No. 4

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR CONSTRUCTING
BRIDGES ALONG RURAL ROADS
(PHASE I)
IN
THE REPUBLIC OF THE PHILIPPINES

JANUARY 1988

JAPAN INTERNATIONAL COOPERATION AGENCY

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P R E F A C E

In response to the request of the Government of the Republic of the Philippines, the Government of Japan has decided to conduct a Basic Design Study on the Project for Constructing Bridges along Rural Roads (Phase I), and the Japan International Cooperation Agency (JICA) sent to the Philippines a study team headed by Mr. Hiro-o Jin, Head of Research Division, Planning and Development Department, Honshuu-Shikoku Bridge Authority, from November 24 to December 23, 1987.

The team had discussions on the Project with the officials concerned of the Government of the Philippines and conducted a field survey in the suburbs of Manila. After the team returned to Japan, further studies were made and the present report has been prepared.

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

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

January, 1988

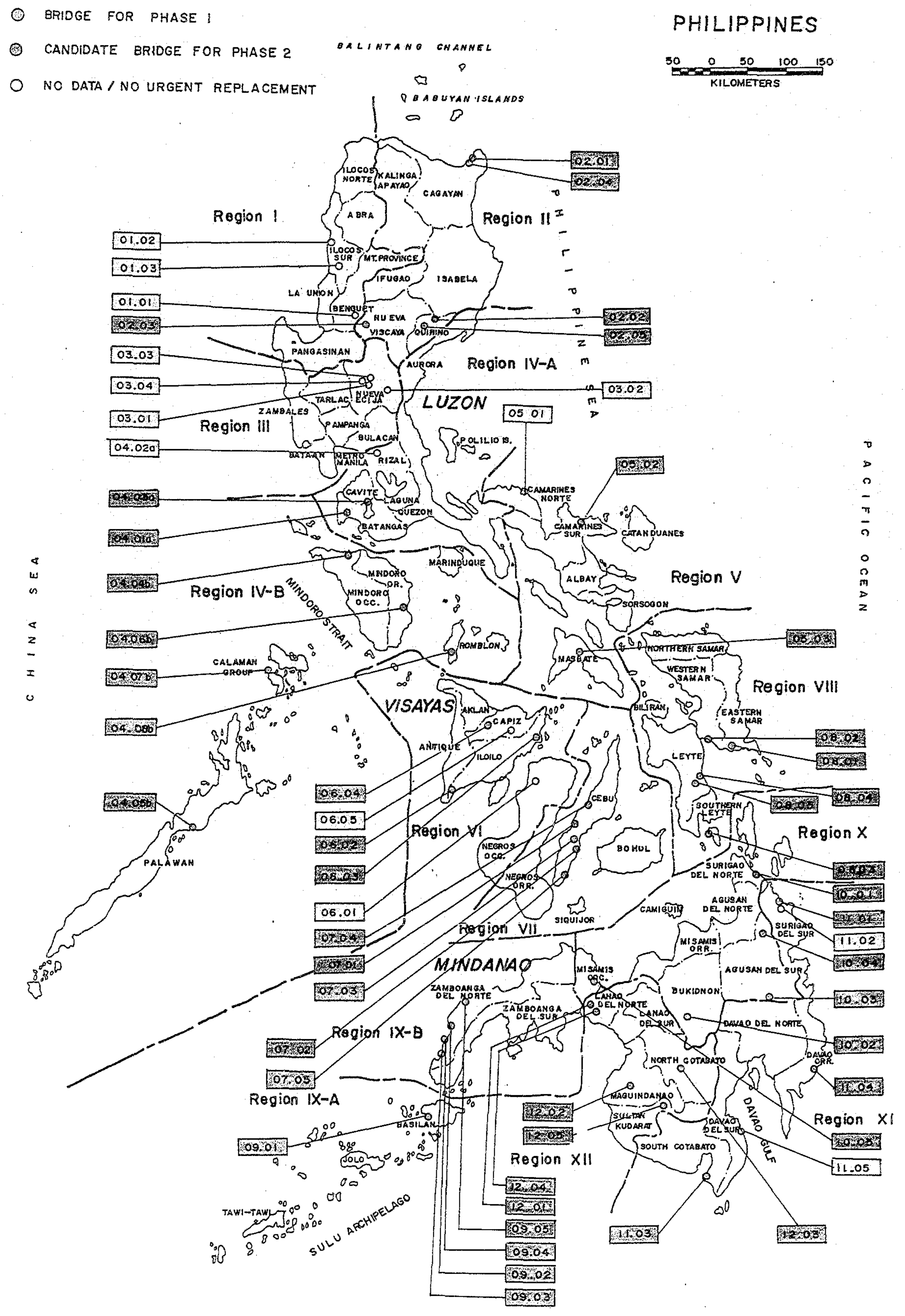
Kensuke Yanagiya

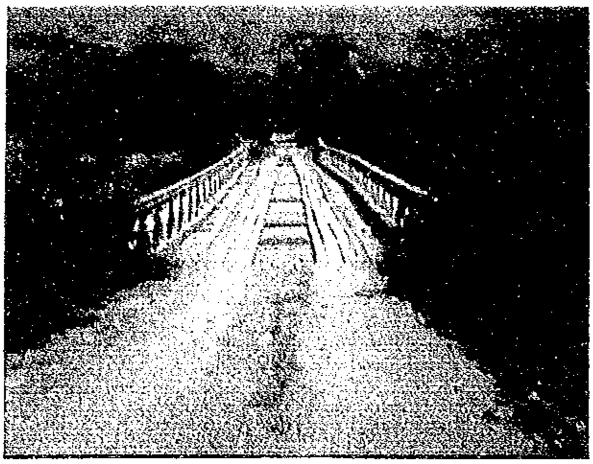
Kensuke Yanagiya

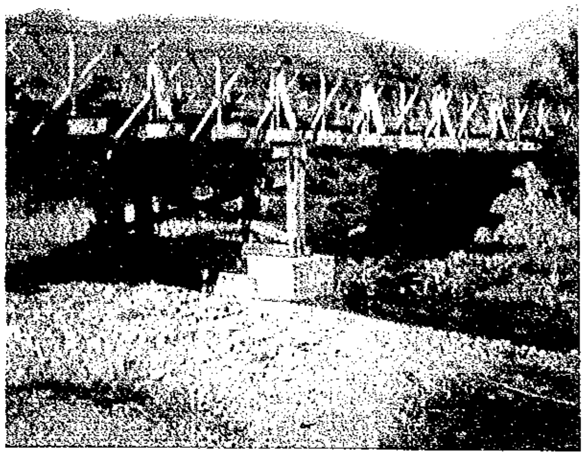
President

Japan International Cooperation Agency

LOCATION OF PROPOSED BRIDGES



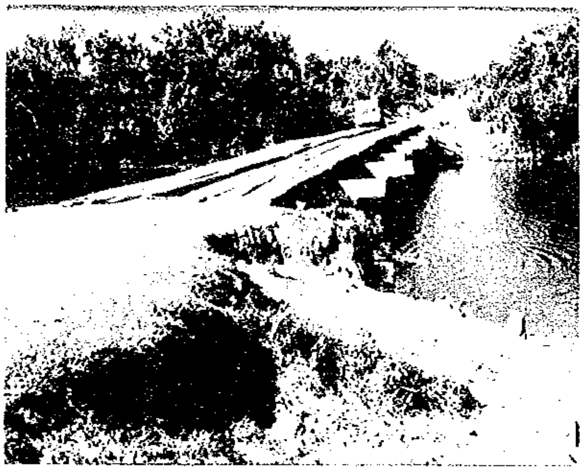




NO. 1

BRIDGE NO. 02.03

NAME OF BRIDGE: BAAN BRIDGE NO.2



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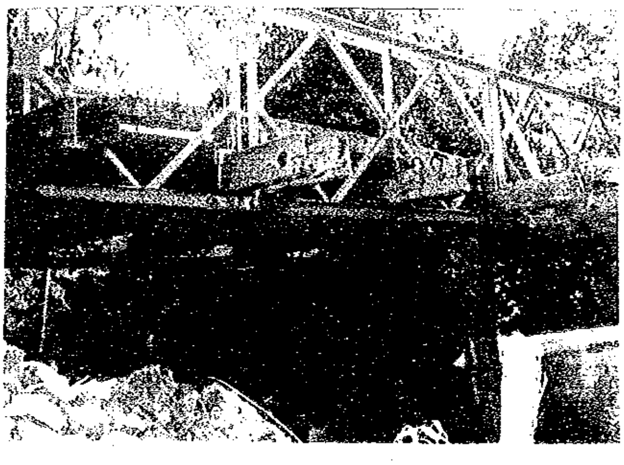

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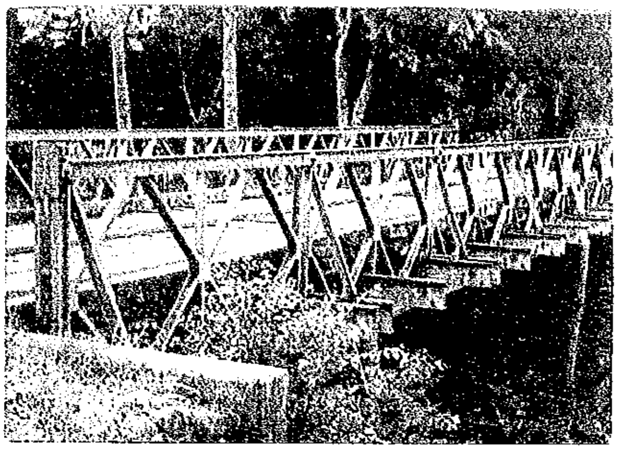

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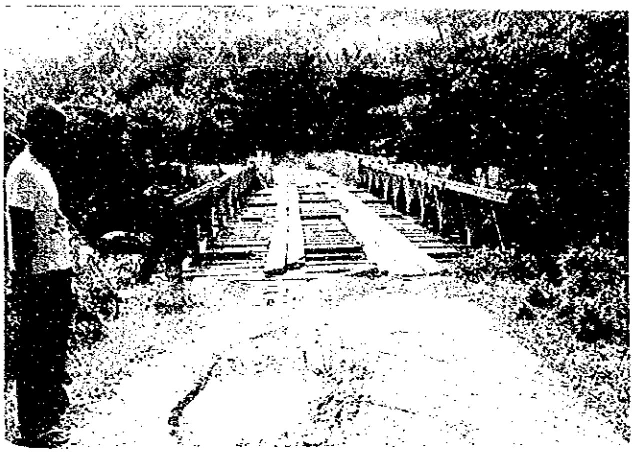
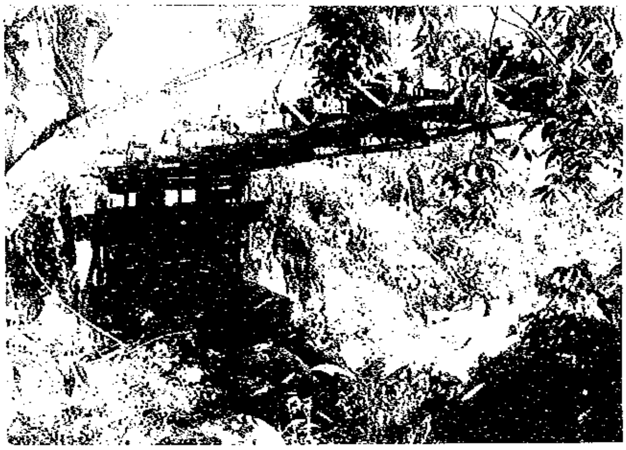

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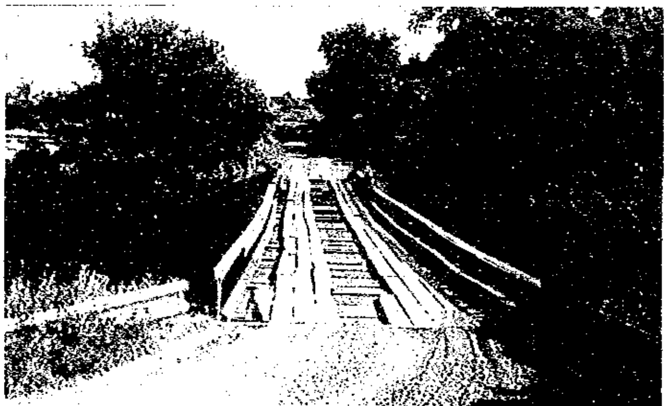


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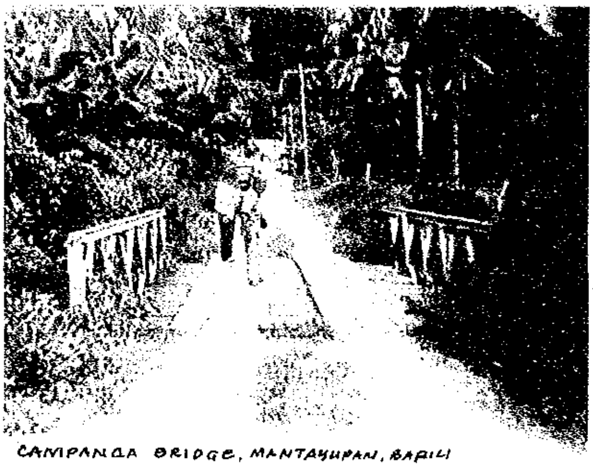
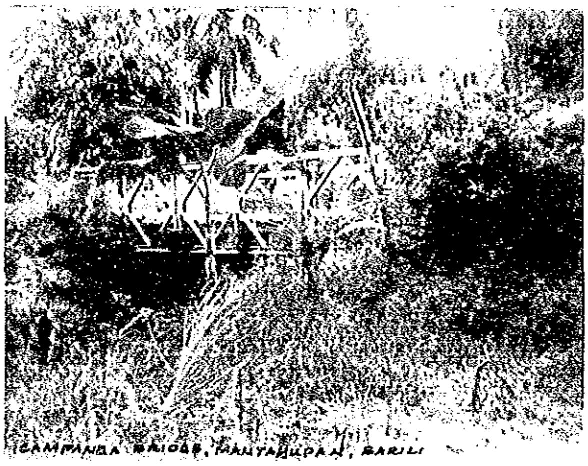
NO. 7
BRIDGE NO. 06.04
NAME OF BRIDGE : GUINTAS BRIDGE





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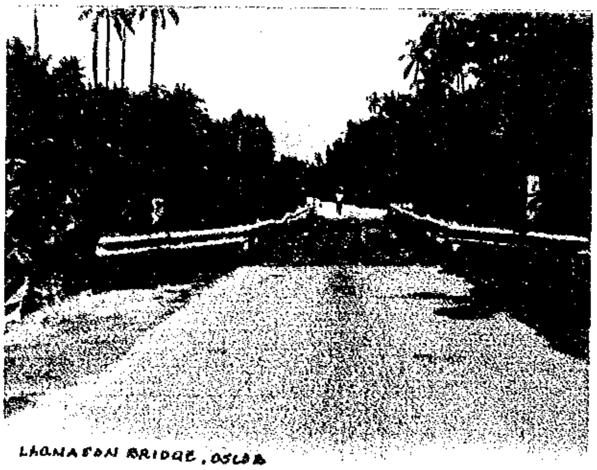

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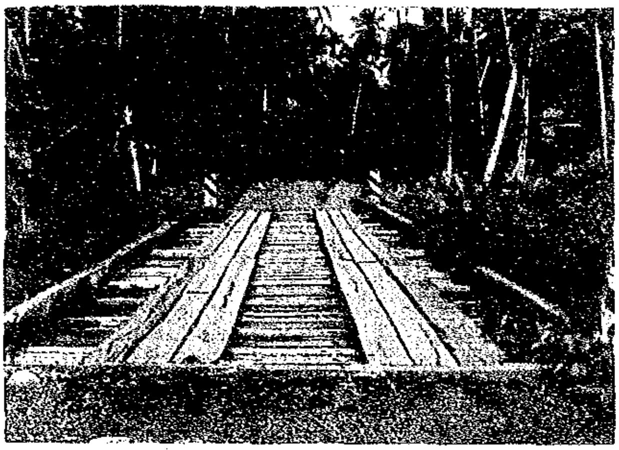
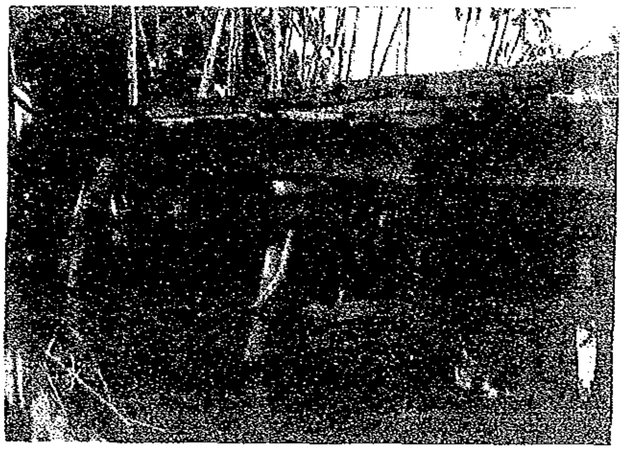

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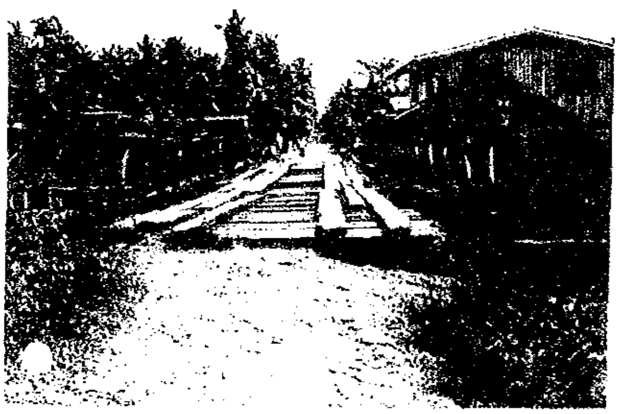
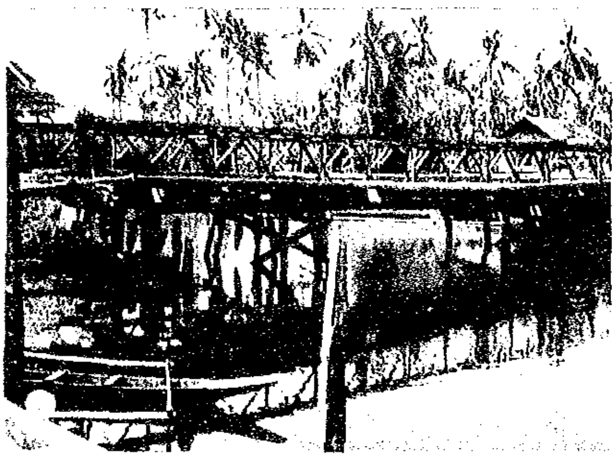

