CHAPTER 2

BACKGROUND OF THE PROJECT

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2.1 Background of the Project

The Government of the Philippines established the "Medium-Term Philippine Development Plan, 1987-1992" on January 1987, which aimed to enlarge and reinforce the physical foundation of the economy to support the overall development thrust of sustained economic growth and social justice. This development plan considers on the establishment and improvement of essential transport facilities in rural areas to increase activities for greater production and to include direct development therein.

However, there are many old and temporary wooden bridges which are often closed to traffic especially during rainy season. This situation constrains the economic development in rural areas since such bridges diminish the function of roads.

Therefore, the immediate 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 rural areas.

On August 1987, the Government of the Philippines requested reconstruction of 58 selected bridges in all regions to the Government of Japan. In response to this request, the Government of Japan entrusted Japan International Cooperation Agency, to conduct the basic design study on Constructing Bridges along Rural Roads on November 1987 for Phase I and February 1988 for Phase II.

As a result of the basic studies, the Government of Japan decided to provide the steel materials of superstructure for 24 bridges under "The Project for Constructing Bridges along Rural Roads Phase I" on April 1988, and to construct 10 bridges under "The Project for Constructing Bridges along Rural Roads Phase II" on October 1988, under Japan's Grant Aid.

Based on the results of the said Phase I and Phase II projects, the Government of the Philippines formulated "FIVE YEAR COMPREHENSIVE BRIDGE RECONSTRUCTION PROGRAM ALONG SECONDARY ROADS" in 1989. "The Project for Constructing Bridges along Rural Roads Phase III" was requested to the Government of Japan as the first year program in the Regions III, IV-A, IV-B and one part of Region I for Japan's Grant Aid which are under implementation.

Under the above background, the Government of the Philippines requested the assistance of Japan's Grant Aid for constructing bridges along rural roads in the Regions V, VI, VII and VIII. In response to this request, the Government of Japan decided to conduct a basic design study on The Project for Constructing Bridges along Rural Roads (Phase IV) (hereinafter referred to as the Project) and entrusted the study to the JICA.

The Project, a continuation of the Phase I, II and III Study, aims to improve essential transport facilities in rural areas securing transportation in areas which are often isolated during the rainy season, by replacing old temporary and dilapidated bridges along rural roads with permanent steel structures.

2.2 Outline of the Request

As described in Section 2.1, the Project is the continuation of bridge reconstruction program along rural roads under which Phase I, II and III were implemented. The Government of the Philippines requested the replacement of 143 bridges in Region V, VI, VII and VIII as the second year program of the Five-Year Plan to the Government of Japan.

In the original list of proposed bridges, a total of 93 bridges were listed. Before the arrival of the Basic Design Study team, the Government of the Philippines requested to add 50 bridges which needed immediate measures to be taken for restoring them from the damages caused by typhoon and heavy rain in these regions. Finally, 143 bridges were considered as the subject of the Basic Design Study.

CHAPTER 3

OUTLINE OF THE PROJECT

CHAPTER 3

OUTLINE OF THE PROJECT

3.1 Objectives

Some of the bridges along provincial and national roads in rural areas are too old and weak to carry the present traffic load. Most of them are dilapidated temporary wooden or simple bailey (temporary steel truss bridge) bridges without concrete deck slab. Short bridge length and insufficient opening of bridges also disturb the smooth flood discharge and cause accumulation of trees and logs flowing from upstream, and these bridges are often closed to traffic especially during the rainy season. Consequently the people living in their influence areas are sometimes isolated.

The replacement by permanent structure or reconstruction of these old and dilapidated timber or bailey bridges will bring about significant savings in transport cost and travel time. It will ensure smooth transportation and contribute greatly to the socio-economic development of the project areas.

In order to make a smooth implementation of the replacement or reconstruction, the Government of the Philippines through DPWH established the Five Year Comprehensive Bridge Reconstruction Program along Secondary Roads (hereinafter referred to as the Five Year Program) in April 1989.

Table 3.1 shows the number of proposed bridges under the Five Year Program.

Table 3.1 NUMBER OF PROPOSED BRIDGE BY PACKAGE/GROUP

Package Number	Region	Number of Proposed Bridge Group 1	Group 2	Total
1st year	I	-	2 (1)	2 (1)
	III	8 (9)	11 (14)	19 (23)
	IV - A	14	9 (12)	23 (26)
	IV - B	8 (9)	3 (2)	11 (11)
	Total	30 (32)	25 (29)	55 (61)
2nd year[1)]	V	11 (14)	7 (10)	18 (24)
	VI	6 (9)	10	16 (19)
	VII	6 (7)	12	18 (19)
	VIII	8 (22)	9	17 (31)
	Total	31 (52)	38 (41)	69 (93)
3rd year	X	15	18	33
	XI	5	12	17
	Total	20	30	50
4th year	IX	9	10	19
	XII	11	20	31
	Total	20	30	50
5th year	CAR	10	9	19
	I	3	3 (5)	6 (8)
	II	8	7	15
	Total	21	19 (21)	40 (42)
GRAND TOTAL		122 (149)	142 (151)	264 (300)

Note: 1: This Project is the second year program
Note: 2: ( ) is revised number of bridges

In line with the Five Year Program and in awareness of the conditions described above, priority is given to replacement of dilapidated and temporary bridges which affect the efficiency of the highway network.

Bridge construction projects will, therefore, be implemented in conformity with the following objectives:

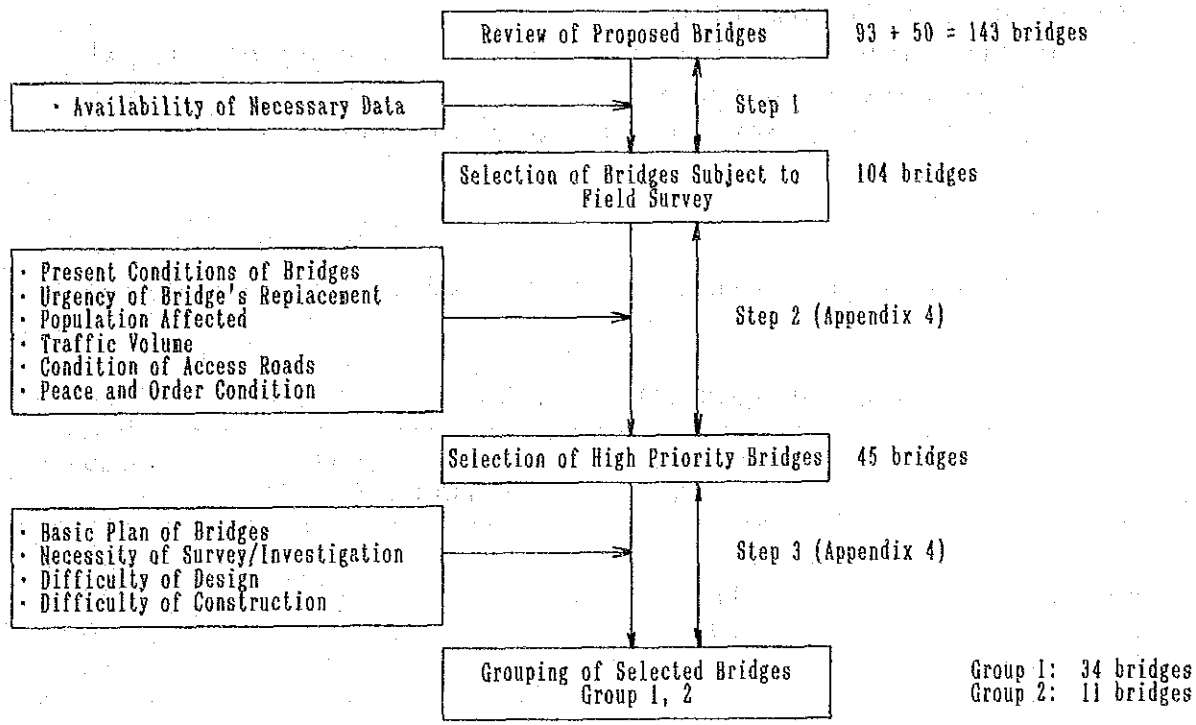
- To provide basic transport facilities in rural areas, and
- To enhance development and facilitate the effective delivery of socio-economic extension services to the communities served.

3.2 Study and Examination on the Request

3.2.1 Appropriateness and Necessities of the Project

The appropriateness and necessities of the Project as Japan's Grant Aid were examined through selecting the requested bridges in accordance with the flow diagram shown in Figure 3.1. The selection procedure is consisted of 3 steps. Step 1 is to evaluate the basic data prepared by the Department of Public Works and Highways (DPWH) and Step 2 and 3 are to study the results of 1st Field Survey (carried by the contracted Local Consultant) for 143 bridges.

Figure 3.1 FLOW DIAGRAM FOR SELECTING BRIDGES



(1) Selection of Bridges for Field Survey (Step 1)

A total of 143 bridges (original request 93 bridges, additional request 50 bridges) accepted as the subjects of

the Basic Design Study were reviewed on their basic data reported through DPWH's own investigations. All of basic data of 143 bridges are filed in Appendix 4 with following items:

- Bridge number, Bridge name, Bridge location
- Present condition of bridge
  Length (m), Type, Present condition,
  Load limit (t)
- Socio-economic and traffic information
  No. of affected Barangay, No. of affected population, Main product, Development plan, Traffic volume (ADT), Traffic composition, Purpose of trip.
- Engineering information
  Topographic condition, Geological condition, River/ Hydrological condition, Present condition of access road.
- Construction information
  Construction materials and equipment, Present condition of transportation route.
- Evaluation of urgency for bridge replacement
- Topographic map
- Pictures

Table 3.2 shows the number of requested bridges by Region.

Table 3.2 NUMBER OF REQUESTED BRIDGES BY REGION

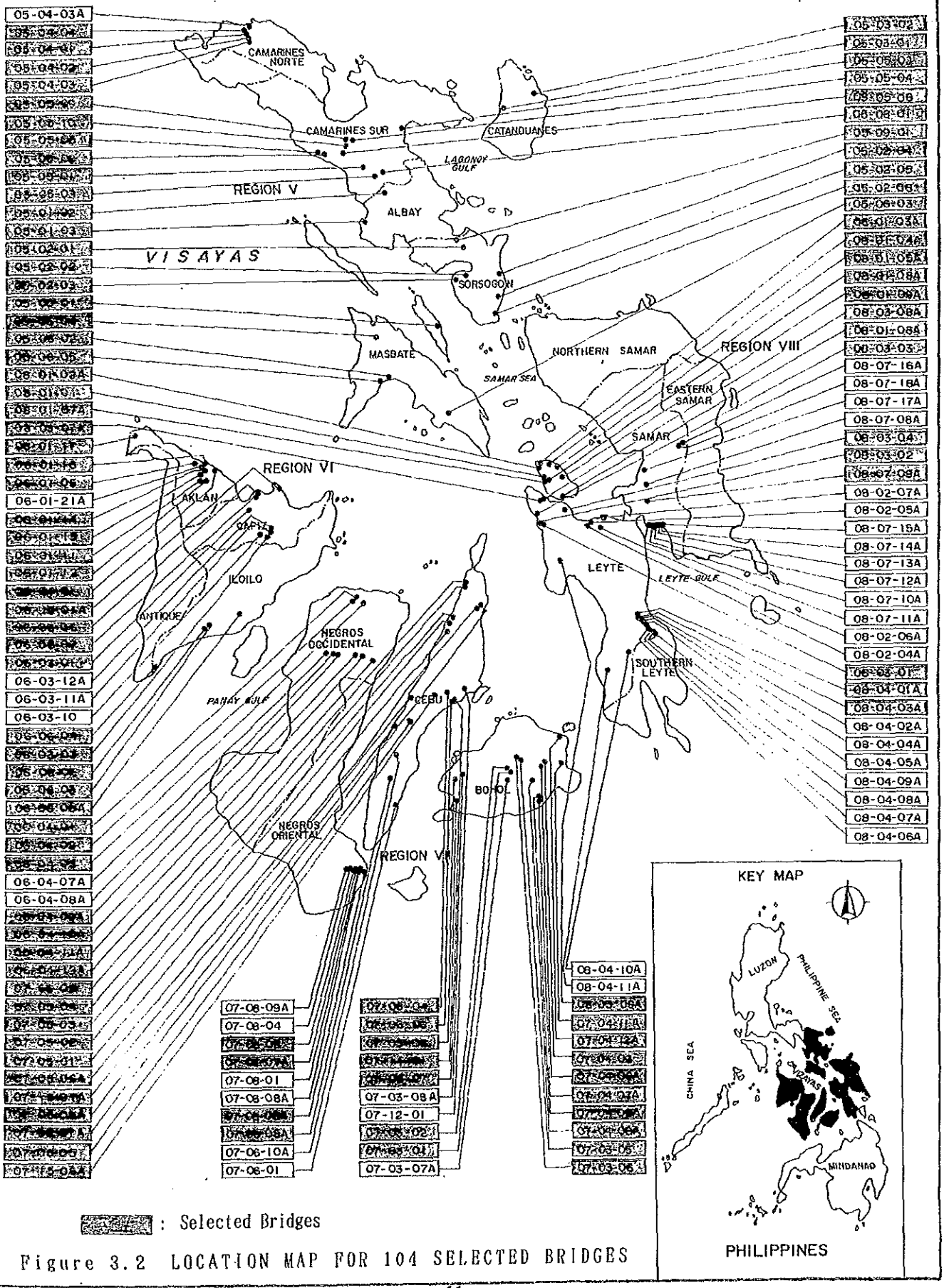
	Original request	Additional request	Total
Region V	24	7	31
Region VI	19	11	30
Region VII	19	21	40
Region VIII	31	11	42
Total	93	50	143

The 104 bridges among of 143 whose basic data were completed enough for the Field Survey were selected in this step. The results are marked by "o" or "x" in the rightest column of Appendix 4. Table 3.3 shows the number of selected bridges by Region.

The results of the 1st Field Study on 104 selected bridges in Step 1 are summarized in Appendix 4, and locations for them are shown in Figure 3.2.

Table 3.3 NUMBER OF BRIDGES FOR FIELD SURVEY

	Original Requested Bridge		Additional Requested Bridge		T O T A L	
	No. of Requested Br.	No. of Br. with Appropriate Data	No. of Requested Bridge	No. of Br. with Appropriate Data	No. of Requested Bridge	No. of Br. with Appropriate Data
Region V	24	24	7	6	31	30
Region VI	19	15	11	9	30	24
Region VII	19	19	21	12	40	31
Region VIII	31	19	11	0	42	19
T O T A L	93	77	50	27	143	104



: Selected Bridges

Figure 3.2 LOCATION MAP FOR 104 SELECTED BRIDGES

(2) Selection of High Priority Bridges (Step 2)

Applying the following criteria to the 104 bridges 43 high priority bridges were selected.

