社会開発協力部報告書

ビルマ国
イラワジ河橋梁建設計画
事前調査報告書（資料集）

昭和60年9月

国際協力事業団

無期限秘

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CONSTRUCTION CORPORATION

Restricted

PRELIMINARY STUDY REPORT

OF

MYAWADDY BRIDGE

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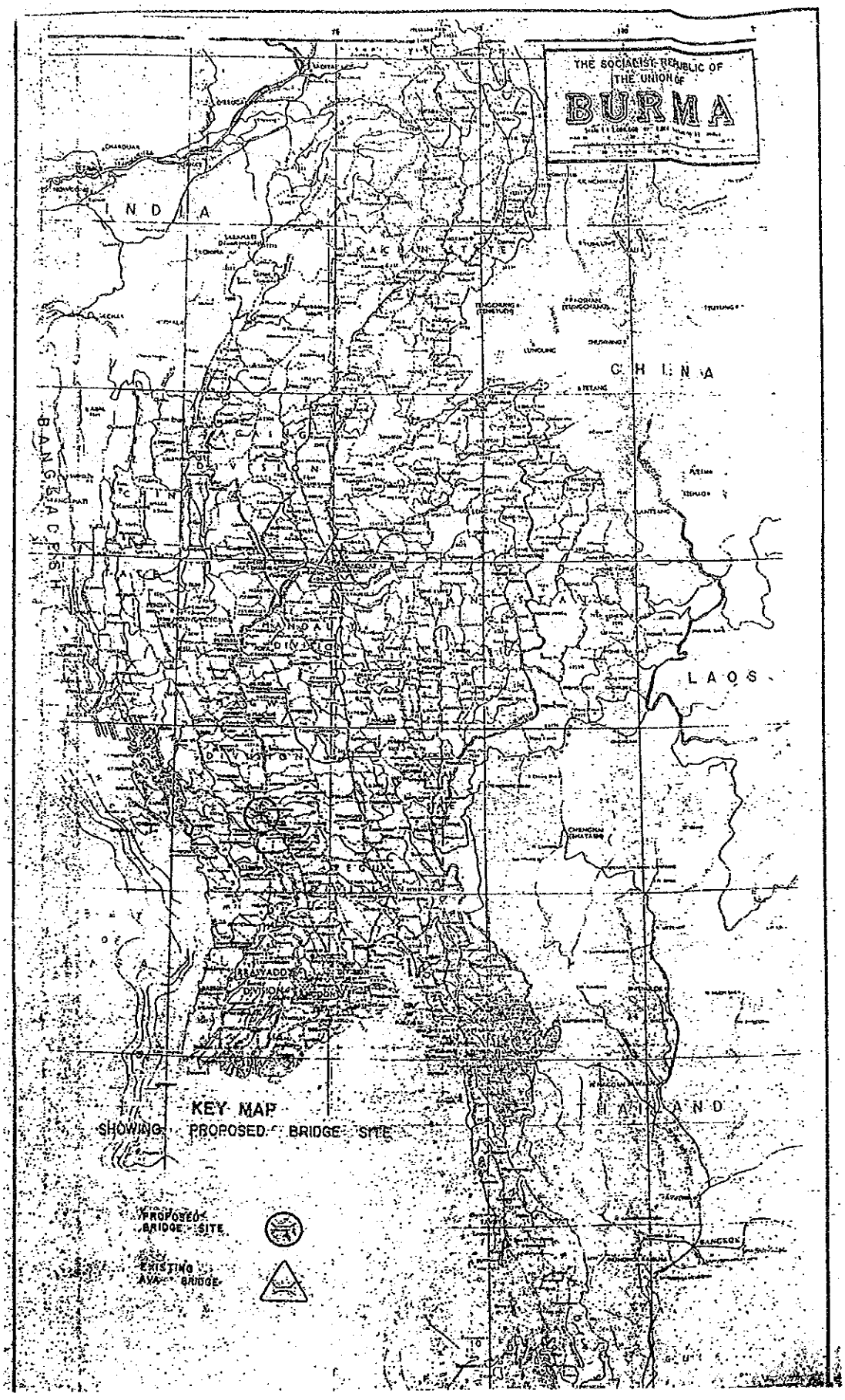
The Myawaddy Bridge Construction Project deals with construction of the Bridge across the Irrawaddy River just north of Prome city near Myawaddy village. The Bridge would be the second bridge to span the Irrawaddy River for the development of western bank apart from Ava Bridge near Mandalay. A Project proposal has been put forward in April, 1985, and a Preliminary Study Mission from Japan would be arriving very soon. To assist the Japanese Mission, a brief preliminary study has been conducted with a review of existing records on similar bridge construction projects including limitted field investigation. The study comprises of two parts; the first part illustrates the economic study of Burma and the influence area of the bridge and the second part includes an engineering study.

The Project is analysed from the technical and economic point of views and is found to be viable. The total cost of the project is Kyat 901.00 Millions for a through type steel road-cum-rail bridge and benefit-cost ratio is found to be 2.163 with an internal rate of return of 17.5% for official rate discounted at 10%. Extreme sensitivity analyses indicate that the Project is still hold even for the case of cost 20% up and benefit 20% down. The Project is worth while to be implemented.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PRELIMINARY STUDY REPORT

OF

MYAWADDY BRIDGE

1. INTRODUCTION

1.1 Burma lies between lattitudes 10° and 29° N and longitudes 92° and 102° E, and covers an area about 678286 square Kilometers of low lands in the basins of the Irrawaddy, Chindwin, Salween and Sittang River and is surrounded by hills and mountains to the East, West and North and is divided by a mountain range running north to south in Central Burma. Most of the fertile land of Burma is in these basins and in time of memorial the rivers had served as a mean of transport facility for the people. It is, therefore, apparent that almost all the development activities of Burma are found in those areas. In addition to these river transport, other modes of transport such as roads and rails are also found to have developed within and along the above mentioned river valleys.

1.2 With the aim of augmenting the economy and social welfare of her populace, industrial and agricultural projects have been implemented for which an effective and efficient communication infrastructure would be needed. To be in line with the State's long term economic plans and to fit in with the regional development schemes, road and rail net-work are planned and developed in ballanced proportion with the regional development. In spite of the abundant national resources, for example, untouched forest and arable land extension within and along the west bank of the Irrawaddy River, this area has been found to be in the initial state of development as compared to the those of the eastern regions of the river. Bearing in mind on this fact, State's Economic Planners have given high priority for the development of this area with a further stress on the regional development.

1.3 Since two decades ago, industries had been set up along the west bank of the Irrawaddy River together with many plans on the agricultural development. The western bank of the Irrawaddy River which was once the bareland is now becoming an area where agricultural and industrial activities are blooming. To link this agricultural and industrial area with other under developed parts in the western bank, construction of Bassein-Monywa Road namely Western Highway is now under implementaion, and about one third of this road had already been bituminized. With the remaining portion being surfaced, the highway is now trafficable all the year round and is now becomming the main arterial road of the western bank of the Irrawaddy.

1.4 The Ministry of Transport and Communication of the Government of the Union of Burma which is responsible for rail-road construction and rail-road transport is also implementing it's share of rail-road transport promotion by way of a new rail-line construction, which would extend the existing rail-road net-work to other parts of the western bank.

1.5 The Irrawaddy River has more than 1412 Kilometers long navigable section and it divides the valley into two sections. At present there is a single rail and road combined bridge near Mandalay and this is known as the Ava bridge, which was constructed since fifty years ago. This bridge alone serves as the key link between Sagaing Division, Chin and Kachin States and the rest of country to the west.

1.6 As mentioned in para. 1.5, inadequate link between the west and east valleys of the Irrawaddy River results in a considerable delay in the transport and distribution of industrial and agricultural products. It also hampers the economic development of the regions on the west bank of the Irrawaddy. Therefore, it has been envisaged that an additional facility is needed to link the two areas of the

Irrawaddy, i.e, eastern and western valleys especially in the middle and lower part of Burma.

1.7 The Government of the Union of Burma has already proposed her desire to have a Rail-Cum-Road Bridge across the Irrawaddy River near Myawaddy Village, just north of Prome city, not far from Site No.1 chosen by the Japanese Feasibility Study Team in 1975.

1.8 MYAWADDY RAIL-CUM-ROAD BRIDGE (here-in-after referred to as "MYAWADDY BRIDGE"), will link the existing road net-work in the eastern side of the Irrawaddy River to that on the western side, which is under the process of development. The bridge will provide an easy interdivisional communication between Sagaing Division, Chin State, Rakhine State and the Irrawaddy Delta Division. On the western bank, the Bassein-Monywa Road, which was completed for a stretch of 32 miles between Kyangin and Okshitpin in 1974, has now been completed as a bituminous road up to Mindon for a length of 85 miles. Moreover, it is now all weather trafficable from Bassein to Monywa. A number of feeder roads such as Monywa-Pale-Gangaw-Haka Road, Pakokku-Pauk-Mindat Road, Seikpyu-Saw-Kanpetlet Road, Salin-Sidoktaya Road, Minbu-An-Tattaung Road, Prome-Taungup-Sandoway Road and Ngathaingyaung-Gwa-Sandoway Road which are situated on the western bank are mostly trafficable during fair weather and they are under improvement for all weather traffic. These roads are linked up with Bassein-Monywa road to cross the Irrawaddy River towards the east. Similarly, on the eastern bank, the Rangoon-Prome-Mandalay Highway runs parallel to the Irrawaddy River and there are a number of roads linking up with this highway, such as Loikaw-Taungoo-Prome Road, Pinlaung-Pyinmana-Taungdwingyi Road, Payangazu-Pyawbwe-Natmauk-Magwe Road and Taunggyi-Meiktila-Kyaukpadaung Road. Most of these roads are trafficable at all weathers. They serve the southern part of Mandalay Division, Shan State, Kayah State, northern part of Karen State, Pegu Division, Rangoon Division and eastern part of Magwe Division.

1.9 The proposed bridge will facilitate the ease transportation of the produce of the influence area where cement factories, glass factory, fertilizer plant, heavy industries, oil refineries, gas turbine stations and cigarette factories are already established, and the expansion of the industries will continue in the Fifth Four Year Plan. In addition, the agricultural and forest products will easily be transported to the needful areas of Burma.

1.10 Moreover, at present, there exist railway transport facilities on the west bank of the Irrawaddy, namely, the Bassein-Kyangin Railway Line. This railway will be extended up to Pakokku in the near future. Plans are also underway to extend the railway net-work from Kyangin towards north up to Pakokku on the western bank and on the eastern bank towards north from Prome to Aunglan and Taungdwingyi. There is also a plan under consideration to link the existing rail to Rakhine State.

1.11 As mentioned above, at present, there exists only one rail-cum-road bridge connecting Sagaing and Mandalay Divisions across the Irrawaddy River at Ava and now it becomes necessary to have one or more rail-cum-road bridges in the middle and lower part of Burma to facilitate the social and economic development of the remaining central and lower parts of Burma. The influenced area map of the Bridge is attached in this report as Annexure - 1.

2. BACK GROUND TO THE REPORT

2.1 During April 1985, a dialogue had been held between the Prime Minister of Japan and the representatives of the Government of the Union of Burma under the leadership of Deputy Prime Minister in regards to the possible avenues of the implementation of the Myawaddy Bridge. A project proposal had been put forward to the Japanese Government for consideration. The Minister of Foreign Affairs of the Japanese Government, Mr. Shintaro Abe, in his letter dated, 31st May, 1985, to the Deputy Prime Minister and the Minister for Planning and

Finance, Thura U Tun Tin, expressed readiness to conduct feasibility study for the Myawaddy Bridge, preceeded by a visit of a Preliminary Survey Team in July, 1985. A copy of the letter is attached as Annexure "A".

3. OBJECTIVE OF STUDY AND THE REPORT OUTLINE

3.1 The purpose of the study in this report is to critically examine the technical, social, and economic viablity of having a bridge across the Irrawaddy River near the Myawaddy Village just north of Prome city. The study includes reviewing past records on similar Bridge Projects, a preliminary field investigation, engineering and economic study which would accomplish the objectives of the Project.

3.2 The study comprises of two phases to examine the technical and economic feasibility of the construction of the bridge across the Irrawaddy River. The first phase consists of engineering studies to select most feasible alignment which would realise maximum benefits for the access road and rail connection from both sides of the river. Once the alignment is determined, the study of the bridge is carried out, taking into account of soil and hydrologic conditions. After that, studies of Burma's economy in general including economic patterns of the influence area of the Project is conducted from which future economic development patterns and traffic streams are projected. The second phase includes an economic evaluation based upon the construction schedule and the capital investment of the Myawaddy Bridge. Computations are also made both for cost and benefit from which benefit-cost ratio as well as internal rate of return are to be computed.

4. THE STUDIES

4.1 ECONOMIC STUDIES

An economic study have been performed to cover Burma's economy in general together with the studies on regional economy, transport systems, and transport economy. These studies would be used as a data base for economic evaluation of the Project.

4.1.1 BURMA'S ECONOMY IN GENERAL

4.1.1.1 Geographic and Demographic Setting

Burma, with the land area of 678286 square Kilometers is situated in the Bay of Bangal and bordered on the west by India and Bangladesh, on the north by China and Tibet, on the east by Thailand and Laos. Topography of the country is generally flat in the south and mid-zone although mountain ranges rising over 10,000 ft in the north and south-west. Climate and vegetation varies considerably between mid-zone and the upper parts of the country as a function of rainfall. In the western and southern zone the rainfall is more than 3840 mm a year, and in the mid-zone the rainfall is between 500-1000 mm. Other parts of the country have an average rainfall of about 2500 mm. The population of Burma as shown in 1983 census indicates that she has a population of about 35.31 million with approximately 76.05 % living in rural areas and the growth rate of population is about 2.02 %.

4.1.1.2 Economic Setting

Burma's economy is based on a diversified agricultural and timber exports which had contributed about 85 % (Kyat 3055 Million in 1984) of the export earnings. During the mid-1970's, the Government of the Union of Burma

had carried out a series of major reforms intended to reorient the policies in a more open and pragmatic fashion. These reforms shifted investment priorities in favour of the primary producing sectors, adjusted producer and retail prices to enhance incentives and rationalised the price structure and introduce work incentive in commercial principles in order to improve the performance of State Economic Enterprises. Economic development during the post-reform period (Financial Year 1977 to 1981) contrasts favourably with the previous period of economic stagnation. From the financial year 1977 to 1981, a real Gross Domestic Product increased by approximately 6.5 percent per annum, as compared with barely two percent annually in the period (Financial Year 1966 to 1976). Consequently, income per Capita grew from K 941 (US $ 131 equivalent) in financial year 1978 to K 1147 (US $ 159) in financial year 1981. The trade balance has been negative for some years, the deficit being financed largely by capital imports. Debt service/export earnings: over 25 %.

4.1.1.3 Transport System

(a) General

Burma has been trying to expand the production of agricultural, fishery and livestock industry, the establishment of consumer industry to substitute the import goods, effective utilization of mineral resources and the development of heavy industry. In order to achieve these aims, it is very urgent to improve and maintain the transport

sector to meet with the ever enlarging demands for such fundamental phases of infrastructure.