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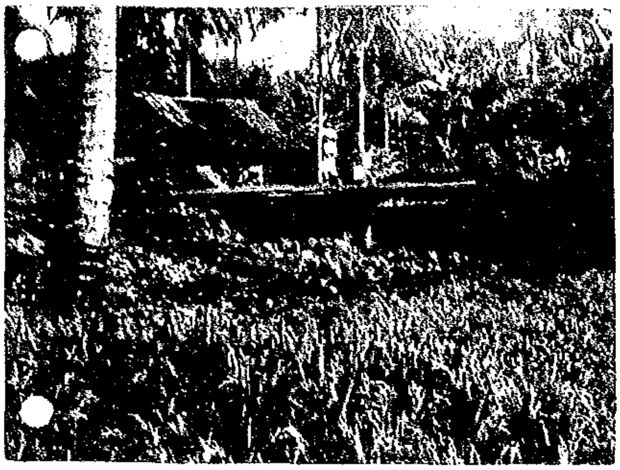

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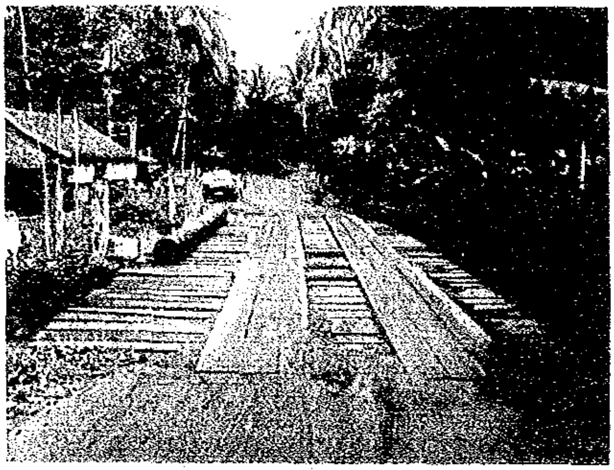

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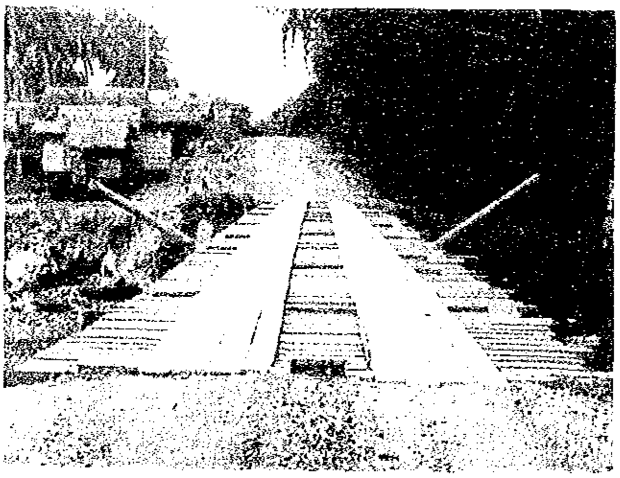

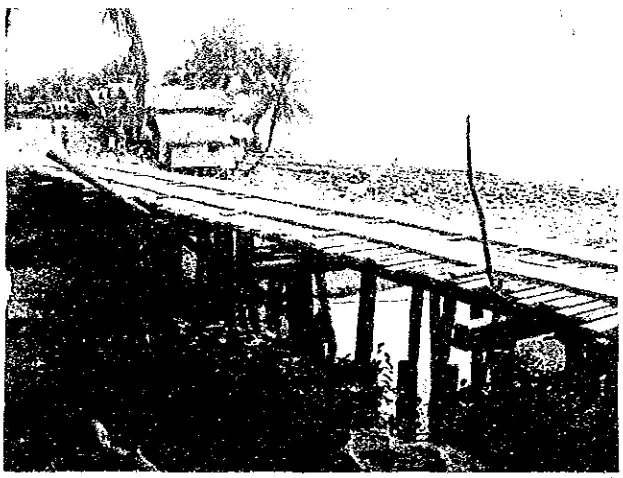

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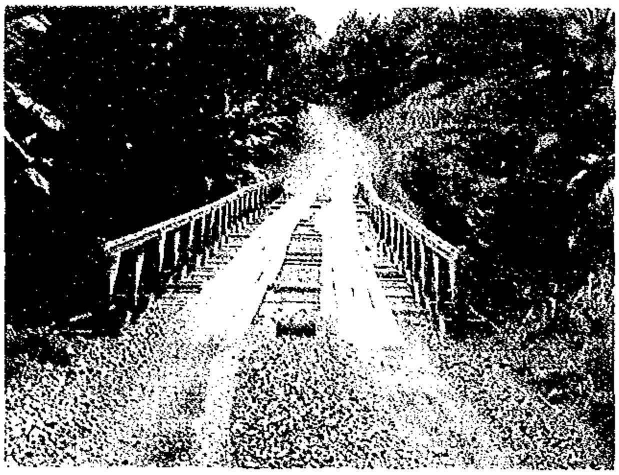

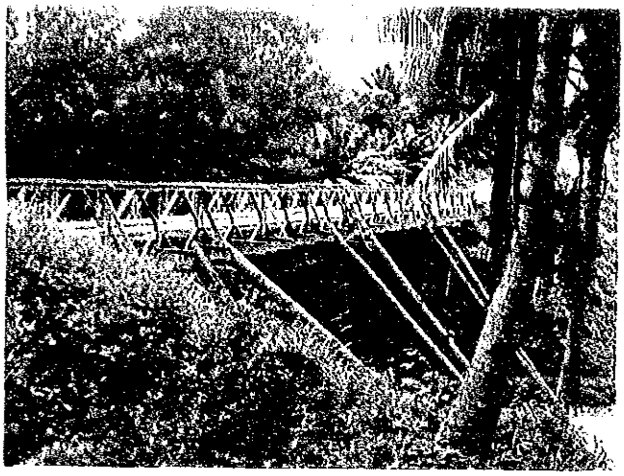

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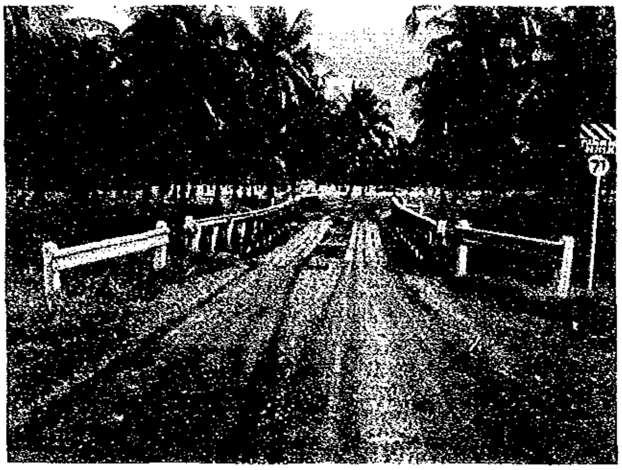

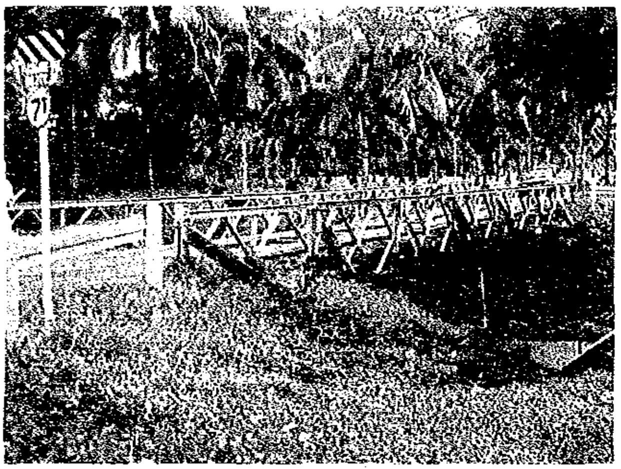

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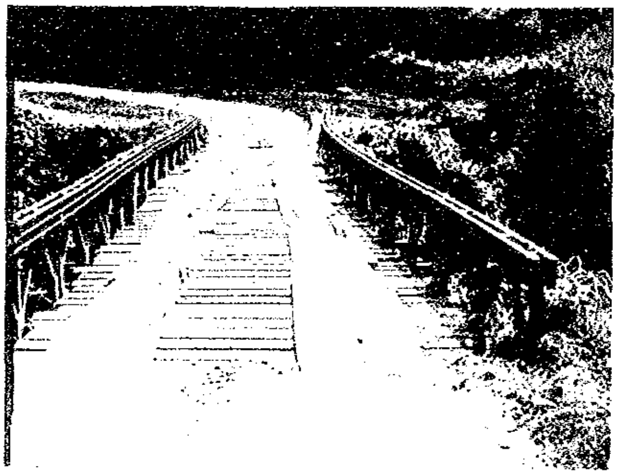

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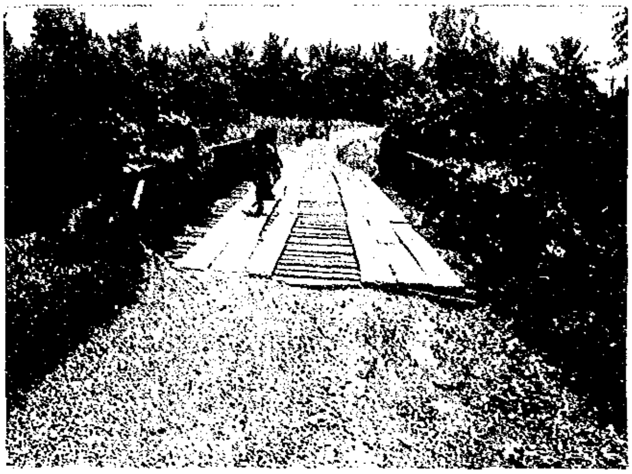

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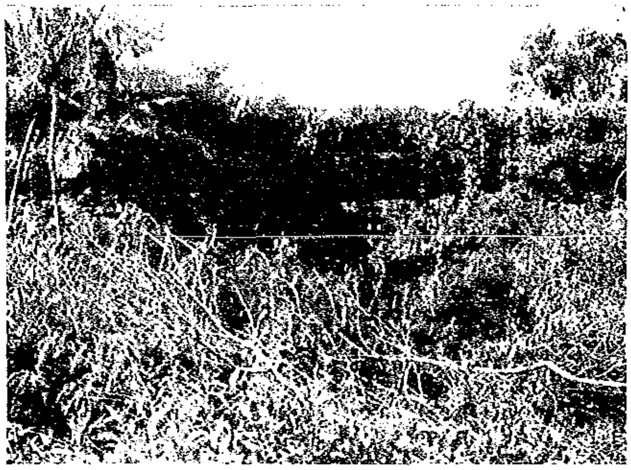

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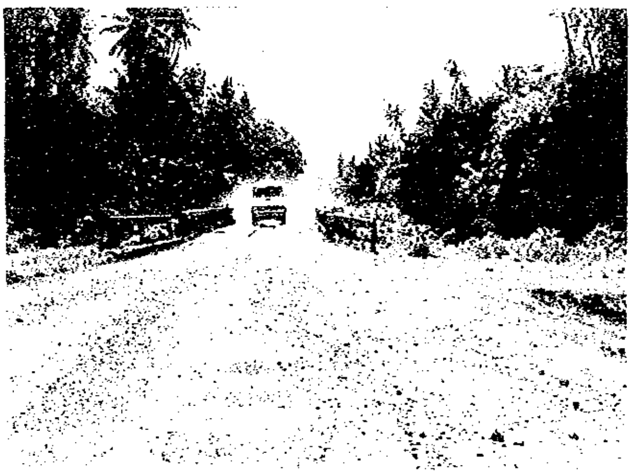

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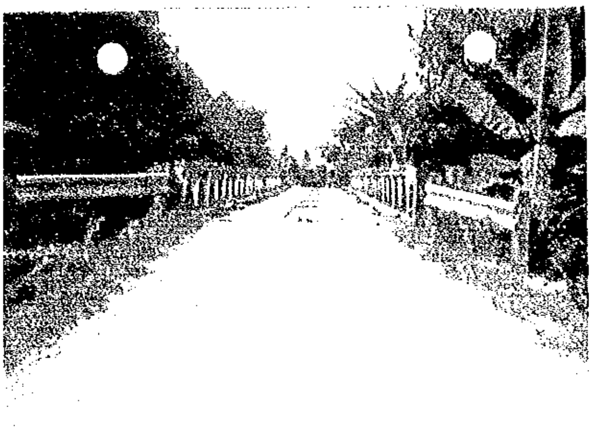

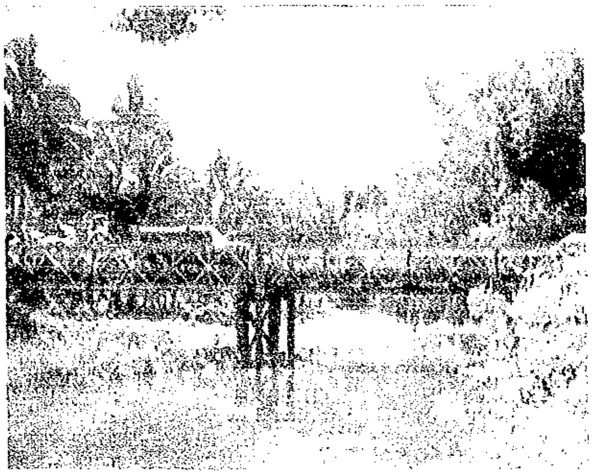

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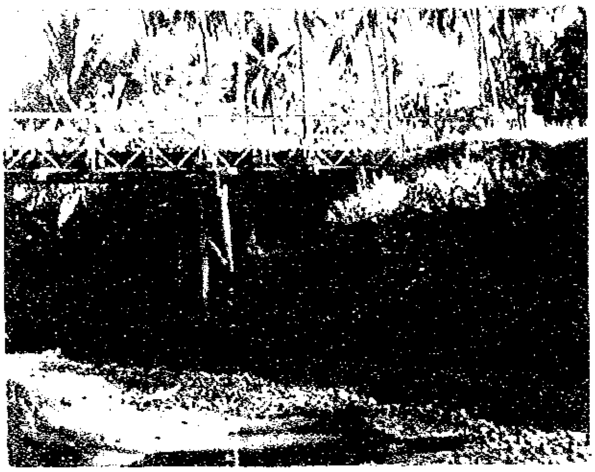

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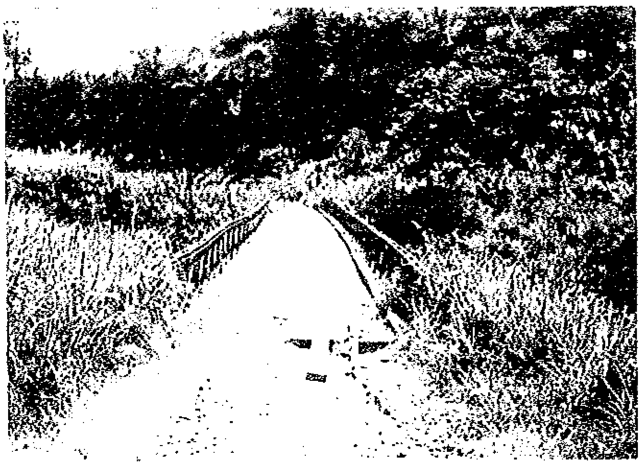

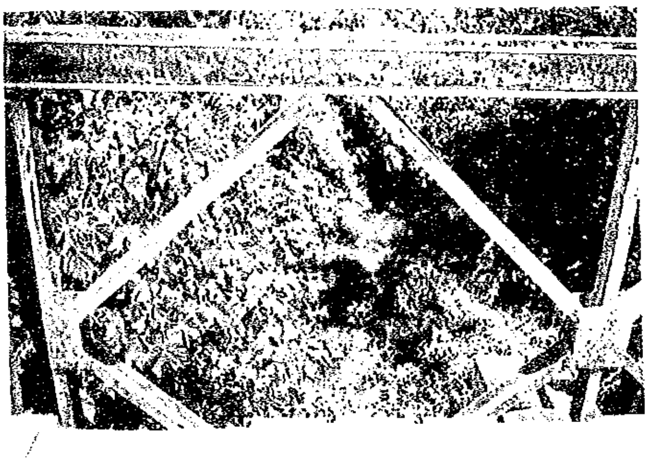

NO. 24
BRIDGE NO. 12.03
NAME OF BRIDGE: UPIAN BRIDGE

S U M M A R Y

SUMMARY

In response to the request of the Government of the Philippines, the Government of Japan has decided to conduct the Basic Design Study on the Project for Constructing Bridges along Rural Roads (Phase I)(hereinafter referred to as "the Study") in the Republic of the Philippines, and the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Basic Design Study Team from the 24th of November to the 23rd of December 1987.

To examine the appropriateness of the project as a grant aid project, the Basic Design Study Team held a series of discussions and consultations with its Philippine counterpart to review the background of the Project and to confirm the requests of the Philippine Government. Information and materials to determine the scope and grade of the Project were collected.

Upon its return to Japan, the Basic Study Team conducted further discussions with relevant agencies of the Government of Japan to determine the necessary steel materials for the Project. Information obtained in the Philippines, problems anticipated in the construction and maintenance of the bridges and the anticipated effects of the project were taken into consideration in preparing a Basic Design.

I. Background and Objective of the Project

The Government of the Philippines aims to reinforce the physical foundation of the economy to support the overall development thrust of sustained economic growth, economic efficiency and recovery. It seeks to establish and improve essential transport facilities in rural areas to increase activities in these areas for greater production and to induce direct development therein.

It has been indicated that some of the bridges in rural areas are old and temporary wooden bridges which often close the traffic, especially during the rainy season. Missing or weak bridges diminish the usefulness of many existing roads. This situation has been regarded as one of the main constraints of the development in rural areas.

The replacement of these old temporary and dilapidated bridges by permanent steel structures will ensure fast, safe and smooth land transportation, which will certainly contribute to the socio-economic development of these areas.

The implementation of the Project is proposed in line with the Highway Development Strategy as envisioned in the Medium-Term Philippine Development Plan, 1987-1992.

