NO.

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR IMPROVEMENT OF VIENTIANE NO.1 ROAD
IN
LAO PEOPLE'S DEMOCRATIC REPUBLIC

JUNE 2005

JAPAN INTERNATIONAL COOPERATION AGENCY

GM
JR
05-131

PREFACE

In response to a request from the Government of Lao People's Democratic Republic, the Government of Japan decided to conduct a basic design study on the Project for Improvement of Vientiane No.1 Road and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Lao People's Democratic Republic a study team from July 14, 2004 till October 10, 2004.

The team held discussions with the officials concerned of the Government of Lao People's Democratic Republic, and conducted field studies at the study area. After the team returned to Japan, further studies were made. The supplementary field survey was conducted from March 24 till April 2, 2005 and from April 11 till April 24, 2005. Then, a mission was sent to Lao in order to discuss a draft basic design. As a result of the studies, 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 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.

June, 2005

Seiji KOJIMA
Vice President
Japan International Cooperation Agency

June, 2005

Letter of Transmittal

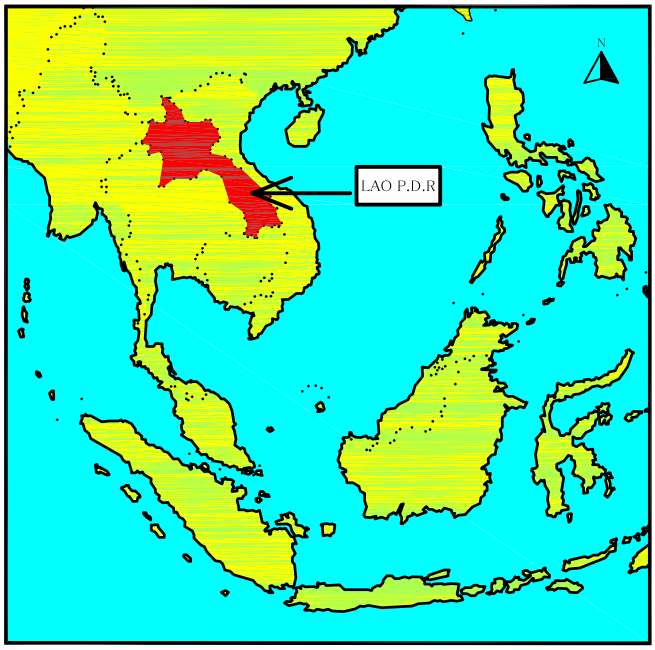
We are pleased to submit to you the basic design study report on the Project for Improvement of Vientiane No.1 Road in Lao People's Democratic Republic.

This study was conducted by Consortium between Katahira & Engineers International and CTI Engineering International, under a contract to JICA, from July 1, 2004 till July 22, 2006. In conducting the study, we have examined the feasibility and rationale of the Project, with due consideration to the present situation of Lao and formulated the most appropriate Basic Design for the Project under Japan's grant aid scheme.

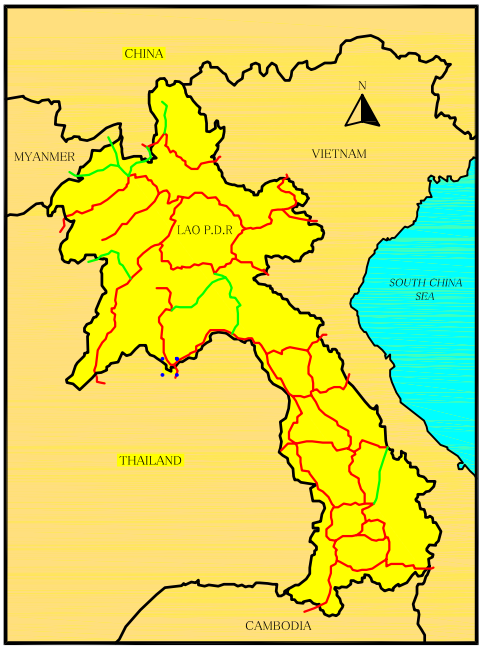
Finally, we hope that this report will contribute to further promotion of the Project.

Very truly yours,

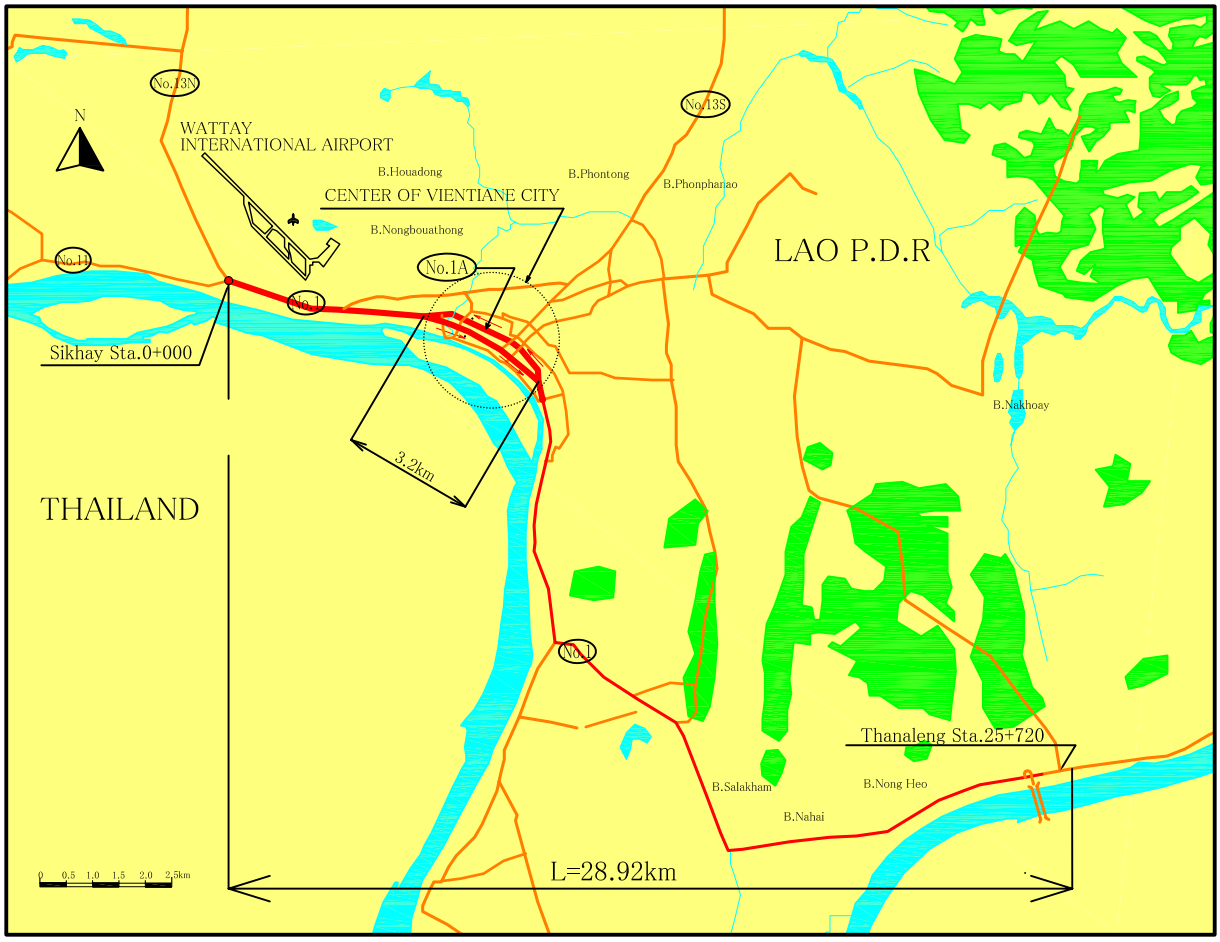
Minoru MIURA
Chief Consultant/Road Planner
Basic Design Study Team on the Project for
Improvement of Vientiane No.1 Road
Consortium between Katahira & Engineers
International and CTI Engineering International