Taking the significance of these transport roles for the general community into consideration, the current situation of transport status in Burma could be summarized as follows:

Total Transport Demand in Burma

Unit 1,000 tons

Particulars	1984/85
1. Domestic Output for Transport	89,512
2. Import	980
3. Total	90,482
4. Short Haulage(up to 25 miles)	52,327
5. Medium Haulage (up to 50 miles)	18,847
6. Long Haulage (50 miles or more)	19,308
7. Transport by State Transport Organizations	13,325
8. Transport by other Organizations	77,157

The total transport demand quantity has increased from 44.39 million tons in the year 1961-1962 to 90.482 million tons in the year 1984-1985. The constituents of transport demand are broken down into 70% of agriculture, livestock, forestry and fishery products, and the remaining 30% into mineral and manufacturing industries.

The constituent ratio of the short, medium and long haul transport for the year 1984-1985 was 60%, 20% and 19.5%, respectively.

The means of transport in Burma consist of the public transport means run by the Government such as Burma Railways Corporation, Inland Water Transport Corporation, Road Transport Corporation, Rangoon Port Authorities, Five Star Line and Burma Port Corporation, and the transport means under the management of the private sectors.

The transport means run by the private management handles much short-haul transport as its main activity. A percentage picture could be broken down into:-

(a) Passenger Traffic:

(1) by Railway	....	42% approx.
(2) by Roadway	....	28% "
(3) by Inland Waterway	....	18% "
(4) by Coastal Shipping	....	10% "
(5) by Airway	....	2% "

(b) Cargo Transport:

(1) Railway	....	42%
(2) Inland Waterway	....	28%
(3) Roadway	....	18%
(4) Airway	....	2%
(5) Coastal Shipping	....	10%

In brief, in the category of passenger transport, the railway and roadway play the main roles, whereas in cargo transport, the railway and the inland waterway take the important shares. Furthermore, it is well worth noting that in Burma the inland waterway

commonly carries a great volume of commodities. The average distances of the passenger transport are:

Roadway	.....	3 miles
Railway and Inland Waterway	.....	20-30 miles
Domestic Airway	.....	200 miles
International Airway	.....	500-650 miles

The average distance for cargo transport:-

Roadway	.....	50 miles
Railway	.....	160 miles
Inland Waterway	.....	200 miles
Domestic Airway	.....	250-350 miles
International Airway	.....	800 miles

The transport distance for cargo normally greatly surpasses the distance for passengers.

(b) Railways

The total mileage of the railway line which is managed by the Burma Railways Corporation is 1960 miles. Out of the total 1960 miles, 91% is single line while the remaining 9% is double line. The track guage is one meter. The corporation is exerting every effort to introduce diesel locomotives as far as circumstances permit. The number of stations is 499. A brief report of the development plans of Burma Railways Corporation is attached in this report as Annexure "B".

(c) Roadways

Since the establishment of the Road Transport Corporation in 1963, the quantity of cargo handled by the corporation and the number of passengers had increased in the succeeding six years by the annual upward rate of 4.4. and 2.9%, respectively. However, this

favourable trend had been stopped in 1969. Since then the cargo volume and number of passengers from the years 1969-70 upto 1972-73 have been declining and the annual decrease rate has been 8.6% and 5.0%, respectively.

The highway net-work is classified into four categories in accordance with the grade of construction.

(1) Bitumen Road
(2) Gravel Road
(3) Earth Road
(4) Minor Road

The table below, hereunder, indicates the highway net-works classified into afore-mentioned categories.

About 85 percent of the total length were one lane road.

Mileage of the Roads in Burma.

Type		Mile
Bitumen		5805
Gravel		4687
Earth		3079
Minor		812
Total length	=	14383

The width of highways is normally 12 feet or more, and the design load for the bridges is generally set at 36 tons.

The number of motor vehicles owned in Burma is about 90285 in the year 1973 and the latest records show that it has increased over a hundred and fifty thousand.

The record also indicates that approximately 58% of the total number of vehicles is concentrated in Rangoon.

Vehicles in Burma tend to be very old, i.e., the vehicles age of 16-19 years amounts to 46.6% and that of 32-35 years to nearly 7% against the total number of vehicles owned.

The average daily traffic over the main trunk highways in Burma has been observed and recorded every two years since 1966 having the resultant figures as shown below.

The Average Daily Traffic over The Main Trunk Highways in Burma

No. of Vehicles/Day

Year	Rangoon Pegu	Pegu Taungoo	Rangoon Tharrawaddy	Tharrawaddy Prome	Prome Thayet	Thayet Magwe	Mandalay Ava Bridge
1984	3500 (Rangoon Htaukyant)	1121	916	823	769	699	3520

The figures are based on the number of car-conversion; viz. Car/Truck-1:2; Car/Heavy-duty Truck and Bus-1:3; Car/Bicycle 1:0.5; Car/Oxcart-1:8; Car/Horse-drawn carriage-1:6.

(d) Inland Water Transport

Inland water traffic is one of the very important transport means parallel to the railway transport. The Inland Water Transport Corporation (IWTC) contributes the transport services to the public namely by means of the Irrawaddy

River in the delta area as well as the routes in other means such as Chindwin, Salween, Ataran, Gyaing etc.

Total length of all the waterway routes amounts to 5,440 Kilometers and the total service traffic accounts for the length of 11,600 Kilometers.

The navigable waterways for the wet season are calculated at 8,050 Kilometers at high-water and for the dry season 6,000 Kilometers at low water.

There are 411 river ports throughout the waterway routes under public service.

(e) Harbours

The quantity of export and import cargo in the port of Rangoon is over 3 Millions. The figures stated include not only the foreign trade cargo but also the quantity of cargo shipped to and from domestic ports such as Akyab, Kyaukpyu, Sandoway, Bassein, Moulmein, Tavoy, Mergui and Kawthaung.

4.2 REGIONAL ECONOMY

The direct influence of the Project, consisted of nine regions is considered to extend up to Pakokku and Monywa in the north, Bassein, Henzada and Tharrawaddy, Prome (East) and Prome(West) in the south, Sandoway in the west and Magwe in the east.

With the idea of finding economic activities in the western bank of the Irrawaddy River a regional economic study is conducted especially to realise pattern of development of demographic, land use, agricultural, industrial and mining activities.

4.2.1 Demography

The Demographic study shows that the nine regions have a population of nearly 4.86 Million which is 7.22 percent of the total population of Burma. The density of population varies from 20 persons/square kilometer to 150 persons/square kilometer. The most populus region is Henzada, having a population density of 150 persons/square kilometer. Generally speaking, the eastern part of the Irrawaddy and the lower Burma are thickly populated, and the population in Sandoway, situated at the western part of the Irrawaddy, is the thinnest. In the eastern part of the Irrawaddy, the population is dispersed over the entire area except for the mountainous zone, whereas the population is concentrated near the small rivers including the tributaries of the Irrawaddy.

4.2.2 Land Utilization

Land utilization in the nine regions could be classified into paddy land, Yaland, Khaing land, garden land, Dhani land, Taungya land, culturable land and forest land which may be reserved or non reserved. The land utilization charateristically differ from one region to another.

In Sandoway, Thayet(west), Thayet(east), Minbu, Pakokku and Monywa, frests-cover almost 70 percent of the surface. Of these regions Sandoway has the largest area of non reserved forest. In the eastern part, the forest development is so advanced that the reserved forest exist in a large proportion. Magwe, Minbu, Pakokku and Monywa being situated in the dry zone of Burma are characterised by Ya land. These regions are under plantations where cotton, groundnut, sesamum, tobacco and pulses are thriving well as they are best suited to the climate of the dry zone. On the other hand, the regions of Tharrawaddy and Henzada being situated in Sourthern Burma, are occupied by paddy due to the possession of a vast area of fertile alluvial land of the Irrawaddy Delta. The paddy land covers almost 35 percent of the

surface of the two regions and rice production from these two regions alone accounts for as much as over 10 percent of the total Burmese rice production. In Tharrawaddy and Henzada area alone a few percent of the surface are covered by non reserved forest, while reserved forest occuppies over 35 percent of the total area of these two regions. In Prome, situating in the eastern part of the Irrawaddy, over 20 percent is cultivable.

4.2.3 Agriculture, Industry and Mining

A lot of agricultural and industrial activities have been recorded since two decades ago due to large scale capital investments allotted for the west bank development. The production and the produce of the agricultural and industrial activities could be summarized below:-

4.2.3.1 Agriculture

The production of main crops such as paddy, groundnut, sesamum, cotton, pulses and maize are projected to reach more than 3.9 million tons in 1984. It could be expressed in detail that rice growing at Tharrawaddy and Henzada regions would account for as much as over 12.5 percent of the nation's total rice production. Magwe predominates groundnut production followed by those from Tharrawaddy and Henzada. A larger sesamum producing regions are Magwe and Minbu. Sesamum and raw cotton production is generally larger in the northern part, such as Monywa and Pakokku, than in the southern part of the nine regions. The Pakokku region is also famous for Virginia tabacco. Pulses production is large in Minbu, Mangwe, Pakokku and Monywa situated in northern part, and Tharrawaddy and Henzada in the southern part, whereas the production of pulses in Thayet and Prome is small. Agriculture is more developed in Tharrawaddy and Henzada than in the other seven regions.

4.2.3.2 Forestry

The main forestry production targets in the nine regions for 1984-85 is over 2 million tons, of which teak is about 0.5 million ton and the rest is hardwood. Tharrawaddy takes the predominance with the production of over 50,000 tons, and Thayet with the production of nearly 30,000 tons. Prome, situating in the eastern part of the Irrawaddy, ranks third with the production target of over 20,000 tons. In the western part, however, the teak resource has hardly been developed especially in Sandoway region. If a logging network is built to haul out teak from the east foot of the Arakan Yoma, and bamboo from its west foot intensively; teak and bamboo production in this area could contribute a great deal to the forest industry in Burma. The volume of hardwood and bamboo in the Arakan ridges are estimated to be 1.5 million and 20.5 million, respectively. Hardwood production is largest in Tharrawaddy followed by those in Magwe and Prome. Bamboo production is highest in Thayet followed by those in Sandoway. Plans are underway to tap the forestry resources with the help of the external agencies in the Fifth Four Year Plan.

4.2.3.3 Industry

In the western bank, an industrial zone with the overall length of 200 miles are being established, and it is now known as the Second Industrial Belt of Burma, apart from those around Rangoon Metropolitan. The industry projects in the middle region of the Irrawaddy are as follows:-

Project Name	Industrial Products
1. Pakokku Cigarette Factory	Tobacco
2. Kyunchaung Gas Generating	Natural gas
3. Kyunchaung Chemical Fertilizer	Chemical fertilizers
4. Wazi Project	Minting
5. Sale Chemical Fertilizer	Chemical fertilizers
6. Kalun Tractor Project	Large-size tractors and trailors
7. Sinde Heavy Industry Project	Motors, diesel engines, farming equipment, electrical appliances and small-size vehicles
8. Tonbo Vehicles Industry Project	Small-size vehicles, plastics and electrical appliances
9. Kyangin Cement	Cement
10. Myanaung Gas Generating	Natural gas and Power generation
11. Thanbaya Kan Oil Refinery	Diesel, Petrol etc.
12. Kyawzwa Fertilizer Plant	Fertizer
13. Methanol Plant	Methanol
14. Liquified Natural Gas Plant	Liquified gas
15. Thayet Cement Mill	Cement
16. Kyine Copper Mining Industry	Copper concentrate

It seems that the progress of the industrialisation in the middle region of the Irrawaddy does provide an outstanding predominance from the view point of the industrial situation, since these regions are the sources of supply of raw materials and energy.

4.2.3.4 Mining

In the Magwe region there are 4 major oil fields, Yenangyaung, Chauk, Man and Htaukshabin. These oil fields produced about 40,000 barrels a day, and there are minor oil fields such as Myanaung, Prome, and Htantabin oil fields which produce over 3,000 barrels a day of crude oil. The oil occurs mainly in the Tertiary rock which stretch from south to north along the Irrawaddy River. The crude oil is processed at Chauk and Syriam refineries. A new refinery is also installed at Thanpayakan, just south of Minbu on the western bank of the Irrawaddy. There are natural gas fields at Chauk, Ayadaw, Yenanchaung, Man, Prome, Myanaung, Shwetaung and Shwepyitha which produce over 50 Million cubic feet per day. Recently, Copper Mining Industry has been established at Kyine in Monywa region which is the furthest among the nine influence regions of the Project. The production is expected to have 36,000 tons of refined copper together with 7.44 Million tons of copper ore in the year 1985.

4.2.4 Future Economic Projections

The aforesaid paragraphs picture the spectrum of economic activities existed at the present moment and it is also agreed upon with the predicted economic projection and patterns of the economic developments as discussed in the Feasibility Study Report of the Irrawaddy River Bridge submitted in 1975. The Feasibility Report of the Irrawaddy Bridge predicted that in 1983:-

(a) working population would increase to 13,928000,

(b) net output of the Nation would be Kyats 14,857 Billion,

(c) main agricultural production of paddy, groundnuts, sessamum, cotton, pulses and maize would produce 11.5 Million tons, and

(d) forestry products would increase to the amount of 1.74 Million tons.

If this trend continues, the economic indicators due to the development effect of the Myawaddy Bridge as forecast in the Feasibility Study Report of Irrawaddy River Construction Project at the end of 1990, at which time the project is planned to be completed utilizing multi-variable analyses would be :-

(a) agricultural production ... 3.13 million tons
(b) forestry production ... 270,000 tons

4.2.5 Transport Economy

The prediction of the transport demand could be carried out by estimating and analysing the pattern of transport in the project area. A survey of the transport pattern of passengers, goods and motor vehicles now crossing the Irrawaddy River is needed for predicting the transport demand on the Myawaddy Bridge. Then the necessary analysis of the survey results would have to carry out for the study of future predictions. The estimation of the present patterns requires analysis of the Origin and the Destination Survey of passengers, goods and motor vehicles transported by ferry boats and motor vehicles transported by the "Z" crafts are also essential. For the analysis of the future pattern after the completion of the Bridge, a gravity transport model has to be chosen to estimate the transport demand from which diverted and generated traffic are predicted. The next step is to ascertain the transport cost by the transport modes based on the transport cost by

transport modes based on various modes such as railways, inland waterways, highways including lorries and buses. Since these costs are based on the financial accounting principles it is to be transformed into a proper economic cost by deducting interests, registration fees, insurance and tax. Then these costs are corrected to the improved circumstances after the completion of the Bridge. Literature research on the report of the Feasibility Study Mission in 1975 reveals that the estimate of passenger traffic by inter-regional origin and destination in 1973 is about 2,769,416 and traffic volume of goods from east-side jetties to west-side jetties of the Irrawaddy River, from west-side jetties to east-side jetties are 59868 and 222038 tons, respectively. In addition, it is estimated that the inter-regional origin and the destination estimate of motor traffic carried by the ferry boats between Prome and Sinde (opposite Prome) alone amounted to 5619 for lorries and 5541 for jeeps.

The focus of traffic volume crossing over the bridge reveals that in 1983 it would be as follows:

Item			Year - 1983
Number of passengers (in thousands)	Railway	Diverted	392.6
		Generated	1,189.0
		Total	1,581.6
	Highway	Diverted	1,387.2
		Generated	5,767.2
		Total	7,154.4
Goods Tonnage (in ton)	Railway	Diverted	80,521
		Generated	
		Total	80,521
	Highway	Diverted	28,290
		Generated	
		Total	28,290

Item			Year - 1983
Number of Motor Vehicles (per one way, day)	Diverted from Z rafts	Lorry	27
		Jeep	24
	Used for the Carriage of Passengers and Goods predicted above	Lorry	8
		Bus	309
		Jeep, etc.	130
	Total	Lorry	35
		Bus	309
		Jeep, etc.	154
		Total	498

The above figures also agree with the prediction that over 1000 vehicles would be crossing per day over the bridge in 1990 as stated in the project proposal. For rail traffic the estimation that 0.1 Million commuters and over 1 Million ton of goods would be crossing the bridge per year as mentioned in the project proposal is not totally agreeable. However, as with the Burma Railways Corporation's plans for the future, it is apparent that it would support the statement.