II. Proposed Bridges

Though a total of thirty-eight(38) bridges was originally proposed by the Philippine side, a revised list of bridges consists of fifty-eight(58) bridges was presented to the Study Team at the first meeting. The revised list initiated by local government entities was officially accepted as the subject for the Study. Based on the basic data of each bridge and the study results from the engineering point of view, the bridges in the newly revised proposal were classified into (3) categories.

1) Phase I Bridges - The steel materials for the bridge construction will be provided by the Japanese Government. The required level of engineering for the bridge construction is relatively easy for the Philippine side to design and construct them by using those materials.

2) Phase II Bridges - All the materials and construction work will be provided by the Japanese Government. The required level of engineering for the bridge construction is relatively high and suitable for the Japanese side to design and construct their sub-structure and super-structure.

3) Others - No data is available or immediate replacement is not necessary.

TABLE 1 PHASING OF BRIDGES

Region	No. of Proposed Brs.	No. of Phase I Brs.	No. of Phase II Candidate Brs.	No Data/ No Urgent Replacement
I	3	-	-	3
II	5	2	3	-
III	4	-	-	4
IV-A	3	-	2	1
IV-B	5	2	3	-
V	3	1	1	1
VI	5	2	1	2
VII	5	3	2	-
VIII	5	3	2	-
IX	5	4	1	-
X	5	4	1	-
XI	5	2	1	2
XII	5	1	4	-
Total	58	24	21	13

NOTE:

Total Length of Proposed Bridges	: 2413 m
Proposed Length of Phase I Bridges	: 750 m
Proposed Length of Phase II Candidate Bridges	: 1199 m
Length of Bridges with No Data/No Urgent Replacement	: 464 m

This report summarizes the output of the study and the basic design for Phase I Bridges.

III. Brief Description of Phase I Bridges

The main features of Phase I bridges are as follows:

. Total Number of Bridges	: 24 Bridges
. Total Length of Bridges	: 750 m
. Length of Spans	: 12 m - 25 m
. Number of Spans	: 12 Spans (12 one-span bridges) 24 Spans (12 two-span bridges)
. Width of Bridges	: Total Width 8.320 m Roadway 3.350 m x 2 Lanes Sidewalk 0.420 m x 2
. Type of Superstructure	: Simply Supported H-Beam Composite Girder
. Number of Substructures	: 48 Abutments (400 mm Concrete Piles) 12 piers (400 mm Concrete Piles)

IV. Scope of Both Governments

. Scope of the Government of Japan

Steel materials consisting of the following are to be provided by the Japan's Grant Aid:

. Steel Girders . Cross Beams]	926 t
. Shoes	302 units
. Drainage Boxes	144 units
. Torque Wrenches	36 units
. Steel Railings and Posts for Bridge Approaches	1,440 m

. Scope of the Government of the Philippines for the Project

The Government of the Philippines is responsible for the completion of the bridge construction within the period of one (1) year after the delivery of steel materials at designated ports of entry provided under the Japan's Grant Aid. The materials necessary for the Project other than aforementioned steel materials are to be borne by the Philippine side.

V. Construction Cost

The construction cost to be borne by the Goverment of the Phillippines was roughly estimated at 300 million yen (about 44 million pesoss).

VI. Construction Schedule

The construction schedule is tentatively programmed as follows:

Steel Materials

. Detailed Design	: May to June 1988
. Tendering	: July 1988
. Fabrication	: August to November 1988
. Shipment	: December 1988

Substructures and Bridge Approaches (to be borne by the Philippine Government)

. Detailed Design	: January to March 1988
. Tendering	: May to July 1988 (Two-span Bridges)
	: July to September 1988 (One-span Bridges)
. Construction	: 10 Months from August 1988 to May 1989 (Two-span Bridges)
	: 8 Months from October 1988 to May 1989 (One-span Bridges)

VII. Executing Agency

The executing agency of the Philippine Government for the Project is the Department of Public Works and Highways (DPWH). The following bureaus of the DPWH are responsible for the corresponding activities:

. Design	: Bureau of Design
. Tendering	: Bureau of Construction
. Construction Supervison	: Regional Offices
. Maintenance	: Bureau of Maintenance

The Project aims to provide transportation facilities for the smooth movement of the people and services among the rural area, and to induce agricultural and industrial development. Thus, the Project will contribute to the development goals of the Philippines, i.e., alleviating poverty, generating more productive employment, promoting equity and social justice, and attaining sustainable economic growth.

This Progect for constructiong bridges along runal roads will benefit the people and its society in rural area, and considering its expected effect, it is quite appropriate to implement it by grant aid of the Japanese Goverment.

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APPENDIX

SEPARATE VOLUME

CHAPTER 1

INTRODUCTION

CHAPTER 1

INTRODUCTION

In response to the request of the Government of the Philippines, the Government of Japan decided to conduct the Basic Design Study on the Project for Constructing Bridges Along Rural Roads (Phase I) and the Japan International Cooperation Agency (JICA) dispatched the Basic Study Team to the Philippines from the 24th November to the 23rd of December 1987.

The Study Team had a series of discussions with the officials concerned of the Government of the Philippines and conducted field investigations together with its Philippine counterparts.

A total of 38 bridges had been initially identified with an aggregate length of about 1,335 linear meters. However, a new list of bridges was later proposed by the Government of the Philippines consisting of 58 bridges with an aggregate length of 2,413 linear meters, which was officially accepted by the Japanese Government as the subject bridges for the Study.

The Project involves the construction of new bridge structures and replacement of old bridges along rural roads throughout the country.

The bridges under this project are planned to cross over rivers with width ranging from 12 to 75 meters, and are planned to use steel materials (e.g. H-beams, bearing shoes, drain boxes, etc.) for their construction.

Based on the basic data of each bridge and the results of the study from the engineering point of view, the bridges in the newly revised proposal were classified into three (3) categories.

1) Phase I Bridges - The steel materials for the bridge construciton will be provided by the Japanese Government. The required level of engineering for the construction is relatively easy for the Philippine side to design and construct the bridge by using those materials.

2) Phase II Bridges - All the materials and construction work will be provided by the Japanese Government. The required level of engineering for the construcction is relatively high and suitable for the Japanese side to design and construct the sub-structure and super-structure.

3) Others - No data is available or immediate replacement is not necessary.

The Minutes of Discussions on this study was exchanged on December 3, 1987 (Refer to Appendix-2) Data and informations collected in the field were further analysed in Japan. This report covers the results of the analysis and the basic design for Phase I Bridges.

CHAPTER 2

BACKGROUND OF THE PROJECT

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2.1 Present Condition of Highways and Bridges

2.1.1 Highways

Of the four (4) transport modes, road, rail, sea and air transport, the road transport is dominant in the Philippines. The road network has been developed rapidly in the last two (2) decades, and carries 90 percent of passenger and 65 percent of freight traffic. Almost all intra-island transport depends on road transport. See Table 2.1-1.

TABLE 2.1-1 APPROXIMATE NATIONAL MODAL SPLIT, 1980

(DOMESTIC TRAFFIC ONLY)

Mode	Freight		Passenger	
	Ton-km (Billion)	Share (%)	Passenger-km (Billion)	Share (%)
Sea	12	(35)	4	(7)
Road	22	(65)	53	(90)
Rail	0.04	(-)	0.04	(1)
Air	(Negligible)	(-)	1.2	(2)

SOURCE: NTPP

As shown in Table 7 of Appendix 7, the Philippines has a total road length of 161,709 km, of which 16.0 percent are classified as national roads, 18.0 percent as provincial roads, 3.0 percent as city roads, 8.0 percent as municipal roads and 55.0 percent as barangay roads.

Only 9,188.15 km of the roads (6.0%) are made of concrete surface, 12,049.78 km (7.0%) asphalted and the remaining 140,470.7 km of unpaved surface consisting of gravel roads (81.0%) and earth surface (6.0%). Most concrete paved stretches are national roads consisting of 6132 km (or 67.0%). Provincial and city roads have approximately 1349.0 km (15%) of concrete pavement, while municipal roads have 1706.25 km (19.0%).

The Ilocos Region has the longest road network, about 11.1 percent of the total road network, followed by the Northern and Southern Mindanao Regions contributing 9.9 and 9.8 percent, respectively.

The National Capital Region (NCR), with respect to total land area, has a road density of 4.6 km/km^2. The densities of the remaining regions range from 0.3 to 0.8 km/km^2.

With a total road network of 161,709 km and 133,258 km^2 of arable area, the Philippines has 1.2 km of road for every square kilometer of arable area. The NCR, being the center of commerce and industry and having a very negligible arable area, has the highest road density of 15 km/km2 while Region V, which is basically an agricultural area, has the lowest road density of only 0.7 km/km2.

Relative to the projected 1985 population, the country has 3 km of road for every 1,000 persons. The regions with very high km of road per thousand population are Regions I, II, IV-B, X, XI, and XII, while the regions with very low km of road per thousand popoulation are NCR and Southern Tagalog Region.

The present highway network is observed to have the following deficiences:

(a) Less than 50 percent of the total network may be considered as all-weather roads. Only about 44 percent of the national road network is paved with concrete or asphalt.

(b) The condition of many roads, especially barangay (feeder) and provincial (secondary) roads and even some national road sections, is poor because of initial low design standards relative to traffic volume, substandard construction, inadequate maintenance, and damage from over-loaded vehicles.

(c) Missing or weak bridges diminish the usefulness of many existing roads.

(d) In some remote areas, access roads connecting with arterial or rural roads are scarce.

2.1.2 Bridges

The Philippines had a total of 218,993.67 linear meters of bridge structures in 1985s of which 75.0% were permanent and 25.0% temporary. The temporary bridges are bailey with wooden trestles, timber, wooden bridges, etc.

These bridges are dilapidated and dangerous, and they often close the traffic, especially during the rainy season. This situation has been regarded as one of the main constraints of development in the country-side.

The region with the shortest length of temporary bridges is NCR with 1.1%, followed by Region III(4.6%), I(10.1%) and IV-A (11.5%). The region with the largest percentage of temporary to permanent bridge length is Region IV-B (49.1%), followed by Region XI (43.1%), VIII (41.0%) and VI (34.7%), as shown in Table 2.1-2.

TABLE 2.1-2 EXISTING BRIDGES BY CLASSIFICATION AND STANDARD

1985 (ALONG NATIONAL ROADS ONLY)

	Permanent (L.M.)	Temporary (L.M.)	(%)	Total (L.M.)
Philippines	163,404.46	55,589.21	(25.4)	218,993.67
N C R	9,293.01	104.00	(1.1)	9,397.01
I	21,095.32	2,367.51	(10.1)	23,462.83
II	16,153.67	4,324.68	(21.1)	20,478.35
III	16,153.67	770.99	(4.6)	16,860.18
IV-A	11,021.75	1,430.01	(11.5)	12,451.76
IV-B	5,968.74	5,769.19	(49.1)	11,737.93
V	10,386.21	3,312.51	(24.1)	13,698.72
VI	14,391.52	7,634.22	(34.2)	22,025.74
VII	9,230.23	3,795.74	(29.1)	13,025.97
VIII	14,954.00	10,379.41	(41.0)	25,333.41
IX	6,808.48	1,796.01	(20.9)	8,604.49
X	13,810.03	5,391.98	(28.1)	19,202.01
XI	7,624.14	5,792.04	(43.1)	13,416.19
XII	6,578.17	2,720.92	(29.3)	9,299.09

NOTE:
Permanent Bridge - Concrete, steel and similar materials.
Temporary Bridge - Bailey, timber, coconut and similar materials.
% - ratio of temporary bridge length to permanent.

At the proposed sites of 58 bridges, there is an existing bridge. The types of bridge is shown in Table 2.1-3 The predominant types of bridges are timber bridges and bailey bridges with timber trestles, both numbering 23, and followed by bailey bridges with permanent substructures. Refer to Table 2.1-3.

TABLE 2.1-3 TYPE OF EXISTING BRIDGES

Timber Bridge	23
Bailey Bridge with Timber Trestle	23
Bailey Bridge with Permanent Substructure	6
Steel Truss Bridge	1
I-Beam Bridge	1
Reinforced Concrete Deck Girder Bridge (RCDG)	1
Spillway	1
Long Bridge	1
No Existing Bridge	1
Total	58

The existing condition of bridges proposed for the Project shows deterioration, dilapildation or deficiencies. The existing structures sag and sway whenever vehicles cross them and are close to collapse due to heavily corroded structural steel members.

Listed hereunder are the comments and observations on the existing temporary bridges made by DPWH's district, city and maintenance engineers :

. Temporary timber trestle bridge is always damaged by flood resulting in frequent repairs of timber ports.
. Maintenance of the long span temporary bridge is excessive.
. Repair work is very expensive and has to be done very frequently.
. Exisiting bridge is out of alignment.
. Capacity of existing bridge may not conform with the live load passing over the bridge.
(Load limits of existing bridges are 3 to 10 tons.)
. Heavy equipment and other heavy cargo trucks cannot cross the bridge safely.
. Truck load hauling agricultural products such as rice and copra, forest and aqua-cultural products, exceed the capacity of the bridge.
. Inconvenient for the travelling public, especially in transporting agricultural products from farm to market.
. Accidents to some motorist when fording the river.
. Traffic jams from water or flood.

2.2 Outline of Related Development Plans

2.2.1 National Development Plan

The Philippine Government announced the "Medium-Term Philippine Development Plan 1987-1992" in January, 1987. The plan analyses the cause of the minus economic growth starting in late 1983 and the present conditions, and setting the new goals of the government. The principal goal is the restoration of economy that leads to the alleviation of poverty and increase of employment opportunities. (Present unemployment ratio 11.8%, part-time employment 35.2%). The major economic indexes of the Philippines are shown in Table 5 of Appendix-7. The composition of expenditure is shown in Table 6 of Appendix-7.

The main points of the Plan are as follows.

(1) National Development Goals

The following four (4) goals are addressed. Their accomplishment fully depends on the economic growth and the Plan emphasizes that cooperation between the pubic and private sectors is indispensable.

a) Alleviation of poverty
b) Generation of more productive employment
c) Promotion of equity and social justice
d) Attainment of sustainable economic growth

(2) Economic Indexes for National Development Goal.
As a target for economic growth, the average growth rate of GNP at 6.8% per annum is expected for the six years from 1987 to 1992. The inflation rate at 7.6% per annum and the GNP per capita at 16,870 peso ($827, $1=20.4 peso) in 1992 are also forecasted. Refer to Table 2.2-1.

2.2.2 Highway Development Plan

The Medium-term Philippine Development Plan 1987-1992 has stated the following policies and strategies for the highway sector:

TABLE 2.2-1

GROSS NATIONAL PRODUCT AND PER CAPITA GNP, 1986-92[a]

	Estimate			Targets				Annual average
	1986	1987	1988	1989	1990	1991	1992	1987-92
Gross National Product (in billion pesos, at constant 1972 prices)	89.4	95.3	101.9	108.6	116.2	124.3	132.7	113.2
Growth rate (%)	1.1	6.5	6.9	6.7	7.0	6.9	6.7	6.8
Gross National Product (in billion pesos, at current prices)	619.6	697.3	811.8	927.3	1,075.7	1,253.2	1,438.0	1,033.9
Inflation Rate (%)	2.0	5.2	8.7	7.0	8.3	8.9	7.4	7.6
Per Capita GNP (in pesos, at constant 1972 prices)	1,597	1,661	1,734	1,808	1,891	1,977	2,064	1,856
Growth rate (%)	–1.3	4.0	4.4	4.3	4.6	4.5	4.4	4.4
Per Capita GNP (in pesos, at current prices)	11,063	12,157	13,825	15,430	17,497	19,934	22,378	16,870

Sources: NEDA and NCSO.

In line with the stress on the development of the rural-agricultural sector, increased emphasis shall be given to the rehabilitation, improvement and expansion of the feeder and secondary network, which consists mainly of farm-to-market roads. The program seeks to convert these roads into all-weather transport facilities. These roads will be underscored particularly in economically depressed areas with low road densities to spur production. Feeder and secondary roads will also be improved in corridors of main highways which have just been or are programmed to be improved; this will provide for a more efficient network to collect and distribute traffic to and from the hinterlands.

Rehabilitation and improvement of major roads will be selectively carried out, particularly, in sections as in Mindanao and Visayas, that can no longer economically serve the present and immediate future traffic volume, and where transport costs are excessively high that restrain production and marketing.

Temporary or weak bridges will be replaced with permanent structures. Measures will be introduced to stabilize road slopes and embankments, and to strengthen pavements to minimize road disasters and closures. This will be complemented by schemes, both structual and non-structural, to reduce the rate of accidents and to improve road traffic safety.

Road maintenance activities will be reinforced in order to defer the huge investments in roads, lengthen their useful lives, reduce transport operating costs, and minimize public inconvenience. For this purpose, the inspection, monitoring and accounting system for maintenance will be strengthened.

The physical targets 1986-92 in the Highway Development Program are shown in Table 2.2-2.

TABLE 2.2-2 HIGHWAY DEVELOPMENT PROGRAM (a)
PHYSICAL TARGETS 1986-92

	Program 1986	Targets 1987	1988	1989	1990	1991	1992	1987-92 Total	% Share to Total
Road (in kms.)	6,475	9,319	10,000	10,538	11,708	12,704	13,711	68,078	100.0
Feeder Roads (Inc. barangay roads)	4,702	6,876	9,458	7,610	8,551	9,255	9,963	49,713	73.0
Secondary roads (Inc. national roads)	1,263	1,403	1,545	1,712	1,856	2,052	2,270	10,838	15.9
Major roads	510	1,040	1,097	1,214	1,301	1,397	1,478	7,527	11.1
Bridges (in lineal meters)	4,899	5,059	5,624	6,219	6,860	7,683	8,465	39,920	

a. Restoration, rehabilitation, improvement and construction.

Sources of basic data: MPWH, MLG

CHAPTER 3

GENERAL CONDITIONS OF THE PROJECT AREA

CHAPTER 3

GENERAL CONDITIONS OF THE PROJECT AREA

3.1 Project Area

The bridges proposed for the Project are located along secondary national and provincial roads in rural areas throughout the country.

The location of each bridge is listed in Table 4.2-3 and shown on the location map.

The number of bridges proposed in each region are shown in Table 3.1-1.