Criteria for Selecting High Priority Bridges

- Extent of damages of existing bridges
- Urgency of bridge replacement
- Future improvement plan of the route
- Number of population affected by bridge replacement
- Estimation of traffic volume
- Condition of transportation route
- Construction period within one year (Scope of Grant Aid)
- Peace and order condition

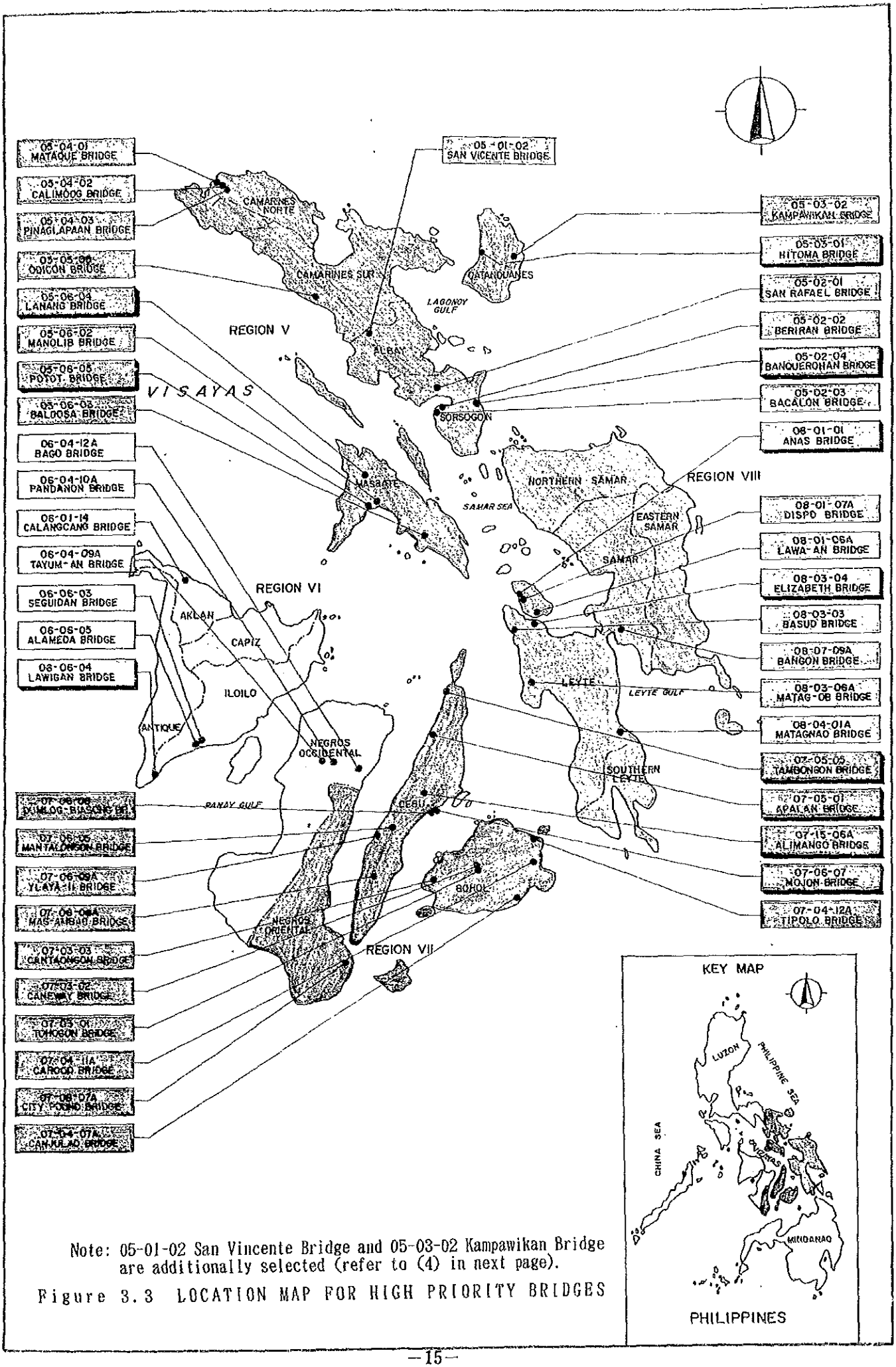
The selected bridges are marked with circle in Remarks of Appendix 4. The reasons of cutting off for 61 bridges are as follows and summarized in Table 3.4:

- Not enough information in basic data
- Bridge under construction or planning by other fund
- Permanent bridge
- Insufficient of access road to the bridge site
- Very low socio-economic impact
- Others

Figure 3.3 provides the locations for high priority bridges.

Table 3.4 REASONS OF CUTTING OFF FOR BRIDGES

Reasons	Bridge Number	
	(Original)	(Additional)
1) Not enough information in basic data	05-01-02	
2) Bridge under construction or planning by other fund	05-04-04 06-04-01 06-03-03	05-05-02 06-03-07 06-03-06
3) Permanent bridge (still in good condition)	06-03-01 06-03-01A	05-02-04 06-01-01 05-05-01 06-01-05 05-05-06 07-06-04 05-08-01 07-15-07A
4) Insufficient condition of access road to the bridge site	05-01-03 07-05-03 08-01-08A 05-03-02 07-05-04 08-01-09A 06-04-11A 07-05-07A 08-03-01 07-04-03 08-01-02A 08-03-02 07-06-06A 08-01-03A 08-03-07A 07-04-08A 08-01-07A 08-03-08B 07-04-09A 08-01-05A 07-05-02	07-03-06 07-08-06A
5) Very low socio-economic impact (Small traffic volume)	05-02-06 05-05-10 06-04-03 05-02-05 06-01-11 06-06-06A 05-05-03 06-01-12 07-03-05 05-05-05 06-01-15 07-08-05 05-05-09 06-04-02	05-09-01 06-01-17 07-05-06A
6) Others	05-06-01 08-04-03A	07-14-01 06-01-16



Note: 05-01-02 San Vincente Bridge and 05-03-02 Kampawikan Bridge are additionally selected (refer to (4) in next page).

Figure 3.3 LOCATION MAP FOR HIGH PRIORITY BRIDGES

(3) Grouping High Priority Bridges (Step 3)

The 43 high priority bridges were classified into Group-1 and Group-2 bridges in accordance with the following criteria:

Criteria for Group-2 Bridge

- Detailed topographic surveys are required because of complicated terrain.
- Geological surveys are required to decide the types of foundations.
- Cofferdams are recommended for the construction of piers inside rivers.
- Erection of steel girders or PC girders are difficult because of deep valleys or long spans.

As a result, 11 bridges were selected as Group-2 and the remaining 32 bridges as Group-1.

(4) Adding 2 High Priority Bridges and Alternating Group of 2 Bridges

Through the discussions between DPWH and the Basic Design Study Team, 2 bridges (05.01.02 San Vincente Br. and 05.03.02 Kampawikan Br.) have been additionally selected for Group-1. Also after considering the results of the field investigations, Alimango Bridge (07.15.06A) selected into Group-1 has been grouped 2 and Ylaya II Bridge (07.06.09A) selected into Group-2 has been grouped 1.

(5) Selected Bridges

The final results are summarized in Table 3.5. The lists and location maps for Group-1 and -2 bridges are shown in Table 3.6, Figure 3.4, Table 3.7 and Figure 3.5, respectively.

Table 3.5 SELECTED BRIDGES

Region	District	Total Number of Requested Bridges	Total No. of Bridge with Appropriate Data	Selected Bridge		
				Total Number of Bridges	Group-1 Number of Bridges	Group-2 Number of Bridges
V	1. Albay	2	2	1	1	0
	2. Sorsogon	6	6	4	3	1
	3. Catanduanes	2	2	2	1	1
	4. Camarines Norte	5	4	3	3	0
	5. Camarines Sur	9	9	1	1	0
	6. Masbate	5	5	4	2	2
	8. Iriga City	1	1	0	0	0
	9. Legaspi City	1	1	0	0	0
	Sub-Total	31	30	15	11	4
VI	1. Aklan	9	8	1	1	0
	3. Capiz	7	4	0	0	1
	4. Negros Occidental 1st and Cadiz City	9	7	3	3	0
	6. Iloilo 1st	4	4	3	2	1
	13. Rozas City	1	1	0	0	0
	Sub-Total	30	24	7	6	1
VII	3. Bohol 1st	7	5	3	3	0
	4. Bohol 2nd	7	7	3	3	1
	5. Cebu 1st	7	7	2	0	2
	6. Cebu 2nd	8	6	5	4	1
	8. Dumaguete City	7	3	1	1	0
	12. Mandaue City	1	0	0	0	0
	14. Tagbilaran City	1	1	0	0	0
	15. Toledo City	2	2	1	0	1
	Sub-Total	40	31	15	11	4
VIII	1. Biliran	9	9	3	2	1
	2. Leyte I	4	0	0	0	0
	3. Leyte II	7	7	3	2	1
	4. Leyte IIIt	11	2	1	1	0
	7. Samar	11	1	1	1	0
	Sub-Total	42	19	8	6	2
	T O T A L	143	104	45	34	11

Table 3.6 LIST OF BRIDGES FOR GROUP-1 (1/3)

No.	Bridge No.	Name of Bridge	Location
1	05.01.02	San Vicente Bridge	Km. 483 + 050 Libon-Bacolod-San Vicente-Burabod-Buga Rd. Albay (Provincial Road)
2	05.02.01	San Rafael Bridge	Km. 556 + 886 San Rafael-Monte-Carmelo-Libtong-Miluya- Amomontiog-Oras-B.Sirang Castilla, Sorsogon (Barangay Road)
3	05.02.02	Beriran Bridge	Km. 608 + 897 Juban-Beriran-Caruhayon Road Juban, Sorsogon (Barangay Road)
4	05.02.03	Bacalon Bridge	Km. 623 + 620 Juban-Magallanes Road Magallanes, Sorsogon (National Road)
5	05.03.02	Kampawikan Bridge	Km. 56 + 649 Jct. Panganiban-Sabloyon Road Panganiban, Catanduanes (National Road)
6	05.04.01	Mataque Bridge	Km. 325 + 601 Bagong Silang-Capalonga Camarines Norte (National Road)
7	05.04.02	Calimoog Bridge	Km. 318 + 036.50 Bagong Silang-Capalonga Road Capalonga, Camarines Norte (National Road)
8	05.04.03	Pinaglapaan Bridge	Km. 315 + 349.30 Bagong Silang-Capalonga Road Capalonga, Camarines Norte (National Road)
9	05.05.08	Odicon Bridge	Km. 2 + 100 From Pasacao-Odicon-Tagbag Road Pasacao, Camarines Sur (Barangay Road)
10	05.06.02	Manolib Bridge	Km. 26 + 946.50 From Masbate Port Masbate-Aroroy Road, Masbate (National Road)
11	05.06.03	Baldosa Bridge	Km. 51 + 860 From Masbate Port Buenavista-Cawayan Road, Cawayan, Masbate (National Road)
12	06.01.14	Calangcang Bridge	Km. 189 + 881.63 Calangcang-Carugdog Road Makato, Aklan (Provincial Road)
13	06.04.09A	Tayum-an Bridge	Km. 24 + 850 Bacolod-Murcia-D.S. Benedicto-San Carlos Bdry., Negros Occidental (National Road)
14	06.04.10A	Pandanon Bridge	Km. 35 + 500 Bacolod-Murcia-D.S. Benedicto-San Carlos Bdry., Negros Occidental (National Road)

Table 3.6 LIST OF BRIDGES FOR GROUP-1 (2/3)

No.	Bridge No.	Name of Bridge	Location
15	06.04.12A	Bago Bridge	Km. 68 + 100 Bacolod-Murcia-D.S. Benedicto-San Carlos Bdry., Negros Occidental (National Road)
16	06.06.03	Seguidan Bridge	Km. 57 + 100 Guimbal-Igbaras-Tubungan Road Tubungan, Iloilo (National Road)
17	06.06.05	Alameda Bridge	Km. 47 + 300 Guimbal-Igbaras Road Igbaras, Iloilo (National Road)
18	07.03.01	Tohogon Bridge	Km. 62 + 260 From Port of Tagbilaran City Carmen-Bacani Road, Boholl (National Road)
19	07.03.02	Caneway Bridge	Km. 63 + 400 From Port of Tagbilaran City Carmen-Bacani Road, Bohol I (National Road)
20	07.03.03	Cantaongon Bridge	Km. 27 + 590 From Port of Tagbilaran City Catagbacan-Antequera Road (National Road) Antequera, Bohol I
21	07.04.07A	Canjulao Bridge	Km. 63 + 410 Jagna-Sierra Bullones Road Bohol I (National Road)
22	07.04.11A	Carood Bridge	Km. 98 + 238 Candijay-Mabini Road Candijay, Bohol II (Provincial Road)
23	07.04.12A	Tipolo Bridge	Km. 132 + 326 Ubay-Tapal Wharf Road Ubay, Bohol II (Provincial Road)
24	07.06.05	Mantalongon Bridge	Km. 50 + 800 Barili-Aloguinsan Road Barili, Cebu II (National Road)
25	07.06.06	Dumlog-Biasong Bridge	Km. 12 + 059 Tabunok-Talisay Road Talisay, Cebu II (Provincial Road)
26	07.06.08A	Mag-Ambac Bridge	Km. 95 + 600 Jct. Barili-Aloguinsan Road Mantalongon, Dalaguete Cebu II (National Road)
27	07.06.09A	Ylaya-II Bridge	Km. 63 + 000 Barili-Mantayupan Road Barili, Cebu II (National Road)
28	07.08.07A	City Pound Bridge	Km. 6 + 246 Balugo-Vicinal Road Dumaguete City (Barangay Road)

Table 3.6 LIST OF BRIDGES FOR GROUP-1 (3/3)

No.	Bridge No.	Name of Bridge	Location
29	08.01.06A	Lawa-an Bridge	Km. 1110 + 620 Cabucgayan-Biliran Biliran Sub-Province (National Road)
30	08.01.07A	Dispo Bridge	Km. 1026 + 270 Naval-Caibiran-Cross Country Road Biliran Sub-Province (National Road)
31	08.03.03	Basud Bridge	Km. 1022 + 900 San Isidro-Tabango-Villaba Road Leyte III (National Road)
32	08.03.06A	Matag-ob Bridge	Km. 1003 + 100 Libangao-Matag-ob-Palompon Road Leyte II (National Road)
33	08.04.01A	Matagnao Bridge	Km. 75 + 102 Abuyog-Silago Road Leyte III (Provincial Road)
34	08.07.09A	Bangon Bridge	Km. 895 + 176 Dolongan-Basey Road Samar (National Road)

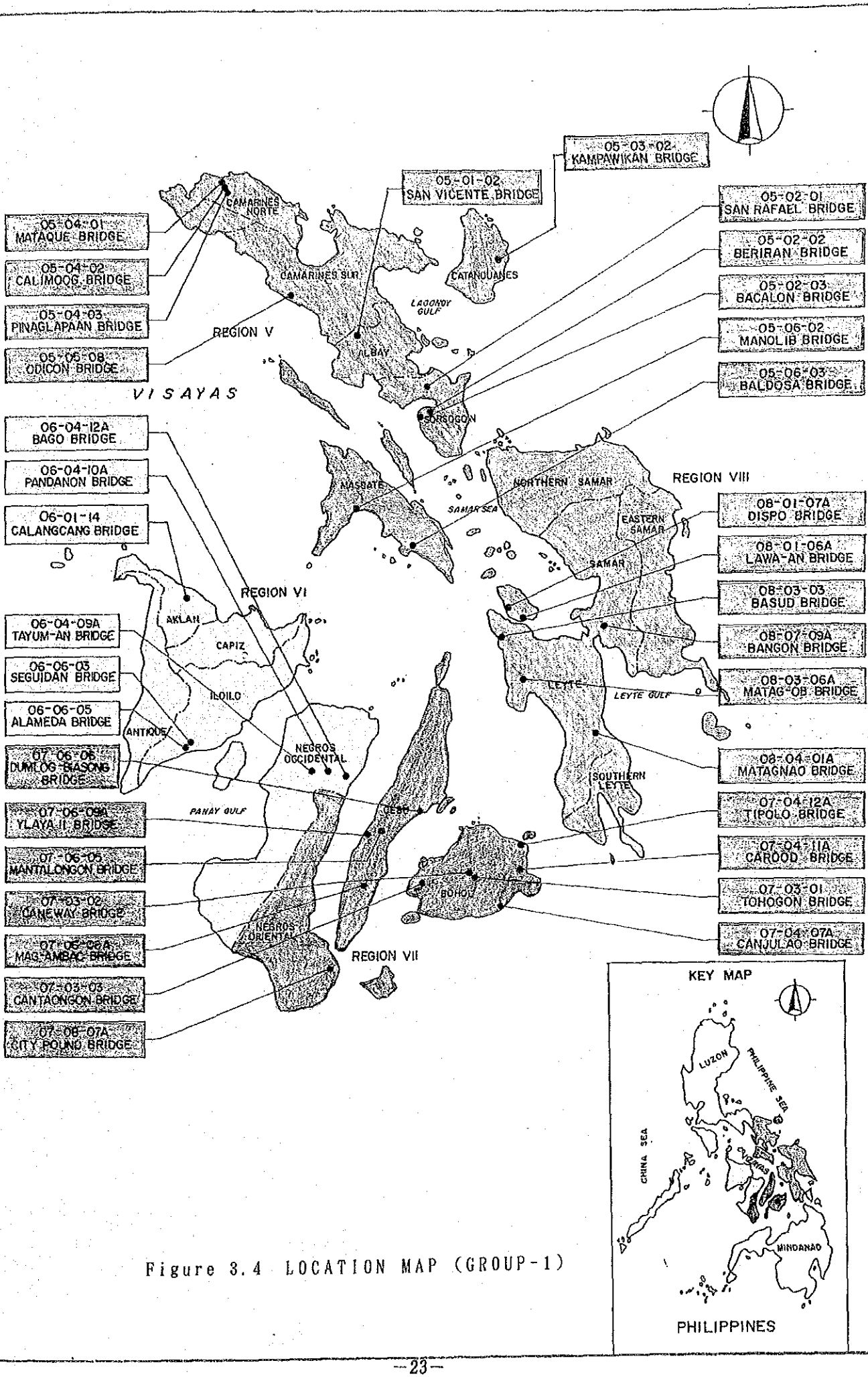


Figure 3.4 LOCATION MAP (GROUP-1)

