No.

JAPAN INTERNATIONAL COOPERATION AGENCY

MINISTRY OF COMMUNICATION, TRANSPORT, POST AND CONSTRUCTION
THE LAO PEOPLE'S DEMOCRATIC REPUBLIC
DEPARTMENT OF HIGHWAYS
THE KINGDOM OF THAILAND

THE DETAILED DESIGN OF
THE SECOND MEKONG INTERNATIONAL BRIDGE
CONSTRUCTION PROJECT IN
THE LAO PEOPLE'S DEMOCRATIC REPUBLIC AND
THE KINGDOM OF THAILAND

# FINAL REPORT

# EXECUTIVE SUMMARY

JUNE 2000

ORIENTAL CONSULTANTS COMPANY LIMITED
NIPPON KOEI CO., LTD.

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The following foreign exchange rate is applied in the study:

US$ 1.00 = 7183.969 Kip (as of January 2000)

US$ 1.00 = 37.914 Baht (as of January 2000)

# PREFACE

In response to the request from the Government of the Lao People's Democratic Republic and the Government of the Kingdom of Thailand, the Government of Japan decided to conduct the Detailed Design of the Second Mekong International Bridge Construction and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to the Lao People's Democratic Republic and the Kingdom of Thailand a study team headed by Mr. HIROTANI Akihiko, Oriental Consultants Co., Ltd., three times between March 1999 to June 2000.

The team held discussions with the officials concerned of the Government of the Lao People's Democratic Republic and the Government of the Kingdom of Thailand, and conducted field surveys at the study area. After the team returned to Japan, further studies were made 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 among our there countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Lao People's Democratic Republic and the Government of the Kingdom of Thailand for their close cooperation extended to the team.

June, 2000

Kimio Fujita
President
Japan International Cooperation Agency

# LETTER OF TRANSMITTAL

Mr. Kimio Fujita,
President
Japan International Cooperation Agency (JICA)
Tokyo, Japan

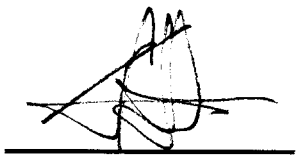
We are pleased to submit to you the Final Report on the Study for the Detailed Design of the Second Mekong International Bridge Construction Project which will be implemented in the Lao People's Democratic Republic and the Kingdom of Thailand.

This Study was conducted by Oriental Consultants Company Limited in association with Nippon Koei Company Limited under a contract with JICA, during the period of March 1999 and June 2000. In conducting the Study, we have completed the Basic Design and the Detailed Design of the Project.

We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA. We would also like to express our gratitude to the officials concerned of the Study, the relevant authorities of the Lao PDR and Thailand, and the Embassies of Japan in both of those countries for their cooperation and assistance throughout our Study.

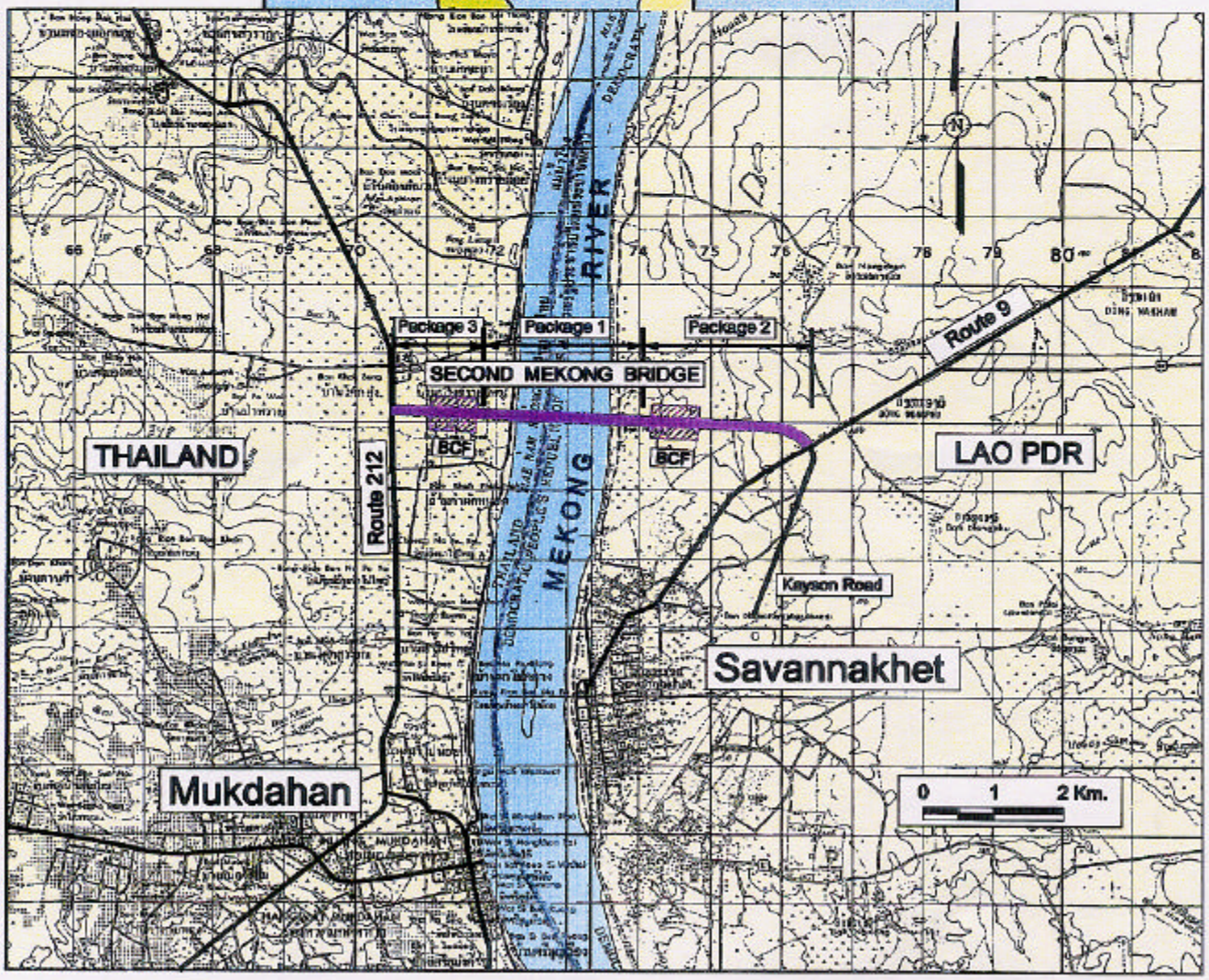
Finally, we hope that this report will contribute to further promotion of the Project.

Very truly yours,
June 2000



Akihiko HIROTANI
Team Leader,
Study Team
The Detailed Design of the Second Mekong
International Bridge Construction Project

# LOCATION MAP


BRIDGE LOCATION MAP

# EAST - WEST TRANSPORT CORRIDOR : MEKONG RIVER CROSSING CONSTRUCTION PROJECT

Perspective View of The Project from the Lao PDR Side

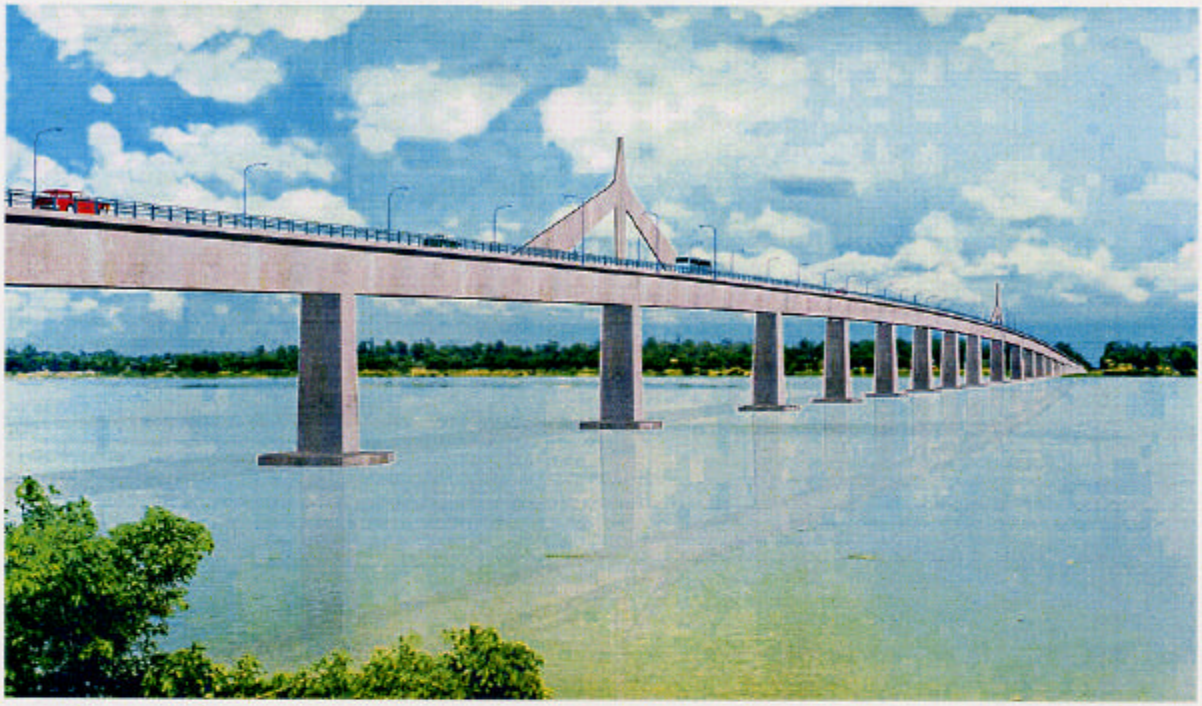
JICA

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) STUDY TEAM

ORICONSUL

ORIENTAL CONSULTANTS COMPANY LIMITED in association with NIPPON KOEI COMPANY LIMITED

View of the Main Bridge from the Lao PDR side



View of the Main Bridge from the Thailand side

# PROJECT SUMMARY

| | |
|---|---|
| **Project objectives** | The Study has been conducted based on the request by both governments of the Lao PDR and Thailand for the detailed design of the Second Mekong International Bridge that is scheduled to link Savannakhet in the southern region of the Lao PDR and Mukdahan in the north-eastern region of Thailand.<br>The study commended with reviews of the SAPROF study of the JBIC, the Basic Design stage during which time various local conditions were surveyed, collected and analized, alternatives were studied and facilities were preliminary designed. Further to the Basic Design, works continued from the detailed designs of the Bridge, roads, Border Control Facilities and others, assessment of environmental impact, constructions, planning, estimation of Project cost, planning on management and maintenance, preparation of draft bidding documents, and transfer of technology during the study duration to counterpart personnel in the both countries. |
| **Study methodology** | Contents and procedures of the Study are :<br>*1) Preparatory work in Japan*<br>① Collection and analysis of related documents and information. ② Reviews on the Study fundamentals, policies, methodology, processes, procedures etc. ③ Preparation of the inception report.<br>*2) First Work on Site*<br>① Discussion and workshops to present the inception report. ② Investigation on existing situations and collection and analysis of data. ③ Investigation of natural conditions e.g. surveying, soil and material properties, hydrologic and hydraulic properties, earthquake and meteorological properties. ④Basic design i.e. determination on design conditions and design criteria, review on the optimum alternative, examination of initial environmental aspects, design on fundamentals, review on construction plan, estimation of project cost. ⑤ Preparation of the Basic Design Report<br>*3) First Work in Japan* (discussions on the Basic Design Report)<br>*4) Second Work on Site*<br>① Presentation of the Basic Design Report. ② Detailed design of facilities e.g. Main Bridge, approach viaducts, connecting and approach roads, traffic changeover, revetment, Border Control Facilities. ③ Environmental impact assessment. ④ Construction planning. ⑤ Management and maintenance planning. ⑥ Project cost estimation. ⑦ Draft Bidding documents. ⑧ Project implementation planning. ⑨ Evaluation and recommendations. ⑩draft final report preparation and presentation to the relevant authorities of the both countries.<br>*5) Scheduled forthcoming work: Second work in Japan* (preparation of the Final Report) |
| **Project outlines** | The Project is planned in three packages (a total length of 6,166m) as follows:<br>*1)Package 1* (International part: L=2,702m)<br>Thailand side: Traffic changeover L=395m, Approach road L=79.4m,<br>Approach viaduct L=5@50m=250m<br>Main Bridge : PC sail type continuous box girder bridge<br>L= 60+4@80+2@110+5@80+2@110+4@80+60=1600m<br>The Lao PDR side: Approach road L=178m,<br>Approach viaduct L=4@50m=200m<br>*2)Package 2* (the Lao PDR side: L=2,514m)<br>Border Control Facility L=650m, Connecting road L=1864m<br>Intersection: National road route 9 (and Kaysone road) and<br>Provincial road route A3.<br>*3)Package 3* (Thailand side: L=951m)<br>Border Control Facility L=436m, Connecting road L=520m,<br>Intersection: National Highway route 212. |
| **Project evaluation** | This Project is an extremely impacted crossing facility of the Mekong River to formulate the Indochina East West Corridor in the Greater Mekong Sub-region that includes China, the Lao PDR, Myanmar, Thailand and Vietnam. Construction of the Project will largely contribute to development of the Mekong sub-region since it will contribute to enhancing exchanges of commodities, transportation local economy and culture. |
| **Conclusion and recommendations** | The Study objectives are fulfilled with economical appropriate and design achievements. Since the Financial ODA Pledge has been made among the Government of the Lao PDR, the Royal Thai Government and the Government of Japan, the Project construction is expected to be implemented as early as possible. |

# OUTLINES OF THE STUDY

The Detailed Design of the Second Mekong International Bridge Construction Project in the Lao PDR and Thailand (hereinafter referred to as the "Project" the "Study").

Study Term : March 1999 – June 2000

Counterpart Agencies : The Ministry of Communication, Transport, Post and Construction of the Lao PDR (hereinafter referred to as the "MCTPC") and the Department of Highways of Thailand (hereinafter referred to as the "DOH")

## 1. Background

The Indochina East West Corridor that links Myanmar in the west and Vietnam in the east and passes through the Lao PDR and Thailand is one of the high priority project for a development of the Greater Mekong Sub-region. The Project will facilitate a crossing of the Mekong River within the Corridor.

The Japan Bank for International Cooperation (hereinafter referred to as the "JBIC"), the official agency responsible for extending financial assistance program of the Government of Japan (hereinafter referred to as the "GOJ"), has pledged loans to the Government of the Lao PDR (hereinafter referred to as the "GOL") and the Royal Thai Government (hereinafter referred to as the "RTG"), in December 1998 to assist in implementation of The Project.

The location of the Project has been selected in the Special Assistance for Project Formation (SAPROF) study of the JBIC in 1998 at a site approximately 5 km north of Savannakhet in the Lao PDR and approximately 7.5km north of Mukdahan in Thailand.

In response to the request of the GOL and the RTG, the GOJ decided to conduct the Study for Detailed Design of the Second Mekong International Bridge Construction Project.

The Japan International Cooperation Agency (hereinafter referred to as the "JICA"), the official agency responsible for implementation of technical cooperation programs of the GOJ, has undertaken the Study in close cooperation with both the MCTPC and the DOH.

## 2. Objectives

Objectives of the Study are as follows:

- Conducting the necessary engineering and environment surveys to get the basic data for the design. The Detailed Design for the Bridge, connecting road and border control facilities, the Environmental Impact Assessment, the Construction Plan, the Maintenance Plan, the cost estimation and Draft Tender Documents.
- To persue technology transfer to the GOL and the RTG counterpart personnel during the course of the Study.

## 3. Study area

The Study area of the Project is located approximately 5km north of Savannakhet and approximately 7.5km north of Mukdahan.

## 4. Outlines of Basic Design Report

The Basic Design Report was submitted to the MCTPC and theDOH in August 1999. The Report contains the following items:

- Project Appreciation
- Social Conditions
- Border Control Facities
- Natural Conditons
- Bridge and Road
- Relocation / Resettlement Plan

- Environment
- Preliminary Cost Estimate
- Public Relation and Technology Transfer

## 5. The Detailed Design

(1) Road

Fundamental parameters for the detailed design such as location, classification, lane geometry assignment, crossings with local roads and relation with the Border Control Facilities (hereinafter referred to as "BCF") were studied, discussed among parties concerned and were determined during the Basic Design stage then the Detailed Design of roads has been completed.

(2) Main Bridge

The type of the Main Bridge had been studied among several alternatives by taking into consideration climate (rain or dry), topography, geology, material supply, local construction industry and other relevant matters. The Bridge is, consequently, established as a PC sail type continuous box girder bridge.

The Detailed Design of the Main Bridge was conducted with regard to the following contents:

| | |
|---|---|
| Bridge type | : PC sail type continuous box girder bridge |
| Bridge and Span length | : 60+4@80+2@110+5@80+2@110+4@80+60 = 1,600m |
| Layout of bridge deck | : 2×4.25m (carriageway) + 2×1.5m (side walk) + 0.5m (median) |
| Erection method | : Precast segment balanced cantilever erection method |
| Pier type | : RC wall type pier |
| Foundation type | : ϕ2.0m cast-in-place RC multi-pile foundation |

(3) Viaduct and Ancillary Works

The type of the Bridge was determined by taking into consideration structural balancing with the Main Bridge, topography and geology.

The Detailed Design of the Approch Viaduct was conducted with regard to the following contents:

| | |
|---|---|
| Bridge type | : PC continuous box girder bridge |
| Bridge length and span | : the Lao PDR side 50.0m@4=200.0m |
| | Thailand side 50.0m@5=250.0m |
| Layout of bridge deck | : 2×4.25m(carriageway)+2×1.5m(side walk)+ 0.5m (median)=12m |
| Erection method | : Temporary staging and cast-in-place concrete method |
| Pier type | : RC wall type pier |
| Abutment type | : RC reverse T-type abutment |
| Foundation type | : ϕ1.0m cast-in-place RC multi-pile foundation |

The type of the Bridge accessary had been studied among several alternative by taking into consideration durability, maintenance and cost.

| | |
|---|---|
| Bridge Bearing | : Elastometric laminated bearing |
| Expansion Joints | : Steel finger joint |
| Guardrail | : Steel type |

(4) Border Control Facilities

Integrated type BCF (combined cargoes + passengers) was selected. Buildings were designed in conformity with respective local laws, codes, standards and other applicable international codes.

## 6. Construction Planning

The entire Project is divided into three (3) contract packages whose construction schedules are described below.

Package 1:Main Bridge, approach viaducts (the Lao PDR and Thailand sides), approach roads (the Lao PDR and Thailand sides) and traffic changeover (Thailand side)..36 months

Package 2:Border Control Facility and connecting road in the Lao PDR side....……...24 months

Package 3:Border Control Facility and connecting road in Thailand side.....……...24 months

## 7. Management and Maintenance

Management and maintenance aspects of the Bridge are described.

## 8. Environmental Study

On the stage of the Basic Design Report of the Project, the initial environmental examination (IEE) has been carried out. Based on the findings of the IEE, the environmental impact assessment (EIA) has been conducted. Environmental impacts from the Project were verified as insignificant.

## 9. Cost Estimation

The Project cost estimation has been made for the following components:

- Package 1 : Further divided into the Package 1A (the Lao PDR Portion) and Package 1B (the Thailand Portion).
- Package 2
- Package 3
- Engineering Services

## 10. Draft Bidding Documents

The following draft documents have been prepared based on the 'Guidelines for Procurement under JBIC ODA Loan' for package 1, package 2 and package 3:

1. Prequalification documents
2. Volume 1: Invitation for Bids
   - Section 1. Instruction to Bidders
   - Section 2. Part 1 – General Conditions
   - Section 3. Part 2 – Conditions of Particular Applications

   Volume 2: Section 4. Technical Specifications

   Volume 3: Section 5. Forms of Bid, Appendix, Bid Security and List of Eligible Countries of JBIC ODA Loans
   - Section 6. Bill of Quantities
   - Section 7. Form of Agreement
   - Section 8. Form of Security
   - Section 9. Schedule of Supplementary Information

   Volume 4: Section10. Drawings

## 11. Implementation Program

The Implementation program of the Project is presented. Seasonal conditions are take into account for commencement of the foundation work in December when the Mekong River water level will be low. The total Project duration from the loan agreement conclusion date to the Bridge opening date is estimated at five years and one month.

# 12. Evaluation and Recommendations

In accordance with the Study, the design objectives are fulfilled in appropriate and economical design achievements. Since the Finance Assistance Pledge has been made among the Government of the Lao PDR, the Royal Thai Government and the Government of Japan, the Project construction is expected to be implemented as early as possible.