TABLE 3.1-1 NUMBER OF PROPOSED BRIDGES

Region		No. of Proposed Bridges
I	Ilocos	3
II	Cagayan Valley	5
III	Central Luzon	4
IV-A	Southern Tagalog	3
TV-B	Southern Tagalog	5
V	Bicol	3
VI	Western Visayas	5
VII	Central Visayas	5
VIII	Eastern Visayas	5
IX	Western Mindanao	5
X	Northern Mindanao	5
XI	Southern Mindanao	5
XII	Central Mindanao	5
Total		58

3.2 Socio-Economic Conditions

(1) Socio-Economic Conditions

According to data furnished by the DPWH, the primary economic activity in the influence areas identified for the proposed bridges is generally agriculture.

All regions produce rice, and out of total 58 bridgeds, 33 bridges have the influence to the flow of this commodity, followed by corn (22 bridges), root crops (21 bridges), coconut (18 bridges), fish (18 bridges), vegetables (11 bridges), fruits (10 bridges), forest products (9 bridges) and livestock (4 bridges), while the Talus bridge is for sugarcane. Mineral products are affected by six (6) bridges located in Regions II, IV, VII, XI and X. Other agricultural crops such as potatoes, coffee and tobacco are affected by the bridges in Region I. See Table 3.2-1.

(2) Traffic Conditions

Based on the traffic survey as of 1986, in the influence areas of bridges along rural roads in the regions, Region V, VI and X presents a high traffic flow (ADT) of 1561, 2420, and 1319, respectively, followed by Regions; XII (686), IX (677), IV (520), XI (450), II (281), VIII (267), and I (237). The lowest traffic volume was 34 vehicles registered in Region VII.

There was no available traffic data submitted for bridges in Region III. Traffic compositions within the influence areas show the traffic of trucks, bus and jeepneys. Data surveyed by the DPWH clearly indicate that the main trip purpose is transportation of agricultural products, followed by business, school and visiting relatives.

TABLE 3.2-1 NUMBER OF BRIDGES PER REGION AFFECTED BY AGRICULTURAL COMMODITY FLOW

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Rice/Palay	2	4	4	6	0	2	1	4	4	2	1	3
Corn	0	3	0	3	0	1	4	3	4	1	1	3
Coconut	0	0	4	2	0	2	4	1	0	1	0	1
Sugar	0	0	0	0	0	1	0	0	0	0	0	0
Tobacco	2	0	0	0	0	0	0	0	0	0	0	0
Forest Products	0	2	3	2	0	0	0	0	1	0	0	0
Fish	0	1	4	1	0	2	1	2	0	1	0	3
Potatoes	1	0	0	0	0	0	0	0	0	0	0	0
Coffee	1	1	0	0	0	0	0	0	0	0	0	0
Fruits	1	1	0	2	0	0	1	3	0	0	0	2
Root Crops	0	5	0	1	0	1	1	5	5	0	2	1
Livestock	0	2	0	2	0	0	0	0	0	0	0	0
Vegetables	1	2	0	1	2	1	1	0	0	0	1	2
Mineral Products	0	2	0	1	0	0	1	0	1	1	0	0
Construction Materials	0	0	0	1	0	0	0	0	0	0	0	0
ADT Range	151- 237	261- 281		208- 520	624- 1,561	60- *2,420	34- 267	96 96	340- 677	55- 1,319	270- 450	76- 686

*AADT 1986

(3) Security Conditions

According to the officials concerned of the Philippine Government, since the situation in the vicinities of the proposed bridges is reported to be generally normal and peaceful as of date, no problems are anticipated during the bridge construction.

The followings are the comments and observations reported by each Region:

. Peace and order in proposed bridge sites and anticipated problems during their constructions should be prudently reviewed but with the presence of the Military Unit nearby, the peace and order during the project implementation will be ensured.

. Since most of the proposed bridge sites are within 10 km from a permanent Philippine Constabulary Camp, a security problem is unlikely to occur.

3.3 Construction Conditions

(1) Natural Conditions

The natural conditions of the country are briefly described in Appendix-10 (Proposed sites are scattered throughout the country)

(2) Arrangement of Construction Equipments

Since the bridges under the Project are planned to be constructed by contractors through bidding, equipments necessary for construction will be arranged by each of the contractors.

It was also reported that construction equipments are available from the DPWH Regional Equipment depots.

(3) Availability of Construction Materials

The construction materials which will be procured by each of the contractors are available locally.

Reinforcing steel and cement will be transported from large cities, while sand, gravel, lumber, etc. are available locally near the proposed bridge sites.

(4) Transportation of Steel Girders

Since the roads leading to the proposed bridge sites which will be utilized for the transportation of steel girders from the designated ports of entry to the bridge sites are generally gravel or concrete paved roads and passable in all weather conditions, no specific problems are foreseen.

These roads are mostly in fair condition, but there are some sections where minor repairs or improvements may be required.

(5) Construction of Detour Roads

For some bridges whose proposed site is located a few meters downstream or upstream of an existing bridge, the construction of a detour road may not be necessary since the existing bailey bridge can be utilized as a detour during construction.

Detour roads, where required, can be constructed within or beyond the road right-of-way limits. The present temporary bridge will be dismantled and re-used as a detour bridge. This will minimize the expense for the construction of a new detour road.

CHAPTER 4

DESCRIPTION OF THE PROJECT

CHPATER 4

DESCRIPTION OF THE PROJECT

4.1 Objectives of the Project

As described in Chapter 2, some of the bridges along rural roads and even some on national roads are too old and weak to carry the the present traffic load. Most of these bridges are temporary wooden or simple bailey type without concrete deck slabs. These bridges often close the traffic, especially during rainly seasons, and consequently people's living in these influence areas are sometimes isolated.

The replacement of these old and dilapidated timber bridges and temporary steel truss bridges by permanent steel structures or reconstruction will bring about significant savings in transport costs and shorten travel times. It will ensure smooth transportation and contribute greatly to the socio-economic development of the project areas.

In line with the Highway Development Program and the cognition on the afore-mentioned present condition, the priority is given to replacement of dilapidated bridges and temporaly bridges which diminish the efficiency of the highway network.

Thus, the Project will be implemented with the following objectives:

(a) To provide basic transport facilities in rural areas; and

(b) To enhance development and facilitate the effective delivery of socio-economic extension services to the communities served.

4.2 Review of Requested Contents of the Project

4.2.1 Proposed Bridges

In the original proposal presented by the Philippine Government, a total of 38 bridges was indicated as shown in the Concept Paper prepared by the Department of Public Works and Highways dated May 1987. (Refer to Appendix 3)

On November 25, 1987, at the first meeting held between both parties, the revised list of bridges which counts 58 bridges was presented by the Philippine side to the Study Team.

The Study Team reported about this revision to the Government of Japan and it was accepted. The Study Team started the basic design study on the newly proposed 58 bridges. Refer to Appendix 4)

The numbers of proposed bridges (original and revised) are shown in Table 4.2-1.

TABLE 4.2-1 NUMBERS OF PROPOSED BRIDGES

Region	Original Proposal	Revised Proposal
I	3	3
II	3	5
III	3	4
IV-A	2	3
IV-B	3	5
V	3	5
VI	3	5
VII	3	5
VIII	3	5
IX	3	5
X	3	5
XI	3	5
XII	3	5
Total	38	58

4.2.2 Phasing of Bridges

(1) Definition of Phase I and Phase II Bridges

The proposed fifty-eight (58) bridges were classified into three (3) types: Phase I bridges, Phase II candidate bridges and bridges with no data/no urgent replacement.

Phase I bridges are defined as those bridges whose substructures can be designed by Filipino engineers and the construction of such bridges including the erection of steel girders can be completed by the Government of the Philippines with steel materials supplied under the Japan's Grant Aid.

Phase II candidate bridges, on the other hand, are defined as those other than Phase I bridges but are appropriate for the Japan's Grant Aid. The whole structures of these bridges ,including superstructures and substructures, are planned to be designed by Japanese Engineers and constructed under the Japan's Grant Aid.

There were nine (9) bridges which had no complete data necessary for basic bridge designing and four (4) bridges whose immediate replacement seemed not necessary. These were not classified to either Phase I or Phase II, and excluded from the list of the Project.

(2) Phasing Criteria

The Government of the Philippines through the Department of Public Works and Highways (DPWH) conducted a survey of the proposed bridges, covering the following items:

(a) Present conditions of bridges

- . Location
- . Type of structure
- . Degree of deterioration
- . Present load limit

(b) Socio-economic data

- Population of Influence areas
- Main products
- Development plans

(c) Traffic Data

- Traffic volume
- Traffic composition
- Trip purposes
- Design traffic load

(d) Topographic Survey

- Topographic map Scale: 1:200
- Profile map Scale: 1:200
- Cross sections Scale: 1:200

(e) Hydrological Data

- Dry and wet seasons
- Highest, lowest and average water elevations

(f) Construction Data

- Availability of equipment, especially for steel girder erection
- Availability of material locally
- Roads and their condition for transportation of steel girders

(g) Pictures

All data and information investigated by the DPWH were compiled in tables for review and evaluation. Refer to Appendix 5: Data of Bridges.

Based on the analysis and evaluation on these data, the lengths and types of bridges were determined.

The criteria employed in phasing bridges are as follows:

(a) Criteria for Phase I Bridges

- Replacement/reconstruction of bridges are in urgent need.
- All data necessary for the detailed design are completed except for geological information.
- No special problems in design of substructures and foundations are expected.
- No difficulty in construction, especially erection of steel girders and construction of substructures, is anticipated.
- Steel girders can be easily transported from the designated ports to the bridge sites.

(b) Criteria for Phase II Bridges

- Replacement/reconstruction of bridges are in urgent need.
- Data necessary for the detailed design are almost completed except for geological information.
- Detailed topographic surveys are required because of complicated terrain.
- Geological surveys are required to decide the types of foundations.
- Cofferdams may be recommended to be used for the constructions of piers inside rivers.
- Erection of steel girders may be difficult because of deep valleys or long spans.
- Steel girders can be easily transported from the designated ports to the bridge site.

(3) Phasing of Bridges

In accordance with the criteria established, all proposed bridges were classified into Phase I, Phase II and others.

Table 4.2-2 summarizes the number of bridges proposed for Phase I and II by regions.

Table 4.2-3 shows the list for Phase I, while Table 4.2-4 the list of candidate bridges for Phase II.

The result of the technical study, especially those on design and construction requirements for the bridges, are presented in Appendix 6.

TABLE 4.2-2 SUMMARY OF PHASING BRIDGES

Regions	No. of Proposed Brs.	No. of Phase I Brs.	No. of Phase II Candidate Brs.	No Data/ No Urgent Rep.
I	3	-	-	3
II	5	2	3	-
III	4	-	-	4
IV-A	3	-	2	1
IV-B	5	2	3	-
V	3	1	1	1
VI	5	2	1	2
VII	5	3	2	-
VIII	5	3	2	-
IX	5	4	1	-
X	5	4	1	-
XI	5	2	1	2
XII	5	1	4	-
Total	58	24	21	13

TABLE 4.2-3 (1) LIST OF BRIDGES FOR PHASE I

Bridge No.	Name of Project	Location
02.03	Baan Bridge # 2	km. 246 + 171 Nueva Vizcaya-Benguet Road Baan, Kayapa, Nueva Vizcaya
02.04	Diora Bridge	km. 634 + 195 Dugo-San Vicente Road Sta. Ana, Cagayan
04.07b	Dipulao Bridge	km. 2 + 706 Coron-Busuanga National Road Coron, Palawan
04.08b	Cogon Bridge	km. 64 + 974 Odiongan (Tulay)-Looc Road Looc, Romblon
05.02	Patitinan Bridge	km. 499 + 200 Sagnay-Tiwi-Albay Bdry. Road Patitinan, Saganay, Camarines Sur
06.02	Cataan Bridge	km. 65 + 930 Tiolas-sinogbuhan Road San Joaquin, Iloilo
06.04	Guintas Bridge	km. 106 + 500 Tapaz-Jamindan Road Jamindan, Capiz
07.03	Campanga Baridge	km. 63 + 500 Carcar-Barili-Mantayupan Road Barili, Cebu
07.04	Camachiles Bridge	km. 49 + 800 Toledo-Tabuelan-San Remgio Road, Talavera, Toledo City
07.05	Lagnason Bridge	km. 115 + 200 Anatalio Bacalso Avenue Lagunde, Oslob, Cebu
08.01	Poray Bridge	km. 1043 + 798 Jct. Buenavista-Lawa-an Road Parina, Balangiga, E. Samar

TABLE 4.2-3 (2) LIST OF BRIDGES FOR PHASE 1

Bridge No.	Name of Project	Location
08.02	Iba Bridge	km. 914 + 800 Basey-Magallanes Road Iba, Basey, Samar
08.05	Pinucawan Bridge	km. 68 + 280 La Paz-Javier-Bito Road Javier, Leyte
09.01	Batungal Bridge	km. 26 + 440 Isabela-Maluso Road Maluso, Basilan
09.02	Mangop Bridge	km. 439 + 740 Sindangan-Lioy Road Zamboanga del Norte
09.03	Canawan Bridge	km. 449 + 740 Sindangan-Liloy Road Zamboanga del Norte
09.04	Piangon Bridge	km. 337 + 380 Dipolog-Sindangan National Road, Sindangan, Zamboanga del Norte
10.02	Maradugao Bridge	km. 1608 + 942 Marandugao-Camp Kibaritan Road, Kalilangan, Bukidnon
10.03	Maundo Bridge	km. 1386 + 957 Pulang Lupa-Patrocinio Road Sta. Josefa, Agusan del Sur
10.04	Sta. Irene Bridge	km. 1282 + 110 Bayugan-Kalaitan-Tandag Road Sta. Irene, Agusan del Sur
10.05	Malubog Bridge	km. 185 + 760 Labuyo-Tangub-Silanga Road Barangay 4, Tangub City
11.01	Lambuano Bridge	km. 1267 + 027 Surigao Sur-Davao Coastal Road, Lanuza, Surigao del Sur
11.03	Calabanit Bridge	km. 1716 + 083 Davao del Sur-South Cotabato Coastal Road Glan, South Cotabato
12.03	Upian Bridge	km. 239 + 002 Cotabato-Bukidnon Road Kimadzil, Carmen, North Cotabato

TABLE 4.2-4 (1) LIST OF CANDIDATE BRIDGES FOR PHASE II

Bridge No.	Name of Bridge	Location
02.01	Sta. Cruz Bridge	km. 640 + 747 Dugo-San Vicente Road Sta. Ana, Cagayan
02.02	Dumadata Bridge	km. 339 + 770 Cordon-Diffun-Maddela-Aurora Road, Mangandingay Cabarroguis Quirino
02.05	Diduyon Bridge	km. 374 + 060 Cordon-Diffun-Maddela-Aurora Road, Maddela, Quirino
04.01a	Binambang Bridge	km. 107 + 540 Balayan-Balibago-Calatagan Road, Caloocan, Balayan, Batangas
04.03a	Leviste II Bridge	km. 92 + 430 Talisay-Laurel-Agoncillo Road, Laurel, Batangas
04.04b	Lumang Bayan Bridge	km. 34 + 954 Mamburao-North Puerto Galera Road, orelan, Abra de Ilog Mindoro Occidental
04.05b	Olangoan Bridge	km. 74 + 524 Puerto Princesa North Road Concepcion, Puerto Princesa City, Palawan
04.06b	Bongabon Bridge	km. 122 + 720 Calapan South-Bulalacao-San Jose Road, Bongabon Oriental Mindoro
05.03	Narangasan I Bridge	km. 31 + 145 Jct. Tawad-Balud Road Milagros, Masbate
06.03	Iyang Bridge	km. 109 + 962 Concepcion-San Dionisio National Road, Concepcion Iloilo
07.01	Banban Bridge	km. 61 + 100 Pinamungahan-Aloguinsan -Mantalongon Road. Pinamungahan, Cebu
07.02	Campacas Bridge	km. 97 + 600 Dalaguete-Mantalongon Road Dalaguete, Cebu

TABLE 4.2-4 (2) LIST OF CANDIDATE BRIDGES FOR PHASE II

Bridge No.	Name of Bridge	L o c a t i o n
08.03	Habay Bridge	km. 1075 + 448 Liloan-San Francisco Road Habay, San Francisco S. Leyte
08.04	Talisayan River Crossing	km. 66 + 800 La Paz-Javier-Bito Road Talisayan, Javier, Leyte
09.05	Patunan Bridge	km. 375 + 090 Dipolog-Sindangan Road Manukan, Zamboanga del Norte
10.01	Hayangabon I Bridge	km. 1202 + 586 Surigao-Davao Coastal Road Hayangabon, Claver Surigao del Norte
11.04	Manay Bridge	km. 1643 + 783 Davao Orientl -Surigao del Sur National Road Manay, Davao Oriental
12.01	Pikinit Bridge	km. 136 + 936 Dobleston-Tukuran Road Caromatan, Lanao del Norte
12.02	Durugao Bridge	km. 216 + 498 Awang-Upi-Lebak Road Durugao, South Upi, Maguindanao
12.04	Dangolaan Bridge	km. 133 + 983 Dobleston-Tukuran Road Caromatan, Lanao del Norte
12.05	Sapakan Bridge	km. 211 + 530 Dulawan-Marbel Road Sapakan, Maguindanao

4.3 Scope of the Japan's Grant Aid

As stated in the Minutes of Discussions for the Project dated December 3, 1987, the scope of the Japan's Grant Aid for the Project covers the following:

(a) Steel Materials Supply for Phase I Bridges

Steel materials consist of:

1. Steel Girders
2. Cross Beams
3. Shoes
4. Drainage Boxes
5. Torque Wrenches
6. Steel Railings, and Posts for the Bridge Approach

(b) Delivery of steel materials from Japan to designated ports of entry in the Philippines.

The Government of the Philippines, on the other hand, is responsible for the construction of Phase I bridges within the period of one (1) year after delivery of steel materials at designated ports of entry provided under the grant aid, as well as necessary measures stated in the Minutes of Discussions.

CHAPTER 5

BASIC DESIGN

CHAPTER 5

BASIC DESIGN

5.1 Design Policy

The basic planning of Phase I Bridges was conducted based on data furnished by the DPWH of the Government of the Philippines. The general views of these bridges were prepared as shown in a separate volume of the Basic Design Study.

Table 5.1-1 illustrates the schematic diagram of Phase I Bridges.

In preparing the said general view, the following design policies were adopted.

1) Maximum utilization of steel materials for superstructures.

2) Maximum utilization of local materials for substructures.

3) Labor intensive construction method shall be employed whenever applicable.