Table 3.7 LIST OF BRIDGES FOR GROUP-2

No.	Bridge No.	Name of Bridge	Location
1	05.02.04	Banquerohan Bridge	Km. 607 + 023.60 Gubat-Barcelona-Bulusan Road Barcelona, Sorsogon (National Road)
2	05.03.01	Hitoma Bridge	Km. 151 + 600 Virac-San Andres-Caramoran Pandan Road, Catanduanes (National Road)
3	05.06.04	Lanang Bridge	Km. 56 + 129.33 From Masbate Port, Masbate-Aroroy Road Masbate (National Road)
4	05.06.05	Potot Bridge	Km. 37 + 739.78 From Masbate Port Masbate-Balud Road, Masbate (National Road)
5	06.06.04	Lawigan Bridge	Km. 70 + 900 Tiolas-Sinogbuhan Road San Joaquin, Iloilo (National Road)
6	07.05.01	Apalan Bridge	Km. 97 + 803 Toledo-Tabuelan Road Cebu I (National Road)
7	07.05.05	Tambongon Bridge	Km. 131 + 248 Antonio de Pio Highway Cebu I (National Road)
8	07.06.07	Mojon Bridge	Km. 0 + 200 From Tabunok Tabunok-Talisay Road, Cebu II (Provincial Road)
9	07.15.06A	Alimango Bridge	Km. 28 + 502 Cebu-Toledo Wharf Road Cantabaco, Toledo City (National Road)
10	08.01.01	Anas Bridge	Km. 102 + 820 From Port of Ormoc City to Naval-Almeria and Circumferential Road Biliran Sub-Province (National Road)
11	08.03.04	Elizabeth Bridge	Km. 984+ 820 Lemon-Sambolawan-Calaguise-Calubian Road Leyte II (National Road)

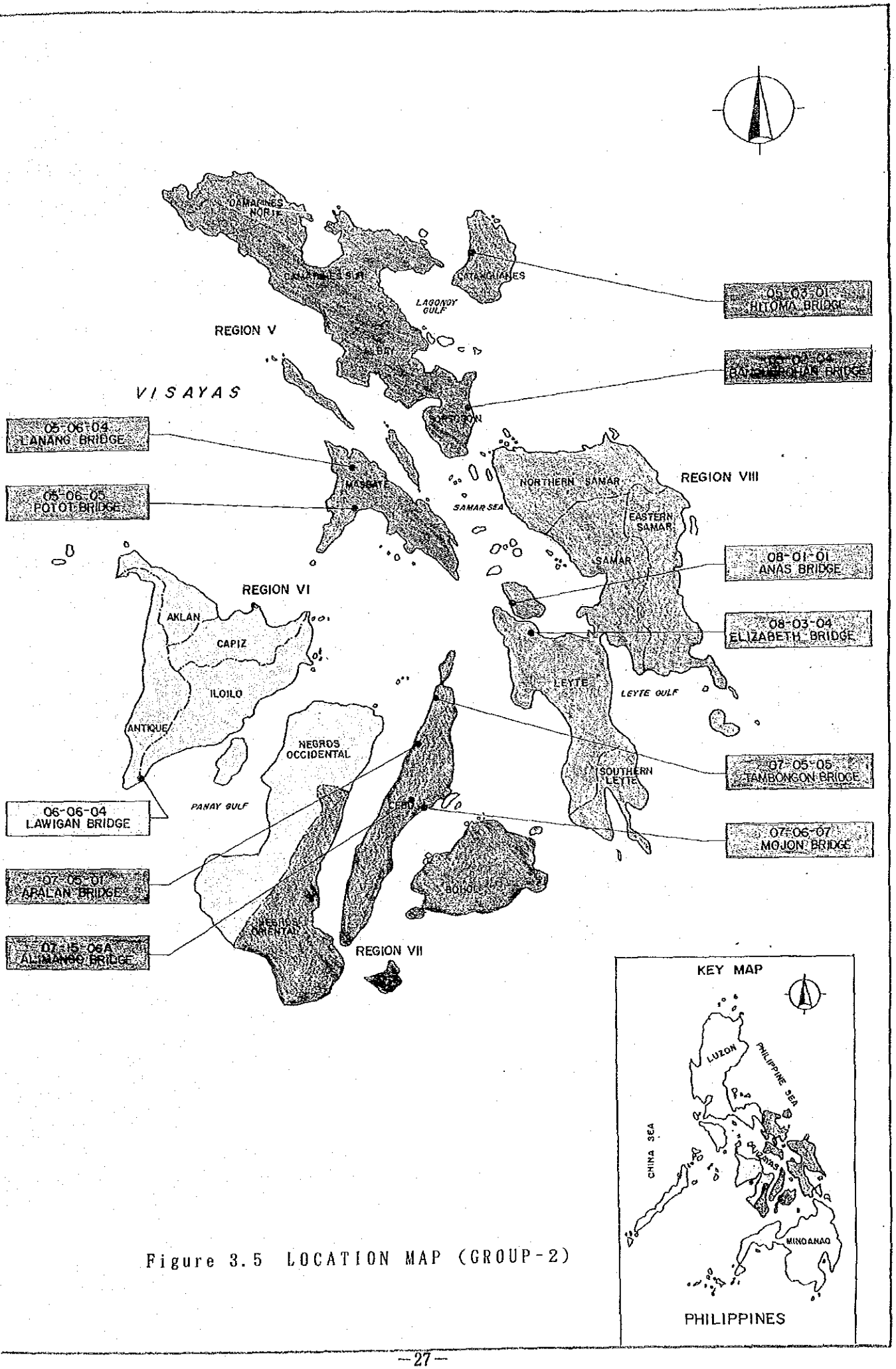


Figure 3.5 LOCATION MAP (GROUP-2)

3.2.2 Study on the Implementation Plan

The Department of Public Works and Highways (DPWH) is the responsible implementing agency of the Project in the Philippines, whose organization is shown in Section 3.3.1.

According to the public investment program in 1990 for DPWH activities shown in Table 3.8, the amount to be invested to highway sector during 1990 - 1994 is 55,000 million Pesos (1990 price) which is approximately 57% of total.

Table 3.8 PUBLIC INVESTMENT PROGRAM

(Unit: 1,000 Pesos)
Constant 1990 Prices

Category	1990	1991	1992	1993	1994	Later Years	Total 1990-1994
1. Highway	8,598,606	8,683,569	10,505,000	13,000,000	14,540,000	23,919,288	55,327,175
2. Ports	561,925	427,831	470,000	520,000	600,000	2,727,416	2,579,756
3. Flood Control, Drainage and Shore Protection	1,767,705	1,804,918	3,300,000	4,000,000	5,700,000	15,643,781	16,572,623
4. Rural Water Supply/ Sewerage	1,614,581	2,572,589	1,400,000	1,060,000	1,225,000	1,170,468	7,872,170
5. School Buildings	1,711,707	2,567,227	2,230,000A/	2,452,000A/	2,697,000A/	-	11,657,934
6. National Buildings	33,937	9,725	11,000	12,000	13,000	-	79,662
7. Urban Infrastructure	109,907	311,687	398,000	517,000	688,000	2,085,934	2,024,594
Total	14,398,368B/	16,377,546	18,314,000	21,561,000	25,463,000	45,546,887	96,113,914

Note: A/ - For elementary school buildings only
B/ - Including tentative allocation for proposed foreign-assisted projects
Source: DPWH (November 23, 1990)

DPWH has planned to directly invest 210 million Pesos to complete the Project i.e. P60 million in 1992, P80 million in 1993 and P70 million in 1994. DPWH also has reserved the following numbers of staff directly in charge of the Project;

Planning Service	10 persons
Bureau of Design	30 persons
Bureau of Construction	20 persons
Bureau of Maintenance	3 persons
Regional Offices Concerned	10 persons/office

The above investment plan, personnel occupation and success of the Bridge Projects of Phase I, II and III show the ability of DPWH to implement and complete the Project.

3.2.3 Situation on Official Assistance of Other International Organizations

Table 3.9 shows the number of bridges classified by funding sources which are reconstructed during the first and second year of the "Five Year Comprehensive Bridge Reconstruction Program along Secondary Roads" (the Five Year Program).

Table 3.9 NUMBER OF BRIDGES BY FUND TO BE RECONSTRUCTED (UNDER "FIVE YEAR COMPREHENSIVE BRIDGE RECONSTRUCTION PROGRAM ALONG SECONDARY ROADS")

Year	Fund	Number of Bridge
1st year	Japan's Grant[1)]	37
	Philippine Fund[2)]	24
2nd year	Japan's Grant[3)]	43
	A D B	2
	US AID	2
	Philippine Fund[2)]	50
	Total	158

Note: 1) completed
2) including un-allocated
3) under planning

Reconstructing approximate a half of 158 bridges are subject to Japan's Grant Aid while each 2 bridges were funded by ADB and US AID.

The reconstruction of bridges excluded in the Five Year Program are implemented under the fund of Philippines, World Bank, ADB, OECF, etc. Among them, the Philippine fund is allocated as an emergency aid and the others are planned for the reconstruction projects for trunk or sub-trunk highways, for instance Philippine-Japan Highway, North Highway, etc.

3.3 Project Description

3.3.1 Executing Agency and Organization

The DPWH is headed by the Secretary who is assisted by five Undersecretaries and six Assistant Secretaries. In the DPWH, there are six Service Offices - Planning, Controllership and Financial Management, Administrative and Manpower Development, Legal, Monitoring and Information, and Internal Audit; and five Bureaus - Design, Construction, Maintenance, Equipment, and Research and Standards. Figure 3.6 shows Organization of the DPWH.

The five 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, 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 Research 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 16 Regional Offices headed by Regional Directors. In addition, there are 116 District Offices and 60 City Engineering Offices, Regional Equipment Centers and Workshops. The latter are under the supervision of the Regional Directors concerned.

The locations of regional offices of this project are shown below.

Region V	Office	Legazpi, ALBAY
Region VI	Office	Iloilo City, ILOILO
Region VII	Office	Cebu City, CEBU
Region VIII	Office	Tacloban, LEYTE

The organization of a Regional office VII is shown in Figure 3.7.

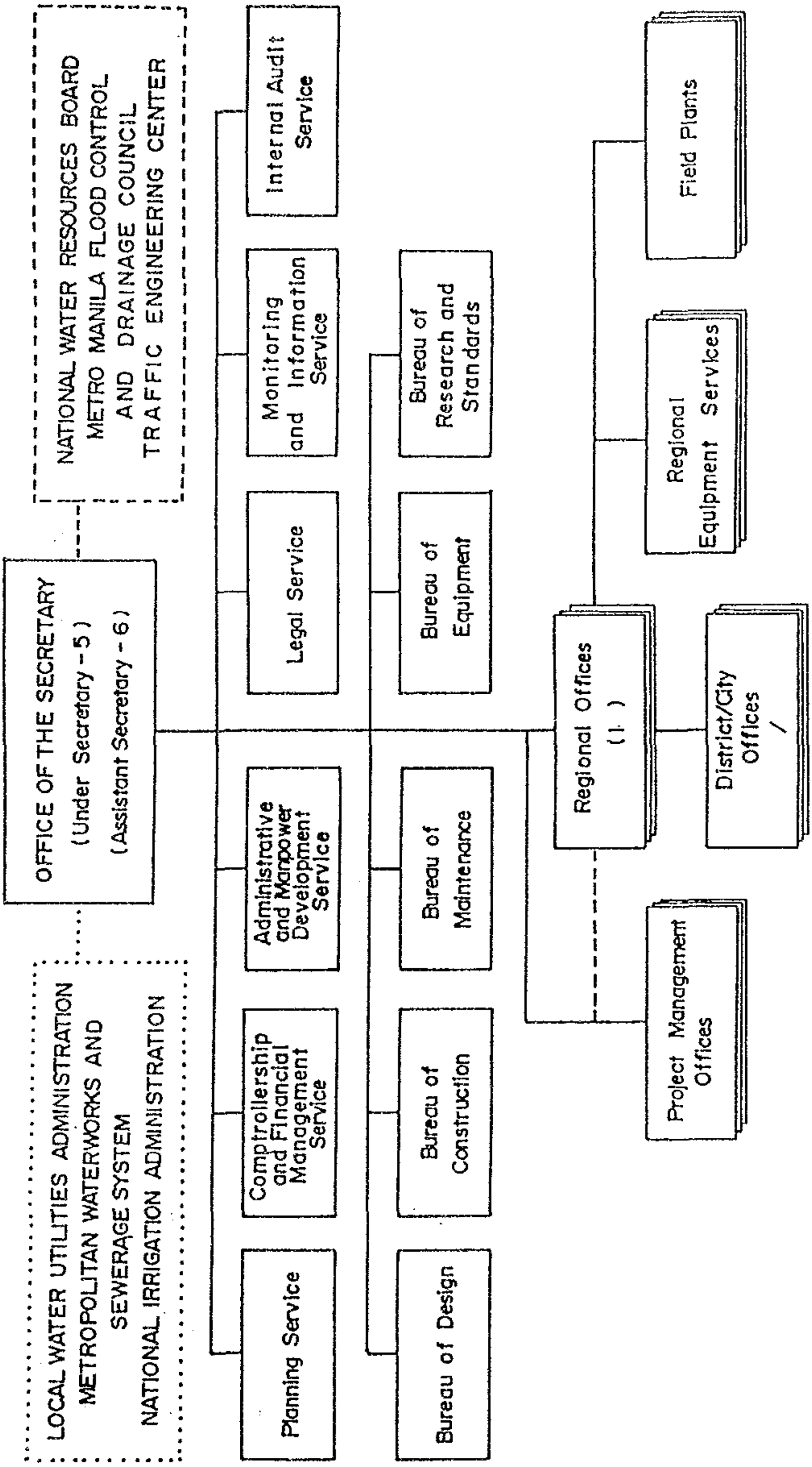


Figure 3.6 ORGANIZATION CHART
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS

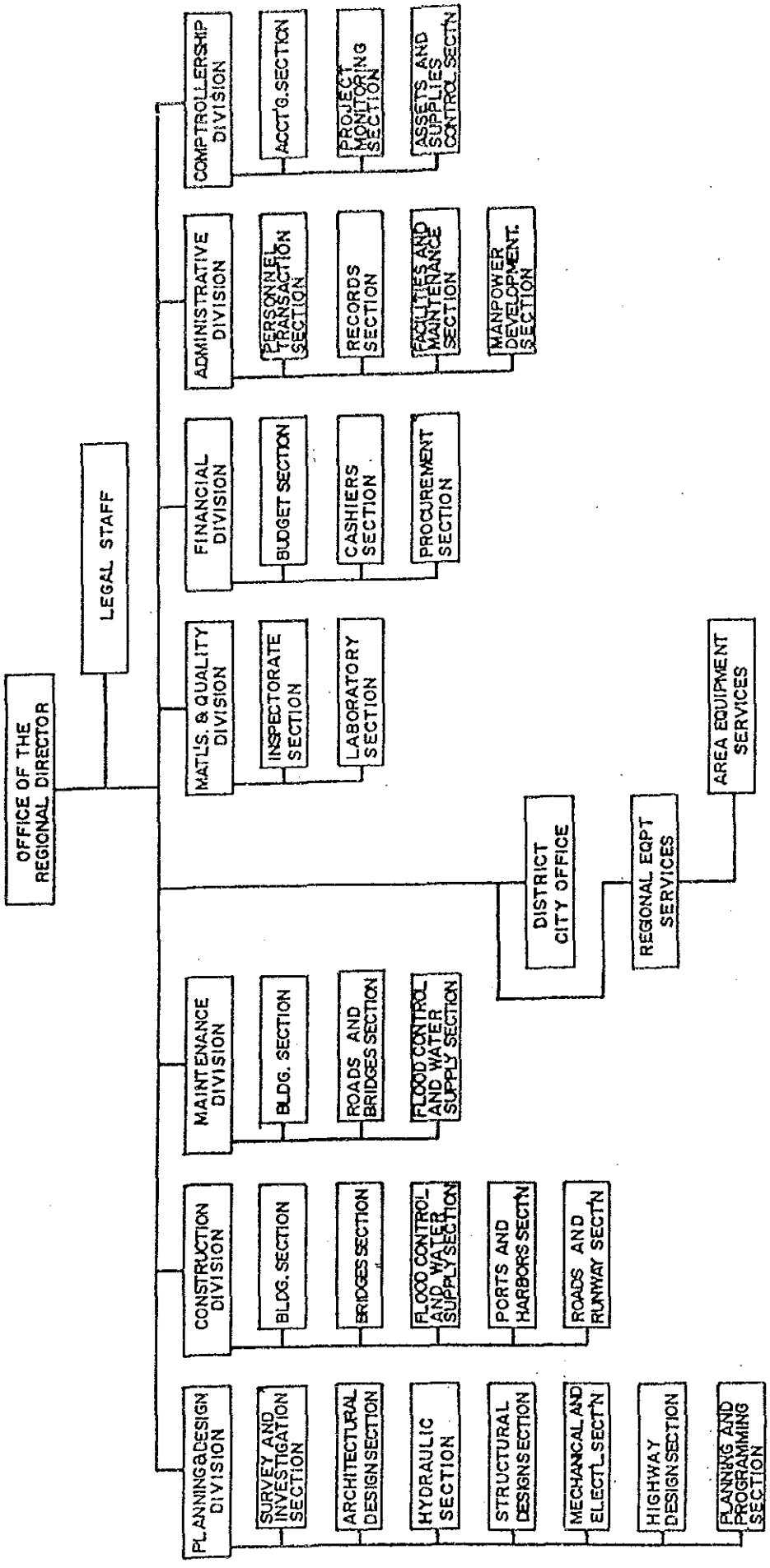


Figure 3.7 ORGANIZATION CHART
REGION VII OFFICE

3.3.2 Outline of Basic Design for Bridges

This section outlines the 45 selected bridges in Group-1 and -2 through the engineering considerations on the basic data, photos, records of joint site inspection with DPWH and the results of the 1st and 2nd Field Studies.

