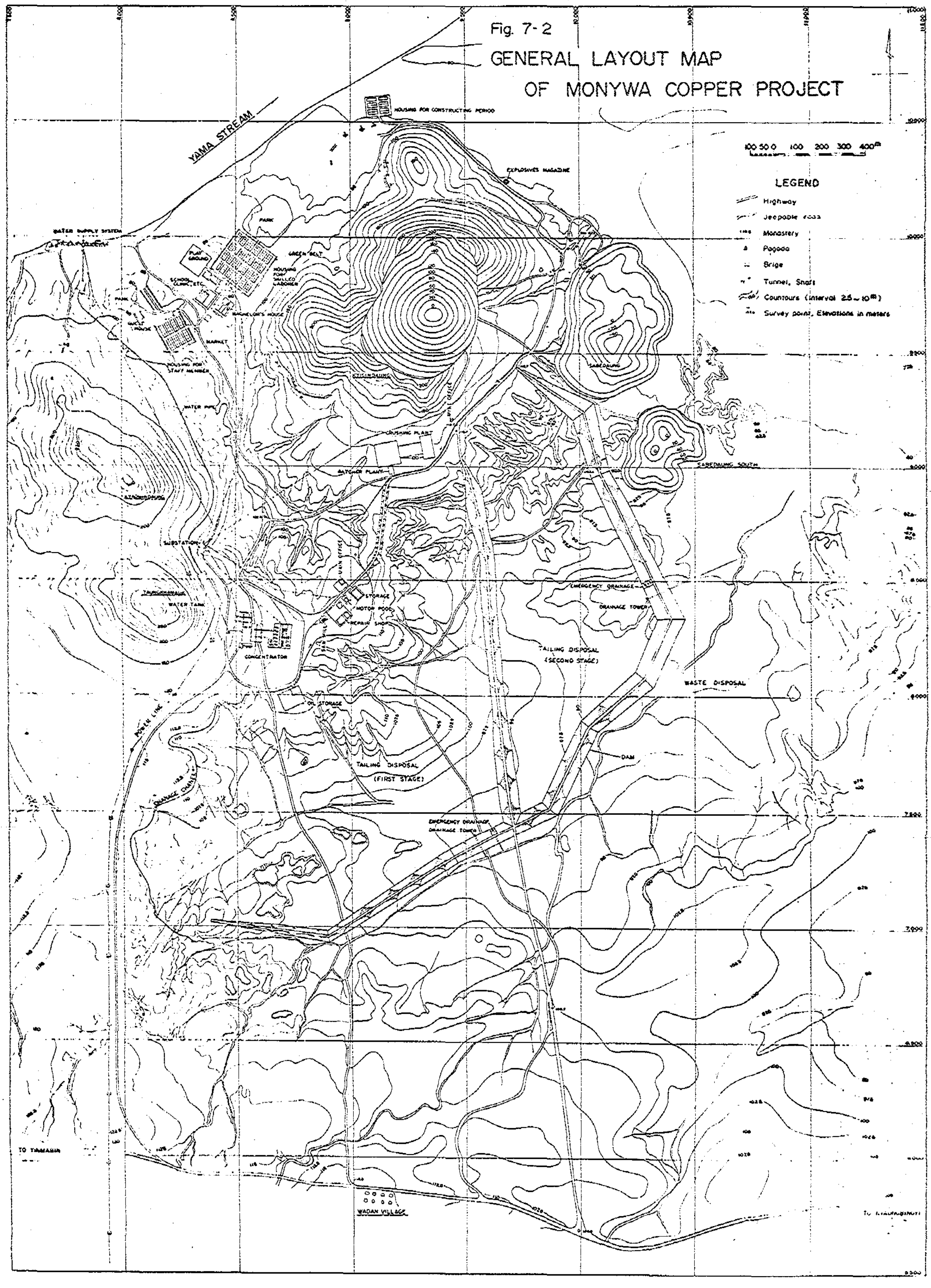
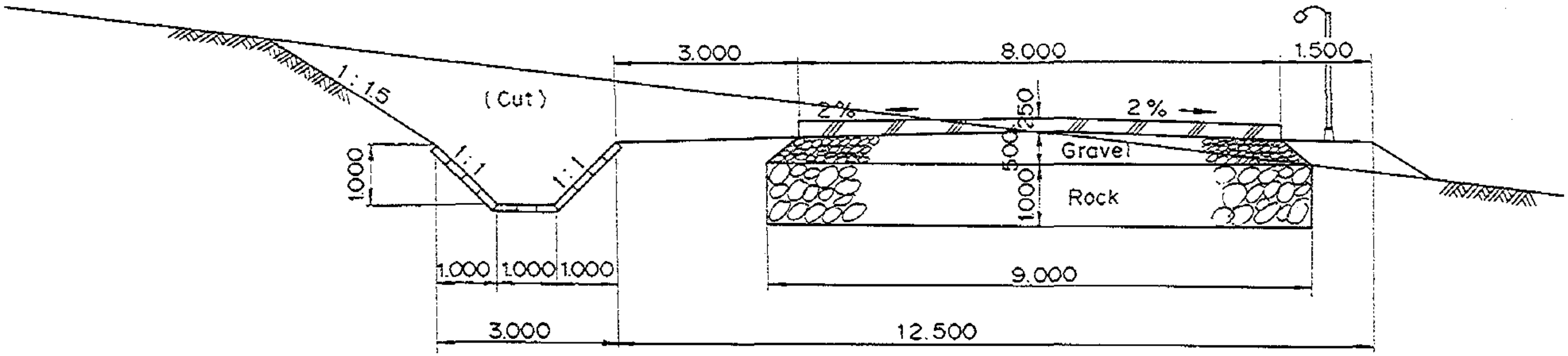


Fig. 7-2
GENERAL LAYOUT MAP
OF MONYWA COPPER PROJECT
100 50 0 100 200 300 400m
LEGEND
Highway
Jeepable road
Monastery
Pagoda
Brige
Tunnel, Shaft
Contours (interval 2.5~10m)
Survey point, Elevations in meters
HOUSING FOR CONSTRUCTING PERIOD
YAMA STREAM
EXPLOSIVES MAGAZINE
WATER SUPPLY SYSTEM
PARK
GREEN BELT
PLAY GROUND
SCHOOL CLINIC, ETC.
HOUSING FOR SKILLED LABORER
BACHELOR'S HOUSE
MARKET
HOUSING FOR STAFF MEMBER
WATER PIPE
SABEDAUNG
CRUSHING PLANT
BATCHER PLANT
SABEDAUNG SOUTH
SUBSTATION
WATER TANK
STORAGE
MOTOR POOL
REPAIR SHOP
CONCENTRATOR
EMERGENCY DRAINAGE
DRAINAGE TOWER
TAILING DISPOSAL (SECOND STAGE)
WASTE DISPOSAL
OIL STORAGE
POWER LINE
DAM
TAILING DISPOSAL (FIRST STAGE)
TO YINMABIN
WADAN VILLAGE