4) River protection shall be provided in order to avoid damage of abutments due to river flow.

5) Footing of pier shall be embeded below river bed.

6) Steel girder shall be fabricated in such size and height that girder can be transported safely and conveniently.

The detailed design of superstructures will be conducted by the Japanese Consultants. On the other hand, the detailed design of substructures, bridge approaches and other structures necessary to complete the Project is the responsibility of the DPWH.

Both designs are in accordance with design criteria established between the DPWH and the Study Team as discussed in this chapter.

It is noted that, although the location of bridges were already indicated in the proposed general views of bridges, the final location of each bridge shall be determined by the DPWH after considering important factors such as topographic and environmental conditions, information on flooding and geometric alignment, as well as construction methods. However, these changes will not alter the length or type of supersturctures.

TABLE 5.1-1

SUMMARY OF PHASE I BRIDGES

NO.	BRIDGE NO.	NAME OF BRIDGES	TYPE OF BRIDGES	NO.	BRIDGE NO.	NAME OF BRIDGES	TYPE OF BRIDGES
1	02.03	BAAN BRIDGE NO. 2	H=3.5m PILE; L=23m F Exp, L=23m Exp F, H=5.0m; H=3.5m	13	08.05	PINUCAWAN BRIDGE	H=3.5m PILE; L=16m F Exp; H=3.5m
2	02.04	DIORA BRIDGE	H=3.5m PILE; L=25m F Exp, L=25m Exp F, H=6.5m; H=3.5m	14	09.01	BATUNGAL BRIDGE	H=3.5m PIBE; L=23m F Exp; H=3.5m
3	04.07b	DIPULAO BRIDGE	H=3.5m PILE; L=25m F Exp; SKEW ANGLE 60°; H=3.5m	15	09.02	MANGOP BRIDGE	H=3.5m PILE; L=17m F Exp, L=17m Exp F, H=4.5m; H=3.5m
4	04.08b	COGON BRIDGE	H=3.3m SPREAD; L=23m F Exp; H=3.3m	16	09.03	CANAWAN BRIDGE	H=3.5m PILE; L=19m F Exp, L=19m Exp F, H=9.0m; H=3.5m
5	05.02	PATITINAN BRIDGE	H=3.3m SPREAD; L=20m F Exp; H=3.3m	17	09.04	PIANGON BRIDGE	H=3.5m PILE; L=20m F Exp, L=20m Exp F, H=5.5m; H=3.5m
6	06.02	CATAAN BRIDGE	H=3.5m PILE; L=20m F Exp, L=20m Exp F, H=10.5m; H=3.5m	18	10.02	MARADUGAO BRIDGE	H=3.3m SPREAD; L=25m F Exp; H=3.3m
7	06.04	GUINTAS BRIDGE	H=3.5m PILE; L=21m F Exp, L=21m Exp F, H=9.0m; H=3.5m	19	10.03	MAUNDO BRIDGE	H=3.5m PILE; L=22m F Exp; H=3.5m
8	07.03	GAMPANGA BRIDGE	H=3.5m PILE; L=12m F Exp; H=3.5m	20	10.04	STA. IRENE BRIDGE	H=3.3m SPREAD; L=22m F Exp; H=3.3m
9	07.04	CAMACHILES BRIDGE	H=3.5m PILE; L=18m F Exp, L=18m Exp F, H=4.5m; H=3.5m	21	10.05	MALUBOG BRIDGE	H=3.5m PILE; L=25m F Exp; H=3.5m
10	07.05	LAGNASON BRIDGE	H=3.5m PILE; L=19m F Exp, L=19m Exp F, H=4.5m; H=3.5m	22	11.01	LAMBUNAO BRIDGE	H=3.5m PILE; L=19m F Exp, L=19m Exp F, H=5.0m; H=3.5m
11	08.01	PORAY BRIDGE	H=3.5m PILE; L=22m F Exp; H=3.5m	23	11.03	CALABANIT BRIDGE	H=3.5m PILE; L=20m F Exp, L=20m Exp F, H=5.0m; H=3.5m
12	08.02	IBA BRIDGE	H=3.5m PILE; L=23m F Exp; H=3.5m	24	12.03	UPIAN BRIDGE	H=5.0m SPREAD; L=25m F Exp, L=25m Exp F, H=12.5m; H=3.5m

5.2 Design of Superstructures

5.2.1 Design Criteria

Design criteria to be adopted for design of superstructures are as follows:

. Design Specification	: AASHTO Standard Specifications for Highway Bridges (13th Edition, 1983)
	: Specification for Highway Bridges, Japan Road Association, 1980
. Live Load	: AASHTO HS-20-44 (MS18) for Roadways
	: 2.873 KN/m^3 for Sidewalks
. Temperature Change	: Rise + 10^o, Fall - 10^o
. Concrete Slab	: (3L + 11) x 1.05, L = Span Length
. Max. Length of Member	: 8.5m

5.2.2 Types of Superstructures

Taking into consideration the fabrication of steel girders in Japan and the construction method in the Philippines, the maximum span length of bridges was decided to be less than 25m.

For bridges with span length less than 25m, based on the experience in Japan, the following three (3) types were judged suitable as more economical types of steel bridges.

. H-Beam Composite Girder
. Plate Girder
. Composite Plate Girder

Figure 5.2-1 shows the comparison of steel weights, except for accessories such as shoes, expansion joints, handrails and drainage boxes. Compared with the fabrication costs of girder types, H-beam composite girder type was selected as the most advantageous type for the Project.

The typical general view of H-beam composite type is shown in Figure 5.2-2, while the typical cross sections of superstructures proposed for Phase I Bridges are shown in Figure 5.2-3.

The number of spans by span length is summarized in Table 5.2-1.

TABLE 5.2-1 NUMBER OF SPANS

Span Length (m)	No of Spans
12	1
16	1
17	2
18	2
19	6
20	7
21	2
22	3
23	5
25	7
Total	36

NOTE: Number of bridges with single span: 12
Number of bridges with two spans: 12
Total number of spans: 36

Considering the location of bridges, weathering steel which provides atomospheric corrosion resistance was recommended to be used for the following bridges. These bridges are located nearby seasides.

TABLE 5.2-2

BRIDGES FOR USE OF WEATHERING STEEL

Bridge No.	Name
02.04	Diora Bridge
04.07b	Dipulas Bridge
04.08b	Cogon Bridge
05.02	Patitinan Bridge
06.02	Cataan Bridge
07.03	Campanga Bridge
07.04	Camachiles Bridge
07.05	Lagnason Bridge
08.01	Poray Baridge
08.02	Iba Bridge
09.01	Batungal Bridge
09.02	Mangop Bridge
09.03	Canawan Bridge
09.04	Piangon Bridge
10.05	Malubog Bridge
11.01	Lambunao Bridge
11.03	Calabanit Bridge
Total	17 Bridges

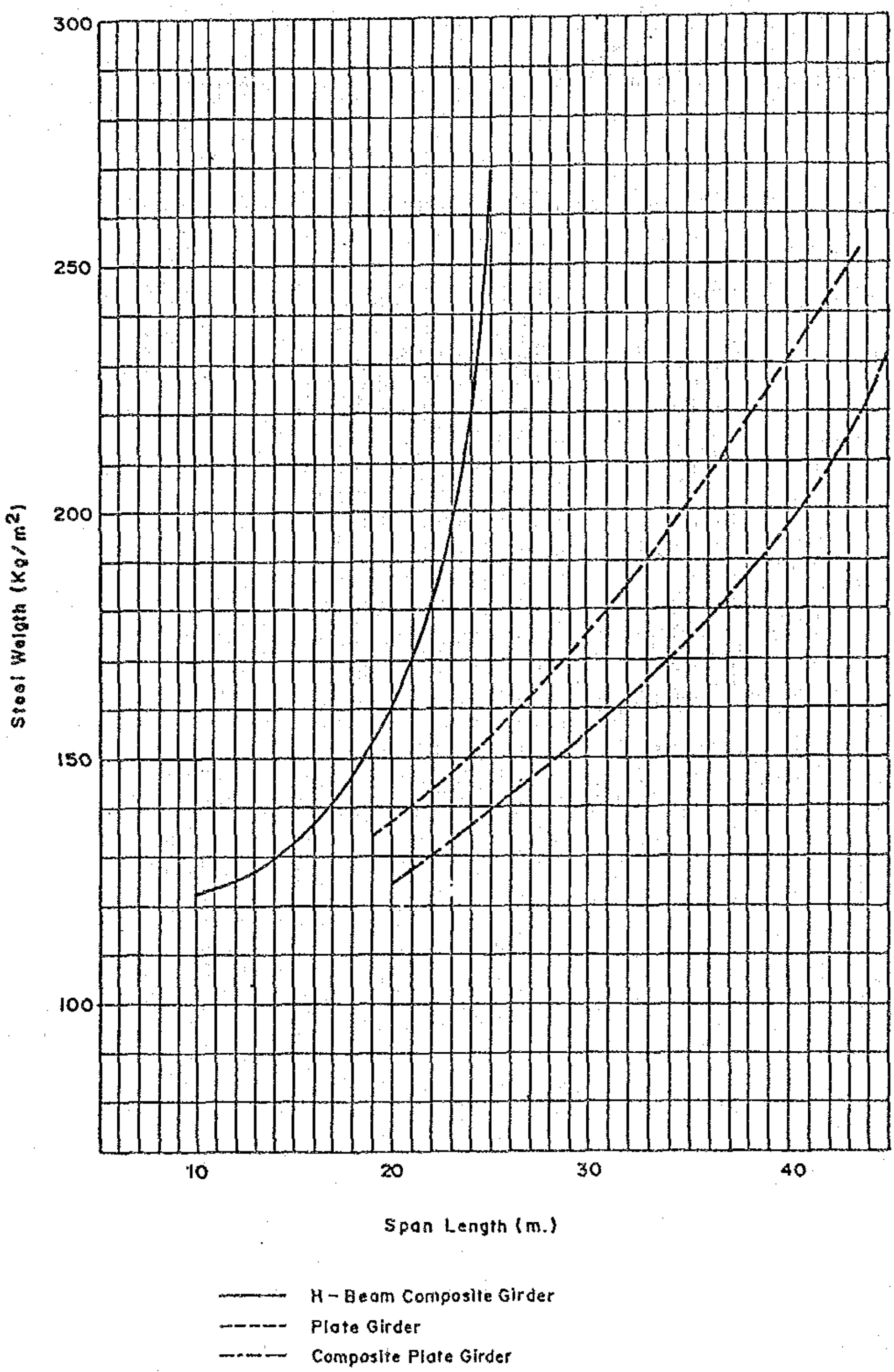


FIGURE 5.2-1 Steel Weight

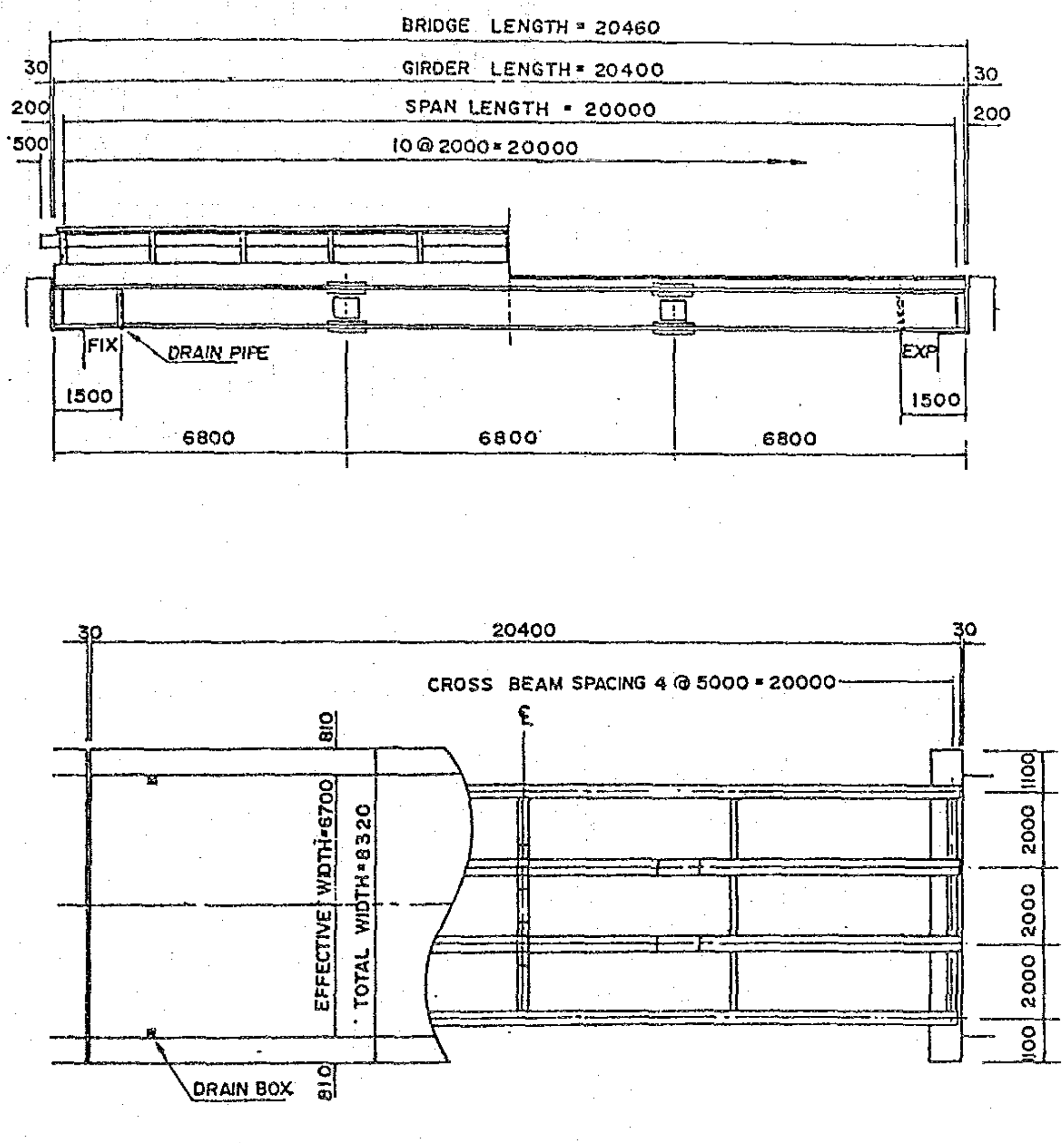
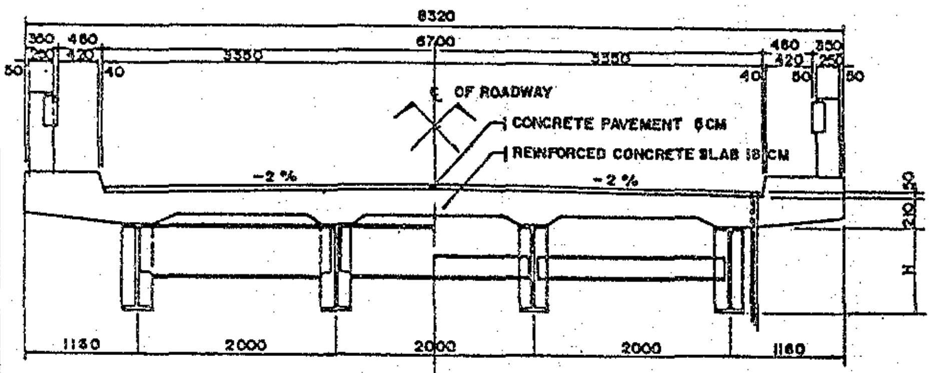
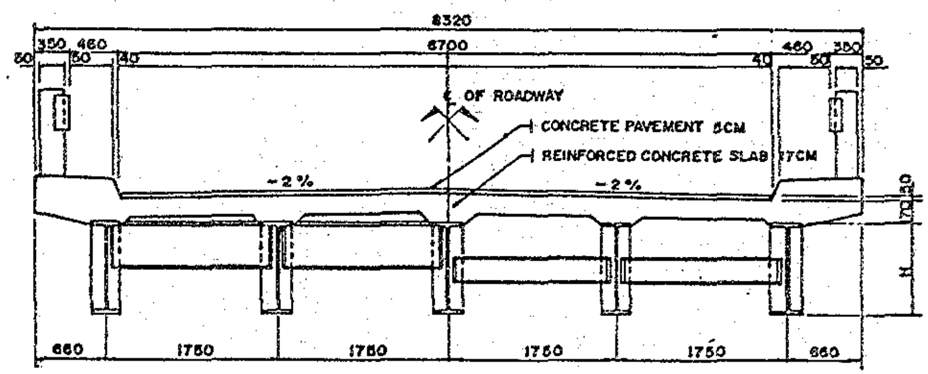


FIGURE 5.2-2 TYPICAL GENERAL VIEW OF BRIDGE



SPAN LENGTH 12m, 16m, 17m, 18m, 19m, 20m, 21m, 22m, 23m



SPAN LENGTH 25 m

DESIGN CRITERIA :

1. TYPES OF BRIDGES
   SIMPLY SUPPORTED COMPOSITE
   H-BEAM BRIDGES
2. LIVELOAD
   AASHTO HS 20-44 (LMS 18)
3. QUALITY OF STEEL GIRDER
   ·SM 50 TA (JIS)

MAIN DIMENSIONS

SPAN LENGTH	NO. OF GIRDER	H	SECTION OF GIRDER	THICKNESS OF SLAB
12	4	700	700X300X13X24	180
16	4	700	700X300X13X24	180
17	4	700	700X300X13X24	180
18	4	792	792X300X14X22	180
19	4	800	800X300X14X26	180
20	4	890	890X299X15X23	180
21	4	900	900X300X16X28	180
22	4	900	900X300X16X28	180
23	4	912	912X300X18X24	180
25	5	900	900X300X16X28	170

FIGURE 5.2.3 TYPICAL CROSS SECTION OF SUPERSTRUCTURE

5.3 Design of Substructures

The DPWH is responsible for the detailed design of substructures, bridge approaches and other structures with technical advice from the Japanese Consultants.