Tables 3.10 and 3.11 show the outlines of bridges for Group-1 and 2, respectively.

Table 3.10 OUTLINE OF BRIDGES FOR GROUP-1 (1/3)

Bridge No. Bridge Name	Existing Bridge		
	Types	Lengths	Width
05.01.02 San Vicente Br.	Bailey Br.	12.0m	4.0m
05.02.01 San Rafael Br.	Spillway	18.0m	5.0m
05.02.02 Beriran Br.	Bailey Br. (Washed out)	19.1m	-
05.02.03 Bacalon Br.	Bailey Br.	12.5m	4.0m
05.03.02 Kampawikan Br.	Bailey Br.	16.0m	-
05.04.01 Mataque Br.	Bailey Br.	34.0m	6.0m
05.04.02 Calimoog Br.	Bailey Br.	14.0m	7.0m
05.04.03 Pinaglapaan Br.	Bailey Br.	19.5m	7.0m
05.05.08 Odicon Br.	Bailey Br.	32.0m	-
05.06.02 Manolib Br.	Spillway	37.1m	5.0m
05.06.03 Baldosa Br.	Spillway	17.2m	5.0m
06.01.14 Calangcang Carugdog Br.	RCPC Br.	11.5m	6.3m
06.04.09A Tayom-an Br.	Spillway	23.8m	-
06.04.10A Pandanon Br.	Bailey Br.	12.3m	-
06.04.12A Bago Br.	Bailey Br.	45.8m	4.0m
06.06.03 Seguidan Br.	Bailey Br.	49.3m	3.0m

Table 3.10 OUTLINE OF BRIDGES FOR GROUP-1 (2/3)

Bridge No. Bridge Name	Existing Bridge		
	Types	Lengths	Width
06.06.05 Alameda Br.	Timber Br.	23.2m	5.0m
07.03.01 Tohogon Br.	Bailey Br.	15.8m	6.0m
07.03.02 Caneway Br.	Timber Br.	12.7m	4.8m
07.03.03 Cantaongon Br.	Bailey Br.	12.0m	4.5m
07.04.07A Canjulao Br.	Bailey Br.	12.0m	6.0m
07.04.11A Carood Br.	Bailey Br.	37.9m	5.0m
07.04.12A Tipolo Br.	Timber Br.	23.15m	5.0m
07.06.05 Mantalongon Br.	Bailey Br.	21.83m	3.3m
07.06.06 Dumolog-Biasong Br.	Spillway	13.7m	6.0m
07.06.08A Mag-Ambac Br.	Bailey Br.	18.0m	4.0m
07.06.09A Ylaya II Br.	Bailey Br.	27.0m	4.0m
07.08.07A City Pound Br.	Spillway	10.0m	9.0m
08.01.06A Lawa An Br.	Timber Br.	12.0m	3.8m
08.01.07A Dispo Br.	Timber Br.	12.0m	4.1m
08.03.03 Basud Br.	Timber Br.	33.23m	4.1m
08.03.06A Matag Ob Br.	Bailey Br.	21.71m	4.0m

Table 3.10 OUTLINE OF BRIDGES FOR GROUP-1 (3/3)

Bridge No. Bridge Name	Existing Bridge		
	Types	Lengths	Width
08.04.01A Matagnao Br.	Timber Br.	18.0m	8.0m
08.07.09A Bangon Br.	Timber Br.	24.8m	4.0m

Table 3.11 OUTLINE OF BRIDGES FOR GROUP-2

Bridge No. Bridge Name	Existing Bridge		
	Types	Lengths	Width
05.02.04 Banquerohan Br.	RCDG Br.	60.0m	6.1m
05.03.01 Hitoma Br.	Bailey Br.	74.0m	4.0m
05.06.04 Lanang Br.	Spillway	36.6m	4.0m
05.06.05 Potot Br.	Bailey Br.	36.6m	4.0m
06.06.04 Lawigan Br.	Bailey Br.	92.3m	4.0m
07.05.01 Apalan Br.	Bailey Br.	27.65m	4.0m
07.05.05 Tambongon Br.	Timber Br.	18.25m	3.8m
07.06.07 Mojon Br.	Spillway (Washed out)	-	-
07.15.06A Alimango Br.	Concrete Arch Bridge	19.3m	6.0m
08.01.01 Anas Br.	Bailey Br.	49.6m	3.5m
08.03.04 Elizabeth Br.	Bailey Br.	43.4m	3.5m

3.3.3 Maintenance Plan

The Bureau of Maintenance is responsible for the maintenance of national roads and bridges in the Philippines.

There are four (4) maintenance categories in the DPWH as follows:

- Routine Maintenance: Daily basis throughout the year
- Periodic Maintenance: Recurrent time cycle of more than one year
- Emergency Maintenance: Unprogrammed activities required in the aftermath of slides, floods, etc.
- Special Maintenance: Outside the scope of normal maintenance operations

In the Philippine Highway Maintenance Management System (PHMMS), there are 56 work activities at present, of which eight (8) activities are related to bridge maintenance, as shown in Table 3.12.

Table 3.12 MAINTENANCE ACTIVITIES FOR BRIDGES

Activity No.	Activity
151	Cleaning
152	Patching of (PC) Concrete Decks
153	Repair of Concrete Bridges
154	Repair of Steel Bridges
155	Repair of Bailey Bridges
157	Clearing Waterways
402	Initial Response to Emergencies
65X	Repainting

It is important that the steel bridges constructed by the Project are monitored in accordance with the maintenance activities indicated in Table 3.12.

3.4 Technical Cooperation

Regional offices are responsible for supervising the construction of Group 1 bridges, and the Bureau of Construction and Bureau of Design should have greater role and participate more aggressively in the implementation of the project. DPWH, therefore, should commit the necessary number and level of engineers required by the project.

JICA will make the counterperts from DPWH trained in Japan, in order to be studied the technology and methodology of bridge and roads construction to the counterperts. Further after coming back to the Philippines, the counterperts should take part in the project, and will try to show the technology and methodology of bridge and road construction to the other people and to improve the technology of methodology of the Philippines.

CHAPTER 4

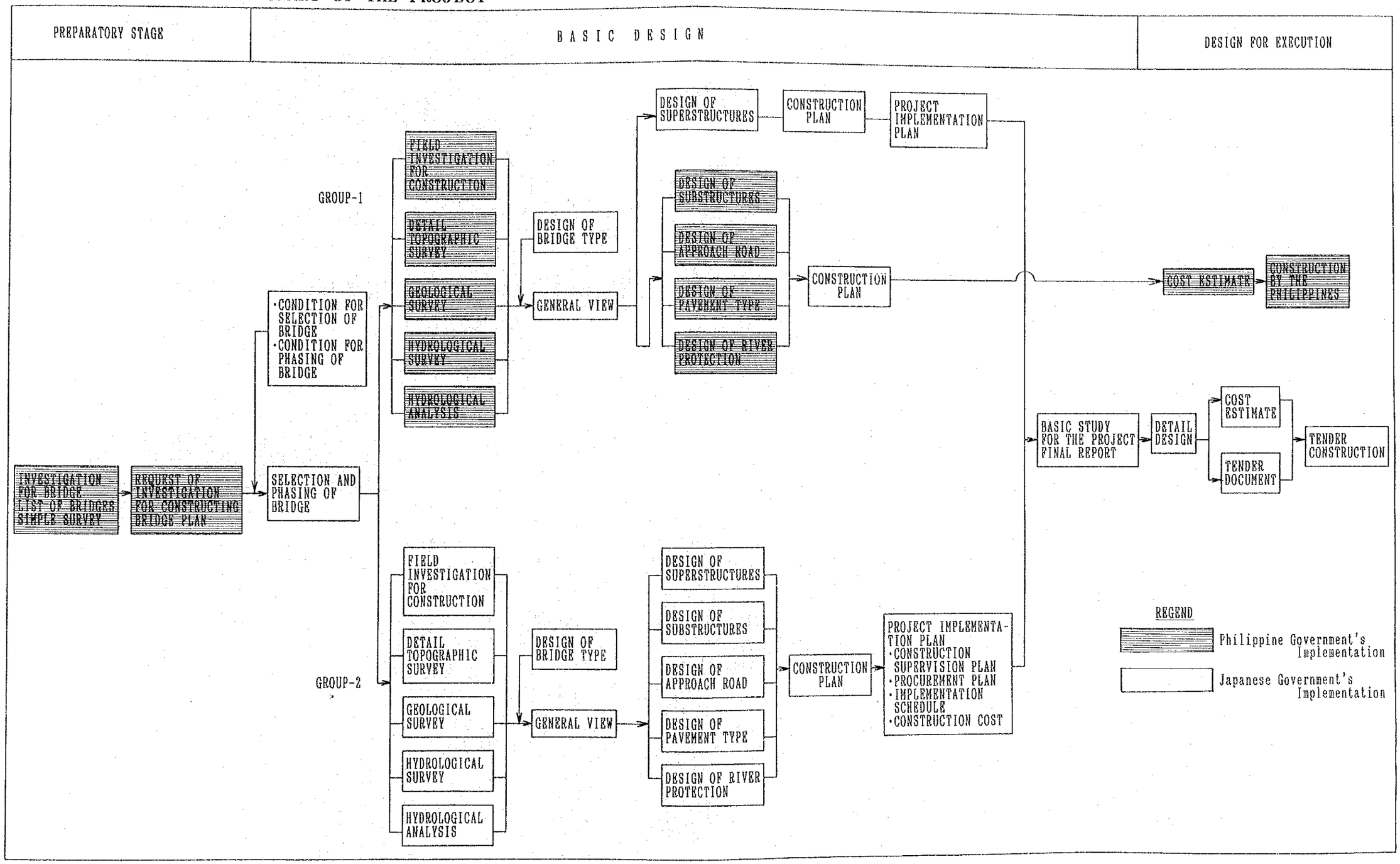
BASIC DESIGN

CHAPTER 4

BASIC DESIGN

The selected bridges are divided into two groups (Group-1 and -2) as described in Chapter 3. The basic planning of Group 1 Bridges was conducted based on data furnished by the DPWH and the results of the First Field Survey. On the other hand, Group-2 Bridges were planned based on the data collected from field investigations and topographic and geotechnical surveys conducted by the Study Team. Table 4.1 shows overall flowchart of the Project. This Chapter consists of two Parts, i.e. PART I for Group-1 Bridge and PART II for Group-2 Bridges.

Table 4.1 OVERALL FLOWCHART OF THE PROJECT



CHAPTER 4 BASIC DESIGN

PART I Group-1 Bridge

PART I Group-1 Bridge

4.1 Design Policy

The following design policies were adopted:

1) Utilization of steel materials for superstructures.

2) Utilization of local materials for substructures.

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

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

5) Footing of piers to be embedded below riverbed.

6) Steel girders to be fabricated in sizes and lengths for safe and convenient transport.

The detailed design of superstructures is carried out by the Japanese Consultant, and the design of other structures necessary to complete the Project is done by the DPWH.

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

While the locations of constructing bridges are indicated in General Views, the DPWH should finally decide the exact locations in accordance with the results of engineering review on the topographical conditions, river conditions, road alignment and construction methods, without any changes in the length and type of bridges.

4.2 Site Surveys and Hydrological Analysis

4.2.1 Field Investigation

The field investigation was carried out by the 1st Study Team

based on the Basic Data of requested bridges prepared by the DPWH. The results are filed in Appendix 4 I and II.

4.2.2 Topographic Survey

Topographic conditions were based on the Basic Data (Appendix 4.I) prepared by the DPWH.

4.2.3 Geotechnical Survey

Geotechnical conditions were based on the Basic Data (Appendix 4.I) prepared by the DPWH.

4.2.4 Hydrological Survey

Hydrological conditions were based on the Basic Data (Appendix 4.I) prepared by the DPWH.

4.2.5 Hydrological Analysis

Same as Section 4.2.4.

4.2.6 Results of Site Surveys and Analysis

The results are summarized in the followings:

Appendix 4.I Basic Data of Requested Bridges
Appendix 4.II Bridge Data for the Study

4.3 Design of Bridge Type

4.3.1 Outline on Design of Bridge Type

Design of the most appropriate type of bridge at the proposed site requires the integrated considerations on the topographical, geological and hydrological conditions as well as the construction conditions, available materials and equipment, and the economic situation.

Therefore, determination of the bridge type and length, etc. was based on the results in Part I Section 4.2.

4.3.2 Bridge Length and Span Length

The bridge length and span length are decided based on M.F.L. (maximum floods level), topographic survey results (topographic map, river cross section and road cross section), photographs, etc.

The followings are the engineering considerations to be taken:

- Pier should locate where they will not obstruct the water flow and interfere with the river system, while Abutment should be on riverside land.

- Taking into consideration on quality of transportation for steel girder materials made in Japan and on the construction method in the Philippines, the maximum span length of bridge should be less than 24 m.

Table 4.2 shows bridge length and span length of each bridge.

Table 4.2 PROPOSED BRIDGE LENGTH AND SPAN LENGTH (GROUP-1)

Bridge No.	Bridge Name	Bridge and Span Length	Bridge No.	Bridge Name	Bridge and Span Length
05.01.02	San Vicente Br.	15m x 2 span = 30m	07.03.01	Tohogon Br.	20m x 2 span = 40m
05.02.01	San Ratael Br.	15m x 2 span = 30m	07.03.02	Caneway Br.	20m x 2 span = 40m
05.02.02	Berlran Br.	23m x 1 span = 23m	07.03.03	Cantaongone Br.	18m x 2 span = 36m
05.02.03	Bacalom Br.	18m x 1 span = 18m	07.04.07A	Canjulao Br.	18m x 1 span = 18m
05.03.02	Kampawikan Br.	24m x 1 span = 24m	07.04.11A	Carood Br.	15m x 3 span = 45m
05.04.01	Mataque Br.	23m x 1 span = 23m	07.04.12A	Tipolo Br.	15m x 2 span = 30m
05.04.02	Callmoog Br.	18m x 1 span = 18m	07.06.05	Mantalongon Br.	15m x 2 span = 30m
05.04.03	Plnaglapaan Br.	23m x 1 span = 23m	07.06.06	Dumlog-Blasong Br.	18m x 4 span = 72m
05.05.08	Odicon Br.	15m + 18m = 33m	07.06.08A	Mag-ambac Br.	15m x 2 span = 30m
05.06.02	Manolib Br.	17m x 3 span = 51m	07.06.09A	Ylay II Br.	15m x 2 span = 30m
05.06.03	Baldosa Br.	18m x 4 span = 72m	07.08.07A	City Pound Br.	18m x 1 span = 18m
06.01.14	Calangcang-Canugdog Br.	20m x 1 span = 20m	08.01.06A	Lawa-an Br.	18m x 1 span = 18m
06.04.09A	Tayum-an Br.	22m x 3 span = 66m	08.01.07A	Dispo Br.	18m x 1 span = 18m
06.04.10A	Pandanon Br.	22m x 1 span = 22m	08.03.03	Basud Br.	18m x 2 span = 36m
06.04.12A	Bago Br.	20m x 2 span = 40m	08.03.06A	Matag-ob Br.	23m x 1 span = 23m
06.06.03	Seguldan Br.	18m x 3 span = 54m	08.04.01A	Matagnao Br.	24m x 1 span = 24m
06.06.05	Alameda Br.	15m x 2 span = 30m	08.07.09A	Bangon Br.	15m x 2 span = 30m

4.3.3 Types of Superstructures

The number of span and span length are summarized in Table 4.3.

