MINISTRY OF COMMUNICATION,
TRANSPORT, POST AND CONSTRUCTION
LAO PEOPLE'S DEMOCRATIC REPUBLIC

NO.

BASIC DESIGN STUDY REPORT ON THE PROJECT FOR IMPROVEMENT OF NATIONAL ROAD ROUTE 9 (PHASE 2) IN LAO PEOPLE'S DEMOCRATIC REPUBLIC

DECEMBER 2000

JAPAN INTERNATIONAL COOPERATION AGENCY
KATAHIRA & ENGINEERS INTERNATIONAL

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PREFACE

In response to a request from the Government of Lao People's Democratic Republic (Lao PDR), the Government of Japan decided to conduct a basic design study on the Project for Improvement of National Road Route 9 (Phase 2) and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Lao PDR a study team from June 24 to August 1, 2000.

The team held discussions with the officials concerned of the Government of Lao PDR, and conducted field studies at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Lao PDR from October 17 to 26, 2000 in order to discuss a draft basic design, and as this result, the present report was finalized.

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

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

December, 2000

Kunihiko Saito
President
Japan International Cooperation Agency

December, 2000

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Improvement of National Road Route 9 (Phase 2) in Lao People's Democratic Republic.

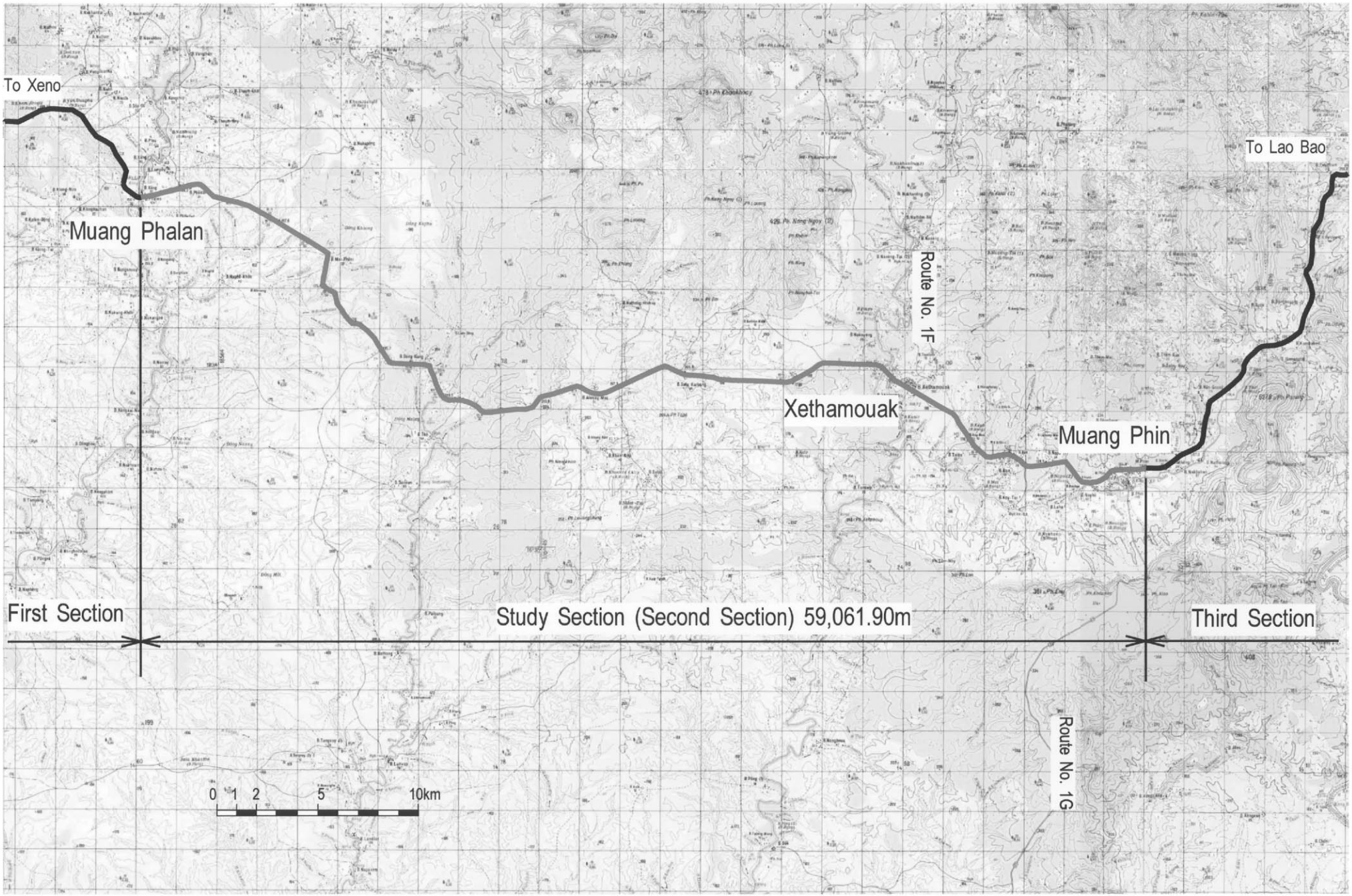
This study was conducted by Katahira & Engineers International, under a contract to JICA, during the period from June 21, 2000 to December 15, 2000. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Lao PDR and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

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

Very truly yours,

Minoru Miura
Project Manager,
Basic Design Study Team on the Project for
Improvement of National Road Route 9
(Phase 2)
Katahira & Engineers International

Location Map of Project Area



Location Map of Study Section

PERSPECTIVE

Abbreviation

AASHTO	:	American Association of State Highway and Transportation Officials
A C	:	Asphalt Concrete
A D B	:	Asian Development Bank
A D T	:	Average Daily Traffic
A F T A	:	ASEAN Free Trade Area
ASEAN	:	Association of Southeast Asian Nations
B T B	:	Bituminous Treated Base
C B R	:	California Bearing Ratio
CH	:	Chainage
D B S T	:	Double Bituminous Surface Treatment
D C T P C	:	Department of Communication, Transport, Post, and Construction
D / D	:	Detailed Design
DOR	:	Department of Roads
E S A L	:	Equivalent Single Axle Load
F / S	:	Feasibility Study
GNP	:	Gross National Product
I D A	:	International Development Association
k i p	:	Kilo pounds
k p h	:	kilometer per hour
lb	:	Libra
L D C	:	Less Developed Countries
M C T P C	:	Ministry of Communication, Transport, Post and Construction
P C U	:	Passenger Car Unit
P D R	:	People's Democratic Republic
p s i	:	Pounds per square inch
RAD	:	Road Administration Division
R C	:	Reinforced Concrete
R O W	:	Right of Way
S B S T	:	Single Bituminous Surface Treatment
S N	:	Structural Number
U X O	:	Unexploded Ordnance
V P D	:	Vehicle Per Day

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CHAPTER 1

BACKGROUND OF THE PROJECT

CHAPTER 1 BACKGROUND OF THE PROJECT

The role of the road network on the transportation system in Loa PDR is quite important as it caters to 75% of cargo transport and 85% of passenger transport. The Government of Lao PDR has intensified the development of its road network, where total road length in the country increased to approximately 23, 000 km as of 1999, about twice of the length 15 years ago. However, the length of paved road is approximately 3,700 km, which is just about 16% of the whole road, and the ratio of its national roads is not more than 45%.

National Road No.9, the project road of this Study, is a national major trunk road of 240 km in length, connecting Savannakhet, beside the Mekong River which borders with Thailand, and Lao Bao, a town close by the border with Vietnam. It is an important route being an access to the South-China Sea. Improvement for its 211 km section was implemented between 1982 and 1988. But majority of the existing road, except for the section of 29 km in length between Savannakhet and Xeno which was improved in 1996 by IDA loan, show serious damage such as presence of cracks, potholes and peeled surface at every turn. It has caused un-passable situations for some types of vehicles during rainy season.

The project road has not functioned properly as a trunk road. Therefore it becomes urgently necessary to carry out improvement work to include the widening of the road and improvement of the bridges.

ADB has propelled "East-West Transport Corridor Project", a general infrastructure program to develop the middle of the Indo-China Peninsula (the north-east of Thailand, the middle-south of Lao PDR and the middle of Vietnam) by the completion of the feasibility study in December 1996. As a result of the study, top priority was given to the central corridor from Mukdahan of Thailand to Da Nang of Vietnam via Savannakhet, Xeno, Daensavan in Lao PDR and Lao Bao in Vietnam.

With these situation, the Government of Lao PDR requested for a Japan's grant aid assistance in 1997 for the improvement of National Road No.9 particularly the section of approximately 211 km in length (Xeno~Lao Bao).

In response to the request of the Government of Lao PDR, the Government of Japan decided to conduct a basic design study on the Project for Improvement of National Road No.9. As an initial step, Japan International Cooperation Agency (JICA) dispatched a Preparatory Study Team in February 1998, and it was agreed by both parties that the 211 km road section be divided into three sections which will be treated respectively in stages. Then, JICA dispatched the Basic Design Study Team for the project on the First Section of

73 km in length (Xeno~Muang Phalan). Based on the result of the basic design study, "The Project for Improvement of the National Road Route 9" was decided to be implemented under Japan's Grant Aid assistance and was started on July 1998 and still on going at the present time.

The Third Section of 78 km in length (Muang Phin~Lao Bao) is being implemented under an ADB loan at present. For the Second Mekong International Bridge, the detailed design was conducted by JICA and implementation of which will be under the loan from Japan Bank for International Cooperation (JBIC).

Later, the Government of Japan decided to conduct a basic design study on the Project for Improvement of National Road Route 9 (Phase 2) for the Second Section of 60 km in length, the implementation of which was still undecided for inclusion among the requested 211 km Section. JICA dispatched the Basic Design Study Team from June 24 to August 1, 2000 for field survey and discussions with the officials of the implementing agency in Lao PDR.

The study team, during its stay in Lao PDR, confirmed the background, objectives and contents of the Project, collected relevant data and surveyed the project site. After returning to Japan, the Study Team evaluated the Project based on the necessity, socio-economic effects, appropriateness and other relevant factors, and the basic design and implementation plan were drawn up.

As a result, the draft basic design for the improvement of the road section of about 60 km in length between Muang Phalan and Muang Phin was proposed. After explanations and consultations on the draft basic design with the officials of Lao side, the basic design of the Project was developed.

CHAPTER 2

CONTENTS OF THE PROJECT

CHAPTER 2 CONTENTS OF THE PROJECT

2.1 Objectives of the Project

National Road No.9 crossing the middle of Lao PDR is a national major trunk road as an access to the South-China Sea and has borne the important role of an international road network as a trans-peninsula road in the Indo-China Peninsula. However, it is urgently necessary that the road improvement work on the existing pavement, which caused the un-passable situation for some vehicles during rainy season, be implemented. "Strategic Direction for the Development of the Road Sector 2000~2015" prepared by Ministry of Communication, Transport, Post and Construction (MCTPC) shows that the improvement project of National Road No.9 scheduled to be completed in 2003 is one of its top priority projects.

The section of this study is approximately 60km in length connecting the end of the First Section and the beginning of the Third Section, the only section whose implementation remains undecided among the improvement projects of National Road No.9.

This project in particular aims to improve the road transport condition in Savannakhet province and to ensure smooth traffic conditions by the improvement of National Road No.9.

By the implementation of this study section, the improvement project of the entire National Road No.9 will be completed.

2.2 Basic Concept of the Project

2.2.1 Existing Condition of the Project Road

The major national roads in Lao PDR are No.1, 2, 4, 6, 7, 8, 9 and 13. National Road No.13, with a total length of 1,370 km, is the main trunk road in the country, which links Luang Prabang in the north and Khong in the south passing through the major urbanized areas of Vientiane, Savannakhet and Pakse. National Roads No.7, 8 and 9 lead to the Vietnamese border, and No.1 to China.

National Road No.9 was constructed at two sections separately. The first section between Xeno and Sepon, Km 0 – Km 163, was designed with a 7 m carriageway and 1 m shoulders by the Russian Design Institute and constructed by the MCTPC during 1984 to 1988. The second section from Sepon to Lao Bao close by the Vietnamese border, Km 163 – Km 211,

was designed with a 6 m carriageway and 1 m shoulders and constructed by Vietnamese engineers and contractors between 1982 and 1986.

The existing pavement conditions of the study section of 60km in length from Muang Phalan to Muang Phin are described in Appendix 6. Pavement Condition Survey.

2.2.1.1 Existing Condition of the Road

(1) Traffic

National Road No.9, as the central corridor of the country, is one of the most heavily traffic routes on the national road network in Lao PDR with daily traffic of 700 vehicles per day. The typical composition of existing traffic flow is as follows:

- High proportion of motor cycles
- Lower proportion of private vehicles
- Higher proportion of commercial vehicles
- Relatively low level of daily traffic (low level of the vehicle ownership & economic activity and generally poor state of the roads)

(2) Alignment

The horizontal and vertical alignments of the road are proper except at few sections.

According to the Russian design documents, the road was designed with the following geometric criteria:

- Minimum horizontal curve radius 250 m
- Minimum vertical crest curve radius 5,000 m
- Minimum vertical sag curve radius 2,000 m
- Maximum gradient 5 %

(3) Road Width

The existing road width varies from 7.5 m to 10.0 m composed of the following carriageway and shoulders.

- Carriageway width ; 6.5 m ~ 8.0 m
- Shoulder width ; 1.0 m ~ 2.0 m

(4) Pavement

The existing pavement consists of DBST surface, macadam base and subbase with a total thickness of about 400 mm, as shown in Figure 2.2.1-1.

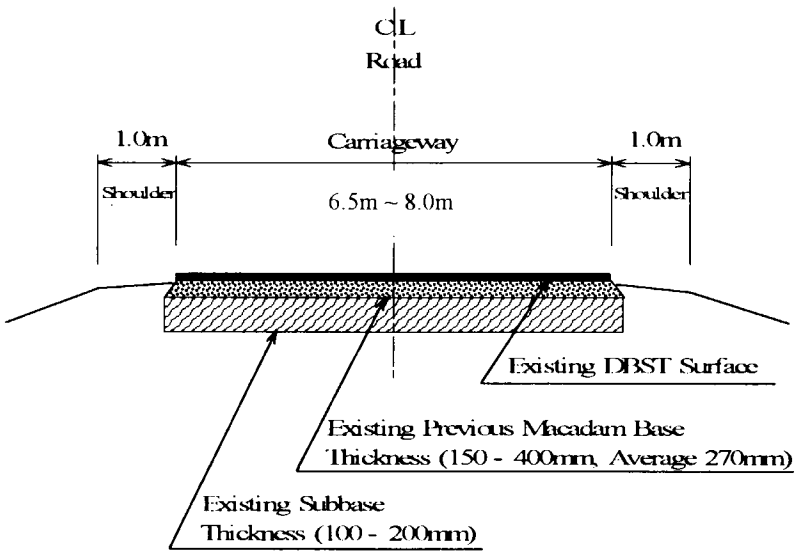


Figure 2.2.1-1 Existing Pavement

The existing pavement, in general, shows several types of deficiencies and deteriorations including transverse/longitudinal alligator cracks, localized failure sections, removal of surface materials, potholes, depression, etc. The existing conditions of pavement are briefly presented in Table 2.2.1-1.

Table 2.2.1-1 Existing Condition of Pavement

Chainage KM	Functional Condition	Structural Condition	Remarks
KM 0 ~ KM 2	Very bad/bad	Medium severity	Many failure sections
KM 2 ~ KM 8	Fair/bad	Low/medium severity	Many failure sections
KM 8 ~ KM11	Bad/very bad	Medium severity	
KM11 ~ KM18	Fair	Low/medium severity	
KM18 ~ KM19	Bad	Medium severity	
KM19 ~ KM20	Good	Low severity	
KM20 ~ KM42	Very bad/bad	Medium severity	Mostly failure sections
KM42 ~ KM45	Bad	Medium severity	Mostly failure sections
KM45 ~ KM48	Good/fair	Low severity	
KM48 ~ KM50	Very bad	Medium severity	Mostly failure sections
KM50 ~ KM52	Fair	Low/medium severity	
KM52 ~ KM61	Very bad/bad	High severity	Mostly failure sections

Note: Structural conditions were evaluated based on severity of alligator cracks.

(5) Culverts and Drainage

On the study section, a total of 61 culverts are installed. Generally, existing culverts provide adequate cross drainage capacity with inlets/outlets at both sides, except at a few locations. The roadside drainages are mostly earth ditches. Erosion and/or sedimentation are observed on them in rolling terrain.

(6) Road Facilities

Traffic signs are installed at some point of junction, bus stops and bridge approaches. Guide posts are installed at culvert locations and bridge approaches.

2.2.1.2 Existing Condition of Bridges

There are 13 bridges along the study section with the types and dimensions, as summarized in Table 2.2.1-2.

Table 2.2.1-2 Summary of Bridges

Bridge Number	Bridge Name	Chainage (KM)	Bridge Type	Bridge Length (m)	Carriageway Width (m)	Side walk (m)
1	Houay Koa	0 + 646	RC Simple Girder	17.74	8.0	2 x 1.45
2	Houay Nha Phenk	7 + 173	RC Simple Girder	39.10	8.0	2 x 1.45
3	Houay Ngua	12 + 079	RC Simple Girder	36.10	8.0	2 x 1.45
4	Huay Sa Loung	18 + 243	RC Simple Girder	36.10	8.0	2 x 1.45
5	Houay Sa Leang	19 + 245	RC Simple Girder	54.10	8.0	2 x 1.45
6	Se Koum Kam	20 + 479	Simple Steel Girder	90.48	7.0	2 x 0.80
7	Houay Jon	22 + 542	RC Simple Girder	24.05	8.0	2 x 1.45
8	Houay Toa	28 + 079	RC Simple Girder	36.10	8.0	2 x 1.45
9	Houay Lak Kouay	40 + 880	RC Simple Girder	42.10	8.0	2 x 1.45
10	Se Tha Mouk	46 + 239	Simple Steel Girder	163.00	7.0	2 x 1.45
11	Houay Ta Sap	52 + 567	RC Simple Girder	18.60	8.0	2 x 1.45
12	Houay Ta Youg	54 + 080	RC Simple Girder	30.05	8.0	2 x 1.45
13	Houay Polo	54 + 421	RC Simple Girder	48.10	8.0	2 x 1.45

The existing conditions of RC bridges are structurally fair, while the other two steel bridges are still serviceable although they show much deflection on the center spans. In general, the structures have some minor deficiencies such as spalled concrete of structural members, inadequate

cover of concrete, damaged expansion joint, etc.

Deficiencies of bridges in view of traffic functionality are summarized as follows:

- Deck slab
  Concrete deck slabs on almost all bridges have irregular surface with hairline cracks.
- Deck drainage
  Decks have no drainage path so that surface water can not be discharged.
- Steel hand railing
  Some of the steel hand railing are damaged or corroded.
- Scour protection
  - Pier foundation of bridges are scoured.
  - Abutment slope protection of bridges are damaged.
- Sidewalk at bridge approaches
  No sidewalks are provided at bridge approaches.

2.2.2 Basic Concept of the Road Improvement

Based on the above mentioned findings and examinations, the importance of the study section is evaluated and summarized on the following aspects.

- Role in road network
- Traffic Demand
  - Early Stage
  - Final Stage
- Socio-economic effect
  - Beneficiary
  - Agriculture
  - Stockbreeding

(1) Role in Road Network

National Road No.9 is a trans-province road in Savannakhet, and it has a vital role in the national road network such as connecting with National Road No.13, No.1F and No.1G at Xeno, Xethmouak and Muang Phin respectively. So that, it has the distinction as the most important traffic facility in related area.

National Road No.9 is the most important route to ensure the access to the South China Sea an open sea for Lao PDR, an inland country. It has carried out the role of international road to support the trade with neighboring Vietnam. Moreover, the importance as an international road will be even greater after the opening of Second Mekong International Bridge, which is scheduled for implementation under a Japanese Yen loan, to connect the three countries of Thailand, Lao PDR and Vietnam.

While, National Road No.9 is included in "East-West Transport Corridor Project", a general infrastructure development program by ADB, whose objective is the completion of a trans-peninsula road in the Indo-China with components of construction of Second Mekong International Bridge connecting Mukdahan of Thailand and Savannaket of Lao PDR, upgrading of Da Nang Port the final destination of the corridor traffic and improvement of National Road No.9.

In addition, National Road No.9 shall carry out a role in "Asian Highway Network Project" planned to realize the ASEAN Free Trade Area (AFTA) propelled by ASEAN. International road network related with National Road No.9 is shown in Figure 2.2.2-1.

(2) Traffic Demand

Compared with National Road No.8 located in the north of the project road, National Road No.9 is currently the most heavy traffic route in the trans-nation roads with an ADT of about 700 vehicles.

The present and forecast average daily traffic at Muang Phin along the study section is shown in Table 2.2.2-1.

Table 2.2.2-1 Present and Forecast Traffic

Average Daily Traffic (ADT)

	Motor-cycle	Bus	Car, Pick-up	Commercial Vehicle	Total
Present in 2000	453	60	51	174	738
Forecast in 2010 *	1,128	575	414	922	3,039
Forecast in 2020 *	2,787	934	1,065	2,026	6,812

* Forecast traffic with the construction of Mekong Bridge and upgrading Road No.9 and related roads.

Source: Technical Report No.3, East-West Transport Corridor Study, ADB, 1997
Traffic Count Survey, July 2000

Figure 2.2.2-1 INTERNATIONAL ROAD NETWORK

The analysis of the forecasted traffic demand by "East-West Transport Corridor Project" indicates that traffic volume in Year 2010 will be about 4 times that in 2000 with the conditions construction of Second Mekong International Bridge and improvement of National Road No.9 and related roads. After 2010, the traffic volume will increase with an annual average growth rate of more than 8%.

However, the study section has not functioned properly due to significant damages on the pavement, comparing with its high grade alignment. The result of the traveling investigation carried out shows necessary traveling time for the study section was 2 hours 16 minutes, and average speed was only 25 kph. Even though the road environment on those days was desirable with less factors on speed reduction, it was far from 80 kph, which is the maximum speed on national roads regulated by traffic law. Moreover, the vehicle used by the traveling investigation was 4 wheel Driving Car with bigger tires. For some other types of vehicles, like the normal passenger cars and the most popular tuktuk in Lao PDR, the road is not passable to them for about 5 months during rainy season on account of deep ruttings and muddy surfaces.

With the improvement of a road's function, necessary traveling time will be reduced to about 57 minutes and average speed will improve to 62 kph. Moreover, every type of vehicles will be able to pass anytime of the year. Therefore, National Road No.9 will carry out the important role on the road transport system not only inside the region but also in the outer regions.

Before completion of the bridge and improvement projects mentioned above, the study section with approximately 60 km in length will handle the traffic as an access road from influence areas to National Road No.13, No. 1F and No. 1G and a road to provide the stable access to Vietnam.