Fig. 7-3 Standard Section of Mine Road



Standard Section of General Road

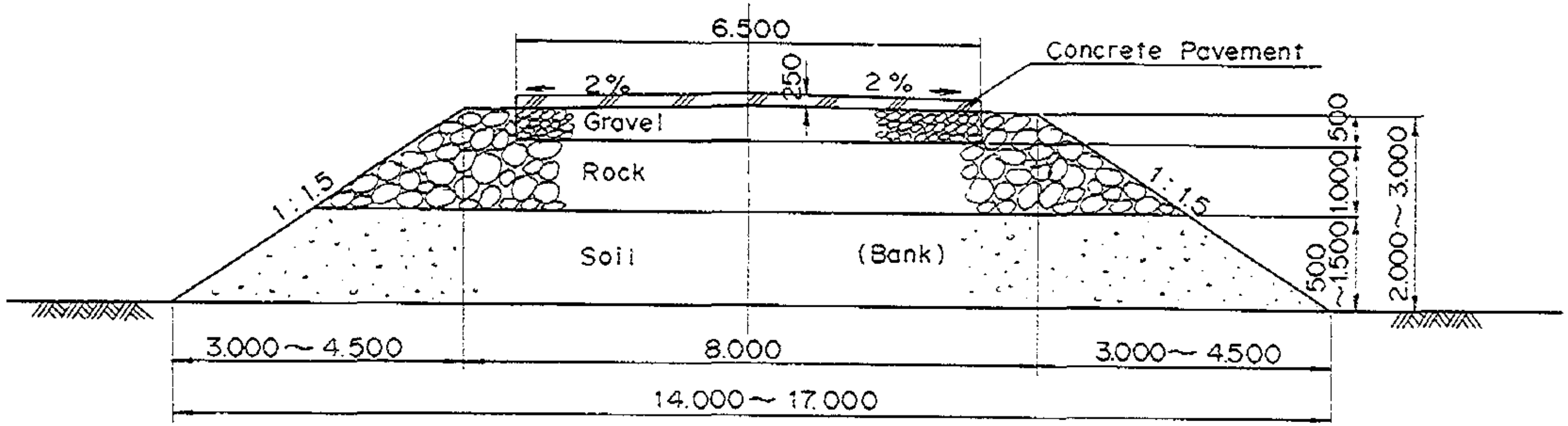


Fig. 7-4 RC Bridge

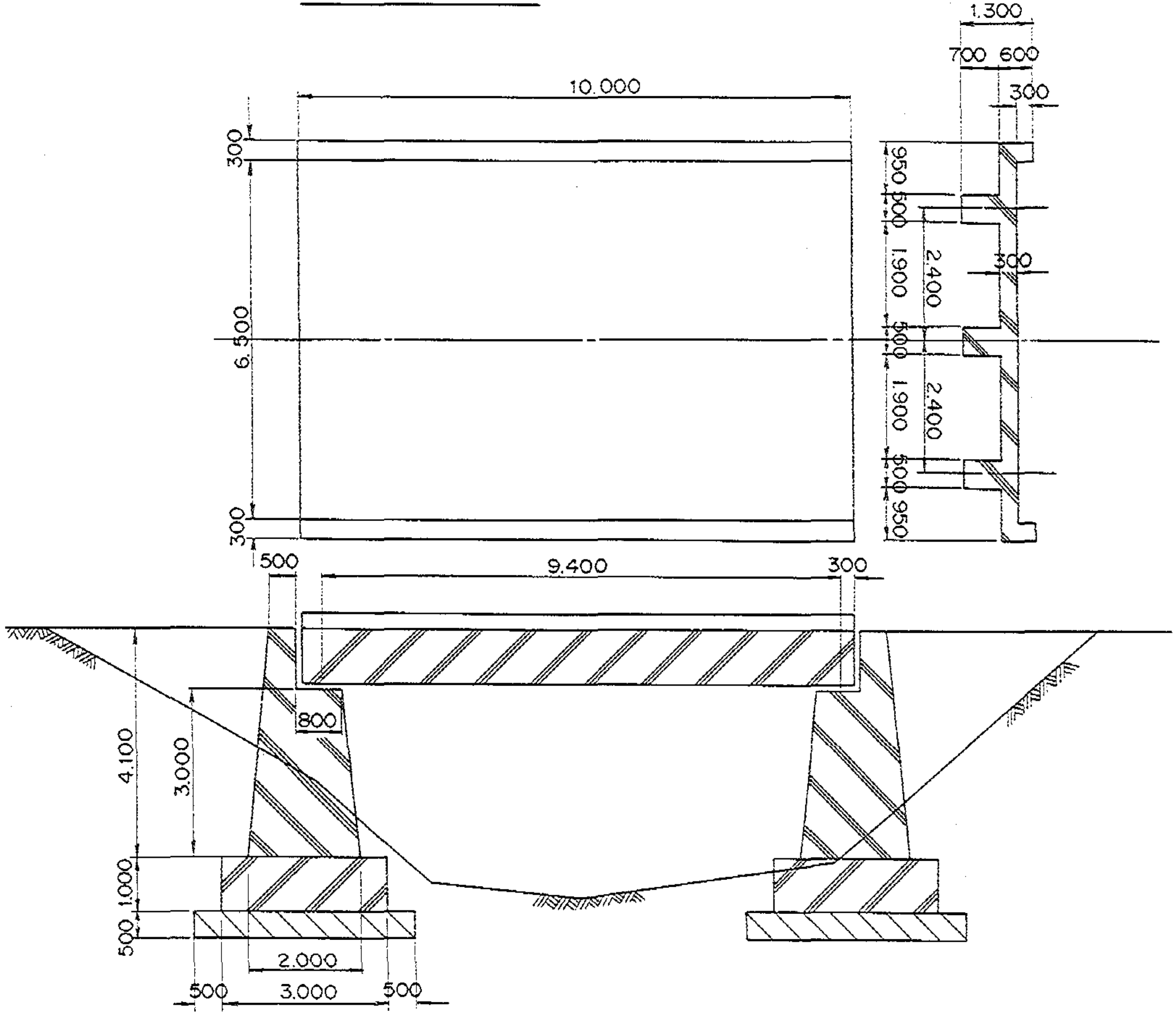


Fig. 7-5 Ferry Port (Monywa Side)

