

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

MINISTRY OF COMMUNICATION, TRANSPORT AND POST
CAMBODIA

**BASIC DESIGN STUDY REPORT
ON
THE PROJECT
FOR
RESTORATION OF CHROY CHANGWAR BRIDGE
IN
CAMBODIA**

FINAL REPORT

NOVEMBER 1992

PACIFIC CONSULTANTS INTERNATIONAL

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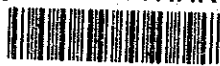
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国際協力事業団

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PREFACE

In response to a request from the Supreme National Council of Cambodia. The Government of Japan decided to conduct a basic design study on the Project for Restoration of Chroy Changwar Bridge and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Cambodia two study teams. The first study team was headed by Mr. Yokoi Yutaka, Deputy Director, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs, and constituted by members of Ministry of Construction, Honshu-Shikoku Bridge Authority and Pacific Consultants International, from the 5th April to the 26th May, 1992. The second one was headed by Mr. Minoru Fujiwara, Director, Structure and Bridge Department, Public Works Research Institute, Ministry of Construction, and constituted by members of Honshu-Shikoku Bridge Authority and Pacific Consultants International from the 12th July to the 2nd August, 1992.

The teams held discussions with the officials concerned of the Supreme National Council of Cambodia, and conducted field studies at the study area. After they returned to Japan, further studies were made. Then, a mission was sent to Cambodia in order to discuss a draft report, and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Supreme National Council of Cambodia for their close cooperation extended to the teams.

November 1992



Kensuke Yanagiya
President

Japan International Cooperation Agency

November 1992

Mr. Kensuke Yanagiya
President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

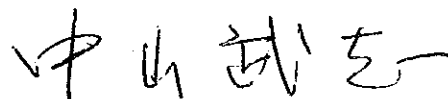
We are pleased to submit to you the basic design study report on the project for restoration of Chroy Changwar Bridge in Cambodia.

This study has been made by Pacific Consultants International based on a contract with JICA, from March 30th to November 30th, 1992. Throughout the study, we have taken into full consideration of the present situation in Cambodia, and have planned the most appropriate project in the scheme of Japan's grant aid.

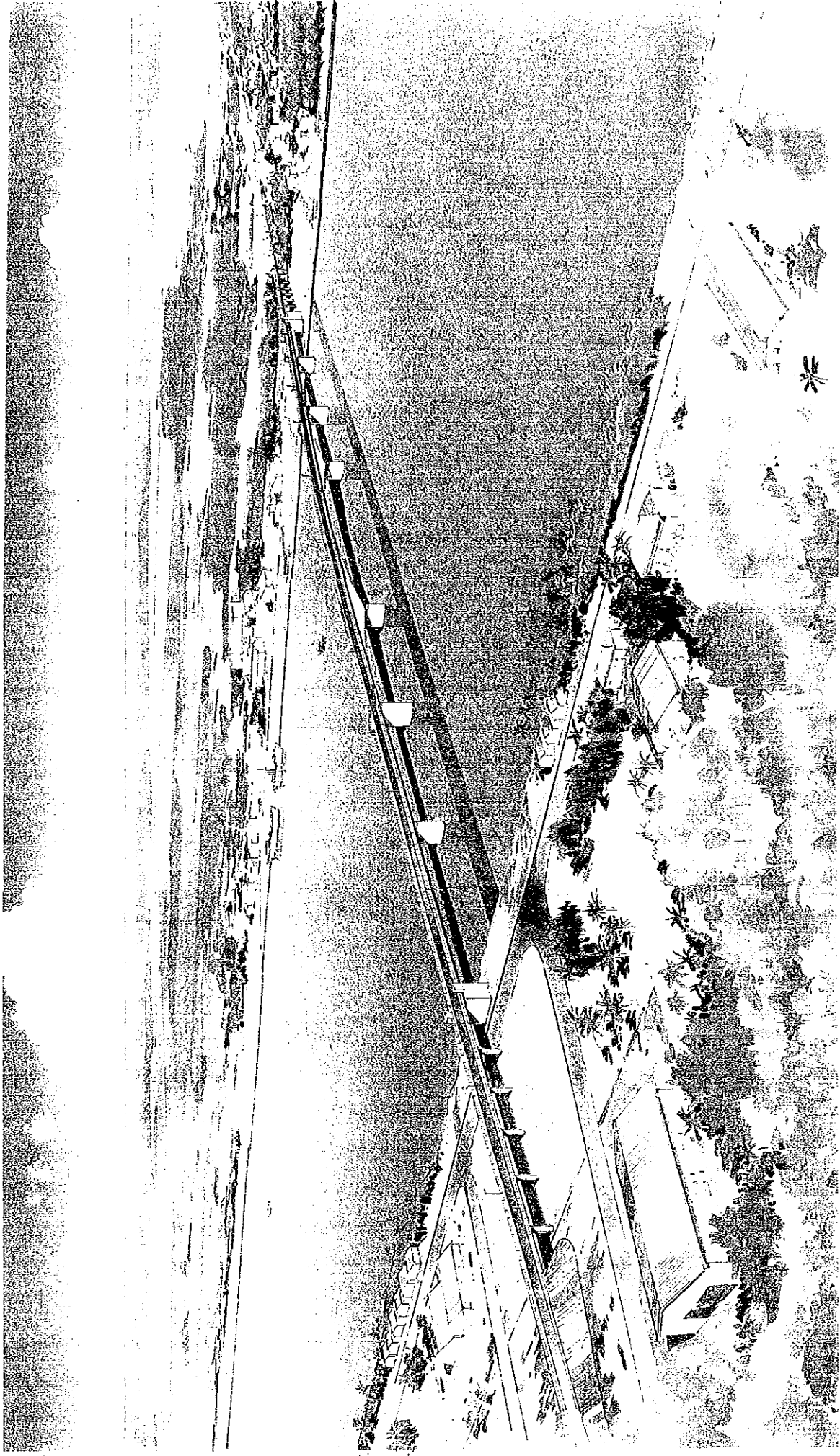
We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA the Ministry of Foreign Affairs, Ministry of Construction, and Honshu-Shikoku Bridge Authority. We also wish to express our deep gratitude to the officials concerned of Ministry of Foreign Affairs, Ministry of Communication, Transport and Post, and the Embassy of Japan in Cambodia for their close cooperation and assistance during our study.

At last, we hope that this report will be effectively used for the promotion of the project.

