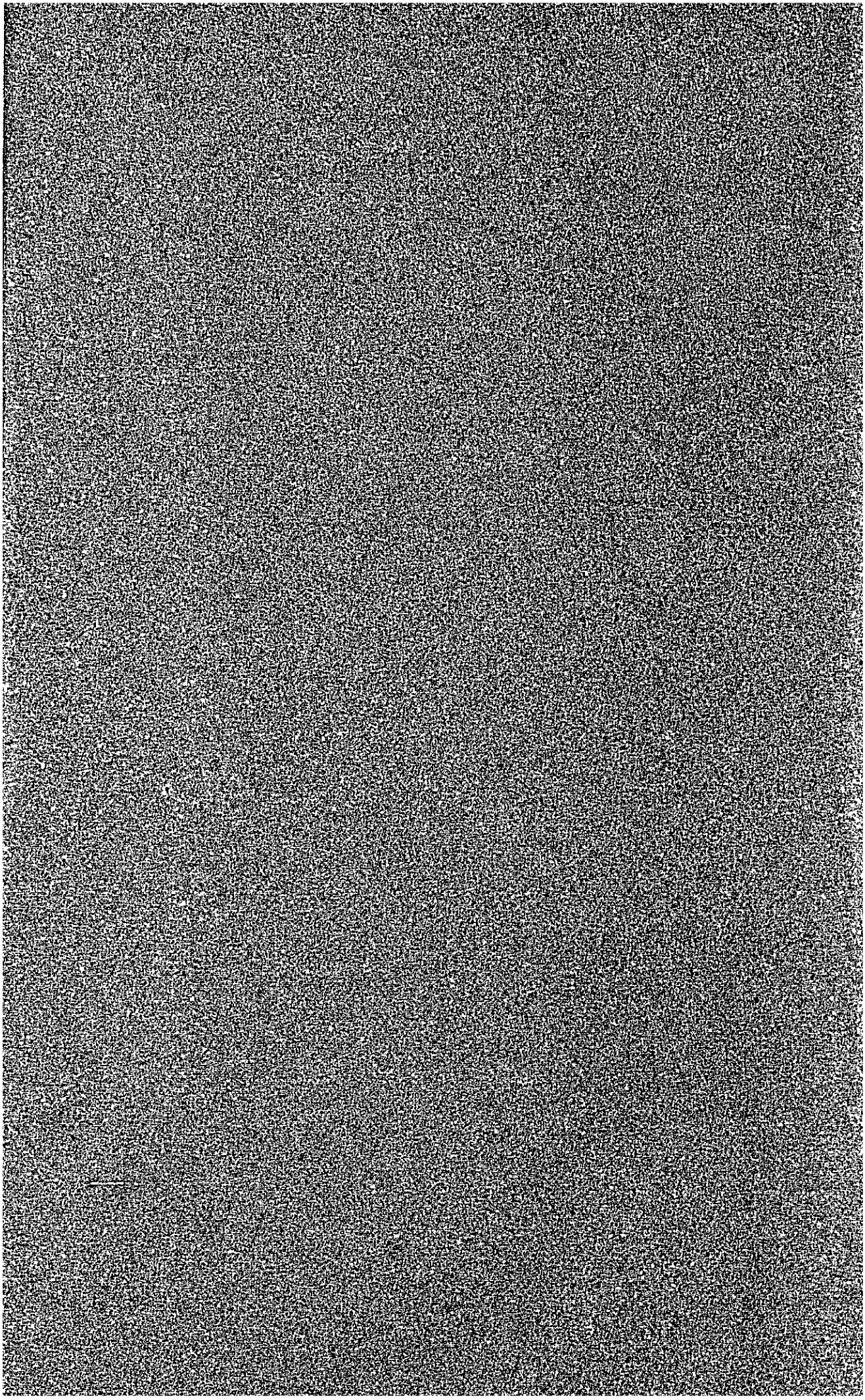
BACKGROUND INFORMATION



GENERAL INFORMATION

BACKGROUND INFORMATION I

I-1 OUTLINE OF BURMA

(1) Position

The Socialist Republic of the Union of Burma (hereafter referred to as Burma) is situated in the western part of Indochina in Southeast Asia, occupying an area extending from Lat. 10° to 28° N and from Long. 93° to 103° E. Burma is bordered by Thailand with the mountain ranges of Dawna and Bilauktanung in the east. The upper stream of the Mekong forms part of the border in the northeast between Burma and Laos; the mountain area of the upper stream of the Salween forms most of the remaining border in the northeast with China. In the west, the mountain ranges of Patkai and Arakan-Yoma form the border with India and Bangladesh.

(2) Area

The total land area of Burma is about 678,000 m^2, or about 1.8 times that of Japan.

(3) Topography

The topography of Burma is high in the north and law in the south. In the northeast lies the Shan Plateau, rich in mineral resources, and the Arakan runs through the northwest. The Shan Plateau, with an elevation of 1,000-1,500 m, forms a large area of tableland, extending from the Yun'nan Province of China in the north to Laos in the east, and continuing to the Tenasserim Mountains in the south.

The Arakan extends from the hills of Chin and Naga in the north to the Patkai Mountains. Many branches of the Irawaddy River form valleys in the Arakan, and the section which is furthest upstream

forms the Manipur Basin containing Imphal. The southern end of the Arakan reaches the sea at Negrais Point.

The southern part of Burma is an extensive delta formed by the three major rivers, Irawaddy, Sittang, and Salween, which flow into the Andaman Sea. This world-famous rice producing area forms the heart of Burma with Rangoon, the capital, at its center.

(4) Population

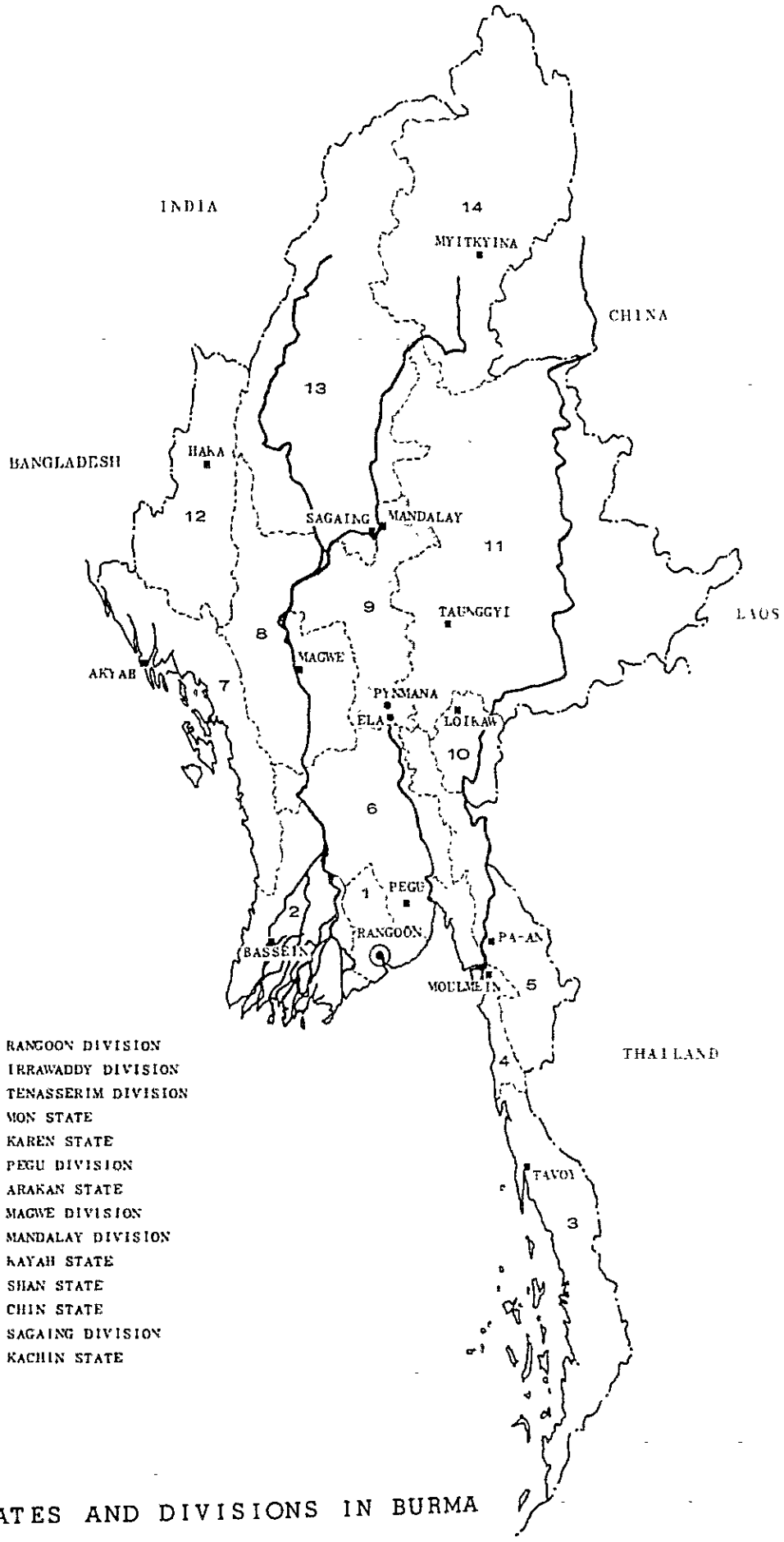
The total population of Burma is 31,510,000 (1977 estimate) with a population density of 46.5 persons/km^2, and increasing at the high rate of 2.2% (1977-78 average).

(5) Ethnology

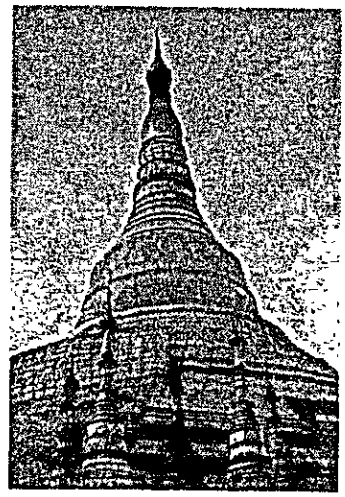
The Burmese, who speak a Tibetan-Burmese language, account for about 60% of the total population. The Shan tribe, numbering about 1,200,000 and inhabiting the north of the Shan Plateau, and the Karen tribe in the south of the plateau, numbering about 1,500,000, form the most important minority tribes in the country. In addition, there are about 50 other tribes such as the Kachin tribe in the hills to the north, numbering about 400,000,and the Chin tribe of the Arakan-Yoma Mountains, numbering about 350,000.

Further, it is estimated that there are about 1 million Indians and 350,000 Chinese, living mainly in urban areas along the coast.

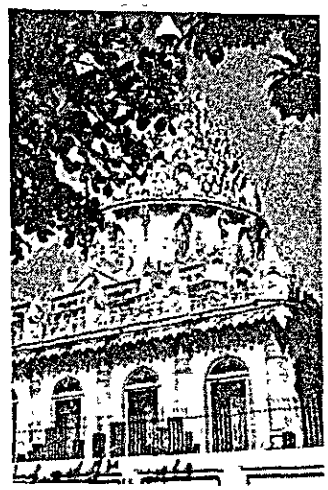
Buddhism (Hinayana) forms the major religion in the country with Buddhists accounting for 85% of the total population. Among other religions Moslems account for 4%, Hindus 4% and Christians 2%.

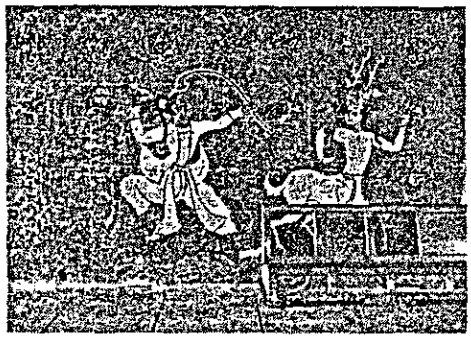


STATES AND DIVISIONS IN BURMA



SHWEDAGON PAGODA





IN RANGOON

I-2 BRIEF DESCRIPTION OF MINING INDUSTRIES IN BURMA

Burma is producing all sorts of mineral resources including not only oil and coal but also non-ferrous metals such as copper, zinc, lead, tin, tungsten, antimony, limestone and other ceramic materials, and precious stones. These industries were, for the greater part, started with British capital during the colonial period, but at present they are nationalized, and all exploitation and development is carried out by governmental organizations.

However, in the course of independence and socialist revolution after the war, development and production of mineral resources have been restrained in spite of the efforts of the authorities concerned. This is largely due to a shortage of skilled engineers, obsolete production and transport equipment. Thus development and production presently fall short of the level achieved prior to the war or Revolution.

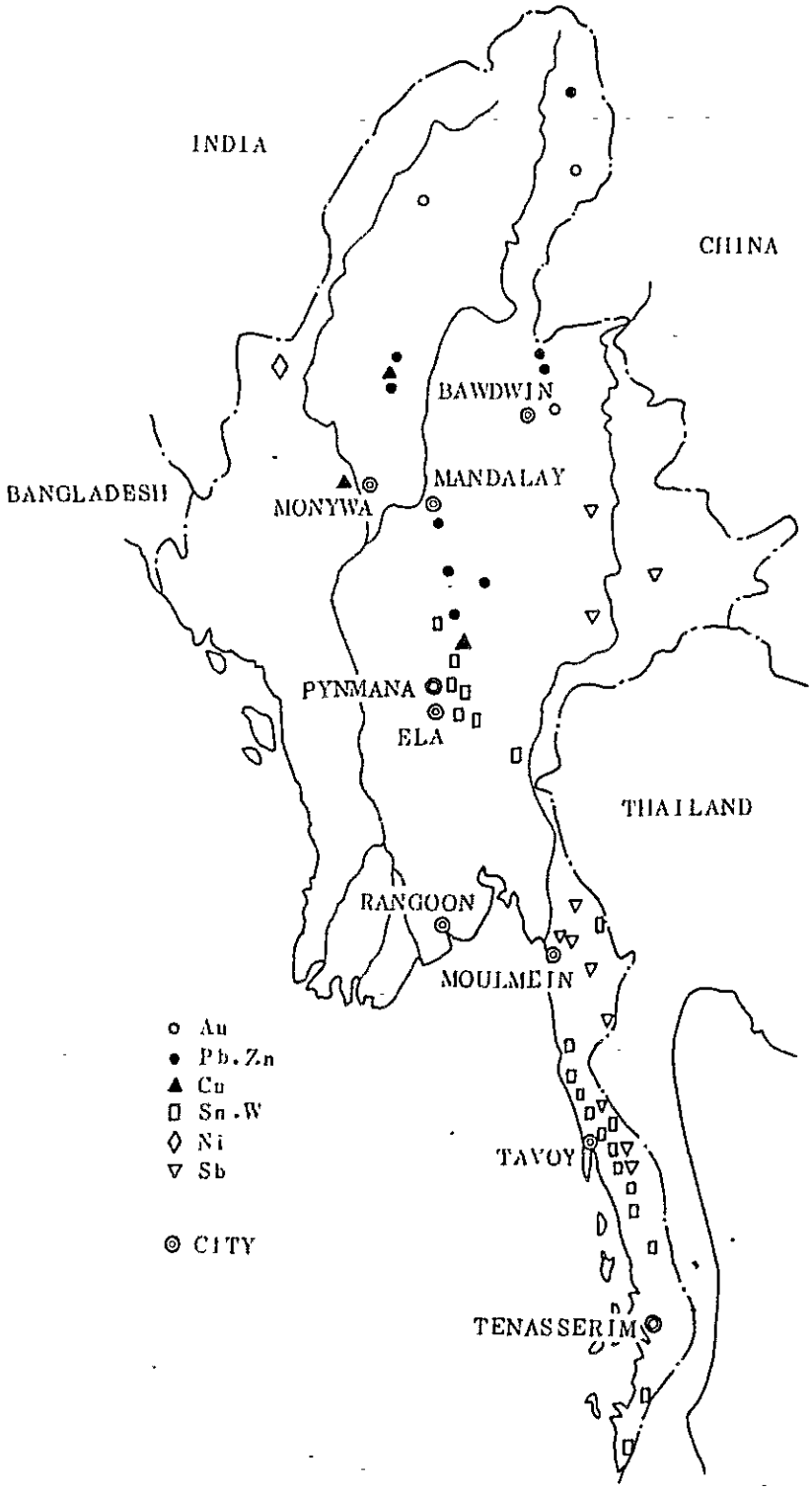
The field of non-ferrous metals is not an exception, and only the Bawdwin Mine, noted from the pre-war period, and a few other mines are being operated on a relatively small scale. For smelting and refining works, for example, there is at present only the Namutu lead smelter which processes the lead concentrate from Bawdwin mines.