Table 4.3 LENGTH AND NUMBER OF SPAN

Span Length	No. of Span
24.0	2
23.0	4
22.0	4
20.0	7
18.0	22
17.0	3
15.0	20
Total	62 spans (1,115 m)

For bridges with span lengths of less than 24 m, the experience in Japan indicates that the following three (3) types will be economical for steel bridges:

- H-beam girder
- Plate girder (non-composite build-up girder)
- Composite plate girder (composite build-up girder)

Composite plate girder, in which slab concrete takes part of the resistant capacity of the girder through the structural synthesis of slab concrete and plate girder, is unsuitable superstructure type in the Philippines because of problems in concrete quality, handling manner and maintenance. On the other hand, H-beam girder has some allowance in its sectional stress and less deflection. Therefore H-beam girder was adopted after the comparison between H-beam girder and plate girder (non-composite). More detailed explanation will be referred to PART II.

4.3.4 Types of Substructures

T-shape abutments and column piers were adopted for the substructures. Column pier can avoid disturbance to the stream lines, when the bridge line crosses the river at oblique angle.

T-shape abutment is required to have at least two lines of piles in order to avoid tilting of the abutment when scouring of the embankment occurs. R.C. rectangular pile of 400 x 400 was adopted for this pile foundations.

4.3.5 Determination of Other Items

1. Bridge Width

The bridge width of 8.32 m, which was proposed by the DPWH, was adopted after the technical verification and being based on the following reasons:

1) According to the highway specification of the DPWH, the minimum carriageway width for 2 lanes and shoulder width are 6.1 m and 0.3 m respectively. The clear zone of 0.46 m and handrail section of 0.35 m also are required for each side of bridge. Thus, the total bridge width is 8.32 m.

2) Providing 2-lane road and bridge is one of principal targets of transport sector investment in the Medium-Term Philippine Development Plan.

3) All bridges constructed under international assistance and planned to be constructed by local fund have 2-lane or more.

2. Road Surface Height

According to the specification of the DPWH, the lower surface of girder shall be heighten with minimum 1.0 m from High Flood Water Level (H.F.L). Road surface height was estimated as a sum in thickness of girder, slab, pavement, etc. to height of the lower surface of girder.

3. Weathering Steel

Depending on the mountainous location of bridge, weathering steel which provides atmospheric corrosion resistance was planned to be used for 10 bridges of Group-1.

4.4 Design of Superstructure

4.4.1 Design Criteria

- H-beam, Plate Girder
  The design criteria for superstructures are as follows:

- Design Specification : AASHTO Standard Specifications for Highway Bridges (13rd Edition, 1983)
  : Specification for Highway Bridges, Japan Road Association, 1989

- Live Load : AASHTO HS-20-44 (MS18) for Roadways
  : 2.873 KN/M2 for Sidewalks

- Temperature Change : rise + 10°, fall - 10°

- Concrete Slab : (3L + 11) x 1.05,
  L = span Length

- Max. Length of Member : 8.5 m

- Concrete Strength : Slab fc = 300 kg/cm²
  Railing fc = 130 kg/cm²

- Reinforcing Bar : fy = 2,400 kg/cm²

4.4.2 Design Results

The result of the analysis are given in the following tables:

(1) Size and Stress Intensity of Girders for Group-1 Bridges
..... Appendix 9 Table 9-1.

(2) Size of Slabs, Girders and Shoes for Groups-1 and Group-2 Bridges ..... Appendix 9 Table 9-3.

(3) Reaction for Abutments and Pier Beams
..... Appendix 9 Table 9-4.

(4) Standard Sketch of Superstructure (H-beam)
..... Appendix 9 Figure 9-1.

4.5 Design of Substructure

4.5.1 Design Criteria

The design criteria for substructures are as follows:

- Design Specification : AASHTO Standard Specifications for Highway Bridges (13rd Edition, 1983)
- Earthquake Load : C = 0.12 with Reference to Relevant AASHTO Provisions
- Concrete Strength at 28 days: fc = 210 kg/cm^2
- Reinforcing Bar: fy = 2,100 kg/cm^2
- Steel Pile : fy = 2,400 kg/cm^2

4.5.2 Design Results

Design results are shown in the following figures:

(1) Standard Sketch of Abutment ..... Appendix 9 Figure 9-4.

(2) Standard Sketch of Pier (span 14m ~ 24m)
..... Appendix 9 Figure 9-5.

4.6 Design of Approach Roads

4.6.1 Design Criteria

The design standard for secondary class national roads specified in the Highway Design Guideline of the Philippines was adopted for the design of the approach roads. Its geometric standard is shown in Table 4.4.

Table 4.4 MINIMUM GEOMETRIC STANDARD

	Flat	Rolling	Mountainous
1. Design Seed (km/hr)	60	50	40
2. Pavement Width (m)	6.70	6.70	6.70
3. Shoulder Width (m)	1.00	1.00	1.00
4. Minimum Radius (m)	120	80	50
5. Maximum Superelevation (%)	8	8	8
6. Maximum Grade (%)	3	5	10
7. Minimum Length of Vertical Curve (m)	60	60	60
8. Minimum Radius for Crest Vertical Curve (m)	1500	1200	1000
9. Minimum Radius for Sag Vertical Curve (m)	1500	1000	800

4.6.2 Typical Roadway Sections

Figure 9-8 in Appendix 9 shows typical roadway sections of the approach roads.

4.7 Design of Pavement Structures

4.7.1 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

4.7.2 Types of Pavement

Portland Cement Concrete (PCC) pavement is recommended, as shown in Figure 4-1.

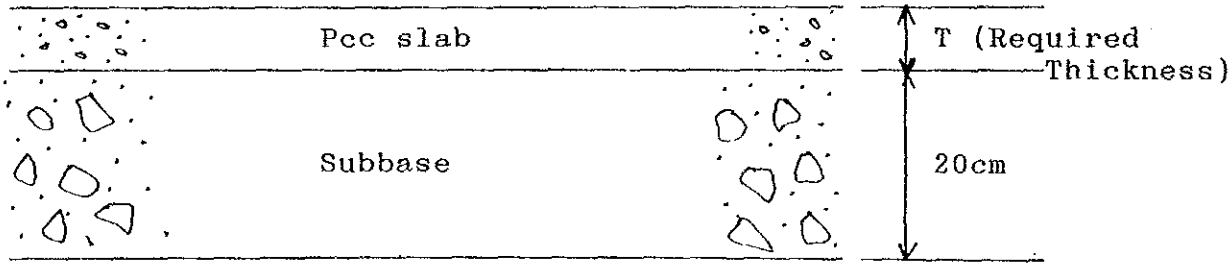


Figure 4-1 TYPICAL CROSS SECTION OF PCC PAVEMENT

The required thickness of PCC slab will be estimated so as to bear the expected number of traffic volume and loads. Table 4.5 shows the recommendations based on the outcomes of the Feasibility Study of the Road Improvement on the Pan-Philippine Highway conducted by JICA on September 1987.

Table 4.5 RECOMMENDED THICKNESS BY PCC SLAB

PCC Thickness

Traffic loading class ($\times 10^6$) \ CBR		2	3	4	5	6	8	10	15	20	Performance Period
Light traffic Loading	L-1 (0.005)	Apply min. 20 cm									More than 25 Years
	L-2 (0.01)										
	L-3 (0.03)										
Heavy traffic Loading	A (0.1)	23cm									15 Years
	B (0.2)	25cm									
	C (0.4)	28cm			25cm						
	D (0.7)	28cm									
	E (1.0)	30cm									
Extra Heavy traffic	F-d (1.5-3.5)	30 or 33 or 35									5-12 Years

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

4.8 Design of River Protection

4.8.1 Required Area of Water Opening

The required water opening for run-off flood discharge was assumed by the Basic Data.

4.8.2 Type of River Bank Protection

As planned for the Phase I, II, and III Bridge Projects, river-bank protection at the front of abutments is constructed when the velocity of river water is over 3 m per second or when erosion and scouring are expected.

Considering the availability of local materials, grouted riprap protection is adopted for the Project. The slope gradient of grouted riprap of 1.5 : 1 was adopted so as to prevent the slope failure of back-filling embankment. It was also proposed that

grouted riprap foundation would be extended into the bedrock or to below the scour depth. Figure 4-2 shows a typical cross section of grouted riprap.

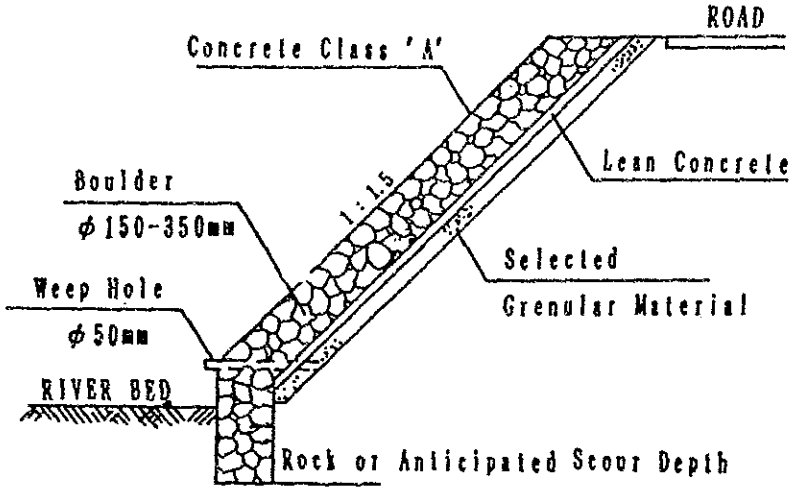


Figure 4-2 RIVERBANK PROTECTION

4.9 Summary of Design Results

The results of design after engineering considerations on the various conditions of each bridge are summarized in Table 4.6. The quantities of main materials are shown as below and in Table 4.7.

· Steel Materials for Superstructure	1,322.651 ton
H-beam	1,117.608 ton
Steel Plate	104.398 ton
Other Steel Materials	100.645 ton
· Accessories	20.574 ton
· Field Paint Materials	6.185 ton
· Guard Rail	66.130 ton
Total	1,415.540 ton

Table 4.6 SUMMARY OF GROUP-1 BRIDGES (1/3)

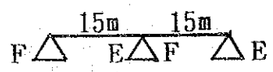
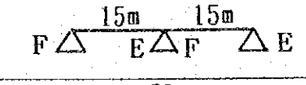
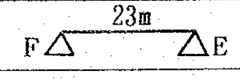
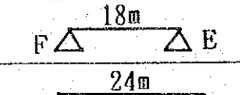
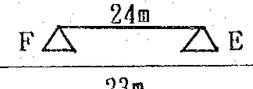
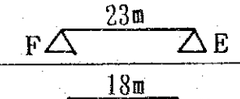
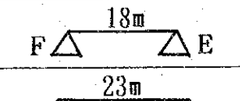
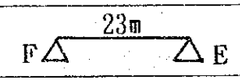
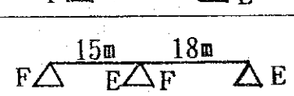
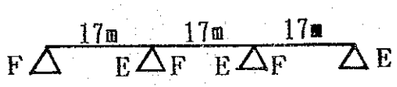
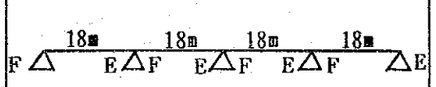
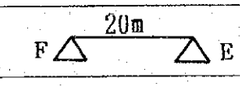
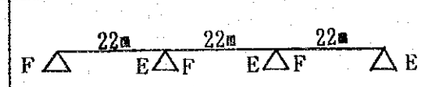
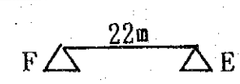
No.	Bridge No.	Name of Bridge	Type of Bridge	Superstructure (H-beam Girder)	Substructure		Approach Road	River Bank Protection	Remarks
					Abutment/Pier	RC Pile Foundation (400mm x 400mm)			
A1	05.01.02	San Vicente Br.		15+15=30m 35.181 t	A1 Abut: H= 4.0m P1 Pier: H= 5.0m A2 Abut: H= 4.0m	15m x 10 piles 15m x 8 piles 15m x 10 piles	Left bank :40m Right bank:50m	Left bank :248.6m² Right bank:250.6m²	
1	05.02.01	San Rafael Br.		15+15=30m 35.181 t	A1 Abut: H= 4.5m P1 Pier: H= 6.0m A2 Abut: H= 4.5m	- - -	Left bank :40m Right bank:40m	Left bank :119.5m² Right bank:119.5m²	
2	05.02.02	Beriran Br.		23m 36.478 t	A1 Abut: H= 3.5m A2 Abut: H= 5.0m	15m x 10 piles 15m x 10 piles	Left bank :30m Right bank:40m	Left bank : 6.0m² Right bank: 28.0m²	
3	05.02.03	Bacalon Br.		18m 21.825 t	A1 Abut: H= 4.0m A2 Abut: H= 4.0m	10m x 10 piles 10m x 10 piles	Left bank :40m Right bank:30m	Left bank : 9.6m² Right bank: 9.6m²	
A2	05.03.02	Kampawikan Br.		24m 38.757 t	A1 Abut: H= 6.0m A2 Abut: H= 6.0m	15m x 10 piles 15m x 10 piles	Left bank :50m Right bank:30m	Left bank :253.0m² Right bank:412.5m²	
4	05.04.01	Mataque Br.		23m 36.478 t	A1 Abut: H= 3.5m A2 Abut: H= 3.5m	15m x 10 piles 15m x 10 piles	Left bank :30m Right bank:30m	Left bank :365.7m² Right bank:394.2m²	
5	05.04.02	Calimoog Br.		18m 21.825 t	A1 Abut: H= 4.0m A2 Abut: H= 4.0m	15m x 10 piles 15m x 10 piles	Left bank :20m Right bank:30m	Left bank :446.2m² Right bank:449.5m²	
6	05.04.03	Pinaglapaan Br.		23m 36.478 t	A1 Abut: H= 3.5m A2 Abut: H= 3.5m	15m x 10 piles 15m x 10 piles	Left bank :30m Right bank:30m	Left bank :148.8m² Right bank:153.4m²	
7	05.05.08	Odicon Br.		15+18=33m 38.418 t	A1 Abut: H= 4.0m P1 Pier: H= 7.5m A2 Abut: H= 4.5m	15m x 10 piles 10m x 10 piles 15m x 10 piles	Left bank :40m Right bank:40m	Left bank :189.5m² Right bank:220.1m²	
8	05.06.02	Manolib Br.		17+17+17=51m 56.231 t	A1 Abut: H= 6.0m P1 Pier: H= 8.0m P2 Pier: H= 6.0m A2 Abut: H= 5.0m	10m x 20 piles 10m x 16 piles 10m x 12 piles 10m x 15 piles	Left bank :50m Right bank:40m	Left bank :226.0m² Right bank:211.3m²	
9	05.06.03	Baldosa Br.		18+18+18+18=72m 81.313 t	A1 Abut: H= 6.0m P1 Pier: H= 8.5m P2 Pier: H=12.0m P3 Pier: H= 9.0m A2 Abut: H= 6.0m	10m x 20 piles 10m x 10 piles 10m x 25 piles 10m x 20 piles 10m x 20 piles	Left bank :60m Right bank:50m	Left bank :337.3m² Right bank:376.8m²	
10	06.01.14	Calangcang Br.		20m 25.784 t	A1 Abut: H= 5.0m A2 Abut: H= 5.0m	10m x 10 piles 10m x 10 piles	Left bank :40m Right bank:40m	Left bank : 75.4m² Right bank: 85.1m²	
11	06.04.09A	Tayum-an Br.		22+22+22=66m 87.883 t	A1 Abut: H=12.0m P1 Pier: H=17.0m P2 Pier: H=19.0m A2 Abut: H= 7.0m	- - - -	Left bank :70m Right bank:50m	Left bank : 11.5m² Right bank: 0.0m²	Weathering Steel Girder
12	06.04.10A	Pandanon Br.		22m 30.625 t	A1 Abut: H= 3.0m A2 Abut: H= 3.0m	10m x 10 piles 10m x 10 piles	Left bank :40m Right bank:20m	Left bank : 5.4m² Right bank: 3.0m²	Weathering Steel Girder

Table 4.6 SUMMARY OF GROUP-1 BRIDGES (2/3)