Map of Asia



Map for Study Area



Location Map

PERSPECTIVE

LIST OF TABLES

Table 1-1	Trunk Road Projects in Vientiane Capital	1-1
Table 2.2.1.1-a-(1)	Design Speed	2-4
Table 2.2.1.1-a-(2)	Width of the Road and Numbers of Lanes	2-4
Table 2.2.1.1-a-(3)	Type of Pavement	2-5
Table 2.2.1.1-a-(4)	Pavement Structure	2-5
Table 2.2.1.1-b-(1)	Extension of Each Type of Drainage	2-6
Table 2.2.1.3-(1)	Function and Roles of Vientiane No.1 Road	2-13
Table 2.2.2.1-a-(1)	Present Traffic Volume	2-16
Table 2.2.2.1-a-(2)	Future Traffic Demand (PCU converted volume)	2-17
Table 2.2.2.1-a-(3)	Traffic Capacity for Each Section (PCU converted volume)	2-17
Table 2.2.2.1-a-(4)	Congestion Degree and Service Level (PCU converted volume)	2-18
Table 2.2.2.1-b-(1)	Structural Design Criteria	2-19
Table 2.2.2.1-b-(2)	Geometric Design Criteria	2-22
Table 2.2.2.1-b-(3)	Present Min. Curve Radius	2-22
Table 2.2.2.1-b-(4)	The Present Maximum Grade	2-22
Table 2.2.2.1-c-(1)	Pavement Structure for Sections	2-23
Table 2.2.2.1-c-(2)	ESAL Value for Each Section	2-24
Table 2.2.2.1-c-(3)	Equivalent Conversion Factor	2-24
Table 2.2.2.1-c-(4)	Design CBR for Each Section	2-24
Table 2.2.2.1-c-(5)	Designed Pavement Structure	2-26
Table 2.2.2.1-c-(6)	Base-course & Sub-grade Replacement Section	2-27
Table 2.2.2.1-d-(1)	Improvement of Soft Ground	2-27
Table 2.2.2.1-e-(1)	Intersections Improvement Plan	2-28
Table 2.2.2.1-e-(2)	Design Criteria for Intersection Improvement	2-29
Table 2.2.2.2-a-(1)	The Present Condition of Drainages	2-29
Table 2.2.2.2-b-(1)	Completion Schedule of Discharge Channels	2-30
Table 2.2.2.2-c-(1)	Type of Drainage and Distance	2-32
Table 2.2.2.4-(1)	Details of Bus Stop	2-36
Table 2.2.2.4-(2)	Details of Parking Lots	2-35
Table 2.2.2.4-(3)	Details of Pedestrian Crosswalks	2-37
Table 2.2.2.4-(4)	Intersections planned with New Traffic Signals	2-37
Table 2.2.2.4-(5)	Details of Guideposts	2-38
Table 2.2.4.3-(1)	Undertakings of Both Governments	2-381
Table 2.2.4.5-(1)	Quality Control Plan for Earthwork and Pavement	2-383
Table 2.2.4.5-(2)	Quality Control Plan for Concrete Work	2-383
Table 2.2.4.6-(1)	Material Procurement Plan	2-384
Table 2.2.4.6-(2)	Equipment Procurement Plan	2-385
Table 2.2.4.7-(1)	Implementation Schedule	2-386
Table 2.5.2-1	Estimation of Annual Cost for Maintenance	2-392

LIST OF FIGURES

Figure 2.2.1.1-g-(1) Plan (Phase-1) (AFD Project) 2-10
Figure 2.2.1.1-g-(2) Plan (Phase-2 & 3) (AFD Project) 2-11
Figure 2.2.1.1-g-(3) Typical Cross Section (AFD Project) 2-12
Figure 2.2.2.1-b-(1) Typical Cross Section 2-20
Figure 2.2.2.1-b-(2) Typical Cross Section 2-21
Figure 2.2.2.1-d-(1) Improvement of Soft Material 2-28
Figure 2.2.2.3-(1) Preparatory Works 2-34
Figure 2.2.2.5-(1) BCP Survey 2-39

ABBREVIATIONS

AASHTO	:	American Association of State Highway and Transportation Officials
ADB	:	Asian Development Bank
AFD	:	Agence Francaise de Development
CBR	:	California Bearing Ratio
DBST	:	Double Bituminous Surface Treatment
DCTPC	:	Department of Communication, Transport, Post and Construction
EL	:	Elevation
EIA	:	Environmental Impact Assessment
ESAL	:	Equivalent Single Axle Load
GDP	:	Gross Domestic Product
IEE	:	Initial Environmental Examination
MCTPC	:	Ministry of Communication, Transport, Post and Construction
PVC	:	Polyvinyl Chloride
RC	:	Reinforced Concrete
SN	:	Structural Number
UNDP	:	United Nations Development Programme
URI	:	Urban Research Institute
VIUDP	:	Vientiane Integrated Urban Development Project
VUDAA	:	Vientiane Urban Development and Administration Authority
VUISP	:	Vientiane Urban Infrastructure & Service Project

SUMMARY

Vientiane No.1 Road is a part of the Asian Highway No.12. This road, by means of the Friendship Bridge, connects Thailand with the northern region (through NR.13N) and the southern region (through NR.13S) of Lao People's Democratic Republic (Lao PDR).