Ore reserves of these underground mineral resources are considered to be of a considerable scale if the geological structure of Burma, output in the pre-war period, and the results of exploratory activities conducted after the war are all taken into account. When compared with adjacent countries, the development of underground resources in this country is still in its very early stages, and there are tremendous possibilities for further exploration and development in the future. The country thus has a promising future, and it is not too much to

say that it is a treasury of underground resources in the Southeast Asian region.

For example, the Monywa Mine (copper), on which the Government of Japan previously conducted a G/G cooperative survey, is of a world scale, with deposits as great as 200,000,000 tons including that of Letpadaung in the vicinity. Further, the area lying between Bawdwin and Bosaing Mines is the site of promising lead and zinc mines, and the area extending from Tenasserim to Shan State is positioned over a great tin-tungsten belt running, from Malaysia across Thailand to Yunnan Province of China, and thus has a number of mines.

The Government of Berma is fully aware of the importance and excellent prospects for the development of underground mineral resources, and is giving the mining industry a priority second only to agriculture and forestry, producing mainly rice and hard wood. The mining industry has priority over the manufacturing industry as an important source of raw materials and fuels to be supplied to the processing and production divisions, and for earning of foreign exchange. The government is exerting efforts for the development of oil and natural gas and, at the same time, is showing extraordinary zeal in developing non-ferrous metals, mainly copper, lead, zinc, tin and tungsten, and in improving the standard of processing.



DEPOSIT OF NONFEROUS METALS IN BURMA

I-3 METEOROLOGICAL OUTLINE OF BURMA AND THE PYNMANA-ELA AREA

I-3-1 METEOROLOGICAL OUTLINE OF BURMA

The climate of Burma can be generally classified into three seasons, namely

- Hot season: From late February to mid-May
- Wet Season: From late May to mid-Octover
- Cool Season: From late October to mid-February

December and January are the most comfortable months of the year. In comparison to the wet season, the other seasons are sometimes known as the dry season.

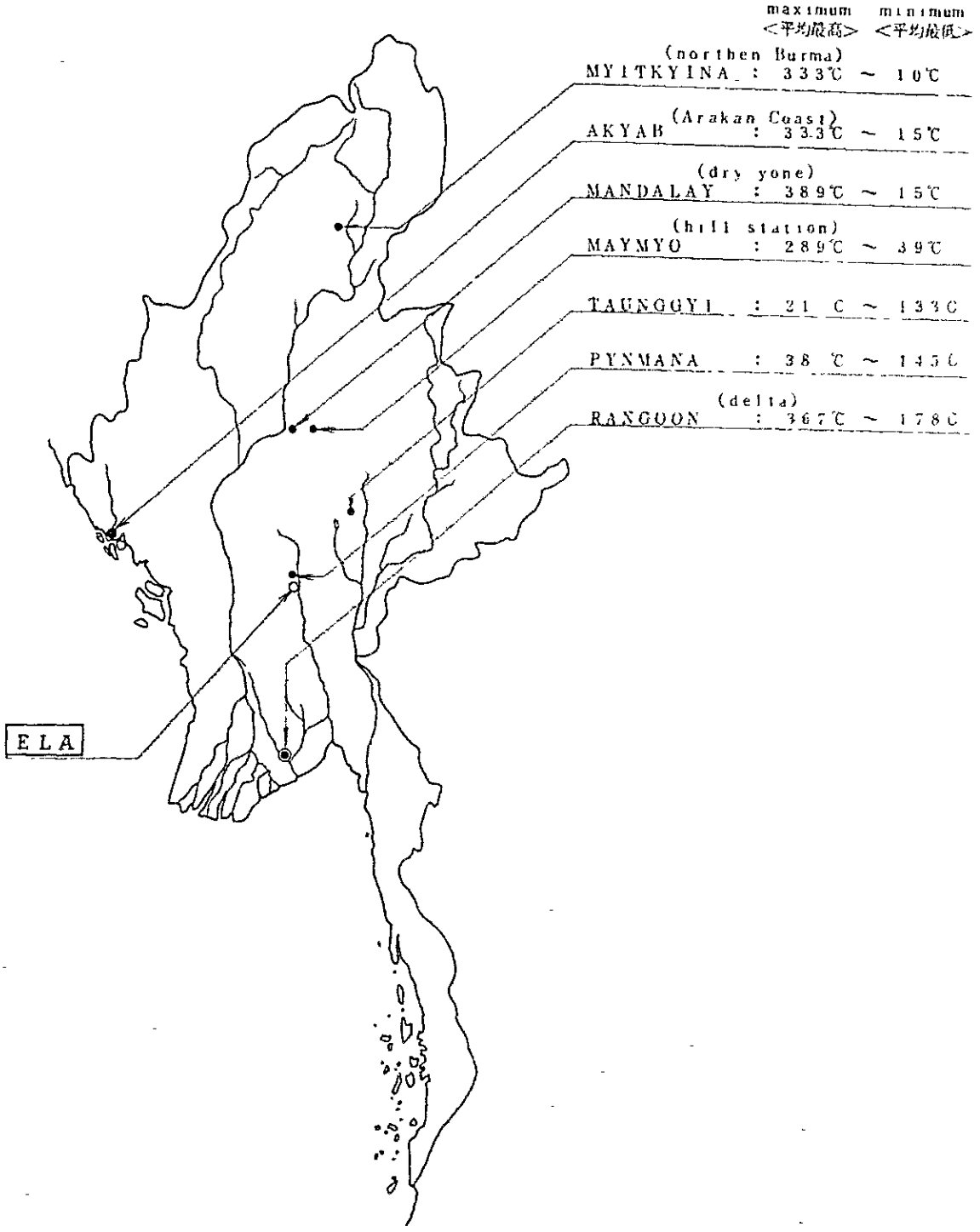
However, Burma has a large land area, approximately 1.8 times the area of Japan, Northern Burma belongs to the subtropical zone, while Central Burma and Southern Burma belong to the tropical zone. Moreover, the climate of various parts of Burma varies according to the distance from the coastal line and with the topography. Therefore, it is difficult to generalize about the temperature, humidity etc., of Burma as such, but the average characteristics may be described as follows;

During the wet season, which lasts half the year, the humidity is high and it is not rare for it to exceed 90% in the period from July to September. During this season, squalls are observed daily. The monthly rainfall during the period from June to August exceeds 500 mm in the coastal areas, but the rainfall decreases gradually towards the interior.

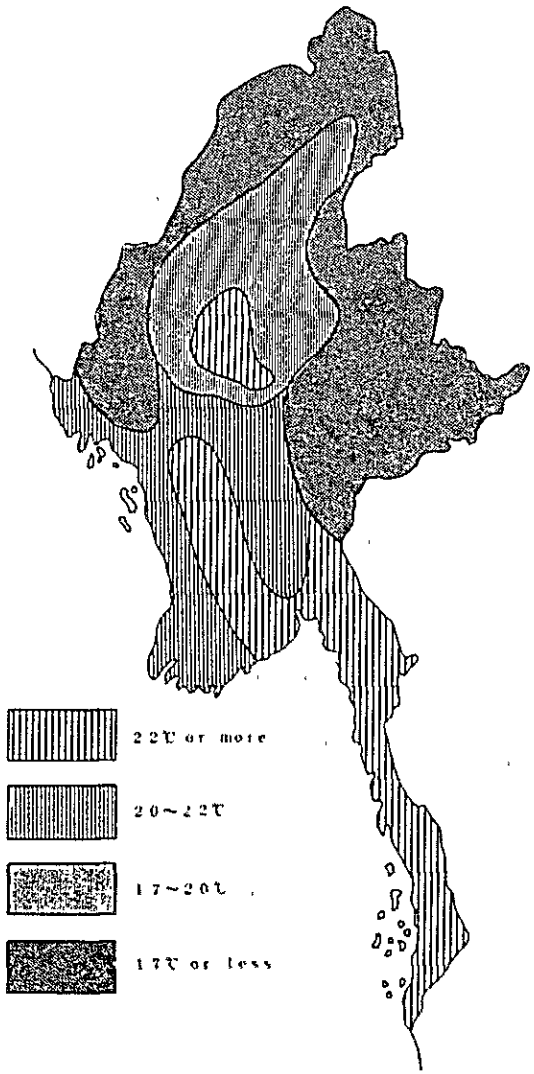
Although the rainy season is long, the rain does not fall all day long, and the maximum temperature is generally 25°C - 27°C, which is not very high. Therefore it is not as gloomy as one could expect. Sweltering weather is felt only during the period just before the beginning of the rainy season, when the average monthly temperature is more than 30°C.

During the dry season, from November to April, rainfall is practically nil, and clear weather prevails until the sky becomes cloudy with mist during the latter half of the dry season.

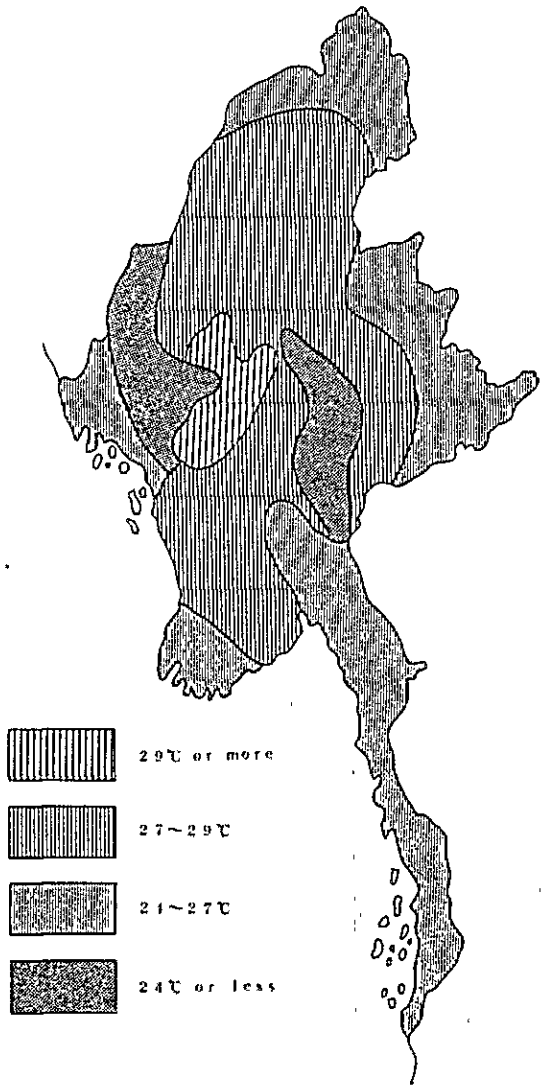
Although the climate is similar to that of the tropical zone of Asia, wind direction differs during winter and summer due to monsoons. During the winter season, north to northeast winds predominate from the continent towards the ocean, while south to southwest winds from the ocean towards the continent predominate during the summer.



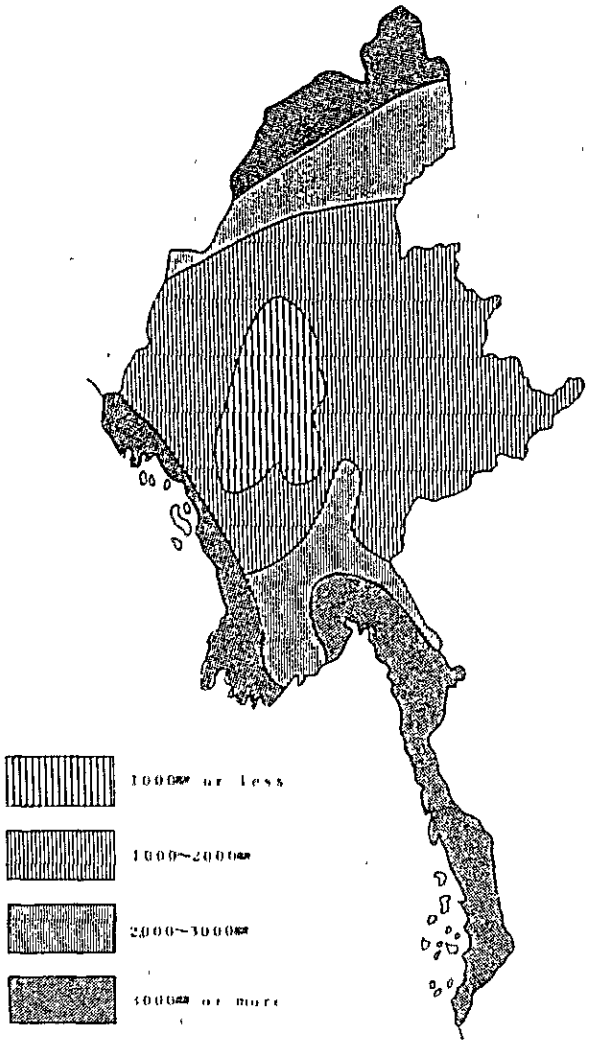
THE AVERAGE OF ANNUAL MAXIMAM AND MINIMUM TEMPERATURE



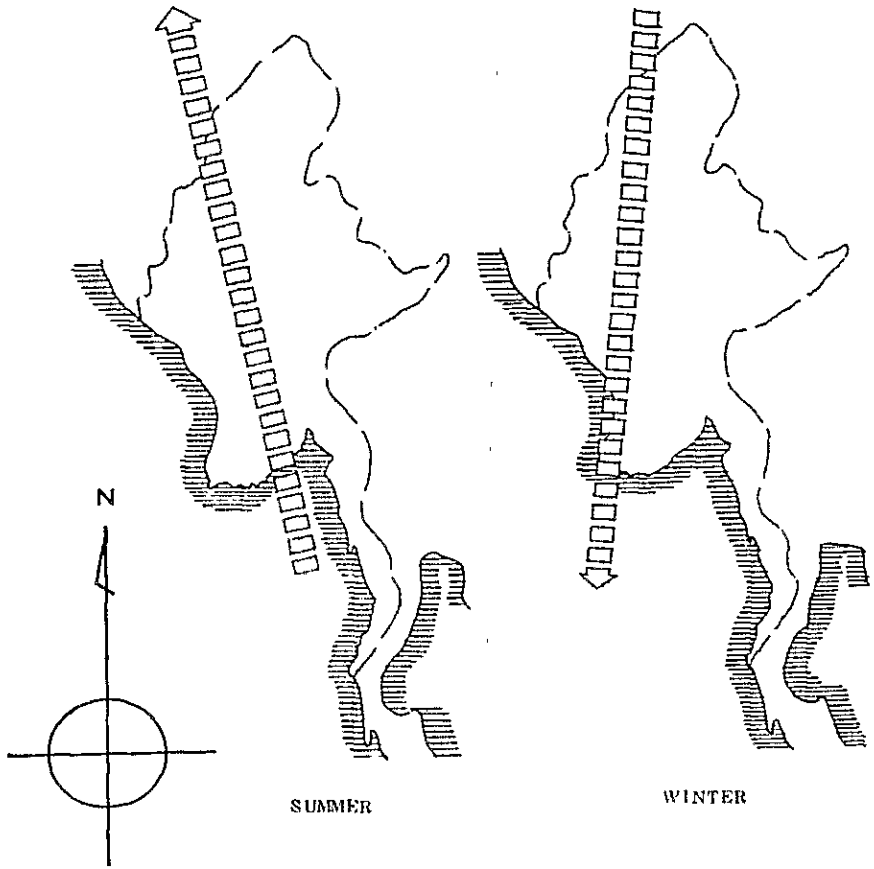
MONTHLY AVERAGE TEMPERATURE IN JANUARY



MONTHLY AVERAGE TEMPERATURE IN JULY



ANNUAL RAINFALL IN BURMA
(AVERAGE OF 1965~1974)



PREVAILING WIND DIRECTION IN BURMA

I-3-2 METEOROLOGICAL OUTLINE OF THE PYNMANA-ELA AREA

The climate of the Ela area where the site for this project is located can be summarized as an Inland Tropical Monsoon Climate.

Meteorological data of Pynmana City, which is 15 km due north of the Ela area, are shown in figures as the average for the 14-year period from 1955 to 1968. Although there are no data available for the Ela area itself, the above data are applicable.