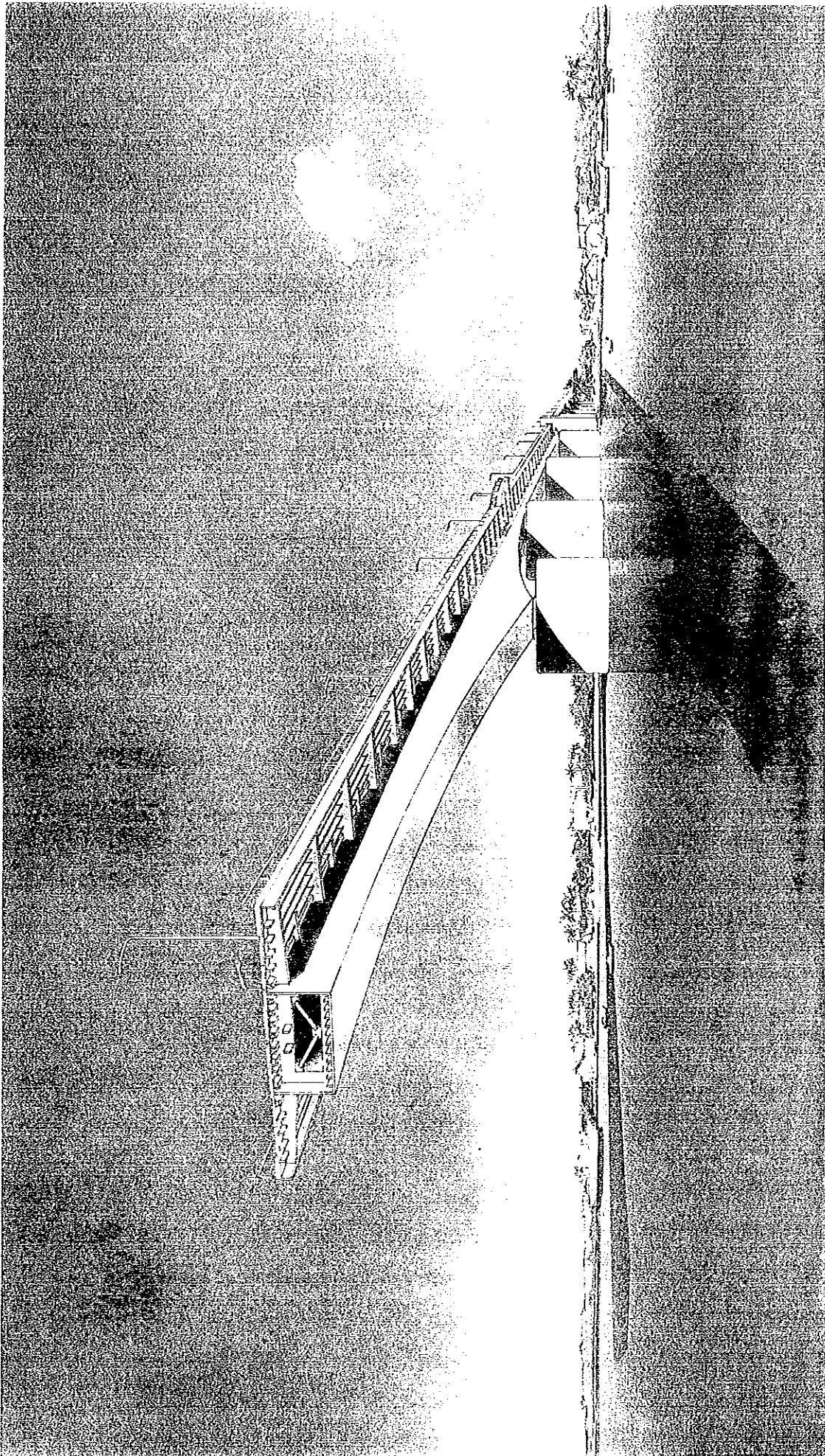
Very truly yours,



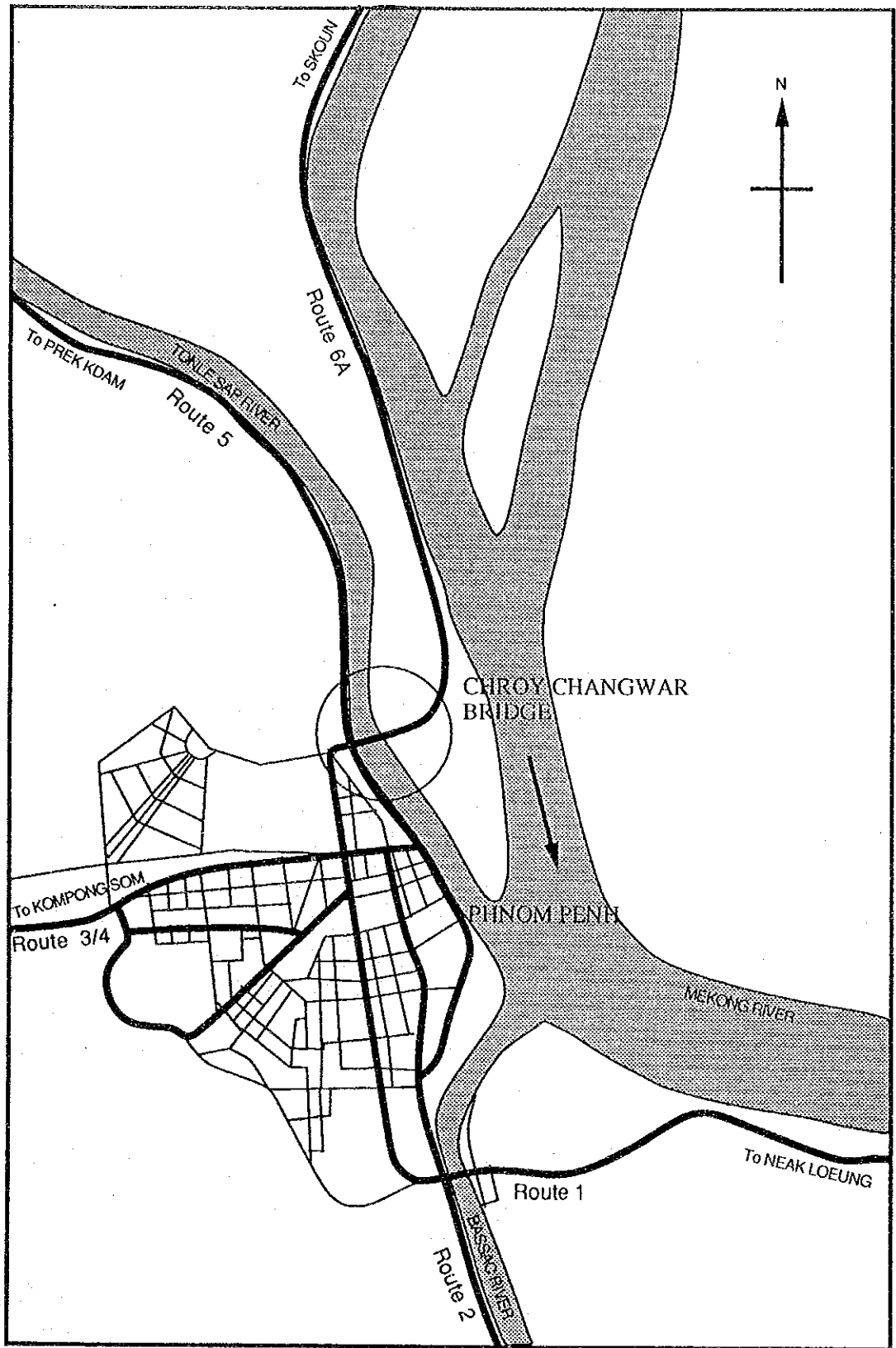
Team leader, Takeshi Nakayama
Basic design study team on the project
for restoration of Chroy Changwar Bridge
in Cambodia
Pacific Consultants International



Bird's-eye View of Future Chroy Chngwar Bridge



Perspective Sketch of Chroy Changwar Bridge Component



Road Network in Phnom Penh and its Surroundings

Summary

SUMMARY

Cambodia is located in the southwestern part of the Indochina Peninsula. It lies between 10 and 15 degrees north latitude and 102 and 108 degrees east longitude. The Country occupies an area of 181,035 sq.km, sharing 2,438 km of land border with Thailand, Laos and Vietnam, and has 389 km of coastline on the Gulf of Siam.