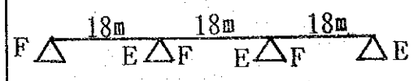
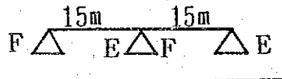
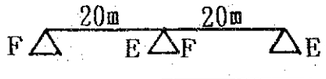
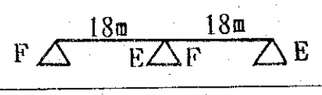
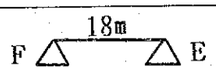
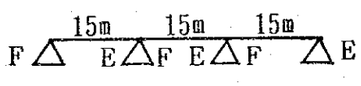
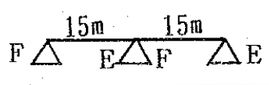
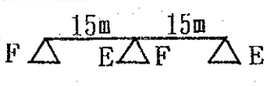
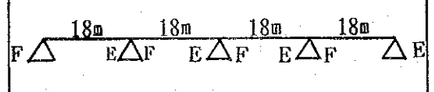
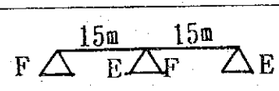
No.	Bridge No.	Name of Bridge	Type of Bridge	Superstructure (H-beam Girder)	Substructure		Approach Road	River Bank Protection	Remarks
					Abutment/Pier	RC Pile Foundation (400mm x 400mm)			
13	06.04.12A	Bago Br.		20+20=40m 49.571 t	A1 Abut: H= 4.5m P1 Pier: H= 7.0m A2 Abut: H= 4.5m	15m x 10 piles 10m x 12 piles 15m x 10 piles	Left bank :10m Right bank:20m	Left bank : 7.2m² Right bank: 53.0m²	Weathering Steel Girder
14	06.06.03	Seguuidan Br.		18+18+18=54m 61.483 t	A1 Abut: H= 3.5m P1 Pier: H= 8.5m P2 Pier: H= 8.5m A2 Abut: H= 4.0m	15m x 10 piles 10m x 12 piles 10m x 12 piles 15m x 10 piles	Left bank :70m Right bank:30m	Left bank : 55.7m² Right bank: 53.4m²	Weathering Steel Girder
15	06.06.05	Alameda Br.		15+15=30m 35.181 t	A1 Abut: H= 3.5m P Pier: H= 6.0m A2 Abut: H= 3.5m	15m x 10 piles 10m x 12 piles 15m x 10 piles	Left bank :30m Right bank:50m	Left bank : 6.6m² Right bank: 6.2m²	
16	07.03.01	Tohogon Br.		20+20=40m 49.571 t	A1 Abut: H= 4.0m P1 Pier: H= 7.0m A2 Abut: H= 4.0m	15m x 10 piles 10m x 16 piles 15m x 10 piles	Left bank :50m Right bank:50m	Left bank :138.4m² Right bank:127.4m²	
17	07.03.02	Caneway Br.		20+20=40m 49.571 t	A1 Abut: H= 5.5m P1 Pier: H= 8.0m A2 Abut: H= 5.5m	15m x 20 piles 10m x 16 piles 15m x 20 piles	Left bank :60m Right bank:40m	Left bank :394.0m² Right bank:268.5m²	
18	07.03.03	Cantaongon Br.		18+18=36m 41.654 t	A1 Abut: H= 3.5m P1 Pier: H= 7.0m A2 Abut: H= 3.5m	15m x 10 piles 10m x 20 piles 15m x 10 piles	Left bank :30m Right bank:40m	Left bank : 4.8m² Right bank: 6.0m²	Weathering Steel Girder
19	07.04.07A	Canjulao Br.		18m 21.825 t	A1 Abut: H= 3.5m A2 Abut: H= 3.5m	10m x 10 piles 10m x 10 piles	Left bank :30m Right bank:40m	Left bank : 4.8m² Right bank: 7.2m²	
20	07.04.11A	Carood Br.		15+15+15=45m 51.774 t	A1 Abut: H= 5.5m P1 Pier: H=10.5m P2 Pier: H=10.0m A2 Abut: H= 5.5m	15m x 20 piles 10m x 20 piles 10m x 20 piles 15m x 20 piles	Left bank :50m Right bank:60m	Left bank :324.5m² Right bank:277.4m²	
21	07.04.12A	Tipolo Br.		15+15=30m 35.181 t	A1 Abut: H= 3.5m P1 Pier: H= 7.5m A2 Abut: H= 3.5m	15m x 10 piles 10m x 12 piles 15m x 10 piles	Left bank :70m Right bank:30m	Left bank : 22.5m² Right bank: 19.0m²	
22	07.06.05	Mantalongon Br.		15+15=30m 35.181 t	A1 Abut: H= 3.0m P1 Pier: H= 7.5m A2 Abut: H= 3.0m	10m x 10 piles 10m x 12 piles 10m x 10 piles	Left bank :40m Right bank:30m	Left bank : 6.0m² Right bank: 6.0m²	Weathering Steel Girder
23	07.06.06	Dumlog-Biasong Br.		18+18+18+18=72m 81.313 t	A1 Abut: H= 7.0m P1 Pier: H= 7.0m P2 Pier: H= 7.0m P3 Pier: H= 7.0m A2 Abut: H= 7.0m	10m x 20 piles 10m x 16 piles 10m x 16 piles 10m x 16 piles 10m x 20 piles	Left bank :40m Right bank:40m	Left bank :479.5m² Right bank:283.3m²	
24	07.06.08A	Mag-Ambac Br.		15+15=30m 35.181 t	A1 Abut: H= 3.0m P1 Pier: H= 7.5m A2 Abut: H= 3.0m	10m x 10 piles 10m x 16 piles 10m x 10 piles	Left bank :50m Right bank:30m	Left bank : 6.0m² Right bank: 6.0m²	Weathering Steel Girder

Table 4.6 SUMMARY OF GROUP-1 BRIDGES (3/3)

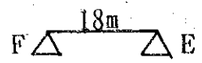
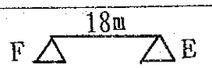
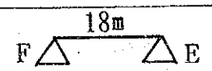
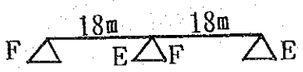
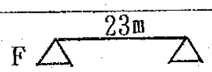
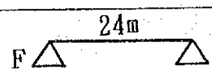
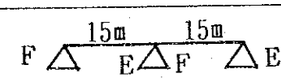
No.	Bridge No.	Name of Bridge	Type of Bridge	Superstructure (H-beam Girder)	Substructure: Abutment/Pier	Substructure: RC Pile Foundation (400mm x 400mm)	Approach Road	River Bank Protection	Remarks
25	07.06.09A	Ylaya-II Br.		15+15=30m 35.181 t	A1 Abut: H= 2.5m P1 Pier: H= 8.5m A2 Abut: H= 3.0m	15m x 10 piles 10m x 10 piles 15m x 10 piles	Left bank :20m Right bank:20m	Left bank : 4.2m² Right bank: 4.2m²	
26	07.08.07A	City Pound Br.		18m 21.825 t	A1 Abut: H= 4.0m A2 Abut: H= 4.0m	10m x 10 piles 10m x 10 piles	Left bank :40m Right bank:30m	Left bank : 9.6m² Right bank: 7.2m²	Weathering Steel Girder
27	08.01.06A	Lawa-An Br.		18m 21.825 t	A1 Abut: H= 3.0m A2 Abut: H= 3.0m	10m x 10 piles 10m x 10 piles	Left bank :30m Right bank:30m	Left bank : 19.1m² Right bank: 23.1m²	
28	08.01.07A	Dispo Br.		18m 21.825 t	A1 Abut: H= 3.0m A2 Abut: H= 3.0m	10m x 10 piles 10m x 10 piles	Left bank :30m Right bank:30m	Left bank : 5.4m² Right bank: 5.4m²	
29	08.03.03	Basud Br.		18+18=36m 41.654 t	A1 Abut: H= 6.0m P1 Pier: H= 5.5m A2 Abut: H= 6.0m	10m x 20 piles 10m x 10 piles 10m x 20 piles	Left bank :40m Right bank:40m	Left bank : 73.8m² Right bank:107.7m²	
30	08.03.06A	Matag-Ob Br.		23m 36.478 t	A1 Abut: H= 3.5m A2 Abut: H= 3.0m	10m x 10 piles 10m x 10 piles	Left bank :50m Right bank:50m	Left bank :136.1m² Right bank:110.0m²	
31	08.04.01A	Matagnao Br.		24m 38.757 t	A1 Abut: H= 4.5m A2 Abut: H= 3.5m	10m x 10 piles 10m x 10 piles	Left bank :30m Right bank:40m	Left bank : 4.8m² Right bank: 4.8m²	
32	08.07.09A	Bangon Br.		15+15=30m 35.181 t	A1 Abut: H= 3.0m P1 Pier: H= 5.5m A2 Abut: H= 3.0m	10m x 10 piles 10m x 8 piles 10m x 10 piles	Left bank :60m Right bank:60m	Left bank : 6.0m² Right bank: 7.2m²	
	Total	34 Bridges		L= 1,115m W= 1,382.669 t	Abutment H= 2.5m 1 unit H= 3.0m 14 unit H= 3.5m 16 unit H= 4.0m 12 unit H= 4.5m 6 unit H= 5.0m 4 unit H= 5.5m 4 unit H= 6.0m 7 unit H= 7.0m 3 unit H= 12.0m 1 unit Total: 68 unit Pier H= 5.0m 1 unit H= 5.5m 2 unit H= 6.0m 3 unit H= 7.0m 6 unit H= 7.5m 4 unit H= 8.0m 2 unit H= 8.5m 4 unit H= 9.0m 1 unit H= 10.0m 1 unit H= 10.5m 1 unit H= 12.0m 1 unit H= 17.0m 1 unit H= 19.0m 1 unit Total: 28 unit	L= 10m 744 piles L= 15m 368 piles	L = 2,690m	A = 8,248.1 m²	

Table 4.7 QUANTITIES OF MAIN MATERIALS

(1) Steel Materials for Superstructure

1) H-Beam

Item	Description	Weight (t)
Main Girder	H-912 x 302 x 18 x 34	169.418
	H-900 x 300 x 16 x 18	90.572
	H-890 x 299 x 15 x 23	126.553
	H-792 x 300 x 14 x 22	321.508
	H-700 x 300 x 13 x 24	277.293
	Sub Total	985.344
Cross Beam	H-596 x 199 x 10 x 15	66.799
	H-400 x 200 x 8 x 13	27.347
	H-350 x 175 x 7 x 11	38.118
	Sub Total	132.264
Total		1,117.608

2) Steel Plate

Item	Description	Weight (t)
Splice	t = 25 ~ 9	77.807
Main Girder	t = 22 ~ 9	18.411
Cross Beam	t = 19 ~ 9	8.180
Total		104.398

3) Other Steel Materials

Item	Description		Weight (t)
D-Bar	D-16		0.682
Studs	ø22 x 150	(48,096 pcs)	24.865
Pad Eye	170 x 150	(1,488 pcs)	1.922
H.T.B.	M 22	(69,852 pcs)	41.126
Shoe	LB 103	(496 pcs)	26.722
Drain	100 A	(248 pcs)	5.328
Total			100.645

(2) Accessories

Item	Description	Weight (t)
Erection Bolt	M 22 (21,167 pcs)	12.701
Drift Pin	ø24.5 x 150 (10,584 pcs)	6.139
Torque Wrench	(34 pcs)	0.204
Calibrator	(34 pcs)	1.530
Total		20.574

(3) Field Paint Materials

Item	Description	Weight (kg)
Under Coat	Red-Lead Paint JIS K 5622	1,158.48
1st Inter Coat	Phenol M.I.O. JIS K 5516	796.30
2nd Inter Coat	Long Oil Phtallic Acid Resin Paint JIS K 5516	1,941.38
Finish Coat	Long Oil Phtallic Acid Resin Paint JIS K 5516	1,779.60
Thinner	JIS K 2201	509.65
Total		6,185.41 (6.185 t)

(4) Guard Rail

Item	Description	Weight (t)
Guard Rail	GR-A-4E (2.176 m)	66.130
Total		66.130

4.10 Construction Plan

This section includes sub-sections, i.e. Transportation Plan, Erection Method for Steel Girder, Construction of Cofferdams, Traffic Control During Construction and Demolition of Existing Bridges. Among these items, sea-transport of material from Japan to the designated ports in the Philippines shall be funded by the Japan's Government and the others shall be by the Philippine Government.

4.10.1 Transportation Plan

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

DPWH designated following international ports for the Project (refer to Appendix 2):

- Manila North Harbor
- Port of Iloilo
- Port of Cebu
- Port of Tacloban

As a result of investigation done by the Study Team, it is required to transport the materials to Iloilo and Tacloban on domestic sea-route after landing and custom clearing in Manila North Harbor. Custom clearing fee in Manila North Harbor shall be borne by the Philippine Government.

Table 4.8 shows the ports designated for each bridge.

Table 4.8 DESIGNATED PORT FOR EACH BRIDGE

Manila South Harbor	Port of Iloilo	Port of Cebu	Port of Tacloban
05.01.02 San Vicente Bridge	06.01.14 Calangcang Bridge	07.03.01 Tohogon Bridge	08.01.06A Lawa-an Bridge
05.02.01 San Rafael Bridge	06.04.09A Tayam-an Bridge	07.03.02 Caneway Bridge	08.01.07A Dispo Bridge
05.02.02 Beriran Bridge	06.04.10A Pandanon Bridge	07.03.03 Cantaongon Bridge	08.03.03 Basud Bridge
05.02.03 Bacalon Bridge	06.04.12A Bago Bridge	07.04.07A Canjulao Bridge	08.03.06A Matag-ob Bridge
05.03.02 Kampawikan Bridge	06.06.03 Seguidan Bridge	07.04.11A Carood Bridge	08.04.01A Matagnao Bridge
05.04.01 Mataque Bridge	06.06.05 Alameda Bridge	07.04.12A Tipolo Bridge	08.07.09A Bangon Bridge
05.04.02 Calimoog Bridge		07.06.05 Mantalongon Bridge	
05.04.03 Pinaglapaan Bridge		07.06.06 Dumlog-Biasong Bridge	
05.05.08 Odicon Bridge		07.06.08A Mag-Ambac Bridge	
05.06.02 Manolib Bridge		07.06.09A Yiaya-II Bridge	
05.06.03 Baldosa Bridge		07.08.07A City Pound Bridge	
11 Bridges	6 Bridges	11 Bridges	6 Bridges

4.10.2 Erection Method for Steel Girder

The erection method for steel girder whose maximum weight and length per unit would be 3.0 ton and 8.5 m respectively was studied based on the data prepared by the DPWH.

The relevant figures of following erection methods are filed in Appendix 9:

Figure 9-9 shows direct erection method (1) using by 22.5 ton crawler crane setting in riverbed. This is the most suitable method when the crawler crane can enter in riverbed.

Figure 9-10 shows direct erection method (2) using by 40.0 ton crawler crane setting on river side road. This method is adopted when the crawler crane can't enter in riverbed.

Figure 9-11 (1) and (2) show Towing-Cable method. This method requires shifting device, juck, rail, carrier, etc. instead of supports and crawler crane with big capacity. The cost of this method is high.

Figure 9-12 shows floating method. The cost of this method is very high, therefore it is seldom to adopt this method but when direct method can't be taken.

The erection method for each bridge shown in Table 4.9 is recommended through the engineering view.