(3) Socio-economic Development

The improvement of National Road No.9 is also expected to contribute to the socio-economic development in the region by providing the stable route for the commodity flow, particularly on sectors of agriculture and livestock which will be the beneficiaries.

Beneficiary

Population of Savannakhet province is estimated at 748,000 in 1999, approximately 15% of total population in Lao PDR. This population will alternately be the direct beneficiaries of the Project in view of socio-economic development of the province, the smooth commodity flow and development of external trade.

All populations of the southern provinces, which are the provinces of Attopeu, Sekong, Saravane and Champasack, with about 1.01 million are also expected to benefit indirectly from the Project.

Table 2.2.2-2 Population by Province (1999)

Unit; Thousand

Province	Area (Km^2)		Population	
1. Savannakhet	21,774	(9.2%)	748	(15%)
2. Vientiane Municipality	3,920	(1.6%)	583	(11%)
3. Champasack	15,415	(6.5%)	558	(11%)
4. Luangprabang	16,875	(7.1%)	406	(8%)
5. Xayabury	16,389	(6.9%)	325	(6%)
6. Vientiane	15,927	(6.7%)	319	(6%)
Whole Country	236,800	(100%)	5,091	(100%)

Source: Basic Statistic-(1975-2000), National Statistic Center, Lao PDR

Agriculture

Savannakhet province is economically dominated by agriculture and forestry. Rice is the main crop in the province, contributing 20% of total production in the country.

Table 2.2.2-3 Rice Production (1999)

Unit; Thousand Ton

1. Savannakhet	420.2	(20 %)
2. Champasack	307.5	(15 %)
3. Vientiane Municipality	229.9	(11 %)
4. Saravanh	139.6	(7 %)
Whole Country	2,094.0	(100 %)

Source: Basic Statistic-(1975-2000). National Statistic Center, Lao PDR

Livestock

Livestock is an important production in Savannakhet province, supplying 18% of buffalos, 22% of cattle and 21% of goats and sheep of total produce in the country.

Table 2.2.2-4 Number of Livestock (1999)

Unit: Thousand heads

Item	Whole Country		Savannakhet		Ranking by Provinces
Buffalo	991.8	(100 %)	183.4	(18 %)	1
Cattle	944.1	(100 %)	204.1	(22 %)	1
Pig	1,036.4	(100 %)	94.0	(9 %)	3
Goats and Sheep	94.4	(100 %)	19.5	(21 %)	1
Poultry	11,214.5	(100 %)	1,248.1	(11 %)	1

Source: Basic Statistic-(1975-2000). National Statistics Center, Lao PDR.

(4) Basic Concept of the Road Improvement

The subject of this study is the Second Section connecting the First Section and the Third Section, both of which are under construction at present, hence the basic concept was decided taking into account both sections.

Basic Concept of the necessary road improvement is shown in Table 2.2.2-5.

Table 2.2.2-5 Basic Concept of Road Improvement

Items	First Section (Japan's Grant Aid)	Second Section (This Study)	Third Section (ADB Loan)
1. Design Standards	MCTPC Road Design Manual with modifications.	MCTPC Road Design Manual with modifications.	MCTPC Road Design Manual with modifications
2. Road Design Class	Class II. (3000-8000 PCU)	Class II. (3000-8000 PCU)	-
3. Design Speed	• 100 kph Flat/Level Terrain • 50~70 kph (Populated area)	- 100 kph Flat Terrain - 70 kph Rolling Terrain - 50 kph (Populated area)	- 100 kph (West of Zepon) Flat - 80 kph (East and Zepon) Rolling - 50~70 kph (Populated area)
4. Road Cross Section	- No of lane : 2 - Lane width : 3.5m - Shoulder : 1.5m 2.5m (populated area) - Paved shoulder : 1.0m (t=5cm) : 2.5m (t=5cm)	- No of lane : 2 - Lane width : 3.5m - Shoulder : 1.5m 2.5m (populated area) - Paved shoulder : 1.0m (t=5cm) : 2.5m (t=5cm)	- No of lane : 2 - Lane width : 3.5m - Shoulder : 1.5m 2.5m (populated area) - Paved shoulder : 1.0m (SBST)
5. Alignment	- Follow Existing Alignment	- Follow Existing Alignment	- Follow Existing Alignment
6. Pavement	- Pavement Life 8 years - 1.8 million ESAL application - Overlay on Existing Pavement -Min 5cm AC -Min 5cm Bituminous Treated Base -Min 12 or 15cm Base -Preparation of Pre-Overlay repair - New Construction -Min 5cm AC -Min.5cm Bituminous Treated Base -10.0cm Base -28cm Cement Treated Subbase -CBR=5 Subgrade	- Pavement Life 8 years - 1.72 million ESAL application - Overlay on Existing Pavement -Min 5cm AC -Min 5cm Bituminous Treated Base -Min 12 or 15cm Base -Preparation of Pre-Overlay repair - New Construction -Min 5cm AC -Min.5cm Bituminous Treated Base -10.0cm Base -28cm Cement Treated Subbase -CBR=5 Subgrade	- 8 million equivalent standard axle - Overlay on Existing Pavement -Min 5cm AC -Min 1cm SBST -17.5cm Base -17.5cm Subbase -Trimming of existing surface (50~100mm) - New Construction -Min 5cm AC -Min 1cm SBST -Min 17.5cm Base -Min 17.5cm Subbase -15cm Lower Subbase(CBR=15) -CBR=5 Subgrade

Basic concept of the improvement for drainage facilities and traffic facilities are shown in Table 2.2.2-6 and Table 2.2.2-7 respectively.

Table 2.2.2-6 Basic Concept of the Improvement for Drainage Facilities

Items	Concept of This Study
Culvert	- New installation, if necessary at flood section, etc. - Extension of insufficient culvert length at widening section, and provide the wing wall, if necessary - Replacement of low capacity culvert
Side ditch	- Provide earth ditch at flat & cut section and populated area
Flood section	- Slope protection with gabion, if necessary at flood section, etc.

Table 2.2.2-7 Basic Concept of the Improvement for Traffic Facilities

Items	Concept of This Study
Traffic sign	- According to Lao Road Design
Lane marking	- Centerline delineation - Edgeline delineation
Guide post / rail	- High embankment - Tight curve - Bridge approach
Bus stop	- Provide at populated areas
Bus Bay	- Provide at Xethamouak and Muang Phin
Access Road	- Provide at 8 places such as stock yard of log, etc.

Any other critical problem was not found in the field investigation.

2.2.3 Basic Concept of the Bridge Improvement

Existing 13 bridges along the study section are determined to be of acceptable conditions without any serious structural deterioration due to traffic loading, and so can still be serviceable up to the time it becomes necessary for reconstruction due to the obsolete structural condition. Reconstruction of existing bridges is not only needless but a waste of the past investment on them. Therefore the improvement of structural capabilities on existing bridges in this study is not planned.

However the roughness on deck slabs of bridges affect the quality of running ability, and it has recommended counter measures. Items to be improved on bridges are as follows:

- To repair and flatten the deck slab
- To provide the sidewalk at bridge approach

Table 2.2.3-1 shows the basic concept of the bridge improvement.

Table 2.2.3-1 Basic Concept of Bridge Improvement

Items	First Section (Japan's Grant Aid)	Second Section (This Study)	Third Section (ADB Loan)
1. Deck slab	- Cover with asphalt concrete (t=5.0cm)	- Cover with asphalt concrete	- Cover with asphalt concrete
2. Expansion joint	- No seriously damaged joint - Butt- joint must be covered with AC - Finger steel joint, no repair	- No seriously damaged joint - Butt- joint must be covered with AC - Finger steel joint, no repair	- install new
3. Inadequate deck drainage	- Drainage paths will be provided through crossfall in AC surfacing	- Drainage paths will be provided through crossfall in AC surfacing	- Provide new drainage paths through kerbs and crossfall in AC surfacing.
4. Steel railing	- Existing steel railing which has a few places of damage and corroding, repair	- Existing steel railing which has a few places of damage and corroding, repair	- Repair, clean and paint
5. Splitted concrete girder	- No repair because of no structural deficiencies	- No repair because of no structural deficiencies	- Cut bars and path repair with non-shrink mortar
6. Cracked concrete	- No repair because of no structural damages.	- No repair because of no structural damages.	- Inject with epoxy
7. Inadequate cover	- No repair because of no progress in corroding of steel reinforcing bars.	- No repair because of no progress in corroding of steel reinforcing bars.	- Chemical surface treatment or path repair
8. Steel bearing	- No repair because of no serious problem.	- No repair because of no serious problem.	- Clean and paint
9. Steel girders	- Fair condition of painting, no repair.	- Fair condition of painting, no repair.	- Clean and paint
10. Scour protection	- Repair with gabion	- Repair with stone masonry	- Repair or provide new gabion or rock protection
11. No sidewalk at bridge approach	- Construct sidewalk with RC guide post.	- Construct sidewalk with RC guide post.	-

2.3 Basic Design

The basic design concept of this study is to improve the section of National Road No.9 from Muang Phalan (CH72.913) to Muang Phin (CH131.075) so as to accommodate the expected traffic demand during the design life and to ensure the safety and reliability of the road transport.

2.3.1 Design Concept

2.3.1.1 Road Improvement

(1) Basic Design Elements

Basic design elements were reviewed in accordance with the Road Design Manual (Provisional Use), Vientiane, 1996, Communication Department, MCTPC, taking into consideration the geometric design standards of the two countries, Vietnam and Thailand, which are presented in Table 2.3.1-2.

Through the study on the considerations applied to the First Section and the Third Section, major design concepts were decided and shown in Table 2.3.1-1.

Table 2.3.1-1 Major Design Concept

Road Design Class		Class II	
Traffic Volume	(ADT)	3000 ~ 8000	
Design Speed	(kph)	100	(Flat Terrain)
		70	(Rolling Terrain)
		50	(Populated Area)
Lane Width	(m)	3.5	
Shoulder Width	(m)	1.5	(General Section)
		2.5	(Populated Area)

Table 2.3.1-2 Comparison of Major Design Elements

Lao PDR																					
Road Design Class	I			II			III			IV			V			VI			VII		
Traffic	> 8000			3000-8000			1000-3000			300-1000			100-300			50-100			< 50		
Administrative Classification	National/Provincial Road												Access/Local/Minor Rural Road								
Terrain	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M
Design Speed (km/hr)	100	80	60	100	80	60	80	60	40	80	60	40	60	40	20	60	40	20	40	30	20
Number of Lanes	4			2			2			2			2			1			1		
Lane Width (m)	3.75	3.75	3.5	3.75	3.75	3.5	3.5	3.5	3.0	3.0	3.0	3.0	2.75	2.75	2.5		3.5			3.5	
Carriageway (m)	15	15	14	7.5	7.5	7	7	7	6	6	6	6	5.5	5.5	5		3.5			3.5	
Vietnam																					
Category of Road	I			II			III			IV			V			VI			VII		
Daily Traffic	> 6000			3000-6000			1000-3000			300-1000			50-300						< 50		
Importance of Highway	International Highway (Special Importance)			International Highway			Secondary Trunk Road						Interregional Provincial Road						Regional Provincial Road		
Terrain	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M
Design Speed (km/hr)	120	-	-	100		80	80	-	60	60	-	40	40	40	25				25	25	15
Number of Lanes	4			2			2			2			1						1		
Lane Width (m)	3.75	-	3.75	3.75	-	3.75	3.5	-	3.5	3.0	-	2.75		3.5						3.5	
Carriageway (m)	15	-	15	7.5	-	7.5	7	-	7	6	-	5.5		3.5						3.5	
Thailand																					
Road Class	0			1			2			3			4			5			Urban Area		
Traffic	above 8000			4000-8000			2000-4000			1000-2000			300-1000			below 300			-		
Road Classification																					
Terrain				F	R	M							F	R	M	F	R	M	F	R	M
Design Speed (km/hr)				90-110	80-110	70-90							7-90	55-70	40-55	6-80	5-60	3-50	60	60	60
Number of Lanes	4			2			2			2			2			1			-		
Lane Width (m)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5				3.5	3.5	3.5
Carriageway (m)	14	14	14	7	7	7	7	7	7	7	7	7	7	7	7		8		-	-	-

- Road Design Class and Traffic
  Based on the forecast of future traffic volume by "East-West Transport Corridor Project", Road Design Class II, which corresponds to 6,812 ADT in 2020, is adopted.

- Design Speed
  Through the study of topography and existing road alignment, the design speed is decided on 100kph in flat terrain and 70kph in rolling terrain. But taking into consideration existing small curves, design speed of the section between KM45+000 and KM61+381 (End Portion of the study section), where topography is classified as flat terrain, 70kph is applied. Speed control of 50kph is introduced in populated area for reason of traffic safety for inhabitants.

- Lane Width
  The Road Design Manual regulates the lane width of 3.75m for flat and rolling terrain and 3.5m for mountainous terrain. However a lane width of 3.5m is utilized for the design to conform with the First Section and the Third Section.

- Shoulder Width
  Shoulder width of 2.5m with paved surface is introduced in populated areas for safety and convenience of inhabitants and sizable number of local traffic including motorcycles and bicycles. In the other general section, a width of 1.5m with gravel surface is utilized.

(2) Basic Design Planning

- Horizontal Alignment
  In view of the function of the existing road, the horizontal alignment is designed to follow the existing centerline as closely as possible so as to avoid the additional land acquisition and the danger of UXO, the area is delivered to be highly contaminated. But in sections with substandard alignment, a separate study is done.

- Vertical Alignment
  The final elevation of improved road is preferred to follow the existing road in order not to hamper present roadside services. It is

also designed to provide the minimum gradient for the drain of road surface.

- Road Facilities
  Required road facilities and control devices such as bus stop, road marking, guide post, traffic sign, road hump etc. are designed in accordance with the Road Design Manual, Communication Department, MCTPC or international standards.

2.3.1.2 Pavement Improvement

(1) Pavement Structures

- Surface Structures
  Asphalt concrete (AC) surface course is applied to conform with the First Section and the Third Section.

- Base and Subbase Course
  In to facilitate maintenance, the same base/subbase structure as the First Section is applied. Cement treated subbase course and granular base course are utilized. Bituminous-treated base was also utilized as top layer of base course, which reduced total thickness of the pavement structure.

(2) Life of Initial Pavement Structure

- Performance period (life) of initial pavement structure is decided as 8 years, which is the same with the First Section, taking into consideration the maintenance capability of MCTPC and initial investment cost.

(3) Rehabilitation Design Planning

- Full-depth reconstruction method and overlay method with AC pavement are applied depending on the existing condition of pavement, CBR of subgrade, and roadside drainage condition.

2.3.1.3 Bridge Improvement

- Basic Design Planning
  In general, measures to increase the structural durability and strength of existing bridges involve a huge amount of cost, but this is not practical except for measures that have guaranteed effect, such as prolonging a life of structure. The bridges are in a reasonable condition at present, and do not show structural deterioration caused by traffic loading, therefore no counter measures for structural reinforcement is proposed.

- Improvement of Running Ability
  The roughness of the surface of deck slabs of existing 11 RC bridges, running ability, are not of as acceptable level. Therefore, such surfaces are recommended to be improved by applying AC overlay. No improvement of running ability is planned for existing steel bridges No.6 and No.10 because the additional dead load of overlay will increase deflection of steel girder.

2.3.1.4 Others

- The climate conditions at the study area is stable i.e. less variation of the temperature, no freeze, but a rainfall amount is seasonal. The reduced workability period during rainy season is considered on the implementation plan.

- The project road in the populated area is busy with pedestrians and bicycles, a widened paved shoulder with 2.5m in width is used in the design. The introduction of bus stops and bus bays is expected to improve convenience for inhabitants who lives along the project road.

- Running speed control of 50 kph is imposed in populated area to ensure the safety of inhabitants. It introduces the road hump at entrance and exit of controlled sections to force to slow down the through traffic.

- Popular road facilities in Lao PDR are utilized for the economical and easy maintenance work by the implementing agency.

- The construction period is 3~4 years generally for a road improvement project of 60km extension. On this study, construction schedule is planned to follow the most effective and economical means within

Japan's Grant Aid scheme. It also considered the coordination with the other sections on the same route for the timing of opening, i.e. the cooperation with the other component of "East-West Transport Corridor Project".

2.3.2 Design Criteria

2.3.2.1 Road Improvement

(1) Geometric Design Standards

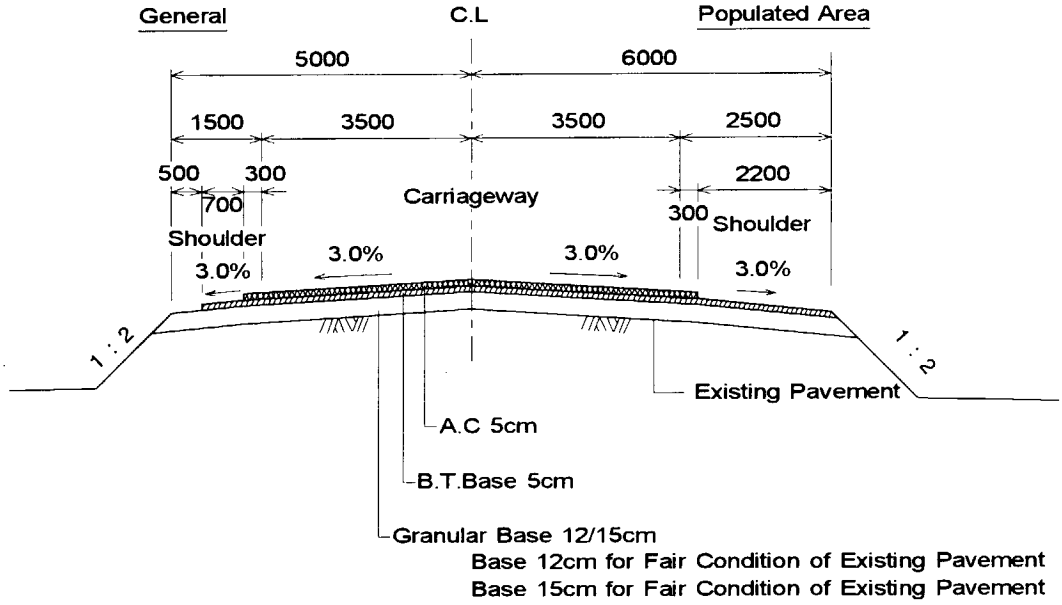
Table 2.3.2-1 summarizes the geometric design standards selected for this study.

Table 2.3.2-1 Geometric Design Standards

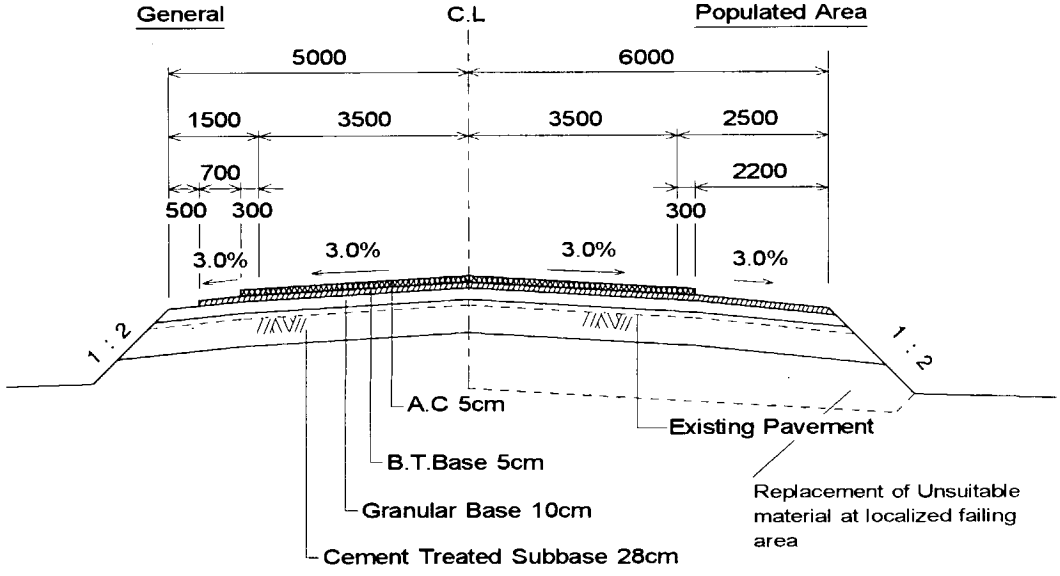
Items	Description
Road Design Class	Class II, ADT 3000 ~ 8000
Design Speed	70kph (Rolling Terrain) 100kph (Flat Terrain)
Lane Width	3.5m
Shoulder	1.5m (General Section), 2.5m (Populated Area)
Max. Gradient	5% (Flat Terrain), 6% (Rolling Terrain)
Min. Horizontal Curve Radii	435m (Flat Terrain), 195m (Rolling Terrain)
Min. Vertical Curve Radii	2.2km (Crest), 2.0km (Sag)
Cross Fall (Carriage)	3%
Cross Fall (Shoulder)	3% (Paved), 3% (Unpaved)
Right of Way	70m

(2) Standard Cross Section

In accordance with the geometric design standards, the standard cross sections were developed as graphically illustrated in Figure 2.3.2-1.



Overlay Section (TYPE-1, TYPE-2)



Note; Unsuitable materials at some sections of localized failing area shall be replaced with selected materials about 1m in depth.

ReconstructionSection (TYPE-3, TYPE-4)

Figure 2.3.2-1 Standard Cross Section

2.3.2.2 Pavement Improvement

(1) Design Criteria

The criteria for the structural design of pavement were established as presented in Table 2.3.2-2.

Table 2.3.2-2 Criteria for Structural Design of Pavement

Category	Value	Description
1. Design Variable		
1.1 Time Constraints		
• Performance Period	8 years	Life of Initial Pavement Structure
• Analysis Period	20 years	Planned Stage Improvement
1.2 Traffic	$3.43x10^6x0.5$	W18, Predicted Number of ESAL
1.3 Reliability		
• Standard Normal Deviate	$Z_R=0$	Not Considered, Reliability 50%
• Combined Standard Error	$S_0=0.45$	Error of Traffic and Performance Prediction
2. Performance Criteria		
2.1 Serviceability	$P_O=4.2$	Initial Design Serviceability Index
	$P_t=2.5$	Design Terminal Serviceability Index
2.2 Serviceability Difference	$P_O-P_t=1.7$	Difference between Initial and Terminal Serviceability Index
3. Material Property		
3.1 Effective Roadbed Soil Resident Modules	$M_R=7500$ psi	$M_R=1500xCBR$ (5)
3.2 Pavement Layer Material Characteristic		Modules (psi) / Layer Coefficient
• AC Surface Course		$E_{AC}=350,000$ / 0.39
• Bituminous Treated Base	1620 lb	$E_{BT}=340,000$ / 0.30
• Granular Base	CBR=80	$E_{BS}=28,000$ / 0.135
• Cement Treated Subbase	CBR=30	$E_{CT}=15,000$ / 0.115
• Granular Subbase	CBR=30	$E_{SB}=15,000$ / 0.115
• Granular Subbase	CBR=15	$E_{SB}=12,000$ / 0.09
4. Pavement Structural Characteristic		
4.1 Drainage		
• Granular Base	m=1.0	
• Granular Subbase	m=0.95	

2.3.3 Basic Design

2.3.3.1 Road Design

The road was designed in accordance with the established design criteria.