# CONTENTS TABLE OF EXECUTIVE SUMMARY

# ABBREVIATIONS

| | |
|---|---|
| **AASHTO** | American Association of State Highway and Transportation Officials |
| **ADB** | Asian Development Bank |
| **ARI** | Average Recurrence Interval |
| **BCF** | Border Control Facility |
| **BMC** | Bridge Management Committee |
| **CBSB** | Cross Border Shuttle Bus |
| **COWI Study** | Original ADB study for the East West Corridor development in 1991, the Southern Thai-Lao Mekong Bridge Project |
| **DCTPC** | Department of Communication, Transport, Post and Construction<br>(province or district of the Lao PDR) |
| **DG** | Diesel Generator |
| **DOH** | Department of Highways (of Thailand) |
| **EIA** | Environmental Impact Assessment |
| **EIED** | Environmental Impact Evaluation Division (of Thailand) |
| **EIS** | Environmental Impact Statement |
| **FWL** | Flood Water Level |
| **GDP** | Gross Domestic Product |
| **GOJ** | Government of Japan |
| **GOL** | Government of the Lao PDR |
| **GPP** | Gross Provincial Product |
| **GPS** | Global Positioning System |
| **HWL** | High Water Level |
| **ICZ** | International Construction Zone |
| **IDA** | International Development Association (World Bank) |
| **IEE** | Initial Environmental Examination |
| **JBIC** | Japan Bank for International Cooperation (Successor of the OECF) |
| **JICA** | Japan International Cooperation Agency |
| **JIS** | Japan Industrial Standard |
| **JRA** | Japan Road Association |
| **JRA-SHB** | Specifications for Highway Bridge of Japan road Association |
| **LWL** | Low Water Level |

| | |
|---|---|
| **MCTPC** | Ministry of Communication, Transport, Post and Construction (of the Lao PDR) |
| **MOSTE** | Ministry of Science, Technology and Environment (of Thailand) |
| **MOTC** | Minister of Transport and Communications (of Thailand) |
| **NR** | National Road |
| **OECF** | Overseas Economic Cooperation Fund (Predecessor or of the JBIC) |
| **PC** | Prestressed Concrete |
| **PCC** | Project Coordinating Committee |
| **PR** | Provincial Road |
| **RC** | Reinforced Concrete |
| **ROW** | Right of Way |
| **RTG** | Royal Thai Government |
| **SAPROF** | Special Assistance for Project Formation |
| **SIDA** | Swedish International Development Agency |
| **STENO** | Science, Technology and Environment Organization |
| **the Study, the Project** | Detailed Design of The Second Mekong International Bridge Construction Project |
| **TIS** | Thai Industrial Standard |
| **UPS** | Uninterrupted Power Supply |
| **VNC** | Valuation and Negotiation Committee |

# EXECUTIVE SUMMARY

## A. INTRODUCTION

This Final Report (hereinafter referred to as the FR) covers all the work results of the JICA Study for the Detailed Design of the Second Mekong International Bridge Construction Project in the Lao PDR and Thailand. The Draft Final Report consists of the following documents.

**(1) Main Report**

- Volume 1 : Executive Summary
- Volume 2 : Main Report
- Volume 3 : Drawings

**(2) Draft Pre-qualification**

**(3) Tender Document**

- Volume 1 :Invitation for Bids, Instruction to Bidders, Conditions of Contract, Form of Bid and Contract
- Volume 2 :Technical Specifications
- Volume 3 :Bill of Quantities
- Volume 4 :Drawings

The Detailed Design of the Bridge, Road and Border Control Facilities were undertaken in accordance with the basic policy and design standards which were proposed by the JICA Study team and agreed by the Ministry of Communication, Transport, Post and Construction of the Lao PDR (hereinafter referred to as the "MCTPC") and the Department of Highways of Thailand (hereinafter referred to as the "DOH") at the Basic Design stage.

The study and works for the Detailed Design of the Second Mekong International Bridge Construction Project have been carried out during the period from March 1999 to March 2000 and the following reports were submitted to the MCTPC and the DOH in accordance with the study schedule as shown in the Figure A-1.

| | | |
|---|---|---|
| • Inception Report | Submitted | April, 1999 |
| • Progress Report No.1 | Submitted | June, 1999 |
| • Basic Design Report | Submitted | August, 1999 |
| • Progress Report No.2 | Submitted | October, 1999 |
| • Progress Report No.3 | Submitted | December, 1999 |
| • Draft Final Report | Submitted | March, 2000 |

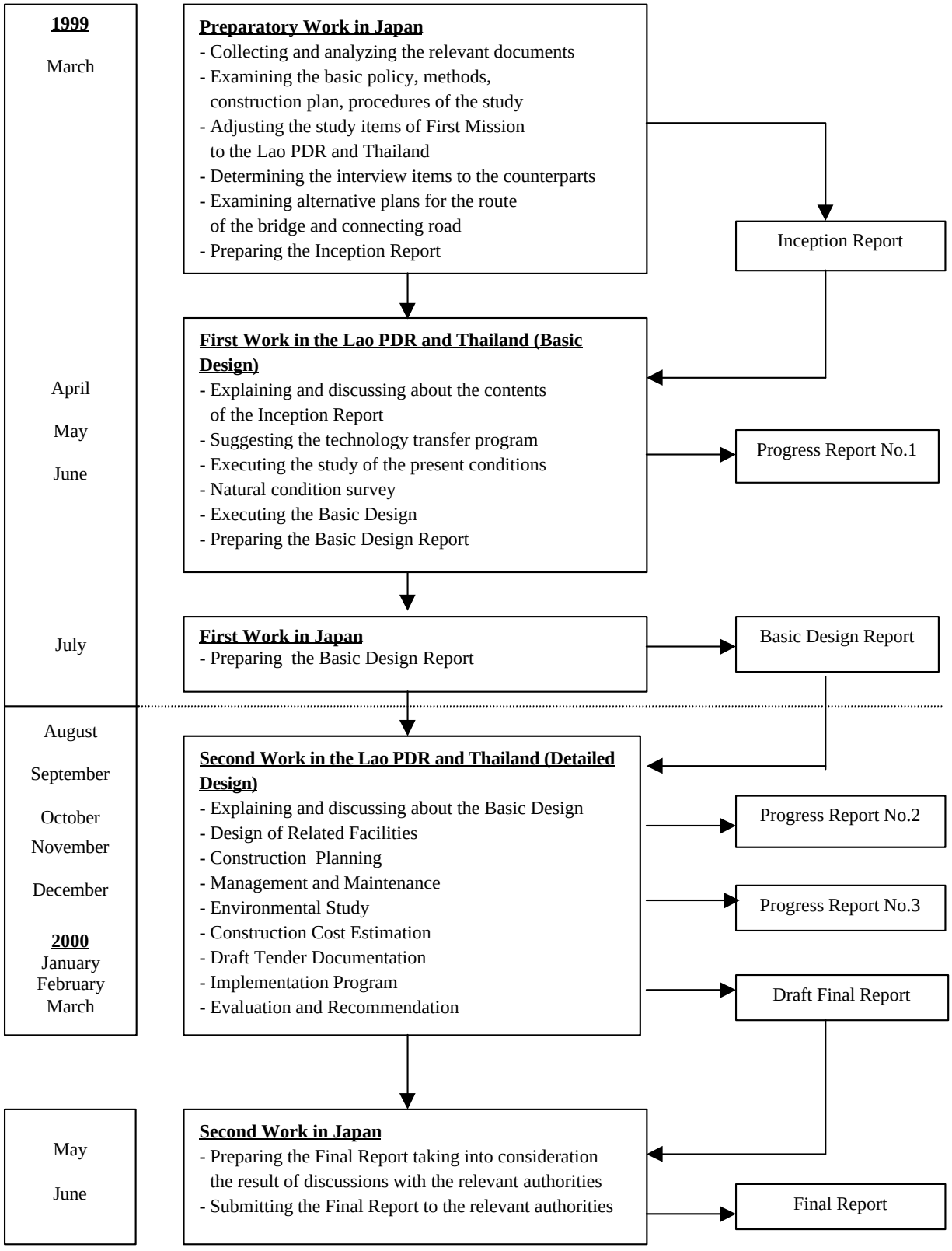



**Figure A-1 Study Flow**

## B. FINAL REPORT

The Final Report covers the following studies and works.

# Chapter 1. Study Contents

In response to a request by the Government of the Lao PDR (hereinafter referred to as the "GOL") and the Royal Thai Government (hereinafter referred to as the "RTG"), the Government of Japan (hereinafter referred to as the "GOJ") decided to conduct the Detailed Design of The Second Mekong International Bridge Construction Project (hereinafter referred to as "the Study" and "the Project").

The Japan International Cooperation Agency (hereinafter referred to as the "JICA"), the official agency responsible for the implementation of the technical co-operation programs of the GOJ, undertook the Study in close co-operation with the authorities concerned of the GOL and the RTG, and dispatched a Study team.

The Japan Bank for International Cooperation (hereinafter referred to as the "JBIC"), the official agency responsible for extending the financial assistance program of the GOJ, has pledged loans to the GOL and the RTG in December 1998 to assist the implementation of the Project.

The Indochina East West Corridor linking Myanmar in the west and Vietnam in the east and passing through the Lao PDR and Thailand is one of the priority project for the development of the Greater Mekong Sub-region. The Second Mekong International Bridge is the Mekong River Crossing of the Corridor. There have been several studies conducted with the financing from the ADB. Finally a Special Assistance for Project Formation (SAPROF) Study by the OECF in 1998, selected a location for the crossing approximately 5 km north of Savannakhet and Mukdahan.

The objectives of the JICA Study are as follows;

- Conducting the necessary engineering and environmental surveys to get the basic data for the design. The Detailed Design for the Bridge, connecting road and border control facilities, the Environmental Impact Assessment, the Construction Plan, the Maintenance Plan, the Cost Estimation and Draft Tender Documents.
- To pursue technology transfer to the GOL and the RTG counterpart personnel during the course of the Study.

The Study area of the Project is located approximately 5.0 km north of Savannakhet in the Lao PDR and approximately 7.5 km north of Mukdahan in Thailand.

The Study is executed in accordance with the Scope of Works of this Study agreed on 24 December 1998 by the GOL, the RTG and JICA, covering the following items;

- Preliminary Study
- Natural Condition Survey
- Basic Design
- Detailed Design
- Environmental Impact Assesment (EIA)
- Construction Plan

- Management/Maintenance Plan

- Estimation of Cost for the Project

- Draft Tender Documents

The Study is conducted as shown in Figure A-1 work flow.

The Ministry of Communication, Transport, Post and Construction of the GOL (hereinafter referred to as the "MCTPC") and the Department of Highways of the RTG (hereinafter referred to as the "DOH") act as counterpart agencies co-operating with the concerned related organizations of each country, to the JICA Study Team and also as coordinating bodies in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the Study, with guidance provided by JICA.

Two committees are involved with political matters of the Study and to solve problems. They are explained as follows;

**(1) Bridge Management Committee (BMC)**

The BMC includes representatives of the MCTPC and the DOH

**(2) Project Coordinating Committee (PCC)**

The PCC consists of personnel of higher status than BMC. The PCC adjusts political matters concerning with the Study and solves the problems, which are not to be solved by the BMC.

The relationship among these institutions is as shown in Figure 1.1 .

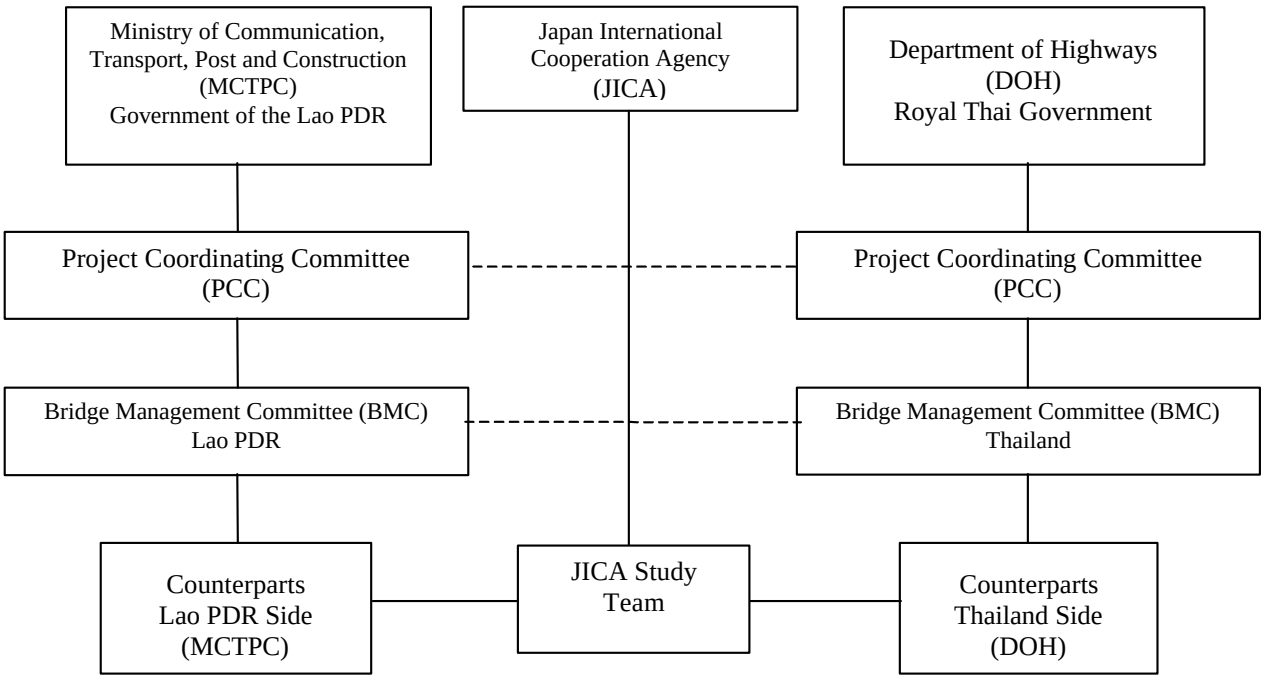



**Figure 1.1 Study Structure**

# Chapter 2. Detailed Design of Road

Fundamental parameters for design, such as location, classification, geometry, lane assignment, crossing with local roads, relation with the Border Control Facility (hereinafter referred to as the "BCF"), were studied, discussed among parties concerned and determined during the Basic Design stage.

## (1) Design Conditions

The geometric design standard of the Project is based on that of the Asian Highway and summarized as shown in Table 2.1.

**Table 2.1 The Geometric Design Standards of the Project**

| Geometric Item | Second Mekong Bridge |
|---|---|
| Class | Asian Highway Class II-L |
| Design Speed | 80km/h |
| Min. Horizontal Curve Radius | 400m |
| Min. Horizontal Curve Radius (without Transition Curve)<br>(without Superelevation) | 900m<br>3,500m |
| Min. Vertical Curve Radius (Crest)<br>(Sag) | 5,000m<br>2,000m |
| Max. Gradient | 4.0% |
| Max. Superelevation | 10.0% |
| Carriageway Width | 3.5 m x 2 = 7.0m |
| Shoulder Width (Traffic Side) | 2.5m |
| Crossfall | 2.0% |
| Right of Way | 50m (the Lao PDR)<br>60m (Thailand) |

## (2) Typical Cross-Section

The typical cross-section of the Lao PDR side connecting road is shown in Figure 2.1 and that of the Thailand side is shown in Figure 2.2. The 11m width median in the Thailand side has been decided on the basis of scheduled widening of the carriageway in the future.

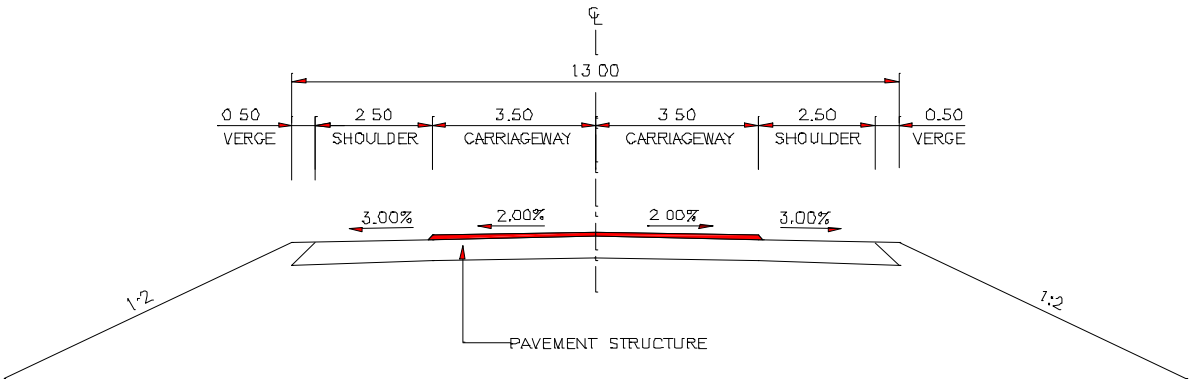



**Figure 2.1 The Typical Cross-section of The Connecting Road in The Lao PDR**

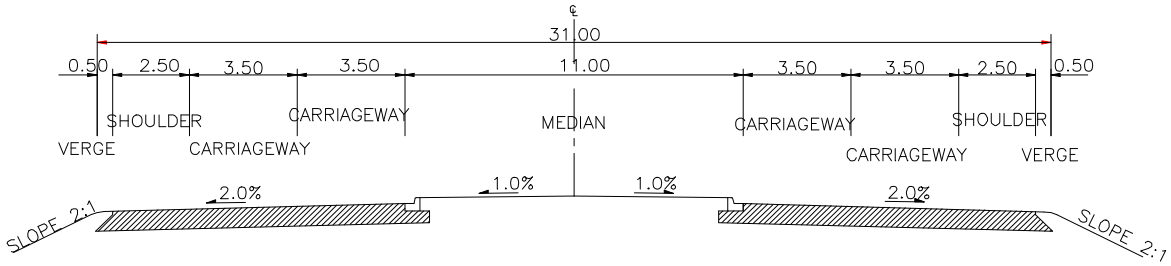



**Figure 2.2 The Typical Cross-section of The Connecting Road in Thailand**

### (3) Horizontal and Vertical Alignment

The horizontal alignment of the road was determined under the various controlling points such as the crossing point of the Bridge, connecting points of Route No.9, A-3 Road in the Lao PDR and Route No. 212 in Thailand, and the land use along the route.

The Vertical alignment of the road was determined on the basis of various vertical control points such as a navigation clearance, BCF elevation, connecting and cross over roads, and land use along the route especially in the Lao PDR side. The horizontal and vertical alignments are shown in Figure 2.3, 2.4.

### (4) Traffic Changeover

The traffic changeover is located between the Main Bridge and the Thailand BCF. The traffic changeover type was decided as an at-grade by reason of its simple and economical structure, as well as the traffic volume increase in the future. The plan of the traffic changeover is shown in Figure 2.5.

The design standards of the traffic changeover are shown in Table 2.2.

**Table 2.2 The Design Standard for Traffic Changeover**

| Standard Item | Second Mekong Bridge |
|---|---|
| Class | Japanese Grade-B |
| Design Speed | 50km/h |
| Number of Lanes | 1 (on each side) |
| Min. Horizontal Curve Radius | 90m |
| Min. Horizontal Curve Radius<br>(without Transition Curve)<br>(without Superelevation) | <br>220m<br>1,300m |
| Min. Horizontal Curve Length | 90m |
| Min. Vertical Curve Radius (Crest)<br>(Sag) | 5,000m<br>2,000m |
| Max. Gradient | 4.0% |
| Max. Superelevation | 10.0% |
| Lane Width | 3.5m |
| Shoulder Width (Traffic Side) | 2.5m |
| Shoulder Width (Center Side) | 1.0m |
| Verge Width | 0.5m |
| Formation Width | 8.0m |
| Crossfall | 2.0% |