The Friendship Bridge and Wattay Airport are the two main gateways to the Lao PDR, with 60% of visitors use the Friendship Bridge and 12% use Wattay Airport. Vientiane No.1 Road is a very important international road that connects these gateways with the center of Vientiane Capital.

However, the present condition of Vientiane No.1 Road is poor and this prevents vehicles from moving safely and smoothly on the road. In combination with the poor road condition, the mixture of high and low speed traffic on the road has resulted in many traffic accidents. In addition, flooding occurs on and along the road in the city center every rainy season due to the insufficient drainage system.

The main objectives of the Project are to contribute to safe and smooth traffic on the road by improving it, to reduce traffic accidents by installing a low-speed lane on the road in order to segregate high and low speed traffic and to prevent flooding on and along the road by improving the drainage system.

JICA conducted a preparatory study to confirm the contents and background of the request from January to February 2003. In this survey, confirmation of priority section in Lao side of the project, existing road condition survey by CBR test, existing road drainage condition survey, traffic condition survey, road improvement and resettlement plans and preparatory environmental survey were conducted.

As a result of this survey, it was ascertained to the necessity and urgency of the road improvement for a length of about 27km in the requested section. Also in the requested section, Lao side highly expects to improve about 10km from Sikhai junction located at about 1km westside of Wattay airport to the center of Vientiane capital city (Thatkaho junction) as a top priority. The necessity and urgency of improvement is very high because of the existing road and drainage conditions in this section are very poor. Based on the result of the preparatory survey, the basic design study for improving the road, for a length of 10km from Sikhai junction located at about 1km westside from Wattay airport to Thatkao junction was commenced. However, during the basic design study, conducted on July 2003, a possibility of buried cultural properties concealment became clear at 6km length in the capital center within the study section. Then, the basic design study was suspended leaving the study on construction schedule and cost estimation, requesting to Lao side to conduct buried cultural properties survey, as the project implementation will be difficult in case of there is a possibility to damage such properties by Japan's grant aid project.

After that, the Study for burial cultural properties survey was carried out in Feb. 2004, and based upon which the Government of Japan determined to support the study that the Lao Government would have conducted with the same purpose. Then, from July 2005, the Basic Study on remaining sections of the previous preparatory study (prioritized section) of 10km and the unconducted section of 17km, including alternative plans, has been carried out. In addition, a preparatory study for burial cultural properties survey, second stage, of "The Project for the Improvement of Vientiane No.1 Road", was conducted in parallel to the present project, that found cultural remains five times more than expected (as the case in Japan and Cambodia). This fact extended the survey period by one month for the classification, arrangement, and analysis of the results. The result of this preparatory study brought the need of careful preparation of the Implementation Program within the area of the Preparatory Study (within the fort),

and even outside of the fort which was out the scope of the preparatory study, and introduced high possibility of cultural buried properties in archeology. All this facts induced the extension of the study period for discussions within the members of the preparatory study team, and the preparation of the detailed Implementation Plan.

The works proceeded in Japan, for the preparation of preliminary cost estimation of the project, that was done by January 2005.

In March 2005, upon the request of the Ministry of Foreign Affairs to decrease the project cost, the project contents and cost were reviewed based on the following process:

- Re-study the alternatives including the scale of the project, based on the data obtained through the study in Japan.
- Implementation of the Second Field Survey for further discussion and adjustment with the parties concerned, and supplemental field survey.
- In the Second Survey in Japan, re-preparation of the Project Plan and the cost estimation based upon the Plan.
- In May 2005, the presentation has been done to the persons in-charge of the Government of Laos, who basically agreed on the new components of the project.

The design concept is based on the following 3 functions of the project road section.

- The Project road has the function as an international trunk road, road for daily living and road for commercial activities.
- Structure design of the road shall consider the present condition of high and low speed mixed traffic.
- The road shall provide safety and comfortable road space for road users.

The design concept of major works is as follows:

- Improvement of the road:
  - To avoid removal of any houses/buildings/trees alongside the existing road.
  - To consider the environment alongside the existing road.
  - To be designed basically by the overlay method.

- Improvement of the road drainage:
  - To minimize the frequent flooding on the existing road, houses and buildings.

- Relocation of the existing water supply pipeline:
  - To relocate the pipelines hindered to the construction of the road drainage.

- Improvement of road facilities:
  - To consider the various functions of road as an international trunk road and a road for economic, social and tourism activities.
  - To ensure safe and comfortable life for residents.

- The buried cultural properties survey:
  - To conduct the survey in the section to be excavated for the construction of underground

structures.

- The project for Vientiane Water Supply Development by Japan's Grant Aid:
  - To coordinate both projects for smooth and efficient implementation.

Based on the results of the Basic Design, the outline of the proposed Project is as fellows:

Target Road: Sikhay Junction～Thanaleng Warehouse (L = 28.9 km)

Major contents of the Project are as follows:

- Improvement of the road:
  Asphalt concrete pavement (50 mm thickness) for whole section, average road width is 14.7 m.
- Improvement of the road drainage:
  Sikhay Junction～Laksong Junction (3.9 km): Urban drainage system for road surface.
  Laksong Junction～Thatkao Junction (6.5 km): Urban drainage system.
  Thatkao Junction～Chinaimo Junction (5.1 km): Urban drainage system for road surface.
  Chinaimo Junction～Thanaleng Warehouse (13.4 km): Existing drainage.
- Relocation of the existing water supply pipeline:
  Relocation work shall be conducted between Laksong Junction and Thatkao Junction (6.5 km)
- Improvement of road facilities:
  - Side walk: Sikhay Junction～Thatkao Junction (10.4 km), mount-up type
    Thatkao Junction～Beerlao (11.3 km), flat type
    Beerlao～Thanaleng Warehouse (7.2 km), shoulder type
  - Street lighting: Installaltion between Sikhay Junction and Chinamo Junction (15.5 km)
  - Road signal: Installation the base for signal facilities
  - Median: Sikhay Junciton～Chinaimo Junction (9.3 km)
  - Others: Access to each house and building.
    To maintain all access along the road.
- The buried cultural survey: Laksong Junction～Thatkao Junction (6.5 km)

The Project will be undertaken by the Japan's Grant Aid and detailed design and construction periods are planned to be about five (4.7) months and twenty three (22.5) months respectively.