The population of the municipality of Phnom Penh was reported as 354,000 in 1981 and as 564,000 in 1987 by the Ministry of Planning and Agriculture. In 1991 the actual population is expected to be considerably higher than the above, somewhere between 800,000 to 1 million.

The Construction of Chroy Changwar Bridge was started in 1960 as a quasi-compensation project by Japan, and was completed in 1963. The bridge is located at the north-eastern end of Phnom Penh City and crosses over the Tonle Sap river. The length of the bridge is of 709 m long. In September 1972, the superstructure of three center spans and the substructure of pier No. 4 were destroyed during the civil war.

The bridge had played a vital role to connect Phnom Penh City with the north-eastern region through Routes 6A, 6 and 7. The restoration of the bridge has been given the highest priority in the improvement plan of infrastructures in Cambodia. The restoration of the bridge is believed to contribute greatly to the social and economic development in the eastern side of the Tonle Sap River.

In the light of its importance and urgency, the Supreme National Council of Cambodia has requested the Japan's Grant Aid for the Project.

In response to the request from the Supreme National Council of Cambodia, the Government of Japan decided to conduct a Basic Design Study on the Project for Restoration of Chroy Changwar Bridge, and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Cambodia the first mission from April 5 to May 26, 1992, and the second mission from July 12 to August 2, 1992.

The team held discussions with the officials concerned of the Supreme National Council of Cambodia and conducted site reconnaissance, traffic survey on National Road No. 5, No. 6 and ferry site in Phnom Penh, structural soundness investigations,

survey for construction and transport planning, geologic and topographic surveys at the study area.

The study team carried out the basic design in detail in Japan based on the results of the field survey.

The Draft Final Report prepared in Japan containing the outline of the project was taken to Cambodia for discussion and agreement with the Supreme National Council authorities from September 21 to September 30, 1992.

Since all piers except piers No. 4 and No. 5 and the remaining portions of the superstructure are sound from the structural viewpoint, the repair of Chroy Changwar Bridge is planned taking the utilization of the remaining portions of the bridge into consideration. Therefore, both horizontal and vertical alignments, length of bridge, elevation and width coincide with the original bridge in principle.

The outline of restoration of the collapsed 265 m long center spans is as follows:

- 1) Type of Superstructure : 3 span continuous steel box girder with steel plate deck.
- 2) Span Length : 65.0 m + 135.0 m + 65.0 m.
- 3) Number of Lanes of Bridge and Approach Roads : 2 lanes (one lane each direction) with cycle track and sidewalk.
- 4) Width of Bridge : 7.0m wide (3.50m x 2) for through lanes 3.80m wide (1.90m x 2) for cycle track and 2.20m wide (1.10 m x 2) for sidewalk.
- 5) Erection Method : Three blocks by a floating crane.
- 6) Type of Foundations : Well type with Steel Pipe Sheet Pile

As for repair works of the existing bridge, major works are paving, repainting and are limited to restoration of the function of the bridge.

Implementation schedule for this project scheme is such that the tendering and the tender evaluation will take about 2.0 months, and the construction period is

estimated as 12 months for Phase I construction, and 7 months for Phase II construction, totaling 16 months including overlapping of 3 months.

The Project Site lies on National Route 6A which serves nine provinces in the north-east region of the country, having a population of 3 million. The Chroy Changwar Bridge, which is located on this route as a starting point, was only one bridge transverse over the Tonle Sap river.

444 m long bridge structure out of 709 m long original bridge remains usable, and only 265 m long collapsed central three spans make this bridge unusable, and connecting National Route 6A was not used for the past twenty years.

In case that the 265 m long central span is reconstructed, Chroy Changwar Bridge as well as National Route 6A will be able to be restored. Thus, it is obvious that the Project can expect economically high returns. The major significance of the Project are summarized as follows:

- 1) High development impact in both Phnom Penh and the eastern side of the Tonle Sap river can be expected after the bridge becomes passable to traffic.
- 2) It will be possible to make use of National Route 6A partially because the starting 11 km stretch is still in passable condition.

In addition, the following effects are expected:

- 1) It enable to facilitate and promote the rehabilitation of National Route 6A.
- 2) It will be possible to make realistic a new Phnom Penh port which is planned along the Mechong River in the Chroy Changwar area.
- 3) It will be possible to supply water, power and telecommunication to the eastern side of the river along to the bridge. The Project will promote the stabilization of livelihood to satisfy the Basic Human Needs (BHN), and improve the level of life in the Chroy Changwar area.
- 4) It will be possible to create effective job opportunities for returnees and demobilized soldiers. It will also contribute to stabilize public welfare.

- 5) It will raise the quality of skilled labours whom the reconstruction and development of the country will require to large extent.
- 6) At present, local traffic consisting of pedestrians, bicycles and motorcycles are forced to use small boats to cross the river and pay a charge. The transport cost will be reduced after the completion of the Project.

In view of the above-mentioned effects, the implementation of the Project is indispensable not only for providing Chroy Changwar Bridge for use as a traffic function but also for promoting the stabilization of livelihood and improving the level of life.

Thus, it is concluded that the implementation of the Project by Japan's Grant Aid System is evaluated as appropriate.

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List of Abbreviations

Alt.	Alternative
BHN	Basic Human Needs
B.P.	Beginning Point
Br.	Bridge
cm	Centimeter
EIV	Economic Intelligent Unit
E.P.	Ending Point
EOJ	Embassy of Japan
FSM	Finite Strip Method
GDP	Gross Domestic Product
GNP	Gross National Product
Gs	Specific Gravity
JICA	Japan International Cooperation Agency
kg/cm ²	Kilogram per Square-centimeter
kg/cm ³	Kilogram per Cubic-centimeter
t/m ²	Ton per Square-meter
km,KM	Kilometer
kw	Kilowatt
lit	Liter
MCTP	Organization of the Ministry of Communication, Transport and Post
m,sq.m,cu.m	Meter,Square-meter,Cubic-meter
mm	Millimeter
m/s	Meter per Second
m ³ /hr	Cubic-meter per Hour
PCI	Pacific Consultants International
PUC	Passenger Car Unit
PS	Horse-power
RBD	Road and Bridge Department
USSR	(old name)Union of Soviet Socialist Republics
veh	Vehicle
W _l	Liquid Limit
W _n	Natural Water Content

Chapter 1: Introduction

CHAPTER 1: INTRODUCTION

1-1 Objectives of the Study

The objectives of the Basic Design Study are as follows:

- (1) to examine the effect of the project and its appropriateness for the Grant Aid Program of JICA;
- (2) to conduct the Basic Design Study to determine the most suitable content and scale of the project; and
- (3) to make a preliminary survey for the rehabilitation of road which connects to Chroy Changwar Bridge in the eastern side of the Tonle Sap River.