(1) Road Shoulder

There are several houses and villages located along the study section. For the convenience of inhabitants in populated area, road shoulder with 2.5m in width was utilized, and road shoulder with 1.5m in width was utilized in the other general section. Location of widened shoulder is presented in Table 2.3.3-1.

Table 2.3.3-1 Section of Widened Road Shoulder

No.	CHAINAGE (km) B. Point	End Point	Length (m)	Village Name	Remarks
1	2+400 ~	2+700	300	Phoxay	
2	10+250 ~	11+280	1,030	Phoxy	
3	15+975 ~	16+500	525	Nonsavang	
4	18+600 ~	18+865	265	Donebans	
5	20+110 ~	20+220	110	Donebans	
6	21+750 ~	22+100	350	Naomsarat	
7	28+450 ~	28+925	475	A. Louy	
8	30+050 ~	30+325	275	Salakay	
9	31+950 ~	32+075	125	Nathong	
10	33+575 ~	34+000	425	Bankonghin	
11	40+150 ~	40+600	450	Anouxanya	
12	41+125 ~	41+525	400	Anouxanya	
13	45+200 ~	45+900	700	Oudomxay	
14	46+800 ~	48+350	1,550	Xethamouak	Bus Bay
15	52+000 ~	52+300	300	Domphougneum	
16	54+160 ~	54+700	540	Nomsaad	
17	59+100 ~	57+300	200	Oudomdy	
18	59+835 ~	61+300	1,465	Muang Phin	Bus Bay
	Total		9,485		

The following criteria was developed to classify areas, places, and locations where widening shoulder is necessary.

- Villages, towns, and thickly inhabited areas are regarded as "populated area" but the areas where they located at a far distance from the road are excluded.

- Fairly big villages are selected, which fronts the road for more than 100 m long.

- In cases where villages, towns, and thickly inhabited areas are located on one side of the road, the area is deemed to be the populated area, and the widening and paving of shoulders are carried out on both sides of the road.

(2) Horizontal Alignment

In view of the function of the existing road, the horizontal alignment was designed to follow the existing center line as closely as possible. Design speed was decided on 100kph in flat terrain, 70kph in rolling terrain and 50kph in populated area.

However, for the section that was extended about 16km between KM45+000 and KM61+381 (End Portion of the study section) which was classified as flat terrain has substandard curves at 10 locations, i.e. smaller curve less than required minimum curve radius R=435m for design speed 100kph, and several populated areas where controlled running speed within 50kph are located. It enforces frequent speed change and/or adjustment to the drivers on these sections.

Therefore, design speed for this 16km stretch was made to conform with 70kph of rolling terrain taking into consideration the safe driving and riding comfort. As a result of this modification, all curves in the study section satisfied the required minimum curve radii for each design speed.

The substandard curves at 5 locations with small central angle, which as not satisfy the required minimum curve length for the design speed, were decided to be improved.

Table 2.3.3-2 shows the elements of curve where improvement of the horizontal alignment was introduced.

The horizontal alignment and design speed of each section are drawn in Figure 2.3.3-1. For the section with speed control of 50kph, road humps are placed at entrance and exit to slow down traffic.

Table 2.3.3-2 Element of Improved Curve

IP No.	Chainage (km)	Design Speed (kph)	Curve Radii (m)		Improved Matters
			Existing	Improved	
5	KM 5+199	100	800	1,000	Improvement of insufficient curve length
24 25	KM22+916 KM23+138	70	390 550	380 550	Adjustment of compound curve
34 35	KM32+575 KM32+714	70	270 450	250 340	Adjustment of compound curve
43	KM42+180	70	360	1,100	Improvement of insufficient curve length
47	KM48+750	70	1,250	2,800	Improvement of insufficient curve length
49	KM51+689	70	1,290	1,290	Adjustment of centerline
50	KM52+727	70	240	400	Improvement of insufficient curve length
51	KM53+210	70	300	300	Adjustment of centerline
52	KM53+964	50	300	300	Adjustment of centerline
58	KM60+332	50	270	270	Adjustment of centerline
60	KM61+124	50	610	800	Improvement of insufficient curve length

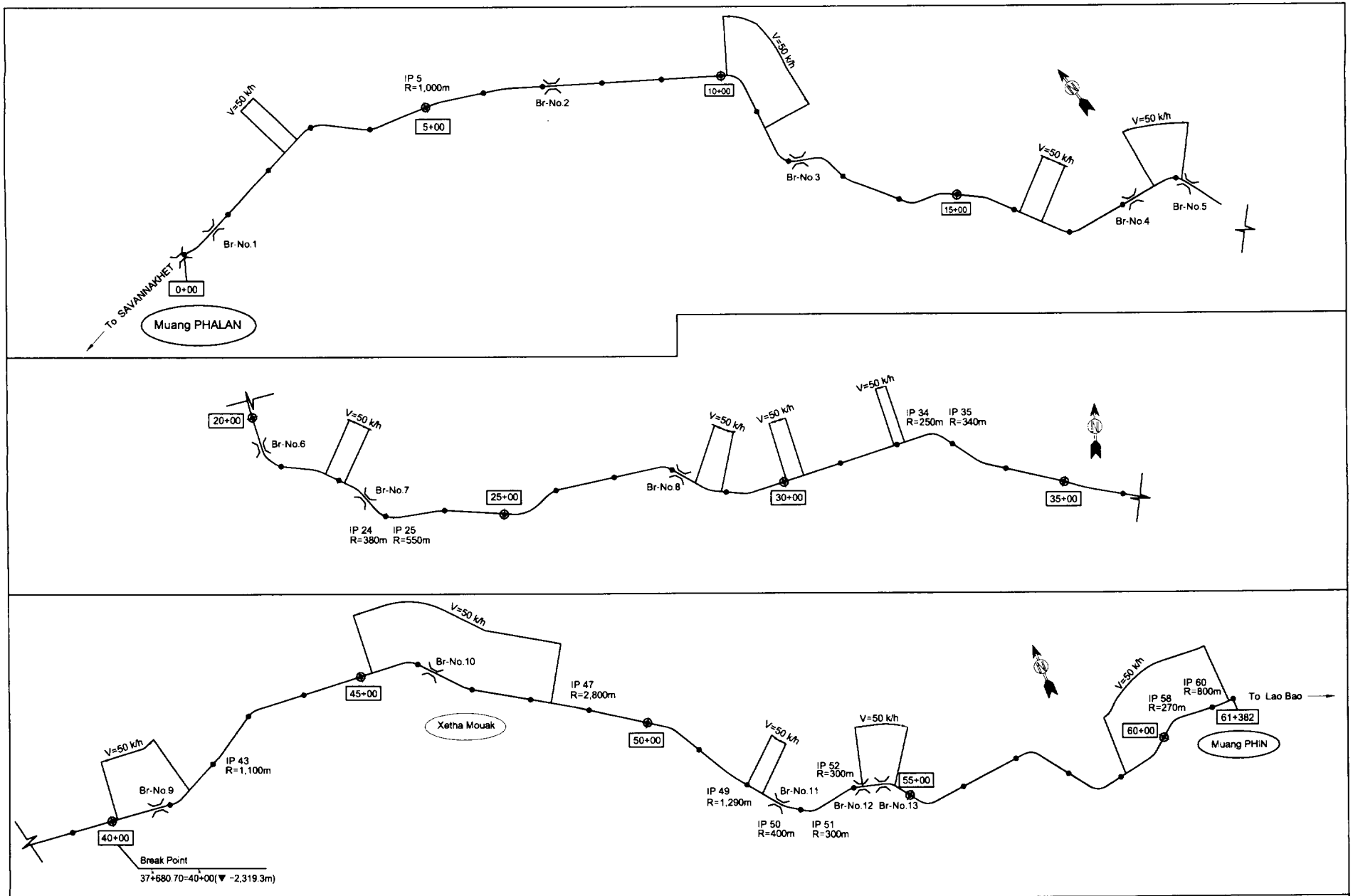


Figure 2.3.3-1 Horizontal Alignment (Improved Curves) and Design Speed

(3) Vertical Alignment

Since beginning and end portions of the study section are located in flat terrain, the maximum grade 3.00% was utilized and which satisfied the requirement (5.0%) of the Design Manual. While, the middle portion is located in rolling terrain, the maximum grade 5.15% was utilized and which satisfied the requirement (6.0%) of the Design Manual.

On the other hand, more than 0.3% of grade is desirable for to care surface drainage, but there are several sections with grades ranging from 0.01%~0.1% on the existing road.

Therefore, normal cross fall was decided to be 3% for smooth drain of surface water, and any other structure that obstruct the drain such as curb, etc. were not provided. Moreover, provision of the drainage system be to permeate the drain in the ground was planned.

2.3.3.2 Pavement Design

The new pavement and overlay structures were designed based on AASHTO Guide for Design of Pavement Structures, 1993.

(1) Design Requirements

Design requirement for flexible pavement involves various factors as shown in Table 2.3.2-2 Criteria for Structural Design of Pavement.

(2) 18-kip ESAL Prediction

Based on the traffic demand analysis and axle load surveys conducted by "East-West Transport Corridor Project", the number of 18-kip equivalent single axle load applications (18-kip ESAL Application) was calculated with damaging factors analyzed in the Corridor Project.

The forecast numbers of 18-kip ESAL applications are summarized in Table 2.3.3-3 and graphically shown in Figure 2.3.3-2.

Table 2.3.3-3 Number of EASL (Xeno-Muang Phin Section)

Type of Vehicle		Bus/ Pickup	Light Truck	Medium Truck	Heavy Truck	Articulated Truck	Total (per year)
Damage Factor		0.383	0.383	1.276	2.598	4.008	
2000	VPD	115	33	209	92	86	535
	ESAL	44.0	12.6	266.7	239.0	344.7	907.0 (331,000)
2010	VPD	241	71	461	201	189	1,163
	ESAL	92.3	27.2	588.2	522.2	757.5	1,987.4 (725,000)
2020	VPD	506	153	1,017	439	417	2,532
	ESAL	193.8	58.6	1,297.7	1,140.5	1,671.3	4,361.9 (1,592,000)

Note: VPD; Vehicle per day per 2-way.
ESAL; Number of ESAL per year per 2-way.

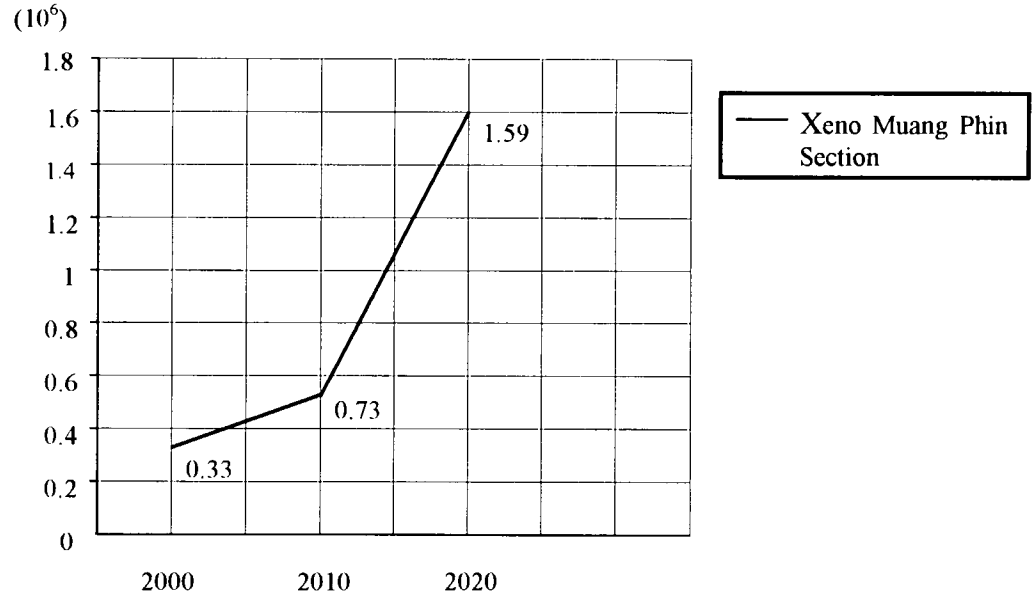


Figure 2.3.3-2 Forecasted Number of ESAL
(Two-way)

Cumulative ESAL application (two-ways) is presented in Table 2.3.3-4.

Table 2.3.3-4 Cumulative ESAL Application (Two-ways)

	Cumulative ESAL
From 2001 to 2008 (8 years)	3.43×10^6
From 2001 to 2010 (10 years)	4.95×10^6
From 2001 to 2012 (12 years)	6.58×10^6
From 2001 to 2020 (20 years)	16.55×10^6

(3) Structural Design for Reconstruction

The structural design of pavement is based on the identification of the flexible pavement structural number (SN) to withstand the predicted number of axle load traffic (W18). Equation for flexible pavement is as follow.

$$Log_{10}(W_{18}) = Z_R \times S_0 + 9.36 \times Log_{10}(SN + 1)$$

$$-0.2 + \frac{Log_{10}\left(\frac{\Delta PSI}{4.2 - 1.5}\right)}{0.40 + \frac{1094}{(SN + 1)^{5.19}}}$$

$$+ 2.32 \times Log_{10}(M_R) - 8.07$$

The structural numbers required for the specified period are presented in Table 2.3.3-5.

Table 2.3.3-5 Pavement Structural Number (SN)

Xeno – Muang Phin Section (one lane)

	W_{18}	SN
From 2001 to 2008 (8 years)	1.72×10^6	3.05
From 2001 to 2010 (10 years)	2.48×10^6	3.24
From 2001 to 2012 (12 years)	3.29×10^6	3.40

Selection of Layer Thickness

SN is converted into actual thickness of surface, base and subbase layers with the following equation.

$$SN = a_1D_1 + a_2D_2m_2 + a_3D_3m_3$$

where;

a_1, a_2, a_3 = Layer coefficients representative of surface, base, and subbase layers, respectively.

D_1, D_2, D_3 = actual thicknesses (in inches) of surface, base, and subbase layers, respectively, and

m_2, m_3 = drainage coefficients for base and subbase layers, respectively

Proposed Pavement Structure (TYPE - 3)

Asphalt Concrete	=	5 cm (1.97 inches)
Bituminous Treated Base	=	5 cm (1.97 inches)
Granular Base (CBR = 80)	=	10 cm (3.94 inches)
Cement Stabilized Subbase (CBR = 30)	=	28 cm (11.02 inches)
Subgrade (CBR = 5)		

$SN = 0.39 \times 1.97 + 0.30 \times 1.97 + 0.135 \times 3.94 \times 1.0 + 0.115 \times 11.02 \times 0.95$
$= 0.77 + 0.59 + 0.53 + 1.20$
$= 3.09 \geqq 3.05$

(4) Structural Design for Overlay

The required thickness of overlay to handle future traffic demand is determined by the following equation:

$$SN_{OL} = a_{OL} \times D_{OL} = SN_f - SN_{eff}$$

where;

SN_{OL} = Required structural number for overlay.
a_{OL} = Structural coefficient for the AC overlay.
D_{OL} = Required overlay thickness (inches).
SN_f = Structural number required to handle future traffic demand.
SN_{eff} = Effective structural number of the existing pavement.

SN_{eff} (From Condition Survey)

$$SN_{eff} = a_1D_1 + a_2D_2m_2 + a_3D_3m_3$$

where;

D_1, D_2, D_3 = Thickness of existing pavement surface, base and subbase layers.
a_1, a_2, a_3 = Corresponding structural layer coefficient.
m_2, m_3 = Drainage coefficient for granular base and subbase.

Layer Coefficients for Existing AC Pavement Layer

- AC Surface (Fair Condition) = 0.25
  - Low–severity alligator cracking more than 10%.
  - Medium–severity alligator cracking less than 10%.
  - Medium and high–severity transverse cracking more 5～10%.

- AC Surface (Bad Condition) = 0.17
  - Medium–severity alligator cracking more than 10%.
  - High–severity alligator cracking less than 10%.
  - Medium and high–severity transverse cracking more 10%.

- Granular Base = 0.12
  - No evidence of pumping, degradation, or contaminating by fines.

- Granular Subbase = 0.05
  - No evidence of pumping, degradation, or contaminating by fines.

Proposed Overlay Structure

Proposed Overlay TYPE-1; (For Existing Pavement with Low–severity alligator cracking)

$SN_{eff} = a_1D_1 + a_2D_2m_2 + a_3D_3m_3$
$= 0.25 \times 1.18$ (3 cm) $+ 0.12 \times 7.87$ (20 cm) + neglect
$= 0.30 + 0.94$
$= 1.24$

$SN_{OL} = SN_f - SN_{eff}$
$= 3.05 - 1.24$
$= 1.81$

Proposed Structure; (TYPE – 1)

Asphalt Concrete = 5 cm (1.97 inches)
Bituminous Treated Base = 5 cm (1.97 inches) Minimum.
Granular Base(CBR 80) = 12 cm (4.0 inches) Minimum.

$SN_{OL} = 0.39 \times 1.97 + 0.30 \times 1.97 + 0.135 \times 4.0$
$= 0.77 + 0.59 + 0.54$
$= 1.90 > 1.81$

Proposed Overlay TYPE-2; (For Existing Pavement with Medium–severity alligator cracking)

$SN_{eff} = 0.17 \times 1.18$ (3 cm) $+ 0.12 \times 7.87$ (20 cm) + neglect
$= 0.20 + 0.94$
$= 1.14$

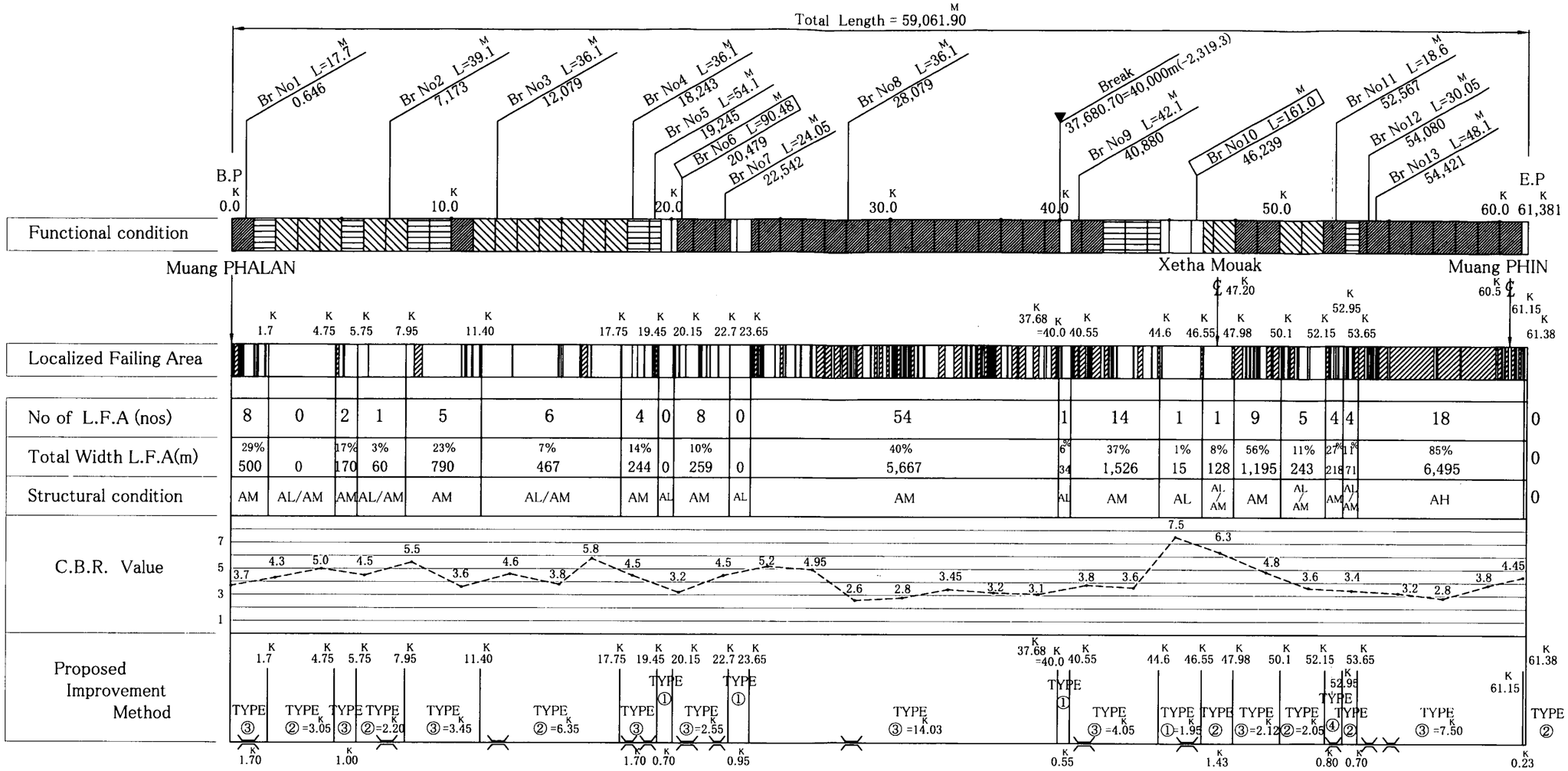
$SN_{OL} = 3.05 - 1.14$
$= 1.91$

Proposed Structure; (TYPE – 2)

Asphalt Concrete = 5 cm (1.97 inches)
Bituminous Treated Base = 5 cm (1.97 inches) Minimum
Granular Base (CBR 80) = 15 cm (5.91 inches) Minimum

SN_{OL} = 0.39 x 1.97 + 0.30 x 1.97 + 0.135 x 5.91
= 0.77 + 0.59 + 0.80
= 2.16 > 1.91

Figure 2.3.3-3 shows the structural and functional condition of existing pavement, localized failure section, CBR value of existing pavement and proposed improvement measures.