A trial focus is also made for highway traffic that would be using the bridge based on:-

(a) current national and influence area population,
(b) population growth rate,
(c) current vehicles ownership statistics,
(d) predicted vehicle ownership trend and current distribution, and on the assumption that

(a) only 60% of the gross township population of the road-net-work live within the influence area;

(b) emphasis is only given to the road net-work composing of all weather road of 12 ft width;

(c) expected high income distribution in this productive land as compared to other regions;

(d) basic socio-economic facts are not considerably different from place to place within this region;

(e) qualities of the road are the same;

(f) no restraint due to the narrow width of the roads is taken into account;

(g) Bassein-Monywa Road will be updated to all weather bitumen road of 12 ft width or more before 1990; using a trip distribution model confirms the statement that over 1000 motor vehicles a day would be using the bridge is true.

4.3 ENGINEERING STUDIES

Engineering studies have been performed to cover the details of the Project area, bridge location, soil and geology, hydrology, navigational requirements of the bridge, type of the bridge, geometric standard, load classification, estimate cost of the bridge (Local and Foreign), equipment requirement, and schedule of construction.

4.3.1 Project Area

The related area for the construction of the proposed bridge across the Irrawaddy River is located just north of Prome city, about 410 Kilometers up stream from its mouth. The location map for the proposed bridge construction site is shown in Annexure 2.

The Irrawaddy basin lies between 93°-37' and 98°-43' east longitudes and 15°-42' and 28°-26' north lattitudes. The catchment area of the basin is 376,200 Km^2 that occupies about 55% of the total area of the country and the total length of the Irrawaddy is 1,820 Kilometers.

In accordance with the topographical observation, the related area is divided into five regions;

No.	Region	Elevation (in feet)
1	Mountainous	over 500
2	Hilly	over 250 to 500 inc.
3	High land	over 100 to 250 inc.
4	Low land	below 100
5	The Irrawaddy River bed	

Annexure 1 shows each region in the related area. The average annual rainfall in the related area of 340,000 Km^2 situated up stream from Prome gauge was estimated at about 2,200 mm. The rainy season lasts six months from May to October during which the total rainfall is about 94% of the annual rainfall. The dry season starts from November and ends in next April.

The yearly mean temperature in the basin varies from 23.9°C in the northern mountain region to 27.8°C in the middle reaches of the river. The highest temperature is observed in May and the lowest in January. The annual difference in the monthly mean temperature varies from 6.4°C in the plain area to 12.7°C in the mountain area.

The relative humidity is very high throughout the year except for the plain area of the basin. It becomes the highest in August and the lowest in March/April. The annual mean humidity is 61% and 91% in the plain area and the northern mountainous zone, respectively.

The records of the average monthly percentage of wind direction at Prome guage clearly show that the basin area is affected by the monsoon, namely, north or northeast wind prevailing from November to next February, changing to south or south-east wind from

March to November. The recorded monthly maximum wind velocity at Mandalay, Minbu and Prome shows that the strongest wind generally prevails in April, May and June. The maximum velocity recorded at the time of observation hours was 8.5 m/sec at Prome.

4.3.2 Bridge Location

The Bridge is located fourteen miles north of Prome city near the village of Kyawzwa in the eastern bank and Myawaddy on the western bank. Map reference is 85 N/1 Z 403045 refering to Burma Survey Map of 1960. This site is to be selected after a careful field study of the most probable sites in the fourth defile of the Irrawaddy River due to an easy approach for access road and rail link, and field investigation reveals the banks are stable and it has the narrowest channel. The points considered in the selection of the bridge location are:-

* Depth - Shallower depth of the river during the dry season, facilitating easier construction of substructure and thus reduction of pier heights.
* Scouring - Scouring action of the bed is negligible due to shallower depth of water during the rainy season when the river is flowing fully.
* Bank stability - Banks are stable and well defined, and the levels of both banks are not appreciablely different.
* Approaches - More shorter approach spans can be provided.
* Water course - The water course is straight and non-meandering at this site.

- Access road - Access road to this area on the eastern side is already in existence and the western approach can easily be constructed.
- Construction - The construction of the bridge will be comparatively easier and the cost will be much reduced at this Bridge site.
- Land acquisition - Being an open land area, the cost of removing built-up structures for bridge approaches is almost nil, hence the cost will be considerably reduced when compared to other sites.
- Land use - Further development within the vicinity of both approaches and land use is possible.

The cross section at the bridge site drawn from the field survey of the river bed and banks is shown in Annexure 4. The width of the Irrawaddy River at the bridge site is approximately 1420 metres. Both banks of the river are stable and the depth of water during the dry season is about 19 metres.

4.3.3 Soil and Geology

Detail field investigation on the bridge site is not yet being done. However, the field survey team comprising of civil engineers, soil engineers, geologists and surveyors were sent to the site, and based on their findings, and after checking with the field investigation expressed for site No.1 in the feasibility study of the Irrawaddy River Bridge Construction Project, the followings are soil and geological facts of the bridge site.

(1) East bank - Massive and homogeneous, medium to fine grain sand stones, mostly poorly cemented, friable and moderately soft, dipping at 20-30 degree towards the bank of the river are not likely to be eroded.

(2) West bank - Sand stones, alternating with varying degree of compactness and hardness.

Detail soil exploration of the abutment sites, river bed, etc., needs further refinement to ascertain the design soil parameters. It should be done after consultation with the Japanese Feasibility Team.

4.3.4 Hydrology

No detail hydrological studies have been done. However, the informations gathered from various metrological stations along the Irrawaddy River and the studies made by the Japanese Feasibility Teams in the year 1975 near this Bridge site indicate that the following criteria are to be adopted.

(a) Design High Water level - 31.838 metres
(b) Drainage area to be used 340890 Km^2
(c) River length 1412 Km
(d) Lowest water depth at the site 19 metres
(e) Highest water depth at the site 32 metres
(f) Lowest elevation of superstructure of the bridge above the highest water level is 16.77 metres.

Other hydrological data such as water level, river discharges, sediment transport, water temperature and velocity would handed over to the Japanese Feasibility Team for further analysis.

4.3.5 Navigational Requirements

Discussions with the Inland Waterway Transport Corporation whose ships are plying along the Irrawaddy River, suggested that:-

- The horizontal clearance between inside faces of piers, except for the approach span, shall be 350 feet or more, taking into account about three times allowance for the overall width of the largest peddler cum cargo flats employed in the Irrawaddy at present.
- The vertical clearance for bridge planning at site shall not be less than 55 feet, taking into account the allowance of about 10 feet for the maximum height above draught of the largest pedlar steamer in the Irrawaddy at present.

According to the Inland Waterway Transport Corporation's long term policy to improve the present navigation condition, Inland Waterway Transport Corporation intends to gradually improve the cargo flat in near future by installing the engine and propeller for self-travelling. It suggests that the overall width of the pedlar steamer cum cargo flats in use will not be further widen for future navigation activity. Therefore, it is considered that the design criteria for the above mentioned facts are applicable for bridge planning.

4.3.6 Bridge Structure

There are many possibilities employing various types of structure such as continuous box girder, bow-string and truss for steel type bridge or the segmental pretressed concrete bridge. However, taking into account of easier construction techniques, construction schedules and construction cost, a steel type bridge, is adopted with the following particulars:-

4.3.6.1 Super Structure

Steel Truss Bridge

The bridge shall be for the combined use of road and rail traffic, with both being on the same level. A continuous truss type for the main bridge should be employed as it may easily be built using cantilever construction method or floating crane method. For the approach spans of the bridge the simply supported trusses shall be used as shown in Annexure 5.

4.3.6.2 Other Structure Types

Other types of the bridge superstructure with different deck arrangement, having rail-road in the lower deck and motor-road in the upper deck should also be considered as an alternative (1) as shown in Annexure 5(a). Another type of bridge superstructure is also proposed with road and rail deck keeping on the same level as an alternative (2) as shown in Annexure 5(b).

4.3.6.3 Substructure

The open caisson sinking method is to be considered for the foundation of mid-stream piers and the bored pile foundation are for abutments and land span piers.

4.3.7 Design Criteria

The following are considered to be appropriate for use in the design of the bridge:-

- Highway live load shall be that of HS 20-44 to the American Specification AASHTO;
- Railroad live load shall be that as per Indian Railway Standard (IRS) Main Line loading of 1929 for metre guage;

- Impact load shall be calculated in reference to the provisions prescribed in AASHTO and in the Bridge Rules of the Indian Railway Standard (adopted in 1941 and revised in 1964);
- Loading of trailer truck carrying a heavy equipment (total weight 60 tons) shall be considered in the design of floor system and or deck slab;
- The vertical clearance for navigation under the bridge shall be 16.77 metre above design high water level and the clear width for such navigable span shall not be less than 106.7 metre;
- The width of the road-way shall be 4.5 m for a single traffic on each side of the main truss or a two lane width on a double deck truss or another two lane bridge and the maximum design running speed of motor vehicles shall be 96.6 Kilometre per hour;
- The rail-road deck shall be of a single-track and metre gauge. The maximum design train speed shall be 96.6 Kilometre per hour;
- The bridge deck shall be provided with a side walk on the outside of each roadway, each 1.5 metre wide;
- The fundamental seismic coefficient shall assume to be 0.12 considering the unfavourable effect of the height of pier, the design seismic coefficient shall be increased by 25% at 150% of the basic unit stress;

- The gradient of the railroad on the bridge shall not be greater than 0.25% and that for the highway on the bridge shall not be greater than 3%;
- Length of bridge structure,

(a)	Main bridge	.....	1100 metre
(b)	Approach bridge	.....	320 "
(c)	Total bridge	.....	1420 "

4.3.8 Construction Materials

The survey of the availability of raw materials such as sand, gravel and stone was made by a material engineer of preliminary investigation team. It was reported that all could be available within the area about 30 miles from the site. However, the quantity available for these should be confirmed by extensive field exploration. Cement could be obtained from Thayet and Kyangin cement factories and the reinforcing steel could also be obtained from Ywama Steel mill near Rangoon, in addition to the steel supplied under Japanese Commodity Loan. The following are the foundings of the material engineer:-

- Aggregate
  Construction materials such as coarse and fine aggregates are available within the vicinity of the bridge site.
- Cement
  Cement of high quality in large amount can be obtained from the Kyangin and Thayet cement factories.
- Timber
  Logs and timber scantling are locally available in large quantity.
- Steel
  Steel for concrete works as well as superstructure steel member could be available from Steel Mill

near Rangoon. A large quantity of it is also available from reserved stock of reinforcing steel supplied under Japanese Commodity Loan.

4.3.9 Man Power

Unskilled labourers for bridge construction works could be obtained from local village folks. For skilled technicians such as welders, bar benders, electricians, fitters, etc., would be made available from other completed bridge projects. They would be assigned to this project in addition to engineers who have already gained experience in completing large scale bridge construction projects implemented under Columbo Plan (Thaketa Bridge), Chinese Loan (Kunlone and Takaw Bridge) and Japanese Grant Aid (Thuwuna Bridge). An advance bridge engineering course is now conducting in the Bridge Training Centre in Rangoon, and (57) bridge design engineers and bridge construction engineers have already been produced so far. The following are the statistical data of bridge engineers and technicians available for the Project:-

Sr.No.	Particulars	Quantity
1.	Senior Bridge Construction Engineer	5
2.	Senior Bridge Design Engineer	2
3.	Bridge Engineer	20
4.	Technician of all grades	200

4.3.10 Machinery and Equipment

Recent studies on the inventory of bridge equipment in hand, indicate that some of the equipment in the Ministry of Construction could be transferred for use in this Project. However, the machinery and equipment requirement would vary accordingly to the type of bridge and the method of construction. Hence, a further discussion with the Japanese Feasibility Study Team over this matter is also needed. Assuming that the bridge will be of steel and that the type of foundation be of open caission

and bored pile, a proposed rough estimate of machinery and equipment requirement are listed in Annexure (6) for further consideration by the Japanese Feasibility Team.

4.3.11 Construction Cost Study

For the purpose of this study, the cost estimate presented was calculated under the economic conditions in 1984/85. The exchange rates between Japanese Yen, Burmese Kyat and US Dollar were set at 250 and 8.5 in one, respectively. The cost estimates compucted hereafter, aimed at carrying out the cost benefit calculation for this Project as well as to establish the unit costs for the various construction work items and the total construction cost.

The cost of construction equipment and imported materials including the freight and insurance charges, were determined refering to the data obtained from a similar project to be implemented with a loan from an External Agency.

The unit construction costs for various items were studied with a detail breakdown of the basic constituents, such as material equipment, labours, technical assistances, etc., under an assumed combination of necessary number of local and foreign labourers.

The breakdown into foreign and local components had been applied from the very basic prices followed by the whole of the cost study.

The cost did not include cost of the access railway and road connection to the Myawaddy Bridge. The Burma side would complete the access railway and road connection from its own resources in time.

4.3.12 Estimated Components

The estimated components for the construction of the bridge includes in the following major items:-

(a) investigation and design,

(b) temporary works, such as temporary site offices, temporary godowns, workshops, temporary electrical and sanitary installation and other preparation works,

(c) construction,

  (i) procurement of all types of structural and constructional materials,

  (ii) labour charges including transport and medical expenses of labours,

(d) procurement of special equipment and materials,

(e) engineering fees, and

(f) contingency.

The summary of the estimated cost for the construction of the bridge is attached to this proposal in Annexure 7. The total estimated amount is Kyats 901 Million (US $ 106 Million).

4.3.13 Project Implementation

The construction schedule of the project implementation is divided into two phases with the first, pre-engineering phase including the detail design to be completed during the first year; the second phase would include actual construction phase, and it is the Burmese side's idea that the bridge would be completed during the next three years. Altogether a period of 4 years would be needed from the time of the feasibility study by the Japanese Team which would begin in 1985. The details are shown in Annexure 8.

5. ECONOMIC EVALUATION

5.1 METHODOLOGY

The basic purpose of the economic evaluation of a project is to measure its economic costs and benefits in order to determine whether its net benefits are at least as big as those obtainable from marginal investment opportunities. Cost benefit analysis, which is going to be adopted in evaluating Myawaddy Bridge Project, is an evaluation method which attempts to measure the impacts on all the interests that may be affected by the bridge project in such a way that they can be directly compared and aggregated to assess the worth of the project to the community at large. In principle, cost benefit analysis considers both the immediate users of a project as well as those who are indirectly affected such as the community at large, which provides the resources for the investment. In applying cost benefit to bridge project evaluation the impact normally measured in money terms are construction, maintenance and operating cost of bridge and on the benefit side, changes in road user cost such as vehicle operating costs savings, travel time savings and accident savings. Other " social " costs or benefits are normally assessed in non-monetary terms, either quantitatively or qualitatively. However, in cases where such costs or benefits are considered particularly significant, consideration should be given to their valuation in monetary terms as part of the cost benefit analysis. A bridge construction project by lowering the total cost of travel over a natural barrier as well as providing a benefit to existing road users equal to the cost reduction may also generate new traffic which also represents benefit to society. The benefits that flow from a bridge must be predicted year by year over the life of the project and aggregated for comparison with the project costs to determine the economic worth of the project. In comparing the relative economic worth of a bridge project, therefore, discounted cash flow and shadow princing techniques must

be employed. Discounting is a weighting process whereby the observed preference of individuals for present benefits or consumption is accommodated by assigning a unit weight to the current period and progressively lower weights to future periods. The principle involvement is that a kyat received to-day is worth more to the recipient than is a guaranteed receipt of a kyat in one year's time regardless of inflation. The shadow pricing technique is a process to work out the real price structure without reflecting any price distortion of the market.