This Final Report has been prepared by the study team, in order to explain the results of the basic design based on the mutual understanding regarding the basic items of the Project and to confirm the components of the basic design study.

1-2 Mission to Cambodia

In response to the request from the Supreme National Council of Cambodia, the Government of Japan decided to conduct a Basic Design Study on the Project for Restoration of Chroy Changwar Bridge (hereinafter referred to as "the Project"), and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent to Cambodia the first mission, which was headed by Mr. Yutaka YOKOI, Deputy Director, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs, and stayed in the country from April 6 to May 25, 1992.

JICA sent to Cambodia the second mission, which was headed by Mr. Minoru Fujiwara, Director, Structure and Bridge Department, Public Works Research Institute, Ministry of Construction and stayed in the country from July 13 to August 1, 1992. JICA sent to Cambodia the third mission, which was headed by

Mr. Akira Fujimoto, Coordinator for International Research Cooperation, Public Works Research Institute, Ministry of Construction and stayed in the country from September 22 to 29, 1992.

The team held discussions with the officials concerned of the Supreme National Council of Cambodia and conducted a field survey at the study area.

In the course of discussions and field survey, both parties have confirmed the main items and the Minutes of Discussions as attached in Appendix-4 were agreed and signed.

1-3 Outline of the Study

The study is split into two phases, namely 1st phase and 2nd phase.

The 1st phase study has a field investigation to make a repair plan of Chroy Changwar Bridge and make a preliminary survey for the rehabilitation of road (Route 6A) which connects to the Chroy Changwar Bridge. Simultaneously, some preparatory works for 2nd phase study also done. Interim Report is made in the end of 1st phase.

In the 2nd phase study, the Basic Design on the repair of Chroy Changwar Bridge is prepared based on the results of 1st phase study.

The schematic flow chart of the study is presented below.

1st phase	Step 1	Preparatory Work
	Step 2	Field Survey
	Step 3	Preliminary Study
2nd phase	Step 4	Field Survey
	Step 5	Basic Design and Preparation of Draft Final Report
	Step 6	Presentation of Draft Final Report
	Step 7	Submission of Final Report

1) Step 1: Preparatory Work (Work in Japan)

Prior to the mobilization of the Study Team in Cambodia, the following works was be done in Japan.

- a. Collection and examination of data and reports
- b. Preparation of the list of data and information to be collected in Cambodia
- c. Preparation of an Inception Report

2. Step 2: Field Survey (Work in Cambodia)

Field Survey was carried out mainly at the Project Sites and comprises the following tasks:

- a. Presentation of the Inception Report
- b. Confirmation of Safety, especially regarding explosives
- c. Site Reconnaissance
- d. Structural Soundness Investigation
- e. Geologic Survey
 - Mechanical boring
 - Standard penetration test
 - Physical tests
(i.e. specific gravity, moisture content, unit weight, gradation, Atterberg limit)
- f. 12-Hour Traffic Count Survey on National Road No. 5, No. 6 and Ferry Site in Phnom Penh

- g. Collection of Data and Information
 - h. Confirmation of the Importance of the Project
 - Study the effect and necessity of the Project
 - Examine the appropriateness for JICA Grant Aid Program
 - i. Determination of the Framework of Basic Design
 - Scope
 - Design standard
 - Time schedule of the Basic Design
 - j. Discussion with the Government concerning the Result of the Study
- 3) Step 3: Preliminary Study (Work in Japan)
- a. Preliminary Study for Repair of the Bridge and National Road 6A
 - b. Preparation of Interim Report
- 4) Step 4: Field Survey (Work in Cambodia)
- a. Explanation of Interim Report
 - b. Topographic Survey
 - c. Understanding of Existing Overall Construction Environment
 - d. Study of existing maintenance management system
 - e. Reconfirmation of bridge repair plan
 - f. Decide the content and scope of work of the construction by each government
- 5) Step 5: Basic Design and Preparation of Draft Final Report
(Work in Japan)

The Study Team carried out the basic design in detail in Japan based on the result of the field survey.

- a. Basic Design
 - Superstructure and substructure
 - Foundations of piers

- b. Examination of Construction Method and Schedule
 - Examination of possible construction method
 - Examination of construction time schedule

- c. Study of Maintenance Management System
 - Bridge structures
 - Approach roads

- d. Project Implementation Schedule
 - Estimated cost of the Project
 - Tentative implementation schedule

- e. Suitability for Grant Aid Project
 - Description of necessity of the Project
 - Impact of the Project
 - Recommendations