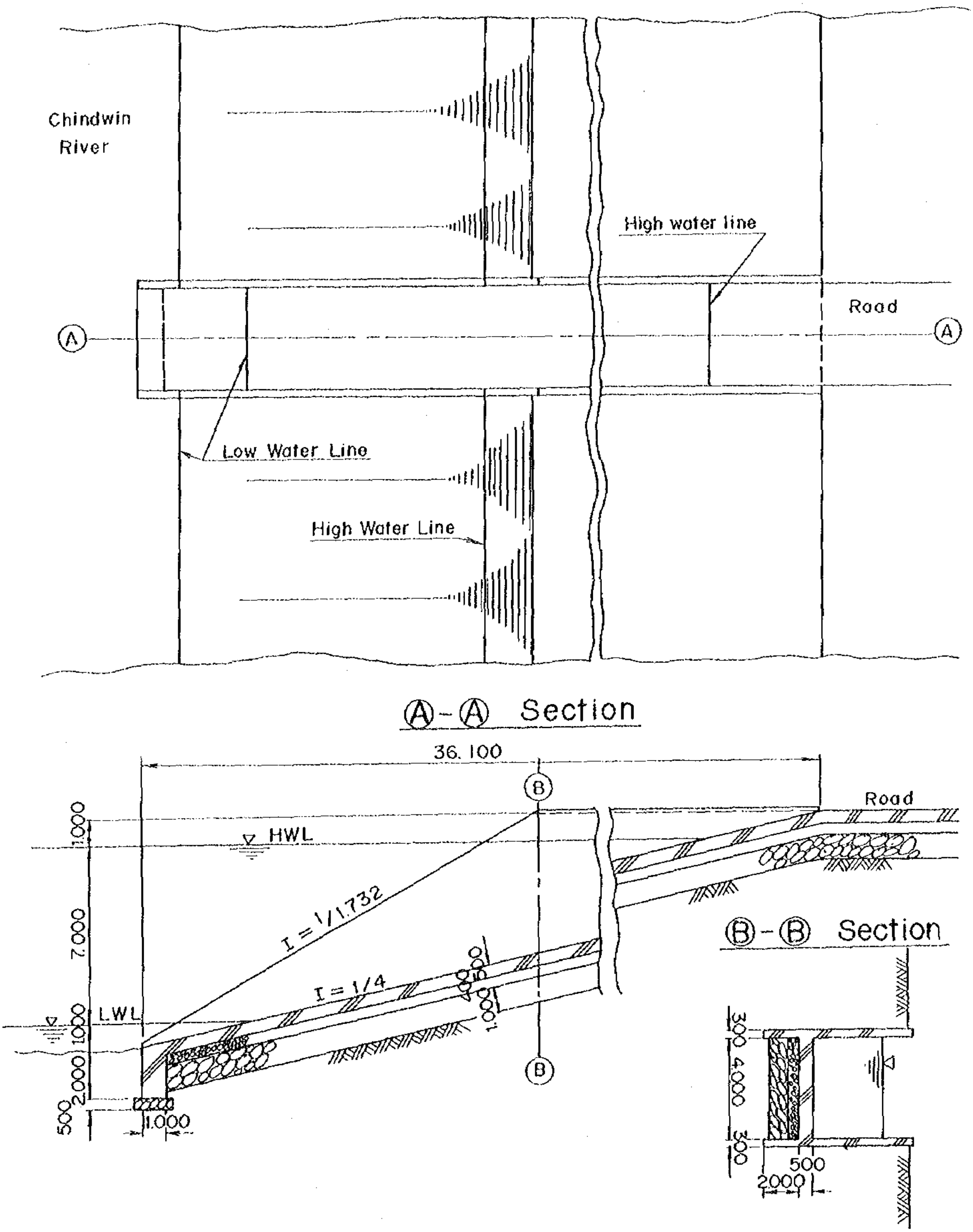


Fig.7-6 Layout of the Monywa North Loading Point

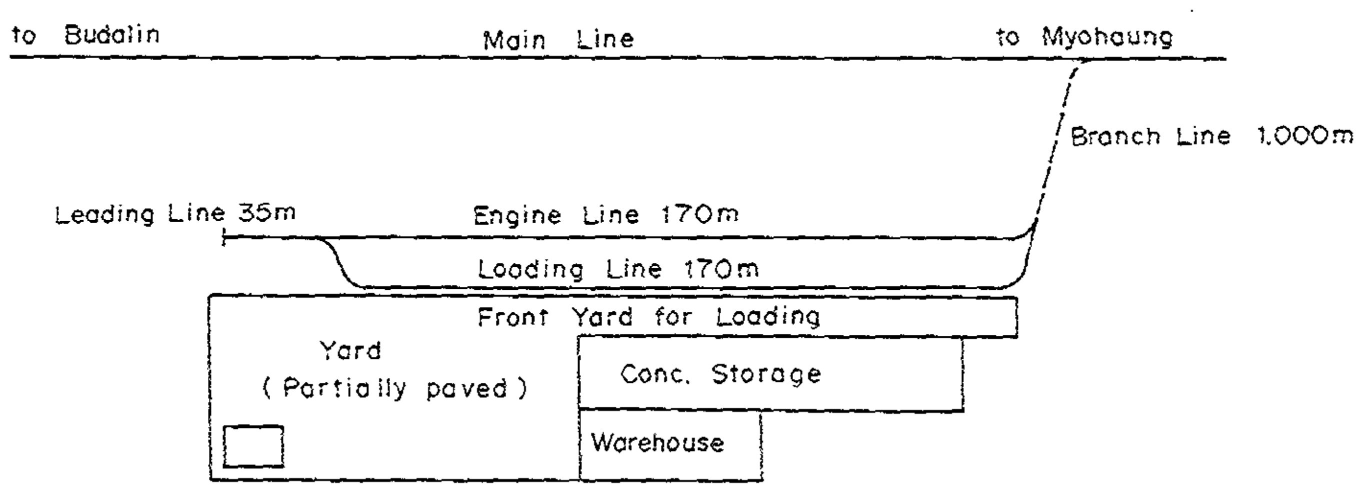


Fig.7-7 SUB STATION GENERAL DIAGRAM

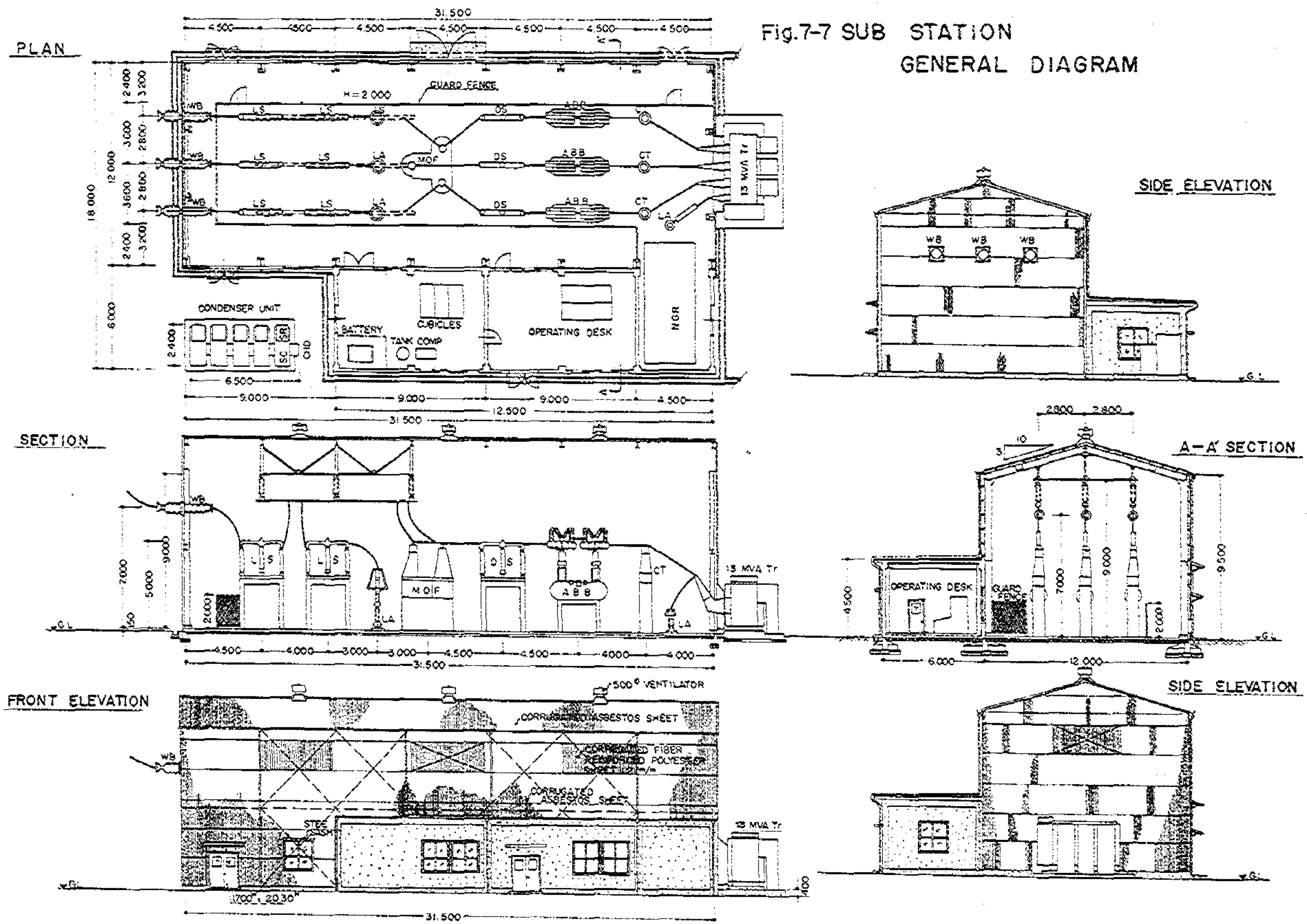


Fig. 7-8 SUB STATION SINGLE LINE DIAGRAM

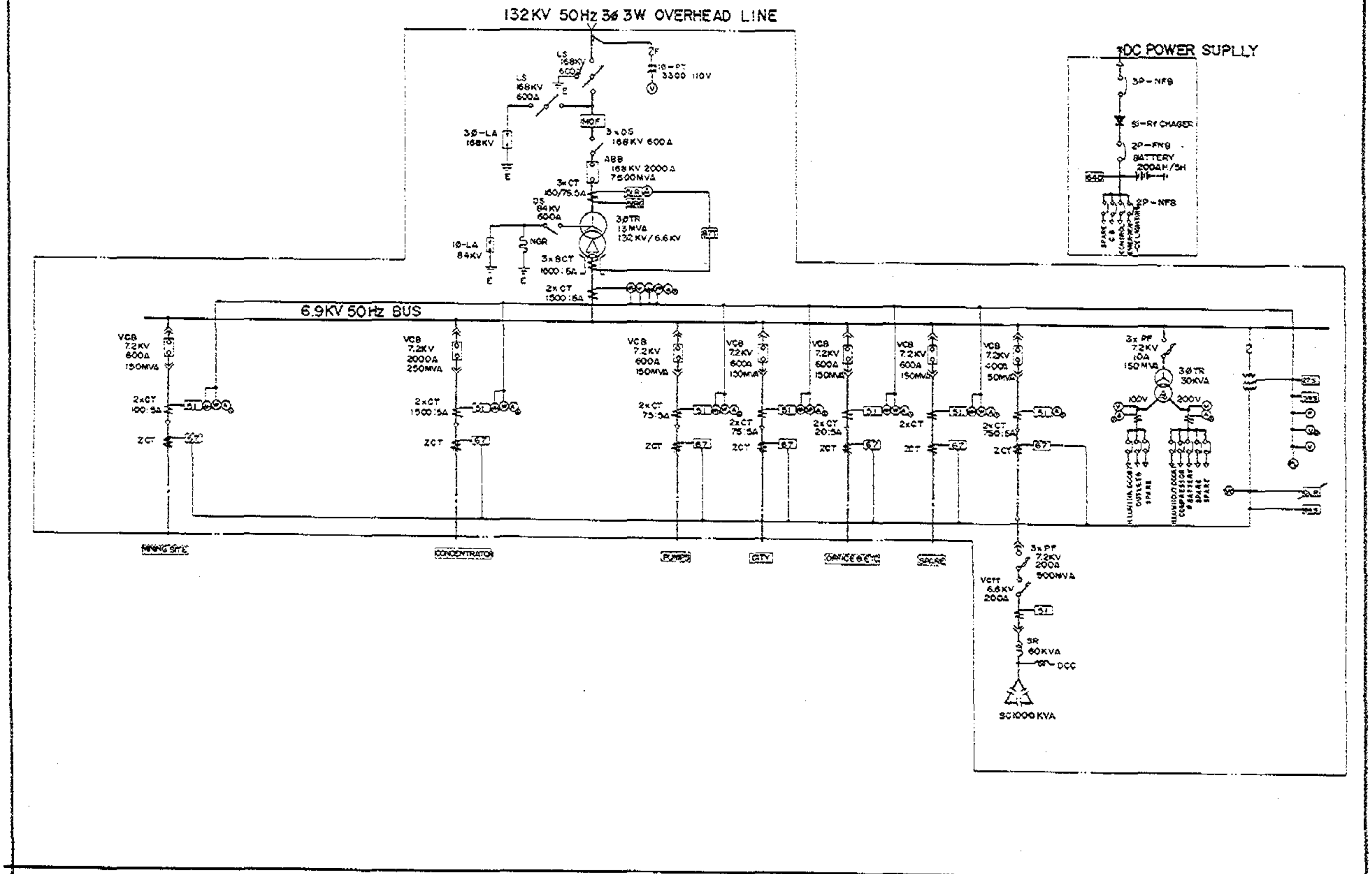


Fig. 7-9 CROSS-SECTION OF YAMA STREAM

SCALE VERTICAL 1 : 200
HORIZONTAL 1 : 1,000

DISCHARGE

Date : 1975 . 12.

Velocity : 0.5 m/sec

Sectional Area : 16.7 m^2

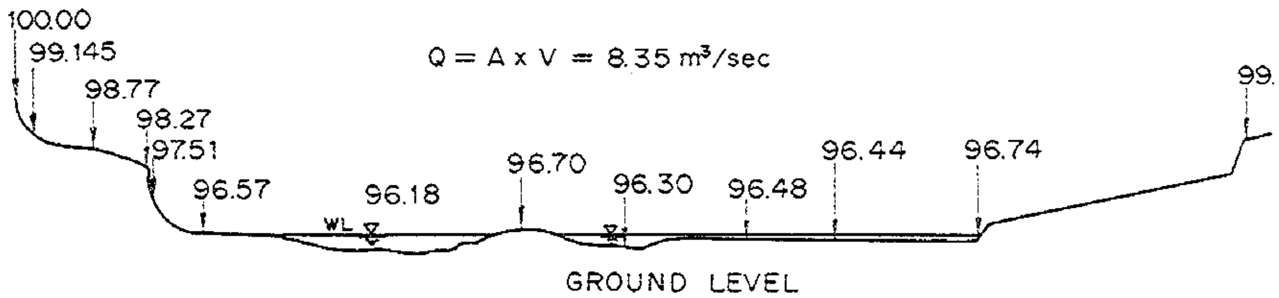
$Q = A \times V = 8.35\ m^3/sec$

Date : 1976. 2.

$V = 0.5 m/sec$

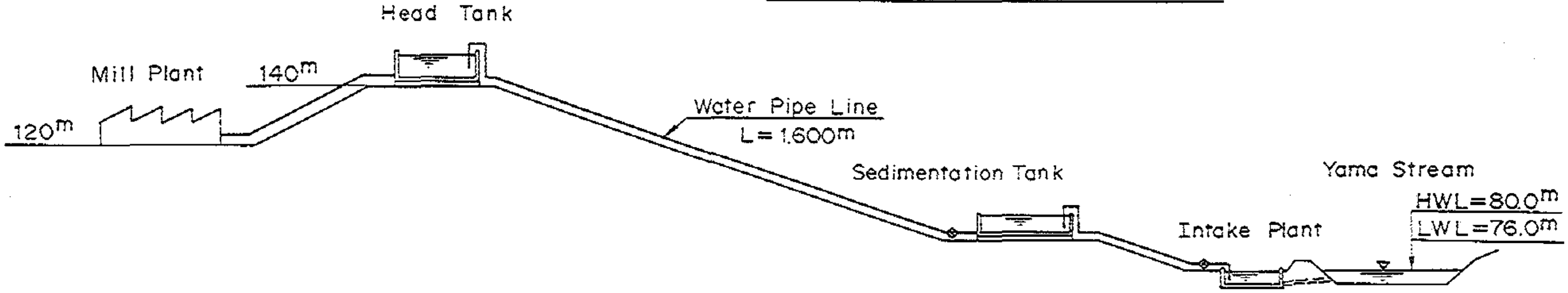
$A = 9.48 m^2$

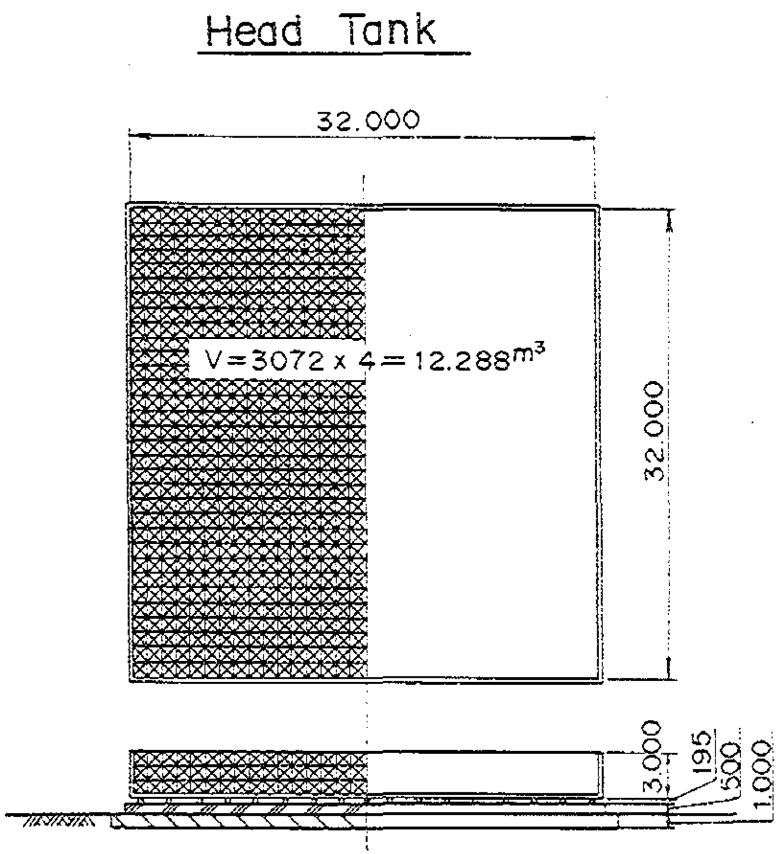
$Q = 4.74\ m^3/sec$



Accumlated Dis.	0	18.0	25.7	50.0	69.2	83.2	131.5	167.5
Distance	0	18.0	7.7	24.3	19.2	14.0	48.3	36.0
No.	No.0	1	2	3	4	5	6	7