5.3.1 Design Criteria

The design criteria to be adopted for designing of substructures are recommended as follows:

Design Specification:	AASHTO Standard Specifications for Highway Bridges (13th Edition, 1983)
Earthquake Load:	C = 0.12 with Reference to Relevant AASHTO Provisions

Concrete Strength at 28 days:

For Superstructures	$f'c = 300\ kg/cm^2$
For Substructures	$f'c = 210\ kg/cm^2$
For Railings	$f'c = 130\ kg/cm^2$

Reinforcing Steel; $fy = 2100\ kg/cm^2$

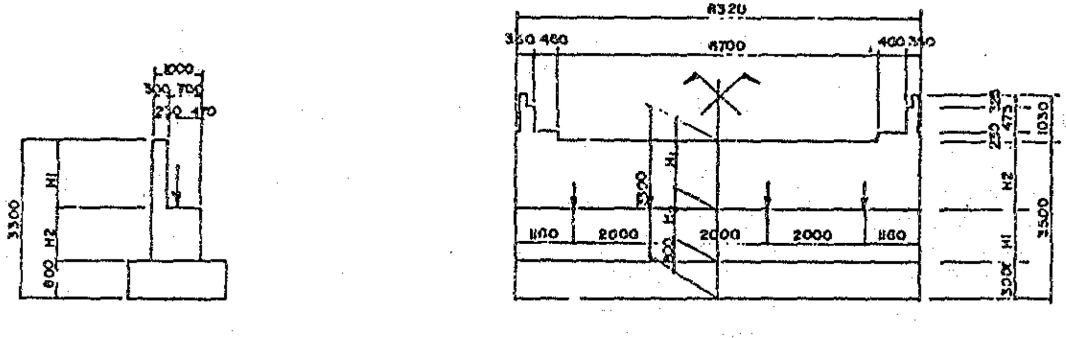
5.3.2 Types of Substructures

The types of substructures adopted for Phase I Bridges are T-type abutments and wall type piers, either spread footings or pile foundations.

T-type abutments on pile foundations are strongly recommended to have at least two (2) lines of piles in order to avoid tilting of abutments and scouring of embankment behind abutments.

The recommended standard types of abutments and piers, both for spread footings and pile foundations, are shown in Figure 5.3-1 and 5.3-2, respectively.

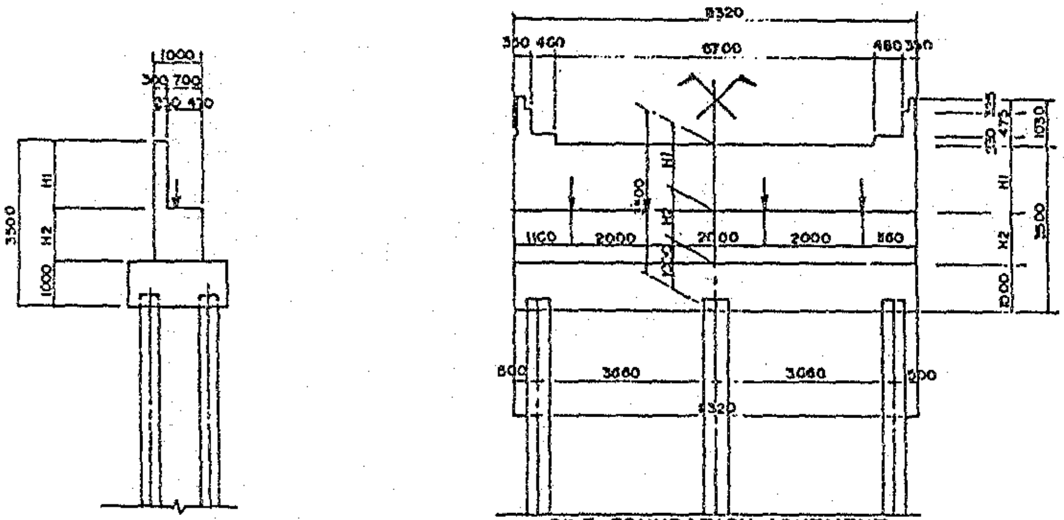
For the convenience of structural design, 48 abutments and 12 piers were grouped into 14 cases, as shown in Table 5.3-1.



SPREAD FOOTING ABUTMENT

TABLE OF DIMENSION

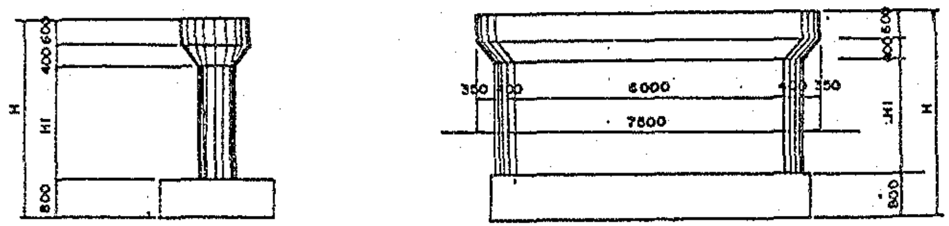
SPAN LENGTH (M)	H1 (M)	H2 (M)	REMARKS
12.0 ~ 17.0	1.220	1.28	12.0 16.0 17.0
18.0 ~ 19.0	1.320	1.18	18.0 19.0
20.0 ~ 25.0	1.420	1.02	20.0 21.0 22.0 23.0 24.0 25.0



PILE FOUNDATION ABUTMENT

FIGURE 5.3-1 STANDARD TYPE OF ABUTMENT

SPREAD FOOTING PIER



PILE FOUDATION PIER

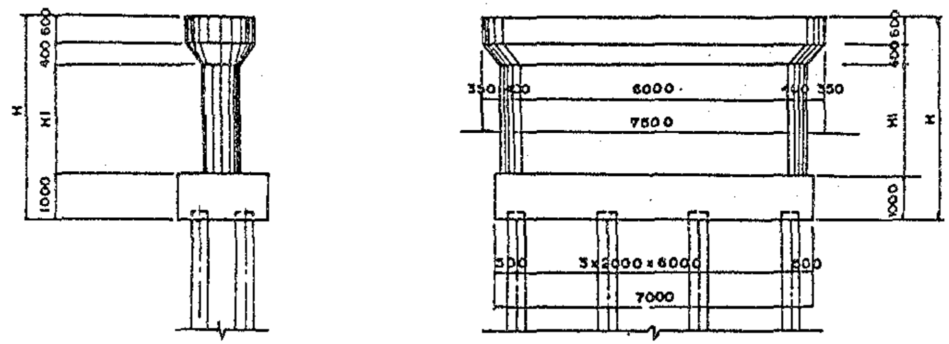


TABLE OF DIMENSION

BRIDGE NO.	H (M)	HI (M)	TYPE OF FOUN
02.03	5.0 m	3.0 m	P
02.04	6.5 m	4.5 m	P
06.02	10.5 m	8.5 m	P
06.04	9.0 m	7.0 m	P
07.04	4.5 m	2.5 m	P
07.05	4.5 m	2.5 m	P
09.02	4.5 m	2.5 m	P
09 03	9.0 m	7.0 m	P
09.04	5.5 m	3.5 m	P
11.01	5.0 m	3.0 m	P
11.03	5.0 m	3.0 m	P
12.03	12.5 m	10.7 m	S

P: PILE
S: SPREAT

FIGURE 5.3-2 STANDARD TYPE OF PIER

TABLE 5.3-1 TYPICAL TYPES OF SUBSTRUCTURES

Abutments on Spread Footings	No. of Substructures
Type 1 (L = 20 - 25 m, h = 3.3 m, Fix)	6
Type 2 (L = 20 - 25 m, h = 3.3 m, Exp)	4
Abutments on Pile Foundations	
Type 3 (L = 20 - 25 m, h = 3.5 m, Fix)	18
Type 4 (L = 20 - 25 m, h = 3.5 m, Exp)	6
Type 5 (L = 18, 19 m, h = 3.5 Fix)	8
Type 6 (L = less than 17 m, h = 3.5 m, Fix)	4
Type 7 (L = less than 17 m, h = 3.5 Exp)	2
T o t a l	48 Abutments
Piers on Spread Footings	
Type 1 (L = 25 m, h = 12.5 m, Exp + Exp)	1
Piers on Pile Foundations	
Type 2 (1 = 17, 18, 19 m, h = 4.5 m, Exp + Exp)	3
Type 3 (1 = 19, 20, 23 m, h = 5.0 m, Exp + Exp)	3
Type 4 (1 = 20 m, h = 5.5 m, Exp + Exp)	1
Type 5 (1 = 25 m, h = 6.5 m, Exp + Exp)	1
Type 6 (1 = 19, 21 m, h = 9.0 m, Exp + Exp)	2
Type 7 (1 = 20 m, h = 10.5 m Exp + Exp)	1
T o t a l	12 Piers

5.4 Design of Pavement Structures

5.4.1 Design Criteria

- Design Specification: AASHTO Guide for Design of Pavement Structure 1986, AASHTO

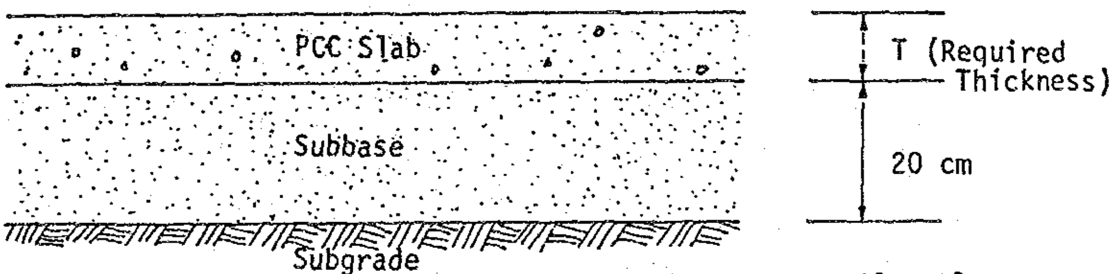
- Serviceability of PCC Pavement: Initial 4.5
  Terminal 2.5

- Pavement Layer Characteristics:
  Modulus of Subbase: 8000 psi
  Modulus of Elasticity of PCC:328 x 10^6 psi

- PCC Modulus of Rupture: 580 psi
- Drainage Coefficient: 0.9
- Load Transfer Coefficient: 4
- Loss of Support: 1

5.4.2 Types of Pavement

Since the length of roads to be constructed under the Project seems to be short, Portland Cement Concerete (PCC) pavement is recommended, as shown in Figure 5.4-1.



(When subgrade is weak, filter layer method/soil replacement method/soil stabilization method shall be employed.)

FIGURE 5.4-1 TYPICAL CROSS SECTION OF PCC PAVEMENT

The required thickness of PCC slab shall be designed to carry the expected number of traffic volumes and loadings. Table 5.4-1 summarizes the recommendation based on the outputs of the Feasibility Study of the Road Improvement on the Pan-Philippine Highway conducted by JICA on September 1987.

TABLE 5.4-1 RECOMMENDED THICKNESS BY PCC SLAB

<table>
<tr><td colspan="2"></td><td colspan="8"></td><td>PCC Thickness</td></tr>
<tr><td colspan="2">CBR / Traffic Loading Class ($x10^6$)</td><td>2</td><td>3</td><td>4</td><td>6</td><td>8</td><td>10</td><td>15</td><td>20</td><td>Performance Period</td></tr>
<tr><td rowspan="3">Light Traffic Loading</td><td>L-1 (0.005)</td><td colspan="8" rowspan="3">Apply Min. Thickness 20 cm.</td><td rowspan="3">More Than 25 Years</td></tr>
<tr><td>L-2 (0.01)</td></tr>
<tr><td>L-3 (0.03)</td></tr>
<tr><td rowspan="5">Heavy Traffic Loading</td><td>A (0.1)</td><td colspan="8">23</td><td rowspan="5">15 Years</td></tr>
<tr><td>B (0.2)</td><td colspan="3">25</td><td colspan="5"></td></tr>
<tr><td>C (0.4)</td><td colspan="3">28</td><td colspan="5">25</td></tr>
<tr><td>D (0.7)</td><td colspan="3"></td><td colspan="5">28</td></tr>
<tr><td>E (1.0)</td><td colspan="8">30</td></tr>
<tr><td>Extra Heavy Traffic Loading</td><td>F-d (1.5-3.5)</td><td colspan="8">30 or 33 or 35 1/</td><td>5 - 12 years</td></tr>
</table>

NOTE: Traffic loading class is expressed in number of ESAL (18-kip equivalent single axle loads)

5.5 Design of River Protection

5.5.1 Required Area of River Openings

River openings shall be provided with enough area to drain the peak discharge of flood at the bridge sites.

The peak discharge of flood is estimated using the Rational Formula:

$$Qp = \frac{1}{3.6} \cdot f \cdot r \cdot A = 2.843\ R_{24}$$

Where:

Qp = Peak discharge of flood (m^3/s)
f = Coefficient of discharge. Refer to Table 5.5-1
r = Average intensity of rainfall within arrival time of flood (mm/h), expressed with the following formula:

$$r = \frac{R24}{24} \left(\frac{24}{T}\right)^{2/3} = 0.0853\ R24$$

$R24$ = Intensity of daily rainfall (mm)

T = Arrival time of flood (h), expressed with the following formula.

$$T = \frac{L}{72 \left(\frac{H}{L}\right)^{0.6}}$$

H = Difference in elevation, between the highest point in the catchment area and the point in consideration, where the flood discharge is to be calculated.(Km)

L = Length of the river, between above two points (Km)

A = Area of basin (Km_2)

TABLE 5.5-1 COEFFICIENT OF DISCHARGE

Conditions in the Basin under Question	Value of f, Coefficient of Discharge
Steep Mountain Area	0.75 - 0.90
Mountain Hill of the Tertiary Period	0.70 - 0.80
Hilly Land and Forested Area	0.50 - 0.75
Flat and Cultivated Land	0.45 - 0.60
Paddy Field when Being Irrigated	0.70 - 0.80
Rivers in Mountain Area	0.75 - 0.85
Small Brooks in Flat Area	0.45 - 0.75
Large River, more than Half of which Basic is flat	0.50 - 0.75

The required area of river opening is analyzed using the Manning's Formula:

$$V = \frac{1}{n} \cdot R^{2/3} \cdot i^{1/2}$$

Where:

V = Velocity of water
n = Coefficient of roughness
i = Hydraulic gradient
R = Hydraulic radius (=Ar/P)
Ar = Area of running water
p = Wetted perimeter

$$Ar = Qp/v$$

Where:

A = Required area of river opening
Q = Peak discharge of flood
V = Mean velocity of stream

5.5.2 Type of River Bank Protection

The construction of river bank protection at the front of abutments is highly recommended, especially when the velocity of water is over 3 m per second or when erosion and scouring are anticipated.

Considering the availability of local materials, grouted riprap protection is adopted for the Project. Grouted riprap is not expected as a structure to prevent soil embankment from failure and therefore must be placed at a slope equal to or flatter than the natural angle of response of the supporting soil. In design, the slope of 1.5:1 is proposed.

The grouted riprap foundations must be extended to bedrock or below the scour depth anticipated. Figure 5.5-1 shows a typical cross section of grouted riprap.

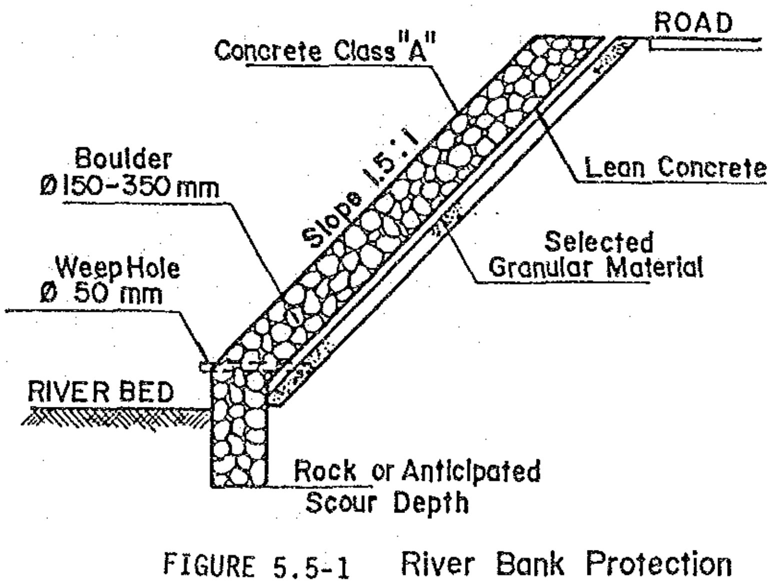


FIGURE 5.5-1 River Bank Protection

5.6 Erection of Steel Girders

Based on data furnished by the DPWH, the erection methods of steel girders were studied. The estimated maximum weight of one piece of steel girder is 3 tons and the maximum length is 8.5m.

Figure 5.6-1 demonstrates the direct erection method (1) from river bed using a 22.5-ton crawler crane. This is the most simple method and recommended wherever the crawler crane can go down onto the river bed.

Figure 5.6-2 shows the direct erection method (2) from the approaching road. This method requires a crawler crane of 40-ton capacity. Therefore, this method is recommended only where crawler crane cannot go down onto the river bed.

Figure 5.6-3 illustrates the towing-cable erection method. This method does not require any crawler crane of large capacity and bent inside river pole, but shifting devices, jacks, rails, cariers, etc. are required. Therefore, this is a relatively expensive method.

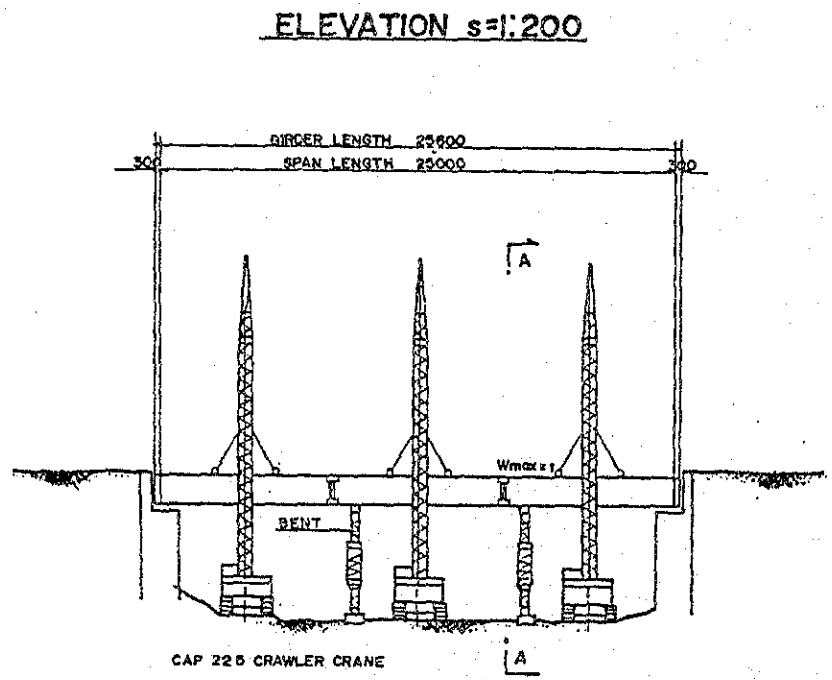
Figure 5.6-4 illustrates the launching erection method which requires an erection nose made of steel girder. Therefore, this method are not recommended. It is only recommended when the direct erection method (2) cannot be applied.