Total project costs of 4,567 million Japanese yen were estimated (Japanese Government's Payment: 4,483 million Japanese yen, Lao PDR Government's Payment: 84 million Japanese yen).

The direct beneficiaries by the Project are those residents with a population of 700,000 (estimated in 2004) who live in Vientiane Capital. The advantageous effects that will result from the implementation of the Project are summarized as below.

① Travel time in the center of the city between Sikhay Junction and Chinaimo Junction is expected to be shortened as a result of improving mobility and segregation of mixed traffic.

Road Section	Before Improvement	After Improvement
Sikhay～Chinaimo (12.3 km)	30 minutes (Average speed: 25 km/h)	21 minutes (Average speed: 35 km/h)

② Safe and smooth traffic will be ensured as a result of improving road facilities such as sidewalk, bus stop, parking lots, pedestrian crosswalks, traffic signals, street lightings and traffic signals.

③ The improvement of the road will provide safe and smooth access to commercial and tourism facilities along the road by car and on foot.

④ Reduction of flooding on and along the road will improve the movement of persons and goods in the city.

Road Section	Before Improvement	After Improvement
Sikhay～Chinaimo	73 times flooding per year (3 hours each for interrupting traffic)	Reducing

⑤ Socio-economic activities will become more active by promoting physical exchange due to the improved function of the trunk road.

⑥ Health and sanitary environment along the road will be improved due to the reduction of flooding.

As mentioned above, significant advantageous effects are expected by implementing the Project. It can be judged that the Project to be undertaken by the Japan's Grant Aid is appropriate from the viewpoint of contributing the Lao nationwide socio-economic vitalization.

Therefore, maintenance shall be adequately done by the Government of Lao PDR to manifest/sustain the Project's significant advantageous effects.

TABLE OF CONTENTS

Preface
Letter of Transmittal
Location Map
Perspective
List of Figures and Tables
Abbreviations
Summary

Page

Chapter 1 Background of the Project 1-1

Chapter 2 Contents of the Project 2-1

2.1 Basic Concept of the Project 2-1

2.2 Basic Design of the Requested Japanese Assistance 2-3
2.2.1 Basic Policy 2-3
2.2.1.1 Basic Concept 2-3
2.2.1.2 Consideration on Natural Conditions 2-13
2.2.1.3 Consideration on Socio-economic Conditions 2-13
2.2.1.4 Consideration on Construction and Procurement Conditions 2-14
2.2.1.5 Participation of Local Construction Companies 2-14
2.2.1.6 Ability of Local Agencies in Management and Maintenance of the Road 2-14
2.2.1.7 Establishment of the Grade of Facilities 2-15
2.2.1.8 Work Plan and Period 2-15
2.2.2 Basic Plan 2-16
2.2.2.1 Improvement of the Existing Road 2-16
2.2.2.2 Improvement of the Road Drainage 2-29
2.2.2.3 Relocation of the Existing Water Supply Pipeline 2-33
2.2.2.4 Improvement of Road Facilities 2-34
2.2.2.5 The Buried Cultural Properties Survey 2-38
2.2.2.6 Drinking Water Supply and Distribution Project (AFD) 2-39
2.2.2.7 Work Plan 2-39
2.2.2.8 Alternative Designs to Contemplate Mitigation of Environmental Impacts 2-40
2.2.3 Basic Design Drawings 2-42
2.2.4 Implementation Plan 2-379
2.2.4.1 Implementation Policy 2-379
2.2.4.2 Implementation Conditions 2-379
2.2.4.3 Scope of Works 2-381
2.2.4.4 Consultant Supervision 2-381
2.2.4.5 Quality Control Plan 2-383
2.2.4.6 Procurement Plan 2-383
2.2.4.7 Implementation Schedule 2-386

2.3 Obligations of Lao People's Democratic Republic 2-387

2.4 Project Operation Plan 2-388

2.5 Rough Project Cost 2-391
2.5.1 Rough Estimate of Project Cost 2-391
2.5.2 Estimated Maintenance Cost 2-392

Chapter 3 Project Evaluation and Recommendations 3-1

3.1 Project Effect 3-1
3.2 Recommendations 3-2
3.3 Project Adequacy 3-2
3.4 Conclusion 3-2

[Appendices]

1. Member List of the Study Team
2. Study Schedule
3. List of Parties concerned in the Recipient Country
4. Minutes of Discussions
5. Cost Estimation Borne by the Recipient Country
6. References
7. Traffic Data
8. Location Map of Underground Facilities

[Appendices in Separate Volume]

Basic Design Drawings

CHAPTER 1

BACKGROUND OF THE PROJECT

CHAPTER 1 BACKGROUND OF THE PROJECT

Ministry of Communication, Transport, Post and Construction planned seven trunk roads improvement projects in Vientiane Capital in 1997.

The improvement work started in 1998 majority with ADB fund. Six projects have already been completed. (refer Table 1-1) The remaining road improvement project is the improvement of the road from Sikhay Junction to Friendship Bridge. This is called Vientiane No.1 Road (including 3 km of the branch stretch in the city center, Vientiane No.1A Road).

Vientiane No.1 Road is a part of the Asian Highway No.12. This road, by means of the Friendship Bridge, connects Thailand with the northern region (through NR, 13N) and the southern region (through NR, 13S) of the Lao PDR. Visitors come to Lao through Friendship bridge (60%) and Wattay Airport (12%).

However, the present condition of Vientiane No.1 is poor such as many potholes・cracks and this prevents vehicles from moving safely and smoothly on this road. In combination with the poor road condition, the mixture of high and low speed traffic on the road has resulted in many traffic accidents.

In addition, flooding has occurred on and along the road in the city center every rainy season due to the insufficient drainage system. Those problems in Vientiane No.1 Road hinder not only the social economic development but also daily activities of residents in Vientiane Capital. Therefore, the improvement of Vientiane No.1 Road is the highest priority project and needs urgent action.

Table 1-1 Trunk Road Projects in Vientiane Capital

Road Number	Length (km)	Status	Average Width (m)	Contractor
1 & 1A	28.92	Basic Design	15.2	---
2 & 2B	12.85	Completed	18	LFH (China)
3 (Part-I) & 3B	3.76	Completed	12	CEI-18 (Vietnam)
4 & 4A	8.60	Completed	9	
3 (Part-II) & 3A	3.41	Completed	12	1st May Co. (Vietnam)
5	10.90	Completed	12	Bpkp/LFH/ CEI-18/1st May Co. (Lao/Vietnam)
6A1 & 6A2	3.59	Completed	12	VMR & B/ CEI-18 (Vietnam)
7	2.00	Completed	12	Lao-Singapore (Lao)

CHAPTER 2

CONTENTS OF THE PROJECT

CHAPTER 2 CONTENTS OF THE PROJECT

2.1 BASIC CONCEPT OF THE PROJECT

Vientiane No.1 Road in Lao People's Democratic Republic, which is passing through the center of Vientiane City and leading to the entrance of Friendship Bridge, is the most important international trunk road and also the vital road for the economic, social and tourism activities.