Fig.7-10 Water Supply System





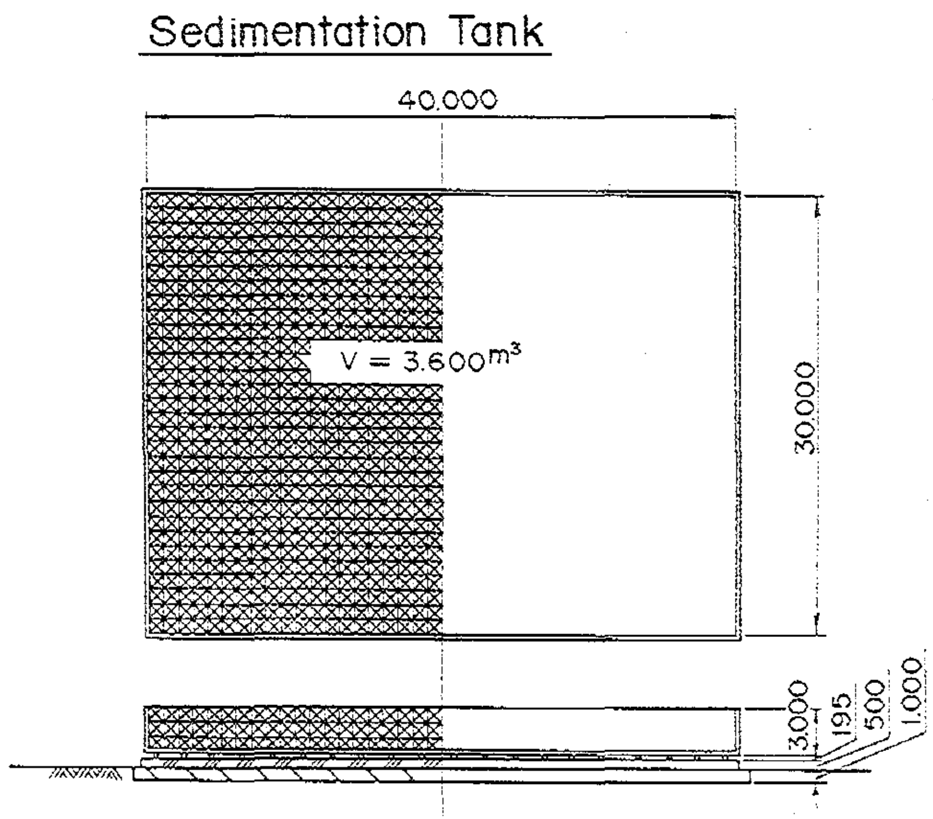
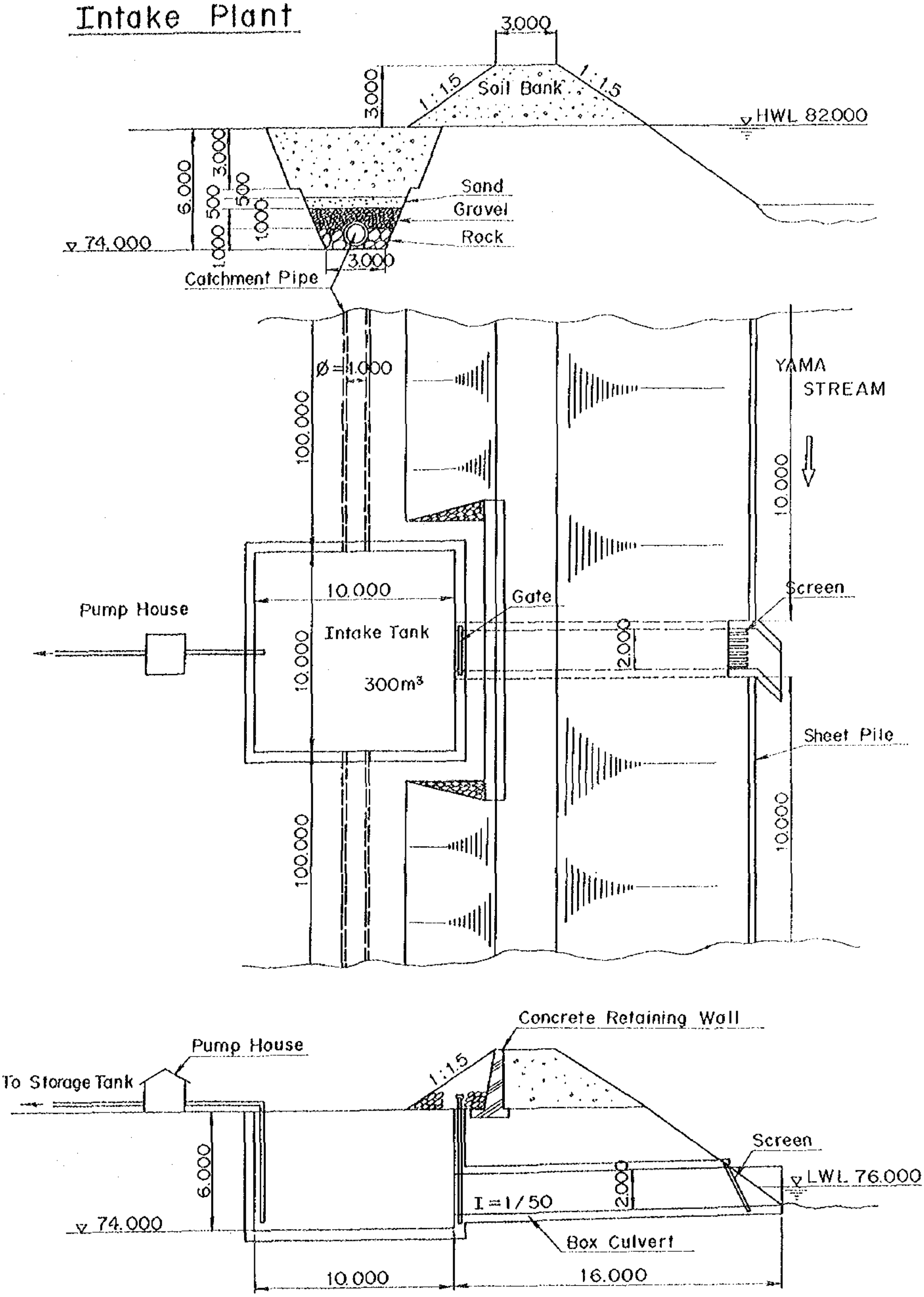


Fig. 7-11

Intake Plant



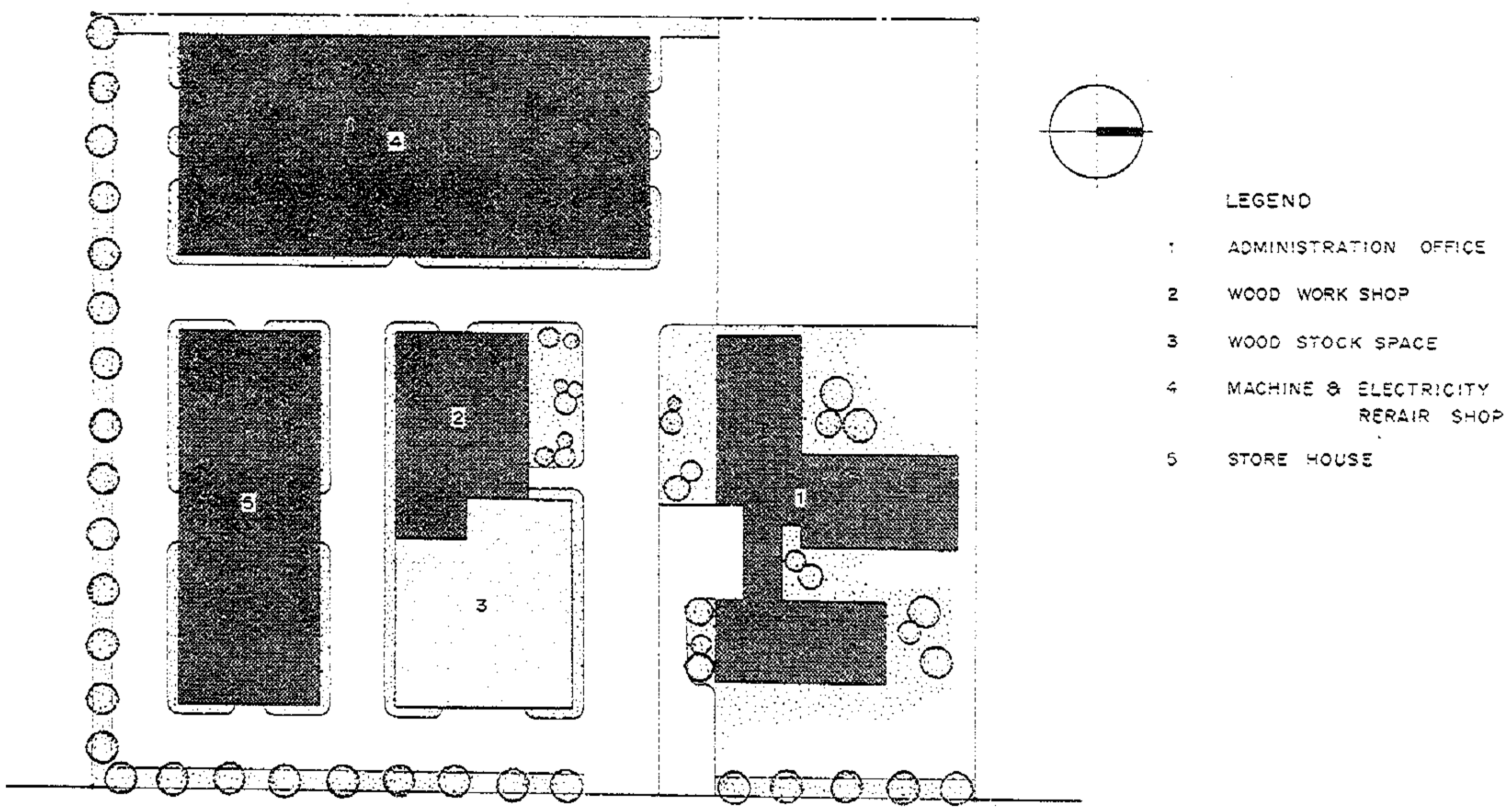
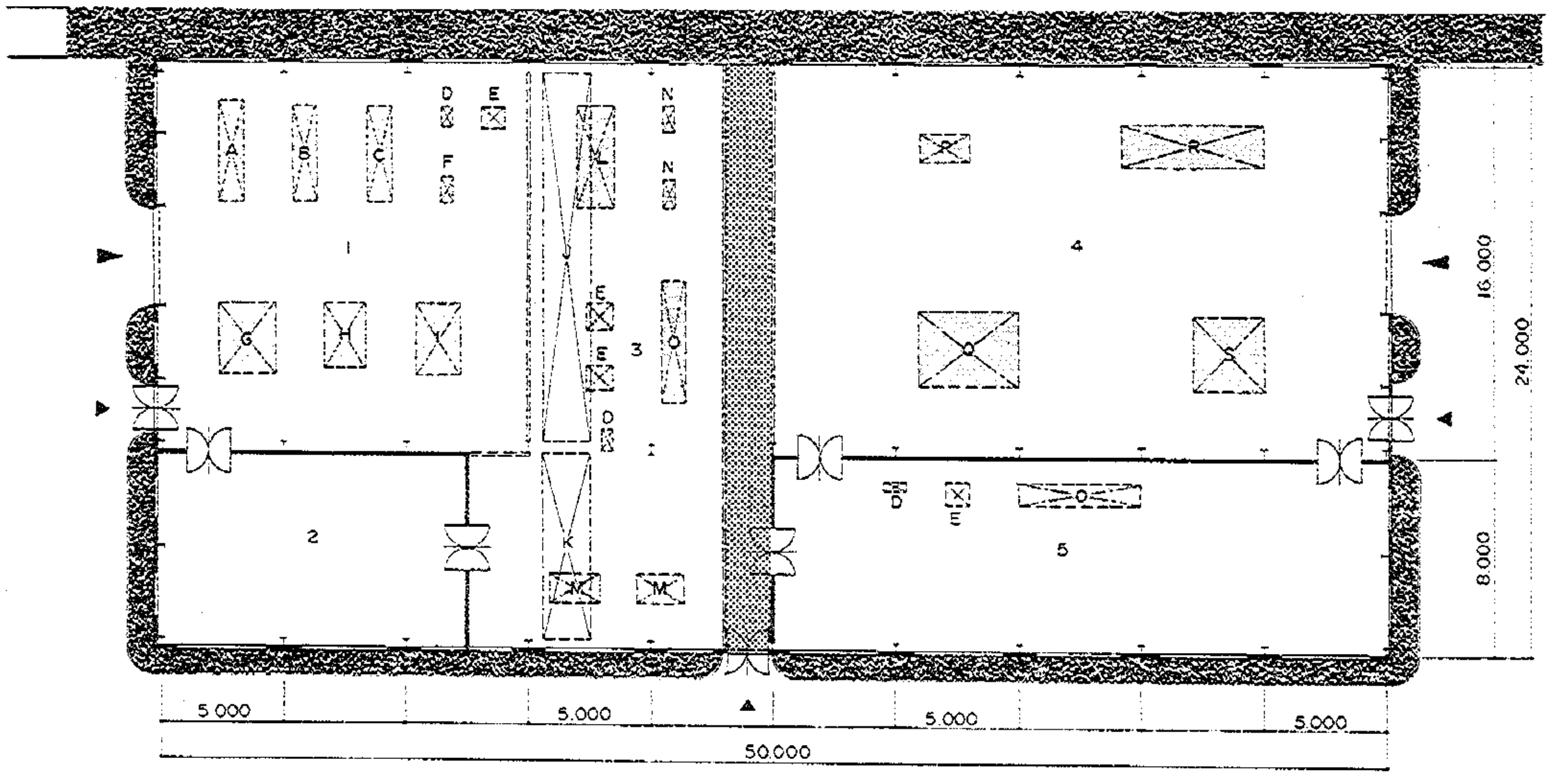