The meteorological conditions of the project area for each season may be summarized from the above figures as follows:

● Hot Season (from late-February to mid-May)

* The monthly mean daily maximum temperature approaches 40°C.
* The humidity is around 60% in the mornings, while it is around 40% in the evenings. Although the difference between morning and evening is relatively large, the humidity level is remarkably low compared to that in other seasons.
* There is almost no rainfall during March and April.
* South to South-East winds predominate.

● Wet Season (from late-May to mid-October)

* The monthly average humidity sometimes reaches even 80% - 85%. On the other hand, due to lack of sunshine the temperature is generally low, and the monthly mean daily maximum is as low as 30°C.
* The rainfall is high with 230mm per month and it reaches 300mm in August.
* South winds predominate.

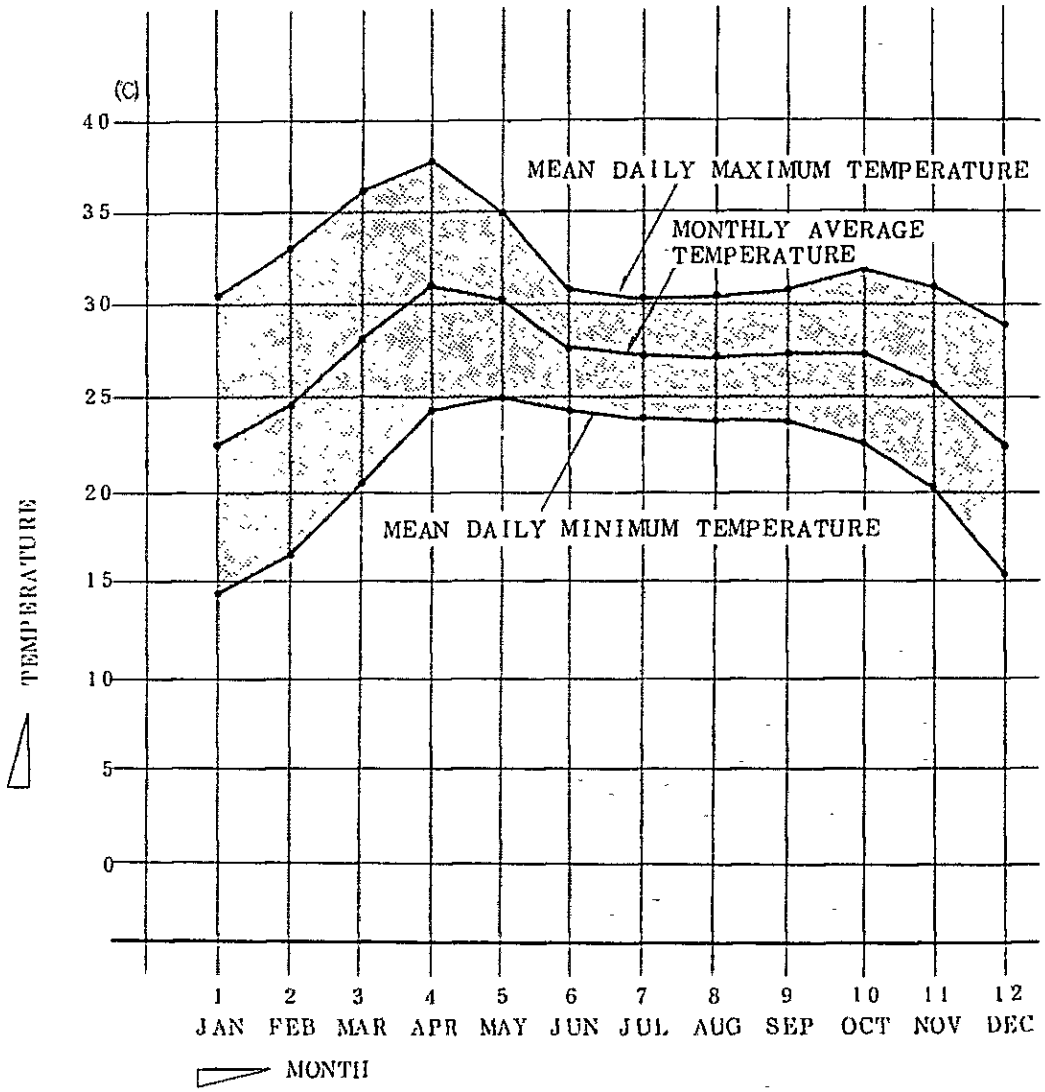
- Cool Season (from late-October to mid-February)
  - * Although the monthly mean temperature is less than 25°C, the diurnal fluctuation is more than 15°C.
  - * Humidity is 60% - 70%.
  - * Rainfall is almost nil.
  - * North and northeast winds predominate.

The annual rainfall is 1370 mm which is almost equal to the 1500 mm rainfall in Tokyo. However, rain is concentrated during the rainy season with practically no rain in the other seasons.

This annual rainfall level is about one-half of that in Rangoon (at about 2600 mm) and is rather low for Burma.

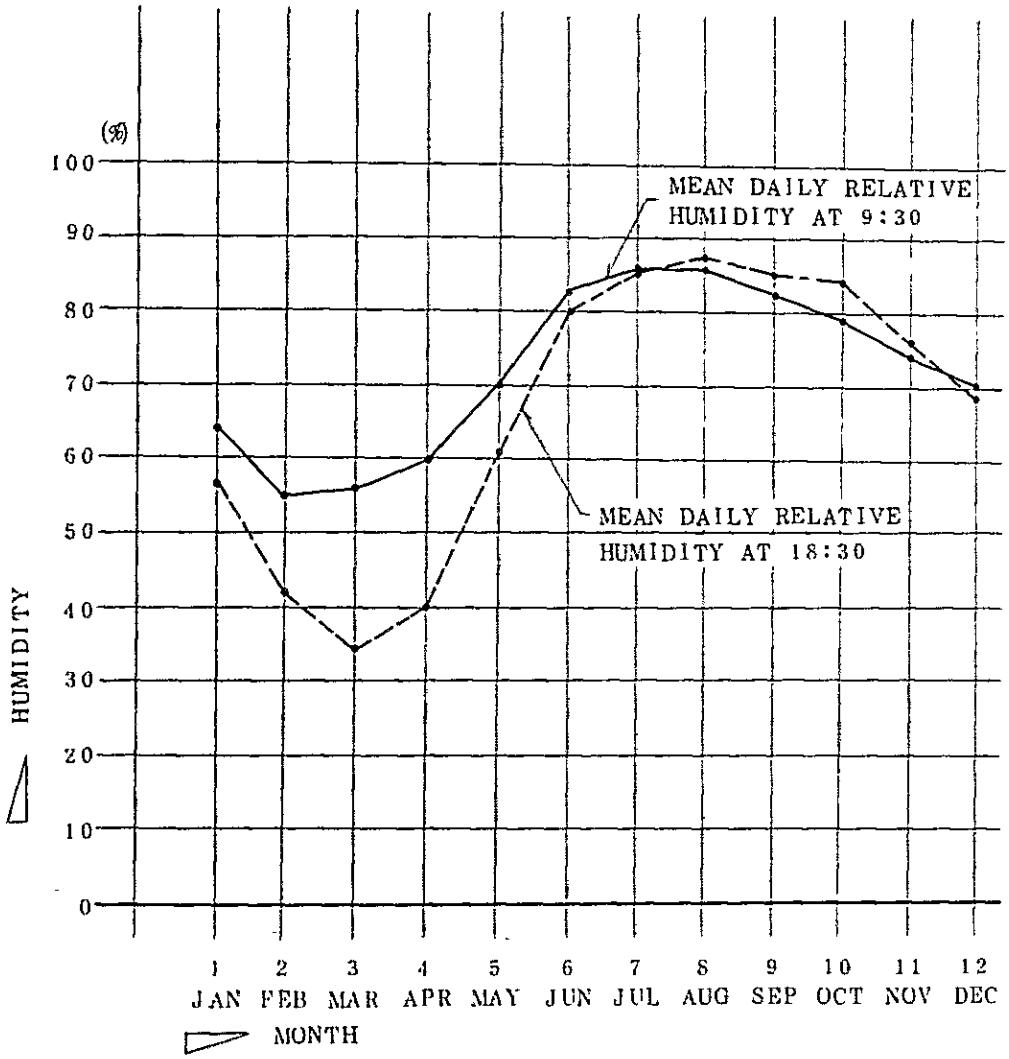
South winds predominate during the season, but the direction of wind moves gradually anticlockwise from the southeast, through east-northeast at the beginning of the cool season until ultimately, north winds become predominant in December and January. As the cold season comes to an end, the direction of wind changes again in a clockwise direction, and south winds become predominant in April. Throughout the year there are practically no west winds.

Although there are few gales due to tropical monsoons in the Ela area, gusts occur quite often and the maximum wind velocity recorded is 84 miles/hour (37.5 m/sec). The period of observation is not clear, but it is thought that the statistical data covered about 15 years.

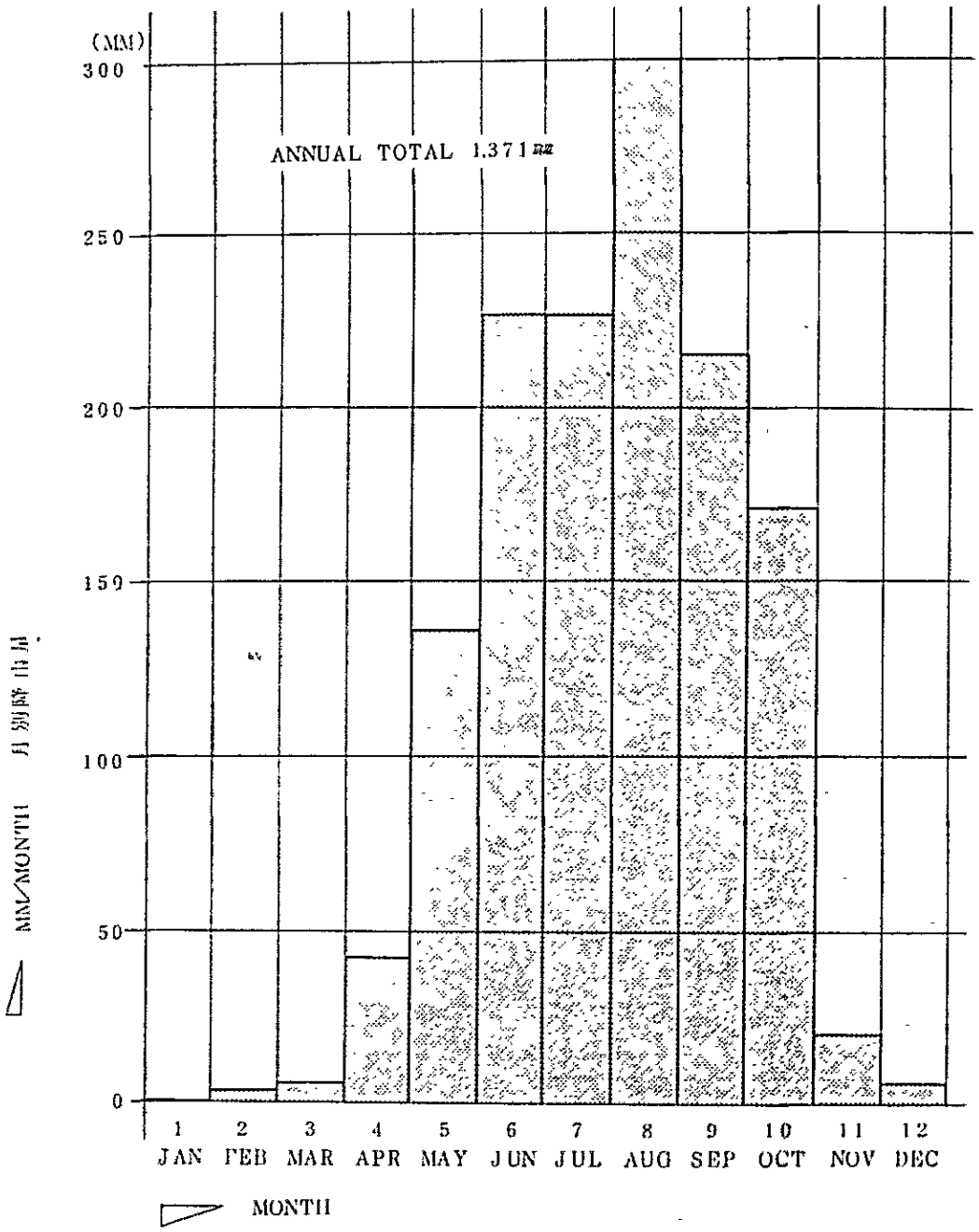


TEMPERATURE IN PYNMANA

(AVERAGE OF 14 YEARS 1955~1968)

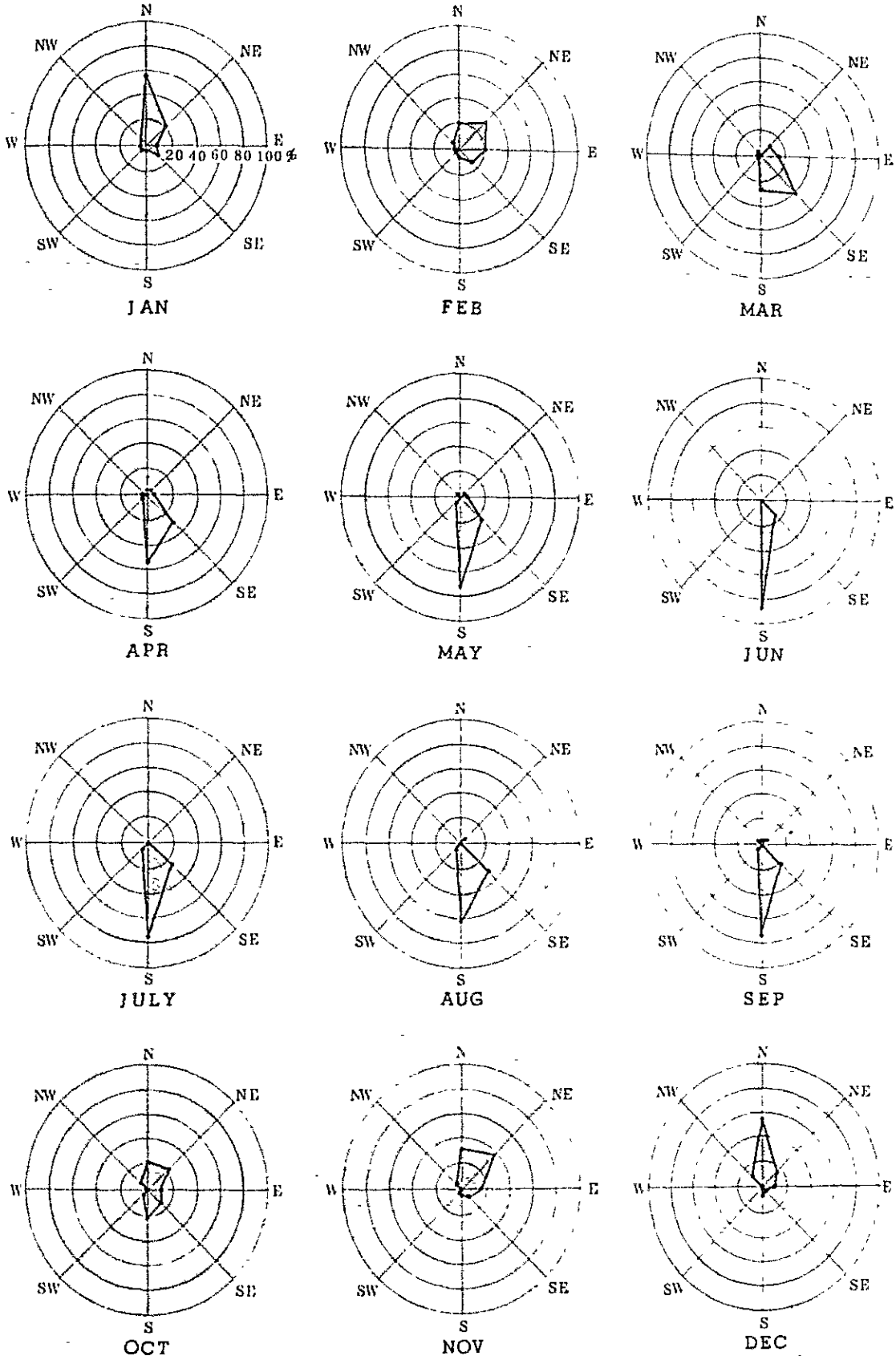


RELATIVE HUMIDITY AT PYNMANA
(AVERAGE OF 14 YEARS 1955~1968)