5.2 QUANTIFIABLE AND QUALIFIABLE BENEFITS

(a) In Myawaddy Bridge Project cash flows for both construction and benefit costs are computed with various discount rates and a construction period of four years is adopted together with the project life of thirty years. The quantifiable benefits in monetary terms are:-

(i) time cost saving of vehicular passengers,

(ii) transport cost savings of goods due to the reduction of fixed, terminal and movement costs,

(iii) time cost savings of commuters of rail net-work,

(iv) cost savings of goods transported across the bridge by rolling stocks, and

(v) costs of elimination of cargo handling of river craft jetties on both ends of the present crossings.

(b) All other qualifiable benefits such as promotion of education, culture, security, national solidarity, regional development, the increased employment opportunity, the raising of professional skills, the effective utilization of resources and the development of materials for the manufacturing industries are not quantified in money terms.

5.3 COST

Costs include direct charges such as material costs, labour wages and equipment appreciations as well as the indirect cost of engineering fees is included, however, the contingency allowance is excluded in computing the cost of Myawaddy Bridge.

5.4 THE FINDINGS

The results of trial computation, using shadow pricing of costs and benefits together with the discounting technique, are summarised below. A trial is also made to compute the internal rate of return which is also the rate of discount that makes the present value of the investment zero.

Particulars	Ratio of benefit and cost	Internal rate of return	Pay back period
Official Rate	2.163	17.50	13 Years
Shadow Rate			
1.50	1.442	13.20	20 Years
1.75	1.236	11.79	24 Years
Sensitivity (cost +20%; Benefit -20%)			
(a) Official Rate	1.442	-	-
(b) Shadow Rate			
1.50	0.961	-	-
1.75	0.824	-	-

6. IMPLEMENTATION METHOD

6.1 The policy of the Government of the Socialist Republic of Burma is to carryout civil engineering works in Burma by force account as far as possible using appropriate para-statal organisations as executing agencies. There are no construction contractors in Burma.

6.2 The Construction Corporation, under the Ministry of Construction, undertakes most of the civil works including all road and bridge construction works in Burma. For grant or loan projects like the construction of Burma Medical Research Institute, a Hospital Complex and Thuwana Bridge and others, Construction Corporation undertakes as a sub-contractor to expatriate construction firms.

6.3 For the construction of Myawaddy Bridge, it is desired to execute the project as stated in para - 6.2 since the Construction Corporation has the capacity and experiences.

7. ENVIRONMENTAL EFFECT

7.1 As the proposed MYAWADDY BRIDGE Construction Project would take place in the area far away from towns and villages, there would be little, if any, need to displace dwellings and their inhabitants. No particular ecological problems are expected with the implementation of the Project.

8. CONCLUSION

8.1 The construction of the proposed Myawaddy Bridge would contribute to the regional development of Burma as a whole and at the same time the bridge would serve as a very important link to form the east-west arterial route passing

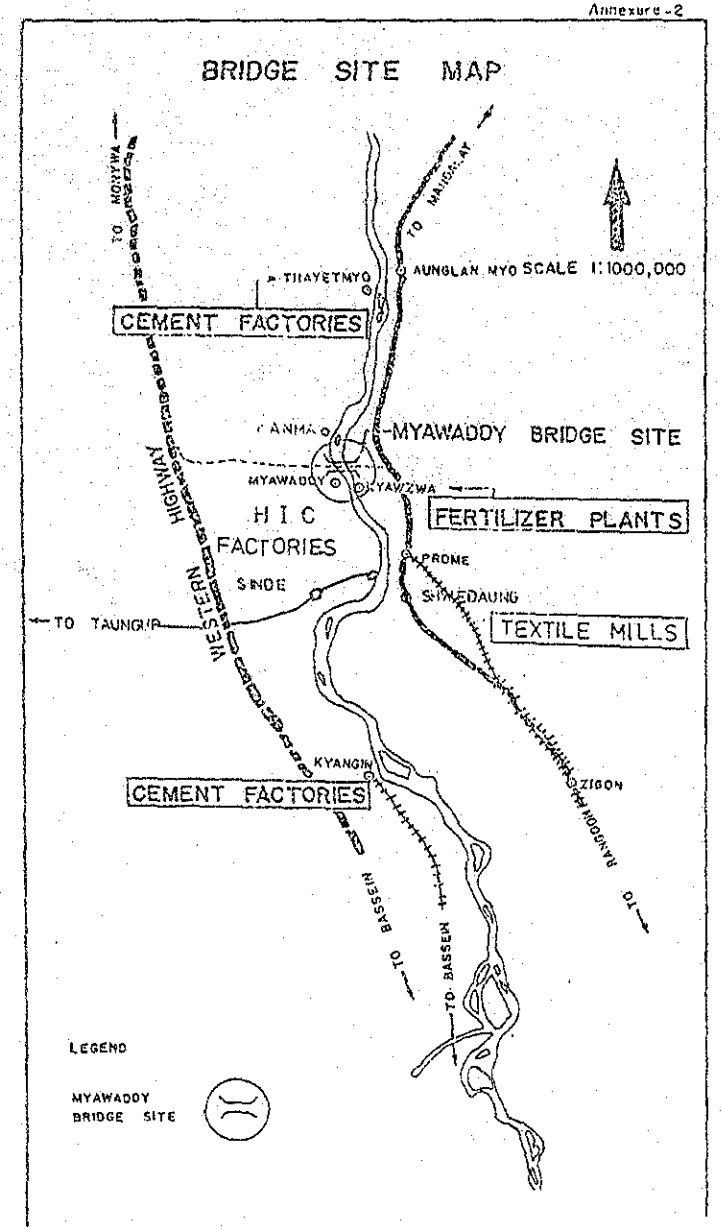
through the central belt of Burma which runs from Kayah and Shan State to the east, Rakhine State, Irrawaddy Division, Chin State, Sagaing Division and part of Magwe Division to the west which serve about 70 to 80% of the area of BURMA. It is also technically feasible and economically viable and hence the implementation of this project is worthwhile.

LIST OF MAJOR REPORTS AND DOCUMENTATIONS USED

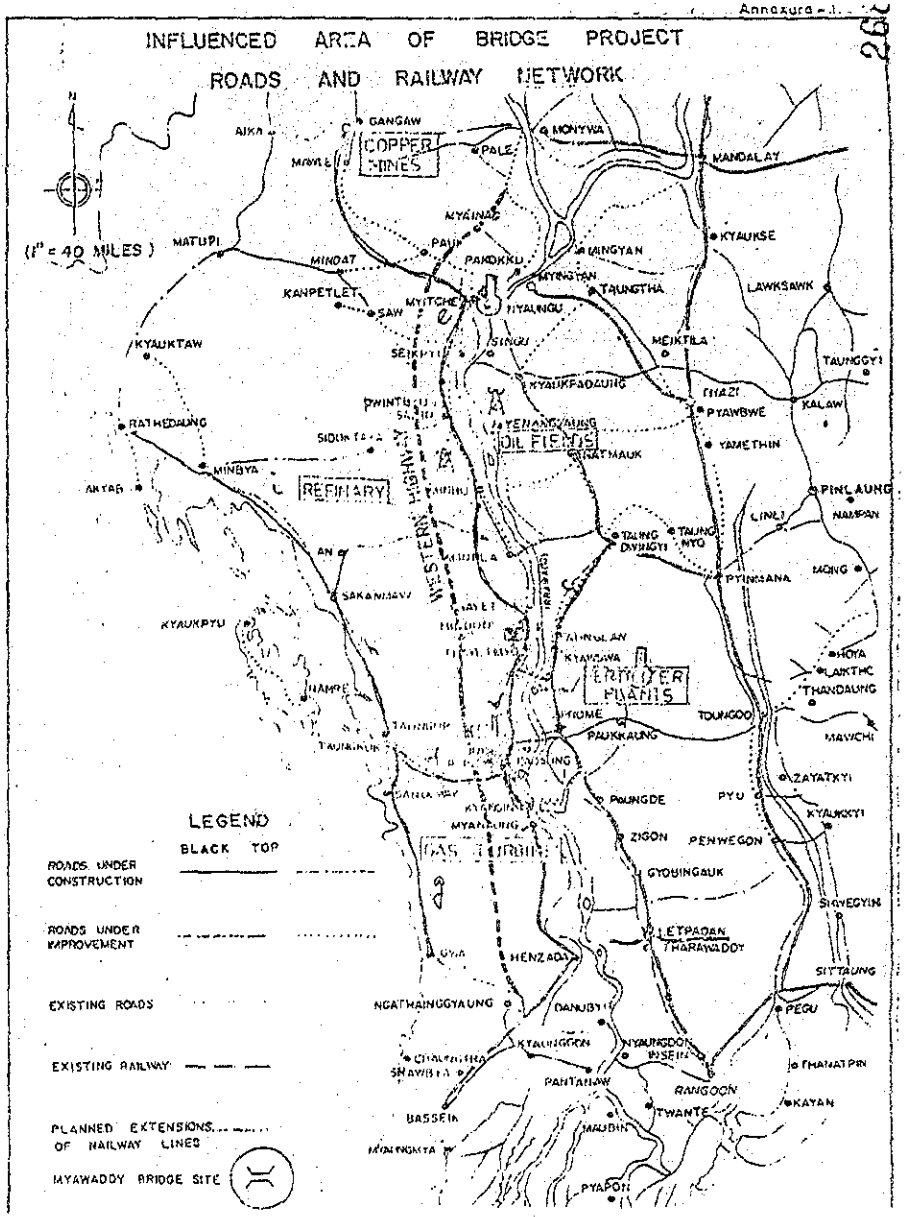
Central Statistical Organization of the Socialist Republic of the Union of Burma	Statistical Abstract 1978 Rangoon, (1979)
Final Report of Feasibility Study for Irrawaddy River Bridge Construction Project	November, 1975, JICA
Cost Benefit Analysis	Edited by Richard Layard, Penguin Modern Economic Readings, 1975
Sector and Project Planning in Transportation	World Bank Staff Paper Number four
Traffic Forecast at Hlaing River Bridge	Construction Corporation Staff Paper, 1984
Project Proposal, Myawaddy Bridge.	Construction Corporation Staff Paper, 1985