Fig. 7-12 LAYOUT MAP OF SERVICING FACILITIES



PLAN

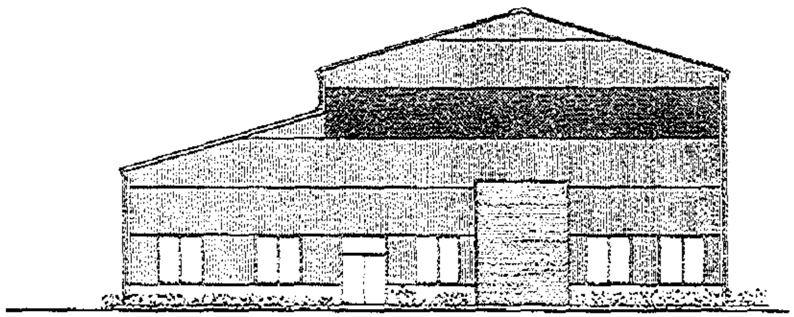
LEGEND

1 MACHINE SHOP
2 TOOL SHOP
3 FINISH SHOP
4 CANNERY SHOP
5 ELECTRICITY SHOP

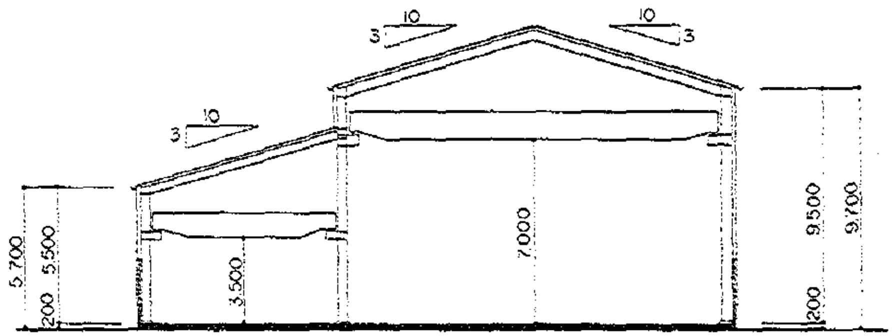
LEGEND

A HEAVY DUTY FACE LATHE
B MEDIUM DUTY ENGINE LATHE (8R)
C (12R)
D SMALL DRILLING MACHINE
E GRINDER
F SMALL HIGH SPEED LATHE
G UNIVERSAL MILLING MACHINE
H SHAPER
I UNIVERSAL GRINDING MACHINE
J CRANE (5T)
K 〃 (2T)
L RADIAL DRILLING MACHINE
M STOOL
N VERTICAL DRILLING MACHINE
O VICE TABLE
P STOOL
Q SHEARING MACHINE
R BENDING ROLL
S HYDRAULIC PRESS BRAKE

Fig.7-13 MACHINE & ELECTRICITY REPAIR SHOP



ELEVATION



SECTION

Fig. 7-14 MACHINE & ELECTRICITY REPAIR SHOP
(SECTION)