RAINFALL IN PYNMANA

(AVERAGE OF 14 YEARS 1955~1968)



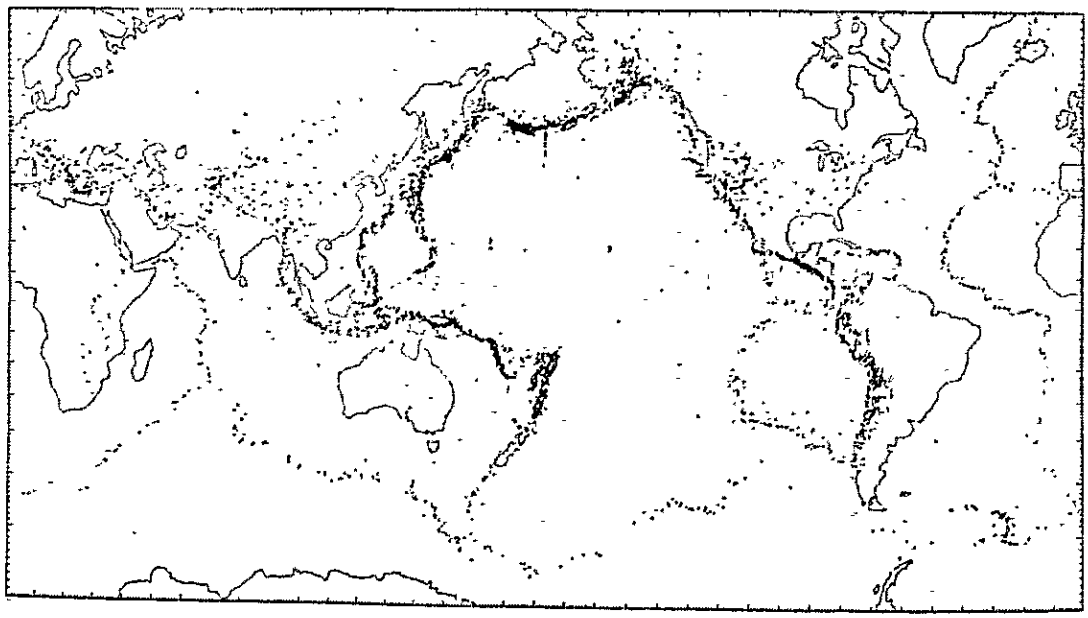
WIND DIRECTION DIAGRAM OF PYNMANA

I-4 EARTHQUAKES IN BURMA AND THE PYINMANA-ELA AREA

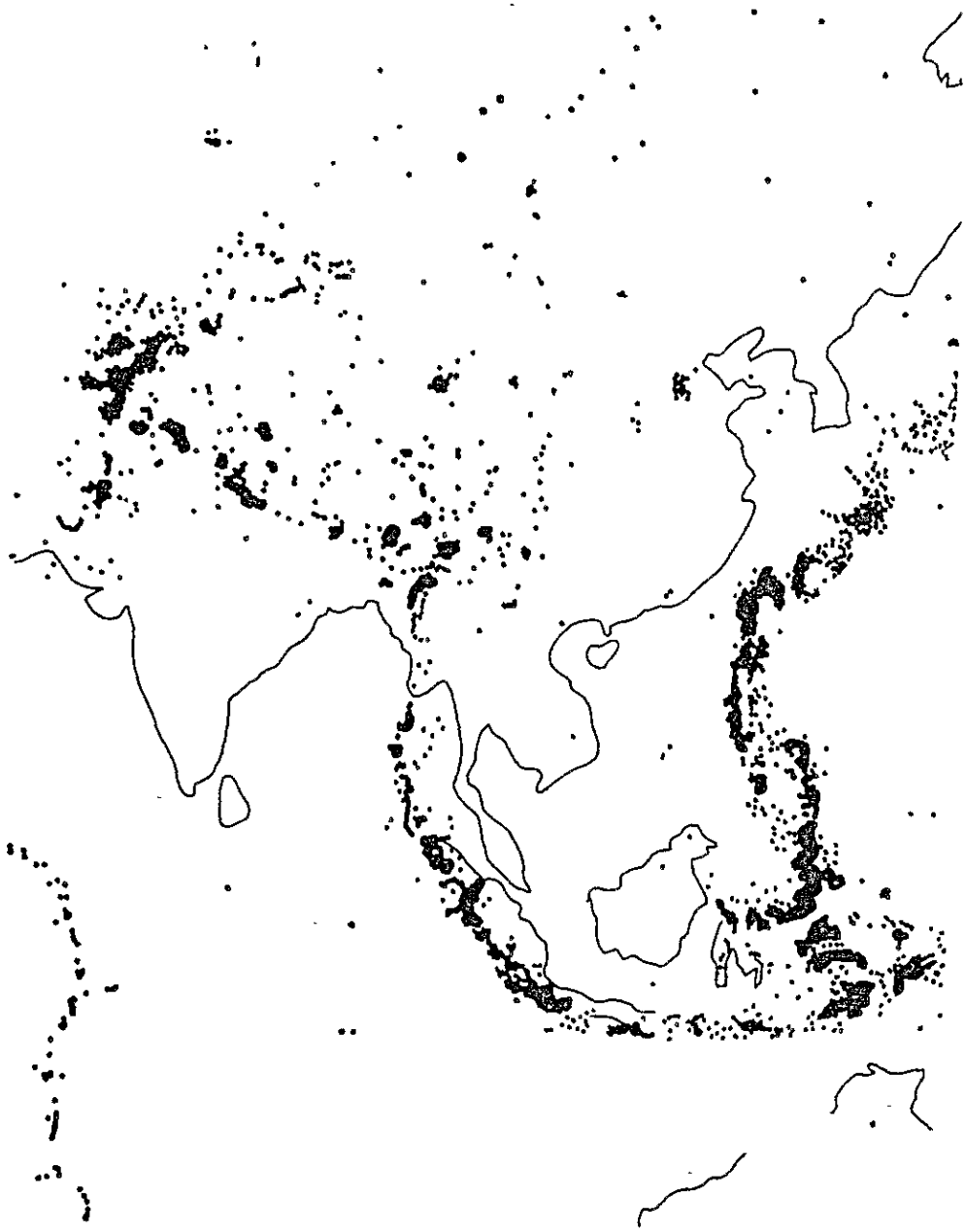
With the Eurasian Seismic Belt traversing the western part of Burma, earthquakes occur frequently.

The Pyinmana-Ela area faces the Sittaung Fault, the great boundary fault running north to south from the vicinity of Schewebo through the Sittaung Valley to the Gulf of Martaban.

Great earthquakes in this area that have been recorded include the earthquake of 23 May 1912 (Epicentre: 21°N, 97°E Magnitude 8) and that of 3 December 1930 (Pyu Earthquake: Epicentre 18°N, 96.5°E), the intensity of the latter being recorded at about VIII according to the Modified Mercalli Earthquake Intensity Scale (hereafter referred to simply as MM). Further, there was an earthquake of moderate intensity on 8 October 1931. This earthquake had its epicentre in the vicinity of Pyinmana.

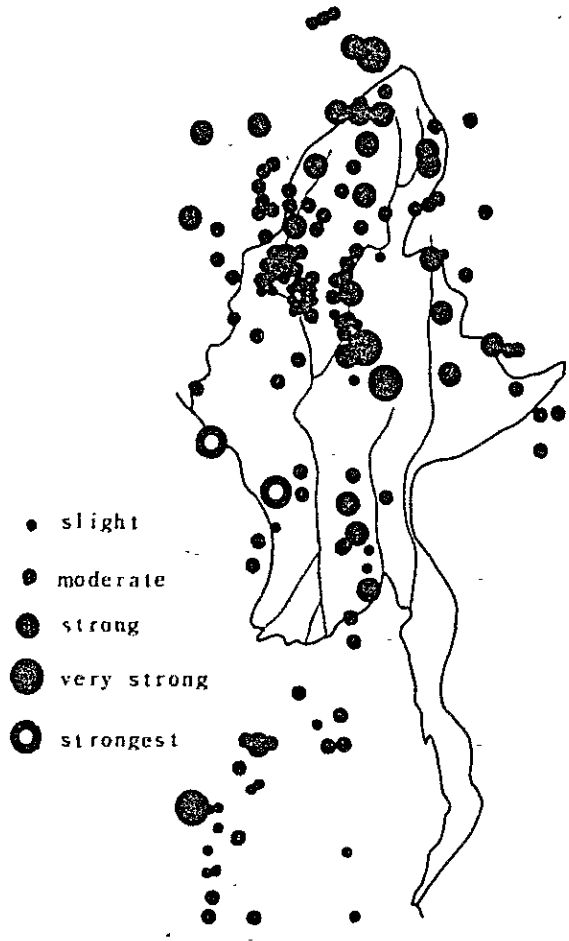


GLOBAL EARTHQUAKE DISTRIBUTION
(ACCORDING TO M·BARAZANGI AND J·DORMAN)



EPICENTER DISTRIBUTION IN SOUTHEAST ASIA

(1961~1967·DEPTH 0-100Km)



EPICENTRE DISTRIBUTION IN BURMA

(1) Earthquake Intensity Distribution in Burma

According to the Intensity Map of Burma obtained from the Construction Corporation, the Ela area, the site of construction, is located on the boundary of MM VII and VIII. Such MM intensity corresponds approximately to intensity V (very strong earthquake) on the seismic intensity scale of the Meteorological Agency, Japan. In the following table the MM intensity scale is shown as it corresponds to the Meteorological Agency intensity scale. The extent of MM VII and VIII are also shown.

From the foregoing earthquake intensity of the Ela Area, the acceleration of ground motion at the time of an earthquake in the Ela area is estimated to be about 150 gal maximum. Now, taking the static horizontal seismic factor (k=0.2) and acceleration of ground motion (200 gal) specified in the Building Standards Law of Japan, the static horizontal seismic factor for the Ela area may be taken to be approximately k=0.15.

Meteorological Agency Seismic Intensity Scale (Japan) and Modified Mercalli Earthquake Intensity Scale

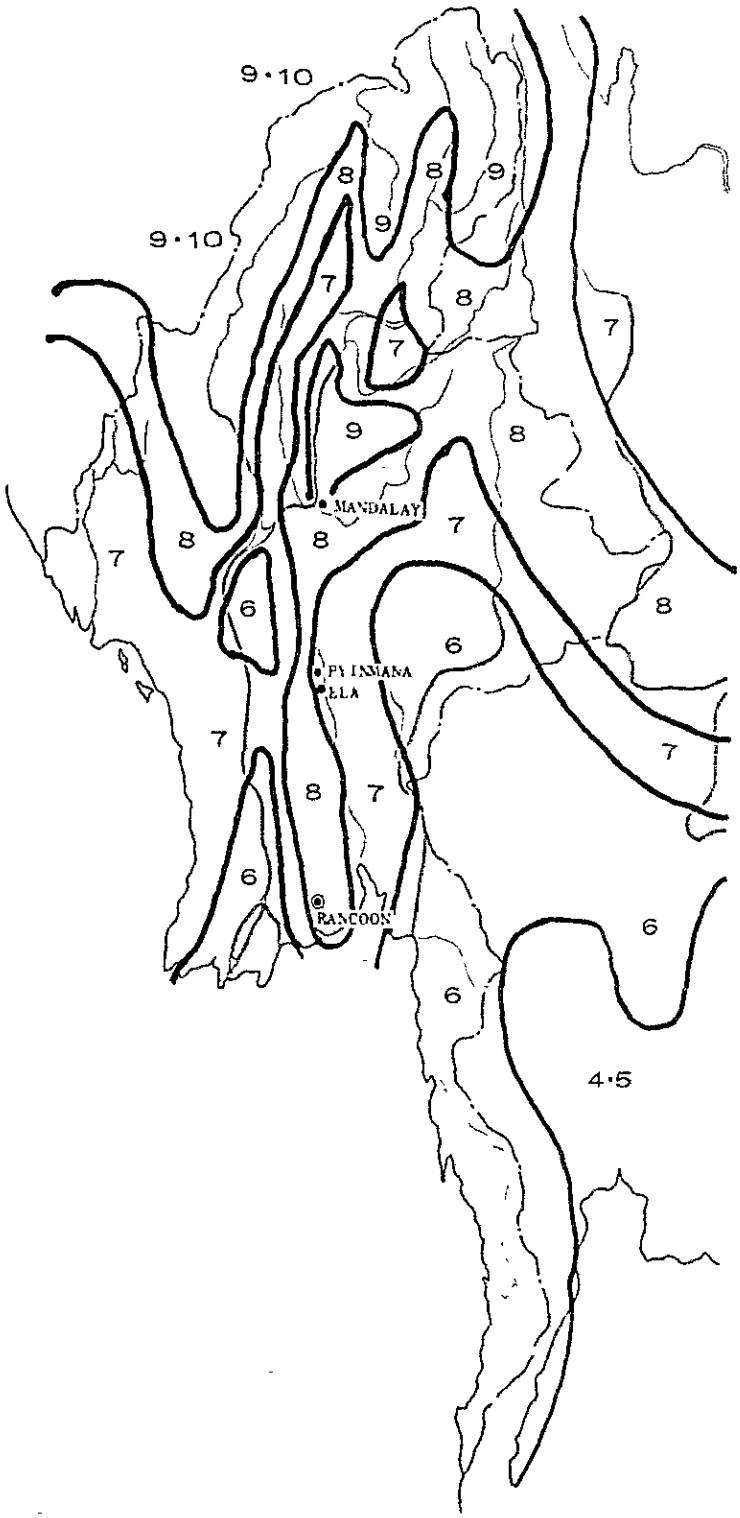
Meteorological Agency Seismic Intensity Scale (Japan)			MM(Modified Mercalli) Earthquake Intensity Scale	
0 :	Not sensed.	0.8 gal & less	Not sensed.	0.5 gal & less
I :	Slight earthquake	0.8 ∿ 2.5 gal	I :	0.5∿ 1.0 gal
			II :	1.0 ∿ 2.1 gal
II :	Weak earthquake	2.5 ∿ 8 gal	III :	2.1 ∿ 5 gal
			IV :	5 ∿ 10 gal
III :	Minor earthquake	8 ∿ 25 gal	V :	10 ∿ 21 gal
IV :	Strong earthquake	25 ∿ 80 gal	VI :	21 ∿ 44 gal
			VII :	44 ∿ 94 gal
V :	Very strong earthquake	80 ∿ 250 gal	VIII:	94 ∿ 202 gal
VI :	Violent earthquake	250 ∿ 400 gal	IX :	202 ∿ 432 gal
VII :	Severe earthquake	400 gal or more	X :	432 gal or more
			XI :	
			XII :	

(Note) gal: Unit of acceleration

MM (Modified Mercalli) Earthquake Intensity Scale

VII	44 ∿ 94 gal Almost all people running out of doors, and considerable damage done to unstable or poorly designed property.
VIII	94 ∿ 202 gal Considerable damage to strong buildings, collapse of chimneys, walls, monuments, etc. and household furniture falling. There is some spouting of sand and mud, and a change in the well water.

(Note) MM intensity scales VII, VIII correspond approximately to Meteorological Agency intensity scale V.



EARTHQUAKE INTENSITY MAP OF BURMA

(2) Earthquake-resistant Design Regulations Drafted for the Union or Burma

As further data concerning earthquakes, there is a draft of "Earthquake-resistant Design Regulations for the Union of Burma" proposed by the Japanese Earthquake Mission, headed by Mr. Syun-ichiro Omote.

The draft Regulations will be described briefly as follows.

1. Design Seismic Coefficient:-

1.1. The horizontal design seismic coefficient shall be determined by the following formula:

$K_h = n1.n2.n3.k_o$

where

k_h : Horizontal design seismic coefficient,

k_o : The Standard horizontal design seismic coefficient (=0.1),

n1 : Seismic zone factor,

n2 : Ground condition factor, and

n3 : Importance factor.