- f. Preparation of Draft Final Report

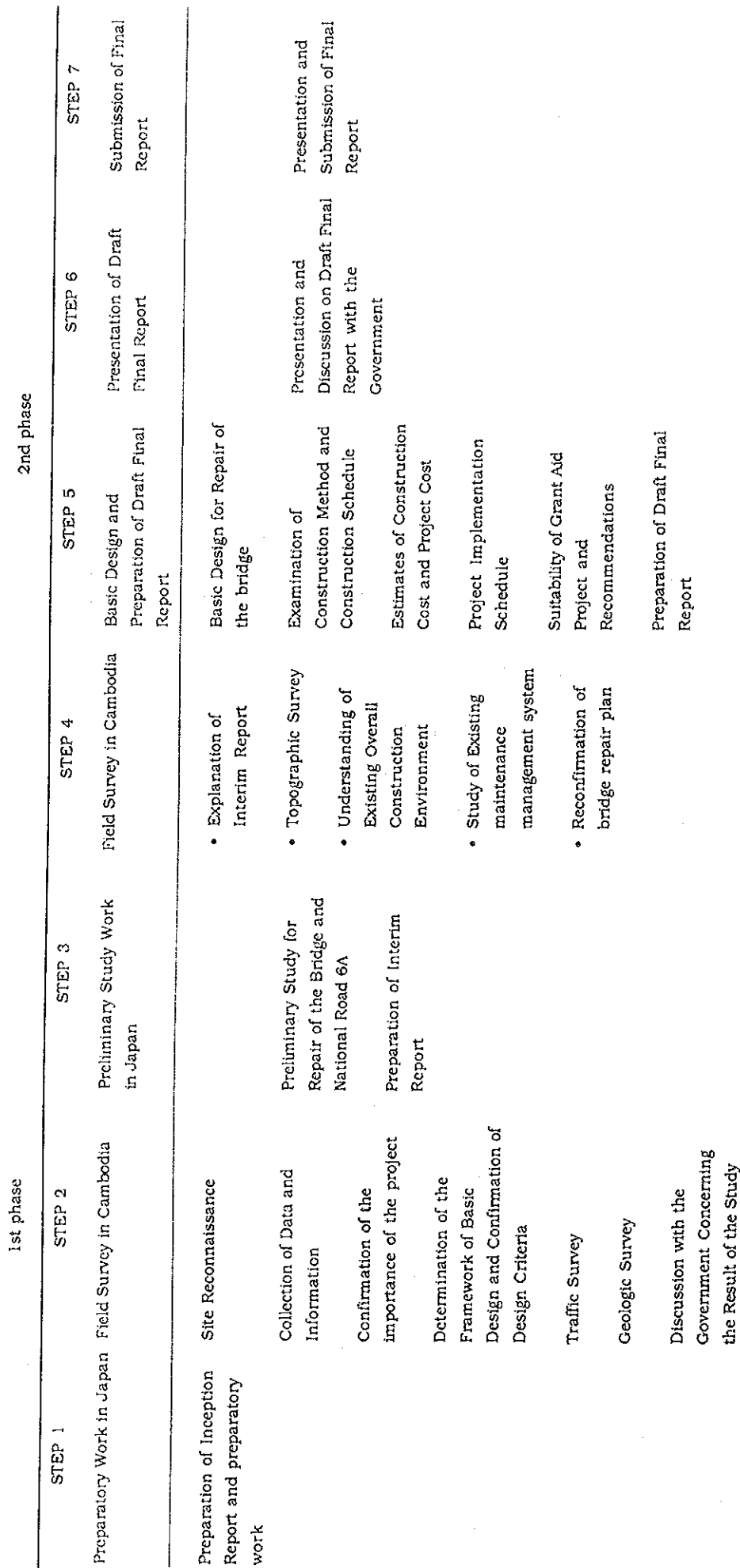
6) Step 6: Presentation of Draft Final Report

The Draft Final Report prepared in Japan was brought to Cambodia for discussion and agreement with the Government authorities.

7) Step 7: Submission of Final Report

The Final Report was prepared in Japan, incorporating some minor revisions thereto, and submitted to JICA.

Fig. 1-1 Flow Chart of the Study



Chapter 2: Background of the Project

CHAPTER 2: BACKGROUND OF THE PROJECT

2-1 Background of the Project

The Construction of Chroy Changwar Bridge was started in 1960 as a quasi-compensation project by Japan, and was completed in 1963. The bridge is located at the north-eastern end of Phnom Penh City and crosses over the Tonle Sap river. The length of the bridge is 709 m long. In September 1972, the superstructure of three center spans and the substructure of pier No. 4 were destroyed during the civil war.

The bridge played a vital role to connect Phnom Penh City with the north-eastern region through Routes 6A, 6 and 7. The restoration of the bridge has been given the highest priority in the improvement plan of infrastructures in Cambodia. The restoration of the bridge is believed to contribute to the social and economic development in the eastern side of the Tonle Sap River.

In the light of its importance and urgency, the Supreme National Council of Cambodia has requested the Japan's Grant Aid for the Project. In response to the request, the Government of Japan decided to conduct a Basic Design Study on the Project.

2-2 Outline of the Request from the Supreme National Council of Cambodia

The contents of the request made by the Supreme National Council of Cambodia are understood to be the following ones.

- 1) Bridge Length : 709 m
(Collapsed Portion 265 m)
- 2) Superstructure : Steel Box Girder with Steel Plate Deck
- 3) Pier Columns : Reinforced Concrete
- 4) Foundations : Spread Foundation
- 5) Number of Lanes of Bridge and Approach Roads : 2 Lanes (One Lane Each Direction) with Cycle Track and sidewalks
- 6) Width of Bridge : 7.0 m wide (3.50 m x 2) for roadway
3.80 m wide (1.90 m x 2) for cycle track
and 2.20 m wide (1.10 m x 2) for sidewalk

2-3 Outline of the Project Area

2-3-1 The Nation

The Nation and Population

Cambodia is located in the southwestern part of the Indochina Peninsula. The decedents of once powerful Khmer empire, which controlled much of the Indochina Peninsula and the presented day Thailand in 10-12th centuries, are now commanding an area of 181,035 sq.km sandwiched between Vietnam to the south and Thailand and Laos to the north.

The population of Cambodia has been reduced during the period of war and serious disturbances (1970-1979). Mekong Committee puts the population of Cambodia in 1970 at 7.06 million and in 1980 at 6.40 million. No census has been made since 1962. Various sources put the population in 1990 ranging from 7.9 to 10 million. The following shows official estimates.

Population of Cambodia

<u>Year</u>	<u>Population (million persons)</u>	<u>Growth Rate (% per annum)</u>
1963	6.00	—
1969	7.00	2.6
1981	6.70	-0.3
1987	7.90	2.8
1990	8.68	3.2
1991	8.92	2.8

Source: Ministry of Planning quoted in EIU Report

The Mekong Committee puts the population in 1990 at 8.3 million and the growth rate at 2.2% per annum. At this rate the population would reach 13 million by 2010.

In the ongoing international effort to restore peace in Cambodia it is planned to resettle refugees who primarily fled to neighboring countries. Approximately 300,000 persons will be added to the population.

Economy

Cambodia belongs to the group of very poor countries in the world, behind all other countries in Asia. The GDP per capita in 1990 was estimated at US\$120, although real figure could be higher if taking into account the wide-spread but non-recorded open market activities.

After the independence in 1952 the economy showed a reasonable growth. Rice export peaked at 569,000 tons in 1964. In the late 1960's the economy slowed and the coup of 1970 triggered the economic collapse. The end of serious disturbances in 1979 re-activated the economy and during 1980s recoveries have been seen in all sectors. A well organized but unofficial barter trade has provided all kinds of necessities coming from Thailand.

Since 1988 the results of policy reforms towards market economy have been felt. Signs of enhanced economic activities are abound although they are difficult to measure.

Agriculture

Some 80% of population are engaged in agriculture, many of them at near subsistence level. The major food crop is rice. In 1987 Cambodia produced 1.85 million tons and recovered the level of 1960 (Note, Population then was 70% of that in 1987). Humanitarian aid and import in cereals have been reduced in recent years, from 156,000 tons in 1988 to 50,000 tons in 1991. The country may be nearing self-sufficiency in food. (Conflicting reports indicate a shortage of 200,000 tons in the coming year. Price of rice in the market however is falling.) Secondary food crops and their 1988 productions are vegetables (266,500 tons), sweet potatoes (77,900 tons), maize (46,900 tons) and soya beans (12,166 tons).

The most productive province was Battambang but is now around Phnom Penh due to the prolonged disturbances.

Industry

Rubber production in Cambodia was one of the most productive in the world. Rubber accounts for one third of export. Rubber wood forest however has been damaged during the period of war. Centers of rubber industry are Kompong Cham and Kratie.