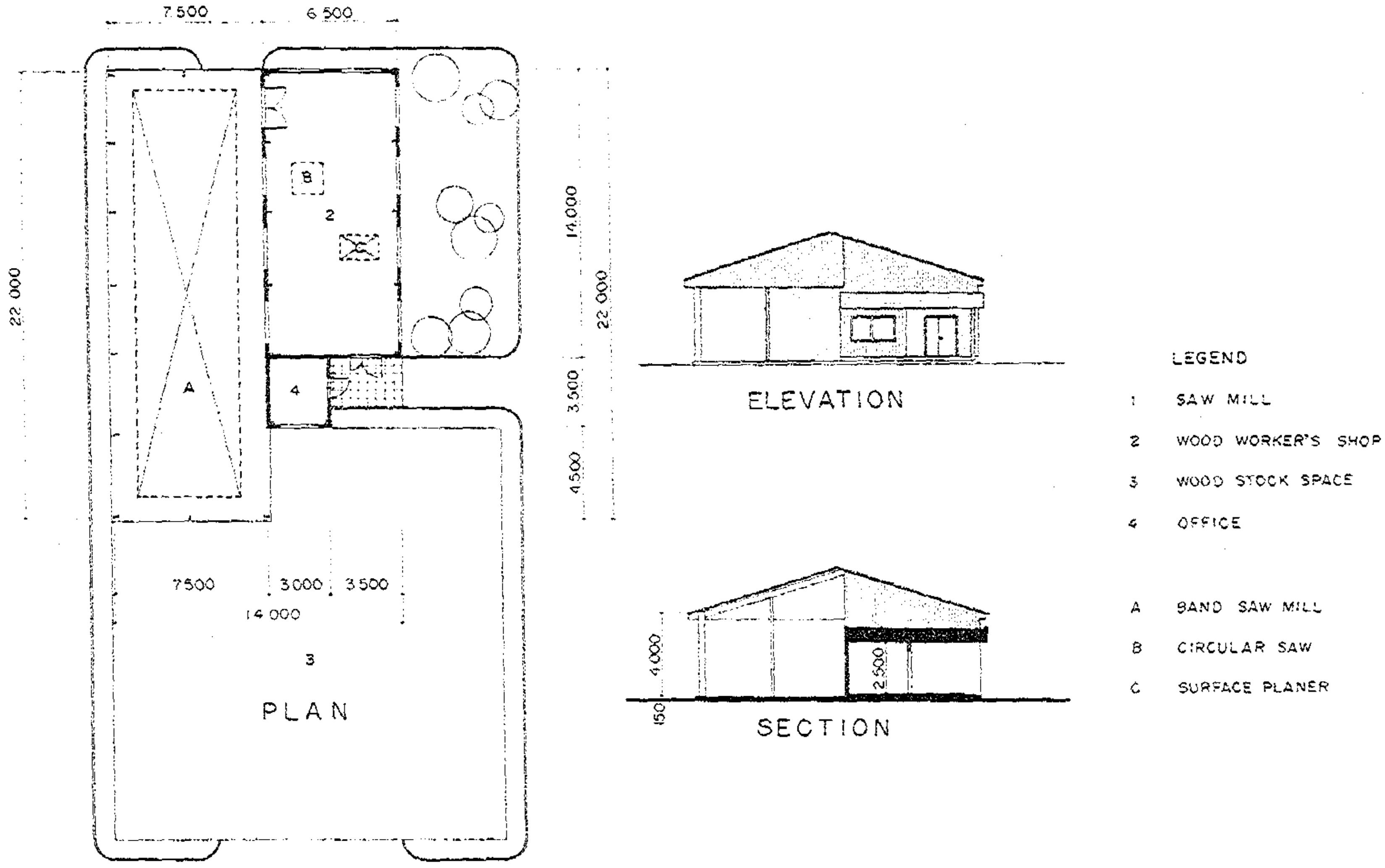


Fig. 7-15 WOOD WORK SHOP

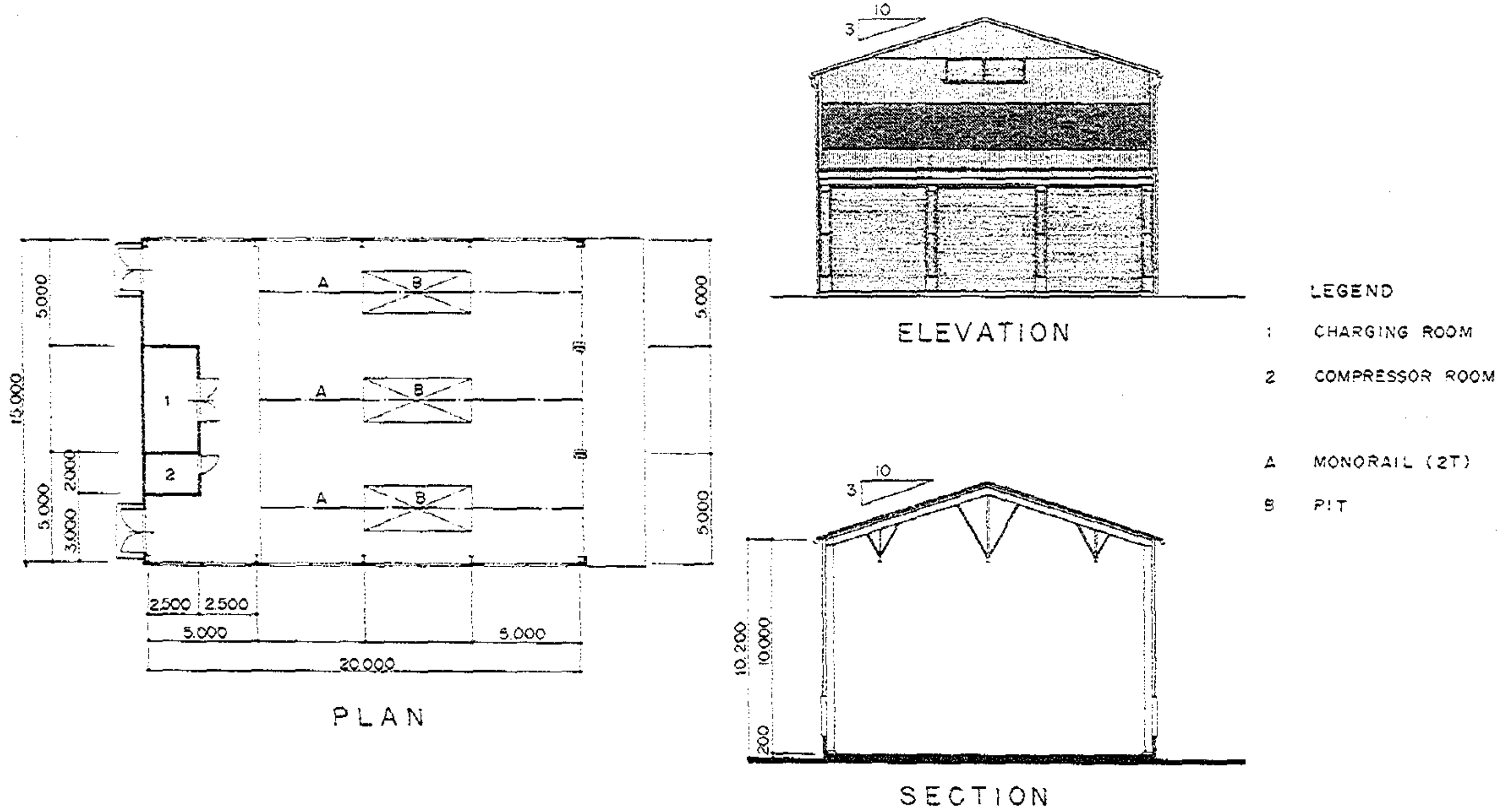
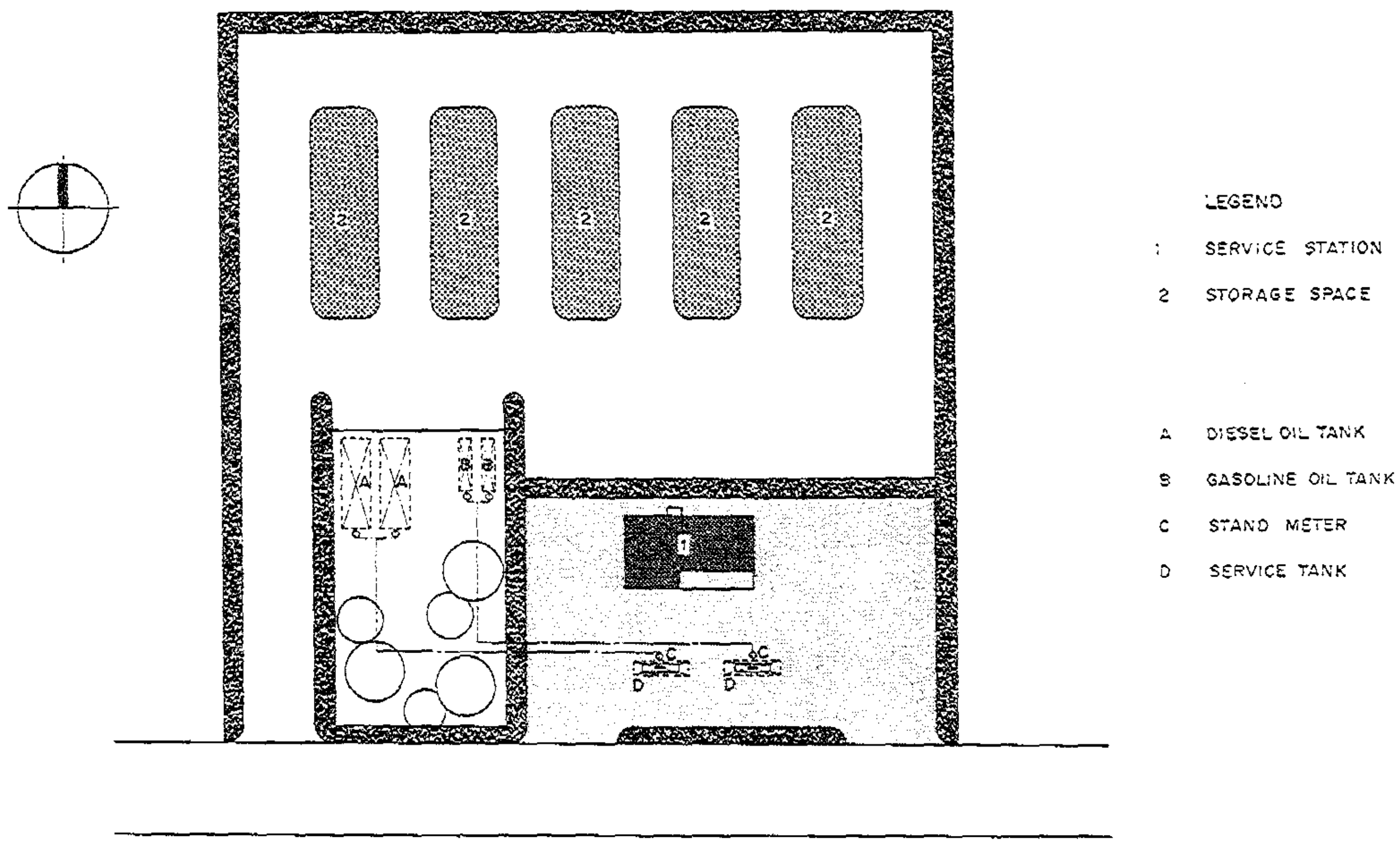


Fig. 7-16 REPAIR SHOP FOR MOTORCAR



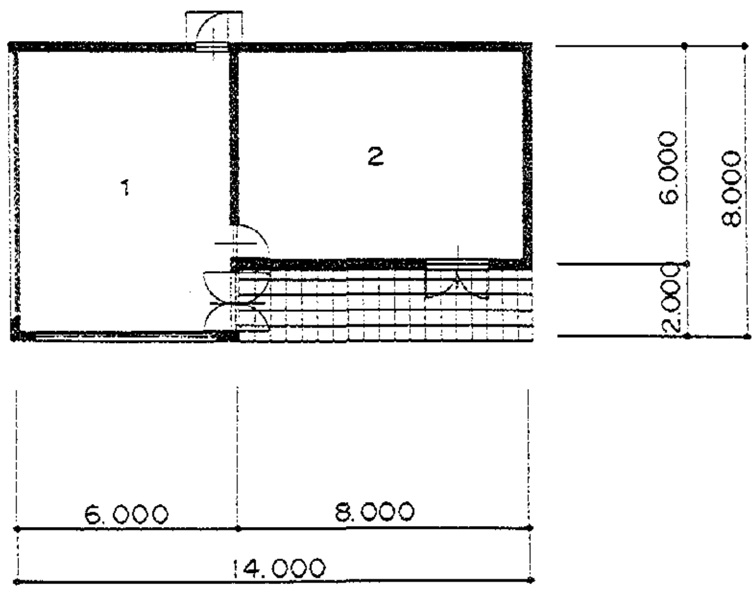
LAYOUT

Fig. 7-17 OIL SERVICE STATION (LAYOUT)