1.2. The vertical design seismic coefficient, k_v may generally be considered as zero.

2. Factors for Modifying the Standard Horizontal Design Seismic Coefficient:-

2.1. Seismic Zone Factor:-

Seismic zone factor shall be determined in accordance with Table 1, in which the zone classification is determined from Fig. 1 (Seismic Zoning Map)

2.2. Ground Condition Factor:-

Ground condition factor shall be determined in accordance with Table 2. (Ground Condition Factor n2)

2.3. Importance Factor:-

Importance factor shall be determined in accordance with Table 3. (Importance Factor n3)

TABLE 1: SEISMIC ZONE FACTOR N1

Zone	Value of n1
A	1.0
B	0.7

TABLE 2: GROUND CONDITION FACTOR N2

Group	Definitions 1)	Value of n2
1	(1) Ground of the Tertiary era or older (defined as bedrock hereafter) (2) Diluvial layer 2) with depth less than 10 meters above bedrock	0.9
2	(1) Diluvial layer 2) with depth greater than 10 meters above bedrock (2) Alluvial layer 3) with depth less than 10 meters above bedrock	1.0
3	Alluvial layer 3) with depth less than 25 meters, which has soft layer with depth less than 5 meters	1.1
4	Other than the above	1.2

(Notes) 1) Since these definitions are not very comprehensive, the classification of ground conditions shall be made with adequate consideration of the bridge site.
Depth of layer indicated here shall be measured from the actual ground surface.

2) "Diluvial layer" means a dense alluvial layer such as a dense sandy layer, gravel layer, or cobble layer.

3) "Alluvial layer" means a new sedimentaty layer made by a landslide.

TABLE 3: IMPORTANCE FACTOR N3

	Value of n3
Public buildings	1.3
Dams	1.5
Bridges	1.0
Harbour structures	1.0

Now, applying the foregoing coefficients n_1, n_2 and n_3 to the actual construction site,

n_1 = 1.0 (Zone A)
n_2 = 1.1 (Group B)
n_3 = 1.3 (Public buildings).

Then, $k_h = n_1 \times n_2 \times n_3 \times k_0 = 1.0 \times 1.1 \times 1.3 \times 0.1 = 0.143$

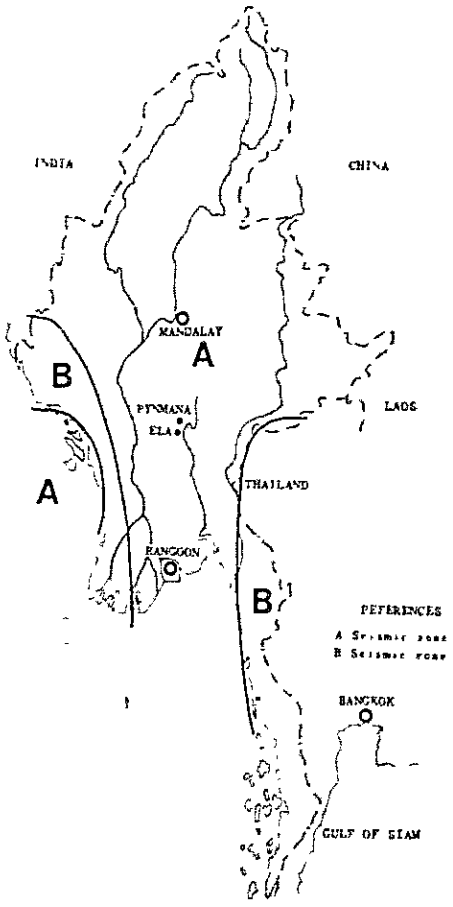


FIG 1 SEISMIC ZONING MAP

I-5 INFRASTRUCTURE OF BURMA

I-5-1 ROADS

(1) General situation

In general, the roads in Burma are not well maintained, with a low percentage of pavement. However in the city of Rangoon and its peripheral area they are well maintained with well-tended trees and adequate traffic signs.

In Burma, there are two representative trunk roads, one being the eastern trunk road running north along the Irawaddy River. The eastern trunk River, and the other being the western trunk road running through the country of Burma south to north along the Irawaddy River. The eastern trunk is also known as Route 1, and the western trunk as Route 2.

Major cities through which the eastern and western trunks run and their mileages from Rangoon are shown below. For travel between Rangoon and Mandalay, the eastern trunk is shorter by 122 miles (196km).

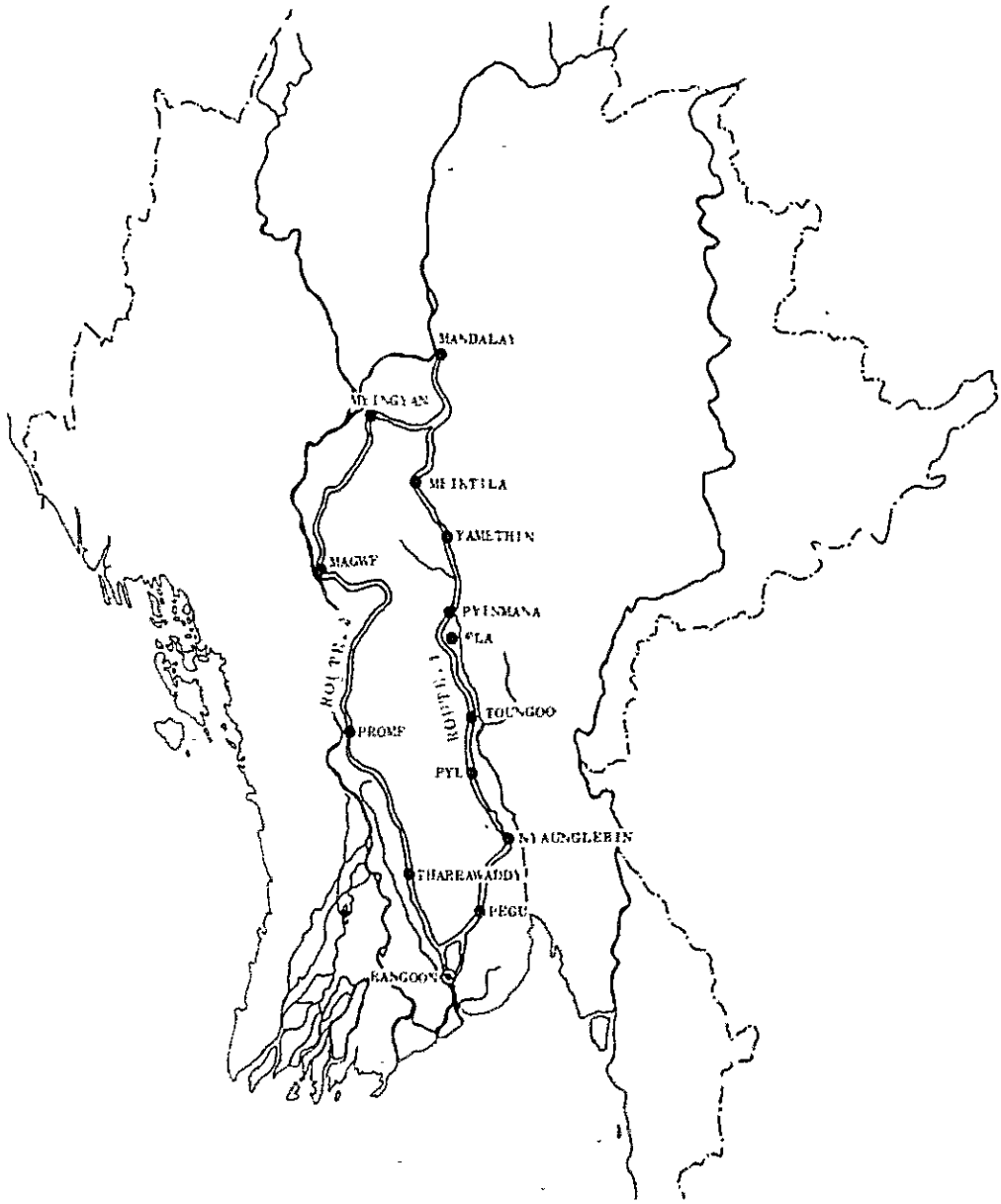
FASTERN TRUNK (ROUTE 1) MILEAGE

Rangoon	0 miles	(0 km)
Pegu	50	(80)
Nyaunglebin	98	(158)
Pyu	142	(229)
Toungoo	175	(282)
Pyinmana	244	(393)
Yamethin	299	(481)
Meiktila	338	(544)
Madalay	430	(692)

WESTERN TRUNK (ROUTE 2) MILEAGE

Rangoon	0 miles	(0 km)
Tharrawaddy	78	(126)
Prome	179	(288)
Magwe	331	(533)
Myingyan	456	(734)
Mandalay	552	(888)

Restrictions in road transportation in Burma are generally as illustrated in the following diagrams.



TRANK ROADS BETWEEN RANGOON AND MANDALAY

(2) Rangoon ∿ Ela road situation

The road transport between Rangoon and Ela will have use the eastern trunk mentioned above (Route 1). The road condition was investigated during the basic design survey. Should construction be started in the future, the means of transport for (acquisition of) construction machines and materials will have a great influence upon the cost and duration of construction. In consideration of this, this investigation was carried out in order to obtain data for examination.

The result is described briefly as follows.

- Passing through the town of Rangoon into the suburbs, fields stretch as far as one can see on both sides of the road. Cultivation is mainly of rice, and similar views were seen over the whole area we covered.
- The ground is nearly flat, and the road runs with little undulation.

- The road has a width of 7.2m ∿ 8.8m with an asphalt pavement at the center approx. 4.8m wide and an unpaved shoulder on each side of the pavement which is 1.2m ∿ 2.0m wide.
- For large vehicles, it is difficult to overtake and pass a preceding vehicle or to pass oncoming vehicles unless the unpaved shoulders are used, and the speed will have to be reduced considerably to avoid danger. In the rainy season, it is particularly necessary to take precautions against slipping. The asphalt pavement was damaged in some places and although repair work was in progress in several places, the repair work seemed to be lagging behind the damage.

- The road is elevated about 1 ∿ 3 m above the ground surface on each side. Apparently this is intended to prevent inundation during the wet season. But there are places where the road is nearly even with the ground surface. Thus the road is by no means free from partial submersion.
- There are no sharp curves which would be difficult for a large vehicle to negotiate.
- Many bridges, both large and small, are located along the road, but the short-span bridges are of concrete or steel beam girders, and the long-span bridges are steel truss bridges, so that strength is assured. The bridges have an inside measurement of 4.8m or more and thus allow passage of large vehicles, but it is difficult for trucks to travel alongside each other in the same or opposite directions.
- The traffic consists mainly of trucks and buses, and the traffic volume is very low.
- Gas stations are available in each of the major towns such as Pegu, Nyanglebin, Pyu and Toungoo, providing convenient fuel supplies.
- The road branching from the trunk road and running the three miles to Ela is of the same construction as the trunk road but the asphalt pavement is badly damaged.

The following table shows the hours of travel (except stops for meals and rest periods) and the actually surveyed mileages. In the actual survey, we started from Rangoon at 06:00 hours in the

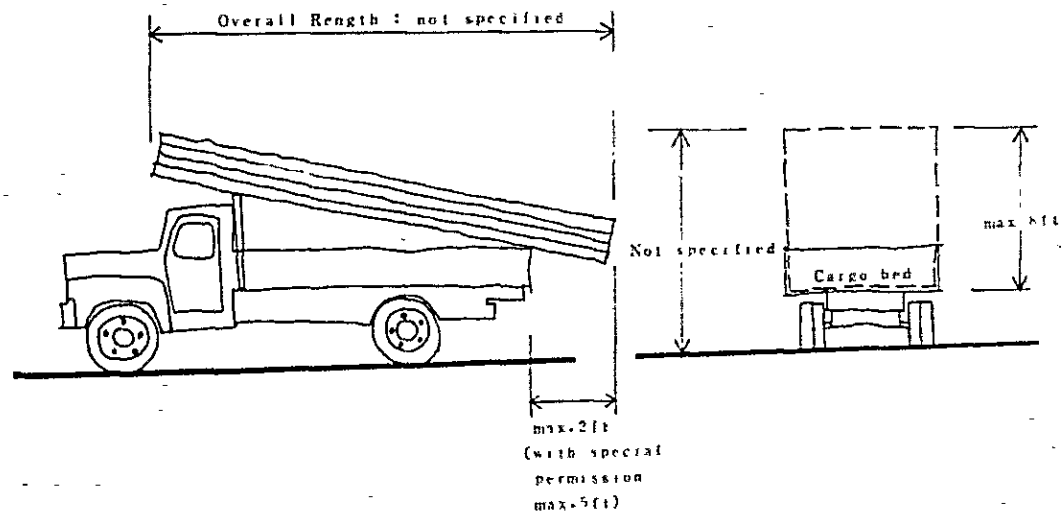
morning and arrived at Ela at 16:00 hours in the afternoon. However, it seems that the hours of travel varies a little.

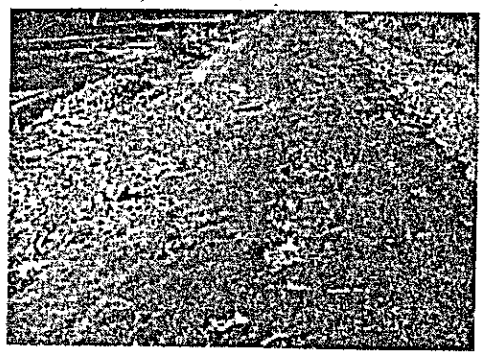
The mileages are those shown on the meter of the car used and are different from the indications on the milestones on the roadside and thus also from the mileages given previously.

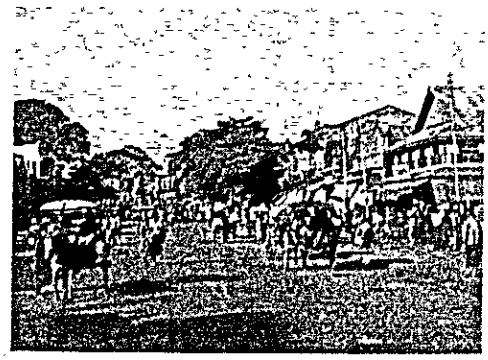
ACTUALLY SURVEYED MILEAGES AND REQUIRED HOURS

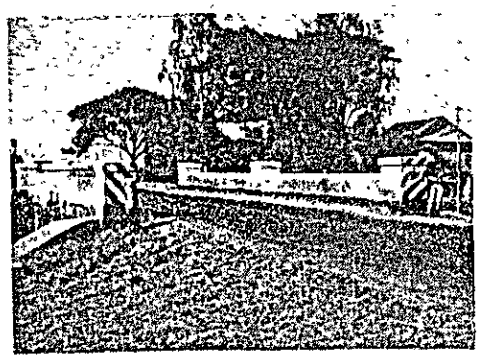
Rangoon	0		0	
		62 miles (100km)		1:50
Pegu	62 miles (100km)		1:50	
		55 miles (86km)		2:00
Nyaunglebin	117 miles (188km)		3:50	
		48 miles (77km)		1:35
Pyu	165 miles (266km)		5:25	
		36 miles (58km)		1:00
Toungoo	201 miles (323km)		6:25	
		58 miles (93km)		2:10
Ela	259 miles (417km)		8:35	

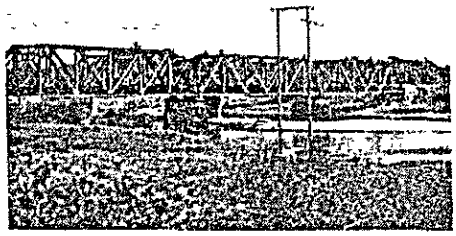
According to the actual survey, the distance between Rangoon and Ela is 259 miles (417km); required time of travel was net 8 hours 35 minutes; and average speed was 30.2 miles (48.6km) an hour.

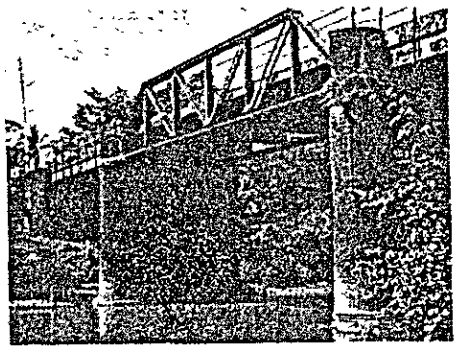












ALONG THE RANGOON
MANDALAY HIGHWAY
(RANGOON~ELA)

I-5-2 BRIEF DESCRIPTION OF RAILWAYS

Railways in Burma are operated by the Burma Railway Corporation.

There are three main lines which start from Rangoon and each has some branch lines:

Rangoon ∿ Mandalay ∿ Myitkyina Line (1,135km).
Rangoon ∿ Prome Line (258km).
Rangoon ∿ Moulmein ∿ Ye Line (414km).