A sizable concentration of industrial production facilities exist north of Phnom Penh along Tonle Sap, a few in Kompong Cham and fertilizer plants in Battambang and Komport, all requiring rehabilitation. An oil refinery with a capacity of 400,000 tons/year is waiting re-opening. A cement plant near Kampot with a capacity of 110,000 tons/year is also waiting rehabilitation.

Forestry

Cambodia has large forestry reserves which used to cover 72% of the area in 1969, totaling 13 million ha. The output in 1960 was 360,000 cu.m of sawlogs. The output dropped sharply during the war and disturbances then resumed again 1980s from a low level. In 1988 it was estimated at 280,000 cu.m. In the meantime, the forest area has been reduced dramatically to 7.5 million ha, or 50% of the area, 1990 export of logs is reported to Vietnam, the USSR and Japan. A substantial volume could be exported unofficially to neighboring countries.

Fishing

Tonle Sap and Mekong river provide rich fishing waters to Cambodia as well as the Gulf of Thailand. The annual catch in 1990 was 91,000 tons, of which 57,900 tons from fresh waters and 26,1000 tons from sea waters.

Development Plans

The government intends to guide the economic development of Cambodia by means of the Second Five Year Plan covering 1991-1995. The plan aims at raising the growth rate of GNP by means of the following measures:

- To develop agriculture especially paddy production and the processing industries.
- To increase labor productivity by modernization of the methods and re-orientation of the economy to a market economy.
- To open the country to foreign investment, cooperation and tourism. To develop foreign trade.
- To reform the central administration and redefine the functions of the provinces and municipalities.

As for transport infrastructure, the Second Plan cites eight specific priority projects, which include reconstruction of the Chroy Changwar Bridge, the repair of Phnom Penh and Kompong Som ports, rehabilitation of railways and national roads.

Transportation

Transport systems in Cambodia somewhat resembles those in Thailand. Highways, railways and waterways converge to the capital city built on a riverbank. Phnom Penh is the hub of 1,750 km of navigable waterways, 14,800 km of highways, of which 2,600 km are asphalted, and 647.6 km of railways. Phnom Penh acts as the distribution center of the country for goods and people. Majority of exports and imports transit through the Phnom Penh port via Mekong river.

The Port of Kompong Som, a deep sea port, was built in 1950s to provide an alternative to the Phnom Penh Port, of which access route lies within another country. It is connected with Phnom Penh by a railway and two roads, RN3 and RN4, all of which still have security problems and are in poor condition; consequently the current role of this port is to serve surrounding areas, particularly Kompong Som and Kampot.

Other major transport facilities included the following:

- Road RN 1 linking Phnom Penh with Ho Chi Min City and the Saigon Port.
- Road RN 5 to the north and Thailand via Battambang.
- Road RN 7 to Ho Chi Min City via Kompong Cham.
- Still closed railway line linking Phnom Penh with Bangkok.
- Secondary sea pots of Koh Kong, Sre Ambel, and Kampot.
- Secondary river ports of Kratie, Kompong Cham, Kratie, and Banam.

Ferry services are provided at major river crossings along the above major highways.

2-3-2 The Project Area

Population

The population of the municipality of Phnom Penh was reported as 354,000 in 1981 and as 564,000 in 1987 by the Ministry of Planning and Agriculture. In 1991 the actual population is expected to be considerably higher than the above, somewhere between 800,000 to 1 million. Considering the inevitable influx of refugees into the city, the higher side estimate should be taken for planning purposes.

The district office of Srok, Kandal Province, in the Chroy Changwar Peninsula gave the population along the route 6A at 53,000 and claimed it was double of the amount in 1970.

Population of the city of Kompong Cham is estimated at 30,000 (Kompong Cham Province 1.38 million) and population of the municipality of Kompong Som at 70,000.

Roads and Road Traffic (RN 5, RN 6, RN 4, RN 3)

RN 5 and RN 6

The results of the traffic counts surveys are summarized below:

Location	(veh./day, both directions)					Total in PCU
	Vehicle Type					
	Bicycle/ Motorcycle	Car/ Pickup	Medium Vehicle	Heavy Vehicle	Bus	
RN 5 km 15+	3,790	775	86	198	33	2,503
P.Kdam Ferry	954	322	28	71	3	798
RN 6 Chun	1,358	260	35	53	1	828
RN 6 Skoun	1,000	153	11	31	2	536

Port traffic is low during the dry season. Annual average daily traffic therefore could be higher than the above for goods traffic. Due to lower intensity of economic activity in the rural areas during the dry season, passenger traffic could also be higher in other seasons. Difficulty in travel during rainy season, however, could deter passenger travel. In the absence of better variation data the above figures were increased by 10% for planning purposes.

At all locations few traffic were observed when nearing sunset. Security problem was evident.

Many motorcycles with a trailing cart are used as jeepneys along RN 5. The service apparently is for short distance trips as no such vehicles are observed on the Prek Kdam Ferry. Some 70% of passenger cars are actually used for long distance omnibus service, such as between Phnom Penh and Kompong Cham. One such vehicle may carry as much as 7 passengers at a fare of 3000 riels per passenger.

The ferry service at Prek Kdam is a major bottleneck of the Phnom Penh Kompong Cham corridor. At present two barges each capable of carrying 2 heavy vehicles and 8 light vehicles in one voyage are being operated by two tug boats. Single lane concrete jetties at both banks are not used due to low water level and barges land directly at river bank. Loading and unloading of vehicles are difficult and one round trip by a barge takes more than 40 minutes. In the morning long queues are formed at both banks. Hours of waiting are not uncommon.

Vehicular traffic crossing Tonle Sap at Prek Kdam was found to be almost entirely those travelling Phnom Penh and Kompong Cham or Kompong Thom. With the completion of the Chroy Changwar Bridge and RN 6A, the entire traffic would shift to the new route.

RN 4 and RN 3

Because of security problems and poor state of temporary bridges along the route, traffic on RN 4 between Kompong Speu and Kompong Som at present is estimated at less than 200 vehicles per day consisting largely of converted buses and trucks and occasional passenger cars. Only vehicles with a high road clearance can reasonably traverse RN 3 between Kompong Som and Kampot. Current road condition of RN 3 to Phnom Penh is in such a poor state that vehicular traffic is extremely low.