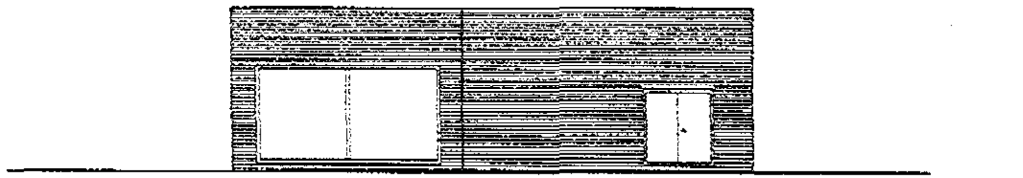
LEGEND

1 OFFICE

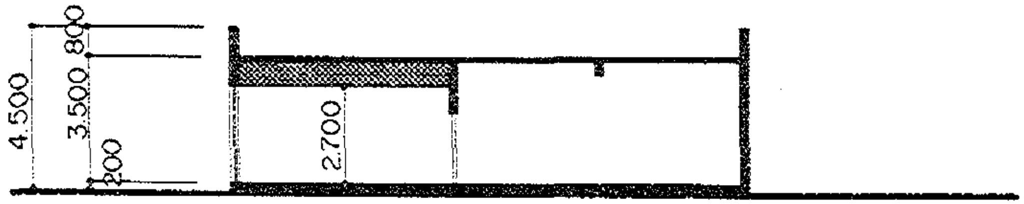
2 OIL STORAGE ROOM



PLAN



ELEVATION



SECTION

Fig. 7-18 OIL SERVICE STATION

Fig. 7–19

LAYOUT OF MINE TOWN

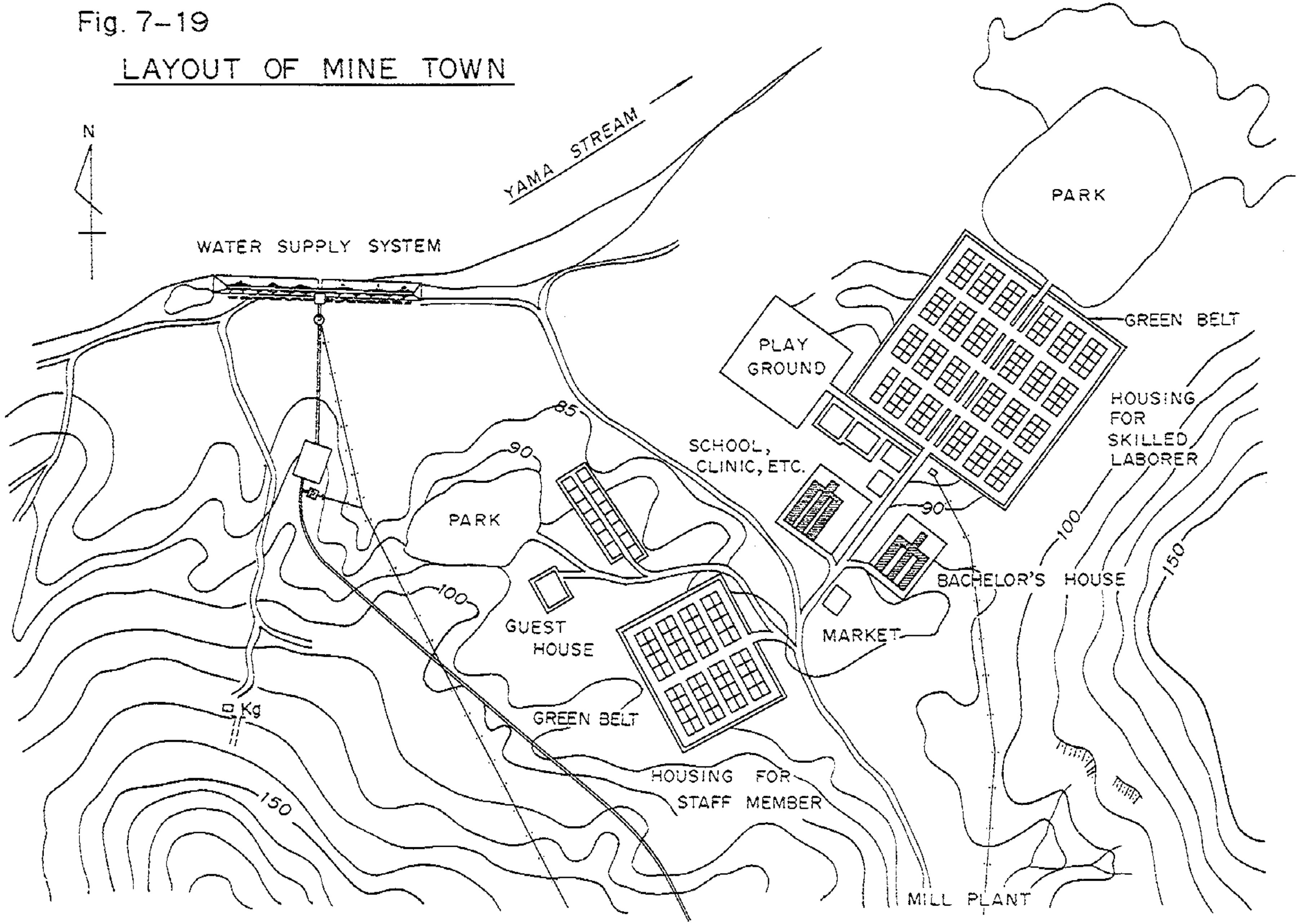


Fig. 7-20 HOUSING FOR SENIOR STAFF MEMBER

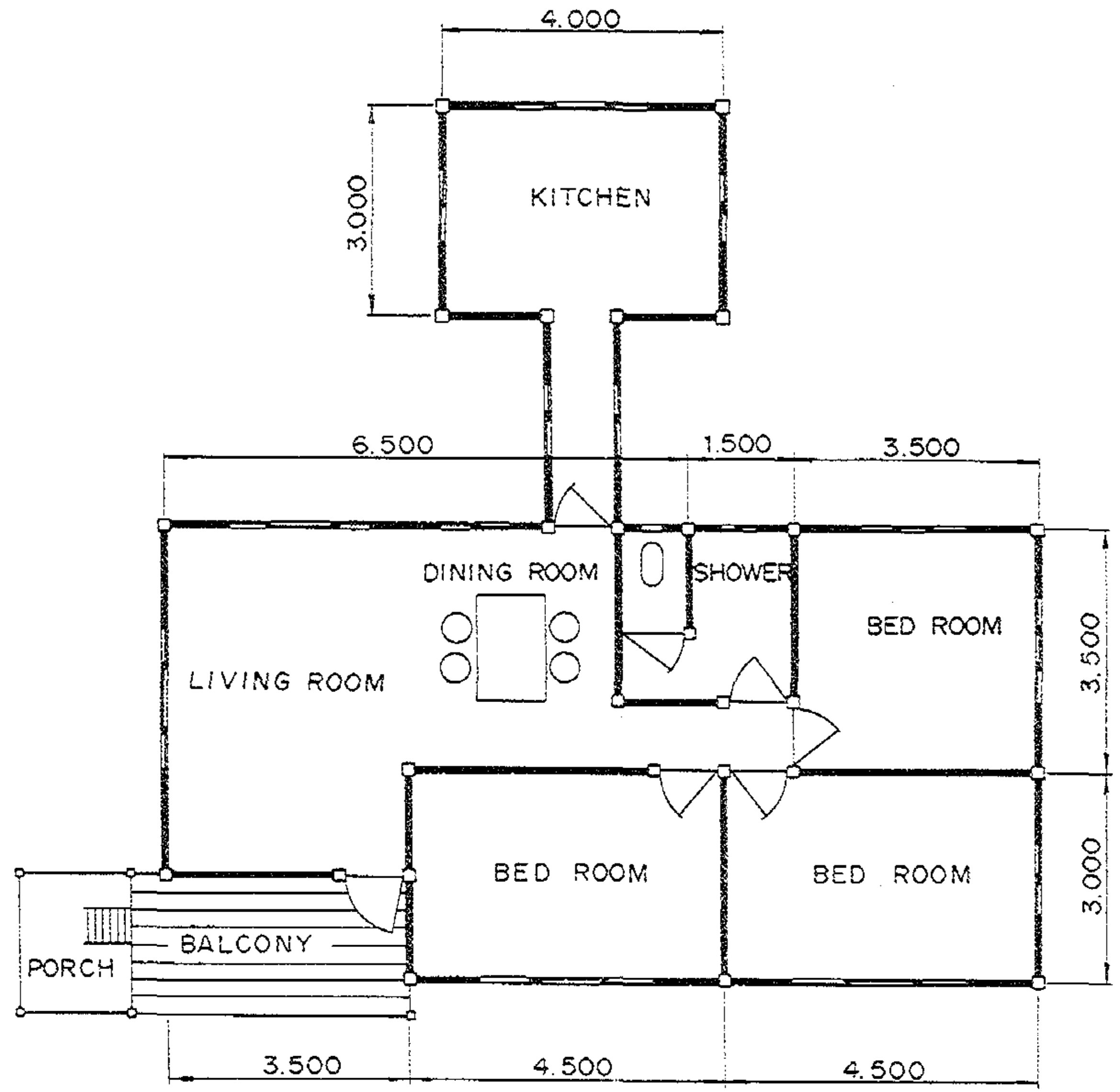
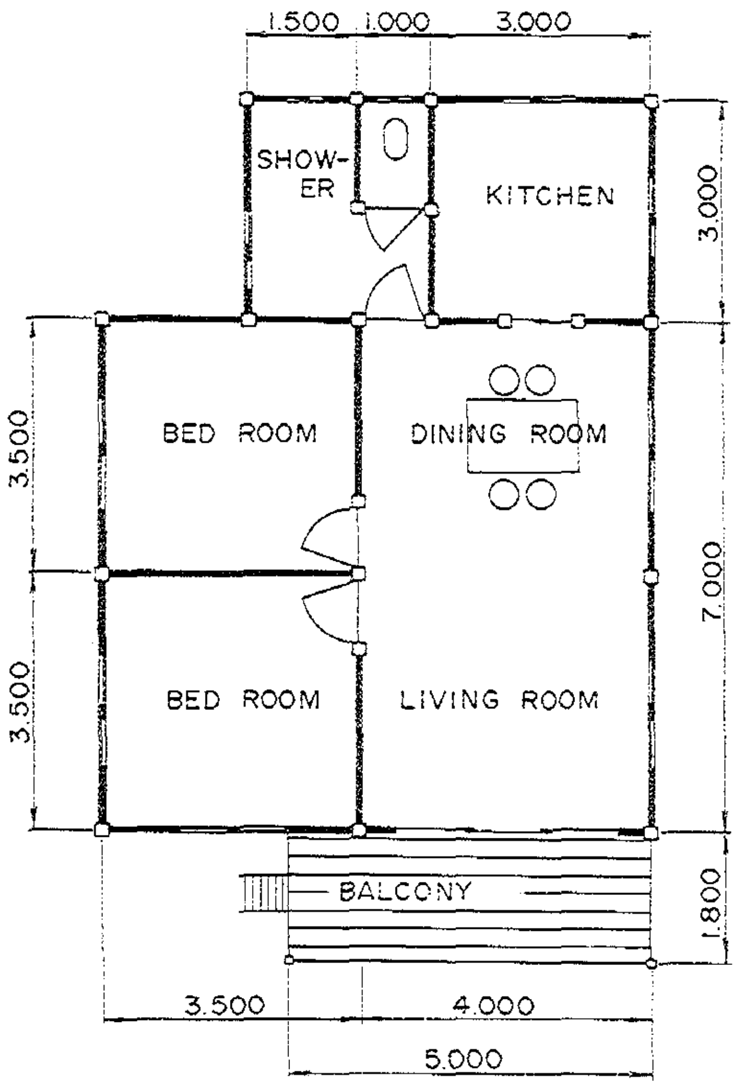