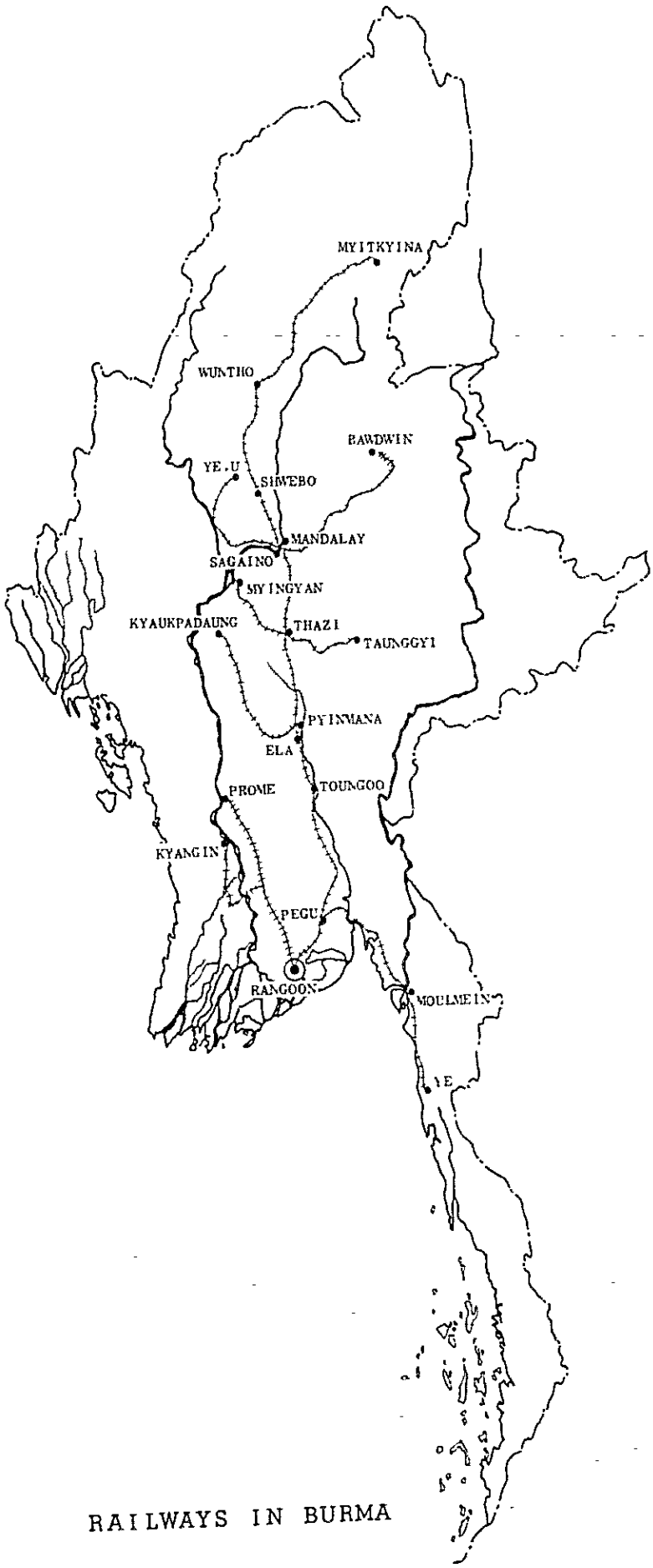
The Rangoon Ye Line separates from the Rangoon ~ Myitkyina line at Nyaunglebin and runs southward. During the Second World War, it was connected to the well-known Thailand - Burma Railway for communication to Thailand, but this railway was removed with termination of the war and no traces are left now.

The Rangoon ∿ Mandalay express along the Rangoon ∿ Myitkyina line stops at the three stations of Pegu, Toungoo and Pyinmana. It takes about 7 hours from Rantoon to Pyinmana and about 5 hours from Pyinmana to Mandalay, in total 12 hours from Rangoon to Mandalay.

The railways in Burma are all of 1.0m gauge. There is no electrified section as yet, and the wagons are pulled by diesel or steam locomotives.

The nearest station to the construction site is the Era Station, two stations toward Rangoon from Pyinmana along the Rangoon ∿ Myitkyina line.

In the following are shown the rolling stock diagrams, rolling stock gauges and limit loads of major freight wagons obtained from the Burma Railway Corporation.

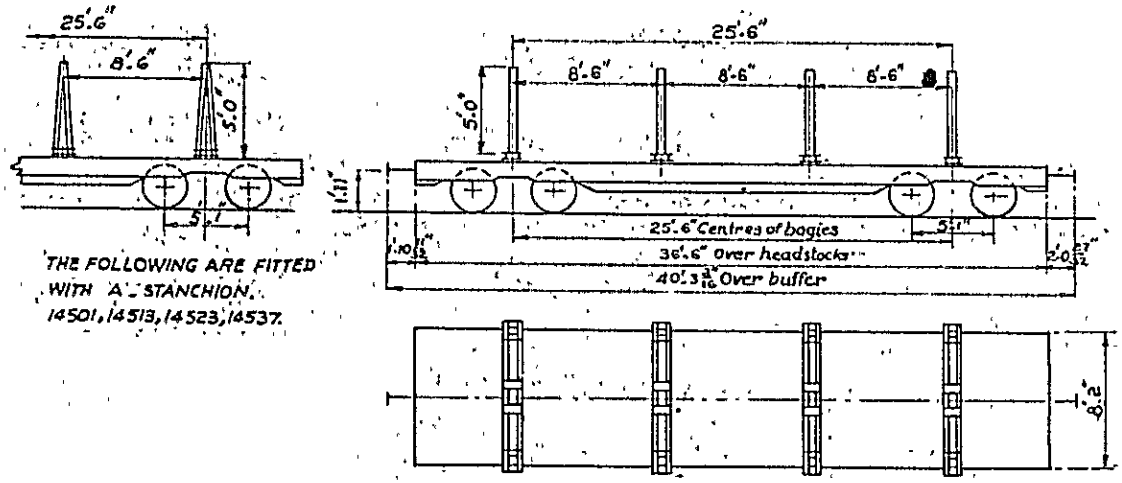


RAILWAYS IN BURMA

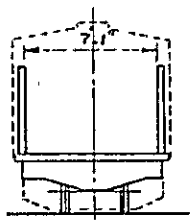
Burma Railways
Metre Gauge

182

WBHV
BOGIE QUADRUPLE BOLSTER TRUCK
on 36'-6" steel underframe
SCALE $\frac{1}{8}$" = 1 FOOT



THE FOLLOWING ARE FITTED WITH 'A' STANCHION.
14501, 14513, 14523, 14537.



Roller bearing A.3 type bogies.

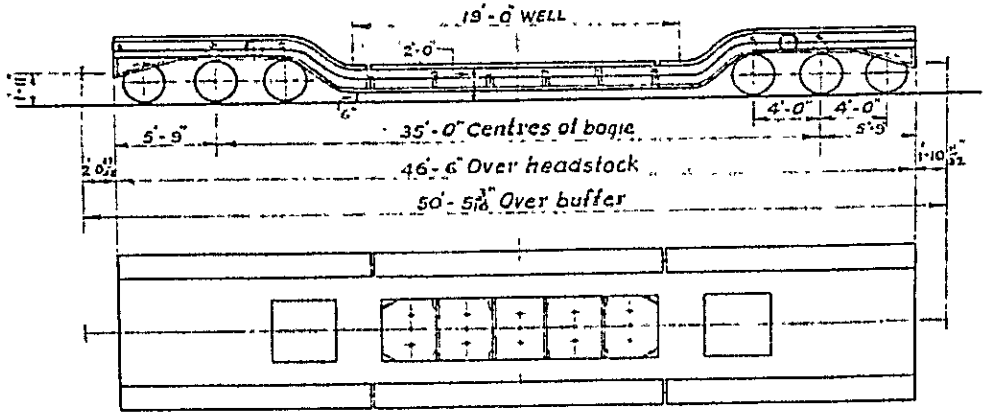
DESCRIPTION

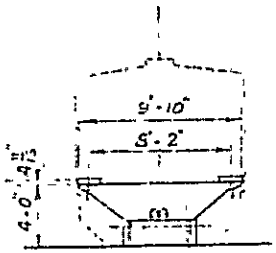
Size of Journals	6 5/8" × 4 11/32"	Gross Load	46 Tons
Centres of Journals	4'. 11 1/4"	Max: axle load	12 Tons
Dia. of wheels on tread	2'. 4 1/8"	Height of stone line	
Height of floor above rail level	2'. 3"	" " ballast line	
Effective floor area.		Vacuum brake, fitted	
Cubic capacity		Cost £	K. 50145·35
Carrying capacity	36 Tons		9181 - 9200 = K. 112355/14.
Tare	12 Tons		

1977. YUGOSLAV. 34 Nos. (ROLLER) 14453-14486
RECEIVED UNDER COLOMBO PLAN/AUSTRALIA
1969 : 70 Nos. (14487. 14556)

YEAR BUILT	NOS ON BOOK	SERIAL NOS OF VEHICLES.
1969	104	14487. 14556
"	"	14453 - 14486.

FFBWHV
BOGIE WELL WAGON
On 46'-6" Steel Underframe
SCALE $\frac{1}{8}$" = 1-FOOT





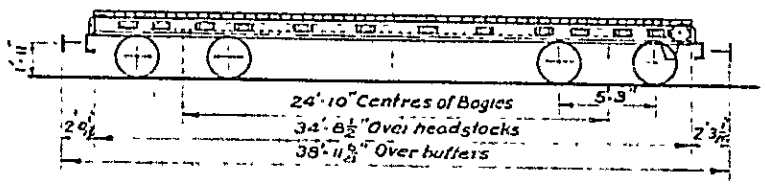
Note.-
Imported vehicles.
From Kisha Seizo. Firm Japan.

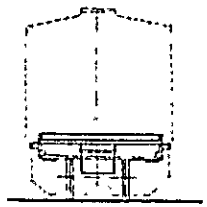
DESCRIPTION

Size of Journal	9" x 4½"
Centres of Journals	4'-10"
Dia: of wheel on tread	2'-4½"
Height of floor above rail level	2'-0"
Effective floor area	155 Sq ft
Cubic capacity	
Carrying capacity	49.2 Tons
Tare estimated	22 TONS
Gross load	72-0 Tons.
Max axle load	12-0 Tons
Height of stone line	
" " Ballast line	
Vacuum brake fitted	NB & VB fitted
Cost £	K

YEAR BUILT	Nº ON LINE	SERIAL Nº OF VEHICLES
1957	5	9501 - 9505

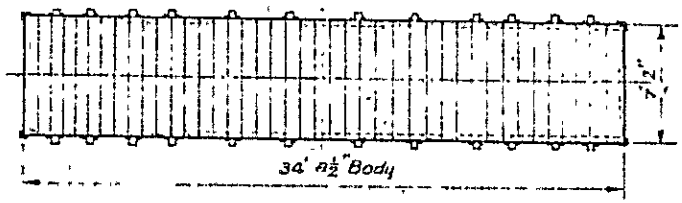
— FBW —
— BOGIE FLAT WAGON —
— on 34'-8½" steel underframe —
— SCALE $\frac{1}{8}$" = 1 FOOT —





NOTE:-

No·16574 converted from SBW diag: No·144.

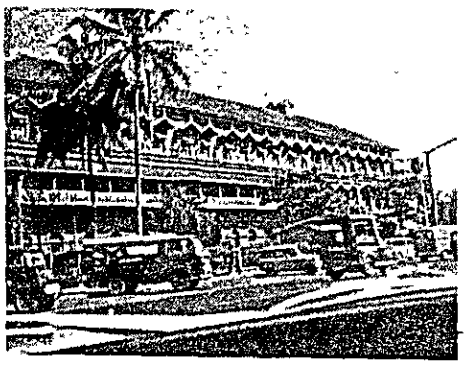


The following are fitted with cattle guards:
16509, 16511, 16509, [illegible], 16535, [illegible], 17001,
17003, 17008, 17007, 17014, 17016, 17005, 17009,
16545, [illegible], 16554, 16515, 16562,

— DESCRIPTION —

Size of Journals	8" x 4½"	Gross load	36 Tons
Centres of Journals	5'-0"	Max axle load	9.7 Tons
Dia of wheel on tread	2'-6"	Height of stone line	
Height of floor above rail level	3'-7⅝"	" " Ballast line	
Effective floor area	248·5 sq ft.	Vacuum brake fitted	
Cubic capacity		Cost £	K
Carrying capacity	27 Tons		
Tare	9 Tons		

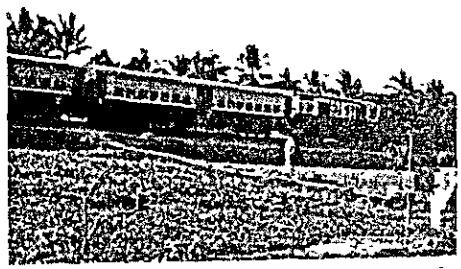
YEAR BUILT	Nº ON LINE	SERIAL Nºs OF VEHICLES
	38	16503, 16504, 16509, [illegible]
		16521, 16522, 16525, 16530
		[illegible], 16545, 16546, 16538
		16539, 16542, 16548, 17005
		16561, 16563, 16567, [illegible]
		[illegible], 16575, 17001, 17004
		17002, 17009, 17016, 17018
		17013, 17015, 17960, [illegible]
		16526, 16556, 16557,
		16534, 16611, 16535,
		16571, [illegible]



BURMA RAILWAYS CORP.

RANGOON STATION

TOUNGOO STATION



COMMUTERS' TRAIN

I-5-3 BRIEF DESCRIPTION OF PORTS

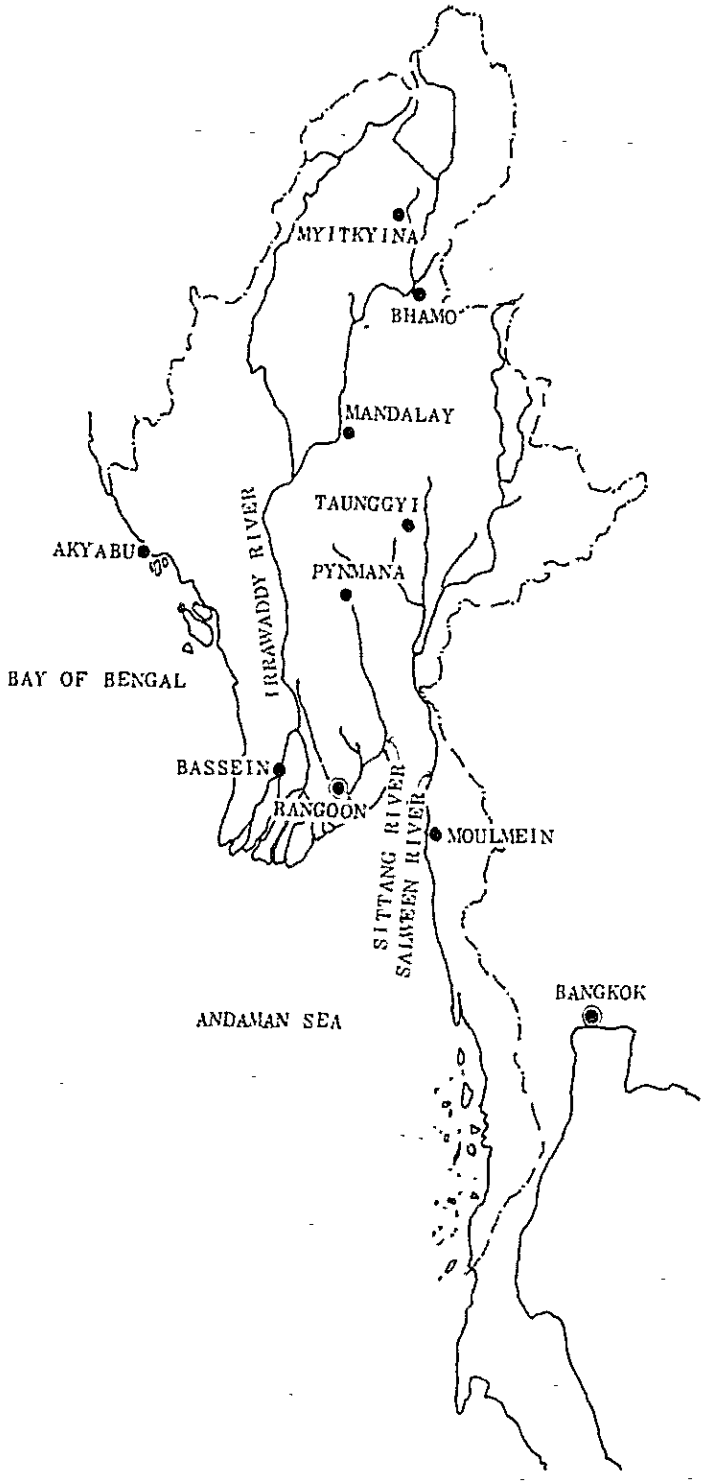
The Port of Rangoon is the largest in Burma, sharing about 85% of the foreign trade and about 45% of the inshore trade, and is particularly active in shipment of rice and timber. Three other relatively large ports may be cited, namely Moulmein, Bassein and Akyab; however, these are minor ports for inshore trading. These ports are all controlled by the Burma Ports Corporation.