A N N E X U R E

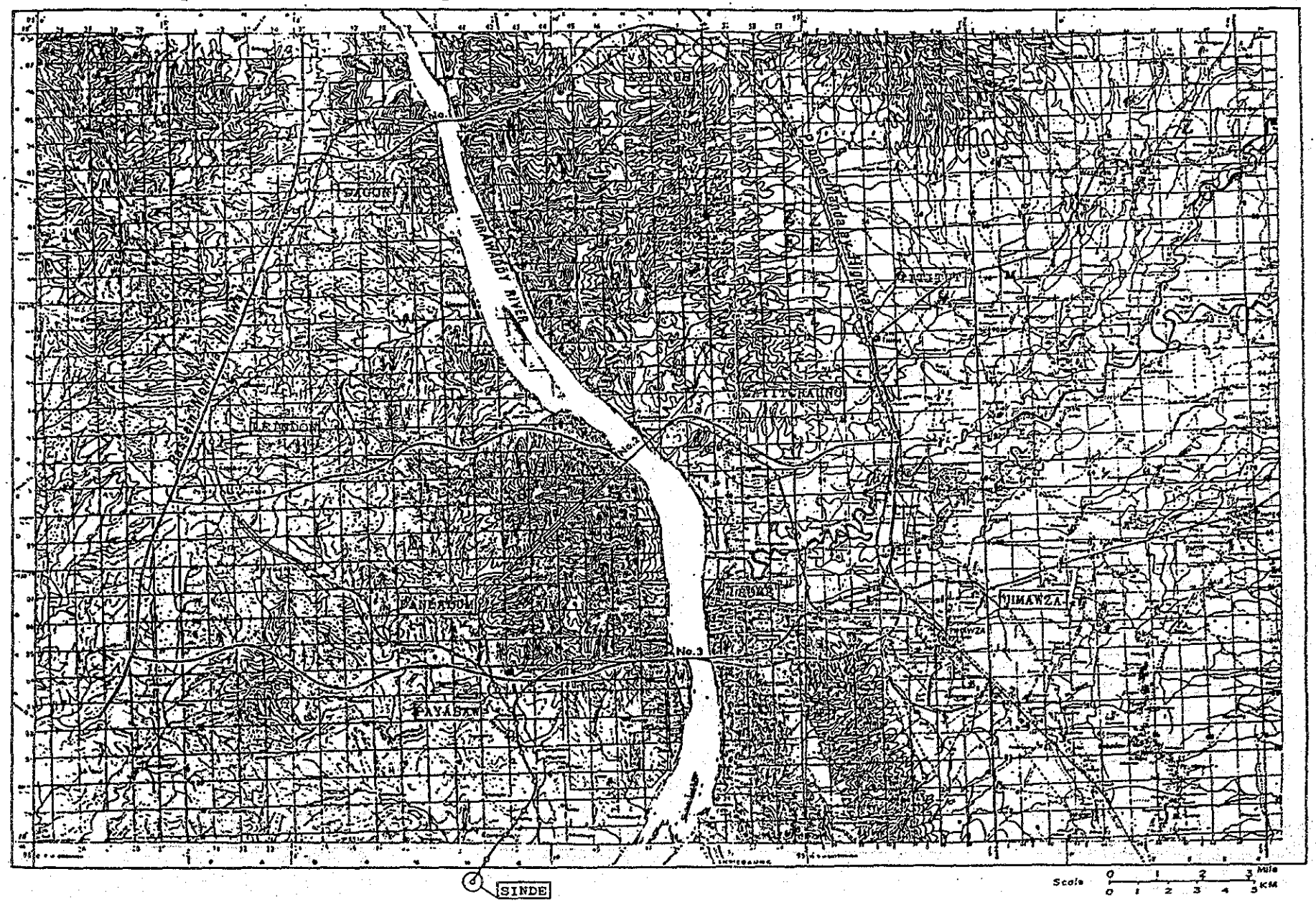
Annexure-2



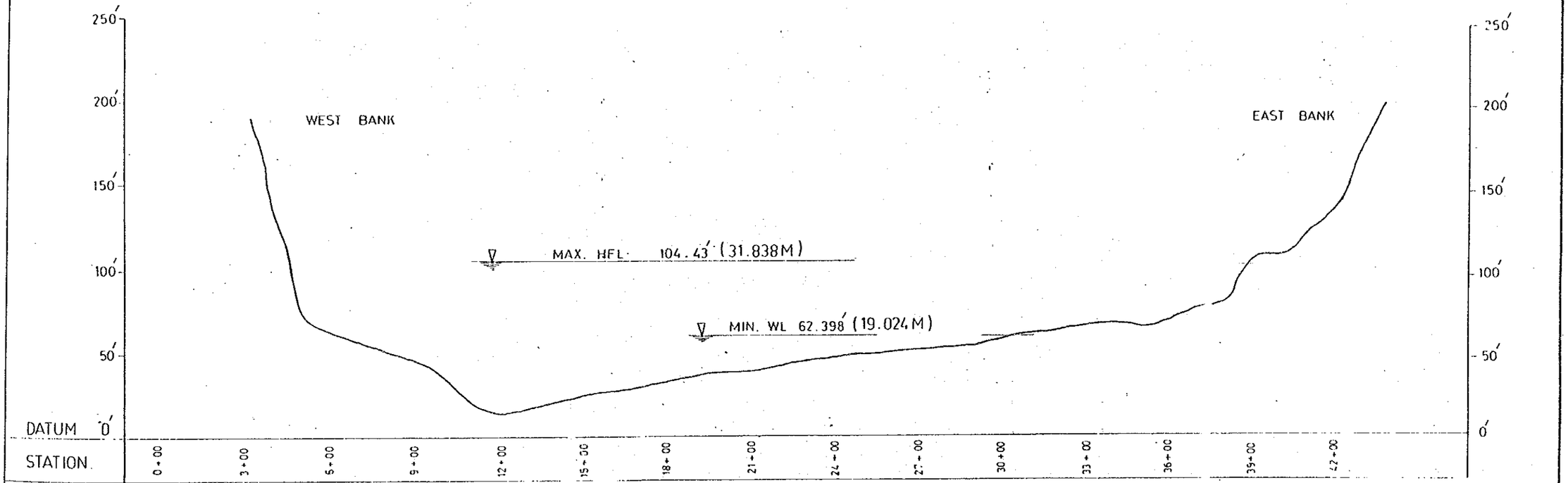
Annexure-1



Project Location Map



SCALE
HORIZONTAL 1 IN = 300 FT
VERTICAL 1 IN = 50 FT

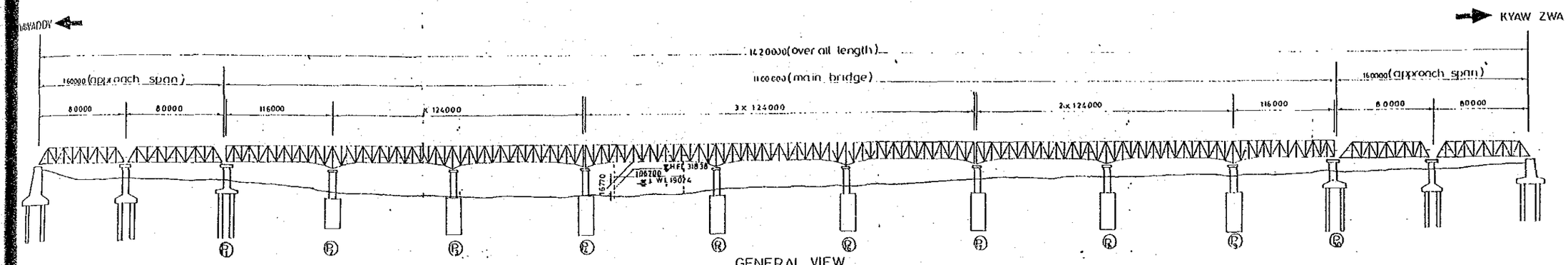


(R.L BASED ON ASSUMED DATUM)

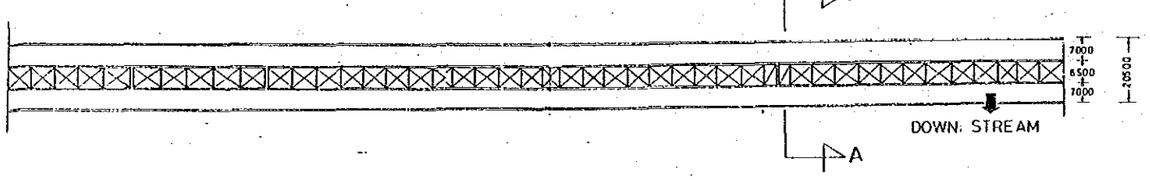
RIVER CROSS SECTION NEAR MYAWADDY VILLAGE

PROPOSED MYAWADDY RAIL_CUM_ROAD BRIDGE

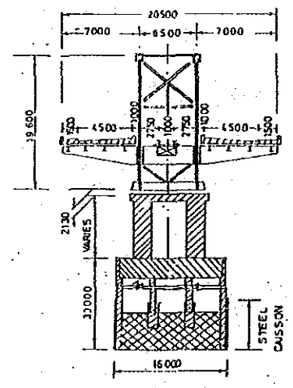
ACROSS IRRAWADDY RIVER



GENERAL VIEW



MAIN TRUSS HALF PLAN

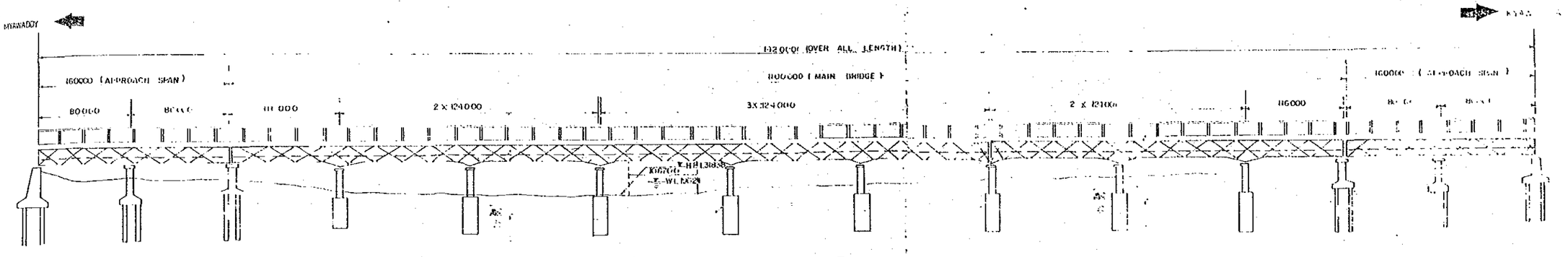


SECTION A_A

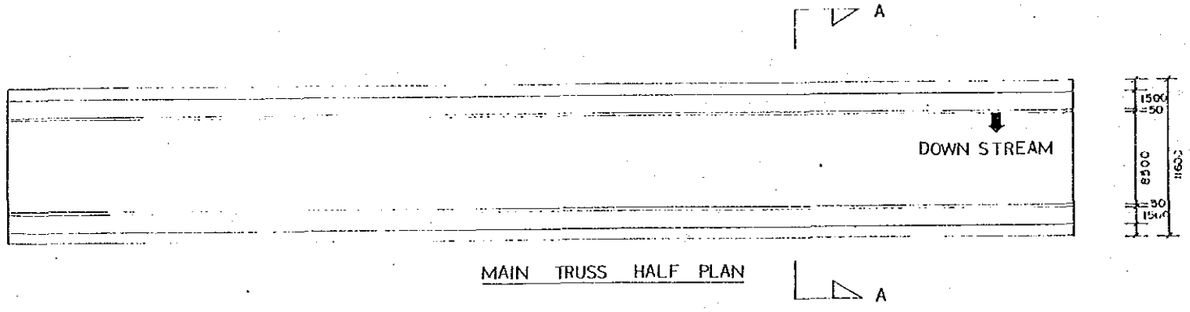
CONSTRUCTION CORPORATION	Drawn by Mg Aye Thein
MYAWADDY_RAIL_CUM_ROAD BRIDGE ACROSS IRRAWADDY RIVER	Traced by Mu Mu Khin
	Checked by U Kyaw Hoe (SDO)
PROPOSED BRIDGE GENERAL LAYOUT	Approved by D.E (Road)

PROPOSED MYAWADDY RAIL_CUM ROAD BRIDGE (Alternative proposal-1)

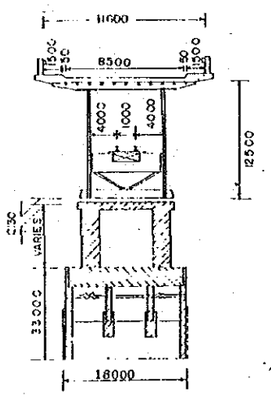
ACROSS IRRAWADDY RIVER



GENERAL VIEW



MAIN TRUSS HALF PLAN

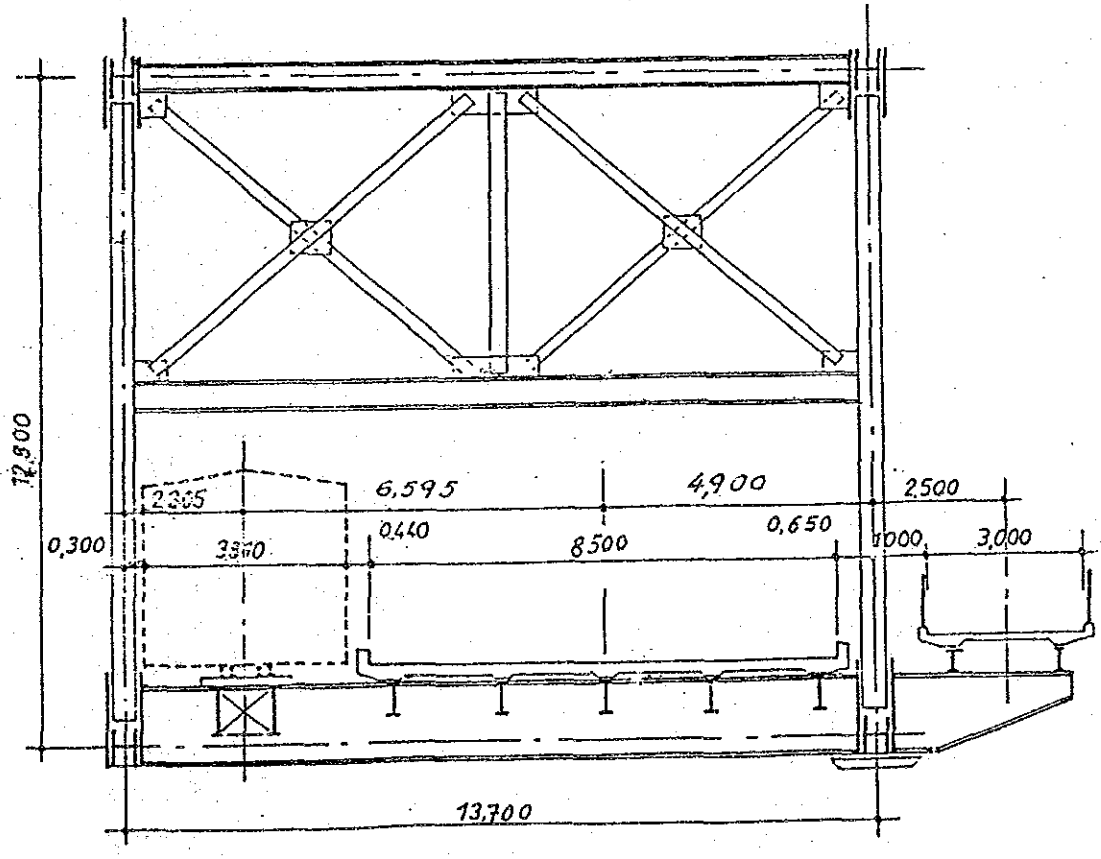


SECTION A.A

CONSTRUCTION CORPORATION	DRAWN BY [illegible]
MYAWADDY RAIL_CUM ROAD BRIDGE ACROSS IRRAWADDY R[illegible]	TRACED BY [illegible]
	CHECKED BY U KYAW [illegible]
PROPOSED BRIDGE GENERAL LAYOUT	APPROVED BY D.E. [illegible]

PROPOSED MYAWADDY RAIL-CUM-ROAD BRIDGE ACROSS IRRAWADDY RIVER

(ALTERNATIVE PROPOSAL-2)



Annexure - 6

Myawaddy Rail-Cum- Road Bridge

Machinery and equipment required for Construction of Steel truss bridge.

Sr. No.	Description	Quantity
1.	Derrick Crane, 30t	2 Nos.
2.	Derrick Crane, 200t	2 Nos.
3.	Traveller Crane (truss) 20t	4 Nos.
4.	Traveller crane (Yard), 20t	2 Nos.
5.	Post crane, 20t	4 Nos.
6.	Crawler Crane, 90t	2 Nos.
7.	Diesel Generator 400KVA	2 Nos.
8.	Diesel Generator, 300 KVA.	2 Nos.
9.	Diesel Generator, 75 KVA	2 Nos.
10.	Compressor, 200 PS	1 No.
11.	" 170 PS	5 Nos.
12.	" 100 PS	4 Nos.
13.	" 50 PS	8 Nos.
14.	Grab hammer for Ø 1000mm	2 Nos.
15.	Batching plant, 30 m^3/hr	4 Nos.
16.	Classifier plant	2 Nos.
17.	Shovel loader, 2 m^3-3m^3	2 Nos.
18.	Agitator truck, 3 m^3	12 Nos.
19.	Concrete pump, 12 m^3/hr	2 Nos.
20.	Clamshell, 3m^3	4 Nos.
21.	Deck barge, 500t	4 Nos.
22.	Tug boat, 60t	1 No.
23.	Anchor boat, 20t	1 No.
24.	Winch, 15-50PS	20 Nos.
25.	Trolly, 30T	10 Nos.
26.	Partable Crushing plant 50m^3/hr	1 set.
27.	Water Supply equipment	1 set.
28.	Electrical equipment	1 set.
29.	Telecommunication equipment	1 set.
30.	Plant loading equipment	1 set.
31.	Transportation truck, barges, etc	1 set.
32.	Office equipment	1 set.
33.	Miscellaneous machinery tools	1 set.
34.	Spare Parts	1 set.

Annexure - 7.

Summary of Estimated Construction cost of Myawaddy Rail-Cum Road Bridge across Irrawaddy River (Steel Truss-Bridge)

(Kyats in Million)

Sr. No.	Subject	Local	Foreign Exchange	Total
1.	Investigation and design	3.00	26.75	29.75
2.	Temporary Works	48.00	11.50	59.50
3.	Construction	89.50	485.25	574.75
4.	Special equipment and materials	34.00	68.00	102.00
5.	Engineering Fees	15.00	30.00	45.00
6.	Physical and financial contingency.	40.00	50.00	90.00
	Total in Kyats	229.50 (27.00)	671.50 (79.00)	901.00 (106.00)

Note - 1 US $ = Ks. 8.50

Annexure - 8.

CONSTRUCTION OF MYAWADDY RAIL-CUM-ROAD BRIDGE

PROPOSED IMPLEMENTATION SCHEDULE

Sr. No.	Particulars	Prepara-tion	1st.Year	2nd.Year	3rd.Year	4th.Year
1.	Site location and Preparation Works	xxxxxxxxxx				
2.	Construction of Sub-Structure		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx			
3.	Construction of Superstructure			xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		
4.	Land scaping and winding up				xxxxxxxxxx	

ANNEXURE " B "

Restricted

A BRIEF NOTE OF BURMA RAILWAYS CORPORATION

Introduction

1. The Burma Railways Corporation System is a metre gauge system with its main line loading of Indian Railways Standard, operated since 1887. The system has the route length of 1960.35 miles mostly running south to north, parallel to the Irrawaddy River.

2. The Irrawaddy River is one of the longest navigable river which is 1238 miles long and divides the country into two parts, east and west. The railway crosses the Irrawaddy at Sagaing and runs 333 miles up to Myitkyina. The Ava bridge was built in 1924 by the Brigweik Co, India at the cost of 10,00,000 sterling pounds. It is the only rail-cum-road bridge of 3948 feet long, crossing the Irrawaddy and founded on well foundations.