Functional condition

Legend (Riding Quality)

- : Very Good
- : Good
- : Fair
- : Bad
- : Very Bad

Structural condition

(Severity of Alligator Cracking)

AL : Low Severity (class 1 cracking)

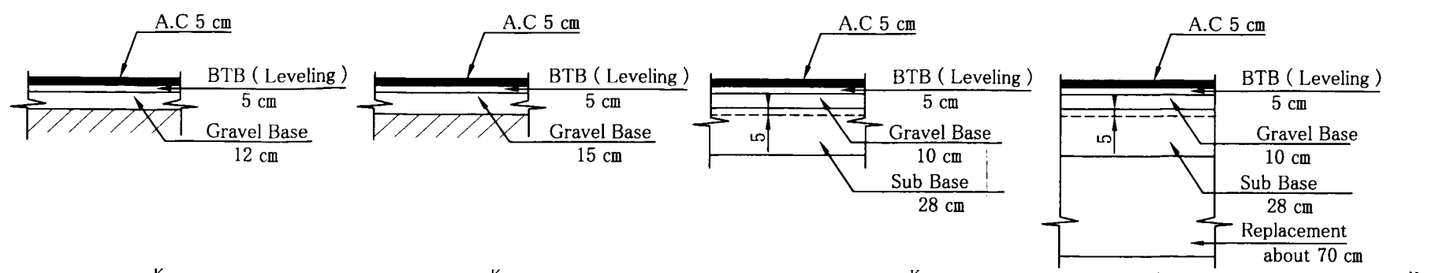
AM : Medium Severity (class 2 cracking)

AH : High (class 3 cracking)

Localized Failing Area (L.F.A)

- : 10 m ~ 100 m
- : 100 m ~ 2,000 m

Proposed Improvement Method



Overley 1 = 4.10 K

(On fair existing pavement)

TYPE - 1

Overley 2 = 15.78 K

(On bad existing pavement)

TYPE - 2

Reconstraction (R.C) = 36.13 K

TYPE - 3

Reconstraction with Replacement(R.R)=3.05 K

(For badly saturated Weak Sub Grade of Localized Failing Area)

TYPE - 4

Figure 2.3.3-3 EXISTING PAVEMENT CONDITIONS AND PROPOSED IMPROVEMENT METHODS

(5) Replacement of Sub-grade (Type-4)

There are 145 locations of localized failure pavement with a total length of 18.0km in the study section. For the various sections totaling 2.8km in length which are of particularly bad conditions, the replacement of sub-grade was recommended. This measure was utilized for the areas of paddy field & irrigation pond, sag portion of vertical alignment, the point of rutting & hollow and the section of swelled embankment.

The sections scheduled for replacement of sub-grade are listed in Table 2.3.3-6.

Table 2.3.3-6 Section of Replacement of Sub-grade (Type-4)

No.	CHAINAGE (Km)	Length (m)	No.	CHAINAGE (Km)	Length (m)
1	10+450 ~ 10+600	150	14	43+000 ~ 43+125	125
2	10+930 ~ 10+990	60	15	43+500 ~ 43+625	125
3	15+750 ~ 15+900	150	16	44+550 ~ 44+620	70
4	24+750 ~ 24+800	50	17	48+010 ~ 48+120	110
5	25+010 ~ 25+150	140	18	48+600 ~ 48+650	50
6	25+650 ~ 25+720	70	19	48+970 ~ 49+000	30
7	26+650 ~ 26+800	150	20	51+450 ~ 51+500	50
8	27+375 ~ 27+525	150	21	51+600 ~ 51+630	30
9	32+300 ~ 32+425	125	22	52+150 ~ 52+567	417
10	34+750 ~ 34+900	150	23	52+586 ~ 52+950	364
11	35+650 ~ 35+700	50	24	55+480 ~ 55+520	40
12	36+950 ~ 36+980	30	25	59+400 ~ 59+450	50
13	40+100 ~ 40+150	50	26	59+750 ~ 59+810	60
				Total	2,846

The remaining section 15.2km which is damaged only on the surface course was evaluated that the reconstruction method (Type-3) is suitable.

(6) Unsuitable Material under Road Shoulder

It was informed that unsuitable material was utilized under road shoulder during the construction of existing road. These material shall be removed and replaced with selected material.

Unsuitable material may not be present or defects were not observed at sections of overlay (Type–1 / Type–2), the removal is not required. It is not required at sections of replacement of sub-grade (Type-4)

because the material under the shoulder will be removed together with sub-grade. Therefore only at section of reconstruction (Type–3) where it is required to specify the replacement as shown in Figure 2.3.3-4.

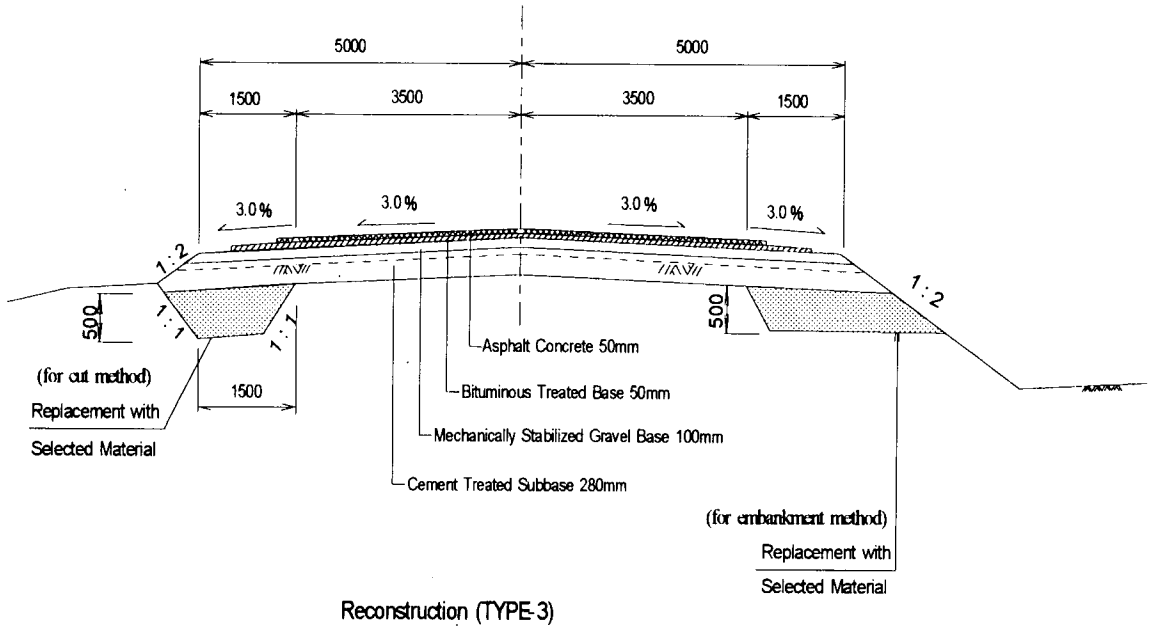


Figure 2.3.3 – 4 Replacement with Selected Material

Table 2.3.3-7 shows the section of replacement of unsuitable material.

Table 2.3.3-7 Section of Replacement of Unsuitable Material

No.	CHAINAGE (Km)	Length (m)	No.	CHAINAGE (Km)	Length (m)
1	0+050 ~ 0+596	546	19	28+165 ~ 32+300	4,135
2	0+714 ~ 1+700	986	20	32+425 ~ 34+750	2,325
3	4+750 ~ 5+750	1,000	21	34+900 ~ 35+650	750
4	7+950 ~ 10+450	2,500	22	35+700 ~ 36+950	1,250
5	10+600 ~ 10+930	330	23	36+980 ~ 37+681	701
6	10+990 ~ 11+400	410	24	40+550 ~ 40+830	280
7	17+750 ~ 18+193	443	25	40+972 ~ 43+000	2,028
8	18+329 ~ 19+195	866	26	43+125 ~ 43+500	375
9	19+349 ~ 19+450	101	27	43+625 ~ 44+550	925
10	20+150 ~ 20+429	279	28	48+120 ~ 48+600	480
11	20+620 ~ 22+402	1,782	29	48+650 ~ 48+970	320
12	22+526 ~ 22+700	174	30	49+000 ~ 50+100	1,100
13	23+650 ~ 24+750	1,100	31	53+560 ~ 54+030	470
14	24+800 ~ 25+010	210	32	54+160 ~ 54+371	211
15	25+150 ~ 25+650	500	33	54+519 ~ 55+480	961
16	25+720 ~ 26+650	930	34	55+520 ~ 59+400	3,880
17	26+800 ~ 27+375	575	35	59+450 ~ 59+750	300
18	27+525 ~ 28+029	504	36	59+810 ~ 61+150	1,340
				Total	35,067

2.3.3.3 Bridge Design

In accordance with the basic design concept and criteria, improvement measures of bridges were carefully examined with emphasis on the improvement of running ability rather than structural reinforcement or reconstruction. The major repair works designed for this study are as follow:

- Abrasion of Deck slab shall be covered with asphalt concrete (t = 5cm) for improvement of running ability.
- Expansion joint shall be covered by overlay.
- Inadequate deck drainage shall be reformed to provide suitable cross fall by means of overlay for drainage of surface water.
- Damaged and corroding steel railing shall be repaired.
- Damaged scour protection and scoured sub-structure shall be repaired with gabion.
- Sidewalk with RC guide posts at bridge approaches shall be provided.

However, overlay is not suitable for bridge No.6 and No.10 as mentioned in previous paragraph 1.3.1.3, so improving its running abilities were not planned. In stead of overlay, running speed is controlled by newly installed road humps at approach of these bridges to minimize the effect caused by the roughness of deck slab.

The existing condition of each bridge and corresponding improvement measures are summarized in Appendix 7. Existing Condition of Bridges and Improvement Method.

2.3.3.4 Muang Phin Intersection Design

There is an intersection on the study section with National Road No.1G at Muang Phin (KM61+006) near end point of study section, which is a T-type un-channelized junction.

Improvement of the intersection was planned by widening of corner cut and road marking for channeling. The drawing of the intersection is shown in Figure 2.3.3-5.

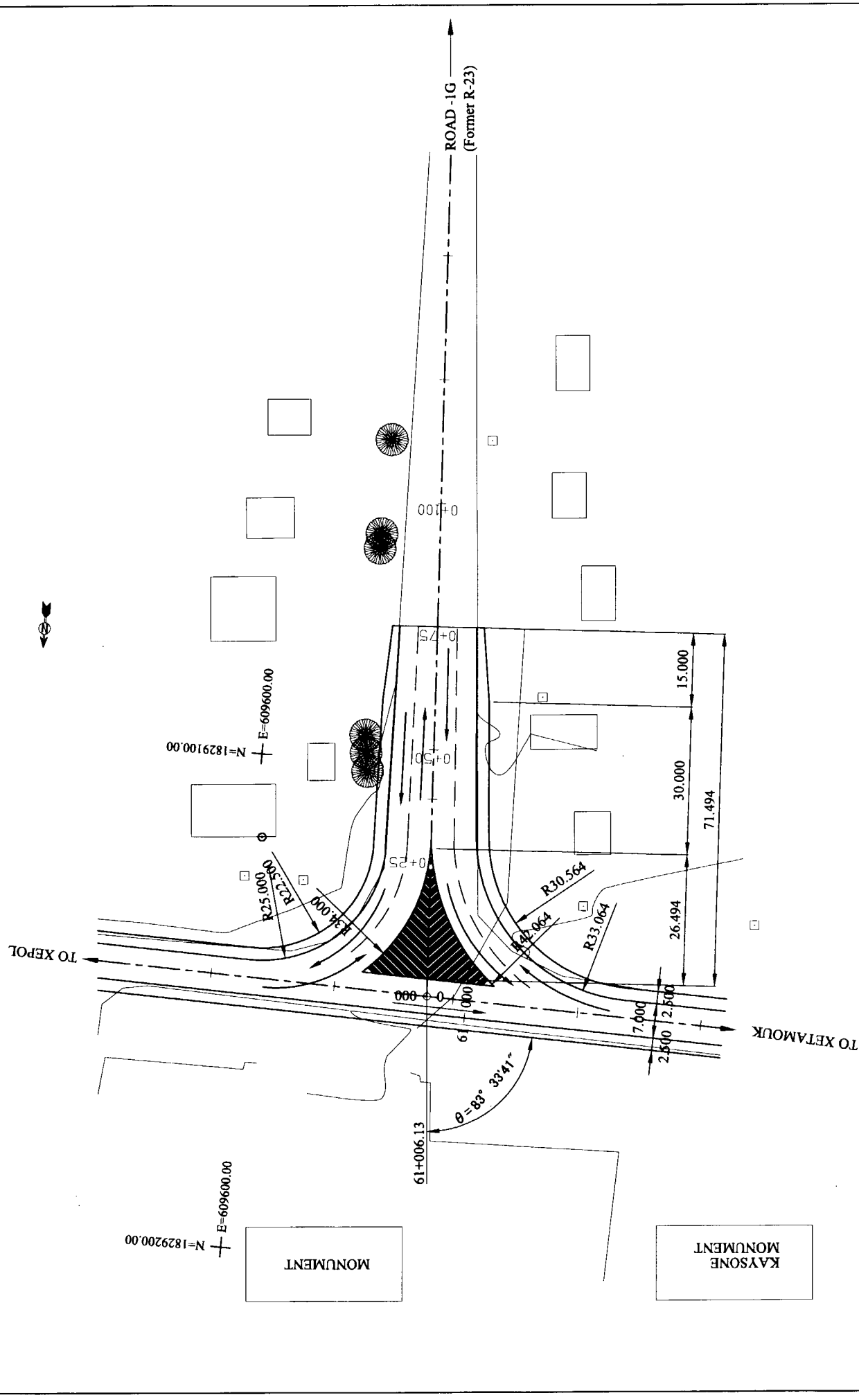


Figure 2.3.3-5 T-Type Intersection for Muang Phin

CHAPTER 3

IMPLEMENTATION PLAN

CHAPTER 3 IMPLEMENTATION PLAN

3.1 Implementation Plan

3.1.1 Implementation Concept

The following are the basic conditions for implementing this project.

- This project, if approved, will be implemented in accordance with the provisions of Japan's Grant Aid Program after the signing of the Exchange of Notes between the Governments of Japan and Lao PDR.
- For this project, MCTPC is the responsible agency and DOR is the implementing agency.
- The detailed design, tenders and construction supervision of this project will be undertaken by a Japanese consulting firm in accordance with a contract between the MCTPC and the consultant.
- The construction of this project will be undertaken by the successful Japanese tender to be awarded the contract by the MCTPC.

The following are the main concepts in the implementation plan:

- The road will be constructed by a Japanese contractor under its direct management, employing labors and leasing available equipment from local sub contractors.
- Materials and equipment necessary for the Project will be procured in Lao PDR as far as available. Items unavailable locally will be procured from Japan or third countries. Third countries will be selected based on conditions, i.e. cost, quality, required delivery time, etc...
- The construction method and progress schedule of the Project will be planned reflecting local conditions of climate, rainy season, topography, geology, transportation and others.
- Easy and low cost method of construction will be utilized for the Project as much as possible.
- Organizations for the construction and the supervision of the Project will be standardized and clearly regulated.

- Traffic and safety controls during construction will be planned to maintain passage for existing traffic;
  - Both traffic lanes will be opened during the improvement work as much as possible.
  - Flagmen and facilities for traffic control shall be arranged.
  - The existing road and bridges shall be opened for traffic during construction. Traffic control and safety control shall be considered carefully.
- Quarry, borrow pit and disposal area shall be selected based on the rationality.
- The measures to cope with UXO contamination shall be taken adequately.

3.1.2 Implementation Conditions

The following are the basic conditions for implementing the project:

(1) UXO (Unexploded Ordnance) Contamination

In Lao PDR, many shells had been shot and many land mines had been laid during the war, and some of these still remain as UXO above or below the ground. In fact several UXO were found during the investigation work for this study.

During the implementation of the project, it is necessary that the UXO search at each stage of the work which is the responsibility of the contractor in preventing accidents, contractor should build a close coordination with DOR and Lao army for the proper execution in the removal and disposal work which is the responsibility of Lao side. Moreover, it's also necessary to educate the labor force regarding the existence of UXO, its danger and how react when found.

(2) Crushed Stone (Aggregate)

Material investigation was carried out for the proposed quarries at 6 locations including the quarry which is utilized in the construct of the First Section. As a result of the investigations and laboratory tests on collected samples, materials at 3 locations out of 6 do not satisfy the required value for the Los Angeles Abrasion Test, and the material at

1 location, which is gneiss, has the tendency of flat cracking. Hence, materials at above 4 locations were deemed not suitable as aggregate of the asphalt concrete. Thus the only possible sites of quarries at the remaining 2 locations, i.e. Ban Nakapong where is utilized in the project for the First Section and Ban Saloy which is located about 4km away from end point of the Second Section to the Third Section side. (Refer Appendix 10. Geotechnical Survey)

There will be difficulty to excavate Ban Nakapong by both projects, because of overlapping of the duration of construction. Therefore it was recommended that crushed stone for this project would be purchased from the company who is currently operating a crushing plant at Ban Nakapong.

Ban Saloy located beside the Third Section is proposed quarry for the project of the Third Section. Possible areas for the excavation is spread over both banks of the H. Alang River, and the operation by both projects is possible. This location was studied to produce crushed stone with own plant of this project.

Result of the general comparative study, Ban Nakapong has the advantage in respect of hauling distance and the cost of crushed stone. Therefore, the production of crushed stone at Ban Saloy for use by this project was not recommended and it was planned to be purchased.

However, the permit to excavate, issued for Ban Nakapong, is not enough for the required volume for the construction of the Second Section, so it is necessary to apply for the additional expansion of quarry. Regarding this matter, it was agreed that Lao side shall get the permission for additional 9 ha at Ban Nakapong before the signing of the Exchange of Notes of this project.

3.1.3 Scope of Works

The undertakings of both Governments, Japan and Lao PDR are listed in Table 3.1.3-1.

Table 3.1.3-1 Undertaking of Both Governments

	Item	Contents	Undertaken by		Remarks
			Japan	Lao PDR	
Road Improvement	Procurement of materials and equipment	Procurement	○		
		Customs clearance		○	
	UXO (Unexploded Ordnance) contamination	UXO Search	○		
		Removal of the UXO, if required		○	
	Temporary work	Acquisition of lots		○	Lots for field office, stock yard and work shop
		Other works than the above	○		
	Acquisition of right-of-way, quarry site, etc.	Acquisition of ROW, etc.		○	
		Removal of existing properties		○	Fences, houses, etc.
		Permission of quarry		○	Additional 9 ha
		Clearing and grubbing	○		Trees, etc.
	Restoration of closed quarry	Landscaping	○		
		Replanting tree		○	
	Main work	Land for disposal of waste materials arising from existing facilities		○	
		Other works than the above	○		

The lots for field office, storage yard and workshop to be prepared by the Government of Lao PDR are estimated at 3.0 ha. These shall be located near the Project area.

3.1.4 Consultant Supervision

A Japanese consultant will supervise the implementation of the Project on behalf of the Government of Lao PDR. The consultant will carry out the detailed design, assist in tendering and execute the construction supervision, in accordance with the contract concluded between the Government of Lao PDR and consultant.

Detailed Design

Major works in the detailed design to be carried out by the consultant are as follows:

- Site Survey for detailed design
- Detailed Design of the Road and related facilities
- Preparation of Drawing and Specifications
- Preparation of Construction Schedule and Cost Estimation
- Preparation of Tender Documents

The necessary time for the detailed design is about 5.5 months.

Assistance in Tendering

The consultant will render the following services during the period from tender publication up to construction contract

- Tender publication
- Pre-qualification
- Tendering
- Tender evaluation
- Contract facilitation

The necessary time for assistance in tendering is about 3.0 months.

Construction Supervision

The consultant will carry out supervision of the construction work, which will be executed by the contractor. The main work items are as follows:

- Inspection and approval of site survey
- Inspection and approval of construction planning
- Quality control
- Progress control
- Measurement of work
- Inspection of safety aspects
- Final inspection and turnover

The construction period is about 30 months. To successfully carry out supervision, the consultant personnel are required to be stationed on the site during the entire construction period.

3.1.5 Procurement Plan

In principle, materials, equipment and labors necessary for the Project are planned to be procured locally as far as available. Items which are not available from local sources which require quality, quantity or cost are planned to be procured from Japan or third countries.

(1) Materials

Popular construction materials in Lao PDR are imported from Thailand and Vietnam. Materials for this project are planned to be procured locally, because imported materials are also available from local stores.

Table 3.1.5-1 shows the procurement plan for major materials.

Table 3.1.5-1 Material Procurement Plan

	Procured from			Remarks
	Lao P.D.R.	Japan	Third Country	
Material for Structure				
Crushed stone	○			
Base course material	○			
Cement	○			Imported
Sand for concrete	○			
Aggregate for concrete	○			
Aggregate for asphalt	○			
Sand for asphalt pavement	○			
Straight asphalt	○			Imported
Asphalt emulsion	○			Imported
Road marking paint	○			Imported
Reinforcing steel	○			Imported
Wire mesh	○			Imported
Precast concrete products	○			Local, Imported
Log pile	○			
Gabion	○			Imported
Rubble	○			
Traffic sign boards	○			Imported
Material for Temporary Structure				
Timber for forms	○			
Plywood for forms	○			Imported
Nails	○			Imported
Annealed wire	○			Imported
Timber for staging	○			Imported
Sand bags	○			Imported
Electric welding bars	○			Imported
Oxygen and acetylene	○			Imported
Safety facilities	○			Local, Imported
H-beams, sheet piles	○			Imported
Oil, fuel and fat	○			Imported

(2) Equipment

There is no leasing company for construction equipment in Lao PDR,

and locally available equipment that could be procured from local contractors is limited. Furthermore, local contractors have less experience on large scale construction and do not own large equipment. So local procurement is only for small equipment available in limited numbers. The unavailable number of small equipment and large equipment will be procured from Japan or the third countries. A base of procurement for construction equipment for Lao PDR is mostly from Thailand by inland transportation, and it is planned to be procured from Thailand in this study, which is not available locally. The procurement of Asphalt Plant and Soil Plant, which is difficult to procure in the third countries, are planned to be procured from Japan.

Procurement plan of the major equipment is shown in Table 3.1.5-2.

Table 3.1.5-2 Equipment Procurement Plan

	Procured from			Remarks
	Lao P.D.R.	Japan	Third Country	
Bulldozer			○	Thailand
Backhoe excavator	○		○	Thailand
Tractor shovel			○	Thailand
Dump truck	○		○	Thailand
Cargo truck	○		○	Thailand
Truck crane			○	Thailand
Wheel crane			○	Thailand
Soil plant		○		
Motor grader			○	Thailand
Macadam roller			○	Thailand
Tire roller			○	Thailand
Vibration roller			○	Thailand
Tamper	○		○	Thailand
Asphalt plant		○		
Asphalt finisher			○	Thailand
Line marker			○	Thailand
Water tank truck			○	Thailand
Submerged pump	○		○	Thailand
Generator			○	Thailand
Concrete mixer	○		○	Thailand
Welding machine			○	Thailand
Belt conveyer			○	Thailand
Pick-up truck(s)			○	Thailand

3.1.6 Soft Component

Due to the existing conditions of National Road No.9 it took 6 hours 20

minutes to travel between Savannakhet and Daensavan (Lao Bao) 240km in length, using a 4 wheel driving wagon during field investigation (average speed: 38kph). Running speed after completion of the project will be quite higher than present (design speed: 50kph~100kph), and MCTPC has to consider some counter measures for the prevention of traffic accidents by the enlightenment activities to inhabitants along the project road.