The Port of Rangoon is an estuary port situated on the west bank of the Rangoon River, a division of the Irrawaddy River, 34km up the coast from Andaman. This port is connected to the Irrawaddy and Sittang Rivers through the network of rivers in the Irrawaddy delta, and serves as a strategic point of the waterway running through Burma from south to north. Along the Irrawaddy River in particular, river boats of several hundred tons are operated from Rangoon for about 600 miles (970km) up to Myitkyina in Upper Burma (or Bhamo in the dry season).

The Port of Rangoon thus serves as a key point in the international as well as domestic transportation systems, and is active throughout the year.

In the port of Rangoon a total of 13 berths are provided as mooring facilities for ocean going vessels. They are designated specifically for passenger boats, and for boats for the shipping of timber, rice and the like. A freighter up to 165m tons can be moored at the berths designated for general cargos.

One 25-ton crane, two 10-ton cranes, about ten 4-ton cranes, and some smaller cranes and forklifts are available as loading equipment on the berth for general cargos.



PORTS AND RIVERS IN BURMA

I-5-4 BRIEF DESCRIPTION OF ELECTRIC POWER SUPPLY

Power generation and supply in Burma is operated by the Electric Power Corporation. Power generation is dependent largely on the water power of the Lawpita Fall on the Balunchang. In 1974-75, 262 towns and 522 villages had electric power supplied, and the total power generation was 780,000,000 KWH against the power consumption of 609,000,000 KWH (about 80% of the generated power) and thus there is a considerable capacity for increased consumption.

The power is supplied from the power plant in 3.3KV, 11KV, 33KV, 66KV, 132KV and 230KV, and the frequency is standardized at 50 Hz.

The voltage for domestic illumination is 230V, and that for drive is 400V, and the rules for electrical wiring, etc. are entirely in accordance with the British Standards.

The voltage variation is insured to be within ±12.5% with reference to 650V as a standard, and the frequency to be within 50Hz±2%.

In the following are shown the power rates (as of December 1978).

	Monthly Usage	Rate
Civil and commercial use	Up to 500KWH/M	54 Pyas (16.7 Yen/KWH)
	501 4,500KW/M	44 (13.6)
	4,501KWH/M or more	40 (12.4)
For living accommodation	Up to 100KWH/M	46 (14.3)
	101 200KWH/M	42 (13.0)
	201KWH/M or more	40 (12.4)
Industrial use	Up to 200KWH/M	25 (7.8)
	201 1800KWH/M	20 (6.2)
	1,801KWH/M or more	15 (4.7)

I-6 ORGANIZATION REGARDING CONSTRUCTION

In Burma, important policies concerning construction are determined by the Construction Council which is controlled directly by the Minister of Construction.

Under this Council there are three departments.

1) Housing Department
2) Construction Corporation
3) Quarry Corporation

The Construction Corporation is the largest organization of these three departments and assumes all tasks concerning public construction in Burma - surveying in general, ground survey, design, procurement of materials, acquisition and maintenance of construction machines, securing workers, execution of work, arrangement for supply of electric power and gas and maintenance of completed buildings.

As for internal organization of the Construction Corporation, there are three Directors of Engineers. They are Directors of Engineers for Planning, Roads and Bridges, and Works. Under the Director of Engineers for Works there are 14 Regional Command Engineers in the respective states and divisions of Burma. The Ela area belongs to the Mandalay Regional Command Engineer. In the case of large projects such as bridges and airports, a Construction Project Unit is installed for each project as an external office of the Director of Engineers for Roads and Bridges. In addition to the foregoing, there are about 340 township organizations or Township Engineer Organizations throughout the country.

The operation expense of the Construction Corporation for fiscal 1977 was about 360,000,000 kyats (about 11,000,000,000 yen) for both construction and maintenance,

but the construction costs alone amounted to about 220,000,000 kyats (about 6,800,000,000 yen).

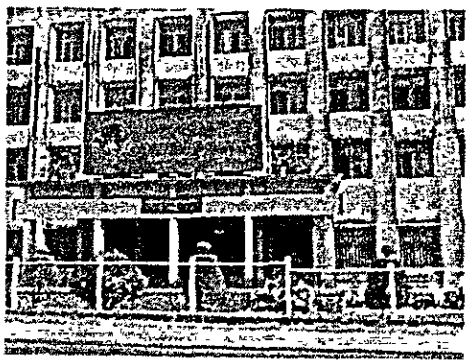
Fiscal 1977 Construction Corporation Operation Expense

Unit: Million kyats

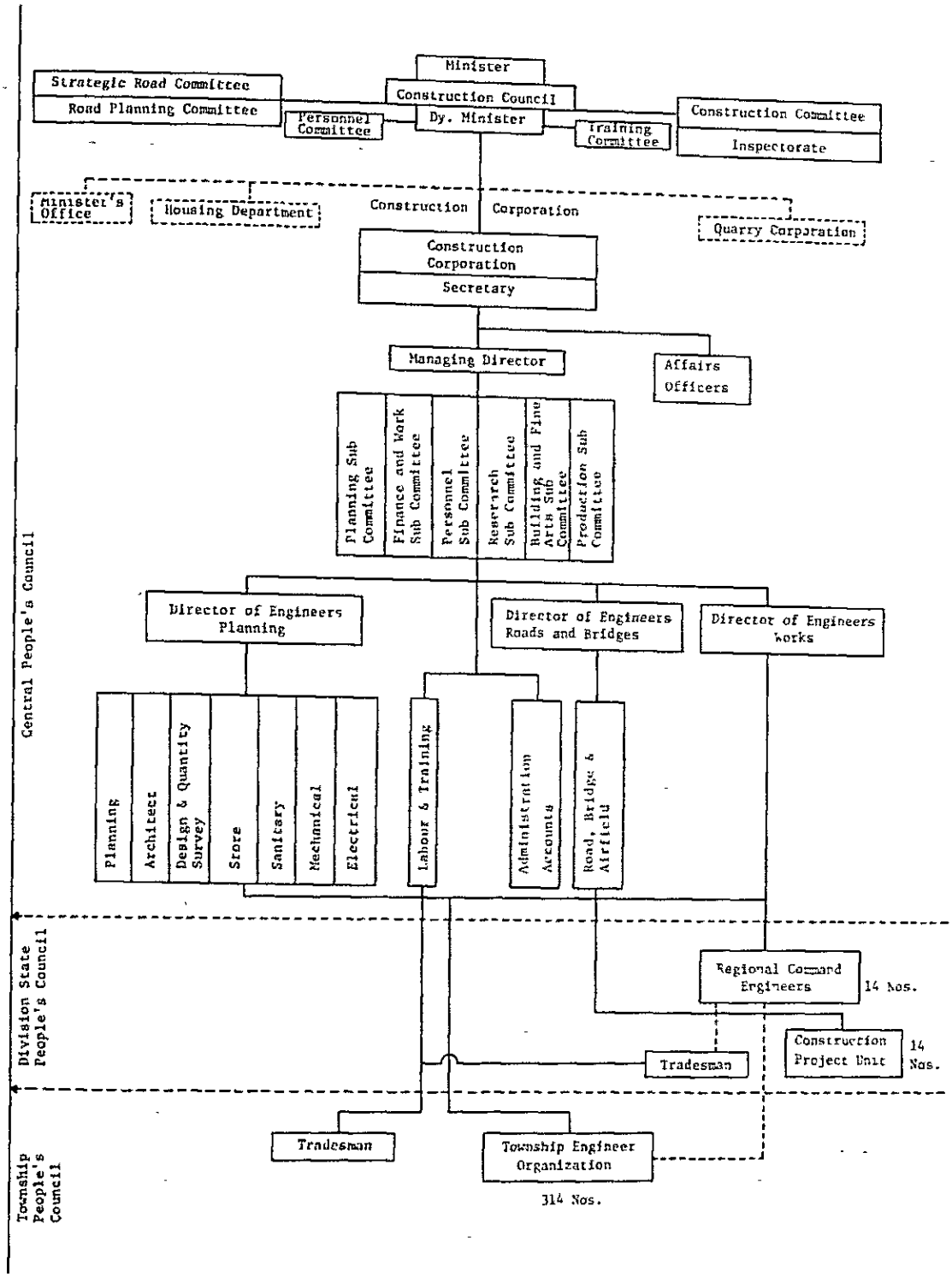
Construction		Maintenance and repair		Total
Building	Civil engineering	Building	Civil engineering	
218.3 (60.9%)	29.7 (8.3%)	31.0 (8.7%)	79.0 (22.1%)	358.0 (100%)
248 (69.3%)		110 (30.7%)		

(Note) 1 kyat = 31 yen.

The Construction Corporation handles a number of projects, one-fourth of which are concentrated in Rangoon. The workers listed in the Construction Corporation are estimated to number as many as 100,000, and it is said that the Corporation is able to recruit necessary personnel for construction wherever the construction site is located. In the case of the present project, few skilled workers are available in the vicinity of Ela so that they will have to be transferred from Rangoon. The engineers will also be dispatched from Rangoon.



CONSTRUCTION CORPORATION



Organization Chart of Construction Corporation

I-7 GENERAL CONSTRUCTION METHODS

We have recently visited several construction job sites in the City of Rangoon to survey the current state of construction work in the area and have collected information. The results of our survey on the current building construction methods in Burma are summarized below.

I-7-1 EARTHWORKS

Excavation work is performed by hand for ordinary work and mechanization is limited only to large-scale construction projects. Foundation work is planned with spread footings over compacted gravel in most cases but, if soil condition is poor, pile foundation is occasionally employed after precasting the reinfoced concrete piles at the site. Factory-built precast concrete pile is not manufactured in Burma.

I-7-2 CONCRETE WORK

Ordinary portland cement manufactured in Burma is used, and imported cement is rarely used. However, supply is not sufficient to meet the demand, and procuring of a certain required amount of cement within a limited period of time is extremely difficult. It is said that in the past completion dates have frequently been greatly delayed because of difficulties in procuring the cement. Quality of cement is in conformity with British Standards BS-12.

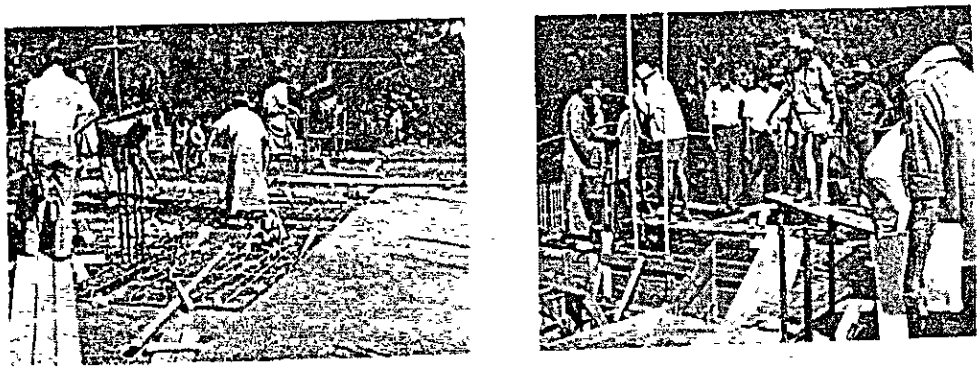
Aggregates used are mainly sands and gravel taken from rivers but crushed stones are occasionally used.

There is no factory for ready-mixed concrete production and concrete mixing is generally performed by a mixer installed at the job site.

Concrete mixing is usually performed by batching by volume, and mixing ratio of cement, sands and gravel is generally 1:2:4 for reinforced concrete structures, 1:1/2:3 for tank structures and 1:3:6 for light structures. Thus, mixing based upon the water-cement ratio is not being used. Admixtures such as air-entraining agents or retarders are not used.

In most cases, the standard strength of concrete, compressive strength at 28 days is 2,500 lbs/in^2 (about 180 kg/cm^2) for ordinary reinforced concrete and 3,000 lbs/in^2 (about 210 kg/cm^2) for special type concrete.

Slump varies depending upon the job sites but generally has a medium hardness with 10cm to 15cm. Concrete is poured by hand using carts or Chinese pans but concrete pumping is not used. The rate of concrete pouring per mixer is 2 to 3 m^3/hour for carts and 0.5 to 1.0 m^3/hour for Chinese pans and, so is extremely low compared with the pouring rate available in Japan by using a concrete pump (30 to 40 m^3/hour).



CONCRETE CAST IN PLACE

I-7-3 FORM WORK

Generally, the board widely called "jungle-wood" is used for sheeting. This has a thickness of about 20mm and is a kind of South Sea lumber resembling lauan; teak is also used occasionally. Plywood forms and steel forms have also been used at special job sites but these are very exceptional cases.

For yokes and supports, square-section jungle wood is mainly used, and the use of steel pipes and supports is limited to special job sites.

For form-ties, both bolts and whips are used together.

I-7-4 REINFORCING BAR WORK

Production of reinforcing steel bars is carried out only by the Ywama Steel Mill. Both deformed bars and round bars are manufactured by electric furnace and by using rerolled steel bars. Yield strength of bars is always greater than 36,000 lbs/in^2 (2,531 kg/cm^2), that is almost equivalent to SDR24 and SRR24 of Japan, but an allowable strength of 18,000 lbs/in^2 (1,266 kg/cm^2) is used in design.

The diameters of reinforcing steel bars are 6, 9, 13, 16, 19, 22, 25, 28 and 32 mm, almost equivalent to those manufactured in Japan.

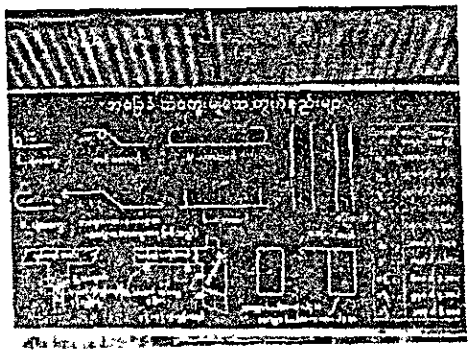
It is usually said that reinforcing bars made in Burma are expensive and imported bars are available at a lower cost.

The minimum clear protection by concrete covering outside the reinforcement is indicated below. However, the covering thickness defined in Japan is the distance

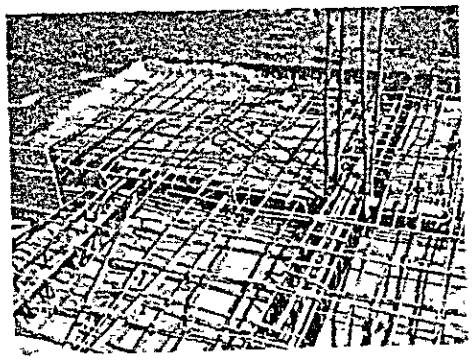
between the external surface of concrete and the surface of hoop or stirrup, but in Burma it must be measured from the surface of the main reinforcement bar.

- Slab: 1/2" (12.7mm) or diameter of bar
- Beam: 1" (25.4mm) or diameter of bar
- Column: 1/2" (38.1mm) or diameter of bar
- Foundation: 3" (76.2mm)

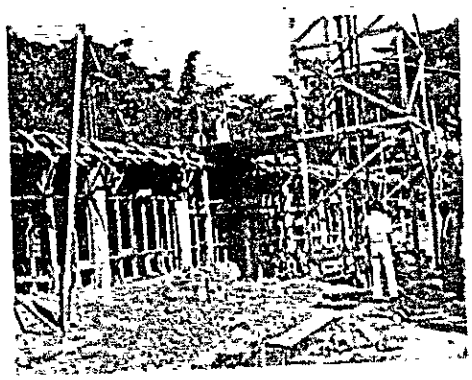
The minimum pitch of hoops is designated as 150mm for 9ø or D10.



DRAWING FOR BAR BENDING



PLACING OF REINFORCEMENT



FORM WORK

I-7-5 STRUCTURAL STEEL WORK

Structural steel is not manufactured in Burma and the country relies completely on imported products. Thus, steel skeleton construction is limited only to major structures such as gymnasiums, factories, stands, buddhist temples, etc.