Fig. 7-21 HOUSING

FOR STAFF MEMBER



FOR SKILLED LABORER

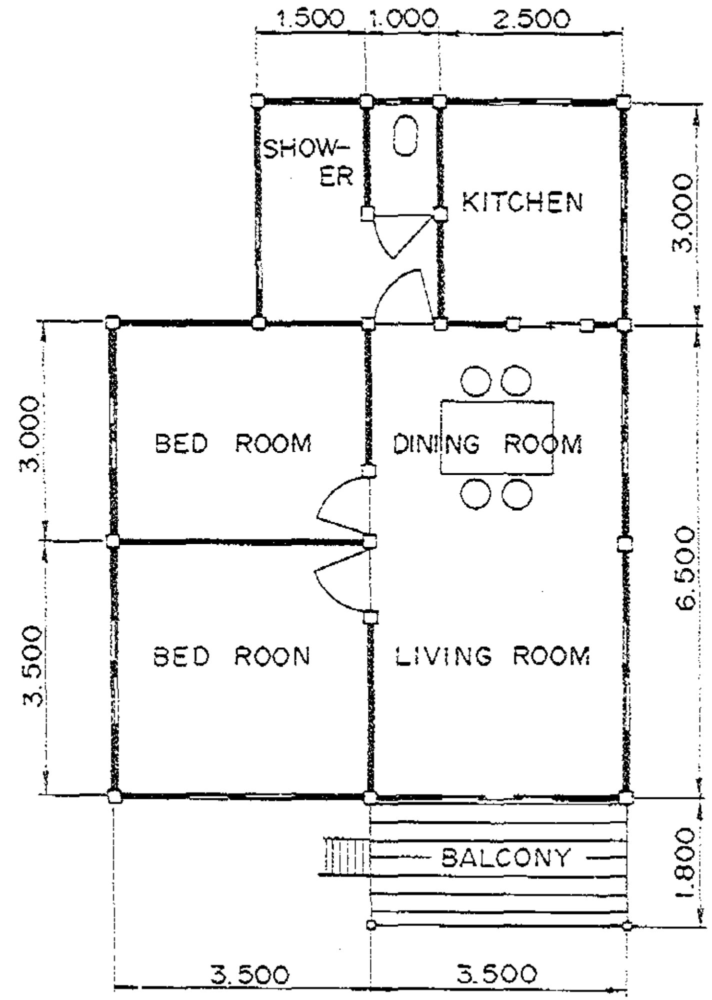
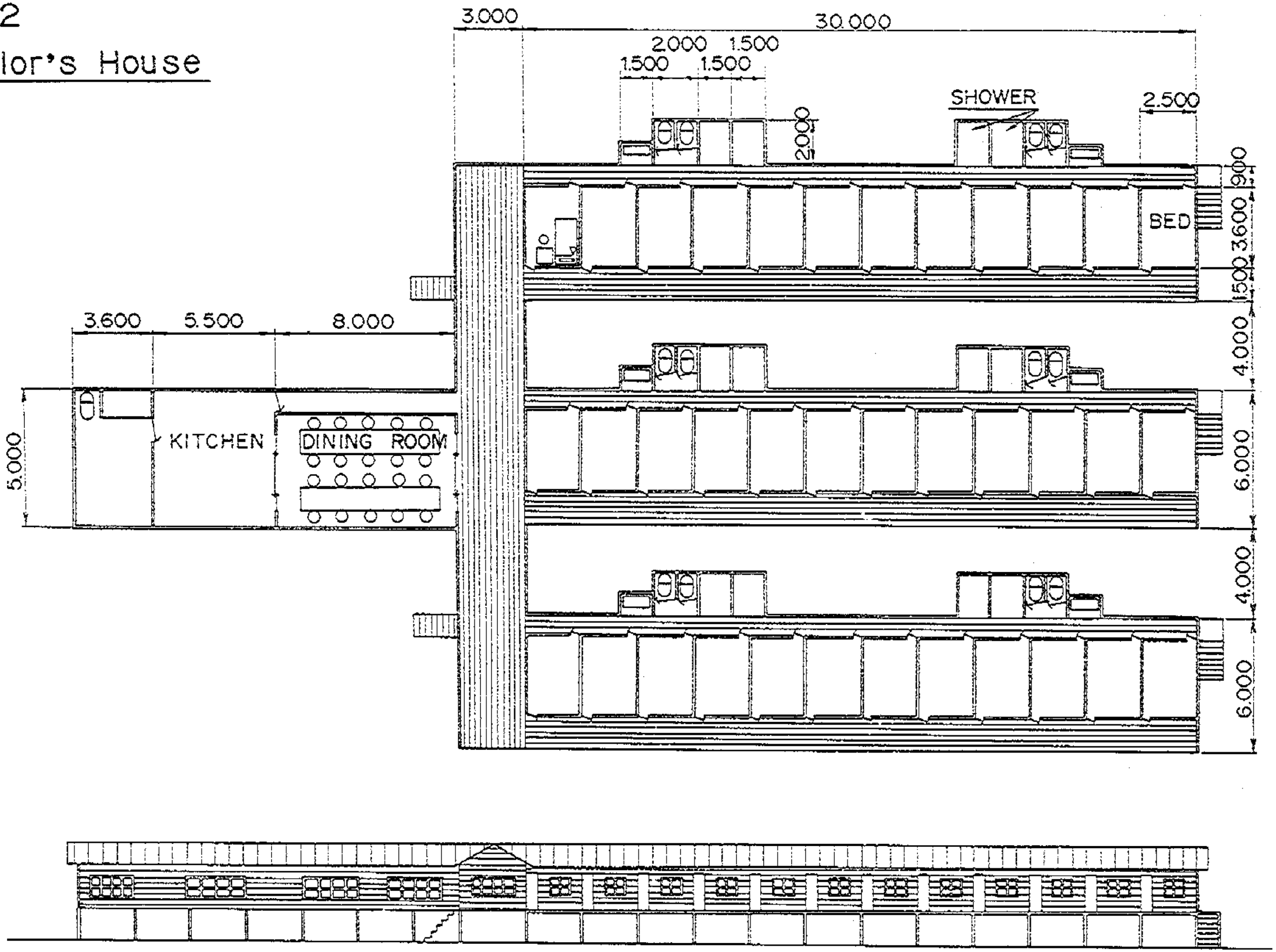
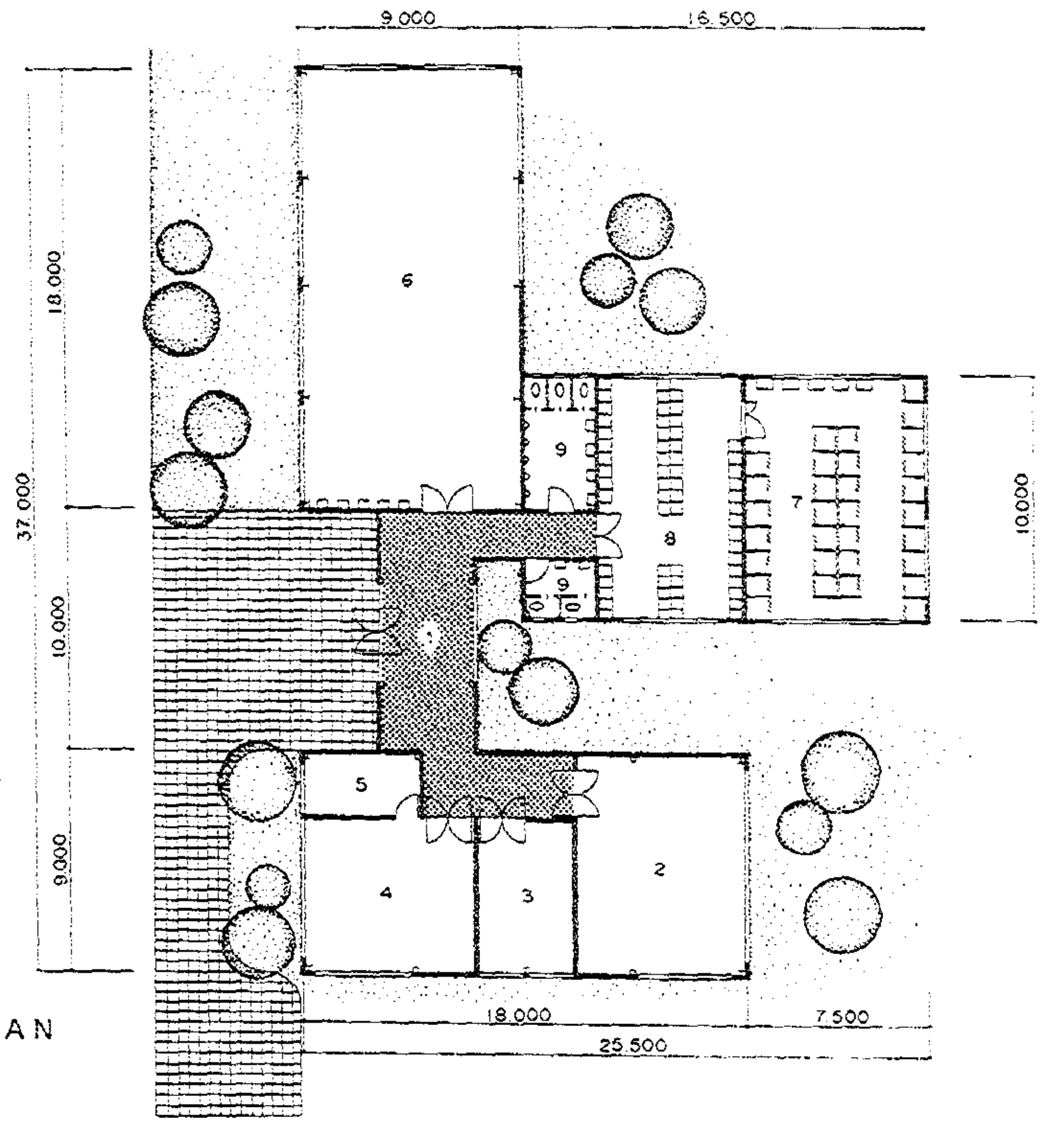


Fig. 7-22

Bachelor's House



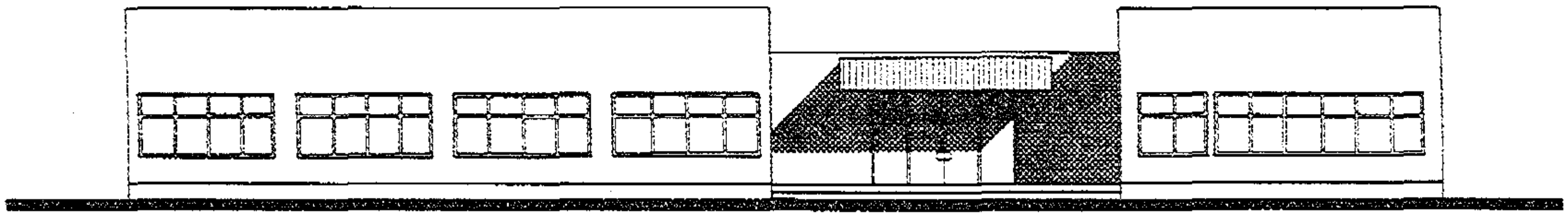


PLAN

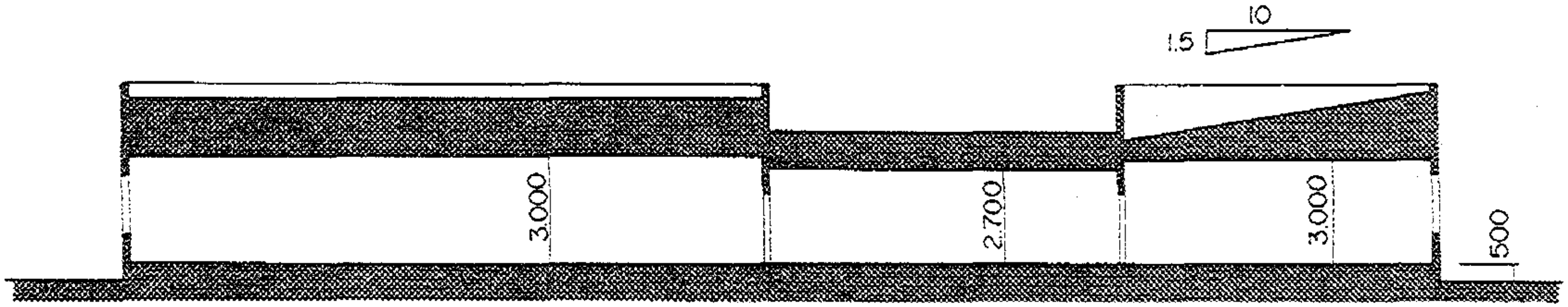
LEGEND

1 ENTRANCE HALL
2 OFFICE
3 RECEPTION ROOM
4 DRAWING ROOM
5 COPYING ROOM
6 DINING ROOM
7 SHOWER ROOM
8 LOCKER ROOM
9 LAVATORY

Fig. 7-23 ADMINISTRATION OFFICE



ELEVATION



SECTION

Fig. 7-24 ADMINISTRATION OFFICE