3. The track permits a maximum axle load of 12 tons and speed on the main line is limited to 45 miles per hour for passenger trains and 25 miles per hour for freight trains. Approximately 27 percent of the track is of 75 lbs rail and 53 percent of the track is with 60 lbs rail. Wooden sleepers have been predominately used and usage of concrete sleeper is increasing slowly but steadily.

4. The Signalling is on the basis of absolute block signalling with block instruments (single line and double line) over 657 miles and paper line clear system on 1180 miles. Semaphors system are provided at 223 stations while colour light signalling is provided at 27 stations. D.C and A.C track circuit have also been provided in a few locations.

Restricted

Railway development Plan

5. To assist the development of the west side of the Irrawaddy, the B.R.C. has a plan to extend it's Bassein-Kyangin rail line towards north and west to tap all natural resources such as, timber, bamboo, paddy, agricultural products, mineral products and other products from heavy industry from the Chin State, Arakan State, Magwe Division, Irrawaddy Division, and at the same time intended to extend it's rail net work to close up the gap between Prome and Taungdwingyi so as to generate the passenger and freight traffic.

6. To develope west bank is a necessity and development should have been done long ago, but due to unforeseen circumstances the development programme had been defered. Infact the B.R.C. had actually taken up the survey works to extend the railroad from Kyangin to Padaung since 1978.

7. The present railway development plan for improvement of west bank and its vicinity are as follows:-

(a) Prome-Kyawswa rail line
(b) Kyangin-Myawaddi "
(c) Myawaddi-Aunglan-Taungdwingyi rail line
(d) Myawaddi-Thayet rail line
(e) Thayet-Gangaw rail line
(f) Myawaddi-Taungkok rail line
(g) Taung Kok-Kwa rail line
(h) Taung Kok-An rail line
(i) An-Rathedaung rail line

Prome-Kyawswa rail line

8. It is intended to extend the Rangoon-Prome rail line up to Taungdwingyi to close up the gap and form a Rangoon-Pyinmana-Taungdwingyi-Prome loop. Since the whole length is 104 miles in length the section is divided into two parts and the first phase

is from Prome to Kyawswa which is 19 miles long. Construction of Prome-Kyawswa rail-line will facilitate not only the loop but also the construction of the new bridge across the Irrawaddy. This Prome Kyawswa rail link will serve as the service and approach rail road to the new bridge head. The estimated cost for construction of this rail road is about 475 lakhs kyat and the construction period will be 3 years starting from 1986-87 budget year.

Kyangin-Myawaddi rail line

9. Extension of railway net work in the west bank had been planned and survey works had been commenced since 1978 to construct a rail road from Kyangin to Padaung. The Kyangin-Myawaddi rail line is 75 miles in length and its estimated cost is 2625 lakhs kyat. This is the 1st phase of the extension work on the west bank-and all rail lines extended on the west bank will be either extended north-wards or westwards to transport natural resources, such as forest products, mineral products, agricultural products etc. This project will commence from 1986-87 and complete in 1992-93.

Kyawswa-Aunglan-Taungdwingyi rail line

10. This line is to extend the Prome-Kyawswa line to close up the Taungdwingyi gap. This linking will form a loop for Rangoon-Pyinmana-Taungdwingyi which will generate passenger as well as freight traffic considerably. The gap between Kyawswa and Taungdwingyi is about 85 miles. The over all tarrain is not as rugged as compared to the west bank. It is estimated that the cost of construction will be about 2125 lakhs kyat.

Myawaddi-Thayet rail line

11. Thayet is one of the cement producing places on the west bank. By linking the rail line almost all cement products from Thayet can be transported by rail line. Myawaddi-Thayet rail line is about 32 miles long and it is estimated that the cost for con-

struction is about 1120 lakhs kyat. It is intended to start the work in 1991-92 and complete in 1994-95.

Thayet-Copper Mine rail line

12. This is further extension of west bank rail net work towards north. The final object is to transport copper concentrate from Copper mine up to Prome and Rangoon. Since the line to be connected from Thayet to copper mine is about 244 miles, this project should be deferred until the end of Fourth four-year Economic Plan, that will be after the end of 2002.

Myawaddi-Taungkok rail line

13. If there were a bridge across the Irrawaddy at Myawaddi, the line running from Myawaddi into Arakan States will play a very important roll in transporting natural resources from Arakan States, especially forest and agriculture products. This rail link will be the first rail link ever constructed in the Arakan States. From Taungkok future rail lines spreading along the Arakan coast will be constructed. The length of the rail line will be about 40 miles and it is expected to commence the work in 1993-94 and to complete in 1997-98. The estimated cost of the project is about 1400 lakhs kyat.

Taungkok-Gwa rail line

14. Taungkok-Gwa connection will very difficult due to giological condition. The coastal strip has sharp cliffs and many drainages. This project is included after Fourth Four-year Economic Plan, but preliminary works are to be carried out steadily.

Taungkok-An rail line

15. This is the extension of the Arakan State rail line from south to north. This project is included after Fourth Four-year Economic Plan.

An-Rathedaung rail line

16. Final rail line linking An and Rathedaung. This project is also included after Fourth Four-year Economic Plan.

Cost of Projects, Investment programme and Works programme

17. Cost of each project and investment programme and works programme for future extensions can be seen in appendix B, C & D.

Extension of rail line map

18. Map showing future extension of rail lines can be seen in appendix E.

Economics aspect

19. The Burma Railways Corporation with its plan to develope especially west bank if Irrawaddy will be very fortunate to have a bridge some where a round Myawaddi to link up the west bank railway net work and east bank railway net work.

20. According to the Burma Railways Corporation future railroad extension plans especially the construction of new Prome-Kyawswa in the Fiscal year 1986-87 and expected to complete in 1989-90 will be very fortunate for the Myawaddi Bridge construction works. The rail line will not only serve the Myawaddi bridge construction as a service line, but also link the east and west railway net work in the future.

21. By constructing the Myawaddi bridge the transportation from Delta area can be handled more efficiently than without the bridge. It is expected that copper, bean and pulses, fruits, timber, cement, machinery, rice, gas and miscellaneous stores will be transported efficiently via the Myawaddi bridge. It is estimated that about 0.2 million tons of goods will be handled yearly, which will contribute about 15.5 million kyats to the railways revenue.

22. With future extension of rail lines forming a Rangoon - Pyinmana-Taungdwingyi--Prome loop and extension of rail lines towards Chin State and Arakan State it is expected that with the bridge across the Irrawaddy, some where around Myawaddi, will generate about 2.1 million of passenger crossing west and east bank which will contribute about 3.8 million kyats to the railway revenue with the present tariff rate.

Benefit

23. The Burma Railways Corporation has the responsibility to transport mass freight and passenger traffic as required by the States and Divisions. Improvements to existing rail lines and extensions have been carried out annually depending on the budget grant.

24. The Burma Railways Corporation has been planned to extend its rail lines and develop the west bank of the Irrawaddy irrespective of the cent per cent economic justification. By extending the railway net work on the west bank part of Irrawaddy and Magwe Divisions, Chin and Arakan States will benefit economically without doubt, but social, educational and political benefits out of this will definitely out balanced the economic justification. This benefit will be "National Benefit".

Conclusion

25. Last but not least, the Burma Railways Corporation with its own extension plans to develop the west bank of the Irrawaddy will fit-in with the plan to construct an rail-cum-road bridge across the Irrawaddy some where around Myawaddi in the very near future. The Burma Railways Corporation expects the Myawaddi bridge to be constructed soon so that the west bank extension rail line may be linked with the east bank extension in time for the sake of the national Development.

Appendix ' B, C & D '

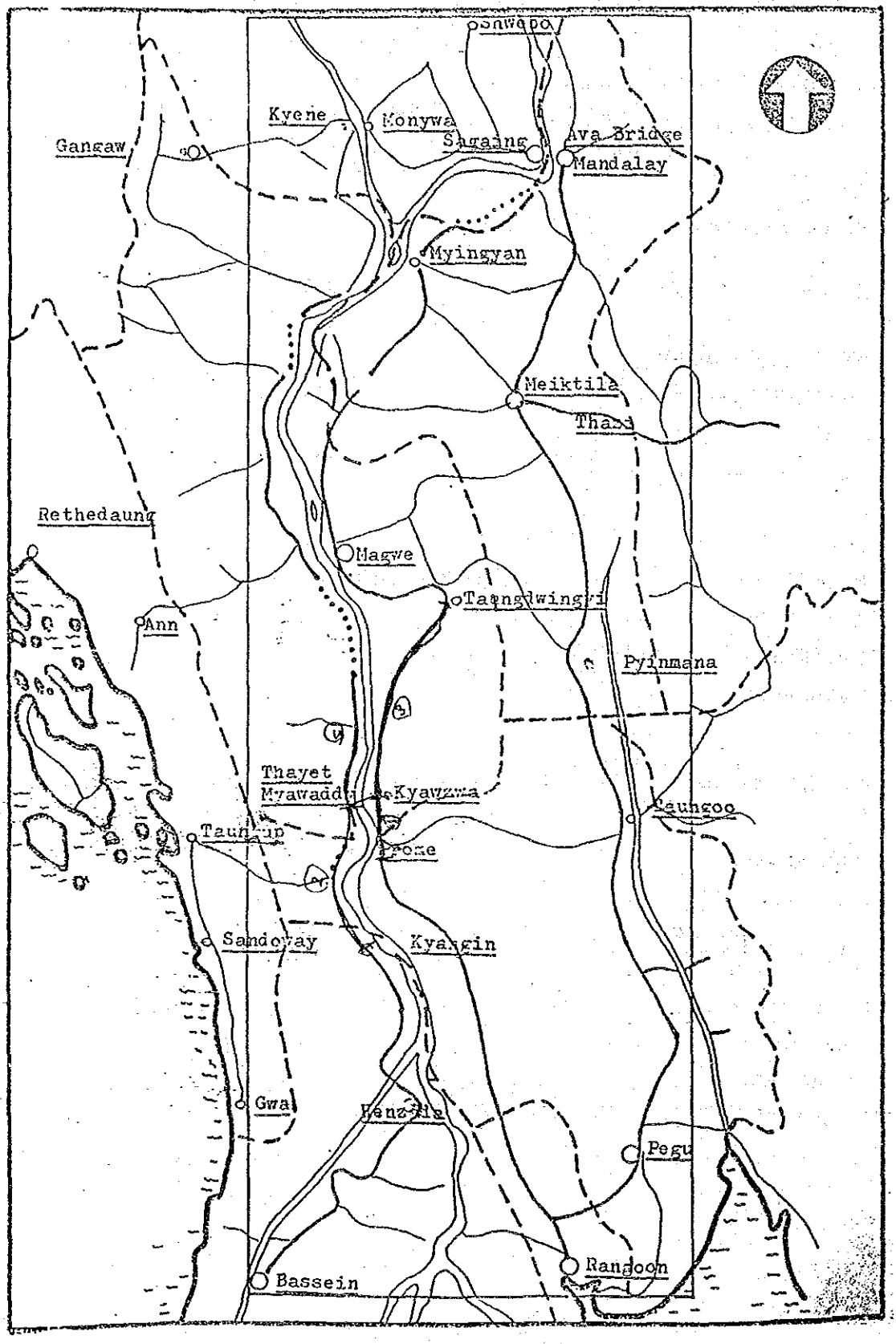
INVESTMENT PROGRAMME FOR RAILWAY EXTENSIONS

(Kyats in Lakhs)

Sr. No.	Name of Work	Total Mile	Total cost / Investment 1986-1990	1990-1994	1994-1998	1998-2002
1.	Prome-Kyawswa	19	475	-	-	-
2.	Kyangin-Myawaddi	75	2325	300	-	-
3.	Kyawswa-Aunglan-Taungdwingyi	85	-	1925	200	-
4.	Myawaddi-Thayet	32	-	1020	100	-
5.	Thayet-Copper Mine	244	6100 - after year 2002			
6.	Myawaddi-Taungkok	40	-	100	1300	-
7.	Taungkok-Gwa	107	3745 - after year 2002			
8.	Taungkok-An	72	2520 - after year 2002			
9.	An-Rathedaung	141	4935 - after year 2002			

Appendix 'E'