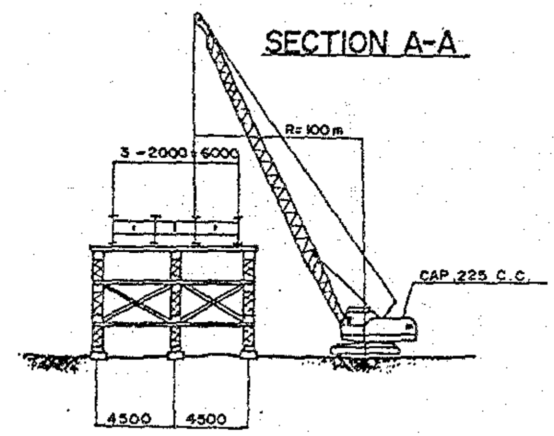
Based on the characteristics of each erection method, erection method were tentatively proposed as shown in Table 5.6-1.

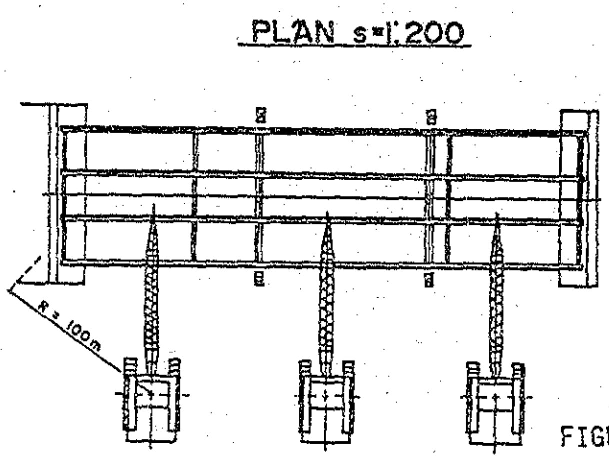
TABLE 5.6-1 PROPOSED ERECTION METHOD

Bridge No.	Name	Span (m)	Erection Device	Type*
02.03	Baan Bridge	23 + 23	Crawler Crane and Bent	1
02.04	Diora Bridge	25 + 25	- do -	1
04.07b	Dipulas Bridge	25 (skew)	- do -	2
04.08b	Cogon Bridge	23	- do -	2
05.02	Patitinan Bridge	20	- do -	1
06.02	Cataan Bridge	20 + 20	- do -	1
06.04	Guintas Bridge	21 + 21	- do -	1
07.03	Campanga Bridge	12	Crawler Crane only	1
07.04	Camachiles Bridge	18 + 18	Crawler Crane and Bent	1
07.05	Lagnason Bridge	19 + 19	- do -	1
08.01	Poray Bridge	22	- do -	1
08.02	Iba Bridge	23	Erection Pole	2or3
08.05	Pinucawanan Bridge	16	Crawler Crane only	2
09.01	Batungal Bridge	23	Crawler Crane and Bent	1
09.02	Mangop Bridge	17 + 17	- do -	1
09.03	Canawan Bridge	19 + 19	- do -	1
09.04	Piangon Bridge	20 + 20	- do -	1
10.02	Maradugas Bridge	25	Erection Pole	2or3
10.03	Maundo Bridge	22	Crawler Crane and Bent	1
10.04	Sta. Irene Bridge	22	- do -	2
10.05	Malubog Bridge	25	- do -	1
11.01	Lambunao Bridge	19 + 19	- do -	1
11.03	Calabanit Bridge	20 + 20	- do -	1
12.03	Upian Bridge	25 + 20	- do -	2

* Type 1: Direct Erection Method 1 (22.5 t Crawler Crane)
Type 2: Direct Erection Method 2 (40 t Crawler Crane)
Type 3: Launching Erection Method





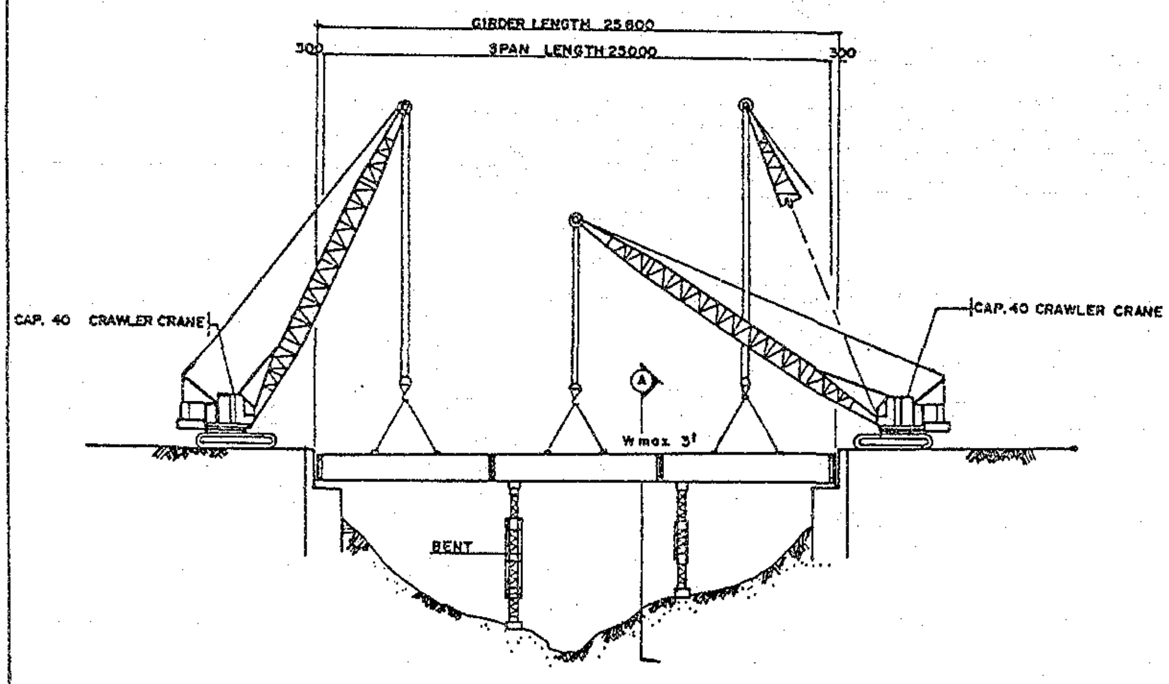


MAIN MACHINE / TOOL

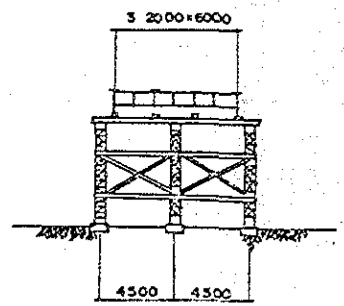
1	CRAWLER CRANE 22.5T	1
2	BENT	2
3	STEEL BLOCK	some
4.	TORQUE WRENCH	1
5	WIRE ROPE 16 ∅	1

FIGURE 5.6-1 **DIRECT ERECTION METHOD (I)**

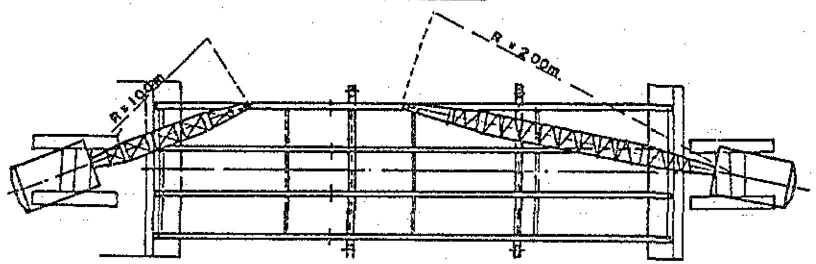
ELEVATION s=1:200



SECTION A-A



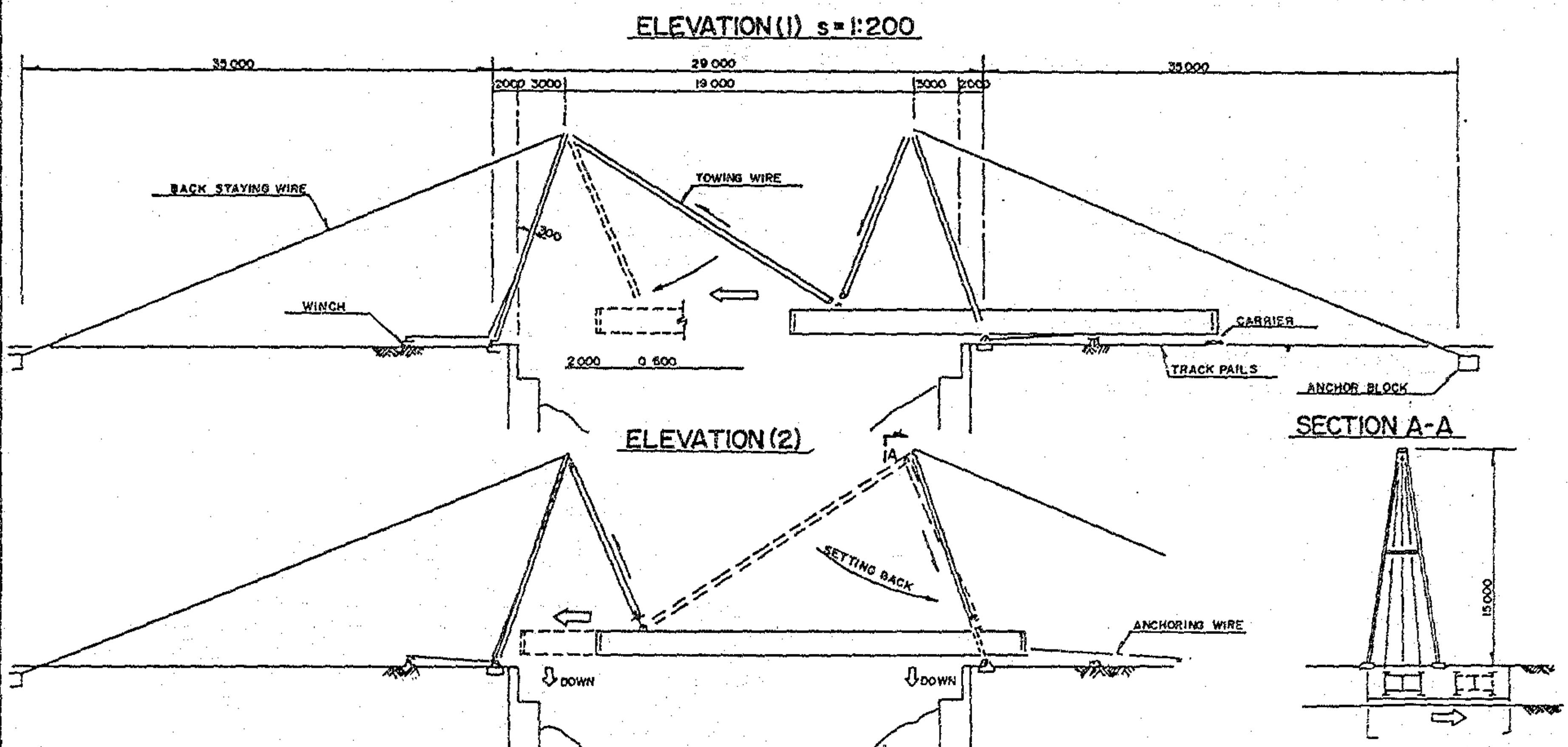
PLAN s=1:200

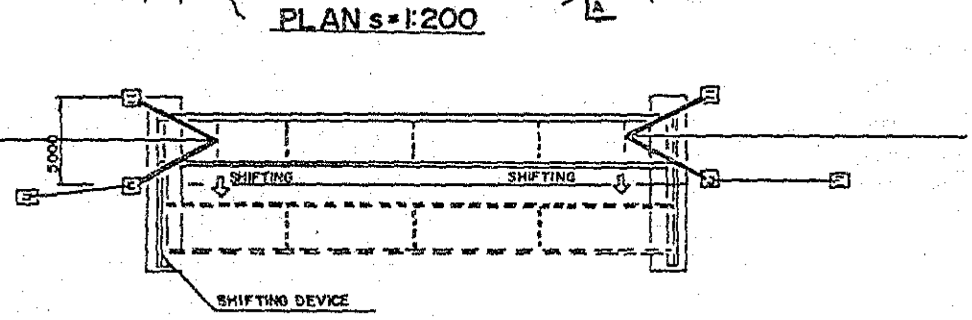


DIRECT ERECTION METHOD (2)

1	CRAWLER CRANE 40T	1
2	BENT	2
3	STEEL BLOCK	SAME
4	TORQUE WRENCH	1
5	WIRE ROPE 16φ	1

FIGURE 5.6-2 **DIRECT ERECTION METHOD (2)**



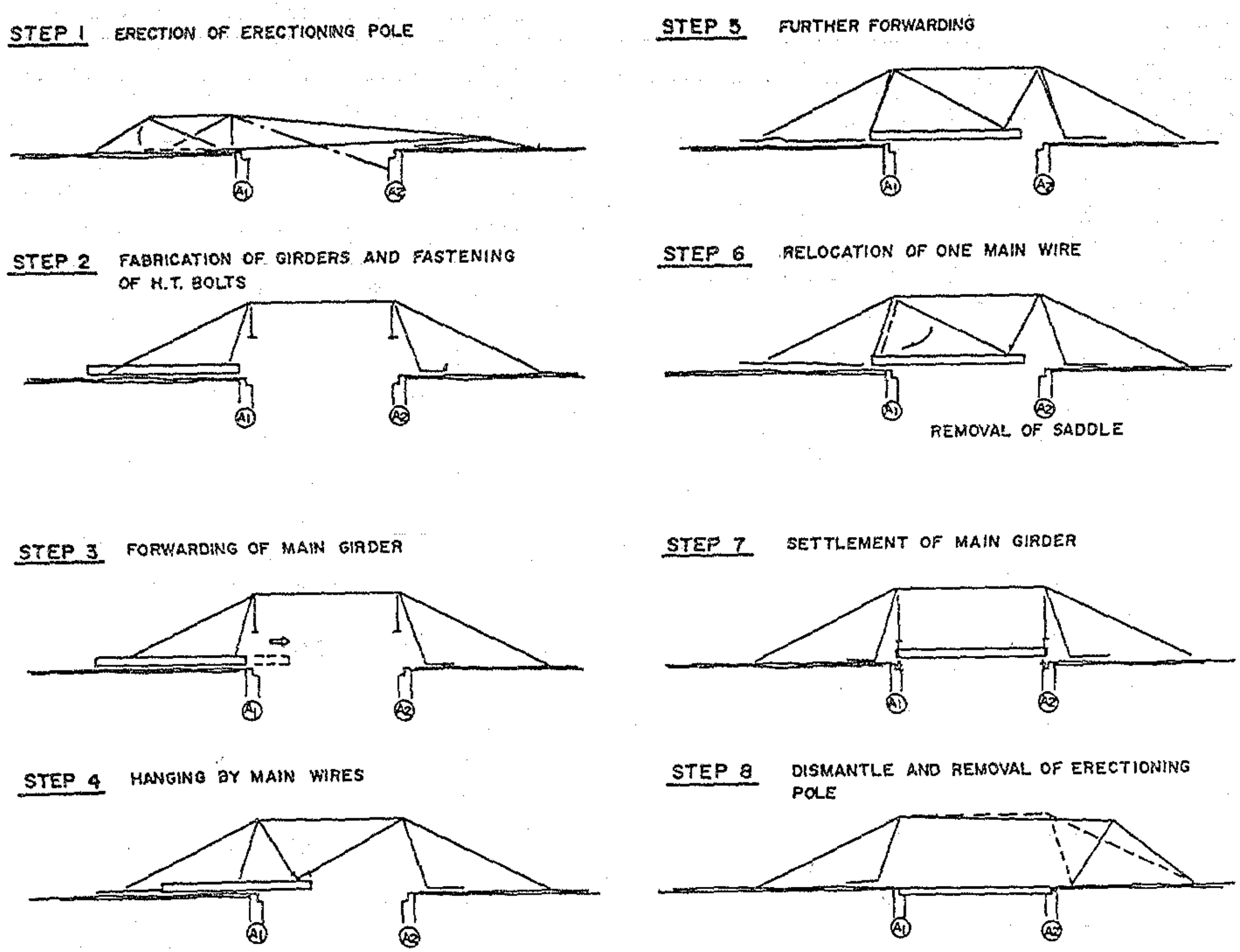


MAIN MACHINE/TOOL

1	ERECTION POLE	2
2.	SHIFTING DEVICE	2
3.	WINCH 3T & WIRE	4
4	JACK 10T	4
5.	TRUCK CRANE 3T	2
6	GENERATOR 23 KVA	2
7	TORQUE WRENCH	1
8	RAIL (37kg) & SLEEPER	
9	CARRIER	2