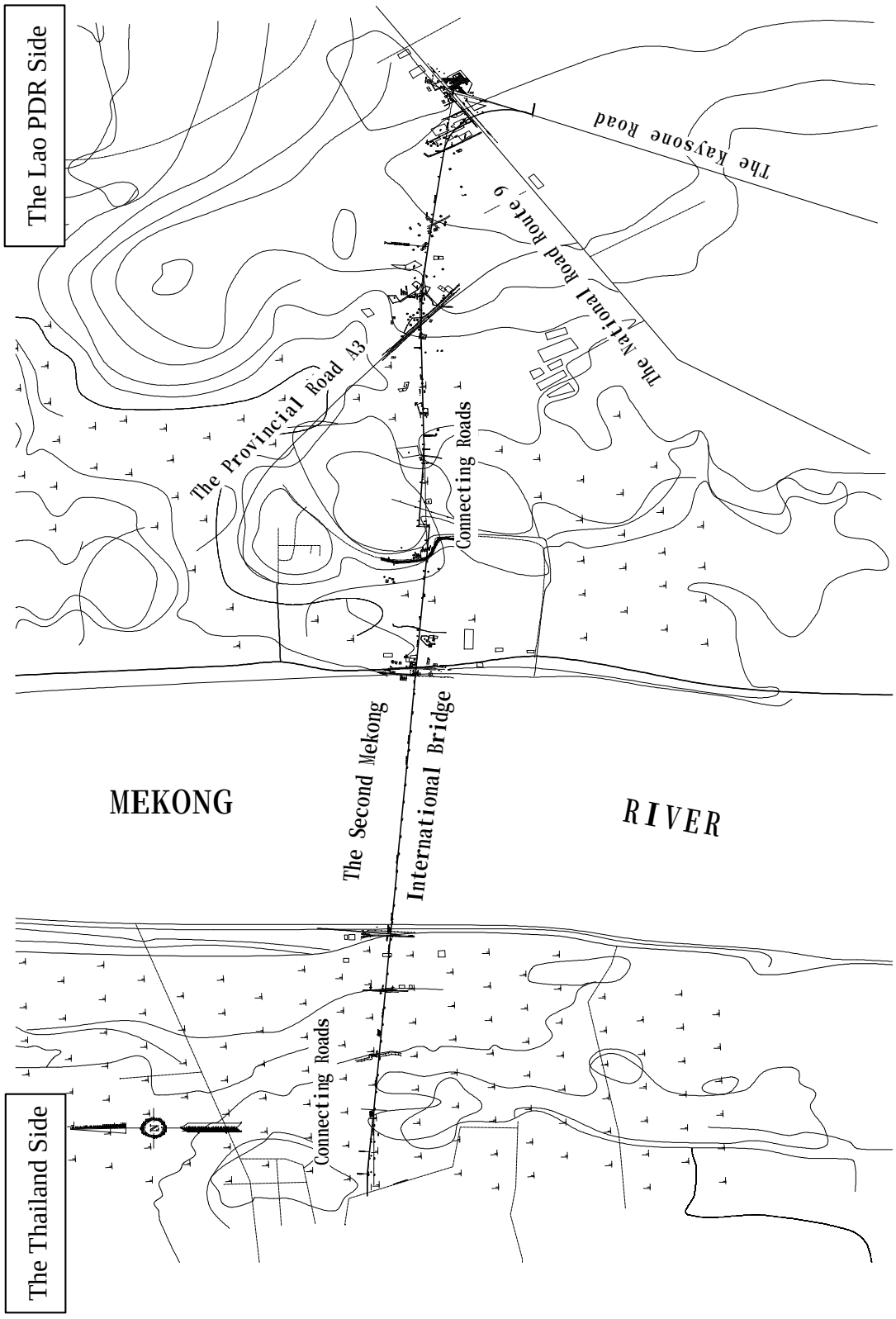



**Figure 2.3 Horizontal Alignment of the Bridge and Connecting Road**

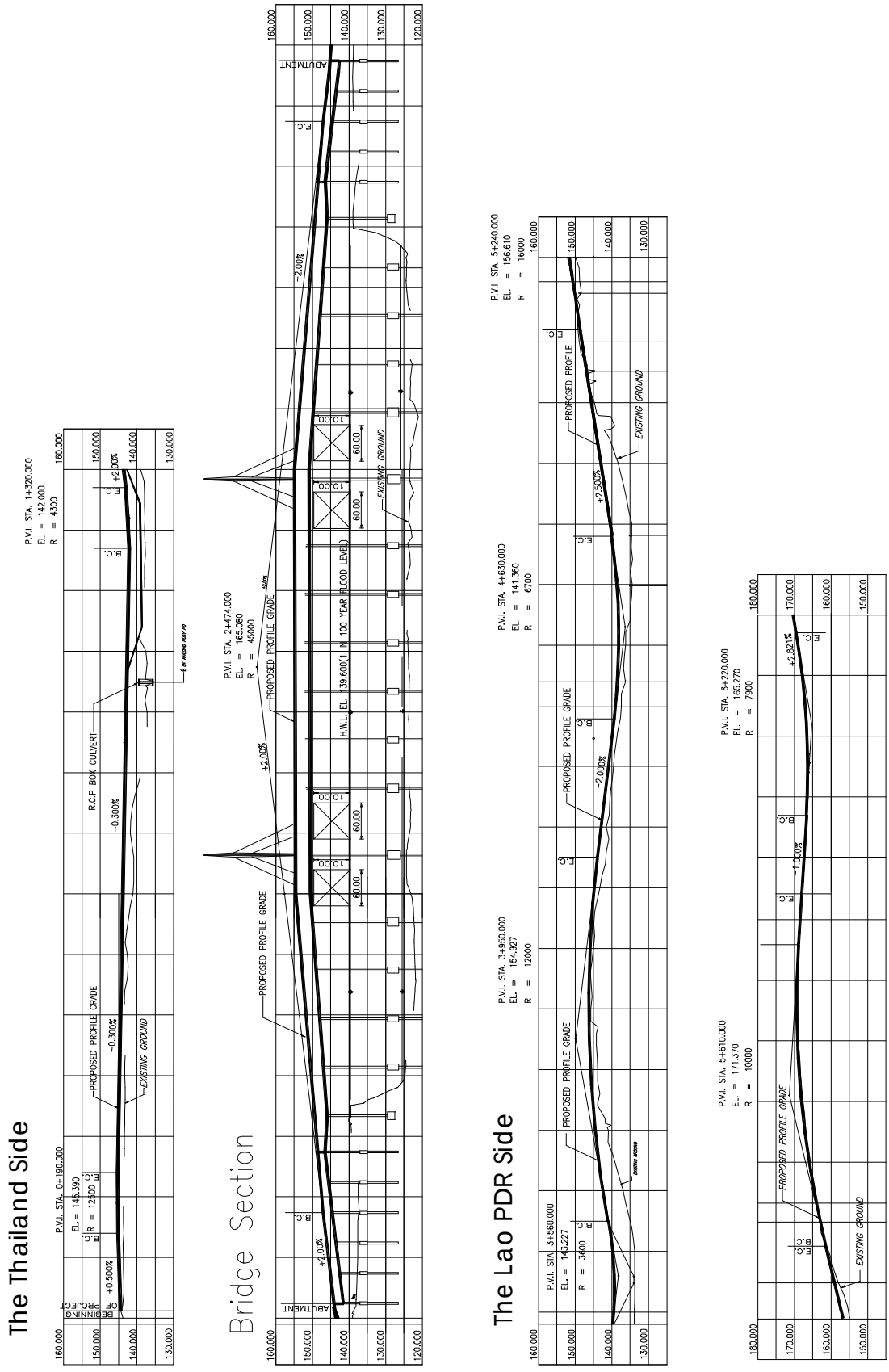



**Figure 2.4 Vertical Alignment of the Bridge and Connecting Roads**

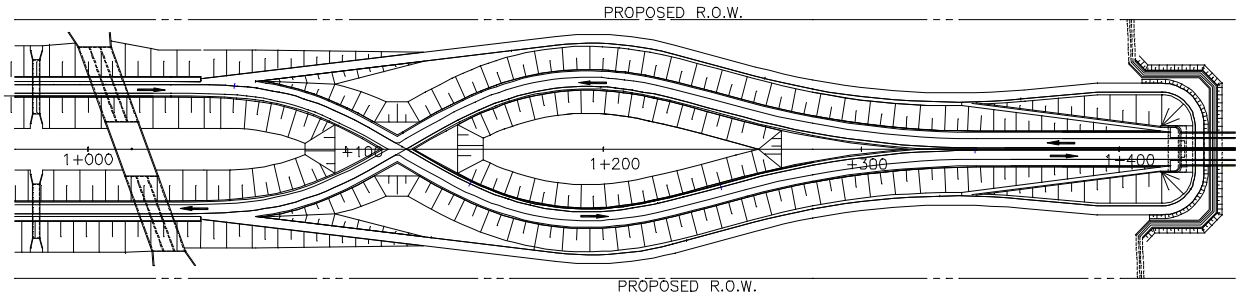



**Figure 2.5 Traffic Changeover**

### (5) Intersection

There are five roads that connect or cross the connecting roads. However, crossing of the riverbank roads at both sides of the River have been planned by using the main Bridge as an overpass in both cases. Therefore, the following three intersections have been designed.

- National Road Route No.9 (the Lao PDR)
- Provincial Road A-3 (the Lao PDR)
- National Highway Route No.212 (Thailand)

#### 1) The National Road Route No.9 Intersection

This intersection connects the connecting road of the Project, the National Road Route No.9 and Kaysone Road. But the crossing angle between the National Road Route No.9 and Kaysone Road is acute at approximately 37 degree. Therefore, an improved roundabout type is proposed for traffic safety and also as a landmark. The intersection plan is shown in Figure 2.6.

#### 2) Provincial Road A-3 Intersection

The crossing angle of connecting road and the Provincial Road A-3 is approximately 42 degree. However, the crossing angle is stipulated as more than 60 degree in AASHTO Standard. Therefore, at the intersection the crossing angle has been modified. The intersection plan is shown in Figure 2.7.

#### 3) The National Highway Route No.212 Intersection

The crossing angle of the connecting road and the National Highway Route No.212 is approximately 89 degree. Therefore, the intersection has been designed as a standard three-leg intersection type based on the DOH Standard Drawings. The intersection plan is shown in Figure 2.8.

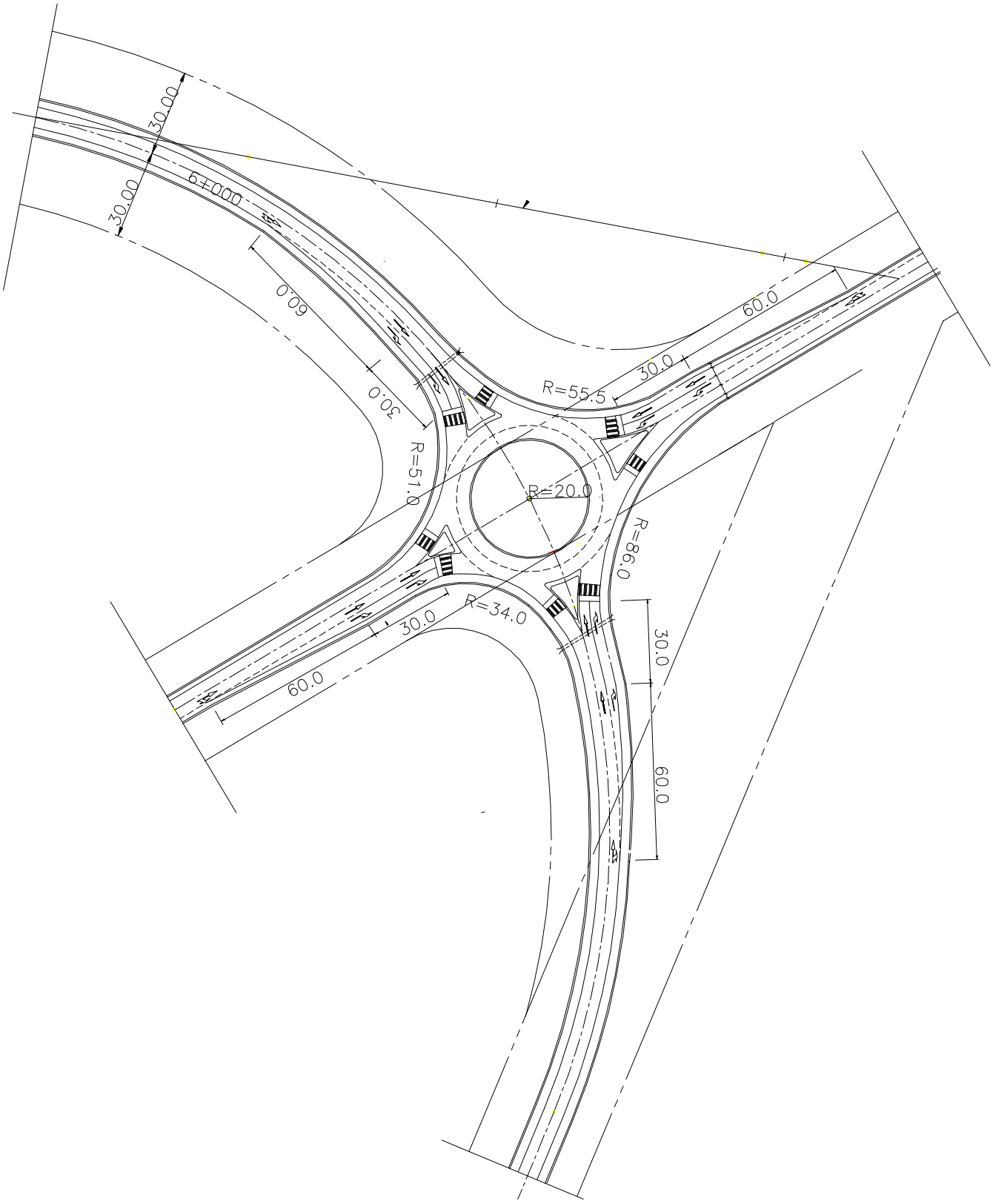



**Figure 2.6 The National Road Route No.9 Intersection**

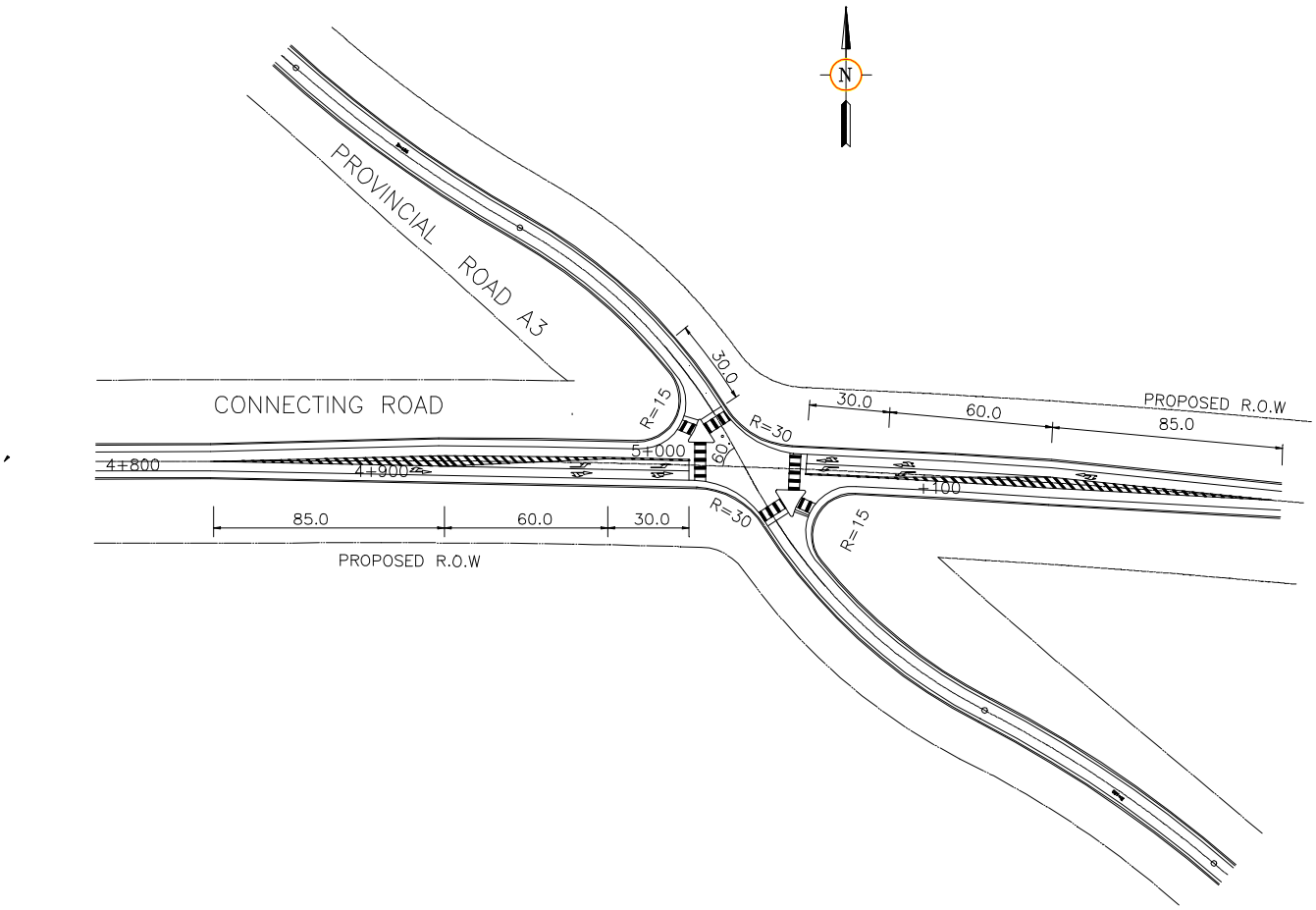



**Figure 2.7 Provincial Road A-3 Intersection**

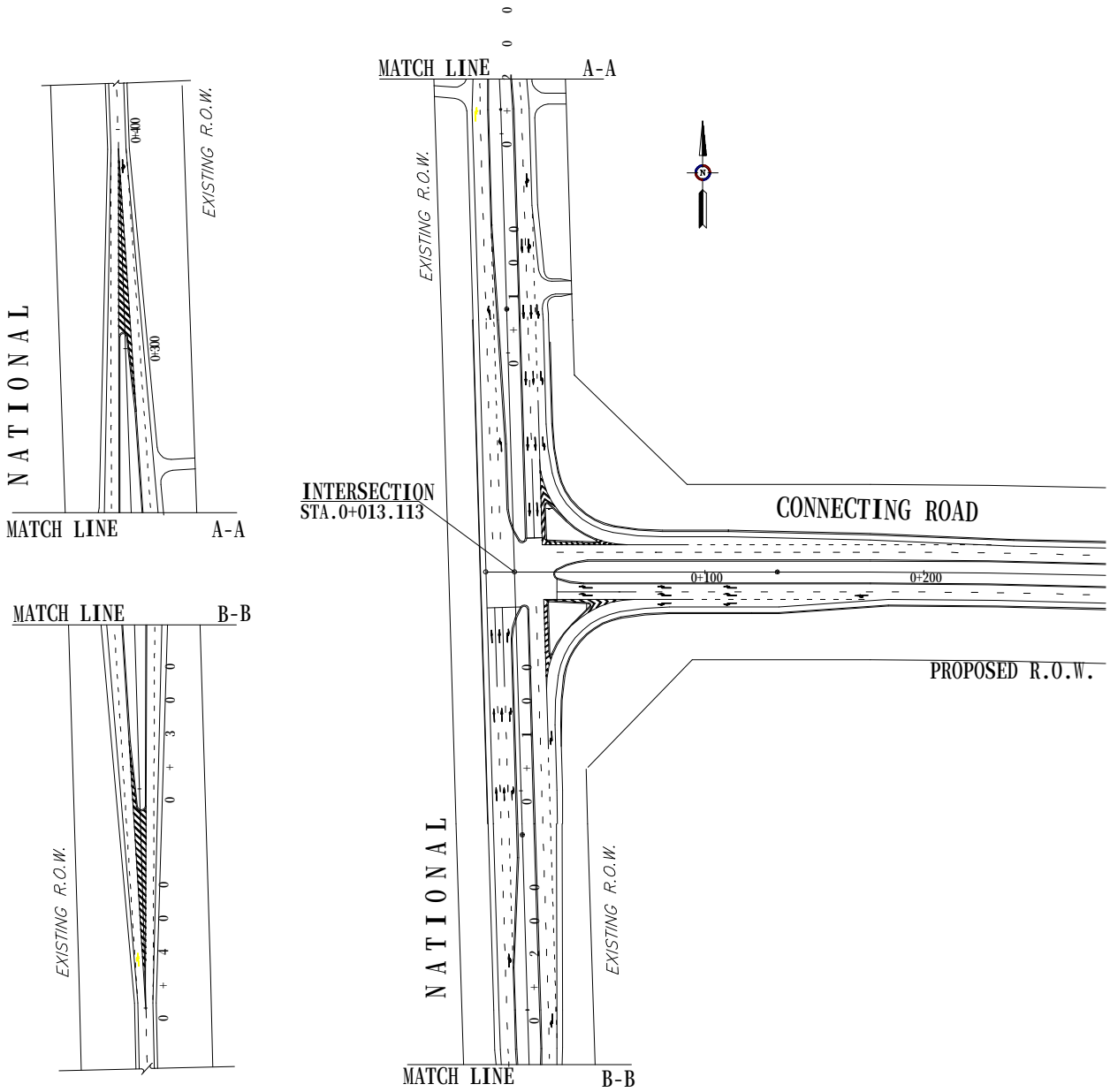



**Figure 2.8 The National Highway Route No.212 Intersection**

### (6) Pavement Structure

The pavement structure design has been determined based on the Manual for Asphalt Pavement and Manual for Cement Concrete Pavement (JRA : Japan Road Association). The Design CBR value of 6 % for subgrade was adopted according to the material testing results.

Design Traffic Volume was determined from the SAPROF Study and the expected average AADT (Annual Average Daily Traffic) of heavy vehicles in year 2003 to year 2009. Compositions are shown in Figure 2.9 for asphalt pavement and Figure 2.10 for concrete pavement.

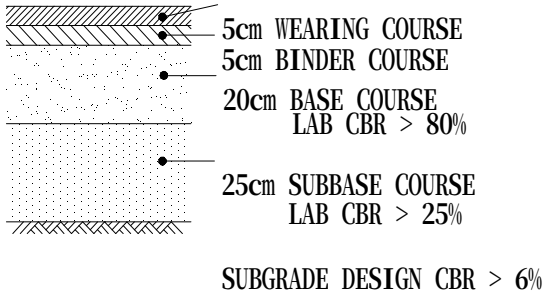



**Figure 2.9**
**Composition of Asphalt Pavement**

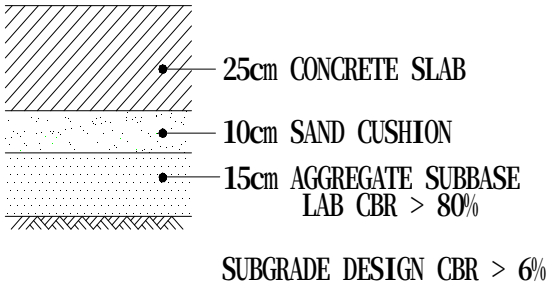



**Figure 2.10**
**Composition of Concrete Pavement**

### (7) Drainage System

The drainage system was determined as shown in Figure 2.11 for the Lao PDR side and in Figure 2.12 for the Thailand side after investigation of the existing drainage system, topographic conditions and discussions with the MCTPC and the DOH.

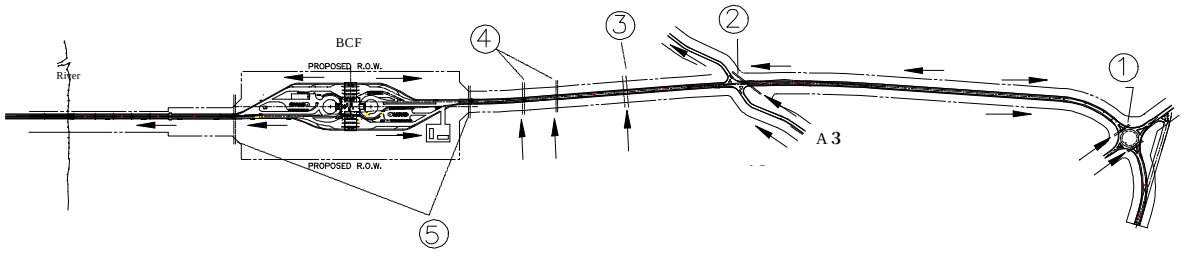



**Figure 2.11 Drainage System, the Lao PDR Side**

① Pipe culverts for drainage at the intersection of the National Road Route No.9

② Pipe culvert for A-3 road drainage.