Despite of such an important component, since the pavement surface as well as the road drainage are deteriorated severely, the urgent improvement of such road conditions has been requested by the Government of Lao People's Democratic Republic to the Government of Japan to be implemented under the Japan's grant aid assistance.

The history of the study by JICA for this project is summarized as follows:

- February 2003 The Preparatory Study for the Vientiane No.1 Road, the section between Sikhai intersection and the entrance of Friendship Bridge (27.5km), in which the section between Sikhai intersection and the Thatkhao intersection is recommended to be a first priority.
- May 2003 The Basic Design Study for the section between Sikhai intersection and Thakhao intersection started, but the Study was terminated in July 2003 due to the existence of buried cultural properties within the section.
- February 2004 The Preparatory Study for finding a solution of resumption of the Basic Design Study was conducted, and the Support Study for Buried Cultural Property Survey on for the Vientiane No.1 Road was requested.
- July 2004 The Basic Design Study for the section between Sikhai intersection and the entrance of Friendship Bridge started.
- March 2005 The study and discussions of the components were executed in order to reduce the project cost.
  The supplemental Basic Design Study for the additional section between the entrance of Friendship Bridge and Thanaleng Warehouse was conducted.

The Project aims to improve the Vientiane Road No.1, the section between Sikhai intersection and Thanaleng Warehouse through the entrance of Friendship Bridge (Total length: 28.9km) for securing the smooth and safe traffic.

Major work of the Project is as follows:

- Improvement of the existing road
- Improvement of the road drainage.
- Relocation of the existing water supply pipeline.
- Improvement of road facilities.
- The buried cultural properties survey
- Coordination with the project for Vientiane Water Supply Development (JICA) and the Drinking Water Supply and Distribution Project (AFD)

The expected effects by the Project are as follows:

- Travel times on the Project road are expected to be reduced and the flow of people and goods will move more smoothly.
- The traffic volume will be increased by the improved road surface and facilities. It will accelerate people and cultural exchange.

2.2 BASIC DESIGN OF THE REQUESTED JAPANESE ASSISTANCE

2.2.1 Basic Policy

2.2.1.1 Basic Concept

2.2.1.1-a Improvement of the Existing Road

(1) Condition of the existing road

Congestion of the traffic is observed in the Project road especially at the rush hours in the morning and evening. Vehicles running in the road are the mixture of various types of cars, within which vehicles driving at slow speed like motorbike and tuk-tuk deem to be one of the main causes for the traffic congestion.

Since the Project road is passing in flat terrain at the left side of Mekong River, it has few questions in terms of the design of road structure and alignment. Even though steep and acute curves are observed at some part of the road, it is not serious problem for traffic because vehicles in urban area are forced to drive at restricted speed.

The existing pavement of the road is all DBST and the surface is severely deteriorated with many potholes and cracks. Some sections of the road are found to have repaired by overlaying, which has been confirmed by trial excavation for CBR test conducted during the Study.

(2) Concept for Improvement

The total length of the Project road for improvement is 28.9km.

The design of the road improvement is based upon the standard of「A Policy on Geometric Design of Highways and Street / AASHTO」and「Road Structure Ordinance」in Japan.

The alignment will be arranged within the existing ROW in order to avoid removal of any houses/buildings/trees alongside the existing road.

The road improvement shall be designed taking into consideration of the fact that Vientiane is the tourism city and the overall view of the improved road should be fit in its surroundings of the tourism city.

The pavement will be designed basically by the overlay method that is advantageous in economic and methodological point of view. And in the section at where the overlay method can be applied, the existing pavement will be utilized as sub-base and/or sub-grade structure. In the section at where the overlay method could not be adopted, the reconstruction method will be alternatively taken up.

The pavement shall be designed on the criteria that the performance period of pavement is 10 years and calculated based on the CBR data and the future traffic demand.

(3) Design criteria

- Traffic volume

The traffic volume counting survey was conducted at 11 locations on the road for 24 hours in order to get the daily average traffic volume. (Refer to Table 2.2.2.1-a-(1))

Base on the data collected by the survey, the future traffic volume in the year of 2017 (10 years later) and 2027 (20 years later) has been estimated as targeted demand for the performance period of the pavement and for study of the traffic lane respectively. (Refer to Table 2.2.2.1-a-(2))

・ Design speed

Design speed is adopted as mentioned in Table 2.2.1.1-a-(1).

Table 2.2.1.1-a-(1) Design Speed

Section		Station	Distance	Distinction	Design Speed
R.No.1	Sikhai~Simuang	0+000~6+880	6,880m	Urban	40km/h
R.No.1A	Laksong~Simuang	0+000~3+220	3,220m		
R.No.1	Simuang~BeerLao	6+880~18+300	11,420m	Suburban	60km/h
	BeerLao~F.Bridge	18+300~24+300	6,000m	Rural	
	F. Bridge~Thanaleng	24+300~25+700	1,400m		

・ Width of the Project road

Width of the Project road is shown in Table 2.2.1.1-a-(2), which is planned taking into account of the present traffic volume, the future traffic demand and the existing road width.

Width of the road shoulder at the section with sidewalk is planned to be 0.35m and that of the section without side walk to be 1.5m in the field area and 2.5m in the village (inhabited) area.

Table 2.2.1.1-a-(2) Width of the Road and Numbers of Lanes

Section		Station (Distance)	Lane Type	Width (m)	Nos. of Lane
R.No.1	Sikhai~Laksong (Both way)	0+000~3+900	T.L.	3.25	4
		(3,900m)	S.L.	2.15	2
	Laksong~R.No.4A (One way)	3+900~4+800	T.L.	3.25	2
		(900m)	C.T.L.	3.25	2
	R.No.4A~Simuang (Both way)	4+800~6+880	T.L.	3.25	1
		(2,080m)	S.L.	2.15	2
R.No.1A	Laksong~R.No.4A (One way)	0+000~1+050	T.L.	3.25	2
		(1,050m)	S.L.	2.15	2
	R.No.4A~Simuang (Both way)	1+050~3+220	T.L.	3.25	2
		(2,170m)	S.L.	2.15	1
R.No.1	Simuang~Thatkhao (Both way)	6+880~7+185	T.L.	3.25	2
		(305m)	C.T.L.	3.25	2
	Thatkhao~F.Bridge (Both way)	7+185~24+300	T.L.	3.25	2
		(17,115m)	C.T.L.	3.25	2
	F. Bridge~Thanaleng (Both way)	24+300~25+700	T.L.	3.50	2
		(1,400m)			

Remark: T.L. = Traffic Lane, S.L. = Slow Lane,
C.T.L. = Combined Traffic Lane

・ Pavement structure

Taking into account of the function of the Project road as a very important international road, the pavement structure is planned to be durable one so as to cope with the future high traffic demand.