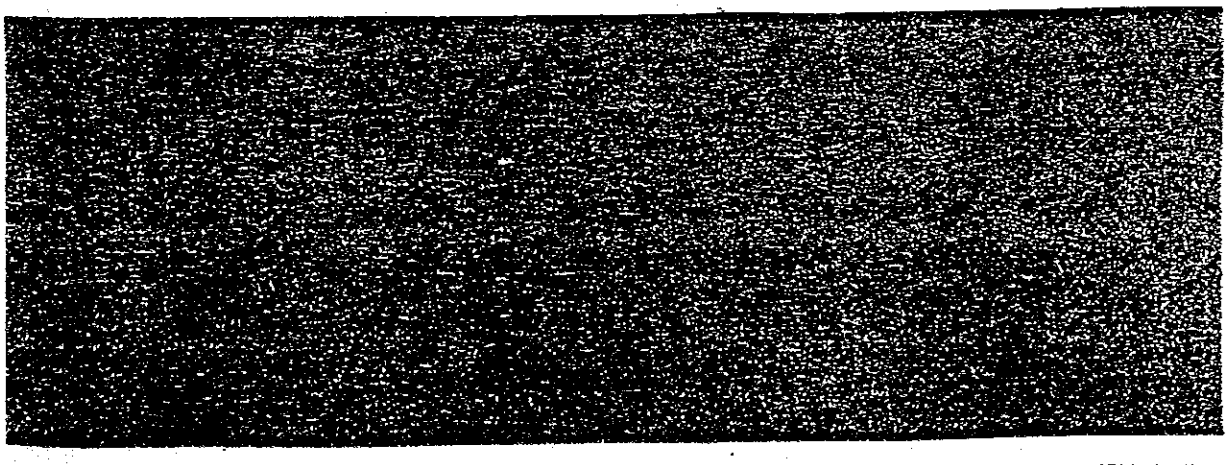
RAILWAY DEVELOPMENT PLAN OF BURMA



THE SOCIALIST REPUBLIC OF THE UNION OF BURMA

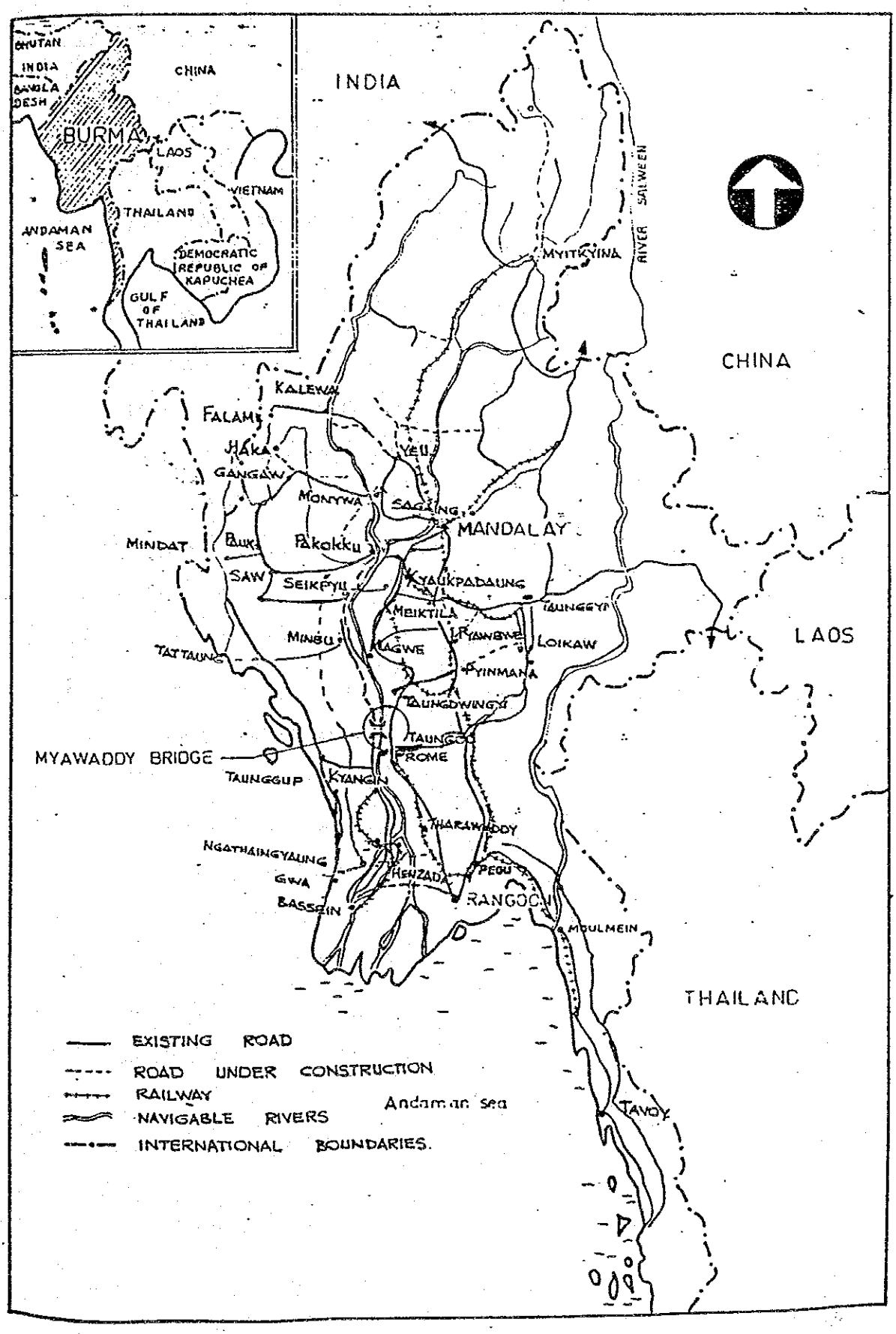
MINISTRY OF CONSTRUCTION

PROJECT PROPOSAL
FOR THE CONSTRUCTION OF
MYAWADDY RAIL - CUM - ROAD BRIDGE
ACROSS IRRAWADDY RIVER



CONSTRUCTION CORPORATION

KEY MAP


BHUTAN
INDIA
BANGLA DESH
CHINA
BURMA
LAOS
VIETNAM
THAILAND
ANDAMAN SEA
DEMOCRATIC REPUBLIC OF KAPUCHEA
GULF OF THAILAND
INDIA
MYITKYINA
RIVER SALWEEN
CHINA
KALEWA
FALAM
HAKA
GANGAW
YEU
MONYWA
SAGAING
MANDALAY
MINDAT
PAUK
PAKOKKU
SAW
SEIKPYU
KYAUKPADAUNG
MEIKTILA
TAUNGGYI
MINBU
MAGWE
KYAUKSE
LOIKAW
LAOS
TATTAUNG
PYINMANA
TAUNGDWINGYI
TAUNGGO
PROME
MYAWADDY BRIDGE
TAUNGGUP
KYANGIN
THARAWADDY
NGATHAINGYAUNG
HENZADA
PEGU
GWA
BASSEIN
RANGOON
MOULMEIN
THAILAND
EXISTING ROAD
ROAD UNDER CONSTRUCTION
RAILWAY
NAVIGABLE RIVERS
INTERNATIONAL BOUNDARIES.
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TAVOY

C O N T E N T

PROJECT PROPOSAL

FOR

CONSTRUCTION OF

MYAWADDY RAIL-CUM-ROAD BRIDGE

ACROSS THE IRRAWADDY RIVER

1. OBJECTIVE

1.1 The aim of implementing the MYAWADDY RAIL-CUM-ROAD BRIDGE CONSTRUCTION PROJECT is to stimulate the social and economic activities of the area lying on the Western Bank of the Irrawaddy, so as to contribute in a significant way to the balanced development of regions in Burma.

1.2 The MYAWADDY RAIL-CUM-ROAD BRIDGE (hereinafter referred to a "the bridge") will link the existing road network on the Eastern side of the Irrawaddy River to that on the Western side which is under the process of full scale development. The bridge will also provide an easy inter-divisional communication. On the Western bank it will serve Sagaing Division, Chin State, Rakhine State and Irrawaddy Delta Division as a number of roads such as Monywa-Pale-Gangaw-Haka road, Pakokku-Pauk-Mindat road, Seikpyu-Saw-Kanpetlet road, Salin-Sidoktaya road, Minbu-Ann-Tat-Taung road, Padaung-Taungup road, Gwa-Ngathainggyaung road are all linked up with Bassein-Monywa Highway to cross the river towards the east. On eastern bank it will serve southern part of Mandalay Division, Shan State, Kayah State, northern part of Karen State, Pegu Division, Rangoon Division and eastern part of Magwe Division, as a number of roads such as Loikaw-Taungoo-Prome-Road, Pinlaung-Pyinmana-Taungdwinggyi Road, Payangazu-Pyawbwe-Natmauk Road and Taunggyi-Meiktila- Kyaukpadaung road are linked up with Rangoon-Prome-Mandalay Highway to cross the river towards the west.

1.3 The bridge will again facilitate the easy transportation of the produce of the influence area where Cement Factories, Glass Factory, Fertilizer Plants, Heavy Industries, Oil Refineries and Gas Turbine Stations are already established and it is learnt that the expansion of industries will be continued. In addition agricultural products will easily be transported to the needful areas of Burma.

1.4 In addition to the road net work there exist railway transport facilities on the western bank of Irrawaddy namely Bassein-Kyangin rail line. On the Eastern bank of the river the Rangoon-Prome and the Pyinmana-Taungdwinggyi-Kyaukpadaung-Kyini routes also are in existance. There will be further development of the rail transportation of both banks.

2. ELEMENTS OF THE PROPOSAL

2.1 The Project proposal comprises of the general description of the bridge location, type of bridge, geometric standard, load classification, estimated cost of bridge (local and foreign) equipment requirement,schedule of construction, economic aspect of project influence area, soil, geology and navigational requirement of the bridge.

3. LOCATION OF BRIDGE

3.1 The proposed bridge site is located near Myawaddy village in middle part of Burma as shown in Annexure - 1. It is a new site not far away from one of the three sites mentioned in the final report of feasibility study for the IRRAWADDY RIVER BRIDGE CONSTRUCTION PROJECT sponsored

by JICA in 1974. The points considered in the selection of this site are:-

- Shallower depth of river during the dry season, which facilitates easier construction of piers and reduction of pier heights.
- Scouring action of the bed is negligible due to shallower depth of water during the raining season where the river is flowing full.
- Both banks are stable and well defined, and the levels of both banks are not appreciably different.
- More shorter approach spans can be provided.
- The water course is straight and non meandering at this site.
- Access road to this area on the eastern side is already in existance and the western approach can be easily constructed.
- At this bridge site the construction of bridge will be comparatively easier and the cost will be much reduced.
- Being an open land area, the cost of removing already built-up structures for bridge approached is almost nil, hence cost will be considerably reduced when compared to other sites.
- Further development within the vicinity of both approaches and land use is possible.

3.2 The cross section at bridge site drawn from the field investigation of river bed and banks is shown in Annexure - 2. The width of the Irrawaddy River at the bridge site is approximately 1420 Metres. Both banks of river are stable and the depth of water during the dry season is about 19 Metres. In the dry season, the navigational

water ways become narrower and hence larger spans for navigational traffic are provided only in deeper portion of the river and multiple short spans are provided in the remaining portion of the river, where sand deposits are generally formed.

4. SOIL AND GEOLOGY

4.1 From the field investigation, the soil and geological aspects are to be summerised as follows:-

MYAWADDY BRIDGE SITE

(a) East bank - Massive and homogeneous, medium to fine grain sand stones, mostly poorly cemented, friable and moderately soft, dipping at 20-30 degree towards the bank of the river not likely to be erroded.

(b) West bank - Sandstone and shale, alternative with varying degree of compactness and hardness coupled with faultline dipping 22-26 degree towards upstream.

5. HYDROLOGY

5.1 The Irrawaddy river has a drainage area of 340890 km^2 with a river length of 1412 km. The river width of Irrawaddy varies largely not only from place to place but also from year to year. The hydrological data such as the water level, river discharge, sediment discharge, water temperature and velocity are available.

5.2 For determination of the lowest elevation of the superstructure of the bridge, it is required to determine the design high water level and the clearance above the design high water level.

At the bridge site, the lowest water level is 19 metre and the highest water level is 32 metre. For the safe navigation of the large steamer and cargo ships the minimum horizontal clearance 106.7m and the vertical clearance 16.77m above design high water level. The estimated maximum flow velocity is about 3 m/sec at proposed bridge site.

6. THE GEOMETRIC STANDARD OF BRIDGE

The geometric standard of the bridge is considered to be in accordance with the standards of Union Highways already in existance on both banks.

7. BRIDGE STRUCTURE

7.1 The proposed type of bridge superstructure has taken into account the following factors:-

- Minimum horizontal clearance of 106.7 metre should be maintained between piers except in the approach spans, for navigational requirement. Minimum vertical clearance above design high water level should be 16.77 metre.
- Optimum span length to reduce the construction cost.
- Technical advantages for the construction of superstructures.

7.2 Material used for the bridge should be determined considering the maintenance cost as well as the adaptability to the local condition.

8. SUPERSTRUCTURE

8.1 Steel Truss Bridge

The bridge shall be for the combined use of highway and railroad traffic, with both highway and railroad bring on the same level.

The deck layout shall be of the separating type with highway road hanging out on the outer side of each main truss.

8.2 A continuous truss type for main bridge should be employed as it may be easily built using cantiliver construction method or floating crane. For approach spans of the bridge the simply supported trusses shall be used. Annexure - 3.

9. OTHER STRUCTURE TYPE

Regarding the selection of the type of bridge only one type of bridge has been mentioned in the proposal. However other types of bridge superstructure such as different types of steel bridges with different deck arrangement and long span prestressed concrete bridge and some other bridge types, which are suitable to the prevailing site conditions may also be considered during the feasibility study.

10. SUBSTRUCTURE

The open caisson is to be used for foundation of mid-stream piers and R.C.D. (Reverse Circulation Drill) foundation are to be used for abutments and land span piers.

11. DESIGN CRITERIA

11.1 Highway live load shall be that of HS 20-44 of the American Specification AASHTO.

11.2 Railroad live load shall be that as per Indian Railway Standard (IRS) Main Line Loading of 1929 for metre gauge.

11.3 Impact load shall be calculated in reference to the concerned provisions prescribed in AASHTO and in the Bridge Rules of the Indian Railway Standard (adopted in 1941 and revised in 1964).

11.4 Loading of trailer truck carrying a heavy equipment (total weight 60 ton) shall be considered in the design of floor system and/or deck slab.

11.5 The vertical clearance for navigation under the bridge shall be 16.77 metre above design high water level and the clear width for such navigable span shall not be less than 106.7 metre.

11.6 The width of road-way on either side shall be 4.5 metre, and the maximum design running speed of motor vehicles shall be 96.6 kilometre per hour.

11.7 The railroad deck shall be of single-track and metre gauge. The maximum design train speed shall be 96.6 kilometre per hour.

11.8 The bridge deck shall be provided with a sidewalk on the outside of each roadway, each 1.5 metre wide.

11.9 The fundamental seismic coefficient shall be assumed to be 0.12. Considering the unfavourable effect of the height of pier, the design seismic coefficient shall be increased by 25% at 150% of the basic unit stress.

11.10 The gradient of the railroad on the bridge shall not be greater that 2.5%, and the gradient for the highway on the bridge shall not be greater than 3%.

11.11 Length of bridge structure.

(a)	Main Bridge	1100 metre
(b)	Approach Bridge	320 "
(c)	Total Bridge	1420 "

12. CONSTRUCTION MATERIALS

12.1 Aggregate

Construction material such as coarse and fine aggregates are available within the vicinity of the bridge site.

12.2 Cement

Cement of high quality in large amount can be obtained from the Kyangin Cement Factory.

12.3 Timber

Logs and timber scantling are locally available in large quantity.

12.4 Steel

High tensile steel wires are to be procured from abroad. As for steel truss members high prestressed steel truss for the whole bridge are to be imported.

12.5 Labour

Unskilled labour for bridge construction works are available from near-by villages. As regards the skilled labour, those who have gained experience in large scale major bridge construction projects could be assigned to this project.

13. MACHINERY AND EQUIPMENT

13.1 Regarding the utilization of machinery and equipment for this bridge project, some of the machinery equipment now in use with other Bridge Project could be transferred to this project.

13.2 The machinery and equipment used for the construction of the Thuwanna Bridge could also be transferred. Since the present bridge is longer than the Thuwanna Bridge and foundation conditions are different, additional as well as new machinery and equipment will be needed for the new bridge. The additional requirement of machinery and equipment are listed in Annexure – 4.

14 ESTIMATED COMPONENTS

14.1 The estimate components for construction of bridge, includes the following:-

(a) Investigation and Design

(b) Temporary works, such as temporary site offices, temporary godowns, workshops, temporary electrical and sanitary installation, and other necessary preparatory works.

(c) Construction.

(i) Procurement of all types of structural and constructional materials.

(ii) Labour charges including transport and medical expenses of labours.

(d) Procurement of special equipment and materials.

(e) Engineering Fees.

(f) Contingency.

15 SUMMARY OF ESTIMATED COST

The summary of estimated cost for the construction of the bridge is attached to this proposed in Annexure – 5. The total estimated amount is Kyats 901 Million.

16. IMPLEMENTATION SCHEDULE

16.1 The construction period of 4 years is envisaged and the implementation schedule is attached to this proposal in Annexure - 6.

16.2 Detailed investigation, studies, data collection and preliminary design should be carried out during the feasibility study.

17. SOCIAL AND ECONOMIC ASPECTS

17.1 Direct benefits are those derived from traffic passing over the bridge. Benefits derived from diverted and generated goods traffic in terms of direct benefit would be very high which is due to the new demand for goods traffic resulting from the bridge construction on account of significant increase in production and consumption of goods in the related industrially developed areas on both banks.

17.2 Benefits derived from diverted passenger traffic consists of cost saving and time saving. The benefit of cost saving is obtained from the difference between the transport cost via the new route passing over the bridge and that via the route without the bridge for each origin and destination. In addition to the above and other benefits derived from the generated passenger traffic as a result of the completion of the bridge will be appreciably large, because vehicular passage across the river over the bridge is possible at any time, day and night without any inconvenience.

17.3 The bridge will provide easy communication between the regional area on the east bank and west bank of the Irrawaddy river. The east bank area comprises of Pegu Division, Mandalay Division and Mgwe Division. The delta region, Rakhine State, part of Magwe and Pegu Division lie in the Western regional area.