③ Box culvert for the upstream drainage.

④ Pipe culverts for the upstream drainage and irrigation

⑤ Pipe culverts for the boundary BCF drainage

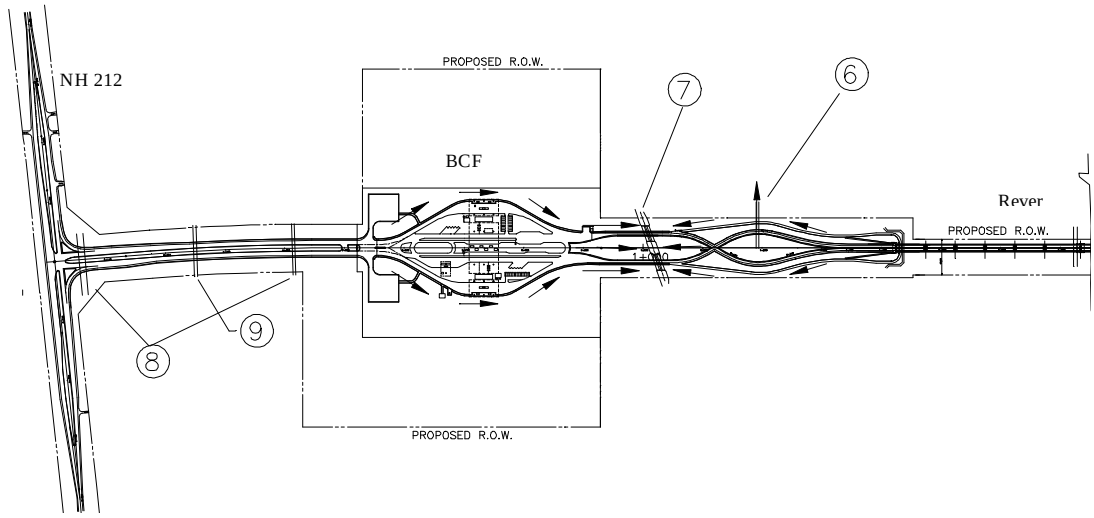



**Figure 2.12 Drainage System, the Thailand Side**

⑥ Pipe culvert for drainage of traffic changeover

⑦ Box culvert for the Po river – 3 cell box 3.6m x 3.6m

⑧ Pipe culverts for the upstream drainage and irrigation

⑨ Pipe culverts for an irrigation canal

# Chapter 3. Detailed Design of Main Bridge

The Main Bridge type had been studied among several alternatives taking into consideration climate (rain/dry), topograply, geology, material supply, local construction industry and other similar matters and was determined as a PC – sail.

### (1) Structural Source

- Bridge type : PC (prestressed concrete) sail type continuous box girder bridge (refer to Figure 3.1).
- Bridge length : 1600m
- Span : 60+4@80+2@110+5@80+2@110+4@80+60m
- Layout of bridge deck : 2x4.25m (carriageway)+ 2x1.5m (sidewalk) + 0 =12.0m (standard section)
- Erection method : Pre-cast segment balanced cantilever erection method
- Alignment : Horizontal Alignment R= ∞
  Vertical Alignment 2.0%
  Crossfall of the road 2.0%
  Crossfall of the side walk 1.5%
- Pier type : RC wall-type pier

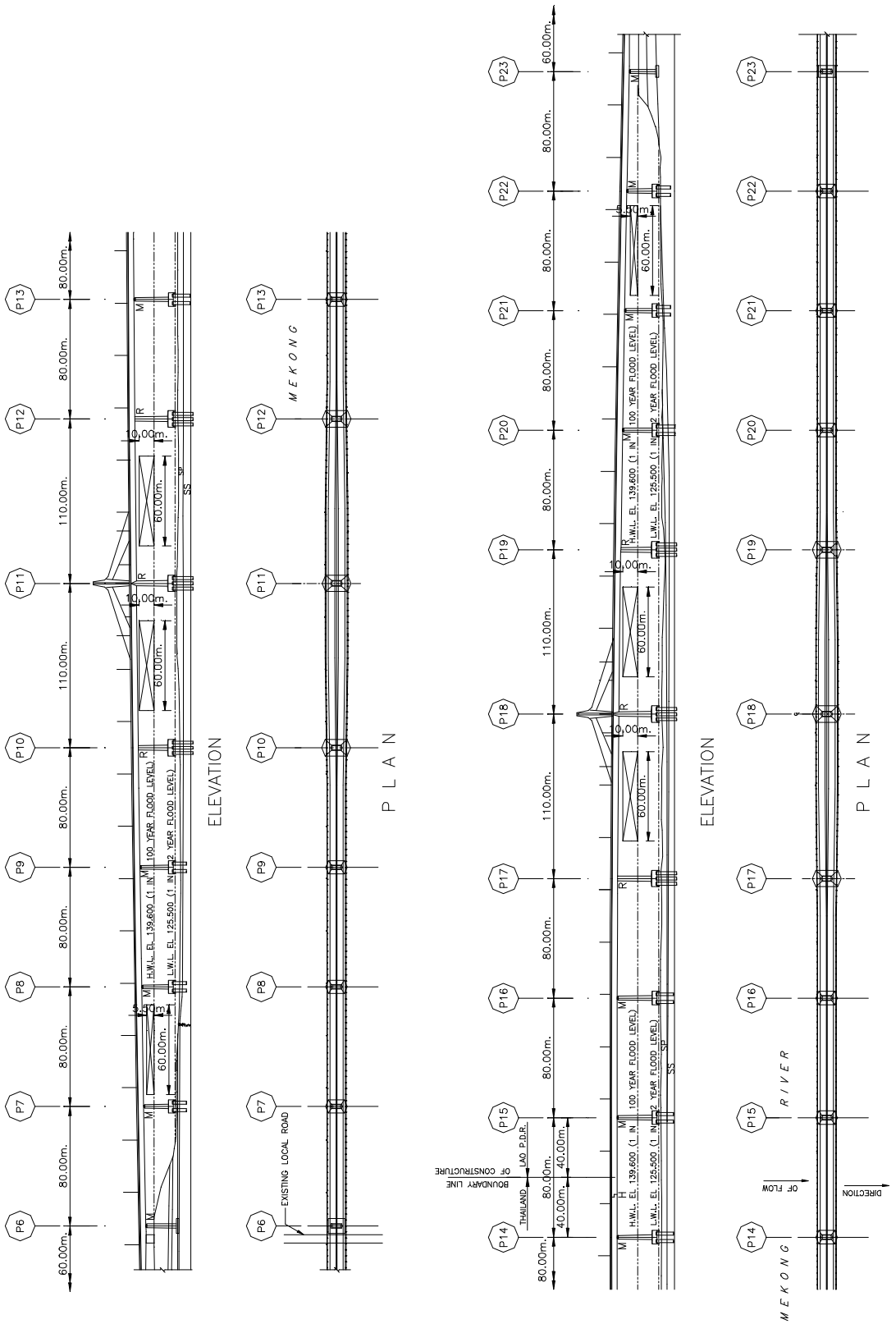



**Figure 3.1(1/2) General View of the Main Bridge**

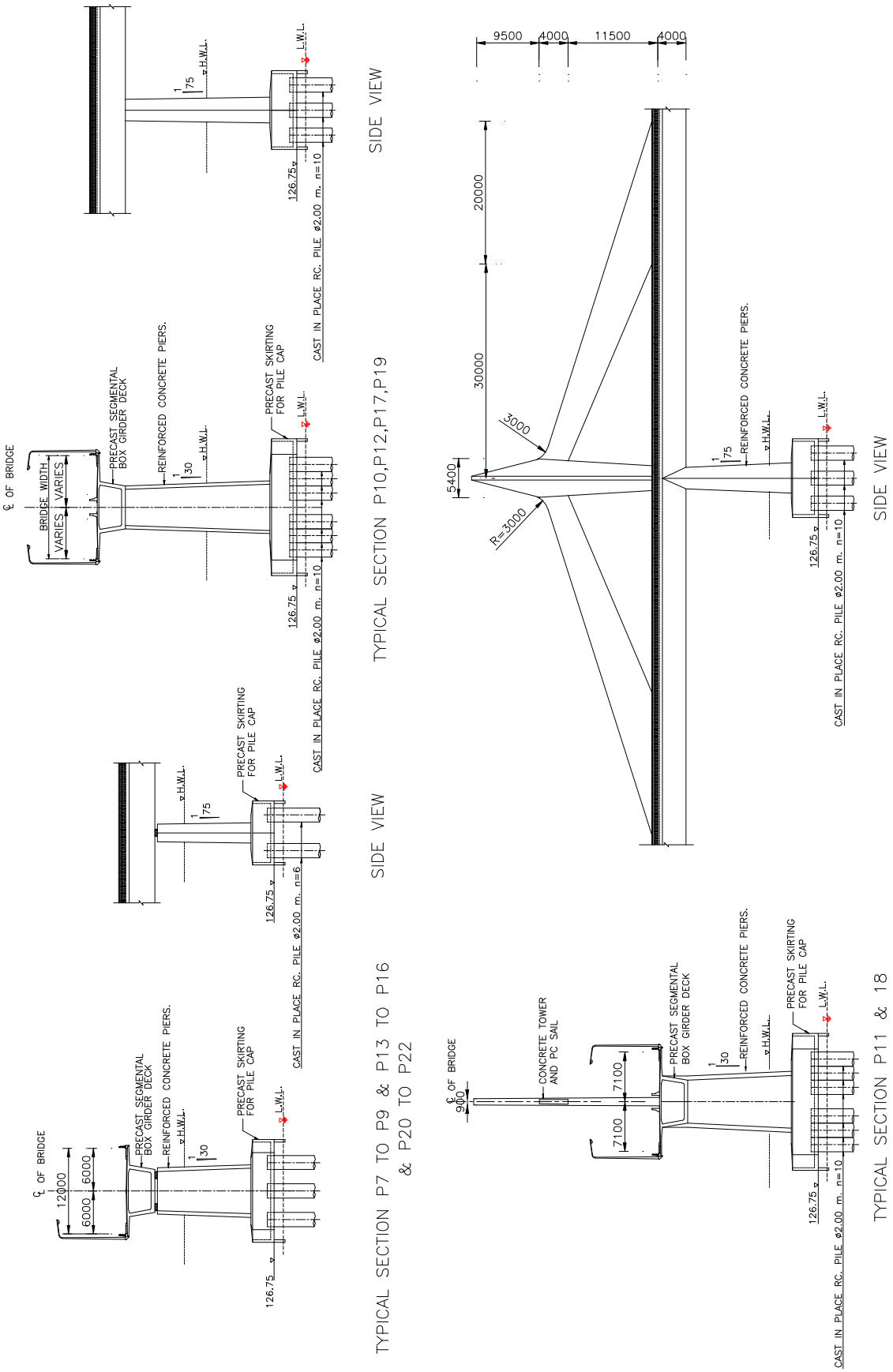



**Figure 3.1(2/2) General View of the Main Bridge**

- Foundation type : ϕ 2.0m cast-in-place RC multis pile foundations (except for P6, P23)
  Spread foundation (P6, P23)
- Bearing strata : Mudstone or sandstone
- Bearing support : Elastomeric laminated bearing
- Expansion joints : Steel finger joint type
- Guardrail : Steel type
- Lighting pole : Steel type

### (2) Design Conditions

Design conditions are shown in Table 3.1.

**Table 3.1 (1/3) Design Standard and Bridge Design Conditions**

| Item | Bridge Design Standard and Conditions | Reference |
|---|---|---|
| a. Design Standard | The design standard of the Bridge is the Japan Road Association (JRA) ; Specifications for Highway Bridge (SHB)1998. | |
| b. Design Load | - Main girder : DOH standard (AASHTO HS 20 –44x1.30)<br>- Deck slab : B-live load by JRA-SHB<br>- Pedestrian live load: AASHTO<br>- Dead load : JRA-SHB<br>Steel material : 77 KN/$m^3$<br>Reinforced concrete : 24.5 KN/$m^3$<br>Prestressed concrete : 24.5 KN/$m^3$<br>Plain concrete : 23 KN/$m^3$<br>Asphalt pavement : 22.5 KN/$m^3$, 50mm thick<br>Handrail : 500 N/m each side<br>Electronic cable : 500 N/m each (including future services)<br>- Seismic load : horizontal load at 6.0% of dead load equivalent static horizontal load in any directions.<br>- Ship impact load : equivalent static force of 3400KN acting in any directions.<br>- Wind load: standard velocity of 48m/s.<br>- Hydrodynamic force : calculated by JRA-SHB, maximum river flow velocity 2.6m/s.<br>- Thermal effect : average concrete structure between 10°C and 40°C.<br>- Drying shrinkage and creep of concrete : 75% relative humidity.<br>- Guard Rail load : JRA-SHB.<br>- Differential settlement : not considered.<br>- Combination of loads : depends on JRA-SHB. | Adjusted from AASHTO<br><br><br>Maintenance purpose<br><br><br><br><br><br><br><br><br>From investigation<br><br>From previous studies<br><br>Refer to survey<br>Refer to survey<br>Refer to survey<br><br>Refer to survey<br><br><br>Rock foundation |

## Table 3.1 (2/3) Design Standard and Bridge Design Conditions

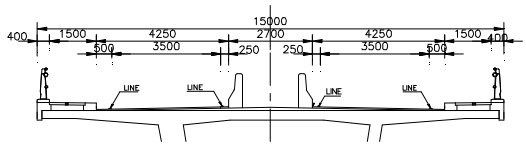
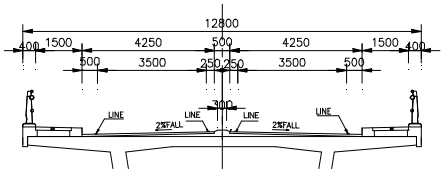
| Item | Bridge Design Standard and Conditions | Reference |
|---|---|---|
| c. Deck Layout and Bridge Attachment | -The bridge deck width between edge guard rails is 12.0m.<br>-The footpath width is 1.5m.<br>-The traffic lane width is 3.5m. The shoulder width on the curbside is 0.5m.<br>-The Mountable median width of standard part is 0.5m.<br>-The road pavement is asphalt concrete pavement, with a thickness of 50mm.<br>  <br>**Standard Section**<br>  <br>**PC Sail Section** | Refer to SAPROF |
| d. Navigation Clearance | -Vertical navigation clearance<br>For the main navigation spans:<br>Not less than 10.0m<br>For the side spans (excluding the extreme side span) :<br>Not less than 5.5m.<br>These clearances shall be based on the HWL (1 in 100 year average recurrence level (ARI) flood level of the river.<br>-Horizontal navigation clearance<br>For all spans (excluding the extreme side span) :<br>Not less than 60.0m. | Refer to SAPROF |

**Table 3.1 (3/3) Design Standard and Bridge Design Conditions**

| Item | Bridge Design Standard and Conditions | Reference |
|---|---|---|
| e. Minimum Span | -The minimum span between piers is 80m. (to secure navigation clearance at HWL and LWL; and to secure clearance from debris during flooding) | Refer to the River Management Training Law of Japan |
| f. Preferable Span | -The Preferable span between piers is 110m. (to secure future development space for navigation and make equivalent span with other Mekong bridges) | Refer to the River Management Training Law of Japan |
| g. Design Water Level | -HWL is 139.6m (1 in 100 year ARI flood water level)<br>-LWL is 125.5m (1 in 2 year ARI water level) | From investigations |
| h. Position of the End Pier of the Main Bridge (Main Bridge Length) | -The Main Bridge length between the centers of the end piers in both the Lao PDR and Thailand is 1,600m. | From investigations |
| i. Clearance of Existing Roads near the Riverbank | -The road height minimum clearance shall be 5.5m.<br>-The road width shall be as of the present conditions. | Refer to DOH Standard |
| j. Bridge Facility | -Bridge lighting, navigation lighting<br>-Emergency telephone | Requested by the Lao PDR and Thailand |

### (3) Superstructure

#### 1) General

The supporting condition of the main girder was determined. The design of the superstructure has been based on construction procedures.

#### 2) Materials

a)Concrete

Compressive strengths of concrete by structure items are as follows.

- Prestressed concrete structure : $\sigma ck = 40N/mm^2$
- Rigid pier : $\sigma ck = 40N/mm^2$
- Pier, footing and abutment : $\sigma ck = 24N/mm^2$
- Cast-in-place RC pile : $\sigma ck = 30N/mm^2$

The strength specified is the compressive strength of concrete cylinders at an age of 28 days.

b)Steel

Reinforcing bar (JIS G3112)

- SD345, Yield strength $\sigma_{sy} \geq 350N/mm^2$
  In the Lao PDR and Thailand, SD390 is the reinforcing bar equivalent to SD345;

SD345 is indicated in drawings.

Strand cable for prestressing steel (JIS G3112)

- Main girder inner cable 12S15.2 (SWPR7BL)
- Main girder external cable, PC sail 19S15.2 (SWPR7BL)
- Deck slab, dapped hinge 4S15.2 (SWPR7BL)

Temporary PC bar (JIS G 3109) ϕ32 (SBPR930/1180)

**3) Design of the Main Girder**

a) Girder transverse cross section

The slab of the Bridge in transverse direction is a PC structure. For high durability, no tensile stress is allowed under design loading. The slab in the Bridge axis direction is a RC structure.

b) Bridge superstructure construction method

The superstructure construction is the precast segmental balanced cantilever method. Inner cables are used for erection load and external cables are for service loads.

c) Support condition of Bridge in axis direction

The supporting condition of the Main Bridge was determined to satisfy a soundness of structure, a good vehicle comfort, an easy maintenance and an economy in life cycle; as follows:

- the main girder is kept as continuous and has only one expansion joint, and fixed bearing at the PC sail tower and adjacent piers (total of six) and the rest, sliding bearings.

d) Saddle structure of main tower

The PC cable shall saddle the main tower structure thus allowing for tensioning in the superstructure on both the right and the left sides of the main tower.

e) Prestressing of PC sail

Design for Bridge axis direction; the sectional stress is analyzed considering the construction method.

Design transverse to bridge axis; bending moment by wind load is considered.

Measure against bending crack occurring at PC sail; prestressing of the PC sail is divided into two stages, 30% at primary and 70% at secondary.

f) Division and joint of the precast segment

The length of the segment was determined with consideration of the maximum segment weight of 140ton. The closure pour at the span center and the pier head of the rigid structure at

P10~12, P17~19 is made of cast-in-place concrete.

g)PC cable system

The PC cable of the main girder axis direction uses both inner and external cables. The inner PC cable under cantilever erection are arranged in the deck slab. The external PC cables are arranged inside the box girder space after girder erection.

**4)The calculation procedure**

The main bridge was analyzed as a two (2) dimensional rigid frame model with elastic support of the lower end of the rigid pier. Calculation of cross sectional force and stress in the member was carried out by using the structural analysis program CONST. Incremental stress of the external cable in calculation of the ultimate bending moment of the main girder was assumed at 105N/mm$^2$ (10.5kg/cm$^2$).

**(4) Pier and Foundation**

**1)General**

The design of the multi piled foundation has been based on full scour to bedrock. In the detailed design the piles have been socketed at least 5m into the bedrock for both stability and securing bearing capacity.

**2)Pile Cap Soffit Level and Skirt Level**

The detailed design study used the IWAI probability analysis for the maximum and minimum monthly water levels. The level exceeding the 10-year return period for the monthly maximum water level was used as the basis to set the pile cap soffit level that was fixed at EL 126.75. A level less than EL 125.25 representing a 5 -year return period for the monthly minimum water level was set for the precast skirt bottom level.

**3)Topographic and Geological Conditions**

The geological survey was carried out at each boring location (6 locations in the Mekong River and 2 locations on each side of the riverbanks on both the Lao PDR and the Thailand sides). The foundation support criteria adopted for the Bridge is a rock layer with an SPT N value ≥50. That is, for foundation support: Mudstone, (N-Value ≥ 50); Sandstone, (N-Value ≥ 50)

**4)Piles and Foundations**

a)P 6 and P 23 (Spread Foundations)

A spread foundation was evaluated as the most suitable foundation type based essentially on aesthetics after erosion as well as construction cost factors. Finally for confirmation, a detailed cost comparison was made between a cast-in-place piled foundation and a spread

foundation. The spread foundation gains its cost benefit by 25% even with substantial cofferdam cost.

b)Piers 7, 8, 9, 20, 21 and 22 (Piles)

These six piers allow movement of the superstructure. They are supported by 6 of ϕ 2.0m reinforced concrete steel cased piles socketed 5m into the rock layer.

c)Piers 10, 12, 17 and 19 (Piles)

These four piers with rigid connection to the superstructure are supported on 10 of ϕ 2.0m piles as in (b) above.

d)Piers 11 and 18 (Piles)

These two piers with a rigid connection to the superstructure support the PC sail tower loads. The support is on 10 of ϕ 2.0m pile as in (c) above.

e)Piers 13, 14, 15 and 16 (Piles)

These four river piers with superstructure movement allowed are supported on 6 of ϕ 2.0m piles as in (b) above.

f)Piers

All piers are standard wall types with small tapers on both the longitudinal and the transverse axes. The edges of piers are beveled at 22° to keep the same geometry as the pile cap ends.

**(5) Riverbank Protection**

Design policy for the revetment is as follows :

**1** ) A typical cross-section of the revetment is to refer to the existing examples of revetment in the neighborhood (refer to Figure 3.2). Then gabion mattress is used at 0.5m thickness. The gradient of the revetment is 1:2.0 at the upper level and 1:2.5 at the lower section. The riverbank on both sides uses the same typical section.

**2** ) As the slope length is long, a 3.0m wide berm is designed at the middle of the LWL and HWL for stability at the slope and for easy construction and maintenance works.

**3** ) The location of revetment toe is under LWL and the tip of the revetment design used does not affect the upper part of the revetment. When the riverbed is eroded at the revetment tip, the section between the toe and the tip will drop to the bedrock.