The overlay pavement is planned as the main structure but for some sections the overlay method could not adopt, the reconstruction pavement structure is adopted. (Refer to Table 2.2.1.1-a-(3))

Table 2.2.1.1-a-(3) Type of Pavement

Section		Station	Distance	Type of way	Type of Pavement	
					Recon.	Overlay
R.No.1	Sikhai~Laksong	0+000~3+900	3,900	Both way	―	○
	Laksong~R.No.4A	3+900~4+800	900	One way	―	○
	R.No.4A~Simuang	4+800~6+880	2,080	One way	○	―
R.No.1A	Laksong~R.No.4A	0+000~1+050	1,050	One way	―	○
	R.No.4A~Simuang	1+050~3+220	2,170	One way	○	―
R.No.1	Simuang~Thatkhao	6+880~7+185	305	Both way	―	○
	Thatkhao~F.Bridge	7+185~24+300	17,115	Both way	―	○
	F. Bridge~Thanaleng	24+300~25+700	1,400	Both way	―	○

The pavement structure of both types is shown in Table 2.2.1.1-a-(4).

Table 2.2.1.1-a-(4) Pavement Structure

Structure	Reconstruction		Overlay
Asphalt Concrete	○		○
BTB	○		○
Base Course	○		―
Sub-base	○		―
Sub-grade	○	―	―

In the overlay section, the existing DBST substitutes to Base Course.

2.2.1.1-b Improvement of the Road Drainage

(1) Condition of the road drainage

Total extension of the road drainage existing at random at both sides of the Project road is approximately 16.3km, the types of which include the side ditch, the U-type gutter and the pipe culvert.

- In the section between Sikhai and Laksong intersection, approx. 40% of total drainage extension is the side ditch.
- In the urban section between Laksong and Thatkhao intersection, approx. 70% of total drainage extension is the U-type gutter.
- In the section between Thatkhao and Chinaimo intersection where is the urban area too, approx. 20% of total drainage extension is the U-type gutter.
- In the section between Chinaimo and Nonghai intersection, the side ditch is observed at some part, but in major section is the natural discharge.

・ In the section between Nonghai and Friendship Bridge, the natural discharge is observed in major section and the side ditch at some part.

The extension for each type of the existing drainage is shown in Table 2.2.1.1-b-(1).

Table 2.2.1.1-b-(1) Extension of Each Type of Drainage

(Length = one side total)

Section (Extension)		Side ditch	U-type G.	P. Culvert
Sikahi~Laksong	(3.9km)	3.40km	4.30km	0.06km
Laksong~Simuang R.No.1	(3.0km)	0.00km	4.50km	0,90km
Laksong~Simuang R.No.1A	(3.2km)	0.60km	4.00km	1.30km
Simuang~Thatkhao	(0.4km)	0.00km	0.80km	0.00km
Thatkhao~Chinaimo	(5.1km)	0.97km	2.10km	0.00km
Chinaimo~Nonghai	(3.0km)	2.80km	0.00km	0.06km
Nonghai~F.Bridge	(9.0km)	8.34km	0.00km	0.55km
F. Bridge~Thanaleng	(1.4km)	1.22km	0.14km	0.00km

The section suffering frequent flooding is between Lakson and Thatkhao intersection.

Main causes of frequent flooding in that section are deemed as follows:

・ Urban drainage system that is the outlet of the existing road drainage is not fully improved yet. (The improvement project of urban drainage system is on going by VUDAA)
・ The section is geographically flat and therefore, proper longitudinal drainage slope can not be kept. (Generally 3.0% slope is required)
・ Drainage inlet boxes are not placed at the proper locations.
・ The road drainage inlets provided at curb are too small to drain out the heavy rainfall concentrated in a short time.
・ Some roads are observed not to have proper cross slope.
・ Side ditches are not maintained and cleaned properly. Therefore soils, debris and garbage piled in the side ditch are preventing smooth flowing of drainage.

(2) Concept of Improvement

Improvement of the road drainage is planned so that the frequent flooding on the existing road, houses and buildings is minimized and contributes to the environmental improvement for the residences.

The improved road drainage in the urban area will be connected to the Urban Drainage System, which functions as the outlet. Some part of the Urban Drainage System have been improved during the year of 1996 to 2001 by ADB Fund and improvement of the other parts are on going from the year of 2002 to 2006.

The road drainage in the suburban area will be connected to the new canal planned to provide at new proper locations.

The road drainage at the section of no sidewalk is planned as the natural discharging system.

Public sewerages are not provided yet alongside the Project road. Therefore it is planned that the public sewage inlet boxes are installed at the private lot adjacent to ROW and the sewage flowed into those inlets drains out to the Project road drainage system.

The road drainage will be designed to have the drain capacity of 2-year probability rainfall and effective area for discharge is considered to be 80% of the full area scheduled.

2.2.1.1-c Relocation of the Existing Water Supply Pipeline

During the previous Basic Study for the Project conducted and terminated in May 2003, this issue has been raised as one of the main issues for implementing the Project.

In the end of the year 2003, the Government of Laos commenced to purchase new pipes and fittings etc for the relocation work by its own financing. However, the work has been terminated because new locations for the relocated pipelines couldn't specify at that moment without close coordination with the road drainage work of the Project.

Considering such previous situations, this relocation work is planned basically to follow the plan made by the Laos side as follows.

(1) The pipeline to be relocated.

- The pipelines hindered to the construction of the road drainage shall be relocated.

(2) Undertakings of both Governments

- The Government of Laos
  - Supply of all necessary materials for relocation, except materials necessary for temporary works
  - All defects resulted from the designing.
  - Connection of water supply pipes to customers.
  - Prior notice of temporary suspension of water supply to customers.

- The Government of Japan
  - All works related to relocation of pipeline except designing.
  - Supply of structural materials required by designing restrictions.
  - Supply of materials required for the temporary work.
    (These materials can be utilized for the other future projects in Laos)

(3) In case it needs to suspend water supply during the relocation work, such works will be carried out within nighttime from 22:00~05:00 with prior approval of the Authority concerned.