On the other hand, it is also important for Japanese Government to secure the appearance and continuation of positive effects by this project to develop the operation and maintenance system on the project road.

Therefore the introduction of "Soft Component" is proposed to secure the early appearance and continuation of effects by this project under Japan's Grant Aid. Soft Component provides the technical assistance to MCTPC, the implementing agency, on the traffic safety measures.

Major activities under the Soft Component are as follows:

- Operation of seminars : It is held twice at the timing of completion of neighbor section around 2002 and 2003.
- Distribution of pamphlets : Pamphlets for the enlightenment of traffic safety are prepared in Lao language for 4 kinds of users deiver, rider, pedestrian and children .
  Prepared pamphlets, total 10,000 sheets, are distributed at seminars.

Seminars will be planned to pass on to attendees the importance of consciousness and knowledge of traffic safety with visual presentation of examples of traffic accidents.

Major items of seminars are as follow:

Traffic Safety: Prohibition of overloading, observance of regulated number of passengers, prohibition of irregular parking, manner of drivers, manner of pedestrians, presentation of examples of accidents, information of traffic regulations, prohibition of unlicensed driving, etc.

Traffic Moral: Crossing at Zebra Zone, observance of traffic signal, observance of traffic sign, observance of traffic lane, retention of safe interval, prohibition of road vending, etc.

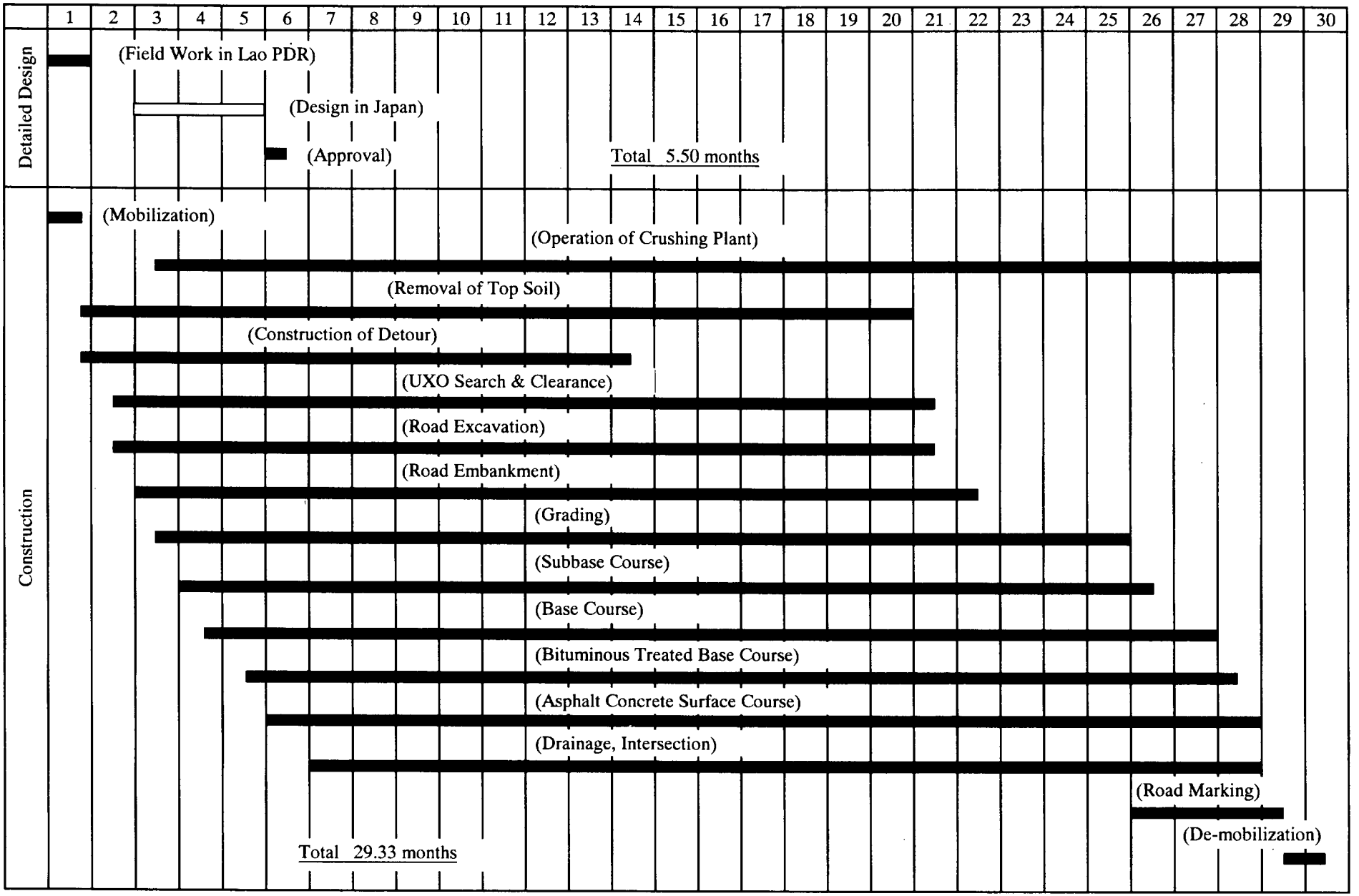
3.1.7 Implementation Schedule

For the planning of implementation schedule it is necessary to coordinate with the other component of "East-West Transport Corridor Project", in particular with the First Section "The Project for Improvement of the National Road Route 9".

Duration for the construction is estimated to be about 30 months taking into consideration UXO removal, quarry permission, right of way, quantities of construction, rainy season, procurement of material, detour control and economic cost.

Table 3.1.7-1 shows the proposed implementation schedule of this project.

Table 3.1.7-1 Implementation Schedule



3.1.8 Obligations of Lao PDR

The following necessary measures shall be taken by the Government of Lao PDR on condition that the Grant Aid by the Government of Japan is extended to the Project:

(1) To provide data and information necessary for the Project.

(2) To secure the land necessary for the execution for the Project, such as the Right of Way, land for Bridges, temporary offices, working areas, storage yards and others.

(3) To acquire the permission of quarry for required additional area.

(4) To clear the sites prior to the commencement of the construction including removal of the UXO (Unexploded Ordnance), if required.

(5) To remove and clear discovered UXOs during construction.

(6) To re-plant tree at closed quarry.

(7) To make passable all roads and bridges leading to the Project sites before the commencement of inland transportation of materials and equipment.

(8) To bear commissions to the Japanese foreign exchange bank for its banking services, based upon the Banking Arrangement, namely the advising commission of the "Authorization to Pay" and payment commission.

(9) To ensure prompt unloading, tax exemption, customs clearance at the port of disembarkation in Lao PDR and prompt internal transportation of the materials and equipment for the Project purchased under the Grant Aid.

(10) To exempt Japanese national from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the verified contracts.

(11) To accord Japanese Nationals whose services may be required in

connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into Lao PDR and stay therein for the performance of their work.

(12) To provide necessary permissions, licences and other authorizations for implementing the Project, if necessary.

(13) To maintain and use properly and effectively the facilities constructed under the Project.

(14) To coordinate and solve any issues related to the Project which may be raised from third parties or inhabitants in the project area during implementation of the Project.

(15) To bear all the expenses, other than those covered by the Japanese Grant Aid, necessary for the Project.

3.2 Project Cost Borne by the Government of Lao PDR

Project cost borne by Lao PDR is estimated at 578.82 million kip. (Refer to Appendix 5).

3.3 Operation and Maintenance Costs

Maintenance of the improved road will be managed by DOR. The pavement will become more durable in the project, and can reduce the time and cost for the maintenance. It means the budget of the maintenance work operated by state enterprises can be saved.

Routine maintenance of roads and related facilities shall be executed. Routine maintenance crews shall be set up and operated under the supervision of DOR. As significant defects are found on roads during routine maintenance, the Government should formulate special maintenance procedure, based upon detailed inspections.

The routine maintenance activities required for the project road are shown in Table 3.3-1.

Table 3.3-1 Routine Maintenance Activities

Inspection	Remarks
Pavement	- settlement, crack, depression, scale, fracture
Shoulder	- scouring, settlement, deformation
Cut slope, Embankment	- slope failure, erosion, etc.
Side ditch (gutter, lid)	- settlement, deformation, etc.
Drainage pipe	- choked, etc.
Drain pit	- sediment, etc.
Outlet	- deformation, etc.
Others	

The annual cost necessary for maintenance of the project section is estimated and presented in Table 3.3-2.

Table 3.3-2 MAINTENANCE PLAN FOR THE PROJECT ROAD

1. Routine Inspection (Total road length :60 Km)

Facility	Inspection Item	Interval	Number of Staff	Equipment/Material	Days	budget (Kip)
.Ditches	Existing of mud, sand, obstacles, etc.	12 times/year	2 persons	Measuring tape, scoop, hammer, bar	96 persons	11,000,000
.Culvert crossing road	Existing of mud, sand, obstacles, etc.	(4 days/round)				
.Pavement	Crack, deformation, potholes, etc.					
.Cut slope	Collapse, erosion, etc.					
.Embankment slope	Collapse, erosion, etc.			Pick-up truck	48 units	18,500,000
.Bridges	Surface of deck, abutment, pier, river condition					
.Road marking	Stain, discolor					
.Sign boards	Damage, deformation, stain, discolor					
					Sub-total	29,500,000

2. Clearing

Facility	Inspection Item	Interval	Number of Staff	Equipment/Material	Days	budget (Kip)
.Ditches	Removal of deposit of mud, sand, obstacle	4 times/year	5 persons	Scoop, bar	80 persons	9,200,000
.Culvert crossing road		(4 days/round)		brooms		
.Pavement				hand tool		
.Cut slope						
.Embankment slope				Pick-up truck	16 units	6,200,000
.Bridges						
.Road marking						
.Sign boards						
					Sub-total	15,400,000

3. Repair

Facility	Inspection Item	Interval	Number of Staff	Equipment/Material	Days	budget (Kip)
.Ditches	Repair of pothole	4 times/year	4 persons		336 persons	38,600,000
.Culvert crossing road	Removal of deposit of mud, sand, obstacle	(21 days/round)		Plate tamper	84 units	11,600,000
.Pavement				Pick-up truck	84 units	32,300,000
.Cut slope						
.Embankment slope				Base course	80 m3/year	18,500,000
.Bridges				Reseal	410 l/year	3,700,000
.Road marking						
.Sign boards						
					Sub-total	104,700,000
					Grand total :	149,600,000

CHAPTER 4

PROJECT EVALUATION AND RECOMMENDATION

CHAPTER 4 PROJECT EVALUATION AND RECOMMENDATION

4.1 Project Effect

Existing Condition of National Road No.9 has not carried out its function properly as a national road due to significant damages. The Government of Lao PDR regards Improvement Project of National Road No.9 as one of the top priority projects, as its First Section and Third Section are already being implemented. Improvement Project of Lao PDR for National Road No.9 will not be concluded without the completion of the Second Section, which is the study section of about 60 km in length connecting Muang Phalan and Muang Phin.

Savannakhet City leading the administration and economy of Savannakhet province is located at the edge of the middle-west of the province. For residents of the province, only National Road No.9, of the trans-province road, provides an access to Savannakhet City. The population of Savannakhet Province is estimated at 748,000 people as of 1999, and all of them will be the direct beneficiary of this project.

In addition, National Road No.9 functions as major trunk road in national road network and as an international road to Vietnam, so the ratio of in flow traffic from outer provinces and neighbor countries is quite high. In view of this situation, it regards the beneficial range of this project as spreading over the middle-south of Lao PDR.

Direct effects by the implementation of this project are as follows:

- Increase of transport volume

  Passenger and cargo transport will increase by the upgrading of capacity and stability of the project road.

	Passenger / day	Cargo / day
2000 (present)	539 vehicles	199 vehicles
2010 (forecast)*	1,908 vehicles	1,131 vehicles

*) Based on F/S report of East-West Transport Corridor Project

- Shortening of necessary travel time

  Necessary travel time between Muang Phalan and Muang Phin will be much shortened as the result of increase of running speed and upgrading of running ability.

	Necessary Travel Time	Ave. Speed
Present	136 minutes (4-WD wagon)	25 kph
After project	57 minutes (All type)	62 kph

- Saving of the budget for road maintenance

  The budget for road maintenance will be minimized due to its having a more durable pavement structure.

	Routine Maintenance	Periodic Maintenance
DBST (Existing)	$694 / km	$1,600 / km・year
AC (After project)*	50% down	25% down

*) Based on the past experience

- Removal of unpassable period

  At present, it is limited to some vehicle types during rainy season due to the occurrence of deep rutting and muddy surface. After the project, it will become in all weather road and be passable to any type of vehicles through the year.

	Unpassable Period	Unpassable Vehicle Type
Present	about 5 months	Passenger Car, Tuktuk
After project	None	None

Indirect effects by the implementation of this project are as follows:

- Saving of vehicle operating cost

  Vehicle operating cost will decrease by the upgrading of running ability (advance of fuel mileage, decrease of maintenance cost, extension of vehicle life and so on).

- Decrease of damage of loads and saving of packing cost

  Damage of loads will decrease by the upgrading of running ability, so packing cost will be saved due to the utilization of simple packing.

- Improvement of living convenience

  Convenience of local residents will be improved by upgrading of access to public facilities, expansion of public transportation and so on.

- Increase of investment

  Value of landuse will rise by upgrading of access, then domestic and foreign investment will increase, which also promotes development of the province.

- Activation of local economic

  It will contribute to the activation of local economic of the provinces by the increase of traffic, saving of transportation cost, regional development and so on.

In this way, this project will contribute to an advanced living standards for local residents and promote socio-economic activity in Savannakhet province and Lao PDR. Moreover it contribute to complete East-West Transport Corridor connecting the north-east of Thailand and Da Nang Port in Vietnam, so it is regarded as important in the development of the Indo-China Peninsula. Thus, it is concluded that the implementation of this project under Japan's Grant Aid is appropriate.

4.2 Recommendation

In additional to the above great effects, that will be expected, this project will widely contribute to advance Basic Human Needs. Thus it is judged that the importance for implementation of this project is large. The Government of Lao PDR shall perform following subjects to secure effects and its sustenance of this project.

- Operation of proper maintenance and its budgetary arrangement
- Acquirement of knowledge and technical skill for AC pavement
- Proper counter measures on traffic safety and its sustainable operation

Among also, it introduces Soft Component which provide technical assistance in this project for the traffic safety measures.

APPENDICES

APPENDIX 1

MEMBER LIST OF THE STUDY TEAM

Member List of the Study Team

1. Field Survey (June 24 to August 1, 2000)

Mr. Kazuo Nakagawa	Leader	Managing Director Office of Technical Coordination and Examination, Grant Aid Management Department, JICA
Mr. Yuichi Matsushita	Project Coordinator	Third Project Management Division, Grant Aid Management Department, JICA
Mr. Minoru Miura	Chief Consultant / Road Traffic Planner	Katahira & Engineers International
Mr. Hidetaka Sagara	Road Designer / Surveyor	Katahira & Engineers International
Mr. Yasuaki Muramoto	Bridge Designer	Katahira & Engineers International
Mr. Masao Aizawa	Natural Condition Surveyor (Soil Mechanics)	Katahira & Engineers International
Mr. Keiichi Murakami	Construction Planner/ Cost Estimator	Katahira & Engineers International

2. Explanation of Draft Report (October 17 to October 26, 2000)

Mr. Yoshikazu Yamada	Leader	Director Third Project Management Division, Grant Aid Management Department, JICA
Mr. Minoru Miura	Chief Consultant / Road Traffic Planner	Katahira & Engineers International
Mr. Hidetaka Sagara	Road Designer / Surveyor	Katahira & Engineers International
Mr. Keiichi Murakami	Construction Planner/ Cost Estimator	Katahira & Engineers International

APPENDIX 2

STUDY SCHEDULE

Study Schedule

1. Field Survey (June 24 to August 1, 2000)

No.	Date		Activities
1	June 24	Sat	Tokyo to Bangkok (Messrs. Miura, Sagara, Muramoto, Aizawa)
2	June 25	Sun	Bangkok to Vientiane (Above 4 people) Internal meeting
3	June 26	Mon	Courtesy call on CIC Courtesy call and meeting with JICA Lao office Courtesy call and discussion with MCTPC
4	June 27	Tue	Discussion with MCTPC
5	June 28	Wed	Vientiane to Savannakhet (Above 4 people)
6	June 29	Thu	Site Survey Tokyo to Bangkok (Mr. Murakami)
7	June 30	Fri	Site Survey Bangkok to Vientiane (Mr. Murakami)
8	July 1	Sat	Site Survey Vientiane to Savannakhet (Mr. Murakami)
9~12	July 2 ~ July 5		Site Survey
13	July 6	Thu	Site Survey Savannakhet to Vientiane (Messrs. Miura, Murakami)
14	July 7	Fri	Courtesy call on Embassy of Japan Discussion with MCTPC, Meeting with JICA Lao office Site Survey
15	July 8	Sat	Site Survey Vientiane to Savannakhet (Messrs. Miura, Murakami)
16~17	July 9 ~ July 10		Site Survey
18	July 11	Tue	Arrival at Savannakhet (Messrs. Nakagawa, Matsushita)
19	July 12	Wed	Courtesy call on Governor of Savannakhet Province Site Survey
20	July 13	Thu	Site Survey
21	July 14	Fri	Savannakhet to Vientiane (Messrs. Nakagawa, Matsushita, Miura, Murakami) Discussion with MCTPC Site Survey
22	July 15	Sat	Internal meeting Site Survey
23	July 16	Sun	Internal meeting Site Survey Savannakhet to Vientiane (Mr. Aizawa)
24	July 17	Mon	Signing of Minutes of Discussions Report to JICA Lao office Site Survey

No.	Date		Activities
25	July 18	Tue	Departure from Vientiane (Messrs. Nakagawa, Matsushita) Vientiane to Savannakhet (Messrs. Miura, Aizawa, Murakami) Site Survey
26~27	July 19 ~July 20		Site Survey
28	July 21	Fri	Site Survey Savannakhet to Vientiane (Mr. Aizawa)
29	July 22	Sat	Site Survey Data collection and analysis
30	July 23	Sun	Site Survey Data collection and analysis Savannakhet to Vientiane (Mr. Murakami)
31~32	July 24 ~July 25		Site Survey Data collection and analysis
33	July 26	Wed	Data collection and analysis Savannakhet to Vientiane (Messrs. Miura, Sagara, Muramoto)
34	July 27	Thu	Report to JICA Lao office Data analysis
35	July 28	Fri	Discussion with MCTPC Data analysis
36~37	July 29 ~July 30		Data analysis
38	July 31	Mon	Vientiane to Bangkok (Messrs. Miura, Sagara, Muramoto, Aizawa, Murakami)
39	Aug. 1	Tue	Bangkok to Tokyo (Above 5 people)

2. Explanation of Draft Report (October 17 to October 26, 2000)

No.	Date		Activities
1	Oct. 17	Tue	Tokyo to Bangkok (Messrs. Miura, Sagara, Murakami)
2	Oct. 18	Wed	Bangkok to Vientiane (Above 3 people) Courtesy call on CIC, Courtesy call on Embassy of Japan Courtesy call and meeting with JICA Lao office
3	Oct. 19	Thu	Explanation of draft report to MCTPC
4	Oct. 20	Fri	Discussion with MCTPC
5	Oct. 21	Sat	Internal meeting
6	Oct. 22	Sun	Hanoi to Vientiane (Mr. Yamada) Internal meeting
7	Oct. 23	Mon	Courtesy call on Embassy of Japan Discussion with MCTPC
8	Oct. 24	Tue	Signing of Minutes of Discussions Report to JICA Lao office
9	Oct. 25	Wed	Vientiane to Phnom Penh (Mr. Yamada) Vientiane to Bangkok (Messrs. Miura, Sagara, Murakami)
10	Oct. 26	Thu	Bangkok to Tokyo (Above 3 people)

APPENDIX 3

LIST OF PARTIES CONCERNED IN LAO PEOPLE'S DEMOCRATIC REPUBLIC

List of Parties Concerned in Lao PDR

Committee for Investment & Cooperation (CIC):

Mr. Latsamee Keomany	Deputy Director General

Ministry of Communication, Transport, Post and Construction (MCTPC):

Mr. Phao Bounaphon	Minister
Mr. Khamloud Sithvakone	Acting Minister

Department of Roads (DOR):

Mr. Sommad Pholsena	Director General
Mr. Viengsavath Siphandone	Acting Director General
Ms. Keoviengsanh Khamkaosy	Director, Disbursement Division
Mr. Chansy Nouanmaly	Director, International Relations Division
Mr. Chanh Bouphalivanh	Director, Road Administration Division
Ms. Chanthanom Souligno	International Relations Division
Ms. Phongeun Souvannavong	Project Monitoring Division
Mr. Vilaxay Phanphyla	Project Manager
Mr. Khattyasak Chayavong	Project Manager
Mr. Seumkhom Chanthavong	Project Manager

Department of Communication, Transport, Post and Construction, Savannakhet Province (DCTPC):

Mr. Xayarath Baphanith	Deputy Director

Provincial Government of Savannakhet:

Mr. Inepong Khaiyavong	Governor
Mr. Thong Tearn	Vice Governor
Mr. Bouakham Sisoulath	Deputy Director, Chief Cabinet Office
Dr. Kongchack Nokeo	Deputy Director, Chief Cabinet Office
Mr. Bounnhou Thammavong	Deputy Director, Planning Division

APPENDIX 4

MINUTES OF DISCUSSIONS

1. At Field Survey

MINUTES OF DISCUSSIONS ON THE BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF NATIONAL ROAD ROUTE 9 (PHASE 2) IN LAO PEOPLE'S DEMOCRATIC REPUBLIC

In response to a request from the Government of Lao people's Democratic Republic (hereinafter referred to as "Lao PDR"), the Government of Japan decided to conduct a Basic Design Study on the Project for Improvement of National Road Route 9 (Phase 2) (hereinafter referred to as " the Project") and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA dispatched to Lao PDR the Basic Design Study Team (hereinafter referred to as "the Team"), which is headed by Mr. Kazuo Nakagawa, Managing Director, Office of Technical Coordination and Examination, Grant Aid Management Department, JICA, and is scheduled to stay in the country from June 25 to July 31, 2000.

The Team held discussion with the officials concerned of the Government of Lao PDR and conduct a field survey at the study area.

In the course of discussions and field survey, both parties confirmed the main items described on the attached sheets. The Team will proceed with further works and prepare the Basic Design Report.

Vientiane, July 17, 2000

Kazuo Nakagawa
Leader
Basic Design Study Team
JICA

Sommad Pholsena
Director General
Department of Roads
Ministry of Communication, Transport, Post and Construction

ATTACHMENT

1. Objective

The Objective of the Project is to improve National Road Route 9 to cope with socio-economic demand of the country.