4) The riverbank protection is provided for at a distance of 50m upstream and 50m downstream from the bridge centerline. The total length is 100m. The length of the protection is the minimum length prescribed by the River Training Management Law of Japan.

5) The end edges of the upstream and the downstream of the revetment will be covered by riprap to join with the existing ground.

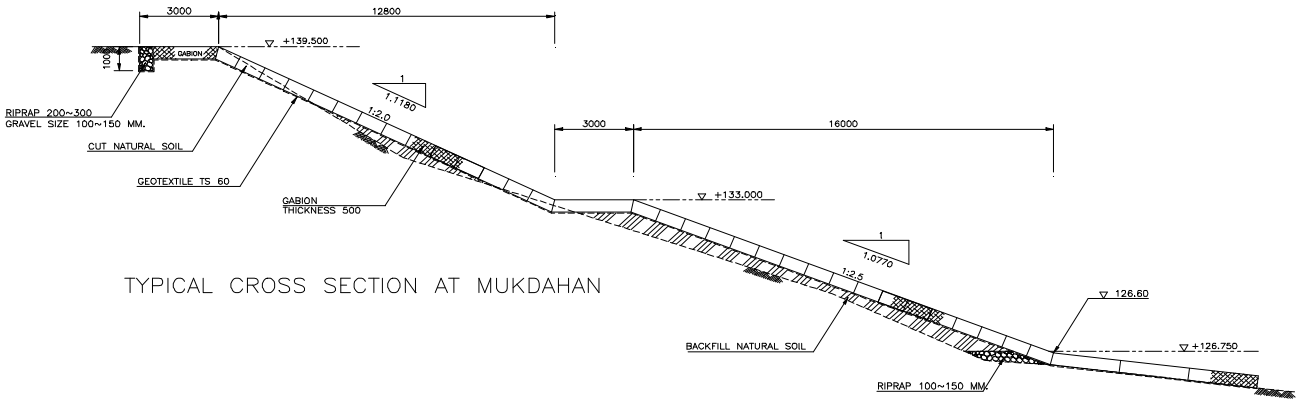



**Figure 3.2 Typical Section for Revetment**

# Chapter 4. Detailed Design of Viaduct and Ancillary Works

This chapter describes about design results of the approach viaducts, and ancillary works of the Main Bridge and approach viaducts.

**(1) Structural Source**

- Bridge type : The Lao P.D.R. Side-4 span PC continuous box girder bridge
  The Thailand Side-5 span PC continuous box girder bridge
  (Refer to Figure 4.1)
- Bridge length Span : The Lao Side-50m@4=200m
  The Thailand Side-50m@5=250m
- Layout of bridge deck : 2x4.25m (carriageway) + 2x1.5m (sidewalk) + 0.5m (median) =12.0m
- Construction method : Temporary staging and cast-in-place concrete method
- Alignment : Horizontal Alignment R= ∞
  Vertical Alignment 2.0%
  Crossfall of the road 2.0%
  Crossfall of the side walk 1.5%
- Abutment type : RC reverse T-type abutment
- Pier type : RC wall-type pier
- Foundation type : ϕ1.0m cast-in-place RC multi pile foundations
- Bearing strata : Mudstone or sandstone
- Bearing support : Elastomeric laminated bearing type
- Expansion joints : Steel finger joint type
- Guardrail : Steel type
- Lighting pole : Steel type

**(2) Design Condition**

Design conditions of the approach viaduct are the same as the main bridge (refer to Chapter 3).

**(3) Approach Viaduct in The Lao PDR (and Thailand in parenthesis)**

**1)Superstructure**

a)Cross section of the box girder

The outer shape matches with that of the Main Bridge, for aesthetic considerations.

b)Support condition for the bridge axis direction

One point of fixity is provided at the middle pier. The abutments and the Main Bridge / viaduct joints use expansion joints.

c)Construction method

The PC box girder is constructed by the cast-in-place concrete method on formwork continuously supported by falsework for a shorter construction periods and also for the shorter span length as well as the smaller pier height.

d)Design of girder transverse cross section

Design method is the same as those of the main girder.

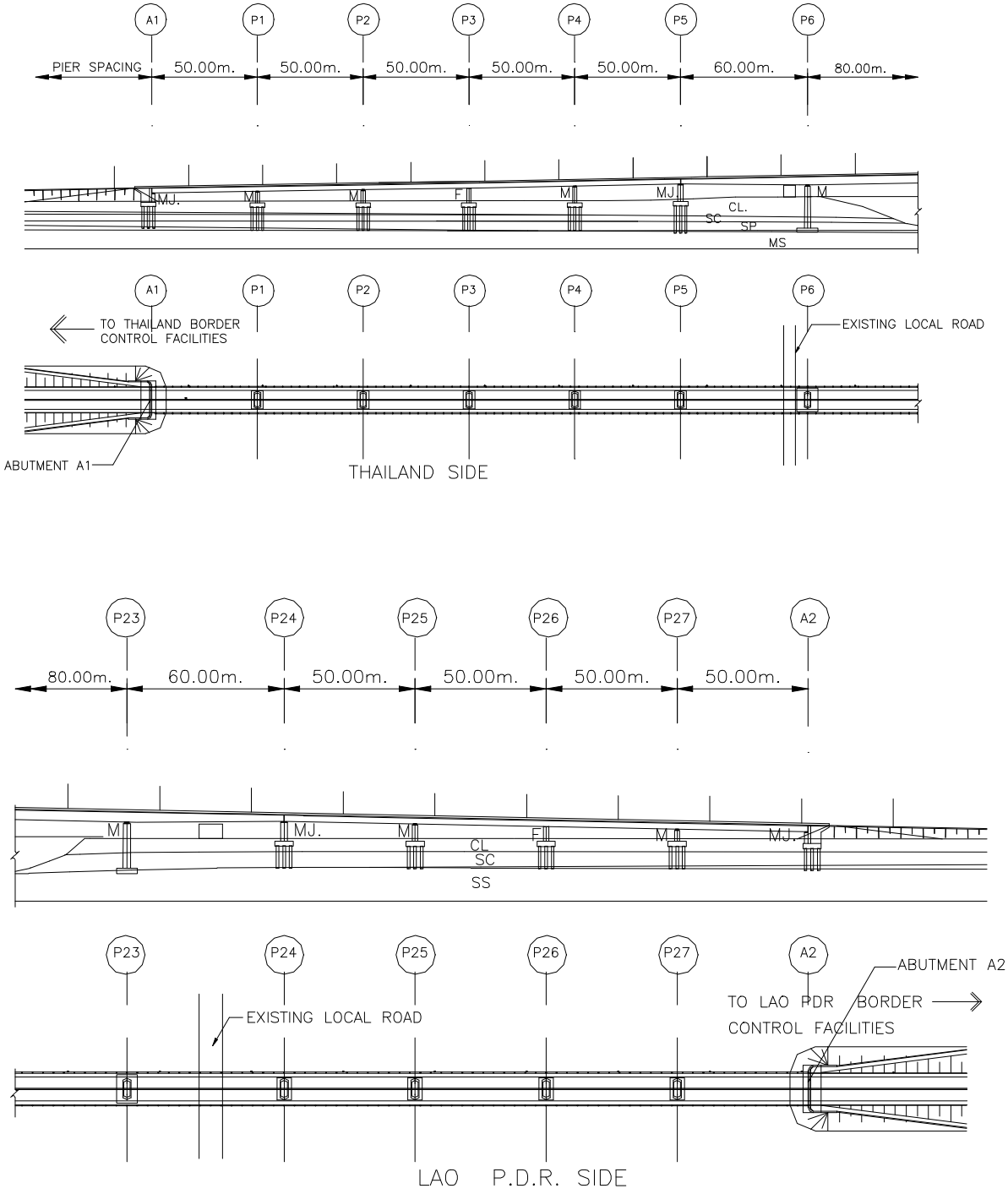



**Figure 4.1 (1/2) General View of the Approach Viaduct**

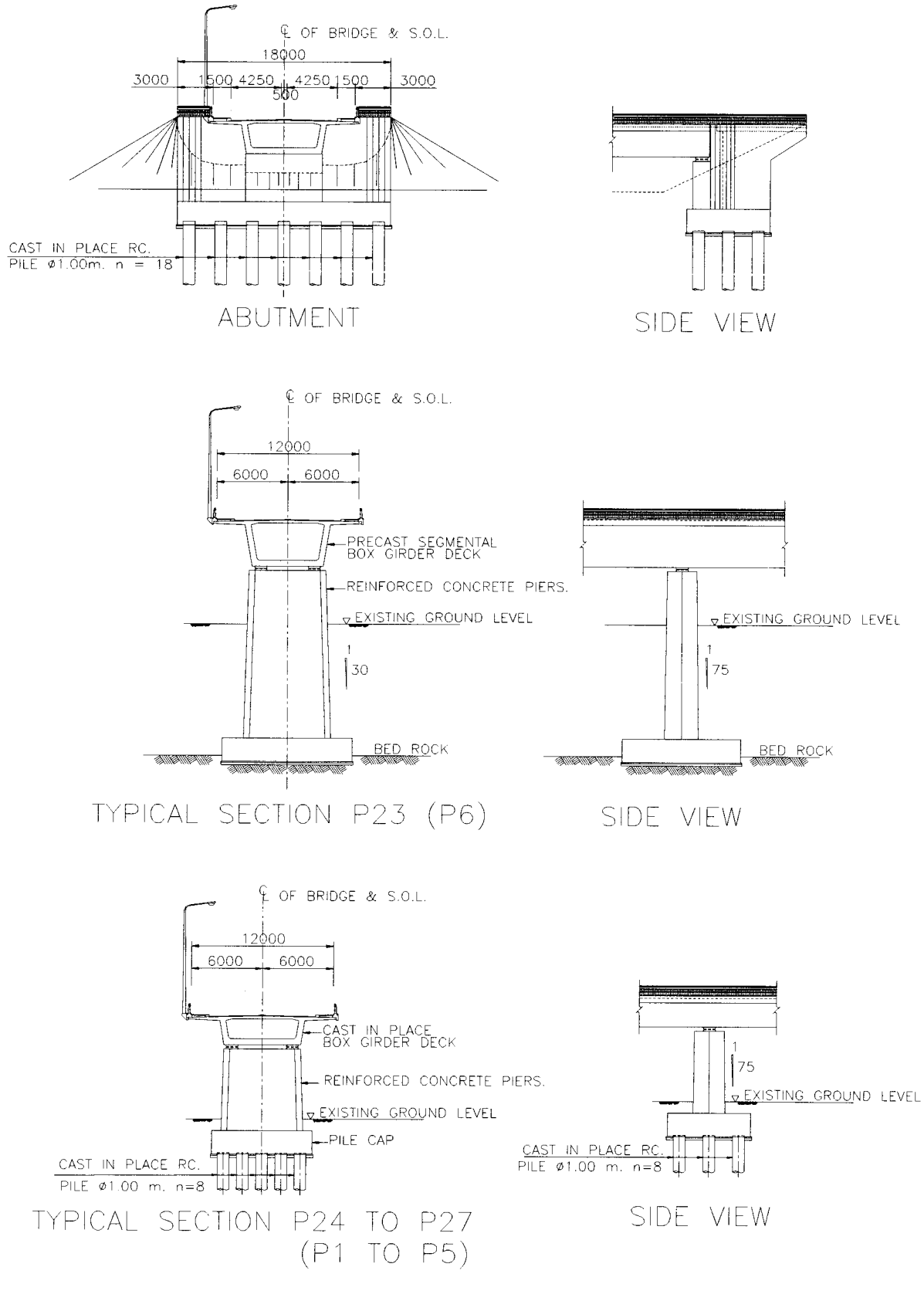



**Figure 4.1 (2/2) General View of the Approach Viaduct**

e)Design procedure of girder

The girder was analyzed as a continuous beam with one fixed point. Calculation of the cross sectional force and stress checking were carried out by using the structure analysis program CONST.

f) Materials

The materials are the same as the Main Bridge.

**2) Pier Foundation and Abutment**

a) Substructure Arrangement

Pier 24(P5), P25(P2•P4),P27(P1) - A reinforced concrete wall type pier with a pile cap supported by 8 of ϕ 1.0 m bored piles. The superstructure is free to move in the bridge axis direction at this pier.

Pier 26 (P3) - A reinforced concrete wall type pier with a pile cap supported by 9 of ϕ 1.0 m bored piles. The superstructure is fixed at the top of this pier, but superstructure rotation is able to take place at this pier.

Abutment A2 (A1) - A reinforced concrete reverse T-type abutment supported by 18of ϕ1.0 m bored piles. The superstructure is free to move in the bridge axis direction at this abutment.

b) Foundations P24, P25, P26, P27 (P5,P2•P4,P3,P1)

In the Contract documents the options of ϕ 1.0 m bored cast-in-place piles and ϕ 0.60 prestressed, precast spun piles will be made available. Contractors will be instructed to carry out further borehole tests to confirm about pile option based on the borehole results.

c) Footings (Pile Caps) P24, P25, P26, P27 (P5,P2•P4,P3,P1)

Footings are of standard rectangular shape of 7m x 8.5 m x 2 meter thick with the footing top located at 1 m below the existing ground surface. Pile concrete is extended into the footing base at a minimum of 100 mm.

d) Abutment A2 (A1)

The abutment A2 (A1) is of the reverse T-type supported on ϕ 1.0 m bored piles. The abutment has wing walls for the support of road embankment.

e) Piers P24, P25, P26, P27 (P5,P2•P4,P3,P1)

All piers are standard wall type piers with small tapers both on the longitudinal and transverse axes. The edges of the piers are beveled at 22° to keep the same shape and geometry with the river based piers.

### (4) Ancillary Works

#### 1) Guardrail

The guard rail is constructed with three parallel steel pipes with a space of 2 meters between the steel posts and at a height of 1.1 meter. It will be fixed along the edge of the deck. This guard rail has been designed to perform dual roles, i.e. vehicle guard and pedestrian guard.

#### 2) Bearing

As durability and maintenance are very important, the "Elastomeric Laminated Bearing" has been selected. The allowable design values are governed by JRA-SHB standards.

#### 3) Expansion Joint

As durability and maintenance are significant, the "Steel Finger Joint " has been selected.

#### 4) Road Lighting

The lighting pole will be fixed on the extended curb of the upstream side. The interval between poles is 35 meters. The average illuminations on the road is 24 lux. The standard illumination required by DOH is 21.5 lux. The electric cable with conduit will be laid in the box under the sidewalk.

# Chapter 5. Detailed Design of Border Control Facilities

## (1) Design Conditions of the BCF

The purpose of the Border Control Facilities (BCF) is to inspect the cross border passengers, various vehicles including loading and unloading trucks and import and export goods before leaving and entering both the Lao PDR and Thailand (refer to Figure 5.1 and 5.2).

The following items were designed for the BCFs

- Main Offices
- Public Toilets
- Inspection Booths
- Spacious Roof Structures
- Check Point and Gates
- Check and Toll Offices
- Officer's Parking Area with Roofs
- Inspection Pit and Truck Scale
- Vehicle Parking Areas
- Powerhouse and Water Receiving Tanks
- Land Reclamation
- Roadwork within the BCF
- Surface Drainage System
- Markings and Signs
- Landscaping
- Incidental Utilities

The civil works are based on the standard of the Department of Highway (DOH) in Thailand as well as TIS (Thai Industrial Standard) while building works are designed basically in conformity with the local laws, codes, standards and other applicable international codes.

The units of measurement to be used for the Project are in metric – ton system since the Pascal and Newton systems are not generally used in the engineering field in the Lao PDR and Thailand.

## (2) Design of the BCFs

### 1) Type of BCF

The type of the BCF is categorized into two; Separate type (cargoes/passengers) and Integrated (cargoes + passengers combined) and the latter has been accepted by both governments considering minimization of operation and maintenance costs as well as the reasons of comparatively minor traffic demand.

### 2) Flow of Passengers and Cars in the BCFs

The BCFs have been designed to allow various traffic to make smooth entry and exit formalities after in depth discussions with the relevant authorities.

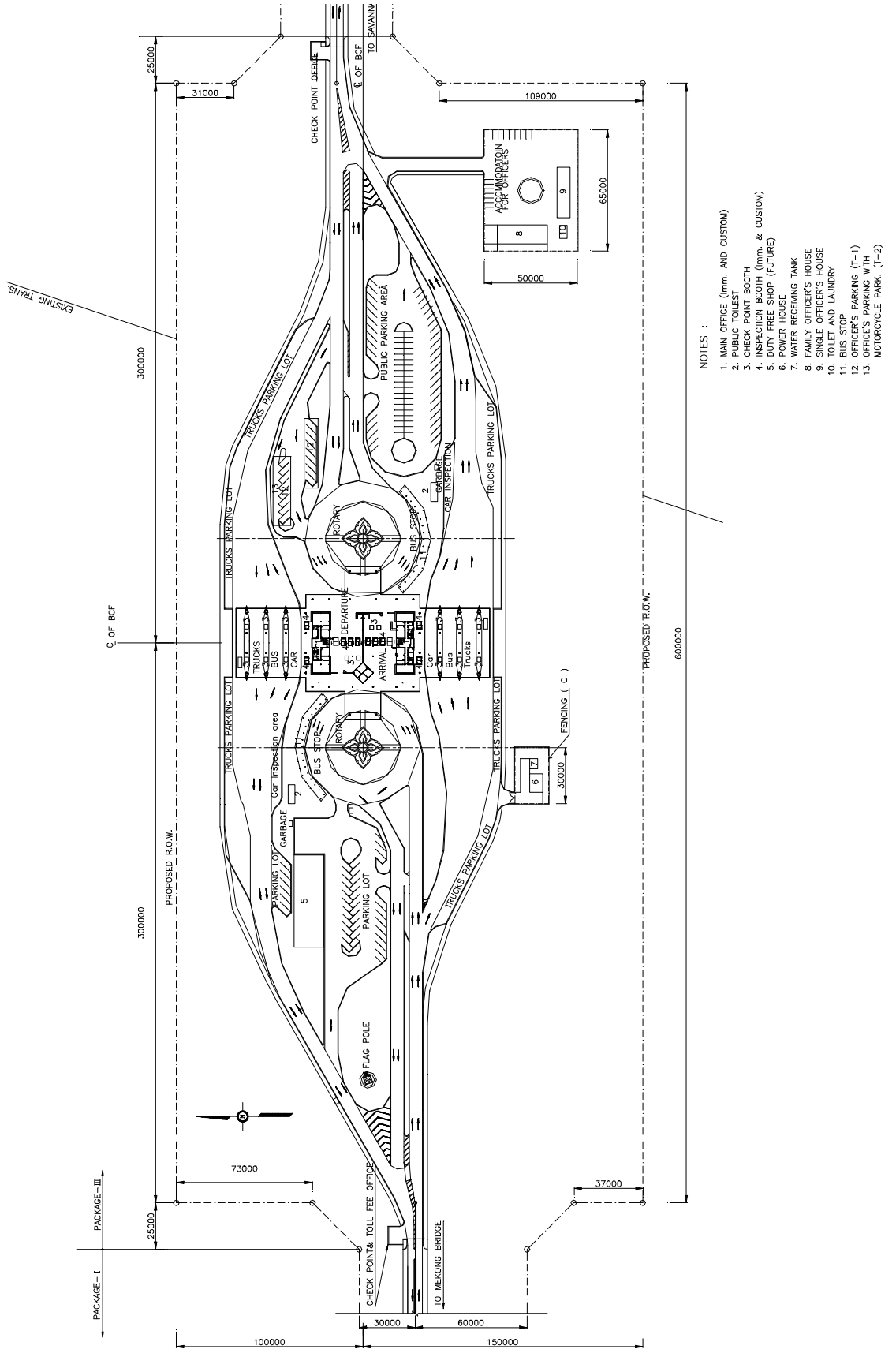



**Figure 5.1 Border Control Facilities – The Lao PDR Side**

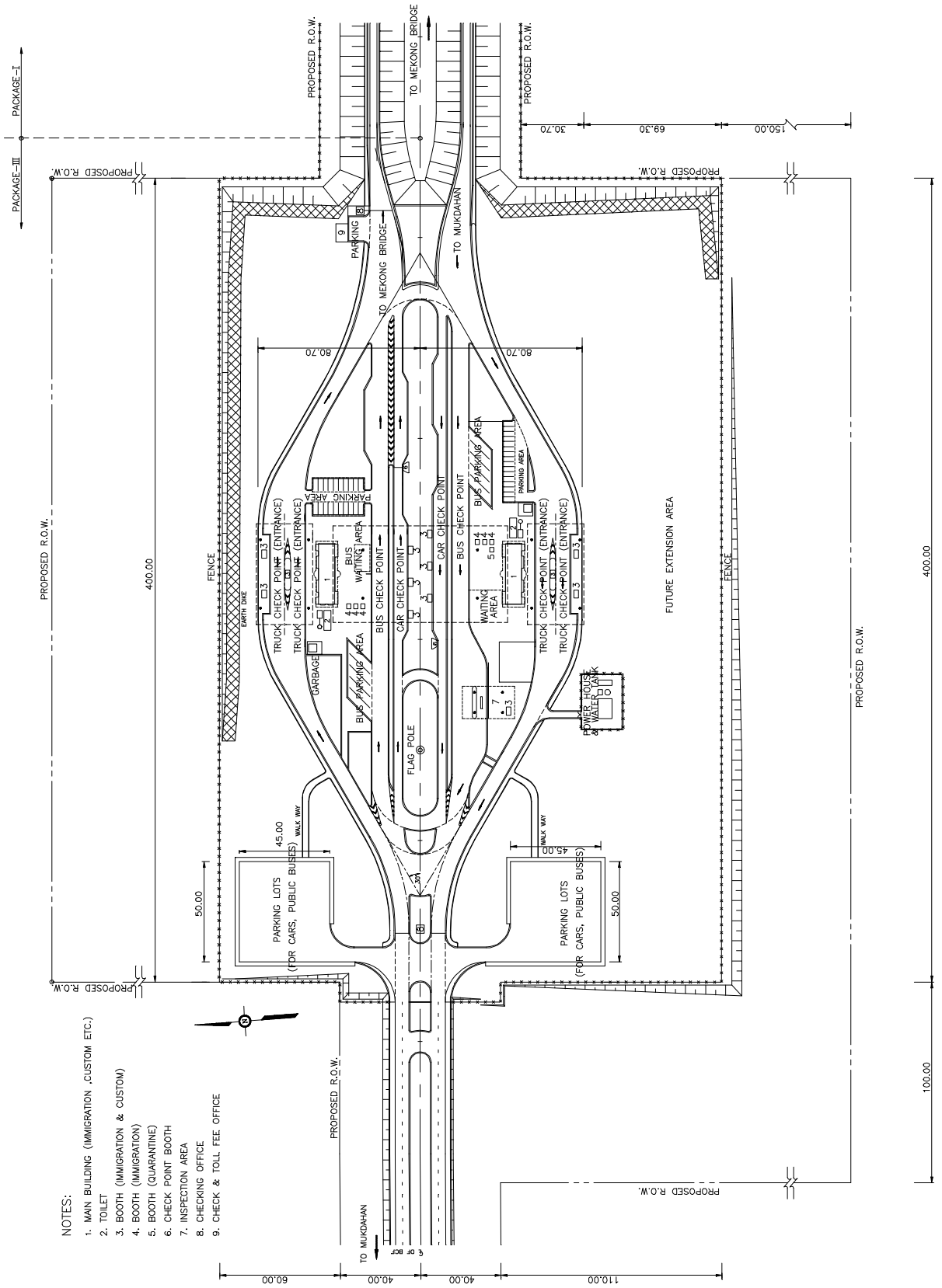



**Figure 5.2 Border Control Facilities - Thailand Side**

### (3) Civil Work

The construction sites for the BCFs need various civil arrangement : earth works for construction of BCFs' sites, drainage system for storm water, pavement for roads and parking area, security provision for boundaries, signs and marking on the pavement and landscaping in the area.