2.2.1.1-d Improvement of the Road Facilities

(1) Condition of the existing road facilities

- Intersection

  There are 18 major intersections in the Project road, within which 7 intersections have been improved but 11 are not improved yet.

- Sidewalk

  The mount up type sidewalk exists in the section between Sikhai and Thatkhao

intersection. The flat type sidewalk is found at places but the demarcation with the traffic lane is not clear. The mount up sidewalk is paved in concrete but some places are bear ground.

In the section between Thatkhao and Chinaimo intersection, the mount up sidewalk is provided at both side but not continuously. In the section between Chinaimo and Thanaleng, no sidewalk is found except at Nonghai intersection that has been already improved.

- Median
  The mount up type median exists in 2.9 km distance between Wattay airport and Laksong intersection. Any other median is not found.
- Bus stop
  In the Project road, only one bus stop with shed exists. The bus stops at anywhere along the road and it is one of the reasons for traffic jam.
- Parking facility
  Parking facility is not found along the Project road. Cars are used to park on the road which reduces the actual traffic lane.
- Road marking
  Road marking is not provided in whole extension of the Project road except some intersections at where the stop line with white color is observed.
- Signboard
  A lot of signboards are found alongside the Project road but they have no particular uniformity of the boards.
- Traffic signal
  Six (6) traffic signals are working at the intersection of Wattay Airport, Route 4A (Route 1 and Route 1A), Route 2, Thatkhao and Nonghai. Two (2) traffic signals for pedestrians are working in front of schools.
- Street lighting
  Street lightings are provided in certain intervals between Sikhai and Chinaimo intersection. But in the section between Chinaimo and Friendship Bridge, no lighting is found except the village area. Two types for lighting system are observed, one is a single pole type and the other is the type installed on existing electricity poles.
- Street trees
  Approx. 485 trees are planted alongside the Project road and 60% of those trees are within the old initial city wall of Vientiane. Big trees with the girth of more than 1.0m are found in front of some temples.
- Structures alongside the Project road
  A lot of structures exist alongside the Project road such as steel and concrete electricity poles, road signboards, street lightings and various advertising boards, etc. Those structures are estimated to number approx. 2,650 or more.

(2) Concept of Improvement

Taking into account of the fact that the Project road has such various functions as an international trunk road and a road for economic, social and tourism activities, improvement of those facilities mentioned above shall be planned to fit in with such various functions and to assure safe and comfort life for all residents along the road.

Further, the improved facilities should fit to the environment as the tourism city 'Vientiane' which has many remarkable tourism spots like old temples and historical buildings in the center.

2.2.1.1-e The Buried Cultural Properties Survey

For the implementation of the Project, the buried cultural properties that exist within the Project road are proposed to be surveyed. In order to conduct the survey in a most economical way, the survey is planned to conduct at the same time with implementation of the Project and to follow to recommendations made in the report of the Support Study for the BCP Survey conducted from July to October 2004 under the Japan's Grant Aid Assistance.

With regards to the BCP survey outside the old initial city wall of Vientiane that is also recommended in the report of the Support Study for the BCP Survey, trial digging survey (between Laksong and 4A Intersection including 1A, L = 2 km) will be scheduled as one of the study items in the Detailed Design Study for the Project so that the Project will be implemented timely and economically.

2.2.1.1-f The Project for Vientiane Water Supply Development (JICA)

At the initial stage of this Basic Study, since some part of the main water pipe in the above Project was planned to install in the same location to the Road Improvement Project, it was planned to implement integrally with the Road Improvement Project.

However, since the implementation of this Project has been postponed, the study of this water pipe installation work excludes from this Basic Study of the Road Improvement Project.

In such circumstances, it is proposed that MCTPC shall prohibit to dig over the Project road for at least 3 years after completion of this Project so that the road shall be maintained in better conditions to secure safer traffics and to minimize damages to the road.

2.2.1.1-g Coordination with the Drinking Water Supply and Distribution Project (AFD)

(1) Condition of this work

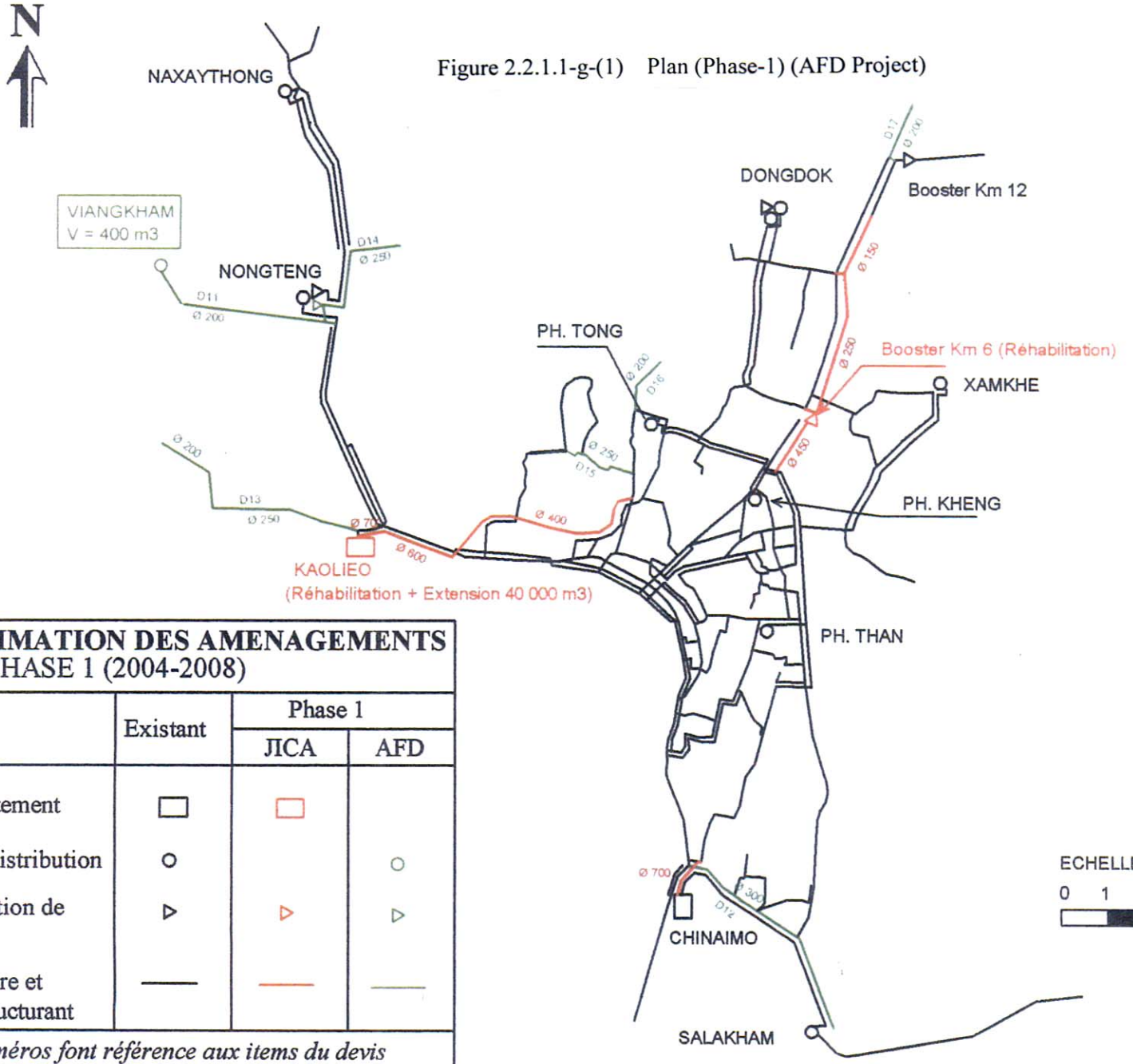
According to the Master Plan made by AFD in April 2004, this work is scheduled to implement in 3-phase. The plan and the typical cross section are shown in Figure 2.2.1.1-g-(1), Figure 2.2.1.1-g-(2) and Figure 2.2.1.1-g-(3).