17.4 The principal agricultural crops, such as paddy, groundnuts, maize, jute and other farm product, fishery product, forest product, and all other factory product such as cement, fertilizer, petroleum product, glass, machinery, equipment and tools from heavy industries project, etc., will be transported via the bridge. This transportation involve approximately 7 million tons of goods, out of which, 50% will be diverted through the bridge.

17.5 Therefore the diverted traffic is estimated to be 550 vehicles per day, which include the traffic towards the regional area on the west bank of the river.

17.6 After completion of the bridge there will be an increase of transportation of goods and passengers, within the direct influence area. In addition newly initiated economic development, concentrated utilisation of economic resources through the improvement of transport system, the arrangement of labour force and population, land utilisation development and other similar development will promote the increase of generated traffic which is estimated to be approximately 450 vehicles per day.

17.7 Therefore the total traffic is estimated to be 1000 vehicles per day.

17.8 The road network on the Western Bank, including Bassein-Monywa Road, Gwa-Ngathainggyaung Road, Padaung-Taungup Road, Minbu-Ann-Tat taung Road, Pale-Gangaw-Haka Road, and other main roads, has been extensively developed during the last five years and there exist future plans for further development.

17.9 The cement mills, fertilizer plant, glass factory, oil refinery, gas turbines, Heavy Industries Project and other major projects are situated on the west bank of the Irrawaddy River and future industrial plans are underway.

17.10 The road network on the west bank extends to the sea ports in the Deltic area and the Rakhine State coastal region and with the completion of the bridge, the agricultural and fishery products, forest products, and other products of the area can be transported to all parts of Burma, using the bridge.

18. ECONOMIC EVALUATION

18.1 Economic aspects of the Project mentioned in para. 17.1 to 17.10 reveal that the generated and diverted traffic on the completion of the project would be about 1000 vehicles per day and about 3.5 million tons of goods produce in the area would also be transported across the bridge.

18.2 Based on these transport parameters, time cost of passengers and the transport cost savings due to reduction of fixed, terminal - and movement - cost are computed and an attempt has been made to evaluate the Project economically by using classical approach.

Construction economic and transport-parameters adopted in the evaluation are referred to similar transport sector project sponsored by other International Agencies.

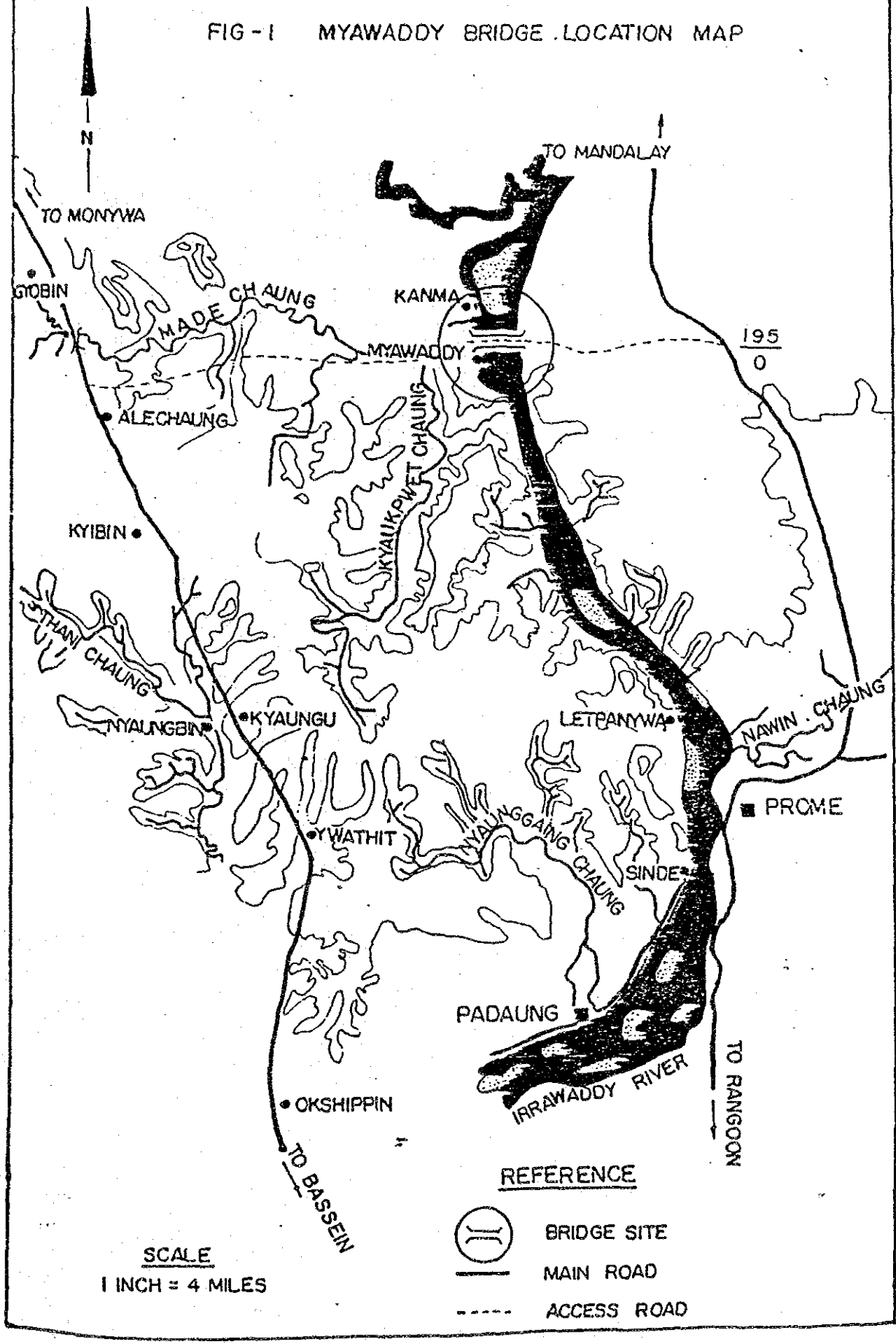
18.3 Trial calculations of the direct benefits on monetary terms of the Project indicate that the Project has a Benefit-Cost ratio of 1.22 and that the Economic Rate of Return is 12.5% at 10% discount rate. It seems that the realization of benefit of the Project is more than 1.5 times the prime Bank lending rate of 8% even for time cost of passengers and cost savings of generated and diverted traffic and goods using the shadow pricing factor of the transport sector reported elsewhere in the other feasible projects. No Sensitivity Analysis (Cost + 20%, Benefit - 20%) has been made as yet due to the limitation of times, however, the Project is definitely viable when the indirect benefits are added to the evaluation.

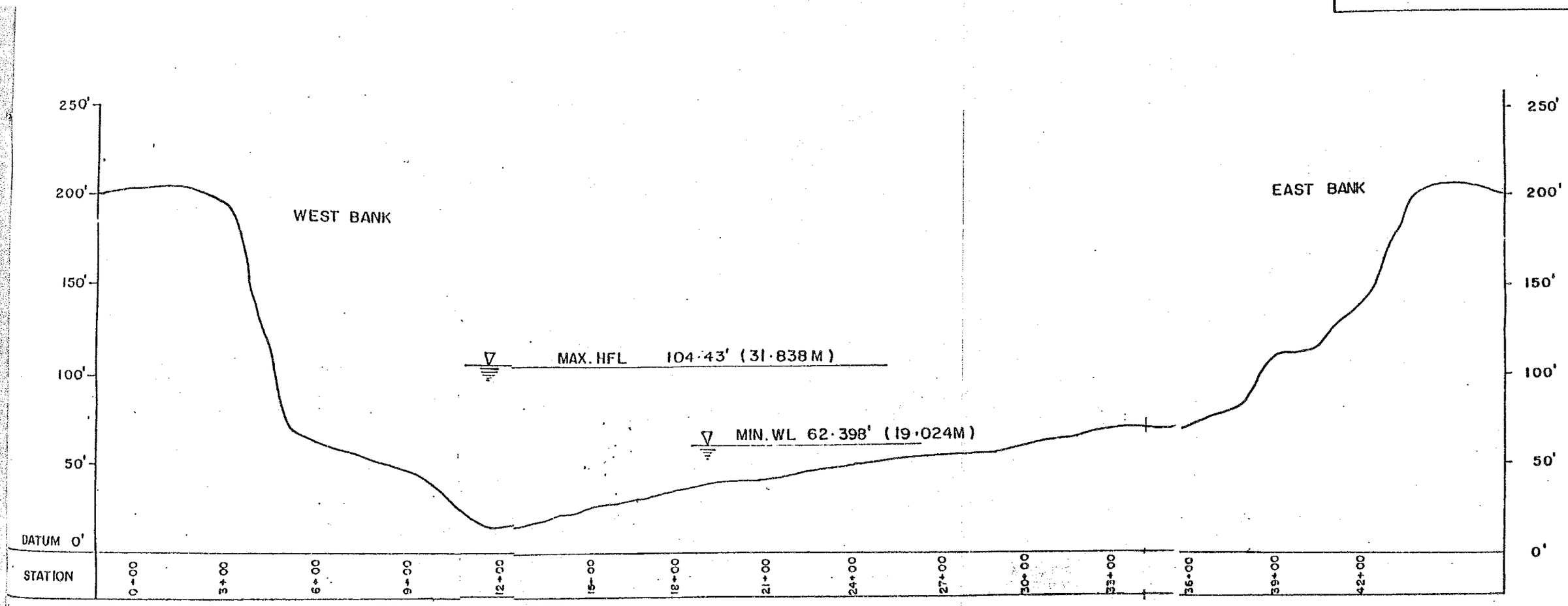
19. CONCLUSION

The construction of the proposed Myawaddy Rail-Cum- Road Bridge will contribute the regional development of Burma as a whole and at the same time the bridge will serve as link to form the east-west arterial route of Burma passing through the central belt which runs from Kayah and Shan State to the East and Rakhine State to the west. It is also technically feasible and economically viable and hence the implementation of thsis project is worthwhile.

Annexure	1	–	Myawaddy Rail-cum-Road Bridge Location Map.
"	2	–	River Cross Section near Myawaddy Rail-cum-Road Bridge.
"	3	–	Plan and Elevation of proposed Myawaddy Rail-cum-Road Bridge.
"	4	–	Machinery and equipment required for Construction of Steel Truss Bridge.
"	5	–	Summary of estimated construction cost.
"	6	–	Proposed implementation schedule.

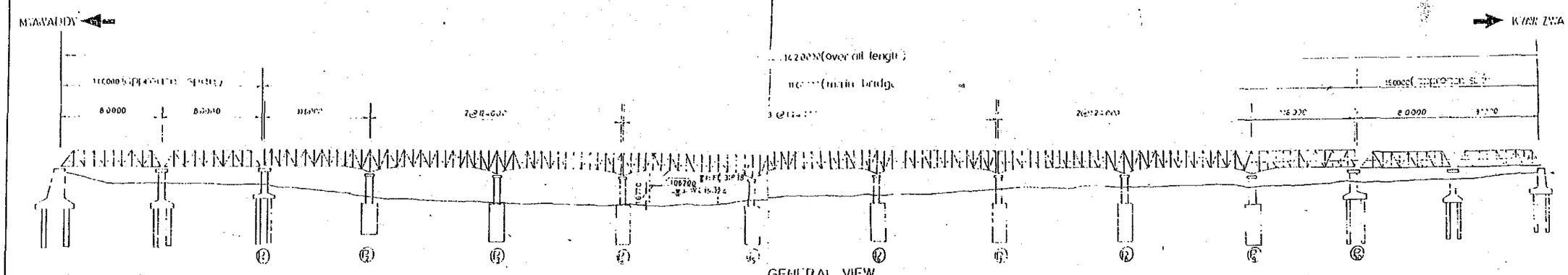
FIG - I MYAWADDY BRIDGE .LOCATION MAP





RIVER CROSS SECTION NEAR MYAWADDY VILLAGE

ACROSS IRRAWADDY RIVER



GENERAL VIEW

MAIN TRUSS HALF PLAN

SECTION A-A

CONSTRUCTION CORPORATION	Drawn by Aja Mg Aye Thein
MYAWADDY RAIL-CUM-ROAD BRIDGE ACROSS IRRAWADDY RIVER	Traced by Mg Mg Kyaw
PROPOSED BRIDGE GENERAL LAY OUT	Approved by U E (Retd)

MYAWADDY RAIL-CUM-ROAD BRIDGE

Machinery and equipment required for Construction of Steel truss bridge

Sr No.	Description	Quantity
1.	Derrick Crane, 30t	2 Nos.
2.	Derrick Crane, 200t	2 Nos.
3.	Traveller Crane (truss) 20t	4 Nos.
4.	Traveller Crane (Yard) 20t	2 Nos.
5.	Post Crane, 20t	4 Nos.
6.	Crawler Crane, 90t	2 Nos.
7.	Diesel Generator, 400 KVA	2 Nos.
8.	Diesel Generator, 300 KVA	2 Nos.
9.	Diesel Generator, 75 KVA	2 Nos.
10.	Compressor, 200 PS	1 No.
11.	" 170 PS	5 Nos.
12.	" 100 PS	4 Nos.
13.	" 50 PS	8 Nos.
14.	Grab hammer for ϕ 1000mm	2 Nos.
15.	Batching plant, 3 m^3/hr	4 Nos.
16.	Classifier plant	2 Nos.
17.	Shovel loader, $2m^3-3m^3$	2 Nos.
18.	Agitator truck, 3 m^3	12 Nos.
19.	Concrete pump, 12 m^3/hr	2 Nos.
20.	Clamshell, $3m^3$	4 Nos.
21.	Deck barge, 500t	4 Nos.
22.	Tug boat, 60t	1 No.
23.	Anchor boat, 20t	1 No.
24.	Winch, 15-50 PS	20 Nos.
25.	Trilly, 30 T	10 Nos.
26.	Partable crushing plant $50m^3/hr$	1 Set
27.	Water Supply equipment	1 Set
28.	Electrical equipment	1 Set
29.	Telecommunication Equipment	1 Set
30.	Plant loading equipment	1 Set
31.	Transportation truck, barges, etc.	1 Set
32.	Office equipment	1 Set
33.	Miscellaneous machinery tools	1 Set
34.	Spare Parts	1 Set

Annexure :- 5

SUMMARY OF ESTIMATED CONSTRUCTION COST

OF MYAWADDY RAIL-CUM-ROAD BRIDGE ACROSS IRRAWADDY RIVER

(Steel Truss Bridge)

(Kyats in Million)

Sr. No.	Subject	Local	Foreign Exchange	Total
1.	Investigation and design	3.00	26.75	29.75
2.	Temporary Works	48.00	11.50	59.50
3.	Construction	89.50	485.25	574.75
4.	Special equipment & materials	34.00	68.00	102.00
5.	Engineering Fees	15.00	30.00	45.00
6.	Physical and financial contingency	40.00	50.00	90.00
	Total	229.50	671.50	901.00
	Total in US $	(27.00)	(79.00)	(106.00)

Note = 1 US $ = Ks. 8.50

Annexure - 6

CONSTRUCTION OF MYAWADDY RAIL-CUM-ROAD BRIDGE

PROPOSED IMPLEMENTATION SCHEDULE

Sr. No.	Particulars	Preparation	1st. Year	2nd. Year	3rd. Year	4th Year
1.	Site Location and preparation Works					
2.	Construction of Sub-Structure					
3.	Construction of Superstructure					
4.	Land scaping and winding up