Table 4.9 ERECTION METHOD FOR STEEL GIRDER (1/2)

Bridge No.	Bridge Name	Span Length (m)	Erection Site Condition	Type	Erection Device
1 05.01.02	San Vicente Br.	15.0+15.0	Possible to go onto the riverbed	1	Crane & Bent
2 05.02.01	San Rafael Br.	15.0+15.0	Possible to go onto the riverbed	1	Crane & Bent
3 05.02.02	Beriran Br.	23.0	Difficult to go onto the riverbed	2	Crane & Bent
4 05.02.03	Bacalon Br.	18.0	Difficult to go onto the riverbed	2	Crane & Bent
5 05.03.02	Kampawikan Br.	24.0	Difficult to go onto the riverbed	2	Crane & Bent
6 05.04.01	Mataque Br.	23.0	Difficult to set up the bent	3	Erection pole
7 05.04.02	Calimoog Br.	18.0	Difficult to set up the bent	3	Erection pole
8 05.04.03	Pinaglapaan Br.	23.0	Difficult to go onto the riverbed	2	Crane & Bent
9 05.05.08	Odicon Br.	15.0+18.0	Difficult to set up the bent	3	Erection pole
10 05.06.02	Manolib Br.	17.0+17.0+17.0	Possible to go onto the riverbed	1	Crane & Bent
11 05.06.03	Baldosa Br.	18.0+18.0+18.0+18.0	Possible to go onto the riverbed	1	Crane & Bent
12 06.01.14	Calangcang Br.	20.0	Difficult to go onto the riverbed	2	Crane & Bent
13 06.04.09A	Tayum-an Br.	22.0+22.0+22.0	Difficult to set up the bent	2 or 3	Crane & Bent Erection pole
14 06.04.10A	Pandanon Br.	22.0	Difficult to go onto the riverbed	2	Crane & Bent
15 06.04.12A	Bago Br.	20.0+20.0	Difficult to go onto the riverbed	2	Crane & Bent
16 06.06.03	Seguidan Br.	18.0+18.0+18.0	Difficult to set up the bent	2 or 3	Crane & Bent Erection pole
17 06.06.05	Alameda Br.	15.0+15.0	Possible to go onto the riverbed	1	Crane & Bent

Table 4.9 ERECTION METHOD FOR STEEL GIRDER (2/2)

Bridge No.	Bridge Name	Span Length (m)	Erection Site Condition	Type	Erection Device
18 07.03.01	Tohogon Br.	20.0+20.0	Possible to go onto the riverbed	1	Crane & Bent
19 07.03.02	Caneway Br.	20.0+20.0	Possible to go onto the riverbed	1	Crane & Bent
20 07.03.03	Cantaongon Br.	18.0+18.0	Possible to go onto the riverbed	1	Crane & Bent
21 07.04.07A	Canjulao Br.	18.0	Difficult to go onto the riverbed	2	Crane & Bent
22 07.04.11A	Carood Br.	15.0+15.0+15.0	Difficult to set up the bent	2 or 3	Crane & Bent Erection pole
23 07.04.12A	Tipolo Br.	15.0+15.0	Difficult to go onto the riverbed	2	Crane & Bent
24 07.06.05	Mantalongon Br.	15.0+15.0	Difficult to go onto the riverbed	2	Crane & Bent
25 07.06.06	Dumlog-Biasong Br.	18.0+18.0+18.0+18.0	Possible to go onto the riverbed	1	Crane & Bent
26 07.06.08A	Mag-Ambac Br.	15.0+15.0	Difficult to go onto the riverbed	2	Crane & Bent
27 07.06.09A	Ylaya-II Br.	15.0+15.0	Difficult to go onto the riverbed	2	Crane & Bent
28 07.08.07A	City Pound Br.	18.0	Difficult to go onto the riverbed	2	Crane & Bent
29 08.01.06A	Lawa-an Br.	18.0	Difficult to go onto the riverbed	2	Crane & Bent
30 08.01.07A	Dispo Br.	18.0	Difficult to go onto the riverbed	2	Crane & Bent
31 08.03.03	Basud Br.	18.0+18.0	Difficult to set up the bent	3	Erection pole
32 08.03.06A	Matag-ob Br.	23.0	Possible to go onto the riverbed	1	Crane & Bent
33 08.04.01A	Matagnao Br.	24.0	Difficult to set up the bent	3	Erection pole
34 08.07.09A	Bangon Br.	15.0+15.0	Difficult to go onto the riverbed	2	Crane & Bent

4.10.3 Construction of Cofferdams

Construction of substructures and river protection should be implemented in the dry season so as not only to reduce the construction costs but also to assure the safety and quality of construction. A temporary cofferdam will be required at any time during construction of substructures and river protection.

The fill type cofferdam is basically recommended while sheet pile cofferdam is proposed where the ordinary water level is relatively high or the river is wide. The typical cross sections of sheet pile and fill type cofferdam are shown in Appendix 9 Figure 9-17 and 9-18, respectively.

4.10.4 Traffic Control During Construction

31 Group-1 bridges except following 3 bridges will be constructed on same alignment of the existing bridges, therefore it is necessary to construct detour including temporary wooden bridges as shown in Appendix 9 Figure 9-10:

06.04.09A Tayon-An Br.
06.04.10A Pandanon Br.
07.04.07A Canjulao Br.

For the above 3 bridges, existing bridges or spillway can be their detour during construction.

4.10.5 Demolition of Existing Bridges

For 31 bridges mentioned in previous Section 4.10.4, the existing bridges shall be demolished at appropriate timing which will be designed through carefully studying the overall construction schedule. For other 3 bridges, the existing bridges will be demolished as soon as possible after completion.

4.11 Project Implementation Plan

4.11.1 Basic Concept

The followings are the basic concept for implementing the Japan's Grant Aid Project after Exchange of Notes (E/N) between both countries:

- Japanese Consultant (the Consultant) shall implement the Project under the consultant Agreement (the Agreement) between the DPWH.
- The consultant will carry out Detail Design for superstructure, Tendering Works and supervision on superstructure materials after the Agreement while substructure shall be designed by the DPWH.
- Tenderers for supplying superstructure materials shall be qualified Japanese contractors.
- Supplying superstructure materials will be constructed by a successful Japanese contractor under the contract between the DPWH. (the Contract)
- The Agreement and the Contract shall come into effect after Verification of Japanese Government.
- DPWH shall execute smoothly and successfully the articles defined in Minutes of Meeting signed on July 1st and October 1st, 1992.

Project contents and undertakings of both governments are described below.

1. Project Contents

The main features of Group-1 Project is shown in following:

	Group-1 Bridge
Total No. of Bridges	34
Total Length of Bridges (m)	1,115
Length of Span (m)	15,17,18,21,22,23,24
Number of Spans	·One span - 14 Br. ·Two spans - 14 Br. ·Three spans - 4 Br. ·Four spans - 2 Br. 62 spans 34 Br.
Width of Bridges (m)	·Total Width 8.32 ·Roadway 3.35 m x 2 Lanes ·Sidewalk 0.42 m x 2 Lanes
Type of Superstructures	·H-Beam Composite Girder - 34 Br.
Type of Superstructures	Abutments: T-Type Abutments (Spread or Pile) Piers: Column-Type Piers (Spread or Pile)
Cofferdams	Earth Cofferdams
Approach roads (m)	Roadways 3.35 m x 2 Lanes Shoulders 1.0 x 2 Lanes Portland Cement Concrete Pavement
River Bank Protection	Grouted Riprap

2. Undertakings of Both Governments

Scope of Grant Aid by the Government of Japan

The Government of Japan intends to provide Grant Aid which covers the following steel materials:

- Steel Materials for Superstructure
  H-beam/Steel Plate/Other Steel Materials
- Accessories
- Field Paint Materials
- Guard Rail

The steel materials will be delivered from Japan to the designated international ports of entry in the Philippines, as mentioned in Section 4.10.1.

The quantities of steel materials are referred to Section 4.9.

Undertakings of the Government of Philippines

The undertakings of the Government of the Philippines are as follows:

- Design and construction of substructures
- Inland transportation of steel materials (from designated ports to bridge sites) and erection work
- Design and construction of slabs and walls
- Design and construction of river bank protection
- Design and construction of drainage system and culverts
- Design and construction of bridge approaches

The Government of the Philippines is responsible to construct Group-1 bridges within the period of one (1) year after arriving steel materials at designated ports of entry provided under the Japan's Grant Aid, as well as to take necessary measures stated in the Minutes of Discussions.

The work quantity is referred to Section 4.9.

4.11.2 Design and Project Supervision Plan

After signing of the Exchange of Notes between the Government of Japan and the Philippines, the detail design and supervision of procurement and delivery related to providing steel material shall be executed by a Japanese consulting firm. The detailed design works shall comprise with the following preparations.

1. Detail Design

- Detail Design and Specifications of Steel Girder
- Cost Estimation of the Project
- Tender and Contract Documents for procurement of steel material

2. Tendering

Consultant shall execute the following services relevant to the tendering.

- Tender Notice
- Tender Prequalification
- Tendering
- Tender Evaluation

3. Manufacture of Equipment

After verification, the supplier will receive the note of contract from the Government of Japan. Then, the supplier will manufacture the equipment.

4. Transportation of Equipment

The Japanese supplier will execute the marine transportation from Japan to designated ports in the Philippines.

5. Supervision for Delivery

- Submission of material specification
- Documentation and submission of erection manual
- Documentation and submission of maintenance manual
- Inspection and delivery

4.11.3 Procurement Plan

Considering the quality control and the time for delivery of the steel materials for the implementation of the Project, the steel material shall be procured in Japan.

4.11.4 Implementation Schedule

Table 4.10 shows the implementation schedule.

Table 4.10 IMPLEMENTATION SCHEDULE

	1	2	3	4	5	6	7	8	9	10	11	12
Detail Design and Tendering		(5.5 months)										
Steel Material Procurement and Supervision		(Manufacture)										
		(7 months)					(Transport, Inspection and Delivery)					

4.11.5 Construction Cost

The construction cost borne by the Government of the Philippines is roughly estimated as 202.8 million pesos, as shown in Table 4.11 and Appendix 11.

Table 4.11 COST BORNE BY THE GOVERNMENT OF THE PHILIPPINES

Custom Clearing Fee	0.2 Million Pesos
Inland Transport	1.7 Million Pesos
Construction	200.9 Million Pesos
Total	202.8 Million Pesos

CHAPTER 4 BASIC DESIGN

PART II Group-2 Bridge

PART II Group-2 Bridge

4.1 Design Policy

The following design policies were adopted:

1) Bridge alignments are decided by the technical examinations of the Study Team after joint-investigation together with the DPWH.

2) Superstructure is steel or prestressed girder.

   - Steel materials of convenient size shall be taken for transportation and fabrication.

   - Prestressed girder shall be fabricated at bridge construction site.

3) Substructure is constructed by using the local materials as much as possible.

4) Concrete pavement is much better than the others because of subsoil conditions.

5) River protection shall be provided in order to avoid damage to abutments by river flow.

6) Detour roads shall be provided as much as possible during construction as required.

The detailed design is carried out by the Japanese Consultant in accordance with the design criteria established by the discussions between the DPWH and the Study Team.

4.2 Site Surveys and Hydrological Analysis

4.2.1 Field Joint-Investigation

The field joint-investigation for Group-2 bridges was carried out during the topographic and geotechnical surveys.

The items investigated were as follows:

- Examining present conditions of bridges, and confirming topographic and geographic features.
- Ascertaining DPWH views concerning locations of bridges to be replaced, and discussing locations from engineering points of view (refer to Appendix 5).
- Determining whether detour roads are required during bridge construction and whether existing roads are useful for detour.
- Investigating conditions of roads and ports to be utilized for transportation of equipment and materials.
- Determining whether the bridge construction will affect existing houses or private properties.
- Collecting rainfall data of sites to know the best timing of constructing substructures.
- Conducting interviews to determine the maximum water level or maximum flood level.

4.2.2 Topographic/Hydrological Survey

To obtain the topographic data necessary for the detailed design of the bridge, access roads and river bank protection, topographic survey was carried out by local topographic company under supervising of the Study Team. Philippine common method as using level machine and transit equipment was adopted.

Contents of the survey

- Centerline Survey : scale 1/200
- Profile Survey : scale 1/200
- Cross Section Survey: scale 1/200
- Setting of Monument :
- Topographic Map : scale 1/200

The results are summarized in Appendix 6.

4.2.3 Geotechnical Survey

To confirm the geological conditions of foundation of bridges for the detailed design, the geotechnical survey was performed by local geotechnical survey company under supervising of the Study Team.

Contents of the Survey

- Standard Penetration Test
- Sampling
- Laboratory Test
  - natural water content test

The quantity list, borhole log and description on subsoil are presented in Appendix 7, while the detailed survey results are reported separately.

4.2.4 Hydrological Analysis

The hydrological analysis was conducted to estimate the magnitude of design discharge and to decide river opening area required for discharge during flooding. The output of the analysis is presented in Appendix 8 and the detailed analysis is compiled in a separate report.

4.2.5 Summary of Site Surveys and Hydrological Analysis

The results of field joint-investigation, topographic/hydrological survey and geotechnical survey are summarized in the following tables:

Table 4.12 : Field Investigation
Table 4.13 : Topographic/Hydrological Survey and Geotechnical Survey

Table 4.12 BASIC INFORMATION OF PROPOSED BRIDGES

No.	Bridge No.	Name & Location of Bridge	Present Condition	Proposed Location of New Bridge	Detour During Construction	Demolition of Existing Bridge	Condition of Access Road	Remarks
1.	05.02.04	Banquerohan Br. Sorsogon	·BCDG ·Deteriorated ·Load limit 5 ton	·Downstream	·Existing bridge can be used	·Not necessary	·Good Condition ·607km from Manila	·Relocation of Electric power line by Electric company ·Under the influence of tide
2.	05.03.01	Hitoma Br. Catanduanes	·Baily Br. ·Deteriorated	·Downstream	·Existing bridge can be used	·Not necessary	·Good Condition ·151km from Manila	·Several weak bridges (Load limit 3-5 tons) are located leading to the bridge site
3.	05.06.04	Lanang Br. Masbate	·Spillway ·Impassable during rainy season	·Same location, but crossing above the existing bridge	·Existing spillway can be used	·Not necessary	·Poor Condition · 56km from Masbate Port	
4.	05.06.05	Potot Br.	·Baily Br. ·Deteriorated	·Upstream	·Existing bridge can be used	·Not necessary	·Good Condition · 37km from Masbate Port	·Deforestation of coconut trees are required
5.	06.06.04	Lawigan Br.	·Baily Br. ·Deteriorated ·Load limit 5 ton	·Same location of existing bridge	·Detour is required at upstream	·Necessary before Construction of New bridge	·Good Condition · 70km from Iloilo	·Relocation of Electric power line/water supply pipe ·Tide
6.	07.05.01	Apalan Br.	·Baily Br. ·Deteriorated	·Upstream	·Existing bridge can be used	·Not necessary	·Good Condition · 97km from Cebu	·Relocation of Electric power line ·Under the influence of tide
7.	07.05.05	Tambongon Br.	·Timber Br. ·Deteriorated	·Downstream	·Existing bridge can be used	·Not necessary	·Good Condition ·131km from Cebu	·Under the influence of tide ·Several weak bridges (Load limit 3-5 tons) are located leading to the bridge site
8.	07.06.07	Mojon Br.	·Spillway	·Same location of existing downstream	·Detour road is existing at downstream	·Not necessary	·Good Condition ·0.2km from -Tabunok	·House demolition ·Relocation of Electric power line
9.	07.15.06A	Alimango Br.	·Concrete Arch Br. ·Deteriorated	·Upstream, crossing above the existing bridge	·Closed	·Necessary	·Good Condition · 28km from Toledo	
10.	08.01.01	Anas Br.	·Baily Br. ·Deteriorated	·Same location of existing bridge	·Detour is required at upstream	·Necessary	·Good Condition ·102km from Tacloban	·Tide ·Relocation of Electric power line/water supply
11.	08.03.04	Elizabeth Br.	·Baily Br. ·Deteriorated	·Downstream	·Existing bridge can be used	·Not necessary	·Good Condition ·984km from Manila	·Relocation of Electric power line

Table 4.13 TOPOGRAPHIC & GEOLOGICAL CONDITIONS (1/3)

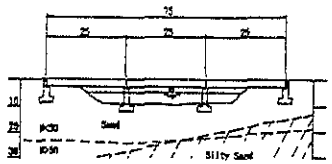
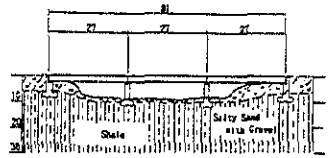
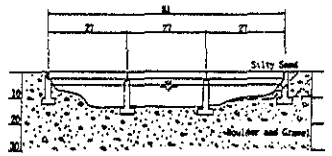
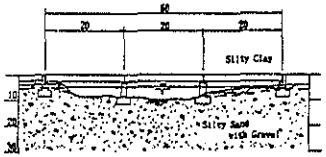
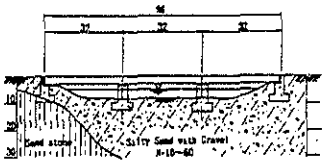
Bridge No.	Bridge Name	Location of Bridge Site	Geological Profile (Approximation)	Topographical Feature	Geological Feature	Recommendation for Bridge Design
05.02.04	Banquerohan Br.	km. 607 + 023.60 Gubat-Barcelona-Bulsan Road Barcelona, Sorsogon		· Situation of bridge is 300m from sea shore. · Downstream side is marshy district with Mangroue · Upstream site at a distance of 4km from the bridge site is hill area with coconut fields.	· No sandy gravel (corals) · Geology of bridge site consist of terrace deposits which is sand. · Approach road of left bank is swamp area. · There are bearing bed at 17m (depth) for bridge foundation.	· Under the influence of tide · There is fishpond at downstream. · Water depth is normally 2m 2.5m
05.03.01	Hitoma Br.	km. 151 + 600 Virac-San Andres-Caramoran Pandan Road, Catanduanes		· There are hill areas. · Situation of bridge is 1km from sea shore. · The surrounding areas are coconut fields. · The left side is a mountain.	· Geology of bridge site consist of silty sand and shale. · The upper strata is silty sand and lower strata is shale. · Bearing bed is shale with N-Value of more than 50.	· Width of river is 74m and wild. · Water depth of the river was 0 meter at the field survey. · River meanders. · There are rocks on the river bed.
05.06.04	Lanang Br.	km. 56 + 129.33 From Masbate Port, Masbate- Aroroy Road, Masbate		· The proposed bridge site is in corn field and coconut field and is surrounded with the hills.	· Geology of the proposed bridge site consist of sand and gravels. · N-Value is more than 50 at the point of a depth of 2 3 from the ground surface.	· Width of the river is wild. · Flood volume is large. · There are many rocks and boulders on the river bed. · River does not meander.
05.06.05	Potot Br.	km. 37 + 739.78 From Masbate Port, Masbate- Balud Road, Masbate		· The proposed bridge site is in corn field of plain.	· Geology of the proposed bridge site consists of clavey silt (upper strata) and sand with gravel (lower strata). · The bearing bed is sand with gravel with with the N-Value of more than 50.	· Water way is a large scale meander. · Water depth is ordinally 1.5 meters. · At the flood, overflow occurs on the roads. (right bank)
06.06.04	Lawigan Br.	km. 70 + 900 Tiolas-Sinogbuhan Road San Joaquin, Iloilo		· The proposed bridge site is situated on the distance of 100m from sea shore and is surrounded by coconut fields and miscellaneous trees.	· Geology of the proposed bridge site consists of sandy silt (upper strata) and sand with gravel (lower strata). · The bearing bed is sand with gravel with N-Value of more than 50.	· Under the influence of tide.