2.Project Site

The project site is shown in ANNEX-1.

3.Responsible and Implementing Agency

The responsible agency of the Project is Ministry of Communication, Transport, Post and Construction (MCTPC).

The Implementing Agency of the Project is Department of Roads, MCTPC.

The organization chart is shown in ANNEX-2.

4.Item requested by the Government of Lao PDR

In the discussion between the Team and the Government of Lao PDR, the following items were finally requested by the Government of Lao PDR. JICA will assess the appropriateness of the request and will recommend to the Government of Japan for approval.

Improvement of the deteriorated road condition on National Road Route 9 including 13 bridges, from Muang Phalan (CH72.913km) to Muang Phin (CH131.075km) (approximately 60km).

5.Japan's Grant Aid Scheme

(1) The Government of Lao PDR understands the Japan's Grant Aid Scheme explained by the Team, as described in ANNEX-3.

(2) The Government of Lao PDR will take necessary measures, as described in ANNEX-4, as a condition for the Japan's Grant Aid to be implemented for the Project.

6.Schedule of the Study

(1) The consultants will proceed with further studies in Lao PDR until July 31, 2000.

(2) JICA will prepare the draft report in English and dispatch a team in order to explain its contents around the middle of October, 2000.

(3) In case that the contents of the report are accepted in principle by the Government of Lao PDR, JICA will complete the final report and send it to the Government of Lao PDR by January, 2001.

7.UXO Removal Work

(1) The Lao side will remove all UXOs in accordance with the results of the UXO search (identification of the location including excavation) conducted by the consulting firm under the

contract with the Team.

(2) The report of the results of the search mentioned above (1) will be notified by the consulting firm to the Team, the Lao side, and JICA Lao office.

(3) The Lao side will report the progress of the removal work monthly and whenever UXO be removed, and submit the certification of all removal work upon its completion, to JICA Lao office.

(4) The Lao side will assign coordinators as liaison among MCTPC, consulting firm (Search teams) and Lao Army. The coordinator will accompany with the consulting firm on site.

(5) Compensation to local people caused by the need to removal structures, damage crops, etc. during the UXO search will be the responsibility of the Lao side. However, the consulting firm will seek approval from the Lao side before taking any action that may cause damage to crops, fences or other structures that may lead to compensation claims.

(6) The Lao side should be responsible for all necessary actions to avoid explosion accident after UXO identification conducted by the consulting firm.

8. Quarry Permission and Environmental Impact Assessment

Quarry areas shall meet the requirements of approvals under the National Forestry Law. JICA will provide necessary data and information to the Lao side at the time of explanation of Draft Basic Design Report around middle of October, 2000.

The Department of Roads, MCTPC shall prepare an environmental management plan clearly defining the works area, environmental constraints, rehabilitation requirements and any necessary compensation provisions based on the Draft Basic Design Report until the end of November, 2000 and shall get the permission of Quarry approved by the Ministry of Agriculture and Forestry before Exchange of Notes.

The condition of tree re-planting of Quarry shall be undertaken by the Lao side.

9.Other relevant issues

(1) The Lao side shall ensure enough budget and personnel to operate and maintain the facilities after the completion of the Project.

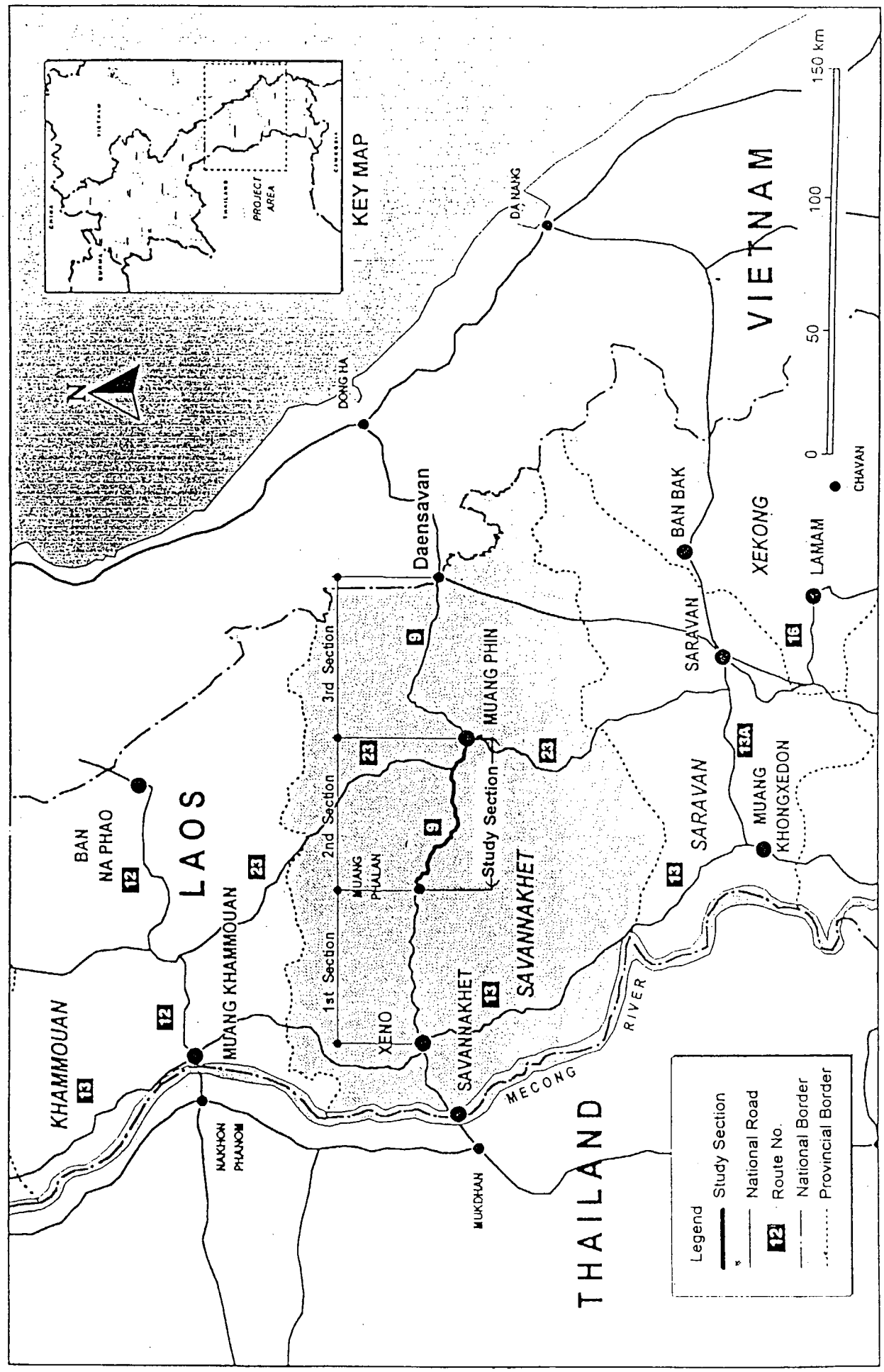
(2) The Lao side has agreed to provide necessary number of counterpart personnel to the Team during the period of their studies.

(3) The Lao side shall submit answers to the questionnaire which the Team handed to Lao side by July 28, 2000.

(4) MCTPC shall coordinate and solve any issues related to the Project which may be raised from third parties or inhabitants in the Project areas during implementation of the Project.

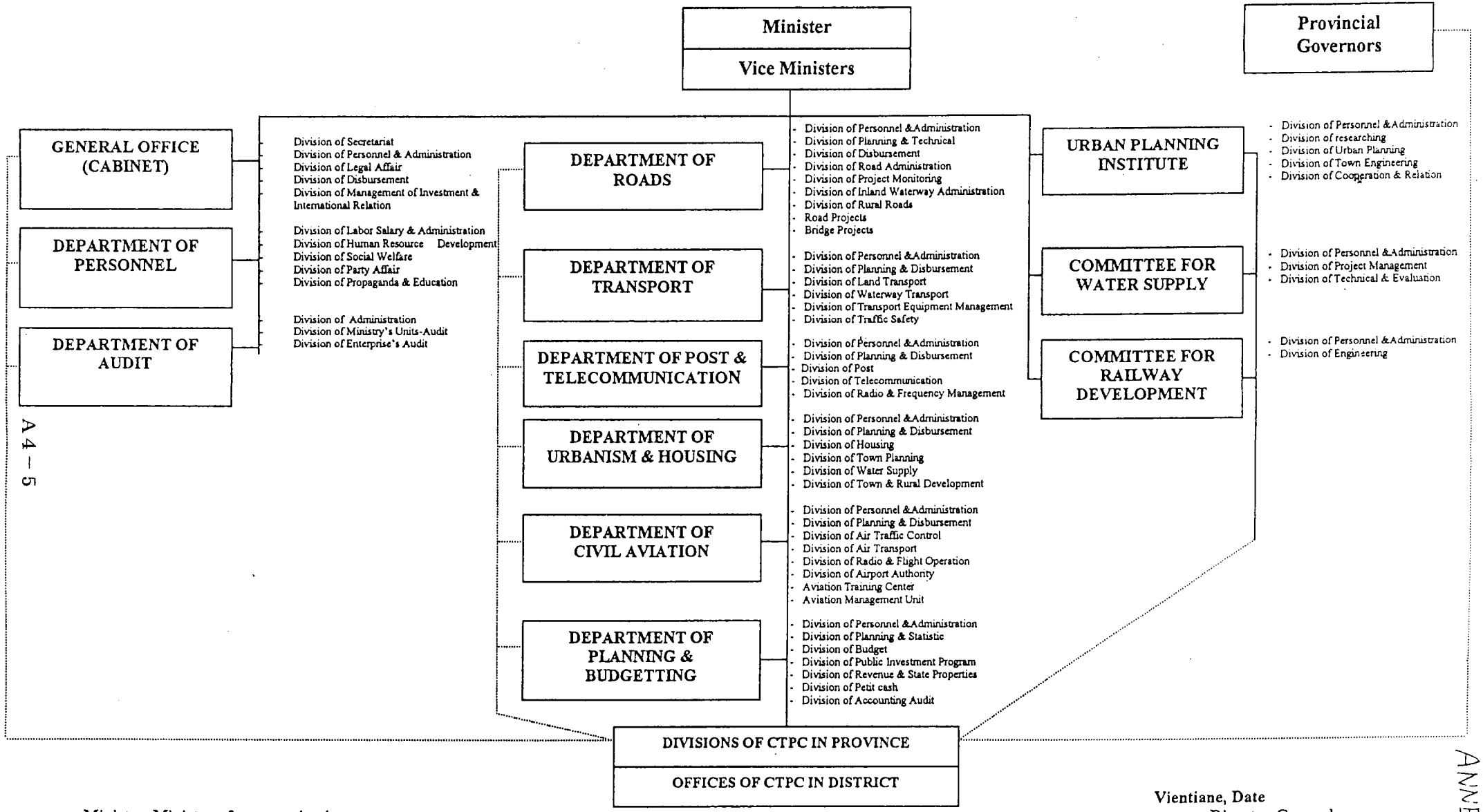
(5) The Lao side will take necessary measures to coordinate between the Government of Japan and the Asian Development Bank.

(6) The Lao side will take all possible measures to secure the safety of the concerned people during the study and implementation of the Project on condition that the Grant Aid by the Government of Japan is extended to the Project.



LOCATION MAP

ORGANISATION CHART OF MINISTRY OF COMMUNICATION TRANSPORT POST AND CONSTRUCTION



A 4 – 5

Minister, Ministry of communication,
Transport, Post and Construction

W. [illegible]

Vientiane, Date
Director General,
Department of Personnel

A. [illegible]

ANNEX – 2

Japan's Grant Aid Program

1. Japan's Grant Aid Procedures.

(1) The Japan's Grant Aid is executed by the following procedures.

- **Application** (request made by a recipient country)
- **Study** (Preparatory Study / Basic Design Study conducted by JICA)
- **Appraisal & Approval** (Appraisal by the Government of Japan and Approval by the Cabinet of Japan)
- **Determination of Implementation** (Exchange of Notes between the Governments of Japan and the recipient country)
- **Implementation** (Implementation of the Project)

(2) Firstly, the application or a request for a Project submitted by the recipient country is examined by the Government of Japan (the Ministry of Foreign Affairs) to determine whether or not it is suitable for Japan's Grant Aid. If the request is deemed appropriate, the Government of Japan entrusts a study on the request to JICA (Japan International Cooperation Agency).

Secondly, JICA conducts the study (Basic Design Study), using a Japanese consulting firm(s). If the background and objective of the requested project are not clear, a Preparatory Study is conducted prior to a Basic Design Study.

Thirdly, the Government of Japan appraises the project to see whether or not the Project is suitable for Japan's Grant Aid Program, based on the Basic Design Study report prepared by JICA and the results are then submitted for approval by the Cabinet.

Fourthly, the Project approved by the Cabinet becomes official when pledges by the Exchange of Notes (E/N) signed by the both Governments.

Finally, for the implementation of the Project, JICA assists the recipient country in preparing contracts and so on.

2. Basic Design Study

(1) Contents of the Study

The purpose of the Study (Preparatory Study / Basic Design Study) conducted on a project requested by JICA is to provide a basic document necessary for appraisal of the project by the Japanese Government. The contents of the Study are as follows:

(a) to confirm background, objectives, benefits of the project and also institutional capacity of agencies concerned of the recipient country necessary for project implementation;

(b) to evaluate appropriateness of the Project for the Grant Aid Scheme from a technical, social and economical point of view;

(c) to confirm items agreed on by both parties concerning the basic concept of the project;

(d) to prepare a basic design of the project.

(e) to estimate cost involved in the project.

The contents of the original request are not necessarily approved in their initial form as the contents of the Grant Aid project. The Basic Design of the project is confirmed considering the guidelines of Japan's Grant Aid Scheme.

The Government of Japan requests the Government of the recipient country to take whatever measures are necessary to ensure its self-reliance in the implementation of the project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country through the Minutes of Discussions.

(2) Selecting (a) Consulting Firm(s)

For smooth implementation of the Study, JICA uses (a) consulting firm(s) registered. JICA selects (a) firm(s) through proposals submitted by firms which are interested. The firm(s) selected carry(ies) out a Basic Design Study and write(s) a report, based upon terms of reference made by JICA.

The consulting firm(s) used for the study is(are) recommended by JICA to a recipient country after Exchange of Notes, in order to maintain technical consistency.

3. Japan's Grant Aid Scheme

(1) What is Grant Aid?

The Grant Aid provides a recipient country with non reimbursable funds needed to procure facilities, equipment and services for economic and social development of the country under the following principles in accordance with the relevant laws and regulations of Japan. The Grand Aid is not in a form of donation as such.

(2) Exchange of Notes (E/N)

The Japan's Grant Aid is extended in accordance with the Exchange of Notes by both Governments, in which the objectives of the Project, period of execution, conditions and amount of the Grand Aid, etc., are confirmed.

(3) "The period of the Grant Aid" means Japanese single fiscal year which the Cabinet approves the Project for. Within the fiscal year, all procedures such as Exchanging of Notes, concluding contracts with (a) consulting firm(s) and (a) contractor(s) and a final payment to them must be completed. However, in case of delays in delivery, installation or construction due to unforeseen factors such as weather, the period of the Grant Aid can be further extended for a maximum of single fiscal year at most by mutual agreement between the two Governments.

(4) Under the Grant, in principle, products and services of origins of Japan or the recipient country are to be purchased.

When the two Governments deem it necessary, the Grant may be used for the purchase of products or services of a third country origin.

However, the prime contractors, namely, consulting, construction and procurement firms, are limited to "Japanese nationals". (The term "Japanese nationals" means Japanese physical persons or Japanese juridical persons controlled by Japanese physical persons.)

(5) Necessity of the "Verification"

The Government of the recipient country or its designated authority will conclude into contracts in Japanese yen with Japanese nationals. Those contracts shall be verified by the Government of Japan. The "Verification" is deemed necessary to secure accountability to Japanese tax payers.

(6) Undertakings required to the Government of the recipient country

In the implementation of the Grant Aid, the recipient country is required to undertake necessary measures such as the following:

(a) to secure land necessary for the sites of the project and to clear and level the land prior to commencement of the construction work,

(b) to provide facilities for distribution of electricity, water supply and drainage and other incidental facilities in and around the sites,

(c) to secure buildings prior to the installation work in case the Project is providing equipment,

(d) to ensure all the expenses and prompt execution for unloading, customs clearance at the port of disembarkation and internal transportation of the products purchased under the Grant Aid,

(e) to exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the Verified Contracts,

(f) to accord Japanese nationals whose services may be required in connection with the supply of the products and services under the Verified Contract, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.

(7) Proper Use

The recipient country is required to maintain and use facilities constructed and equipment purchased under the Grant Aid properly and effectively and to assign staff necessary for their operation and maintenance as well as to bear all expenses other than those to be borne by the Grant Aid.

(8) Re-export

The products purchased under the Grant Aid should not be re-exported from the recipient country.

(9) Banking Arrangements (B/A)

(a) The Government of the recipient country or its designated authority shall open an account in the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). The Government of Japan will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by Government of the recipient country or its designated authority under the contracts verified.

(b) The payments will be made when payment requests are presented by the Bank to the Government of Japan under an Authorization to Pay (A/P) issued by the Government of the recipient country or its designated authority.

Major Undertakings to be taken by Each Government

NO	Items	To be covered by Grant Aid	To be covered by Recipient side
1	To secure land		●
2	To clear, level and reclaim the site when needed		●
3	To bear the following commissions to a bank of Japan for the banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
4	To ensure prompt unloading and customs clearance at the port of disembarkation in recipient country		
	1) Transportation of the products from Japan to the recipient country	●	
	2) Tax exemption and customs clearance of the products at the port of disembarkation		●
5	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●
6	To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the verified contract		●
7	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid		●
8	To bear all the expenses, other than those to be borne by the Grant Aid, necessary for construction of the facilities		●
9	To coordinate and solve any issues related to the Project which may be raised from third parties or inhabitants in the Project area during implementation of the Project.		●
10	To re-plant tree of Quarry		●

2. At Explanation of Draft Report

MINUTES OF DISCUSSIONS ON THE BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF NATIONAL ROAD ROUTE 9 (PHASE 2) IN LAO PEOPLE'S DEMOCRATIC REPUBLIC (EXPLANATION ON DRAFT REPORT)

In July 2000, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched a Basic Design Study Team on the Project for Improvement of National Road Route 9 (Phase 2) (hereinafter referred to as "the Project") to Lao People's Democratic Republic (hereinafter referred to as "Lao PDR"), and through discussion, field survey, and technical examination of the results in Japan, JICA prepared a draft report of the study.

In order to explain and to consult Lao PDR on the components of the draft report, JICA sent to Lao PDR the Draft Report Explanation Team (hereinafter referred to as "the Team"), which is headed by Mr. Yoshikazu Yamada, Director, Third Project Management Division, Grant Aid Management Department, JICA, from October 18 to October 25, 2000.

As a result of discussions, both parties confirmed the main items described on the attached sheets.

Vientiane, October 24, 2000

Y. Yamada

Yoshikazu Yamada
Leader,
Draft Report Explanation Team,
Japan International Cooperation Agency

Viengsavath Siphandone
Acting Director General,
Department of Roads,
Ministry of Communication, Transport, Post and Construction

ATTACHMENT

1. Components of the Draft Report

The Government of Lao agreed and accepted in principle the components of the draft report explained by the Team.

2. Japan's Grant Aid Scheme

The Lao side understands the Japan's Grant Aid Scheme and the necessary measures to be taken by the Government of Lao as explained by the Team and described in Annex-3 and Annex-4 of the Minutes of Discussions signed by both parties on July 17, 2000.

3. Schedule of the Study

JICA will complete the final report in accordance with the confirmed item and send it to the Government of Lao by January, 2001.

4. UXO Removal Work

(1) Both sides confirmed the UXO removal work to be taken by the Lao as described in "7.UXO Removal Work" of the Minutes of Discussions signed by both parties on July 17, 2000.

(2) The Lao side should submit the certification of all removal work at Basic Design Stage to JICA Lao office.

(3) The Lao side will remove all UXOs without delay when UXOs are found at construction stage.

5. Other Relevant Issues

(1) The Lao side shall ensure enough budget and personnel to operate and maintain the facilities after the completion of the Project.

(2) MCTPC shall coordinate and solve any issues related to the Project which may be raised from third parties or inhabitants in the Project area during implementation of the Project.

(3) The Lao side will take necessary measures to coordinate between the Government of Japan and the Asian Development Bank.

(4) The Lao side will take all possible measures to secure the safety of the concerned people during the implementation of the Project on condition that the Grant Aid by the Government of Japan is extended to the Project.

(5) Based on the request from the Lao side, the Team explained the plan of the consultant services for a safety measure for inhabitants as one of the components of the Grant Aid. The Lao side agreed to the plan in principle.

APPENDIX 5

COST ESTIMATION BORNE BY THE GOVERNMENT OF LAO PDR

Cost Estimation Borne by the Government of Lao PDR

1. Land Acquisition

It was informed by DOR that right of way for a national road is 70 m width which is 35 m each on both sides from centerline. The necessity of additional land acquisition is not required because this project was designed within present right of way of the whole stretch.

2. Compensation

For the implementation of this project, it is necessary to relocate some huts and cultivated land. It was estimated that the compensation for the relocation, based on the unit cost provided by DOR, and is shown below.

Huts

Chainage	Number	Area (m^2)
KM 0 + 100	4	128
KM 2 + 250	5	160
KM 10 + 800	11	132
KM 46 + 800	2	30
KM 47 + 400	5	212
KM 48 + 100	5	120
KM 50 + 400	1	28
KM 60 + 500	4	76
Total	**37**	**886 m^2**
	Unit Cost	Kip 10,000 /m^2
	Compensation	Kip 8,860,000

Cultivating Land

Chainage	Area (m^2)
KM 0 + 300	800
KM 18 + 100	200
KM 19 + 200	1,800
KM 33 + 900	300
KM 40 + 200	400
Total	**3,500 m^2**
Unit Cost	Kip 400 /m^2
Compensation	Kip 1,400,000

3. Removal & Clearance of UXO

In this study, UXO search was carried out only on 44.9 ha where it is planned construction of the detour. For the remaining 133.8 ha in construction area, the contractor shall carry out UXO search work during construction. However, it shall be the responsibility of the Government of Lao PDR to remove and to make harmless discovered UXO. It is estimated that the necessary cost for UXO clearance based on the unit cost provided by DOR as shown below.

133.8 ha x Kip 4,000,000/ha = Kip 535,200,000

4. Re-planting Trees at Closed Quarry

Operation of quarry is not planned in this project. However expansion of an existing quarry, about 9 ha, is required to excavate the necessary volume of crushed stone for this project. After closing the quarry, Japanese side shall carry out land restoration , while it shall be the responsibility of Lao side to replant trees. It is estimated the replanting cost based on the unit cost provided by DOR as shown below.