FIGURE 5.6-3(1) **TOWING-CABLE METHOD**

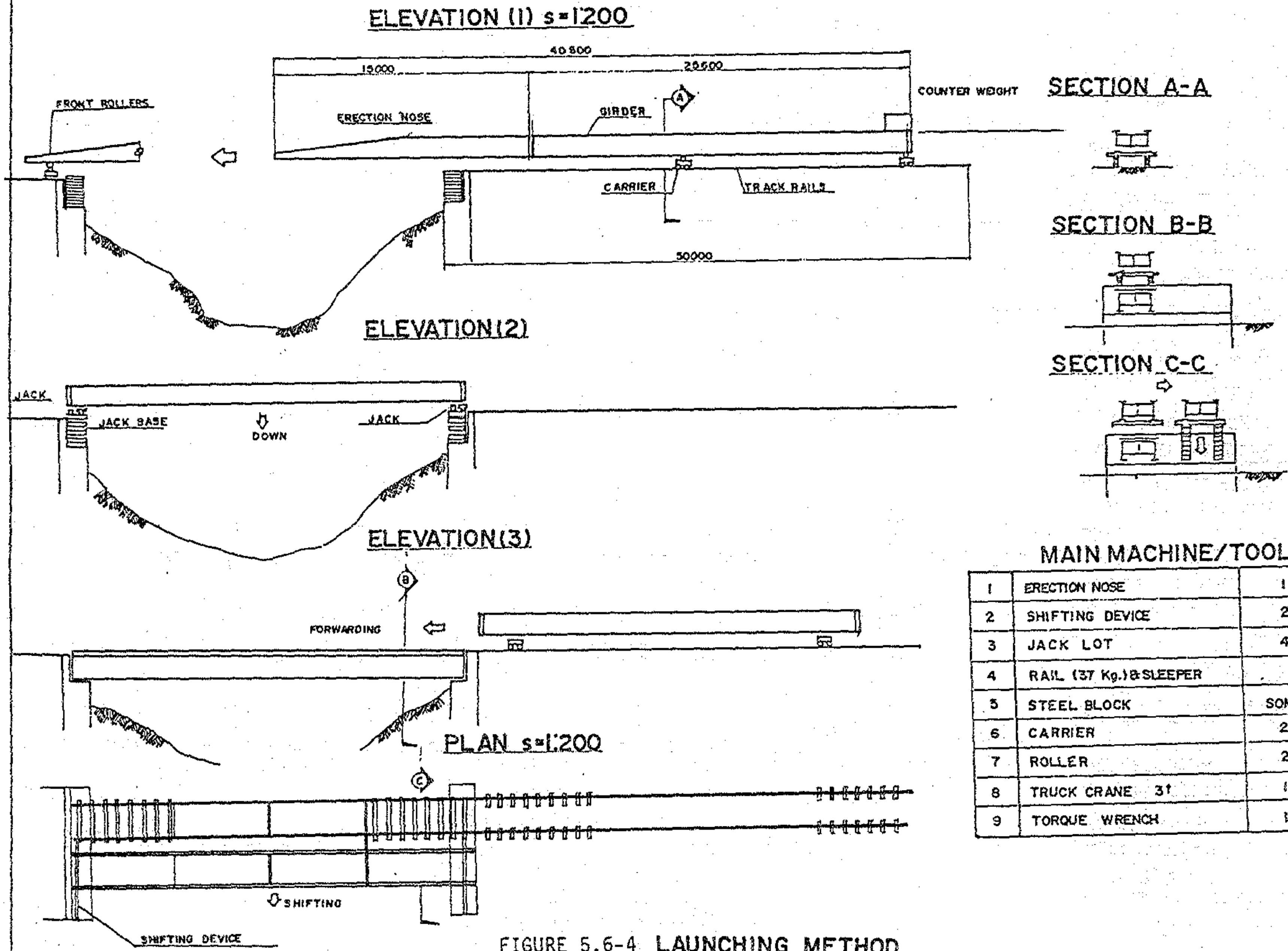
PROCEDURE DIAGRAM



FLOW CHART

PREPARATION OF FOUNDATION FOR ERECTIONING POLE. PREPATION OF ANCHORAGE FOR BRACING WIRE.
↓
FABRICATION OF ERECTIONING POLE ON THE GROUND SURFACE.
↓
PREPATION AND FIXING OF WINCH.
↓
PREPARATION OF WOODEN SHEAR LEGS FOR ERECTION OF ERECTIONING POLE.
↓
WIRING AND FIXING OF MAIN WIRE.
↓
ERECTION OF ERECTIONING POLE.
↓
PREPARATION OF RAILING AND ROLLER.
↓
FABRICATION OF GIRDERS AND FASTENING OF HIGH STRENGTH BOLTS.
↓
TEMPORAL ARRANGEMENT BEARING SHOE.
↓
PREPARATION OF SIDE SLIDING UNIT (FOR 4 MAIN GIRDER BRIDGE ONLY.
↓
PREPARATION OF SADDLE ON THE ABUTMENTS.
↓
FORWARDING OF MAIN GIRDER.
↓
HANGING BY MAIN WIRES, FURTHER FORWARDING, RELOCATION OF ONE WIRE, FINAL LOCATING.
↓
REMOVAL OF SADDLE ON THE ABUTMENTS.
↓
SIDE SLIDING OF MAIN GIRDER. (FOR 4 GIRDER BRIDGE ONLY.
↓
FIXING OF CROSS BEAMS.
↓
DISMANTLING OF SIDE SLIDING UNIT (FOR 4 GIRDER BRIDGE ONLY)
↓
PREPARATION OF SHEAR LEGS FOR LAYING DOWN OF ERECTIONING POLE.
↓
LAYING DOWN, DISMANTLE AND REMOVAL OF ERECTIONING POLE.
↓

FIGURE 5.6-3(2) **TOWING - CABLE METHOD**



MAIN MACHINE/TOOL

1	ERECTION NOSE	1
2	SHIFTING DEVICE	2
3	JACK LOT	4
4	RAIL (37 Kg.) & SLEEPER	.
5	STEEL BLOCK	SOME
6	CARRIER	2
7	ROLLER	2
8	TRUCK CRANE 3t	1
9	TORQUE WRENCH	1

FIGURE 5.6-4 LAUNCHING METHOD

5.7 Shipment of Steel Materials

The steel materials provided under the Japan Grant Aid will be delivered from Japan to the designated ports of entry in the Philippines.

After discussions with the DPWH officials, the following six (6) ports were designated for the Project:

- Manila South Harbor/Manila International Container Terminal
- Iloilo
- Tacloban
- Cagayan de Oro
- Davao (SASA)
- Cebu

The port facilities of the six (6) ports are presented in Table 5.7-1.

TABLE 5.7-1 FACILITIES OF PORTS

ITEM \ Name of Port	Manila South Harbor	Manila International Container Terminal	Iloilo	Tacloban	Cagayan De Oro	Davao (SASA)	Cebu
1. Port Facility							
a. Max. Size of Vessel							
. Overall length	Max. 245 m. Ave. 128 m.	Max. 204 m. Ave. 163 m.	Max. 164 m. Ave. 93 m.	Max. 157 m. AVe. 128 m.	Max. 188 m. Ave. 130 m.	Max. 195 m. Ave. 128 m.	Max. 190 m Ave. 125 m
. Breadth	Max. 50 m. Ave. 18.5 m.	Max. 30 m. Ave. 24 m.	Max. 21 m. Ave. 14 m.	Max. 23 m. Ave. 18 m.	-	Max. 30 m. Ave. 19 m.	Max. 32 m Ave. 19 m
. Draft	Max. 16 m. Ave. 6.3 m.	Max. 11 m. Ave. 7.4 m.	Max. 10 m. Ave. 5 m.	Max. 8 m. Ave. 3.5 m.	Max. 8 m. Ave. 5 m.	- Ave. 9 m.	Max. 9 m Ave. 5 m
. Dead Weight Gross Ton	9,838 tons	13,428 tons	8,322 tons	10,174 tons	8,392 tons	12,658 tons	8,150 tons
b. Berth Facilities and Number							
. Length	4,200 m.	900 m.	3,500 m.	680 m.	890 m.	920 m.	4,174 m.
. Type	Pier Type	Wharf Type	Wharf Type	Wharf Type	Wharf Type	Wharf Type	Pier/Wharf
c. Cargo Handling by Barge							
. Anchorage Place	Outside and inside breakwater	Outside and inside breakwater					
. Capacity of Barge	27 vessels	27 vessels					
. Number of Barge	231	231					
d. Shore Facilities							
. Type	Tango Gantry Crane, Roro facilities	Tango Gantry Crane, Roro facilities			Level Luffing		Level Luffing
. Number	4	4					
e. Condition of Discharge Area							
. Shed	2,875 - 4,056 m^2		2,596 m^2	1,728 m^2	4,800 m^2		6,264 m^2
. Outdoor Storage Space							
Apron Space			17,882 m^2	7,480 m^2	15,232 m^2	69,000 m^2	342,128 m^2
Lights	Available	Available					
Security for Storage	Available	Available	Available	Available	Available	Available	Available
f. Maximum Cargo Size and Weight							
. Weight	3,983,480 M.T.	1,114,632 M.T.	108,483 M.T.		105,272 M.T.	625,204 M.T.	204,215 M.T.

CHAPTER 6

IMPLEMENTING ARRANGEMENT

CHAPTER 6

IMPLEMENTING ARRANGEMENT

6.1 Executing Agency and Organization

The Department of Public Works and Highways (DPWH) is the executing agency of the Project for Constructing Bridges along Rural Roads.

The DPWH is headed by the Secretary who is assisted by five (5) Undersecretaries and six (6) Assistant Secretaries. In the Department proper, there are six (6) Service Offices - Planning, Controllership and Financial Management, Administrative and Manpower Development, Legal, Monitoring and Information, and Internal Audit; and five (5) Bureaus - Design, Construction, Maintenance, Equipment, and Research and Standards. Refer to Figure 6.1-1: Organization of the DPWH.

The five (5) Bureaus have the following major functions:

- Bureau of Design ------- undertakes project development, engineering surveys, and designs of infrastructure facilities.
- Bureau of Construction -- provides technical services for the construction, rehabilitation, betterment and improvement of infrastructure facilities.
- Bureau of Maintenance --- provides technical services and supervision on the maintenance and repair of roads and bridges and other associated structures.
- Bureau of Equipment ----- manages all Government construction and maintenance of equipment, including procurement and dispersement to the regions.
- Bureau of Reserach and Standards -- provides research and technical services on quality control and on the management of materials, plants and ancillary facilities for the production and processing of construction and maintenance materials.

At the regional level where the infrastructure projects are implemented, the DPWH has 14 Regional Offices each headed by a Regional Director. In addition, there are 92 District Offices and 59 City Engineering Offices, Regional Equipment Centers and Workshops. The latter are under the supervision of the Regional Director concerned. These offices serve as the implementing arms of the DPWH. Locations of Regional Offices are shown in Table 6.1-1. The organization of a Regional Office is shown in Figure 6.1-2.

Figure 6.1-1 ORGANIZATION CHART

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS

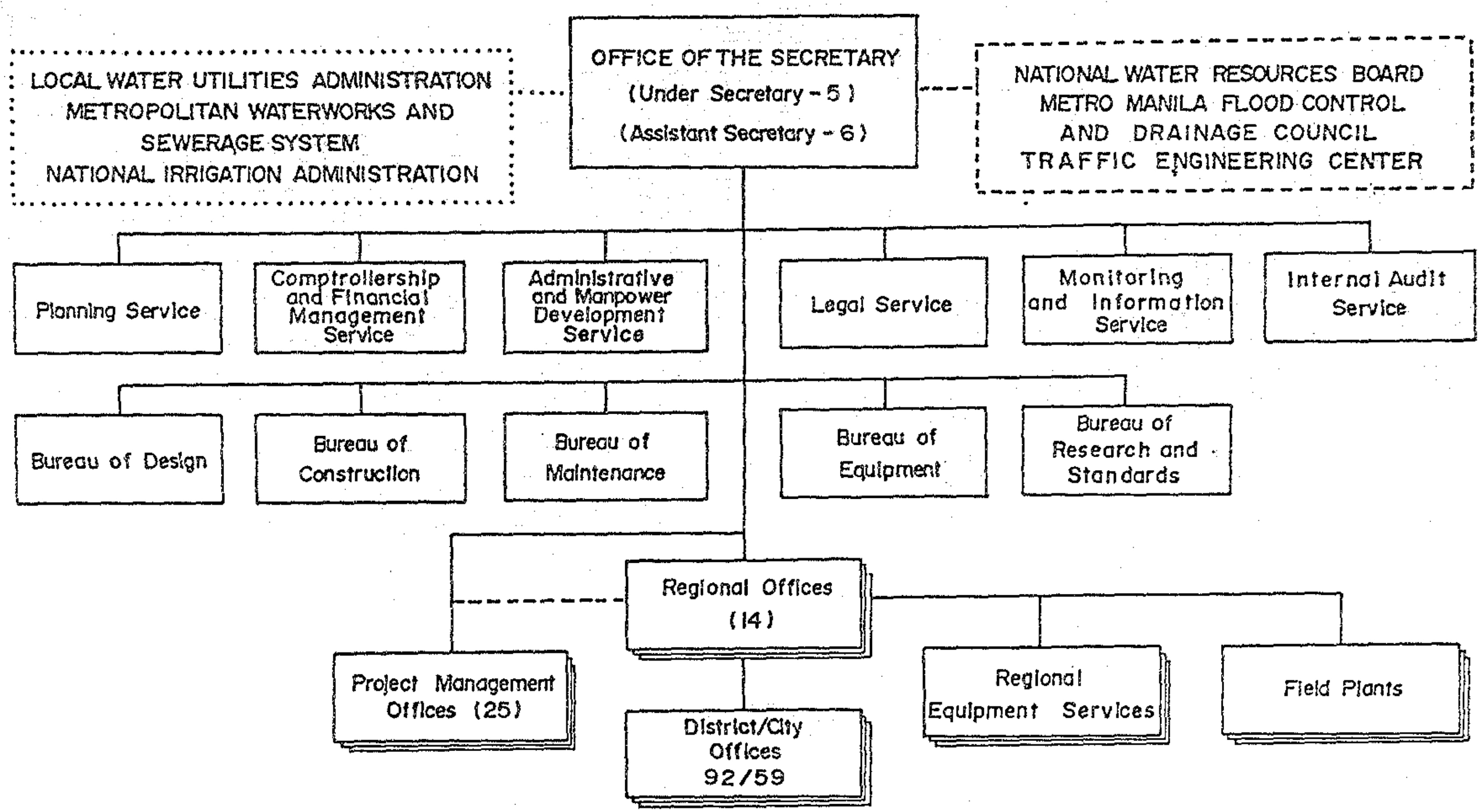


Figure 6.1-2 ORGANIZATIONAL CHART
OFFICE OF THE REGIONAL DIRECTOR

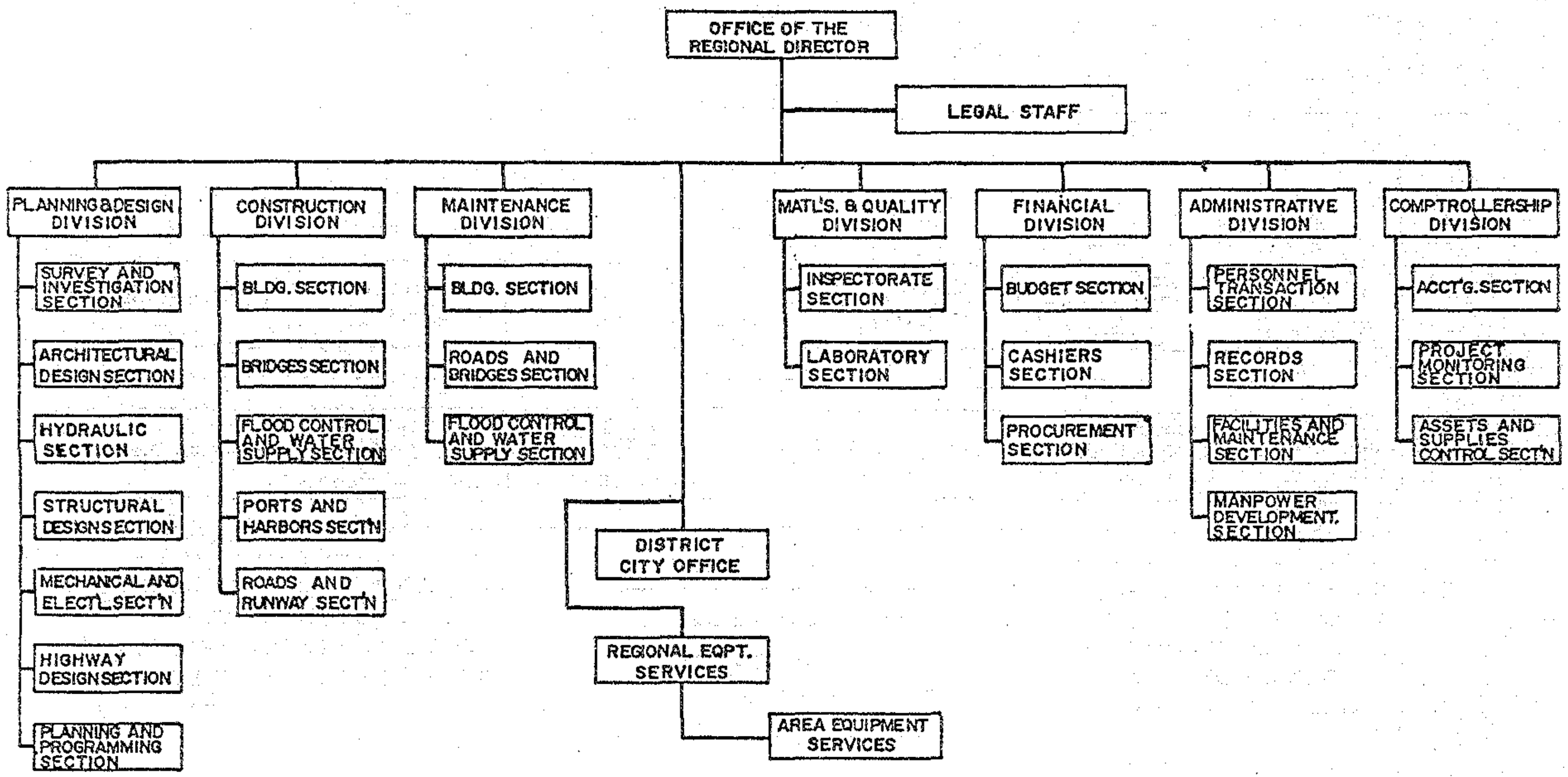


Table 6.1-1 Location of Regional Offices

	Region	Location
1	Region I	San Fernando, LA UNION
2	Region II	Tuguegarao, CAGAYAN
3	Region III	San Fernando,PAMPANGA
4	Region IV-A	Quezon City, METRO MANILA
5	Region IV-B	Quezon City, METRO MANILA
6	Region V	Legaspi City, ALBAY
7	Region VI	Ioilo City, CAPIZ
8	Region VII	Cebu City, CEBU
9	Region VIII	Palo, LEYTE
10	Region IX	Zamboanga City, ZAMBOANGA DEL SUR
11	Region X	Cagayan de Oro Cituy, MISAMIS ORIENTAL
12	Region XI	Davao City, DAVAO
13	Region XII	Cotabato City, MAGUINDANAO
14	NCR	2nd Street, Port Area, Manila