### (4) Building Work

The BCFs contain various kind of buildings and facilities, which have been designed under the following considerations.

#### 1) Floor Area

**Table 5.1 Number of officials required for BCF**

| Main Offices | The Lao PDR BCF | Thailand BCF |
|---|---|---|
| Custom | 20 | 20 |
| Immigration | 30 | 30+10 * |
| Quarantine | 5 | 5 |
| O/M | 15 (Bridge Operation) | - |
| **Total** | **70** | **65** |

* 10 officials may consist of 3 for labor, 2 for insurance, 3 for operation and maintenance, and 2 for travel information services.

#### 2) Structural Consideration

a) Foundations

Based on the result of the geological investigation, foundations of the major buildings in the Thailand BCF utilize prestressed concrete piles approximately ϕ300mm x 18m long.

b) Meteorology Consideration

Air Temperature, wind velocity and seismic effect have been considered in the detailed design.

c) Structural Materials and Loads :

Dead load and live load were calculated in accordance with the EIT (The Engineering Institute of Thailand) or ASCE (American Society of Civil Engineer) and the structural materials for concrete, reinforcing bars and structural steel have been set out based on the TIS, ACI, ASCE and other standards.

#### 3) Building Design Features

Major buildings have been designed to be reinforced concrete framing structures with clay

brick wall partitions, while the spacious structural steel roofs are designed to be uniform spacious roof trusses. All buildings are finished with domestic ceramic tiles and paint to exterior walls. Most office rooms are finished with vinyl floor tiles, paint on cement plastered walls and rockwool acoustical ceiling tiles. All finish materials are selected from the best local quality, durability and easy maintenance.

#### 4) Architectural Treatment

The main office building in the Lao PDR BCF is considered to be a contemporary modern building with due consideration of the conventional Laotian style ornamentation, while the main office and other buildings in Thailand BCF are given with a contemporary architectural treatment of functionality and simple appearance by reducing unnecessary ornamentation.

### (5) Utilities

#### 1) Utility Plan of the BCF – the Lao PDR

Utilities in the Lao PDR side BCF is designed with the following consideration.

a) Power Supply System

The BCF receives the electric supply from EDL's (Electricite du Laos) transmission line (T/L) and distributes to the each facility. The emergency diesel generator system (DG) is provided against the possible commercial power failure.

(Power supply system data)

- Rated Voltage : 22kV
- Phase : 3 (three)
- Frequency : 50 Hz
- Transformer capacity : 500 kVA (2 sets)
- DG capacity : 100kVA

b) Outdoor lighting system

The outdoor lighting system of the buildings generally used a HID sodium lamp fixture.

c) Water Supply System

The water supply for toilets and other portions use the city water from the water purification plant in Savannakhet

d) Wastewater Drainage System

The wastewater from toilets and others is treated by septic tanks and discharged into the surface water drainage manhole.

e) Building Electric System

The major electric work items to be involved are as follows:

- Lighting System
- Power Outlet System
- Public Announcing System
- Private Telephone System
- TV System (outlet and wiring only, excluding antenna)
- Computer System (outlet and wiring only )
- Lightning Protection System
- Grounding System

f) Building Mechanical System

The major mechanical work items are as follows:

- Air-conditioning and Ventilating System
- Water supply and Wastewater Drainage Systems
- Fire Fighting System (fire extinguishers, fire hydrant systems)

**2) Utility Plan of the BCF – Thailand**

Utilities in the Thailand side BCF is designed with the following consideration.

a) Power Supply System

The BCF receives the electric supply from PEA's (Provincial Electricity Authority) transmission line (T/L) and distributes to each facility. The emergency diesel generator system (DG) is provided against the possible commercial power failure.

(Power supply system data)

- Rated Voltage : 22kV
- Phase : 3 (three)
- Frequency : 50 Hz
- Transformer capacity : 500 kVA
- DG capacity : 100kVA

b) Outdoor lighting system

The outdoor lighting system of the buildings generally uses HID sodium lamp fixture.

c) Water Supply System

The water supply for toilets and other portions utilize ground water which is pumped up into receiving tanks.

d) Wastewater Drainage System

The waste water from toilets and others is treated by septic tanks and discharged into the surface water drainage manhole.

e) Building Electric System

- Lighting System
- Power Outlet System
- Public Announcing System
- Private Telephone System
- TV System (outlet and wiring only, excluding antenna)
- Computer System (outlet and wiring only )
- Lightning Protection System
- Grounding System

f) Building Mechanical System

- Air-conditioning and Ventilating System, Fire Fighting System , Fire extinguishers

# Chapter 6. Construction Planning

## (1) General

This Chapter addresses the required construction materials, equipment, facilities, and construction conditions and schedule.

The entire Project is divided into three (3) contract packages as described below.

Package 1 : Main bridge, approach viaducts (the Lao PDR and Thailand sides), approach roads (the Lao PDR and Thailand sides) and traffic changeover (the Thailand side).
Package 2 : Border Control Facility and connecting road in the Lao PDR side.
Package 3 : Border Control Facility and connecting road in the Thailand side.

The climate in the Project area can be divided into two (2) seasons as follows.

- Rainy season : from the middle of April until the middle of October.
- Dry season : from the middle of October until the middle of April.

The annual fluctuation of the River water level must be carefully taken into consideration for determination of the level of the pile caps and the construction period of the Bridge substructure.

For geological conditions, there is a distinct feature of the Project site that medium to hard rock surface exists at quite shallow depths under the ground and riverbed. This fact has effect on selection of methods and equipment proposed for construction of foundations, piles, piers and abutments.

## (2) Procurement Planning

### 1) Concrete aggregate, stone and embankment

The raw materials for the concrete aggregate, road pavement and embankment are planned to be procured from local suppliers. If the river aggregate is found not suitable then it will be obtained from an approved quarry source, either in the Lao PDR or Thailand side.

### 2) Wood materials

The wood materials for construction, such as logs, squares, planks are available at local saw mills in Savannakhet. Water-proof plywood for concrete formwork will be purchased in Thailand.

### 3) Cement, concrete admixtures and steel

Except for some special admixtures, almost all of the admixtures, cement for concrete and steel are available in Thailand.

#### 4) Labor

Semi-skilled and common labor for the works will be recruited from the surrounding area of the job site in both the Lao PDR and Thailand. However, skilled labor for construction of the large scale Bridge is insufficient in the Lao PDR, Labor will have to be recruited from Thailand, and possibly other Asian countries.

### (3) Construction Method for Main Bridge

#### 1) Construction of Substructure of P7 through P22 (Piers in the River)

Construction of cast-in-place piles in the River shall be carried out using steel stand pipe. For excavation of the riverbed material (sand & gravel) inside the casing, hammer grab excavation and the reverse circulation method can be considered. However, for the rock excavation under the riverbed material, only the reverse circulation method with rock roller bit can be considered applicable, when considering the geological characteristics of the foundation bed.

The bottom formwork of the pile cap will be done using precast panels supported on steel members welded to the side of the top of the pipe casings. A precast skirt tied into the pile cap will be also used as side formwork.

#### 2) Superstructure

The precast segmental balanced cantilever method is adopted as the recommended construction method of the Main bridge.

For production of the precast segment, there are two (2) type match-casing method, the one is the “long line casting” method and the other is the “short line casting” method. Because the main girder height is constant, the short line method has advantages in labor-saving and reduction of production yards. However, success will depend upon the accuracy of adjustment of the match-cast segment.

There are two erection methods for the pre-cast segment balanced cantilever erection: 1) Erection nose method, 2) Launching gantry (Erection Truss) method. In case of erection nose method, moving of the segment is done by using a barge when such severe conditions of the Mekong River such as high flow velocity (V=2.6 m/s) in the rainy season and a large fluctuation of the water level a considered, the launching gantry method may be more preferable. The size of the launching gantry shall be suitable for both standard spans (80m) and the longest spans (110m). Girder erection can be started from both the Lao PDR side and/or Thailand side.

Prestressing of the PC sail is divided into two stages. The primary prestress (30% of total prestress) is applied before concreting of PC sail after the segment is joined. The secondary prestress (70% of total prestress) is applied by the PC steel after concreting of the PC sail.

### (4) Construction Method for Approach Viaduct

Cast-in place RC piles with 1.0m diameter shall be penetrate at least 1.0m into the base rock. According to the boring data obtained at site a hard silty clay layer with N-value higher than 30 exists about 5m under the ground surface with a thickness of 4 m. Equipment for the excavation shall be selected to meet with the above geological conditions and the reverse circulation method will be recommended.

The PC continuous box girder type was adopted. Since the length of these Bridges are relatively short and located on the land with a low elevation, the "All Staging Method" can be used for the in-situ construction of the continuous PC girders.

### (5) International Construction Zone

An International Construction Zone around the Project Site shall be legally established by the Government of the Lao PDR and Thailand in order to secure the free movement of equipment and materials and Consultants, Contractors and other relevant persons, in spite of the border, with an identification card.

### (6) Border Control Facilities and Road Works

There is no special construction work which require special construction technique and equipment for the construction of the Border Control Facilities and road works. All necessary materials, equipment and manpower can be commonly procured in the Lao PDR and/or Thailand. The following issues, however, shall be taken into consideration in terms of construction planning.

1) All earth works (excavation and embankment) and gravel course works will be suspended during rainy season.
2) Steel frame and painting works, waterproofing works, exterior finishing work of the Border Control Facilities shall also be carried out during dry season.
3) Since Border Control Facilities consist of many kinds of instruction works such as civil works, building works, mechanical works and electrical works, interference between these works shall be carefully considered to avoid double works.

### (7) Construction Schedule

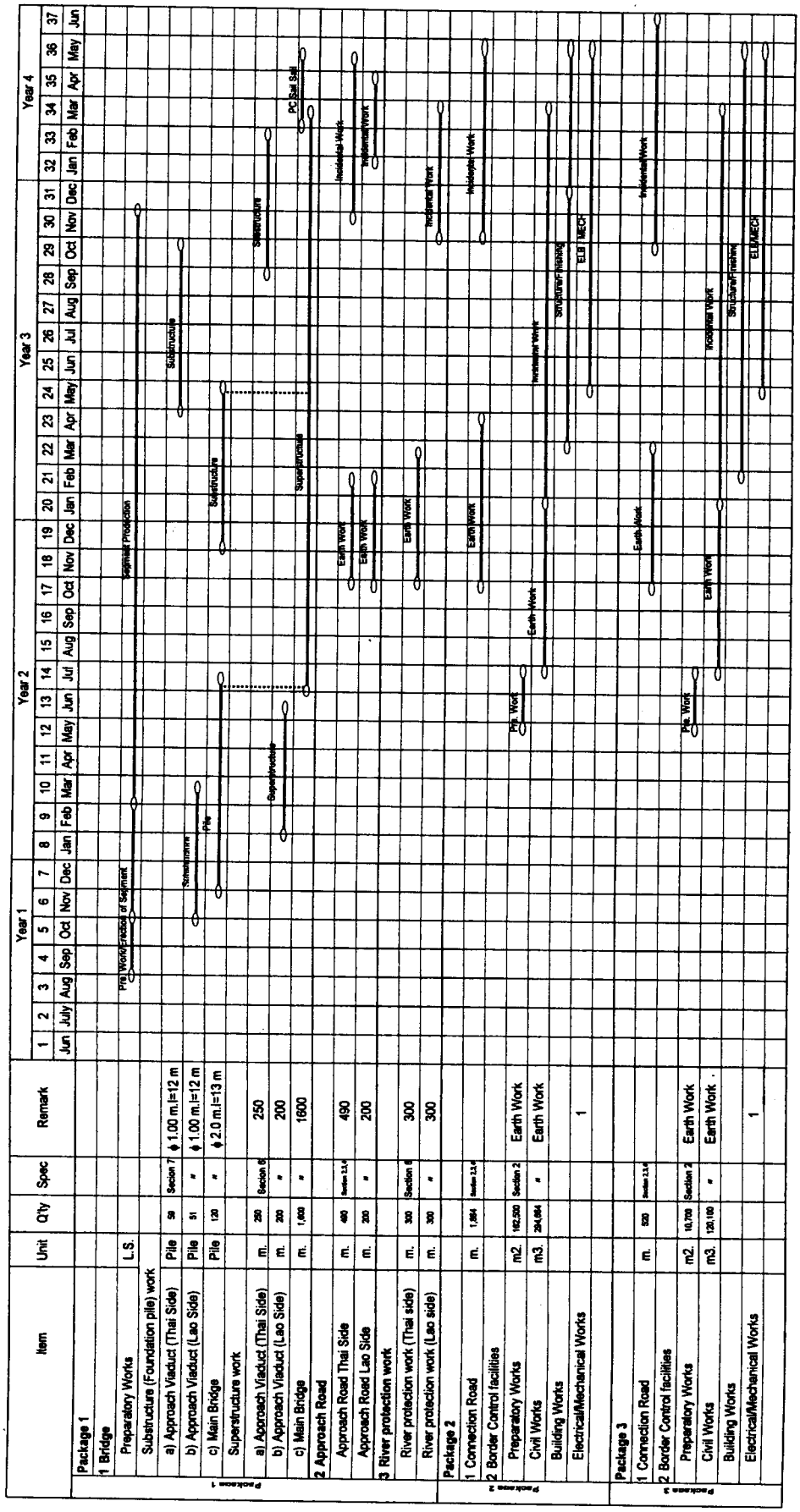
According to the detailed study on the time required for construction of the respective facilities, the following duration have been estimated for the Project construction (refer to Table 6.1 and Table 6.2).

- Main Bridge and Approach Viaduct : 36 months
- Approach Roads and Connection Roads : 24 months
- Border Control Facilities : 24 months

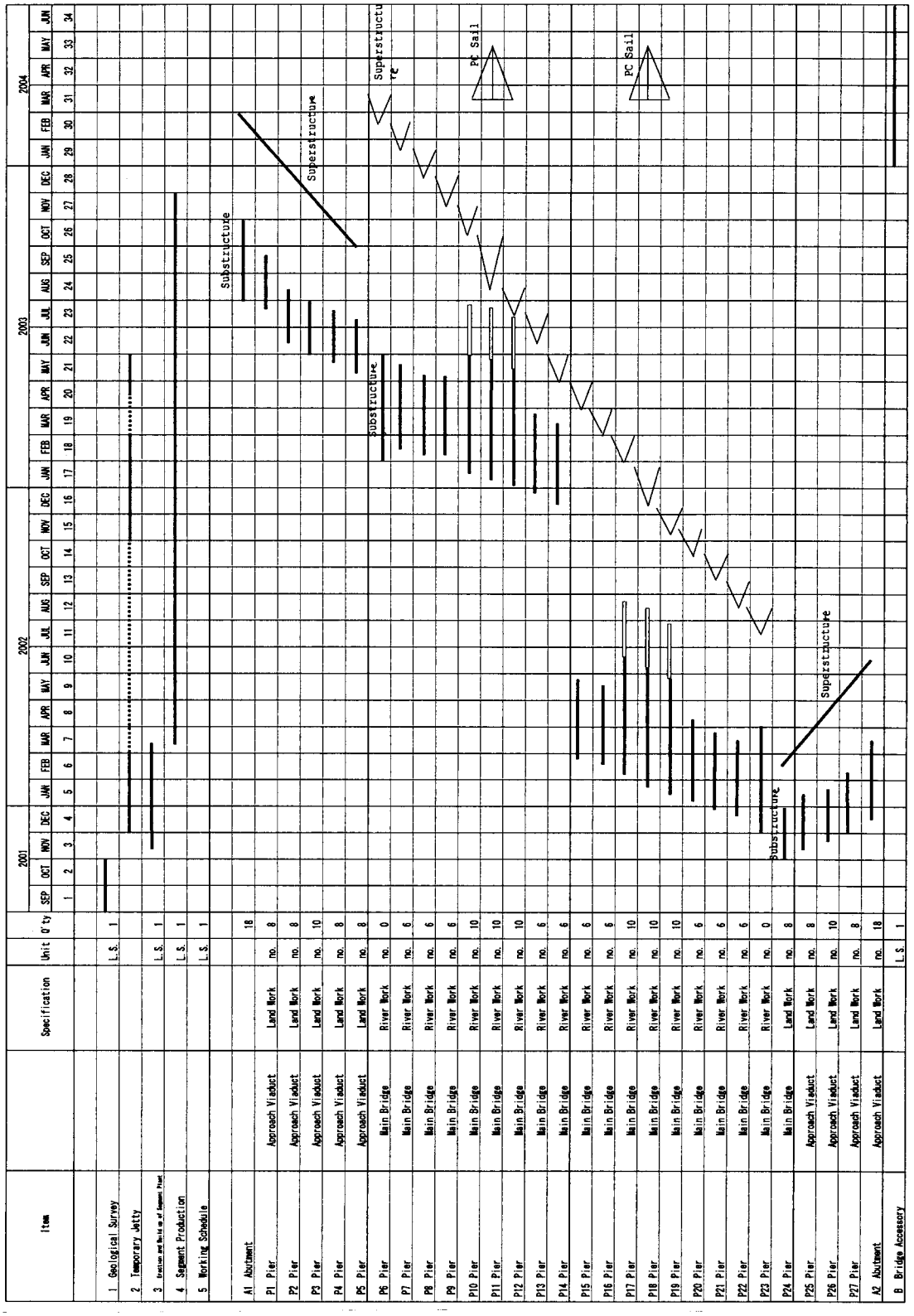
The above construction duration were estimated taking into account delays due to the rainy season.

It should be noted that the construction duration of 36 months for the Main Bridge (which is the critical path in the whole Project) is estimated under the assumption that the construction can commence at the beginning of the first dry season.