Phnom Penh Ferry Services

Within the boundary of the City of Phnom Penh there are four river crossings by boats connecting Phnom Penh with the opposite river banks. The southernmost one serves Phnom Penh with a boat link to a place on the Mekong bank and

would not directly be affected by the bridge. Remaining three, one upstream and two downstream of the bridge, are primarily used by people living in the area opposite of Phnom Penh across Tonle Sap. Dawn-to-dusk traffic surveys were carried out at the crossings and the results are shown below:

Type	Upstream	Downstream A	Downstream B
Pedestrian (persons/day)	631	493	962
Motor/bicycle (vehicles/day)	754	692	449

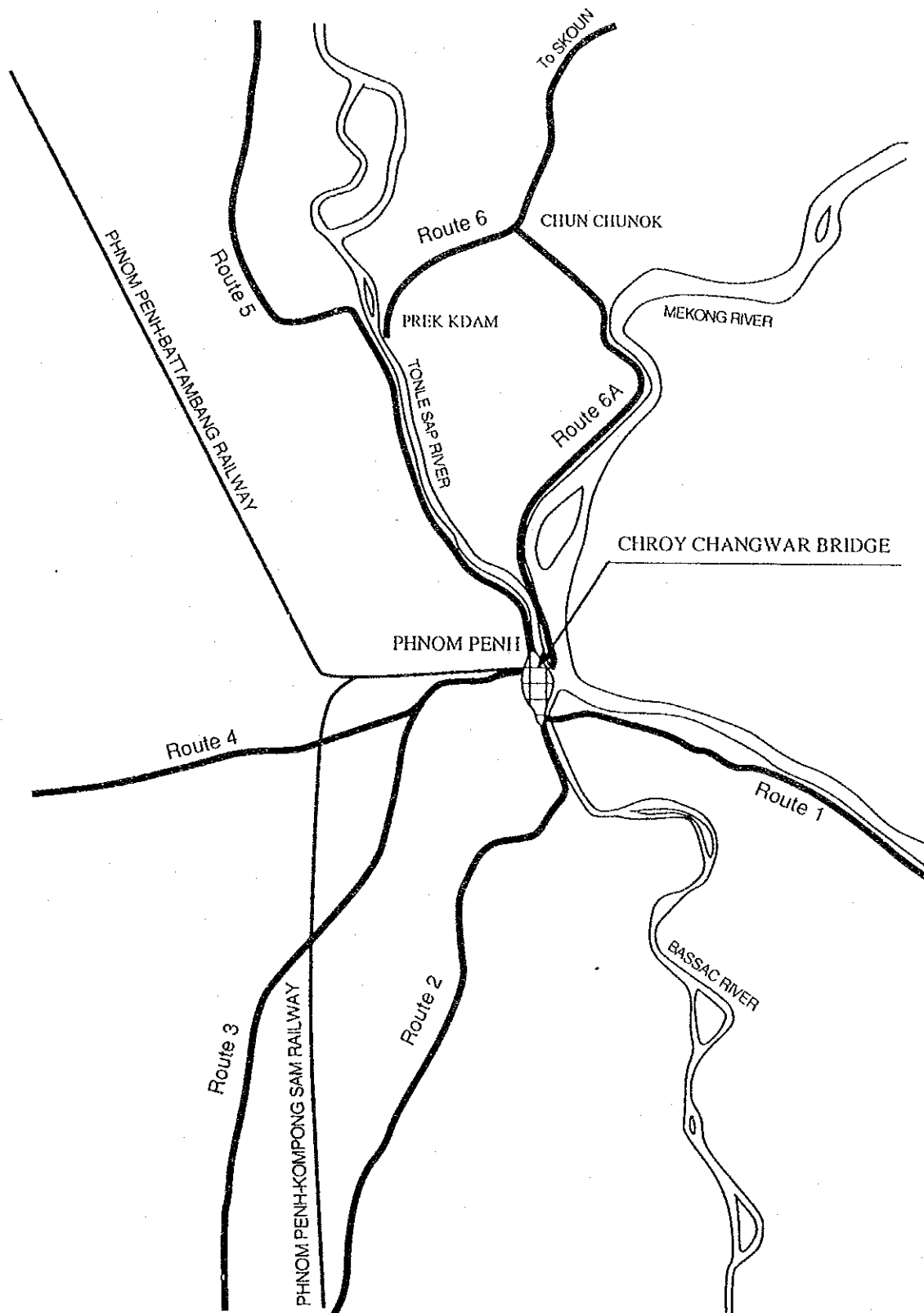


Fig. 2-1 Road Network in Phnom Penh and its Surroundings

Chapter 3: Outline of the Project

CHAPTER 3: OUTLINE OF THE PROJECT

3-1 Objectives of the Project

The objective of the Project is to repair the bridge over the Tonle Sap River to contribute to the enhancement of the nation's economic activities.

3-2 Study and Examination on the Request

3-2-1 The Scope of the Project

After discussions with the Basic Design Study Team during 2nd field survey period, the following items were finally confirmed as the Scope of the Project by the Cambodia side.

- 1) 265m long New Bridge Construction
 - a) Bridge Span Arrangement : 65m + 135m + 65m
 - b) Type of Superstructure : Steel Box Girder with Steel Deck
 - c) Type of Pier Columns : Reinforced Concrete
 - d) Type of Foundations : Well type with Steel Pipe Sheet Pile
 - e) Number of Lanes of Bridge : 2 Lanes (One Lane each direction)
and Approach Roads with Cycle Track and Sidewalk
 - f) Width of Bridge : 7.0m wide (3.50m x 2) for Through
Lanes with 3.80m wide (1.90m x 2)
for Cycle Track and 2.20m wide
(1.10m x 2) for Sidewalk
- 2) Repair of damaged approach roads including approach slab
- 3) Removal of old surface pavement and construction of surface pavement on bridge and approaches
- 4) Removal of rust, repair of local damages and repainting on the bridge
- 5) Local reinforcement of the existing substructures, if any
- 6) Installation of illumination above bridge and approaches
- 7) Reinstatement of median strip, channel islands, traffic signals, traffic signs, guard rail, fence, separator, plantation, right-of-way stakes or monuments, lighting, etc.

3-2-2 The Appropriateness and Necessity of the Project

The Project site lies on National Route 6A which serves nine provinces in north-east region of the country, having 3 million population. The Chroy Changwar Bridge, which is located on this route as a starting point, was only one bridge transverse over the Tonle Sap River.

Inter-regional traffic toward these provinces have been forced to divert to Prek Kdam, 30km north of Phnom Penh to cross the Tonle Sap river by ferry boats since 265m long central span of the bridge was destroyed by the civil war in September, 1972.

Local traffic consisting of pedestrian bicycles and motorcycles are also forced to use small boats across the river.

The bridge has played a vital role to connect Phnom Penh City with the north-eastern region through Routes 6A, 6 and 7. The restoration of the bridge has been given the highest priority in the improvement plan of infrastructure in Cambodia.

Yet 444m long bridge structure out of 709m long original bridge remains usable and only 265m long collapsed central three spans make it impossible to connect with National Route 6A for the past twenty years.

In case that the 265m long central span is reconstructed, Chroy Changwar Bridge as well as National Route 6A will be able to be restored. Thus, it is obvious that the project can expect economically high returns.

In addition, the restoration of the bridge is believed to contribute to the social and economic development in the eastern side of the Tonle Sap river.

In view of the above-mentioned effects, the implementation of the Project is indispensable to ensure the reconstruction of infrastructure in Cambodia. On the other hand, the Supreme National Council of Cambodia has been restricted severely in terms of budget and technique.

3-3 Project Description

3-3-1 Executing Agency and Operational Structure

Road and Bridge Department (RBD), Ministry of Communication, Transport and Post is the Government agency responsible for the implementation of the Project.