Thus there is no such category of worker as a scaffolding man, and carpenters do this kind of work instead. However, they are unable to work as quickly as Japanese scaffolding men can.

To cope with the problem of unavailability of structural steel, major structures are frequently planned by making use of prestressed concrete construction, and the latest example of this type of construction is the Diet Building which is now being built.

I-7-6 BRICK MASONRY WORK

It is said that the culture of Burma is "the culture of bricks and bamboo", because most of the religious and cultural remains typified by stupas and large statues of Buddha generally have framings made of brick. Brick has a very long history in this country, various kinds of brick are available, and there are many skilled brick layers.

Since olden times there have been brick factories scattered throughout the country, and these are not centralized even now because of the nature of this product. However, standards of bricks are not always unified and it seems that there are many variations in size and quality.

Special-order products such as facing hollow bricks, floor brick tiles and fire bricks are also available.

I-7-7 WOODWORK

Along with rice, timber is an important Burmese export and comprises a variety of species, but as construction materials, the following are mainly used:

- Pyinkado - Structural and fixture materials
- Padauk - Structural material
- Teak - Finishing and fixture materials

Pyinkado is an tree indigenous to Burma. It is produced in a great quantity and is far superior to oak in its dynamic properties. It is thus excellent as a building structural material.

Teak is a high-class finishing material in Japan. But, in Burma, it is used generously not only as a finishing material but for fixtures. In some cases it is used even for lathing of wall or ceiling.

In the following table are shown the general standards for the allowable unit stress and modulus of elasticity of these timbers in Burma.

ALLOWABLE WORKING STRESSES FOR TIMBER

Unit: lb/in^2 (kg/cm^2)

Type of Stresses	Pyinkado	Teak	Padauk	In/Kanyin
Bending at Extreme Fibre	2500(175.8)	2000(140.6)	2500(175.8)	1500(105.5)
Longitudinal Shear	240(16.9)	120(8.4)	175(12.3)	130(9.1)
Axial Compression	1900(133.6)	1200(84.4)	1700(119.5)	760(53.4)
Compression Perpendicular to Grain	970(68.2)	450(31.6)	1050(73.8)	400(28.1)
Tension Parallel to Grain where no stress Concentration Exists	1900(133.6)	1200(84.4)	1700(119.5)	760(53.4)
Modulus of Elasticity	$2.00\times10^6(140\times10^3)$	$1.44\times10^6(100\times10^3)$	$1.65\times10^6(120\times10^3)$	$1.30\times10^6(90\times10^3)$

I-7-8 INTERIOR FINISHING WORK

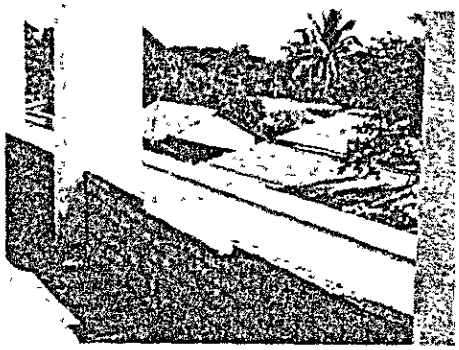
Ceilings are generally not suspended and, instead, the underside of the structure immediately above is used as the ceiling. Suspended ceilings are used in air-conditioned buildings but this occurs only rarely. In most cases, ceilings are made by applying mortar or plaster directly to the underside of the upper structure or slab. This is done partly because direct application of the ceiling finish to the underside of the slab above is more economical, but the main reason is probably that maintaining a high ceiling is necessary for comfort in this country where the weather is frequently extremely hot and humid.

In finishing walls, boards or plywood is usually not used; instead, in most cases mortar or plaster is applied directly to the surface of structural brick walls.

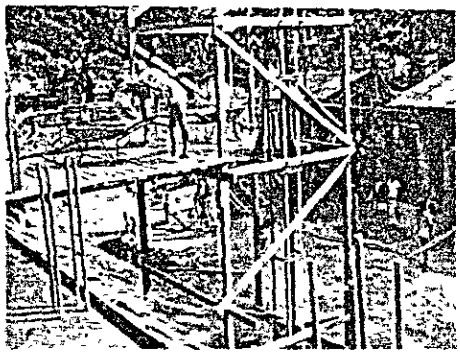
I-7-9 TEMPORARY WORK

For scaffolding, the double-pole scaffold and single-pole scaffold widely used in Japan for intermediate-rise and low-rise buildings are also used in Burma; the cantilevered scaffold is used only occasionally. The material used for double-pole or single-pole scaffold is generally bamboo, and steel pipes are not used for this purpose.

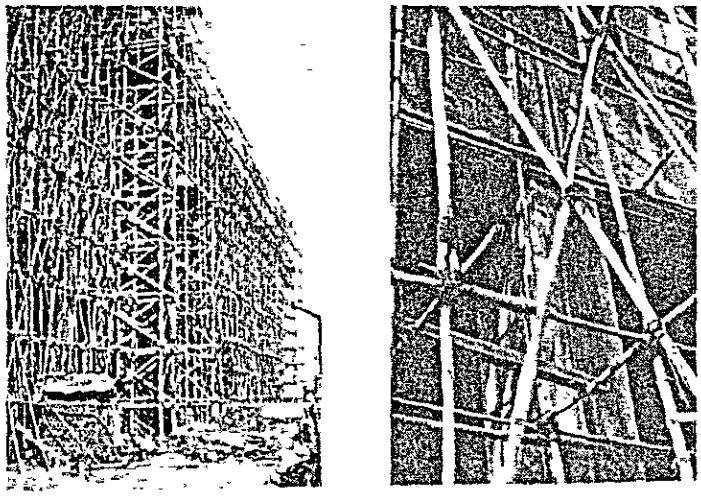
For transporting building materials vertically to each floor, simple lifts operated by winch are used for both men and freight. The lift tower and concrete tower are framed with wooden trusses.



BRICK LAYING



WOODEN LIFT



BAMBOO SCAFFOLDING

I-7-10 CONSTRUCTION LABOR SITUATION

As described above, mechanization of construction work in Burma is progressing very slowly and this industry is greatly dependent upon the manual labor, many construction workers being available. However, most of them are unskilled, and skilled workmen are in rather short supply.

To cope with this problem, the Construction Corporation founded the Central Training Center of Thuwrenna in 1966 for re-training workers in all areas related to the operation of the Corporation, and have trained about 10,000 construction workers up to now. One of the characteristics of this country is that there are many female workers.

Working hours vary depending upon the job fields but the standard is as shown in the table below. It indicates that starting, ending and lunch times all come slightly earlier than in Japan. Working hours are extended occasionally for special procedures such as concrete pouring.

WORKING HOURS FOR CONSTRUCTION

Monday through Friday:	7:30 to 11:00	12:00 to 16:00
Saturday:	7:30 to 11:00	
Sunday & holiday:	Not working	

During the wet season, during the six months from May to October, the mean air temperature reaches about 30°C and humidity reaches 95%. This, together with the rainfall, causes extremely low productivity.

INFORMATION ON THE CONSTRUCTION COST

BACKGROUND INFORMATION II

II-I CONSTRUCTION MATERIALS

II-1-1 ACQUIRING CONSTRUCTION MATERIALS

Construction materials produced in Burma comprise natural materials such as sand, gravel, stone, lime, timber, etc., and their secondary products: cement, crushed stone, asbestos slates, terrazzo block tiles, plywood and wooden fixtures, and further clay and calcined products of clay or bricks, earthenware pipes and tiles. Reinforcing bars are also produced domestically but not in large quantities.

Supply of such construction materials is undertaken by the corporations shown below:

- Gravel and sand - Construction Corporation
- Cement and bricks - Ceramic Industries Corporation;
- Timber - Timber Corporation; and
- Reinforcing bars - Metal Industries Corporation

In acquiring construction materials from the Corporations other than the Construction Corporation, orders should be made systematically and in good time. Otherwise, problems are apt to occur in the quality, quantity and delivery.

Construction materials, equipment and machines other than those produced domestically in Burma will all be imported from Japan. However, if there are any materials which are no longer produced or are not available unless ordered specially in Japan but are available in the neighboring countries of Burma, and if there are no problems regarding the quality, quantity and delivery

of such materials, importation from the neighboring countries must be considered. Further, if there are any materials which are very expensive in Japan but are available more cheaply from neighboring tion countries, their acquisition will also have to be considered.

II-1-2 TRANSPORT OF CONSTRUCTION MATERIALS FROM JAPAN

(1) Sea Transport

Shipping services from Japan to Rangoon, including both regular and non-regular services, are operated presently by the following one corporation and three companies:

- Five Star Line (Burma) - 1~2 Services/month;
- Nippon Yusen (Japan) - 1 Service/month;
- Osaka Shosen Mitsui Senpaku (Japan) - 1 Service/month;
- Everette (Panama) - Tramper service.

It takes two weeks to navigate from the Port of Yokohama direct to the port of Rangoon, or one to two months if the ship calls at Nagoya, Kobe, Pusan, Hong Kong and Singapore.

The sea transport cost is, in the case of machines, 70.3 US$/$m^3$ plus 14.8% for banker's charges and 32% for insurance; the total is as follows:

$$70.3\ \text{US\$/m}^3 \times (1 + \underset{\text{Banker charge}}{0.148} + \underset{\text{Insurance}}{0.32}) = 103.2\ \text{US\$/m}^3 \text{ or } 20{,}700\ \text{¥/m}^3$$

The shipping service of Burma is operated by the Burma Five Star Shipping Corporation which presently has three ocean-going freighters.

Port services of Burma are managed by the Burma Ports Corporation. Warehouse charges at the Port of Rangoon are as shown in the table below.

Port of Rangoon Warehouse Charges

Period	Charge
Less than 3 days	0
3 ∿ 29 days	1.5 kyats (Y46.5)/t.day
30 days or more	3 kyats (Y93)/t.day

(2) Land transport (Internal transport)

Transport from the port of Rangoon to the work site at Era is either by railway or truck.

To Era, the railway and road run parallel, and the distance is about 220 miles (354 km) by railway or about 260 miles (418 km) by road. The road is thus 40 miles longer (64 km) than the railway line. But, in the case of rail transport, the materials will have to be transported by trucks for about 1.2 miles (2 km) from Era Station to the work site.

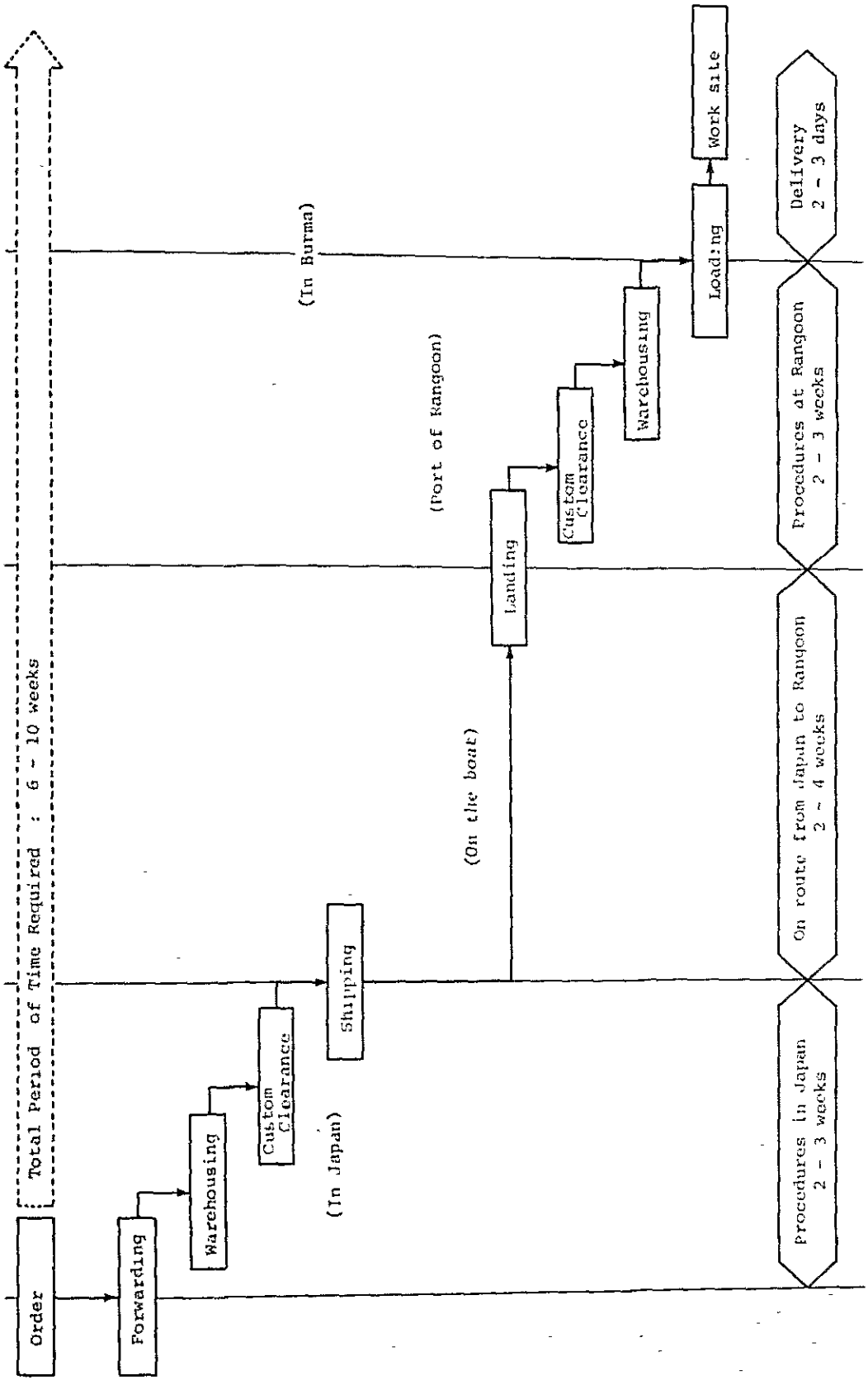
The transport expense is not much different in either case, being 100 kyats/t (¥3100/t) by railway or 104 kyats/t (¥3224/t) by truck.

The rail transport is to be undertaken by the Burma Railways Corporation, and the truck transport by the Road Transport Corporation, so that it is important to determine the transport schedule as early as practicable and make arrangements with both corporations.

(3) Transport period

It will take at least six weeks (one and a half months) for the materials to be shipped from Japan, landed at the Port of Rangoon and transported to the work site at Era.

The number of days required for procedures and transport of the materials from shipment to delivery at the site is as set out below.



The transport period shown here is that which is required normally if all procedures are executed smoothly. Thus, it is important that the preparation of necessary documents, custom clearance procedures and other arrangements be carried out smoothly. Particularly, with respect to the procedures invalving the Burmese authorities, it is best to have thorough discussions with the various Government organs concerned.

II-2 PRICES OF CONSTRUCTION MATERIALS AND LABOR COSTS

II-2-1 PRICES OF CONSTRUCTION MATERIALS

According to the data presented by the Construction Corporation, the unit prices of the principal construction materials available in Burma (in 1978 ∿ 1979 rates) are as shown below.

Cement	ton	500 kyats	(¥15,500)
Sand	100 cft	60	(1,860)
River gravel	"	150	(4,650)
Brick	1,000 pcs.	300	(9,300)
Timber (Pyinkado)	ton	1,500	(46,500)
Timber (Jungle wood)	"	1,200	(37,200)
Timber (Teak)	"	2,800	(86,800)
Reinforcing bar	"	7,500	(232,500)

II-2-2 LABOR COSTS

Labor costs in 1978 ∿ 1979 according to the Construction Corporation are:

Skilled	16 kyats (¥500)/day
Unskilled	7 kyats (¥220)/day

II-2-3 WORK EFFICIENCY

According to a survey at the site of construction of public housing, the following work-hours by craftsmen and laborers would be required for a building of a floor space of 1,022 m^2.

Engineer	80 man.day	0.078 man day/m^2
Head skilled	400	0.39
Skilled	4,750	4.65
Unskilled	5,260	5.15
Total	10,490 man day	10.26 man day/m^2

The work efficiency at the time of construction of the building of Japanese Embassy completed late in 1977 was as shown below.

Concrete caster	per m^3	0.45 man day
Reinforcing bar worker	per ton	6.25
Brick layer (Wall)	per m^3	0.19
Plasterer (Wall)	per m^2	0.16
Painter (Wall)	per m^2	0.08