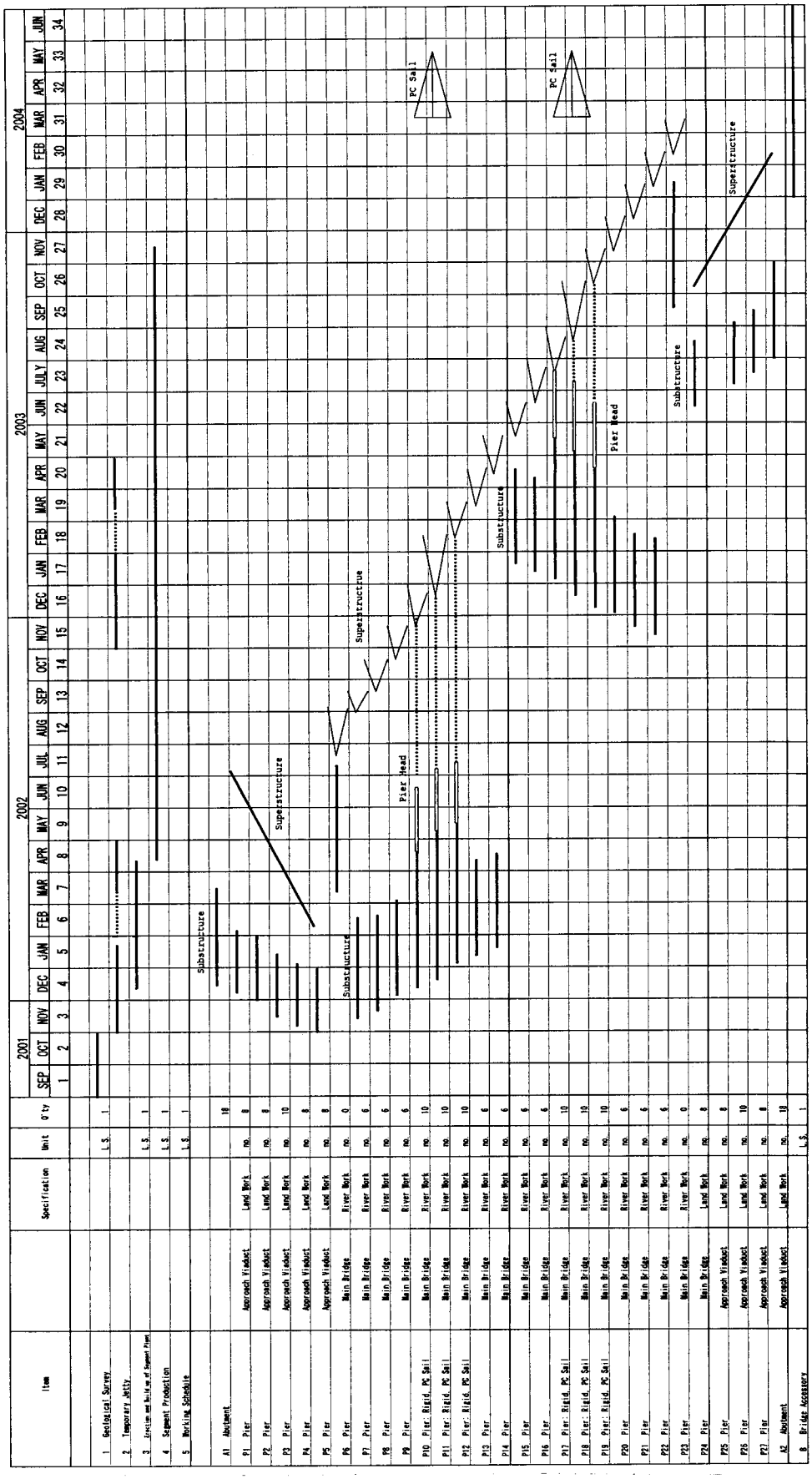
# Table 6.1 Construction Schedule of the Whole Project



# Table 6.2 (1/2) Construction Schedule of Case 1 (Starting from the Lao PDR Side)



# Table 6.1 (2/2) Construction Schedule of Case 2 (Starting from the Thailand Side)



# Chapter 7. Management and Maintenance

This chapter briefly reflects and comments on the management and maintenance aspects of the Second Mekong International Bridge and Border Control Facilities. It also discusses on two or more country agreements and other agreements which will become applicable as the result of opening the Bridge and the completion of a strategic link within the East West Corridor

## (1) Management and Maintenance

The introduction describes about the management and maintenance aspects at the Friendship Bridge during construction and mentions on the committees that were set up to operate the Bridge after opening.

### 1) Friendship Bridge

The committees and their management functions are discussed in more details in as far as they affect both countries.

a) The Legal Implementation Committee – to set up the legal procedures and to establish a Commission and a Bridge Authority.
b) The Commission – to implement the policies, administration and maintenance conditions for the bridge.
c) The Bridge Authority – to act as the policy decider for the BCF and bridge operations on a day to day basis.

### 2) Organization for the Construction of Project

This section reviews the committees set up for the design, pre-construction and construction stages of the Second Mekong International Bridge Construction Project both in the Lao PDR and Thailand.

a) The Project Co-ordination Committee – its members and organization are similar to the Commissions set up for the Friendship Bridge.

b) The Bridge Management Committee – to deal with the contractual matters of the Project and to effectively act as the "Employer" through designation of a Project Manager during bridge construction.

The organization structure of the Project at construction time is also discussed and a structure recommended.

### 3) Management after Completion

The criteria for management after completion is discussed and it is recommended that a similar system to those of the Friendship Bridge be established subject however to improvements that both the Lao PDR and Thailand accept.

a) Legal Committee b) Commission c) Bridge Authority

The Bridge Authority will direct the activities of management and maintenance, and only if agreement between the two countries could not be achieved, the Commission will resolve such problems. The Commission will also set the policy for the Bridge Authority.

**4) Operation and Maintenance**

The operation and maintenance costs are discussed with administration table at 2% of the budgeted construction cost and maintenance (routine and periodic) cost are estimated at approximately US$50,000 per year.

**5) Maintenance of the Bridge, Road and BCF**

The most critical point on maintenance of the facilities are correct realization about states of the structure serviceability. Fundamentals of state realization is inspection, that is, early discovery of irregularities from careful inspection, immediate repairing and others are vital for safety and for the bridge safety securing.

Inspection will be classified into (a) daily inspection, (b) periodical inspection, and (c)special inspection.

**(2) Cross-border Issues**

**1) Immigration Issues**

Immigration issues at the new Bridge are discussed on the basis of both countries to streamline and simplify procedures. Visas on arrival are an important issue which must be seriously addressed, and the extent of movement with border pass movement should be extended.

**2) Customs and Transportation Issues**

A review of existing conditions went back to the 1978 Transit Agreement between the Lao PDR and Thailand. The ASEAN Framework Agreement on the Facilitation of Goods in Transit is commented on as part of the Hanoi Plan of Action, which was signed in December 1998.

The Facilitation of Goods in Transit Agreement signed on 5 March 1999 between the Lao PDR and Thailand is mentioned with particular emphasis on the fact that protocols have not been finalized and as a result nothing much has happened to change the previous transportation methods, which are inefficient and cost the Lao PDR significantly.

Finally the historic tripartite agreement on 26 November 1999 for the Facilitation of Cross Border Transport of Goods and People is commented on. However, if any Protocols are implemented, cross border traffic will be able to move more freely from country to country within the Lao PDR and Thailand.

# Chapter 8. Environmental Study

In the phase of the basic design of the Project, the Initial Environmental Examination (IEE) has been carried out. Then this study has been followed by a detailed field survey of the Environmental Impact Assessment (EIA) for the Detailed Design of the Project.

## (1) Initial Environmental Examination

The IEE results showed that the environmental impacts of the Project is considered to be minor. In order to establish the integrated environmental protection program in the Detailed Design stage for the Project, it is required to carry out the detailed environmental study of the present situation and examination of mitigation and/or elimination of the negative impacts which might be attributed to the project development. The environmental factors which are to be subject to further detailed environmental study are identified based on the IEE results.

The investigation items of each environmental factors identified and their framework of technical specification are given below.

- Water Quality
- Aquatic Life
- Air Quality/Noise/Vibration
- Social Environment

## (2) Environmental Impact Assessment

### 1) Existing Environmental Study

a) Water Quality

Methodology of the study will identify the Mekong river at 2 sampling stations as : 1,000 m. upstream and 1,000 m. downstream of the Second Mekong International Bridge Construction Project. The parameters for water sampling consisted of temperature, pH, turbidity, conductivity, DO, COD, $BOD_5$, SS, oil & grease, lead and fecal coliform bacteria.

Results of the study is shown in Table 8.1

**Table 8.1 Water Quality**

| ITEMS | UNIT | ANALYSIS RESULTS | |
|---|---|---|---|
| | | ST1 | ST2 |
| Temperature | °C | 24.5 | 24.5 |
| PH | | 7.83 | 7.86 |
| DO | mg/l | 7.94 | 7.76 |
| Turbidity | NTU | 339 | 321 |
| Conductivity | mS/cm | 199.7 | 196.8 |
| Suspended Solids | mg/l | 352 | 283.5 |
| Fat, Oil & Grease | mg/l | N.D. | N.D. |
| BOD 5days | mg/l | 3.6 | 3.6 |
| COD | mg/l | 15.74 | 27.56 |
| Lead (Pb) | mg/l | 0.0044 | 0.0014 |
| Fecal Coliform Bacteria | MPN/100ml | 23 | 23 |

b) Aquatic Life

Methodology : Organism sampling and benthic organism sampling were conducted along the Mekong River at 2 sampling stations as : 1,000 m. upstream and 1,000 m. downstream of the Second Mekong International Bridge Construction Project.

Results of the Study is shown in Table 8.2

**Table 8.2 Aquatic Life**

| Scientific Name | Station 1 | Station 2 |
|---|---|---|
| PHYTOPLANKTON | | |
| Pymlum Bacillariophyta (Diatoms) | | |
| Diatoma elongatum Agardh | 49,500 | 143,000 |
| Melosira granulata (Ehrenburg) Ralfs | - | 5,500 |
| Navicyla radiosa Kuetzing | - | 5,500 |
| Surirella robusta var. Splendida (Ehr.) Van Heurck | 22,500 | 11,000 |
| Synedra acus Kuetzing | 4,500 | 11,000 |
| Subtotal Phytoplankton | 76,500 | 176,000 |
| ZOOPLANKTON | | |
| Phylum Protozoa (Protozoans) | | |
| Arcella vulgaris Ehrenburg | - | 5,500 |
| Centropyxis aculeata Stein | 13,500 | 5,500 |
| Difflugia globulosa Dujardin | 4,500 | - |
| Phylum Rotifera (Rotifers) | | |
| Nothoca acuminata (Ehrenburg) | 4,500 | - |
| Phylum Arthropoda (Arthropods) | | |
| Insect larva | 4,500 | - |
| Subtotal Zooplankton | 27,000 | 11,000 |
| Grand total | 103,500 | 187,000 |

c) Air Quality

Methodology : Measure the existing air quality along the Project at 3 stations (2 stations in the Thailand side and 1 station in the Lao PDR side)

The parameters measured the carbon monoxide (CO), nitrogen dioxide ($NO_2$), total suspended particulate (TSP), particulate matter (PM-10), lead (Pb) and sulfur dioxide.

d) Noise

Methodology : Measure the existing noise level (equivalent sound level 24 hours) along the project at 3 stations (2 station in the Thailand side and 1 station in the Lao PDR side) for 3 consecutive days especially at the following sensitive receptors.

e) Vibration

Methodology : The vibration along the proposed route is measured by velocity transducer at 3 stations (2 stations in the Thailand side and 1 station in the Lao PDR side)

f) Social Environmental Survey

Methodology : - Preliminary field investigation
- Interview with the people in the concerned villages
- Number of sampling:106samples in the Lao PDR and 120samples in Thailand, respectively

Results of the Study : the Lao PDR side

Regarding the project information, most of the respondents reported of having received the Project information through the survey officers etc. Majority of the responders supported the Project. The main reasons for the project's advantages are good transportation and communication system (more convenience in travelling), followed by good economic conditions and number of tourists will be increased. In contrast, the most important reason for the Project's disadvantage is that people have to lose their land and houses because of the Project.

# Chapter 9. Cost Estimation

The Project will be divided into three (3) construction packages according to the scope of the work between the two countries. Package 1 is an International tender package with one Contractor and two Contracts, the one with the Lao PDR and the one with Thailand. The construction cost of Package 1 is separated between the Lao PDR and Thailand exactly at the center of the Main Bridge.

## (1) Conditions of Construction Estimation

1) The cost estimation is performed under estimation standard on the Lao PDR, Thailand and Japan, while data were collected in the Lao PDR and Thailand.
2) Basic date of cost estimation: The cost estimation are based on the prices ruling at December 1, 1999.
3) Exchange rate of currencies: The currency exchange rate will be decided on the monthly average of the past one (1) year (January 1999 – December 1999).

## (2) Standard for the Cost Estimation

### 1) Main Bridge and Approach Viaduct

Since the standard for cost estimation of the Main Bridge in both the Lao PDR and Thailand are not available, the cost estimation has to be based on the Japanese standard set by the Ministry of Construction and other relevant agencies.

### 2) Other Structures

The standard of local cost estimation are available for the estimation of the structures including the road structure. Manpower and equipment input requirement will be based on the local standard costs.

## (3) Labor and Material Cost

The labor cost used for cost estimation is based on the current standard market price. The prices will be verified by the Government standard prices if available.

The price of construction materials are based on the current market price obtained during the Detailed Design period. The price will be verified under the Government standard price.

# Chapter 10. Draft Bidding Documents

## (1) General

### 1) Basic Policies

Basic policies as follows are set up for preparation of the Bidding Documents:

a) Internationalization shall be emphasized wherever is possible on Technical Specifications, Payment Method, Bill of Quantities, etc.
b) If there is a strong local practice, this is considered and also is taken into account where applicable.
c) The JBIC Sample Bidding Documents is used as much as possible.
d) The bidding documents for Package 1 is compiled to recognize one bid for two Contracts.
e) Strong element of local practice is considered in making out the Contract conditions.
f) The Components of the Draft Bidding Documents are as follows:

<The Components of the Bidding Document>

**VOLUME 1 :** Invitation for Bids
Section 1. Instruction to Bidders
Section 2. Part 1- General Conditions
Section 3. Part 2- Conditions of Particular Application
**VOLUME 2 :** Section 4. Technical Specifications
**VOLUME 3 :** Section 5. Forms of Bid, Appendix , Bid Security and List of Eligible Countries of JBIC ODA Loans
Section 6. Bill of Quantities
Section 7. Form of Agreement
Section 8. Form of Security
Section 9. Schedule of Supplementary Information
**VOLUME 4 :** Section 10. Drawings

### 2) Basic Guidlines

a) Procurement under JBIC ODA Loans October, 1999.
b) Sample Bidding Documents under JBIC ODA Loans for Procurement of Civil Works in November 1999

### 3) Bidding Method

The Draft Bidding Documents for each package have been prepared based on the following bidding methods.

Contract Package 1: Two Envelope System (the Lao PDR and Thailand)
Contract Package 2: One Envelope System (the Lao PDR side)
Contract Package 3: One Envelope System (the Thailand side)

## (2) Prequalification

The prequlification document is prepared on the basis of the Guidelines for Procurement under JBIC ODA Loans. Prequalification will be carried out in accordance with evaluation criteria qualifying from viewpoints of particular experiences, technical capability and financial capability.

**(3) Instructions to Bidders**

The Bidding procedures comply with the International Competitive Bidding according to the JBIC Guideline for Procurement under JBIC ODA Loans.

Instruction to Bidders is prepared on the basis of JBIC Sample Bidding Documents which can propose the bidding procedures to correspond to both governments which have been followed with different bidding procedures respectively.

In addition, all the forms for bidding and contract are fundamentally based on the modified version of the JBIC Sample Bidding Document.

**(4) Conditions of Contract**

The conditions of Contract takes up the Fourth Edition of FIDIC which are applicable for general use for the civil works if bidders are invited on an international basis. The particular conditions, subject to minor modification, are also suitable for use on domestic contracts.

**(5) Technical Specifications**

Technical specifications are prepared on the basis of following policies.

**1) Civil Works**

The Technical Specifications is prepared exclusively for the Second Mekong International Bridge Construction Project on the basis of AASHTO Standard Specifications for Highway Bridges Sixteen Edition in 1996, Division II – Construction, and local practices in both countries.

**2) Architectural Work (Border Control Facilities)**

The Architectural Technical Specifications basically conform to the BAEI9I and AISC for Structural Analysis, ACI Building Codes Requirements for Structural Concrete, AISC of EIT (The Engineering Institute of Thailand) for Structural Analysis, TIS or other international laws or codes.

**(6) Bill of Quantities**

The BQ itemizes according to the finished items given to provide a common basis for bidding. The basis of payment is the actual quantities of works ordered and carried out, as measured by the Contractor and verified by the Engineer and valued at rates and prices tendered in the priced Bill of Quantities.

The Bill of Quantities for Package 1 is divided at the center of the Main Bridge which marks the point of change of ownership. Unit prices in priced Bill of Quantities is the same between the contracts, and that overhead and profit are shared proportionally with the amount of the Bill of Quantities.

# Chapter 11. Implementation Program

### (1) General

The Implementation Schedule is presented without showing calendar year. It takes the seasonal conditions into account for the commencement of foundation works in the river in December to make use of the low water period of the Mekong River. It has also taken into account that the Detailed Design and basic construction planning have been completed including the Main Bridge, Border Control Facilities and connecting road by JICA Study team as of March 2,000.

A project organization is presented in order that the two Governments may proceed the Project smoothly and effectively with the assistance of the Consultant.

### (2) Implementation Plan

The Revised Implementation Schedule, with a Project Commencement date in the beginning of May of year-1 and completion date in the end of June of year-6, the tenure of which will come up to 5 years and 1 month from the date of Loan Agreement till the Bridge opening, is established as in Table 11.1.

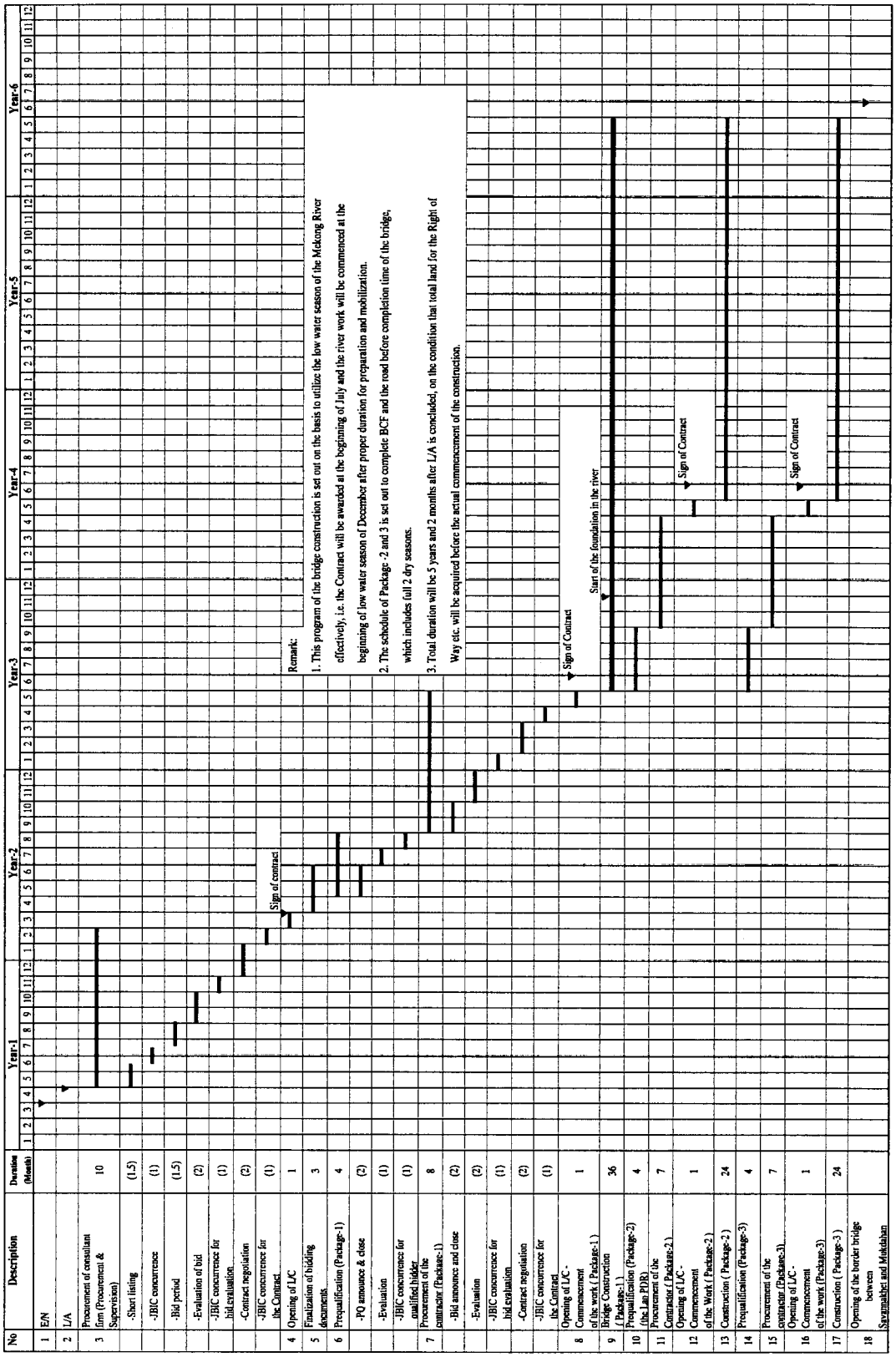
### (3) Project Organization

After conclusion of the Loan Agreements, the both Governments shall become responsible for proceeding with the project and shall commence the procurement of supervision consultant and construction Contractor for Package 1 jointly, and construction Contractors for Packages 2 and Package 3 severally. Project Organization is shown in Figure 11.1.

### (4) Disbursement Schedule

The Disbursement Schedule of the Second Mekong International Bridge Project is shown in Table 11.2. The schedules have been formed in two cases of either side launching from side to side.