Table 4.13 TOPOGRAPHIC & GEOLOGICAL CONDITIONS (2/3)

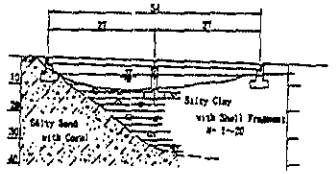
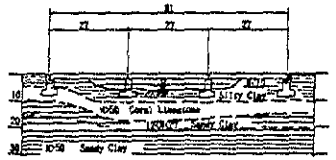
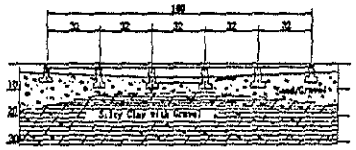
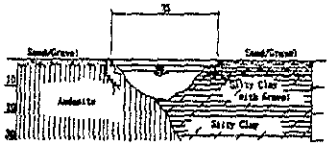
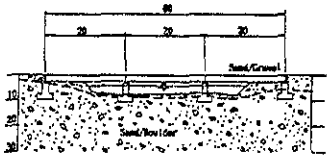
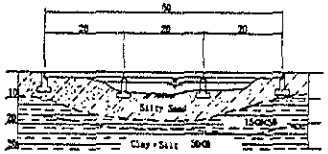
Bridge No.	Bridge Name	Location of Bridge Site	Geological Profile (Approximation)	Topographical Feature	Geological Feature	Recommendation for Bridge Design
07.05.01	Apalan Br.	km. 97 + 803 Toledo-Tabuelan Road Cebu I		· The proposed bridge site is located on the distance of 70m from the sea shore and is surrounded by coconuts fields. · Second approach road is flooded at high tide.	· Geology of left bank side of the bridge consists of silty sand with shell fragments and corals, and right bank side consists of silty clay with shell fragments and coral. · Bearing bed is silty sand with N-Value of more than 50.	· Under the influence of tide.
07.05.05	Tambongon Br.	km. 131 + 248 Antonio de Pio Highway Cebu I		· The proposed bridge site is in sea. · Upstream side is fish pond.	· The proposed bridge site is located in the inlet. · Coral limestone with thickness of 4 ~ 8m is situated on depth between 5m ~ 10m from ground surface. And its lower strata is sandy clay. · Bearing bed is sandy clay with N-Value of more than 50.	· Under the influence of tide.
07.06.07	Mojon Br.	km. 0 + 200 From Tabunok Tabunok-Talisay Road Cebu II		· The proposed bridge site is in plain. · River is large scale meander. · There are so many boulders. · Flow velocity is fast during flood.	· River width at the bridge site is narrow. · There are many boulders and sand with gravel on the river bed. · Bearing bed is sand with gravel or silty clay with N-Value of more than 50.	· Generally, river width is so wide.
07.06.09A	Alimango Br.	km. 28 + 502 Cebu-Toledo Wharf Road Cantabaco, Toledo City Cebu II		· The proposed bridge site is surrounded with mountainous district. · There are many boulders and gravels on the river bed. · The one side of the road is a mountain with steep slope, and the other side is a valley.	· Left bank consists of andesite, and right bank consists of silty clay and clayey silt. · N-Value is more than 50 at a depth of 7m from surface on right side.	· The proposed bridge site is narrow as like a throat. · Upstream site has a sleep river gradient.

Table 4.13 TOPOGRAPHIC & GEOLOGICAL CONDITIONS (3/3)

Bridge No.	Bridge Name	Location of Bridge Site	Geological Profile (Approximation)	Topographical Feature	Geological Feature	Recommendation for Bridge Design
08.01.01	Anas Br.	km. 102 + 820 From Port of Ormoc City to Naval-Almeria and Circumferential Road, Biliran Sub-Province 0		• The proposed bridge site is situated on the distance of 300m from a mouth of the river. • There are many boulders of sizes with 30cm 60cm on the river bed. • A large alluvial corn (fan) spreads around 3km upstream from the bridge.	• Stratum consists of ground and cobble stone. • Sandy gravel (N: Value more than 50) is adopted for the bearing stratum.	• River bed gradient is gentle and ordinary flow is slow.
08.03.04	Elizabeth Br.	km. 984 + 820 Lemon-Sambolawan-Calaguise-Calubian Road Leyte II		• The river is meandering, and both of side is eroded at upstream site. • Ordinary water level is about 1m. • The surrounding areas are in houses, and Banana Field.	• The proposed bridges site consists of sandy silt and clayey silt. • Bearing stratum consists of clay and silt.	• River bed gradient is gentle and ordinary flow is slow.

4.3 Design of Bridge Type

4.3.1 Outline on Design of Bridge Type

The hydrological and geological conditions of each bridge were discussed to determine the most appropriate type of bridge. The conditions of Group-2 bridges are follows:

(1) 05.02.04 Banquerohan Bridge

Hydrological Condition

The Barcelona River is relatively shallow with small velocity and 60 meters in width.

There is a shoal at the upstream of the existing bridge, where the waterway separates into two. The two waterways join together near the existing bridge where the river becomes wide.

The proposed bridge site is located at a distance of 200 m from the river mouth.

Topographical and Geological Condition

There are many coconut and mangrove trees around the bridge.

The geological strata is composed of upper and lower alluvial sandy gravel. N-Values of the upper and the lower are more than 30 and 50 respectively.

The measure for soft ground is necessary for the approach road in the leftbank. Piles for foundations of abutment and piers shall be penetrated into the lower sandy gravel.

Construction Condition

Soil cofferdam can be adopted for the construction of pier inside the river because of shallow water and small velocity.

(2) 05.03.01 Hitoma Bridge

Hydrological Condition

Hitoma River has a width of about 74 meters and is surrounded with mountains. At the time of the site investigation, there was no water in the river. On the river bed, gravel and sand could be seen. The river bed gradient is relatively steep.

Topographical and Geological Condition

The proposed bridge site is located at low flatland with coconut plantation.

The geological feature is composed of sand, gravel and shale strata. The upper is composed of sand and gravel (N: less than 50, thickness 3 meters), and the lower is composed of shale (N: more than 50). The shale is expected for bearing stratum.

Construction Condition

Spread footing foundation constructed by open-cut method is recommended for the pier, because of shallow water level and bearing stratum (2 ~ 3 m).

(3) 05.06.04 Lanang Bridge

Hydrological Condition

Lanang River has a width of about 45 meters and flows in a mountainous terrain. Its flood discharge is extremely large. Rocks and boulders can be seen in the river bed.

Topographical and Geological Condition

The proposed bridge site is located in the mountainous terrain, and is surrounded with coconut trees, corn and grass fields.

The geological feature is composed of sand and gravel strata.

N-Value reaches more than 50 at 2 ~ 3 meters depth from the ground surface.

The sand and gravel strata is expected for bearing stratum.

Construction Condition

Spread footing foundation constructed by open-cut method is recommended for piers and abutments, because of shallow water level and bearing stratum (2 ~ 3 m).

(4) 05.06.05 Potot Bridge

Hydrological Condition

The Potot River has a width of about 40 meters and big velocity. And the water is relatively deep. The river stretches in a zigzag line near the existing bridge.

Topographical and Geological Condition

Low terrace develops on both sides of the river. The proposed bridge site is located in flat areas, and is surrounded with corn fields.

The Geological feature is composed of clayey silt and sandy gravel strata. The upper is clayey silt (N: less than 50, thickness 4 ~ 6 meters), while the lower is sandy gravel (N: more than 50).

Piles for foundation of pier and abutment shall be penetrated into the sandy gravel.

Construction Condition

As the river is relatively shallow and its flow is steady and slow, soil cofferdam can be adopted for the construction of pier.

(5) 06.06.04 Lawigan Bridge

Hydrological Condition

Lawigan river has a width of about 90 meters. At upstream of the bridge, the river stretches in a zigzag line.

The stream velocity is relatively small. The water depth at the left side of the river is 1.5 meters, and its depth at the right side is 0.5 meters.

Topographical and Geological Condition

The proposed bridge site is located in flatland near the river mouth, and is surrounded with coppices and coconut plantations.

The geological feature is composed of clayey silt and sandy gravel strata. The upper is composed of clayey silt (N: less than 50, thickness: 4 ~ 6 meters), and the lower is composed of sandy gravel (N: more than 50).

Piles for foundation of pier and abutment shall be penetrated into the lower sandy gravel.

Construction Condition

The bridge is located near the river mouth.

As the river is relatively shallow and its flow is steady and slow, soil cofferdam can be adopted for the construction of pier.

(6) 07.05.01 Apalan Bridge

Hydrological Condition

As the bridge site is located near the seashore, the tide largely affects to the structures.

It is necessary to consider erosion caused by waves on approach road (right side of the river) during typhoon season.

Topographical and Geological Condition

The proposed bridge site is located in flat areas and is surrounded with coconut plantation.

At the left side of the river, silty sand layer with coral fragments (N: more than 50) is existing about 6 ~ 7 meters in depth.

At the right side of the river, the upper layer consists of poor subsoil (silty clay with shell fragments, N: less than 10, thickness: more than 15 meters), while the lower layer consists of silty sand with coral fragments (N: more than 50, depth: more than 30 meters).

Construction Condition

Soil improvement works should be necessary for approach road on right riverside.

Revetment protecting the approach road from waves is required on the right side of the river.

Pile footing foundation should be needed for the construction of pier and abutment.

(7) 07.05.05 Tambongon Bridge

Hydrological Condition

Tambongon Bridge is situated at the coast. There are several fish ponds in upstream.

Tidal current is very rapid and the depth of water is also deep.

Prestressed concrete girder should be adopted for salty water resisting.

Topographical and Geological Condition

The proposed bridge site is located at the flat coast. The stratum is composed of coral limestone and sandy gravel strata (N: more than 50).

Pile footing foundation is adopted for the pier and abutment. Test piling should be necessary for confirming the penetration depth on coral limestone.

Soil improvement works are necessary (N: less than 10, thickness: about 10 meters) for approach road (north side of the bridge).

Construction Condition

The tidal current is comparatively rapid and water is deep. Therefore steel sheet piles are required for the construction of pier and abutment inside the sea.

For the manufacturing of prestressed concrete girder, the southern area of the bridge can be used.

(8) 07.06.05 Mojon Bridge

Hydrological Condition

Mananga River has a width of about 100 meters. The river stretches in a zigzag line near the bridge. The stream is relatively rapid.

Topographical and Geological Condition

The proposed bridge site is located in a wide flood plain urban zone. The geological feature is composed of sandy gravel, silty clay and clayey sand stratum which have more than 50 of N-Value. Pile footing foundation is adopted for the pier and abutment.

Construction Condition

At the time of ordinary water level, the stream is steady flow with small velocity and shallow.

Therefore soil cofferdam is adopted for the construction of pier.

(9) 07.15.06A Alimango bridge

Hydrological Condition

Panda River has a width of about 16 meters, and stretches in a zigzag line near the bridge.

The riverbed gradient is comparatively steep at the upstream side.

The maximum water level is high and stream velocity is high.

Topographical and Geological Condition

The proposed bridge site is located at a steep gorge, and is surrounded in mountainous terrain with banana and coconut plantations.

The bearing stratum is "Andesite" in the left side of the river and silty clay (N: more than 50) in the right side.

Spread footing foundation on the Andesite and pile foundation system on the silty clay are adopted for the left abutment and the right abutment respectively.

Construction Condition

Since the ordinary water level is low, but the riverbed gradient is extremely steep at the upstream of the bridge, it is necessary to pay attention on "a flash flood" during the construction.

Approach road on the left side of the river faces weathering Andesite.

(10) 08.01.01 Anas Bridge

Hydrological Condition

Anas River is located at 300 meters to upstream from its river mouth. And the river has relatively high velocity.

The river has a width of about 45 meters. Cobble stone and gravel can be seen in the river bed.

The river stretches in a zigzag line at upstream side.

Topographical and Geological Condition

The proposed bridge site is located in flatland, and is surrounded with rice fields. A large alluvial corn (fan) extends around 3 km to upstream from the bridge.

The geological feature is composed of gravel and cobble stone strata. Sandy gravel (N: more than 50) is adopted for the bearing stratum. To avoid scouring by rushing stream,

pile footing foundation should be adopted for the construction of pier and abutment.

Construction Condition

Stream with high velocity and large volume of discharge during flood results in accumulation of cobble stones in the riverbed.

It is necessary to investigate the penetration depth of piles prior to the construction, because of presence of cobble stones in the river bed.

(11) 08.03.04 Elizabeth Bridge

Hydrological Condition

The river has a width of about 45 meters and stretches in a zigzag line at both sides of the bridge.

Lateral erosion can be seen at the river terrace on the left side.

The river has relatively small velocity, but maximum water level is very high.

Topographical and Geological Condition

The proposed bridge site is located in flat areas, and is surrounded with corn fields.

The geological feature is composed of sandy silt and clayey silt mixture.

Construction Condition

Clayey silt mixture (N: more than 50, depth: 16 ~ 20 meters) should be adopted for bearing stratum.

The river has a depth of 1 meter at the ordinary water level. Soil cofferdam can be adopted for the construction of the pier.

4.3.2 Bridge Length and Span Length

The bridge length and span length are decided based on M.F.L. (maximum flood level), the results of topographic survey (topographic map, river cross section and road cross section) and the results of hydrological analysis.

The followings are the engineering considerations to be taken in design of locations for pier and abutment:

- Pier should locate where they will not obstruct the water flow and interfere with the river system.
- Abutment should be on the riverside land in order to protect it from river stream.

On the other hand, the span length are estimated by the Japanese Design Guideline specified as follow:

$$Q \geq 500 \text{ m}^3/\text{sec} \qquad L = 30 + 0.005\,Q$$
$$Q \leq 500 \text{ m}^3/\text{sec} \qquad L = 20 + 0.005\,Q$$

where: Q = design flood discharge, m^3/sec
L = span length in meter

The bridge and span length to be adopted in bridge design were decided as shown in Table 4.14.

Table 4.14 PROPOSED BRIDGE LENGTH AND SPAN LENGTH (GROUP-2)

Bridge No.	Bridge Name	Bridge Length by Hydrological Analysis (m)	Computed Span Length (m)	Bridge and Span Length (m)
05.02.04	Banquerohan Br.	88.0	22.0	25 x 3 span = 75
05.03.01	Hitoma Br.	85.6	33.6	27 x 3 span = 81
05.06.04	Lanang Br.	77.8	35.2	27 x 3 span = 81
05.06.05	Potot Br.	61.4	21.2	20 x 3 span = 60
06.06.04	Lawigan Br.	93.0	22.5	32 x 3 span = 96
07.05.01	Apalan Br.	37.2	31.8	27 x 2 span = 54
07.05.05	Tambongon Br.	78.0	32.6	27 x 3 span = 81
07.06.05	Mojon Br.	160.0	34.0	32 x 5 span =160
07.15.06A	Alimango Br.	23.4	21.2	35 x 1 span = 35
08.01.01	Anas Br.	60.8	21.6	20 x 3 span = 60
08.03.04	Elizabeth Br.	59.8	22.2	20 x 3 span = 60

4.3.3 Types of Superstructures

The number of span and span length are summarized in Table 4.15.

Table 4.15 LENGTH AND NUMBER OF SPAN

Span Length	No. of Span
35.0	1
32.0	8
27.0	11
25.0	3
20.0	9
Total	32 spans (843 m)