9 ha x Kip 3,862,000/ha = Kip 34,758,000

5. Total Cost Borne by the Government of Lao PDR

The cost borne by Lao side for the implementation of this project is total of the above and estimated at 580.2 million Kip.

APPENDIX 6

PAVEMENT CONDITION SURVEY

Pavement Condition Survey

Accurate condition survey which assesses a pavement's physical distress is vital to a successful improvement work. In order to evaluate the pavement condition of existing roads, the following surveys were conducted.

- Visual Survey
  - Functional condition (Present Serviceability Rating)
  - Structural condition (Structural adequacy and effective structural capacity)
  - Other relevant Condition (Shoulder, Drainage, Environment etc.)
- Material Testing
  - C.B.R Test (Strength of subgrade)

1. Functional Condition

The functional condition of existing pavement are visually assessed based on comfortability of road users and pavement functional deterioration such as roughness, potholes, and safety consideration. Based on the field survey, the conditions were classified into the following four (4) categories for each section of 1km.

- Good (G)
- Fair (F)
- Bad (B)
- Very Bad (VB)

2. Structural Condition

The structural condition of existing pavement involves the assessment of current condition based on distress including its type, amount and severity.

The following distresses were visually assessed.

- Fatigue or alligator cracking (AL,AM,AH)
- Localized Failing area (LFA)
  - Disintegrated underlying layer
  - Collapse of AC surface
  - Stripping of AC basecourse

Alligator cracking which is considered a major structural distress of AC pavement, were assessed and classified into the following level of severity for each sections of 1km.

- Low Severity (AL)
  Longitudinal disconnected hairline cracks running paralleled to each other. The cracks are not spalled. (class 1 cracking)
- Medium Severity (AM)
  Further development of low-severity alligator cracking into pattern of pieces formed by cracks that may be lightly surfaced spalled. (class 2 cracking)
- High Severity (AH)
  Medium alligator cracking has progressed so those pieces are more severely at the edges and loosened until the cell rock under traffic (class 3 cracking)

Each section of 1 km was assessed and rated at highest severity level of the Section.

The following road condition surveys were conducted to assess the existing condition of road and pavement.

- General Condition of Existing Road
  - Chainage
  - Alignment
  - Road width (Carriage way, Shoulder)
  - Pavement Type (Carriage way, Shoulder)
  - Road structure
  - Roadside environment
- Pavement Condition of Existing Road
  - Functional Condition
  - Structural Condition
  - Geotechnical Investigation

General conditions of existing road are reported in Table 6-1.

Table 6-1 General Condition of Existing Road

1	2			3		4	5	6	7	
Chainage (Km)	Align-ment	Road width		Pavement Type		Functional Condition	Structural Condition	Road Structure	Roadside Environ-ment	Remarks
		Carriage way (m)	Shoulder (m)	Carriage way	Shoulder					
0.0-1.0	F	7.7	2.5	D	G	B	AH(LFA)	B	P/R	Br.No1 0.6km
1.0-2.0	F	6.5	1.5	D	G	B/T	AH/AM	B	P	
2.0-3.0	F	7.5	1.5	D	G	F	AM	B	P/R	
3.0-4.0	F	7.0	1.0	D	G	F	AM	B/L	F	
4.0-5.0	F	7.0	1.2	D	G	F/B	AM/LFA	B/L	F	
5.0-6.0	F	7.1	1.5	D	G	B	AM/LFA	B/L	F	
6.0-7.0	F	7.2	1.0	D	G	F	AM	B/L	R/F	
7.0-8.0	R	7.0	1.0	D	G	F	AM	B/L	F	Br.No2 7.2km
8.0-9.0	F	7.0	1.0	D	G	B	AH(LFA)	B/L/C	F	
9.0-10.0	R	6.5	1.5	D	G	B	AH	L/C	F	
10.0-11.0	R	7.0	1.0	D	G	VB	AH(LFA)	L	P/R	
11.0-12.0	R	7.5	1.0	D	G	F	AM	L/B	P/R	
12.0-13.0	R	7.5	1.0	D	G	F	AM	B/L	F	Br.No3 12.1km
13.0-14.0	R	7.2	1.0	D	G	F	AM	B/L	F	
14.0-15.0	R	7.5	1.0	D	G	F	AM	L	P/F	
15.0-16.0	R	7.3	1.0	D	G	F	AM	B/L	F	
16.0-17.0	R	7.2	1.2	D	G	F	AM(LFA)	B/L	F/P	
17.0-18.0	R	7.4	1.1	D	G	B	AH	B/L/C	F	
18.0-19.0	F	7.0	1.3	D	G	B	AH(LFA)	B/L	R/P	Br.No4 18.2km
19.0-20.0	F	7.5	1.4	D	G	B/G	AH/AL	B	P/F	Br.No5 19.2km
20.0-21.0	F	7.2	1.1	D	G	B	AH(L.F.A)	B/L/C	P/F	Br.No6 20.5km
21.0-22.0	R	7.2	1.1	D	G	B	AH(L.F.A)	B/L/C	P/F	
22.0-23.0	F	7.1	1.2	D	G	B/G	AH/AL	B/L/C	F	Br.No7 22.5km
23.0-24.0	R	7.2	1.1	D	G	G/B	AH/AL	B/L/C	F	
24.0-25.0	R	6.9	1.2	D	G	B	AH(L.F.A)	L	F	
25.0-26.0	R	7.0	1.1	D	G	VB/B	AH(L.F.A)	B	F	
26.0-27.0	R	6.8	1.3	D	G	VB/B	AH(LFA)	B/L/C	F	
27.0-28.0	R	7.0	1.5	D	G	VB/B	AH(LFA)	B/L/C	F	
28.0-29.0	R	7.2	1.0	D	G	B	AH(LFA)	B/L/C	F/R	Br.No8 28.1km
29.0-30.0	R	7.0	1.0	D	G	B	AH(LFA)	B/L/C	F	
30.0-31.0	R	6.9	1.1	D	G	B	AH(LFA)	L/B	F/R	
31.0-32.0	R	6.8	1.0	D	G	B	AH(LFA)	B	F/R	
32.0-33.0	R	6.9	1.3	D	G	V.B/B	AH(LFA)	B/L/C	P/R	
33.0-34.0	R	6.8	1.2	D	G	B	AH(LFA)	L/B	P/F	
34.0-35.0	R	7.0	1.5	D	G	V.B/B	AH(LFA)	B/L/C	P/R	
35.0-36.0	R	6.9	1.4	D	G	V.B/B	AH(L.F.A)	L/C	F/P	
36.0-37.0	R	7.2	1.3	D	G	V.B/B	AH(L.F.A)	B/L/C	F/P	
37.0-37.7	F	6.9	1.2	D	G	B	AH(LFA)	B/L	F	
										Equation
40.0-41.0	R	7.2	1.1	D	G	G/B	AL/AH	B/L/C	R/P	Br.No9 40.9km
41.0-42.0	R	7.3	1.4	D	G	B	AH(LFA)	B/L/C	F/P	
42.0-43.0	R	7.2	1.1	D	G	B	AH(L.F.A)	B/L/C	F	
43.0-44.0	R	7.3	1.2	D	G	V.B/B	AH(LFA)	B/L/C	F/P	
44.0-45.0	R	7.1	1.1	D	G	V.B/B	AH/AL	B/L/C	F/P	
45.0-46.0	R	7.5	1.0	D	G	G	AL	B/L/C	R/P	
46.0-47.0	F	7.3	1.2	D	G	G/F	AL/AM	B/L	R/P	Br.No10 46.3km
47.0-48.0	F	7.5	1.3	D	G	F	AM	L	R	(Xetha Mouak)
48.0-49.0	F	7.0	1.5	D	G	V.B/B	AH(L.F.A)	B/L	R/W	
49.0-50.0	F	7.2	1.5	D	G	B	AH(L.F.A)	B/L	P/W	
50.0-51.0	F	7.5	1.5	D	G	F	AM	B/L/C	P/F	

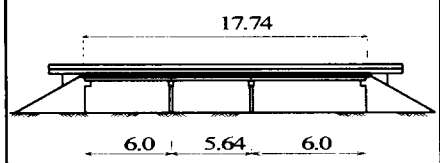
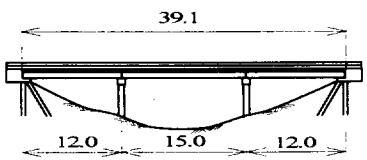
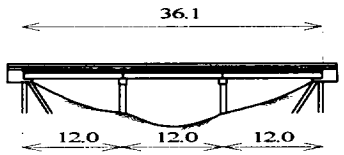
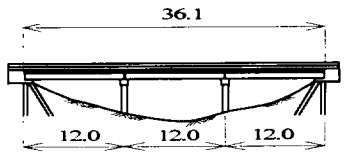
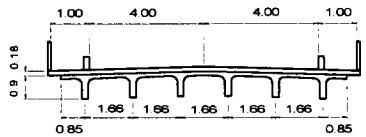
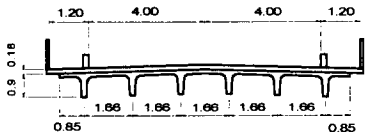
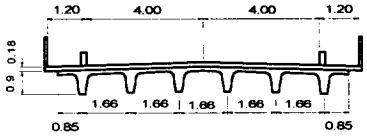
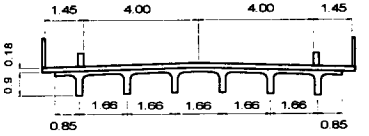
1	2			3		4	5	6	7	
Chainage (Km)	Align-ment	Road width		Pavement Type		Functional Condition	Structural Condition	Road Structure	Roadside Environ-ment	Remarks
		Carriage way (m)	Shoulder (m)	Carriage way	Shoulder					
51.0-52.0	F	7.2	1.2	D	G	V.B/B	AH/AM	B/L/C	P/R	
52.0-53.0	F	7.6	1.0	D	G	V.B	AH(L.F.A)	B/L	P/F	Br.No11 52.5km
53.0-54.0	F	7.5	1.2	D	G	F/B	AM/AH	B/L	P/P	
54.0-55.0	F	7.2	1.0	D	G	B	AH(L.F.A)	B	R/P	Br.No12 54.1km
55.0-56.0	F	7.5	1.0	D	G	B	AH(LFA)	B/L/C	R/F	Br.No13 54.4km
56.0-57.0	F	7.5	1.5	D	G	B	AH(LFA)	B/L/C	P/F	
57.0-58.0	F	6.6	1.0	D	G	B	AH(LFA)	B/L/C	P/F	
58.0-59.0	F	7.0	1.2	D	G	B	AH(LFA)	B/L/C	R/F	
59.0-60.0	F	7.2	1.4	D	G	V.B/B	AH(LFA)	B/L	R/P	
60.0-61.3	F	7.3	1.2	D	G	B/F	AH/AH	B/L	R	(Muang Phin)

1) Chainage
   Distance from the beginning point of the Project
2) Alignment
   F = Flat
   R = Rolling
   M = Mountainous
3) Pavement Type
   D = Double Bituminous Surface Treatment
   S = Single Bituminous Surface Treatment
   G = Gravel
4) Functional Condition
   G = Good
   F = Fair
   B = Bad
   VB = Very Bad
5) Structural Condition
   AL; Low-severity Alligator Cracking
   AM; Medium-severity Alligator Cracking
   AH; High-severity Alligator Cracking
   LFA; Localized Failing Area
6) Road Structure
   L; Level
   B; Embankment
   C; Cut
7) Roadside Environment
   R; Resident Area
   P; Rice Field
   F; Forest Area
   W; Wasteland

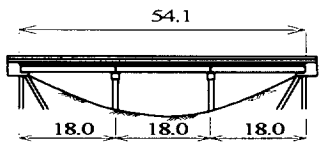
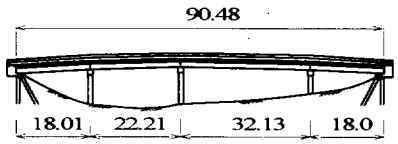
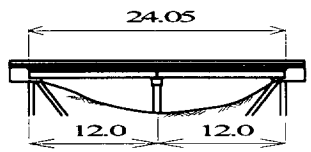
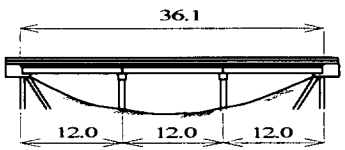
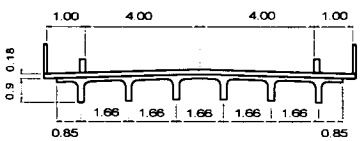
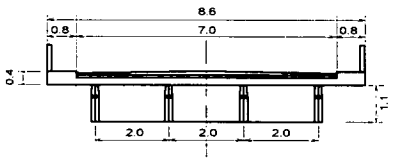
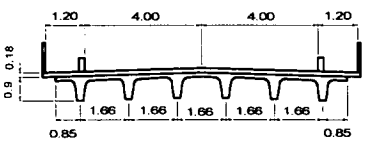
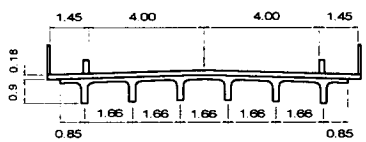
APPENDIX 7

EXISTING CONDITION OF BRIDGES AND IMPROVEMENT METHOD

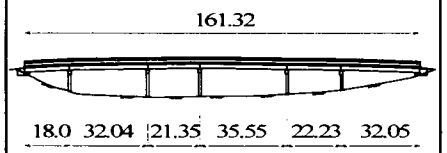
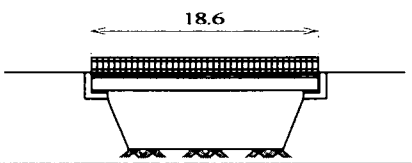
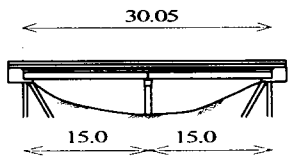
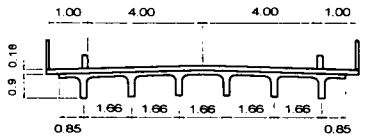
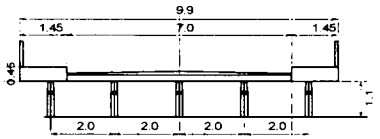
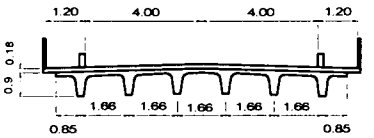
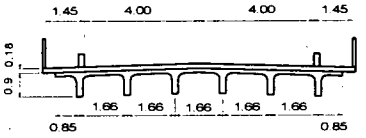
Existing Condition of Bridges and Improvement Method (1/4)

Name of Bridge		No.1 Bridge		No.2 Bridge		No.3 Bridge		No.4 Bridge	
		Existing	Improvement	Existing	Improvement	Existing	Improvement	Existing	Improvement
Side View									
Cross Section of bridge									
Type	Super Structure	R,C,Simple girder		R,C,Simple girder		R,C,Simple girder		R,C,Simple girder	
	Support	Plate type		Plate type		Plate type		Plate type	
	Expansion Joint	Butt joint		Butt joint		Butt joint		Butt joint	
	Abutment	Gravity Type		Abutment on pile bent		Abutment on pile bent		Abutment on pile bent	
	Pier	Wall type		Wall type		Wall type		Wall type	
Item of Space Investigation	Concrete Slab	Hairline cracks in all most all section	Overlay with asphalt concrete	Hairline cracks in all most all section	Overlay with asphalt concrete	Hairline cracks in all most all section	Overlay with asphalt concrete	Hairline cracks in all most all section	Overlay with asphalt concrete
	Girder	Fair	No repair	Fair	No repair	Fair	No repair	spalled concrete	No repair
	Expansion Joint	Fair	Overlay with AC	Rusted	Overlay with AC	Rusted	Overlay with AC	Rusted	Overlay with AC
	Drainage	Bad	Provision of drainage paths with AC overlay	Bad	Provision of drainage paths with AC overlay	Bad	Provision of drainage paths with AC overlay	Bad	Provision of drainage paths with AC overlay
	Railing	Rust and damage in members on both sides	Repair	Rust and damage in members on both sides	Repair	Rust and damage in members on both sides	Repair	Rust and damage in members on both sides	Repair
	Scouring of Abutment/pier	Scouring on Abut.	Repair	Scouring on Abut.	Repair	Scouring on Abut.	Repair	Scouring on Abut.	Repair
	Approach sidewalk	Insufficient width	Repair	Insufficient width	Repair	Insufficient width	Repair	Insufficient width	Repair
	Special Issue	-----	-----	-----	-----	-----	-----	-----	-----

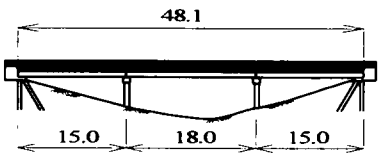
Existing Condition of Bridges and Improvement Method (2/4)

	Name of Bridge	No.5 Bridge		No.6 Bridge		No.7 Bridge		No.8 Bridge	
		Existing	Improvement	Existing	Improvement	Existing	Improvement	Existing	Improvement
	Side View								
	Cross Section of bridge								
Type	Super Structure	R,C,Simple girder		Steel Simple girder		R,C,Simple girder		R,C,Simple girder	
Type	Support	Plate type		Roller type		Plate type		Plate type	
Type	Expansion Joint	Butt joint		Butt joint		Butt joint		Butt joint	
Type	Abutment	Abutment on pile bent		Abutment on pile bent		Abutment on pile bent		Abutment on pile bent	
Type	Pier	Wall type		Wall type		Wall type		Wall type	
Item of Space Investigation	Concrete Slab	Hairline cracks in all most all section	Overlay with asphalt concrete	Hairline cracks in all most all section	No repair	Hairline cracks in all most all section	Overlay with asphalt concrete	Hairline cracks in all most all section	Overlay with asphalt concrete
Item of Space Investigation	Girder	Fair	No repair	much deflection	No repair	Fair	No repair	Spalled Concrete	No repair
Item of Space Investigation	Expansion Joint	Rusted	Overlay with AC	Fair	No repair	Rusted	Overlay with AC	Rusted	Overlay with AC
Item of Space Investigation	Drainage	Bad	Provision of drainage paths with AC overlay	Bad	No repair	Bad	Provision of drainage paths with AC overlay	Bad	Provision of drainage paths with AC overlay
Item of Space Investigation	Railing	Rust and damage in members on both sides	Repair	Rust and damage in members on both sides	Repair	Rust and damage in members on both sides	Repair	Rust and damage in members on both sides	Repair
Item of Space Investigation	Scouring of Abutment/pier	Scouring on Abut.	Repair	Scouring on Abut.	Repair	Scouring on Abut.	Repair	Scouring on Abut.	Repair
Item of Space Investigation	Approach sidewalk	Insufficient width	Repair	Insufficient width	Repair	Insufficient width	Repair	Insufficient width	Repair
Item of Space Investigation	Special Issue	-----	-----	-----	-----	-----	-----	-----	-----

Existing Condition of Bridges and Improvement Method (3/4)

	Name of Bridge	No.9 Bridge		No.10 Bridge		No.11 Bridge		No.12 Bridge	
		Existing	Improvement	Existing	Improvement	Existing	Improvement	Existing	Improvement
	Side View								
	Cross Section of bridge								
Type	Super Structure	R,C,Simple girder		Steel Simple girder		R,C,Simple girder		R,C,Simple girder	
	Support	Plate type		Roller type		Plate type		Plate type	
	Expansion Joint	Butt joint		Butt joint		Butt joint		Butt joint	
	Abutment	Abutment on pile bent		Abutment on pile bent		Abutment on pile bent		Abutment on pile bent	
	Pier	Wall type		Wall type		Wall type		Wall type	
Item of Space Investigation	Concrete Slab	Hairline cracks in all most all section	Overlay with asphalt concrete	Hairline cracks in all most all section	No repair	Hairline cracks in all most all section	Overlay with asphalt concrete	Hairline cracks in all most all section	Overlay with asphalt concrete
	Girder	Fair	No repair	much deflection	No repair	Fair	No repair	Fair	No repair
	Expansion Joint	Rusted	Overlay with AC	Fair	No repair	rusted	Overlay with AC	Fair	Overlay with AC
	Drainage	Bad	Provision of drainage paths with AC overlay	Bad	No repair	Bad	Provision of drainage paths with AC overlay	Bad	Provision of drainage paths with AC overlay
	Railing	Rust and damage in members on both sides	Repair	Rust and damage in members on both sides	Repair	Rust and damage in members on both sides	Repair	Rust and damage in members on both sides	Repair
	Scouring of Abutment/pier	Scouring on Abut.	Repair	Scouring on Abut.	Repair	Scouring on Abut.	Repair	Scouring on Abut.	Repair
	Approach sidewalk	Insufficient width	Repair	Insufficient width	Repair	Insufficient width	Repair	Insufficient width	Repair
	Special Issue	-----	-----	-----	-----	-----	-----	-----	-----

Existing Condition of Bridges and Improvement Method (4/4)

	Name of Bridge	No.13 Bridge							
		Existing	Improvement	Existing	Improvement	Existing	Improvement	Existing	Improvement
	Side View								
	Cross Section of bridge								
Type	Super Structure	R,C,Simple girder							
Type	Support	Plate type							
Type	Expansion Joint	Butt joint							
Type	Abutment	Abutment on pile bent							
Type	Pier	Wall type							
Item of Space Investigation	Concrete Slab	Hairline cracks in all most all section	Overlay with asphalt concrete						
Item of Space Investigation	Girder	Fair	No repair						
Item of Space Investigation	Expansion Joint	Rusted	Overlay with AC						
Item of Space Investigation	Drainage	Bad	Provision of drainage paths with AC overlay						
Item of Space Investigation	Railing	Rust and damage in members on both sides	Repair						
Item of Space Investigation	Scouring of Abutment/pier	Scouring on Abut.	Repair						
Item of Space Investigation	Approach sidewalk	Insufficient width	Repair						
Item of Space Investigation	Special Issue	-----	-----						

APPENDIX 8

DESIGN STANDARDS

Design Manual (Provisional Use), Communication Department, MCTPC

I	**Road Design Class**	**I**			**II**			**III**			**IV**			**V**			**VI**			**VII**		
II	**Traffic** (ADT)	> 8000			3000-8000			1000-3000			300-1000			100-300			50-100			< 50		
III	**Terrain**	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M
IV	**Design Speed (km/hr)**	100	80	60	100	80	60	80	60	40	80	60	40	60	40	20	60	40	20	40	30	20
V	**Total Formation Width**	32	32	20	21.5	21.5	11	12	12	8	9	9	7	7	7	6.5	6.5	6.5	6	6	6	5.5
1	Number of Lanes	4			2			2			2			2			1			1		
2	Lane Width (m)	3.75	3.75	3.5	3.75	3.75	3.5	3.5	3.5	3.0	3.0	3.0	3.0	2.75	2.75	2.5		3.5			3.5	
3	Carriageway (m)	15	15	14	7.5	7.5	7	7	7	6	6	6	6	5.5	5.5	5		3.5			3.5	
4	Median Width (m)	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	Island between motorized and non-motorized traffic	2 x 3	2 x 3	-	2 x 3	2 x 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	Paved shoulder (m)	2x0.5	2x0.5	2 x 2	2x0.5	2x0.5	2 x 2	2 x 2	2 x 2	2 x 1	2 x 1	2 x 1	2x0.5	2x0.75	2x0.75	2x0.5	-	-	-	-	-	-
7	Lane for slow traffic (m)	2 x 3	2 x 3	-	2 x 3	2 x 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	Unpaved shoulder (m)	2x0.5	2x0.5	-	2x0.5	2x0.5	-	2x0.5	2x0.5	-	-	-	-	-	-	-	2x1.5	2x1.5	2x1.25	2x1.25	2x1.25	2 x 1
VI	**Max. Gradient (%)**	5	6	7	5	6	7	6	7	8	6	7	8	7	8	9	7	8	9	8	9	10
VII	**Min. Horizontal Curve (m)**	400	250	130	400	250	130	250	130	60	250	130	60	130	60	20	130	60	20	60	30	20
VIII	**Min. Vertical Curves :**																					
1	Crest (km)	10	5	2.5	10	5	2.5	5	2.5	1	5.0	2.5	1	2.5	1	0.5	2.5	1	0.5	1	0.5	0.2
2	Sag (km)	3	2	1.5	3	2	1.5	2	1.5	0.6	2.0	1.5	0.6	1.5	0.6	0.2	1.5	0.6	0.2	0.6	0.4	0.2
IX	**Superelevation (m)**	3 - 10																				
X	**Crossfall :**																					
1	Paved (%)	2 - 3																				
2	Unpaved (%)	3 - 4																				
3	Paved Shoulder (%)	> 3																				
4	Unpaved Shoulder (%)	> 4																				
XI	**ROW Reserve (m)**	60						40						30						20		
XII	**Bridge Design Live Load**	HS - 25 - 44												HS - 20 - 44								
XIII	**Max. Axle Load (Ton)**	9.1																				

APPENDIX 9

TOPOGRAPHIC SURVEY

Topographic Survey

For the execution of a basic design on the study section with about 60 km in length (Muang Phalan~Muang Phin), following surveys were carried out in this study. And the results were reflected on drawings of this basic design.