# Table 11.1 Implementation Program of the Second Mekong International Bridge Project




| No | Description | Duration (Month) |
|---|---|---|
| 1 | E/N | |
| 2 | L/A | |
| 3 | Procurement of consultant firm (Procurement & Supervision) | 10 |
| | -Short listing | (1.5) |
| | -JBIC concurrence | (1) |
| | -Bid period | (1.5) |
| | -Evaluation of bid | (2) |
| | -JBIC concurrence for bid evaluation | (1) |
| | -Contract negotiation | (2) |
| | -JBIC concurrence for the Contract | (1) |
| 4 | Opening of LC | 1 |
| 5 | Finalization of bidding documents | 3 |
| 6 | Prequalification (Package-1) | 4 |
| | -PQ announce & close | (2) |
| | -Evaluation | (1) |
| | -JBIC concurrence for qualified bidder | (1) |
| 7 | Procurement of the contractor (Package-1) | 8 |
| | -Bid announce and close | (2) |
| | -Evaluation | (2) |
| | -JBIC concurrence for bid evaluation | (1) |
| | -Contract negotiation | (2) |
| | -JBIC concurrence for the Contract | (1) |
| 8 | Opening of L/C - Commencement of the work ( Package-1) | 1 |
| 9 | Bridge Construction ( Package-1 ) | 36 |
| 10 | Prequalification (Package-2) (the Lao PDR) | 4 |
| 11 | Procurement of the Contractor ( Package-2) | 7 |
| 12 | Opening of L/C - Commencement of the Work ( Package-2 ) | 1 |
| 13 | Construction ( Package-2 ) | 24 |
| 14 | Prequalification (Package-3) | 4 |
| 15 | Procurement of the contractor (Package-3) | 7 |
| 16 | Opening of L/C - Commencement of the work (Package-3) | 1 |
| 17 | Construction ( Package-3 ) | 24 |
| 18 | Opening of the border bridge between Savannakhet and Mukdahan | |

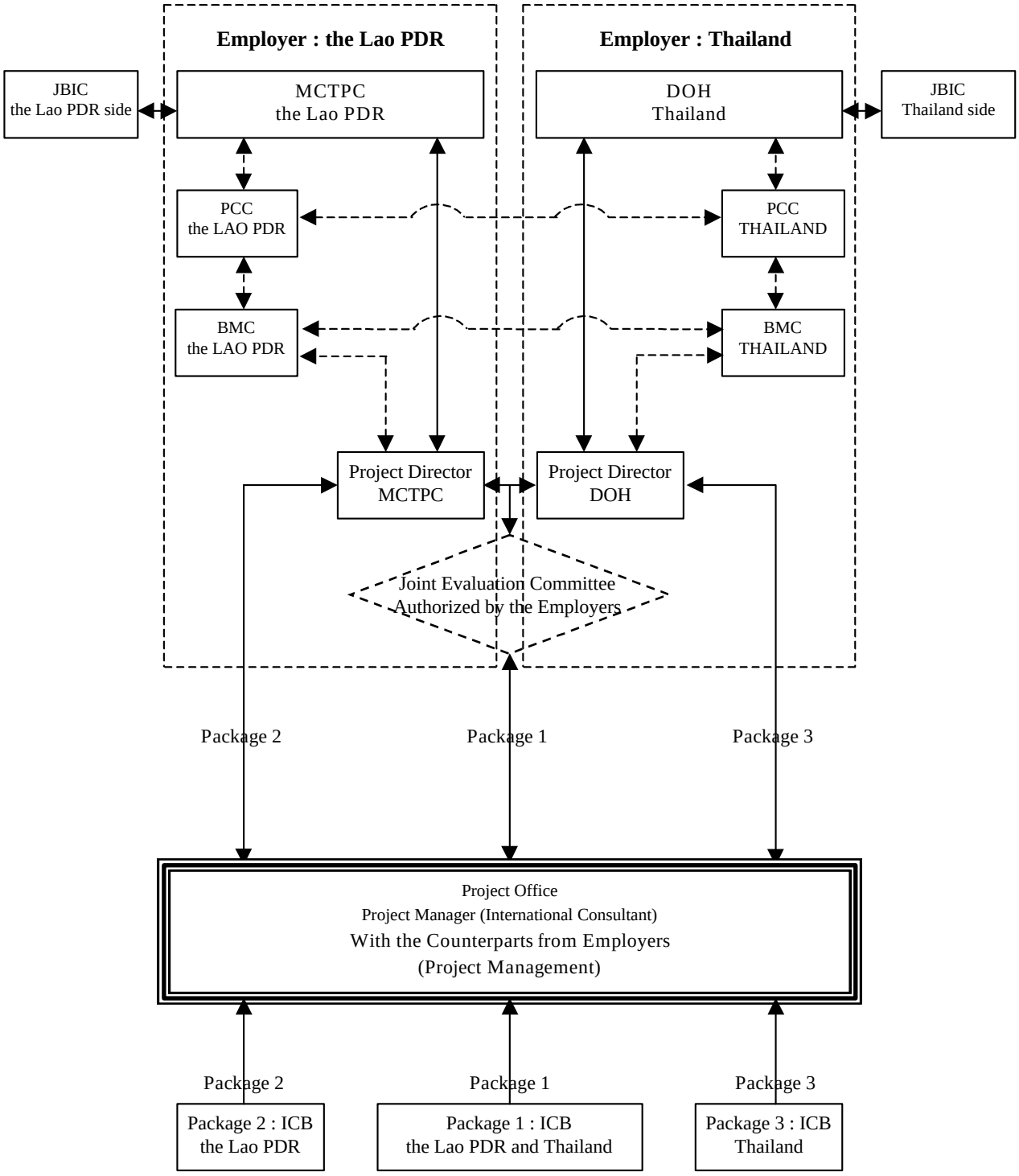



**Figure 11.1(a) Organization for the Preconstruction**

**The Second Mekong International Bridge Construction Project**

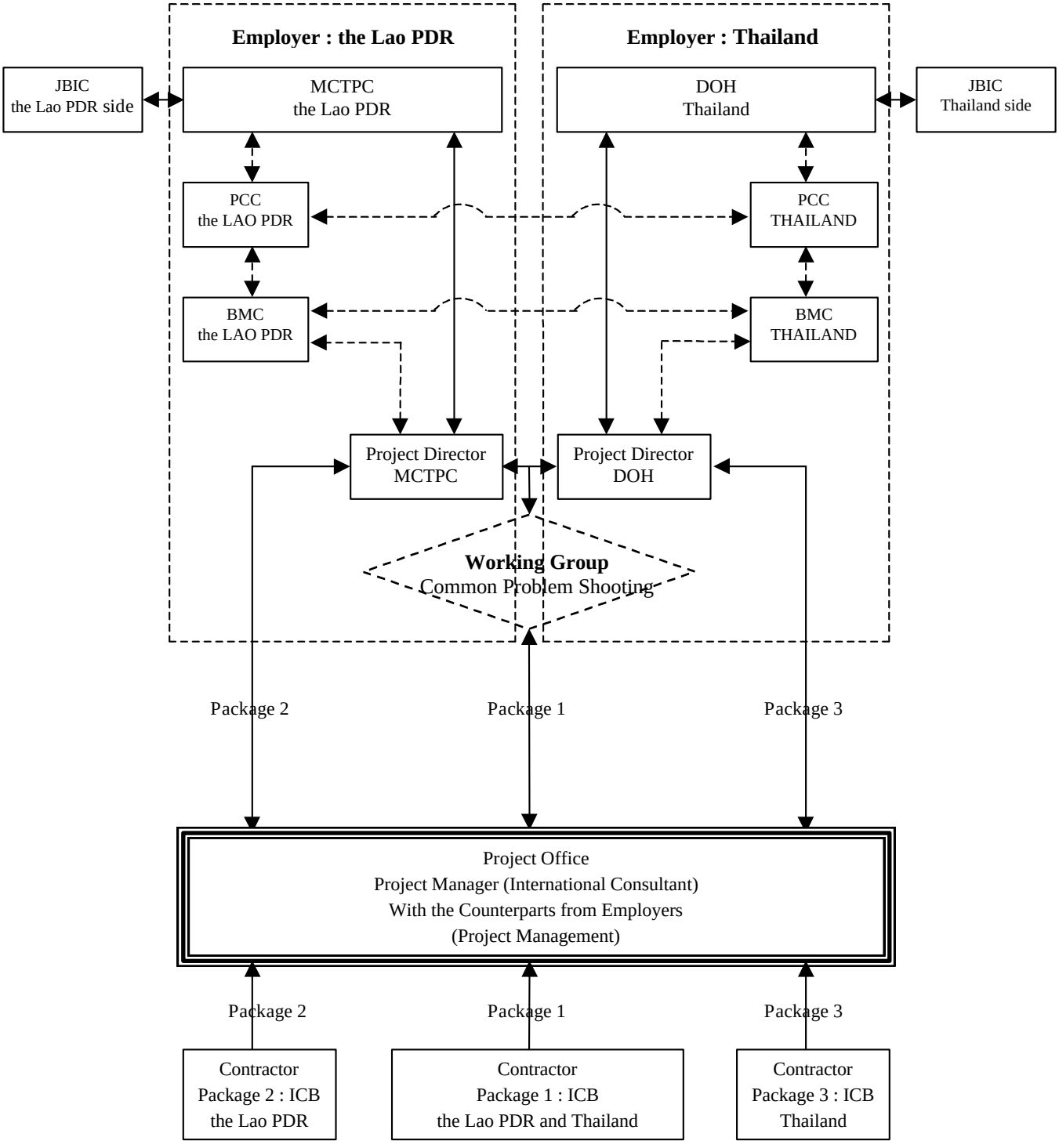
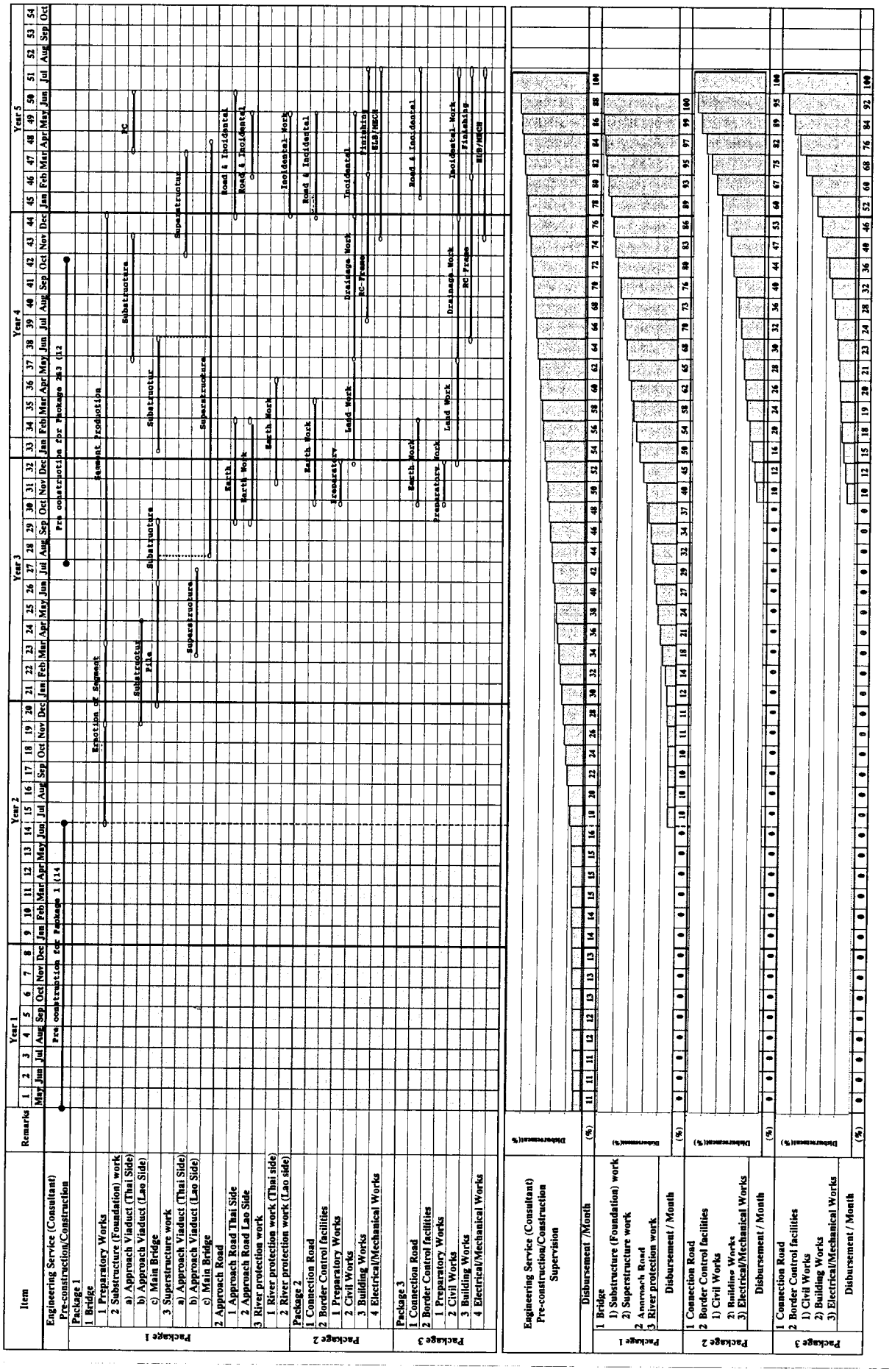



**Figure 11.1(b) Organization for the Construction Supervision**

**The Second Mekong International Bridge Construction Project**

# Table 11.2 Disbursement Schedule of the Second Mekong International Bridge Construction Project



# Chapter 12. Evaluation and Recommendation

Owing to the Study, the design objectives are satisfied along with the economical design achievements. Since the Finance Pledge has been made among the Lao PDR, the Kingdom of Thailand and Japan, the Project Construction is desired to be implemented as early as possible.

# C. APPENDIX

# C-1 OUTLINE OF BASIC DESIGN

## 1. INTRODUCTION

This Basic Design Report (hereinafter referred to as BDR) covers all data and findings of the Second Mekong International Bridge Construction Project during the first 4 months from the study inception.

## 2. BASIC DESIGN REPORT

The Basic Design Report covers the following studies and works.

### Chapter 1. Study Contents

Study objectives, study background, schedule and study structure including the related organizations of each country are described in this chapter.

### Chapter 2. Project Appreciation

An appreciation of the Project and an investigation of the socio-economic conditions of both the Lao PDR and Thailand including the roads and adjacent city areas are described.

Development policy and plans for transportation, road networks and traffic situation in each country as well as the project area are discussed.

### Chapter 3. Natural Conditions

The following surveys were carried out to obtain natural conditions for design of the Bridge, Border Control Facilities and connecting roads.

- Topographic Survey:

  Topographic drawings have been completed by the Study Team in order to carry out the basic design and further studies.

- Geological / Materials Survey

  Sufficient data are collected for the foundation planning and for material source data investigation related to sand, aggregate and embankment soil.

- Hydrological and hydraulic survey

  The high water level (HWL) has been calculated from records of flood level near the site, and the following parameters have been set.

- HWL of a 1 in 100 years average recurrence interval (ARI) flood water level is adopted at +139.60 m for the Main Bridge design.
- HWL of a l in 25 years ARI flood water level is adopted at +138.50 m for the approach and connecting roads.

- Meteorology and Seismic Survey

- Wind velocity of 48 m/sec is applied to the design.
- Seismic force coefficient of 0.06 has been calculated from available seismic records within a 500 km radius of the site.

# Chapter 4. Social Conditions

Social conditions such as land acquisition, river navigation, environment and design standards for the Bridge and connecting roads are discussed. It is recommended that an international construction zone be applied after detailed discussion on its implications. Recommendations are made for the Main Bridge package and 2 other packages that combine the Border Control Facilities and connecting roads in the Lao PDR and Thailand.

Design standards that will be used on both the Bridge and connecting roads are outlined in this chapter.

Navigation and river transportation aspects are briefly mentioned while the environmental impact on the border cities of Mukdahan and Savannakhet are anticipated.

# Chapter 5. Bridge and Road

## 5.1 Road

### (1) Design Conditions

Design standard will be basically under the road design standard of the Asian Highway Class II-Flat Terrain classification. The National Highway Route No. 212 intersection will be designed according to the road design plan under DOH. Furthermore, missing items from these standards were applied on the basis of the relevant standards such as Road Structure Ordinances in Japan or AASHTO.

### (2) Horizontal and Vertical Alignment

The crossing of the Bridge is the point proposed by the Study Team based on the route in SAPROF study. The Bridge will be located perpendicular to the Mekong River axis to minimize the bridge length.

Recommendations on the horizontal alignment of the Bridge and routing of the various alternative approach roads are made for the best connecting road alternative on the Lao PDR side. The vertical alignment of the connecting roads and the Bridge are analyzed using various controlling design parameters. Finally a cut / fill balancing gradient for the connecting roads and the Bridge is selected at 2%.

### (3) Traffic Changeover

The traffic changeover is planned on the Thailand side of the Mekong River between the BCF and the Bridge. Type A is selected and its characteristics are agreed by the Lao PDR and the Thailand authorities.

**(4) Intersections**

The connecting roads link the national road Route 9 in the Lao PDR with the national highway Route No. 212 in Thailand as well as an at-grade intersection with the Provincial Road A3 in the Lao PDR. Three intersections were carefully studied and planned to enable smooth connection of traffic.

**(5) Pavement Structures**

The carriageway section shall be paved with asphalt concrete. The traffic changeover and BCF sections shall have reinforced concrete pavement because the traffic passing through these sections may frequently stop and apply braking forces to the pavement.

Intersections in the rural area shall be paved with asphalt concrete in accordance with the DOH standards in Thailand.

For the pavement design, the annually average daily traffic volume on connecting roads is available from results of the traffic survey by the SAPROF study.

**(6) Drainage Systems**

After site investigations, study on drainage plan of the connecting roads was carried out under consideration of the drainage system and the topographic conditions.

**5.2 Bridge**

**(1) Design Condition**

**Design Standards and Bridge Design Conditions**

| Item | Bridge Design Standard and Conditions | Reference |
|---|---|---|
| a. Design Standard | The design standard of the Bridge is the Japan Road Association: Specifications for Highway Bridge (JRA-SHB). | |
| b. Design Load | - Vehicular live load for the carriage-way is 80% of B-live load by the JRA-SHB. | Adjusted to AASHTO |
| c. Deck Layout and Bridge Attachment | | Refer to SAPROF |
| d. Navigation Clearance | - Vertical navigation clearance<br>For 2 spans around the center of the Bridge:<br>Not less than 10.0m<br>- Horizontal navigation clearance<br>For all spans (excluding the extreme side spans)<br>Not less than 60.0m | Refer to SAPROF |
| e. Minimum Span | - The minimum span between piers is 80m.<br>(to secure navigation clearance at HWL and LWL; and to secure clearance from debris during flooding) | Refer to Law of Japan River Management |
| f. Preferable Span | - The preferable span between piers is 110m. | Refer to Law of |

| | | |
|---|---|---|
| | (to secure future development space for navigation and making span identical to other Mekong Bridges) | Japan River Management |
| g. Design Water Level | - HWL is 139.6m (1 in 100 year average recurrence interval flood water level)<br>- LWL is 125.5m (1 in 2 years water level) | From Investigation |

**(2) Length of the Bridge**

The Main Bridge length is 1,600m, which is the sum of lengths between riverbanks and approximately 70m offset on each side.

**(3) Superstructure of the Main Bridge**

The type of the Main Bridge was studied among several alternatives of PC box girder and a final one was agreed by the Lao PDR and Thailand to be a prestressed concrete box girder bridge of the basic spans of 80m with the PC sail type wider spans of 110m at two locations (total of four spans) through the analyzing process. The section of 110m span length is strengthened with the PC sail so as not to vary the main dimensions of the box girder from those of the 80m span length sections.

**(4) Substructure of the Main Bridge**

For the Main Bridge, a comparative study for 3 foundation types was carried out. Pile foundation with pile diameter ϕ2.0m was selected after investigating the economic efficiency, construction efficiency and structural efficiency. The piles must be cast-in-site reinforced concrete piles, with an embedment into the rock stratum of 1m + 2D (D : pile diameter).

**(5) Approach Viaduct**

Approach viaducts, total length of 200m in the Lao PDR side and 250m in Thailand side, are requested in order to reduce adverse effect to local community because of too high embankment. The span length of 50m was used to harmonize with the Main Bridge structure.

**(6) Riverbank Protection**

The riverbank protection will be installed only to protect substructures of the Main Bridge.

**(7) Construction Plan**

The Study Team recommended the Project be divided into three construction packages according to work details below. Package 1 will be an International Package with one tender and two contracts, the one with the Lao PDR and the other with Thailand.

1) Package 1 (The Lao PDR and Thailand sides)
   -Main Bridge and approaches
   -Revetment work

2) Package 2 (The Lao PDR side)
   -Connecting road from the national road Route 9 to the Lao PDR border facilities boundary.
   -Border Control Facility

3) Package 3 (The Thailand side)

-Connecting road from the national highway Route No.212 to the Thailand border facilities boundary

-Border Control Facility

The construction schedule is based on an appropriate construction period considering site conditions that vary between a high and low water level, the size of the Project and other conditions at the construction site. The total construction period is estimated at 36 months.

# Chapter 6. Border Control Facilities

### 6.1 Natural and Social Conditions

#### (1) The Lao PDR – BCF

The Lao PDR Border Control Facility (BCF) will be located between 470 and 1,070 m from the Mekong riverbank and it is contained in an area of approximately 600 x 250m=150,000sq.m or 15 Hectares (149m above MSL).

#### (2) Thailand – BCF

The Thailand Border Control Facility (BCF) will be located between 800 and 1200 m from the Mekong riverbank and from 500 to 900m from the National Highway Route No.212 and are contained in an area of 500m x 600m=300,000sq.m or 30 hectares (144m above MSL).

### 6.2 Cross Border Traffic System

Three modes of transports (Transfer type, Through type and Separated types) were proposed and the transfer type (use of cross border shuttle buses) had been unanimously accepted by both governments.

### 6.3 Design Conditions

The type of the BCF can be categorized into Separate type (cargoes/passengers) and Integrated type (combined cargoes + passengers). Integrated type of the BCF has been accepted by the both governments. The building design was conducted in conformity with respective design code and standards of the buiulding of both countries.

# Chapter 7. Relocation / Resettlement Plan

Since the negligible number of dwellings are encountered on the Project alignment, resettlement of people will not be required on the Lao PDR and the Thailand sides.

# Chapter 8. Environment

The present condition of the natural environment is dealt with in details and the socio-economic environmental issues considered in accordance with the guidelines of both JICA and OECF.

1) Environmental impact assessment is not required.

2) Initial environmental examination of this project showed little influence; all of which can be minimized by appropriate mitigation measures.

## Chapter 9. Preliminary Cost Estimation

The Project cost comprises construction cost (including the Bridge, approach viaducts, approach roads and connecting roads, and Border Control Facilities), land acquisition and compensation costs, engineering services, project administration costs, physical and price contingencies. The total project cost was estimated at US$68,873,8710 (Yen 8,261,264,760).

## Chapter 10. Public Relations and Technology Transfer

The issue of a good relationship with the public both during the design and at the construction stage is emphasized. A technology transfer program including oversea training during the construction stage is proposed.