The operational structures of the executing agency are shown in Figs. 3-1 and 3-2.

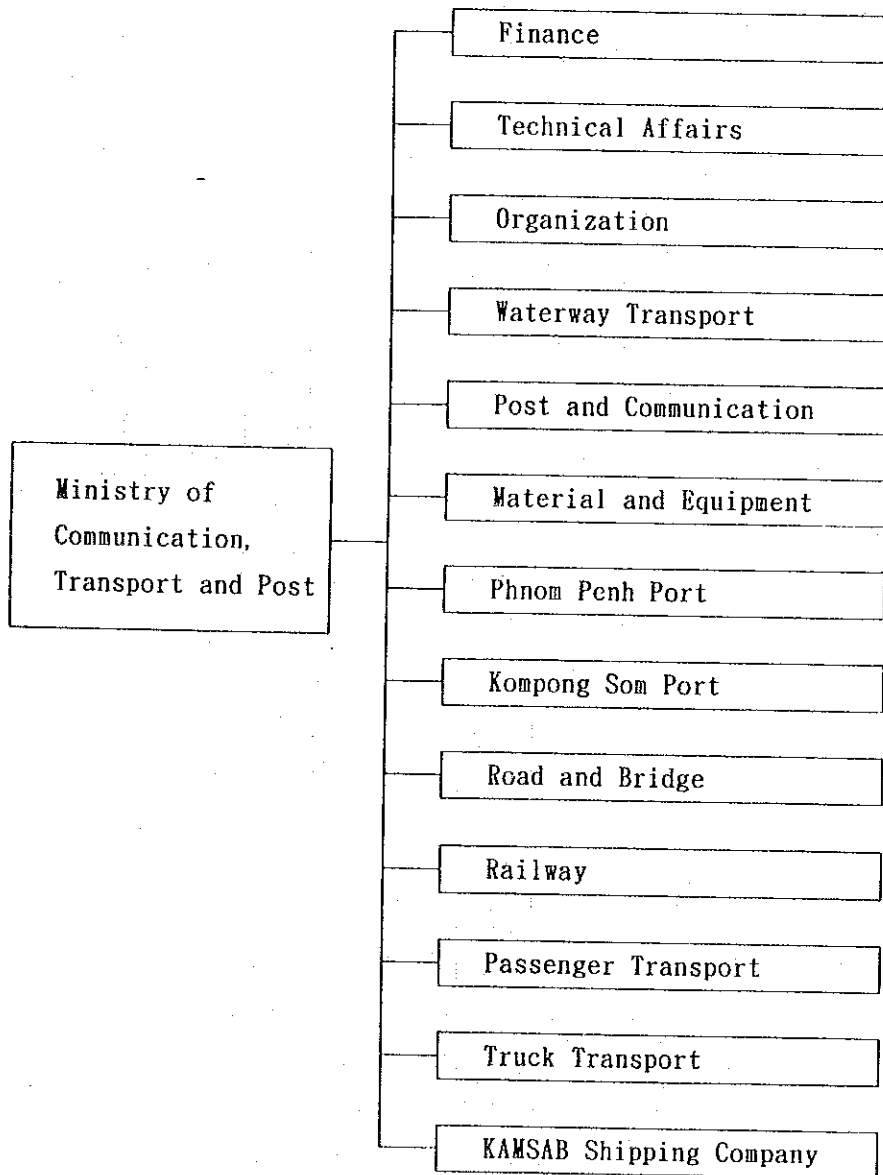


Fig. 3-1 Organization of the Ministry of Communication, Transport and Post

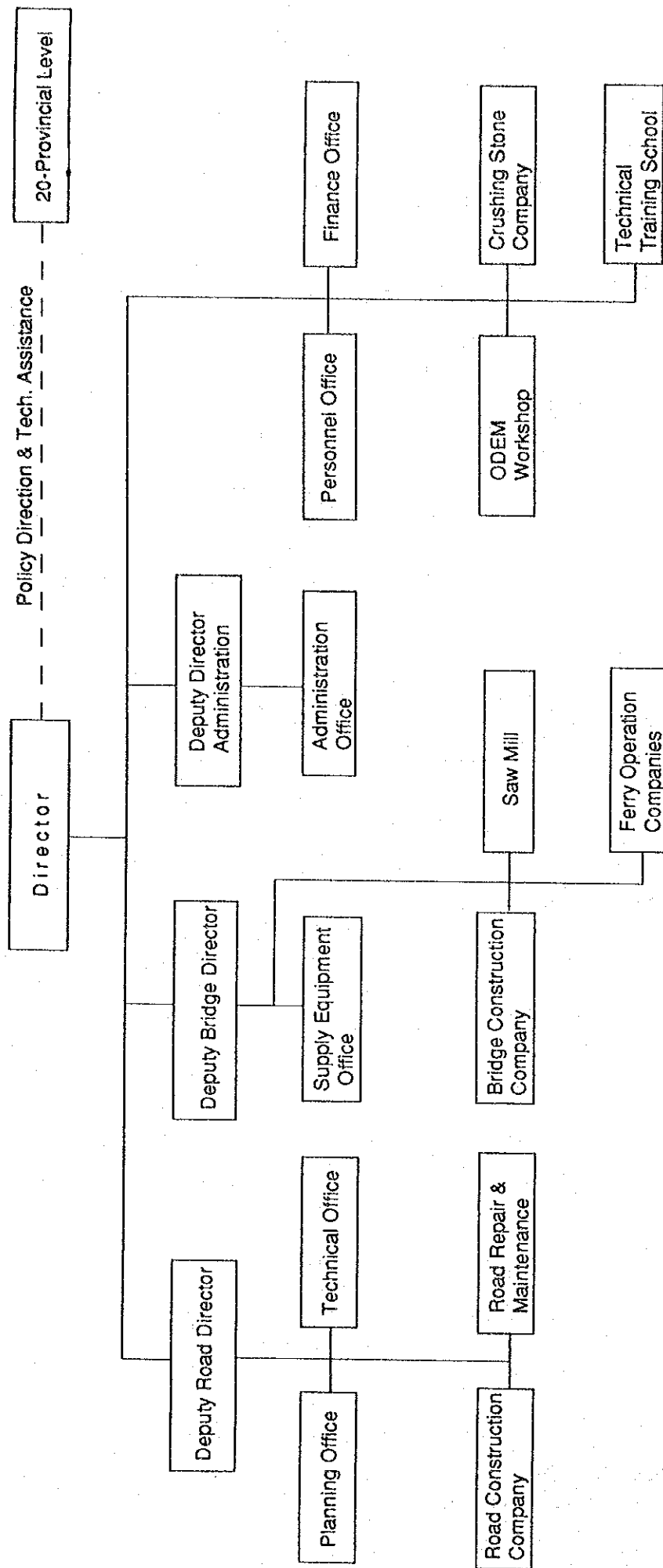


Fig. 3-2 ORGANIZATION CHART OF ROAD AND BRIDGE DEPARTMENT (RBD)