1. Route Survey

Route survey was carried out along the centerline of existing road. Technical specification is as follows:

1) Centerline survey

The centerline of existing road was observed with maximum interval of 50 m. It established BC (beginning of curve), EC (end of curve) and IP (intersection point) on the curves and observed the horizontal alignment.

2) Longitudinal profile survey

Leveling survey was carried out along the centerline of existing road. It was observed with maximum interval 80 m and established temporary bench mark at every 500 m.

3) Cross section survey

Leveling survey was carried out at every 100 m for cross section along the normal line to the centerline. The distance to be covered is 20 m each on both sides of the centerline. Every inclination points were observed, and the location of houses, side ditches, fence, etc. were noted on the field book and reflected on drawings.

4) Drawings

Based on the result of route survey, it prepared drawings with scales as follows:

Plan 1/1000 with contour interval 1 m
Profile Vertical 1/100 Horizontal 1/1000
Cross Section 1/200

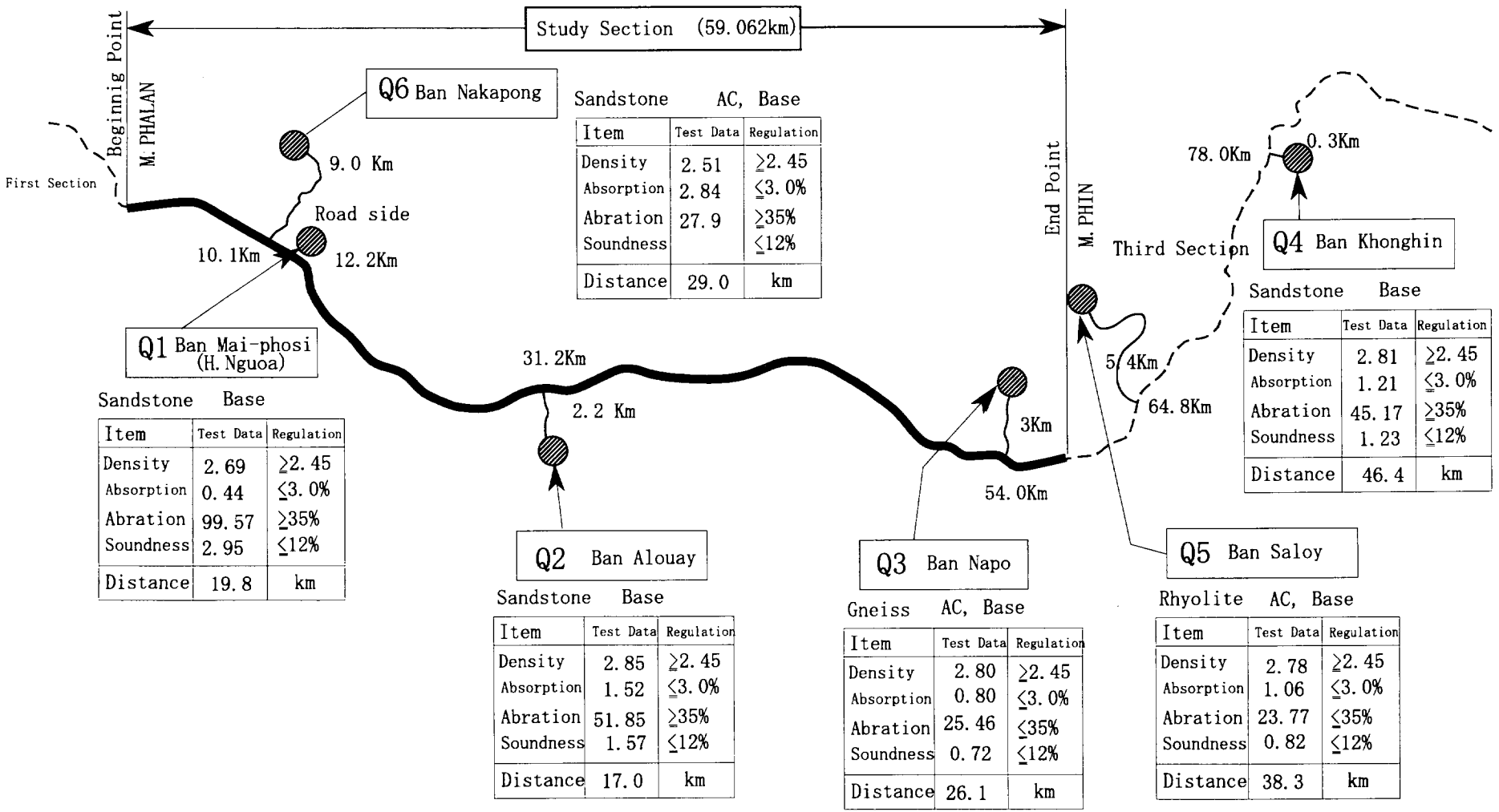
2. Plane Table Survey

Area around existing 13 bridges were observed by plane table survey with scale 1/200 and contour interval 1 m. The area to be covered was as follows:

Length : Bridge length plus 20 m each on both sides from edges of bridge
Width : 25 m each on both sides of the centerline

APPENDIX 10

GEOTECHNICAL SURVEY



Candidate Quarries and Test Data

Table 10-1 Test Data for Sub-grade

Sample No.	Chainage	Classification	Attergerg Limits (%)		Specific Gravity	Sieve Analysis (%)								CBR
			LL	PI		75	50	25	9.50	4.75	2.00	0.425	0.075	
1	0 + 025	Clayey Sand	42.00	24.05	2.72			100	94.73	88.34	83.87	81.63	40.34	3.7
2	2 + 032	Clayey Sand	41.00	23.99	2.72			100	84.29	72.89	67.13	63.00	38.74	4.3
3	4 + 136	Clayey Sand	41.00	24.21	2.72			100	86.90	66.80	50.23	45.19	34.62	5.0
4	6 + 095	Clayey Sand	40.00	23.92	2.72			100	96.02	83.59	69.48	65.21	49.39	4.5
5	8 + 246	Clayey Sand	38.00	20.04	2.69		100	97.41	86.53	63.86	51.95	46.12	32.11	5.5
6	10 + 536	Clayey Sand	41.00	23.68	2.70			100	89.69	78.16	69.52	67.12	38.64	3.6
7	12 + 736	Clayey Sand	26.50	17.13	2.67			100	84.82	68.46	51.51	44.51	19.38	4.6
8	14 + 966	Clay with gravel	40.05	24.10	2.70		100	98.79	94.45	80.42	63.52	60.27	50.57	3.8
9	16 + 450	Clayey Sand	42.00	24.40	2.71		100	96.96	87.43	75.60	61.15	52.41	40.37	5.8
10	18 + 300	Clayey Sand	23.00	15.26	2.68			100	93.26	89.89	85.73	81.69	38.31	4.5
11	20 + 405	Clayey Sand	41.00	24.14	2.71			100	93.23	77.57	68.10	59.35	37.70	3.2
12	22 + 440	Clayey Sand	41.00	24.10	2.71		100	98.98	94.25	72.12	52.96	45.27	39.20	4.5
13	24 + 470	Clayey Sand	42.00	23.86	2.72			100	88.64	63.04	50.64	47.84	29.92	5.2
14	26 + 505	Clayey Sand	41.00	23.94	2.72			100	95.00	80.46	70.50	67.12	42.58	4.9
15	28 + 470	Clayey Sand	40.00	23.71	2.71		100	97.72	94.06	83.70	74.87	71.59	41.05	2.6
16	30 + 620	Clayey Sand	39.50	22.88	2.70			100	95.87	79.97	66.04	61.87	33.92	2.8
17	32 + 686	Clayey Sand	30.50	18.47	2.68			100	91.19	75.24	64.94	61.13	32.26	3.4
18	34 + 740	Clayey Sand	41.00	23.50	2.71			100	94.61	77.56	60.84	55.96	41.83	3.2
19	36 + 770	Clayey Sand	43.50	24.86	2.72			100	93.72	82.33	71.13	65.86	44.62	3.1
20	41 + 305	Clayey Gravel	40.00	24.12	2.70		100	68.53	44.83	35.94	29.41	25.41	22.93	3.8
21	43 + 440	Clayey Sand	43.00	24.07	2.72		100	98.96	96.93	89.42	74.05	67.43	46.22	3.6
22	45 + 355	Clayey Gravel	41.00	23.66	2.71		100	96.56	66.04	53.19	41.80	33.15	25.15	7.5
23	47 + 380	Clayey Gravel	41.50	24.47	2.72		100	86.48	59.83	46.57	36.79	29.27	20.51	6.3
24	49 + 450	Clayey Gravel	40.50	24.27	2.71	100	93.07	76.55	59.61	50.61	42.97	36.64	29.49	4.8
25	51 + 380	Clayey Sand	41.00	24.28	2.71			100	92.35	71.96	63.81	55.08	46.54	3.6
26	53 + 360	Clayey Sand	41.00	23.95	2.71		100	98.48	85.27	72.13	56.60	44.99	36.14	3.4
27	55 + 475	Organic Sand	42.00	25.79	2.71			100	92.59	78.88	64.60	58.01	45.74	3.2
28	57 + 520	Clayey Sand	41.00	24.92	2.71			100	83.12	65.16	52.33	47.31	35.92	2.8
29	59 + 560	Clayey Sand	40.00	23.07	2.72			100	90.95	87.92	84.49	79.79	44.32	3.8
30	61 + 135	Clayey Sand	42.00	23.95	2.72		100	95.91	88.56	75.22	52.98	42.95	36.12	4.4

APPENDIX 11

TRAFFIC SURVEY

Traffic Survey

For satisfying the accuracy of a basic design, Traffic Survey was carried out to determine present traffic volume on the study section.

In accordance with the specification of this study, traffic count was carried out at 3 locations, which were Muang Phalan (Km 0 + 200), Xethamouk (Km 47 + 950) and Muang Phin (Km 60 + 300), on July 13 and 14, 2000. Observed vehicles were recorded on every 1 hour by direction and vehicle type in 12 hours on each days. Classification of vehicle is into 10 types as shown below.

Passenger Car (include wagon and jeep)
Pick-up Truck
Mini Bus (include tuktuk and pick-up utilized for bus)
Bus (include truck utilized for bus)
Medium Truck (2 axle)
Large Truck (More than 2 axle)
Trailer
Special Vehicle (Tractor, Construction equipment, etc.)
Motor Bike
Bicycle

The weather was rain on July 13 and cloudy/fine on July 14.
However, there was not much difference on traffic volume of each days and it satisfied the accuracy of this study.

The results of traffic count at 3 locations are shown in Table 11-1～3 respectively.

Table 11-1 Traffic Volume at Muang Phalan (Both direction, Ave. of 2 days)

No.	Vehicle Type	Traffic Volume / hour 6:00～18:00												Total
		6:00～7:00	7:00～8:00	8:00～9:00	9:00～10:00	10:00～11:00	11:00～12:00	12:00～13:00	13:00～14:00	14:00～15:00	15:00～16:00	16:00～17:00	17:00～18:00	
1	Passenger Car	0	0	0	0	0	0	0	0	0	0	1	0	1
2	Pick-up Truck	2	1	3	2	2	3	4	4	1	4	2	4	32
3	Mini Bus	3	3	6	8	4	2	4	2	4	6	3	2	47
4	Bus	0	1	0	2	0	1	2	2	0	1	1	0	10
5	Medium Truck	2	4	2	2	3	6	4	4	2	3	2	1	35
6	Large Truck	3	5	3	7	7	5	8	4	11	4	8	11	76
7	Trailer	4	4	1	4	2	7	4	4	4	7	6	8	55
8	Bicycle	36	60	30	39	41	19	18	13	20	9	15	19	319
9	Motor Bike	13	38	24	17	25	14	14	23	18	15	18	22	241
10	Special Vehicle	3	4	1	2	2	2	1	1	1	0	1	1	19
	Total	66	120	70	83	86	59	59	57	61	49	57	68	835

Table 11-2 Traffic Volume at Xethamouk (Both direction, Ave. of 2 days)

No.	Vehicle Type	Traffic Volume / hour 6:00～18:00												Total
		6:00～7:00	7:00～8:00	8:00～9:00	9:00～10:00	10:00～11:00	11:00～12:00	12:00～13:00	13:00～14:00	14:00～15:00	15:00～16:00	16:00～17:00	17:00～18:00	
1	Passenger Car	0	0	0	1	0	0	0	0	1	0	0	0	2
2	Pick-up Truck	2	1	1	1	1	9	3	2	3	2	2	5	32
3	Mini Bus	1	1	1	2	3	4	2	5	2	2	2	3	28
4	Bus	1	1	1	1	1	2	1	0	2	2	0	1	13
5	Medium Truck	1	0	2	2	2	2	1	0	4	3	5	5	27
6	Large Truck	3	4	2	0	1	4	2	1	1	3	6	5	32
7	Trailer	2	1	3	4	1	5	0	1	0	4	9	2	32
8	Bicycle	74	71	52	42	28	26	33	33	33	32	50	54	528
9	Motor Bike	18	33	19	23	18	19	23	18	20	26	25	22	264
10	Special Vehicle	1	4	1	3	1	1	1	1	0	0	3	6	22
	Total	103	116	82	79	56	72	66	61	66	74	102	103	980

Table 11-3 Traffic Volume at Muang Phin (Both direction, Ave. of 2 days)

No.	Vehicle Type	Traffic Volume / hour 6:00～18:00												Total
		6:00～7:00	7:00～8:00	8:00～9:00	9:00～10:00	10:00～11:00	11:00～12:00	12:00～13:00	13:00～14:00	14:00～15:00	15:00～16:00	16:00～17:00	17:00～18:00	
1	Passenger Car	0	0	1	0	0	0	0	0	1	0	0	0	2
2	Pick-up Truck	1	5	3	3	5	3	1	2	6	5	5	8	47
3	Mini Bus	1	1	2	2	3	6	2	6	4	1	4	0	32
4	Bus	0	1	1	2	1	1	1	1	0	3	2	1	14
5	Medium Truck	2	2	1	1	0	3	2	2	3	4	5	9	34
6	Large Truck	7	3	1	1	2	1	1	1	0	2	4	4	27
7	Trailer	2	1	4	3	3	1	3	1	1	9	2	6	36
8	Bicycle	44	49	41	23	21	21	20	21	17	16	32	30	335
9	Motor Bike	39	41	43	38	32	31	27	27	38	36	44	30	426
10	Special Vehicle	0	3	1	0	0	0	3	1	1	2	1	1	13
	Total	96	106	98	73	67	67	60	62	71	78	99	89	966

APPENDIX 12

UXO SEARCH

UXO Search

In order to ensure the safety precautions at project site, UXO search aims at finding out remaining UXO, which shall be removed by Lao side, before the construction of this project.

1. Stage 1

a) Desk Top Review

On the desk top review, study section (60 km) was divided into 40 sections and Readings of Fragment/Scrap on every 50 m^2 were analyzed. Readings of Fragment/Scrap on each sections were shown 2~39. The records of past and present were also investigated carefully. Based on the results, it was presumed that many UXO are lying at sections between KM 0 km~KM 10 km and KM 45 km~KM 60 km.

b) Safety Support and Search

The Safety Support was carried out to ensure the safety during the site survey by the team. During site survey, UXO search was carried out on topographic survey route and bridge site, by search equipment, and the areas where UXO were discovered was clearly indicated with red tape. For the excavation and piling deeper than 30 cm during survey and pitting, deep search was carried out. During safety support, a total of 15 unexploded bombs were discovered at 8 locations.

Safety Support was also carried out at 5 locations of proposed quarry and its access road for the investigation and sampling. Discovered was some fragments of bomb only.

c) Sampling

Sampling Search including determining degree of metallic content and conditions of vegetation was carried out to determine the degree of contamination of UXO on the project site, and the search was planned on Stage 2. Sampling area is approximately 2 % of project site and is 100 m^2, where length is 2 m and width is 25 m each on both sides of centerline, at every 100 m along road.

First, it cuts vegetation to use search equipment effectively, then shallow search is done by metallic detector. Secondly, deep search is done by magneto meter. During sampling search, total 68 unexploded bombs were discovered.

2. Stage 2

Based on the result of stage 1, the area and specification for search work on Stage 2 was determined.

Procedure

1) Detection : To remove obstacles on the ground and search for UXO by metallic detector and magnetometer.

2) Excavation & Confirmation : To excavate the point where reactions are observed on detection and confirm whether reaction is due to UXO or scrap. If it is UXO, it shall be indicated by red pile and red tape.

3) Clearance : To remove and dispose for being harmless (to be executed by Lao side)

Search area was 44.9 ha with 7.4 m~10.4 m in width around detours which will be constructed in the project. For the remaining area, UXO search shall be carried out during construction, and it is estimated at 133.8 ha.

Area of UXO search carried out in Stage 2 is shown in Figure 12-1.

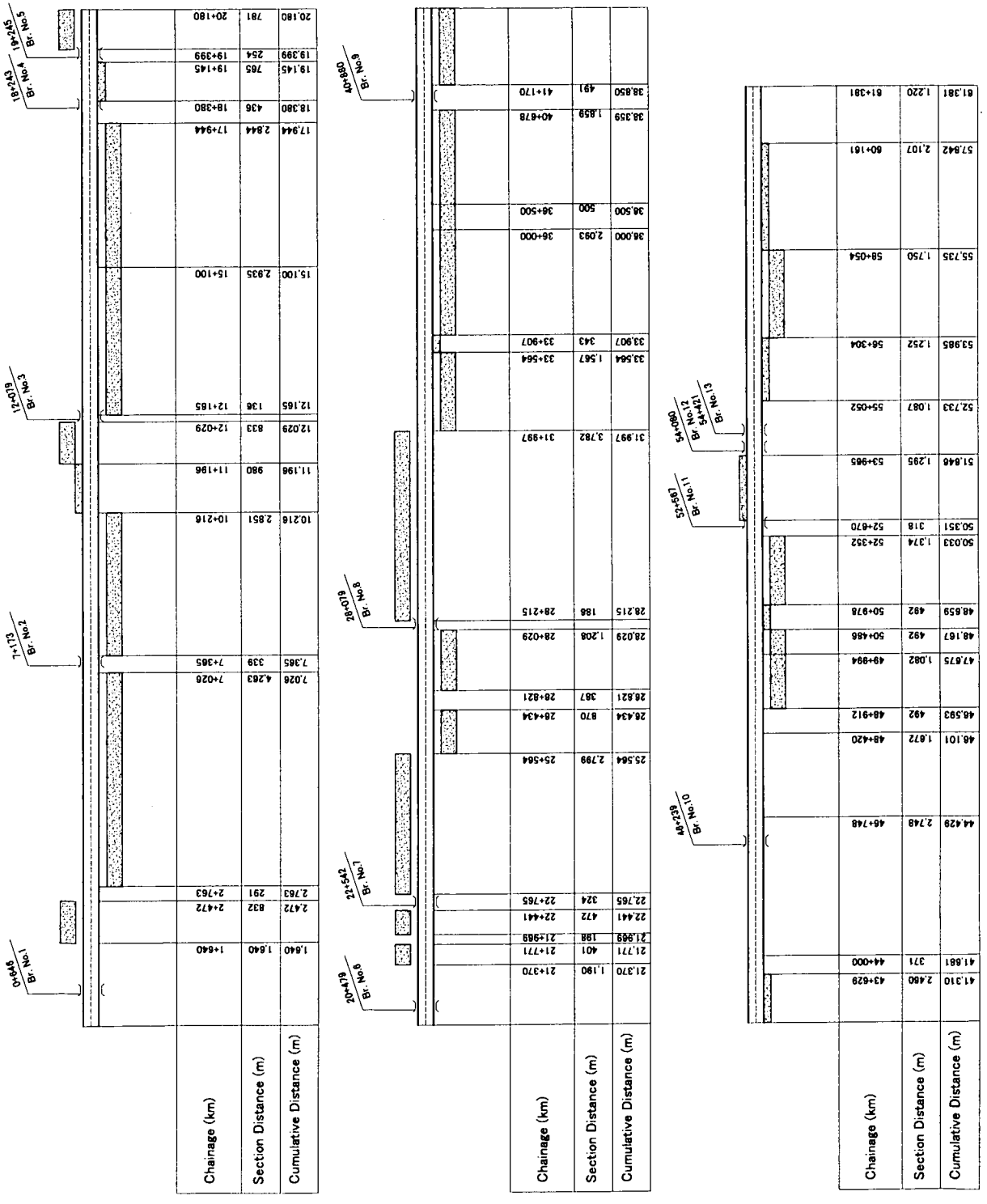


Figure 12-1 Area of UXO Search on Stage 2