(2) Coordination of the work

As the results of discussions with LWSC, which is the implementation agency of the work in the Government of Laos, it is agreed that the work necessary close coordination with the Project is just the Phase 1 that is to lay DIP ϕ 300 pipe in the distance of 5.9km.

Further it is necessary that the work is to complete before the Project commences. The necessary information of the road project will be provided to LWSC through MCTPC at the time when the Study Team visits Laos for the explanation of Draft Final Report of the Project.

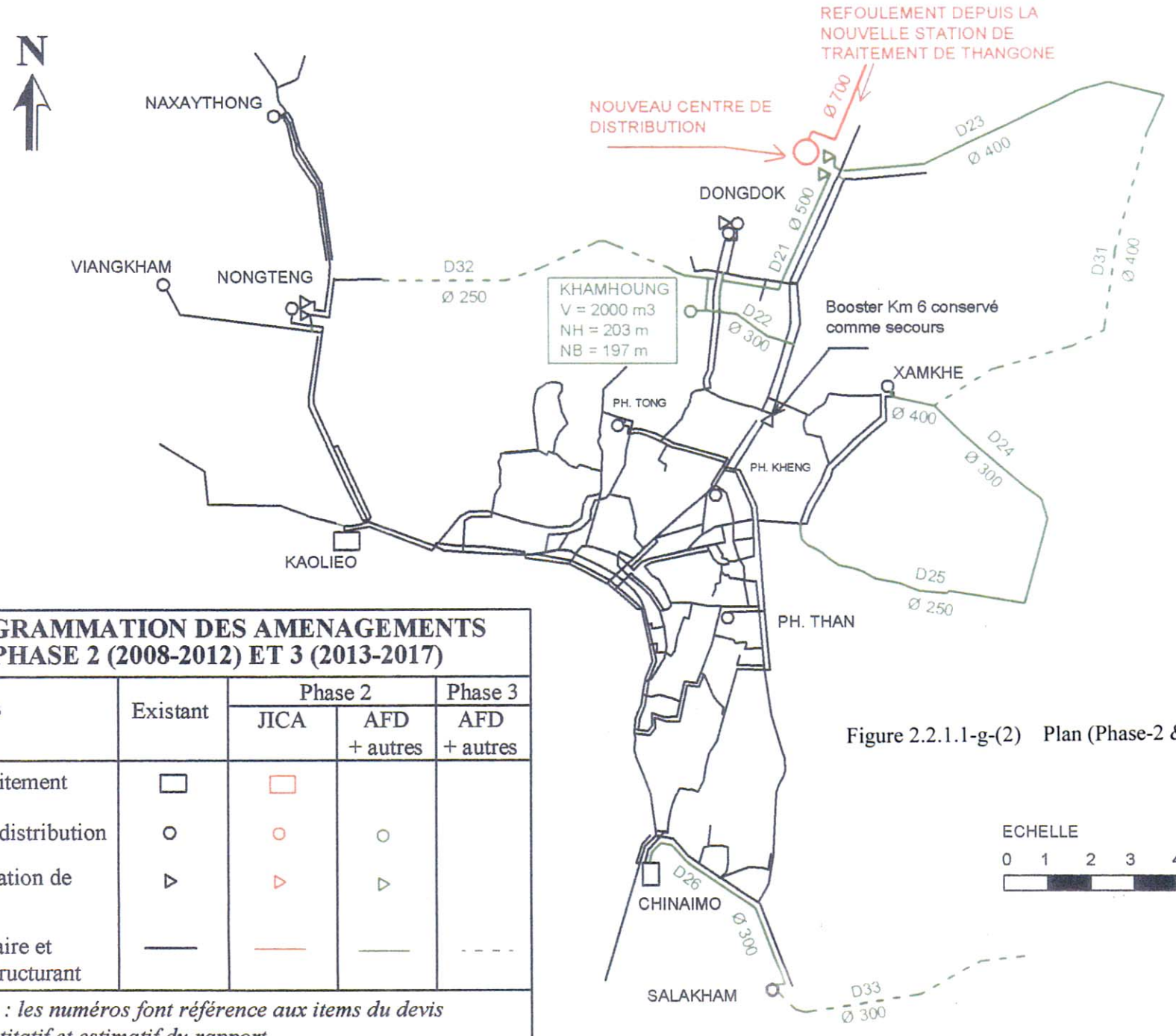
Figure 2.2.1.1-g-(1) Plan (Phase-1) (AFD Project)



PROGRAMMATION DES AMENAGEMENTS PHASE 1 (2004-2008)			
Ouvrages	Existant	Phase 1	
		JICA	AFD
Station de traitement	▭	▭	
Réservoir de distribution	○		○
Booster ou station de reprise	▷	▷	▷
Réseau primaire et secondaire structurant	—	—	—

Note : les numéros font référence aux items du devis quantitatif et estimatif du rapport

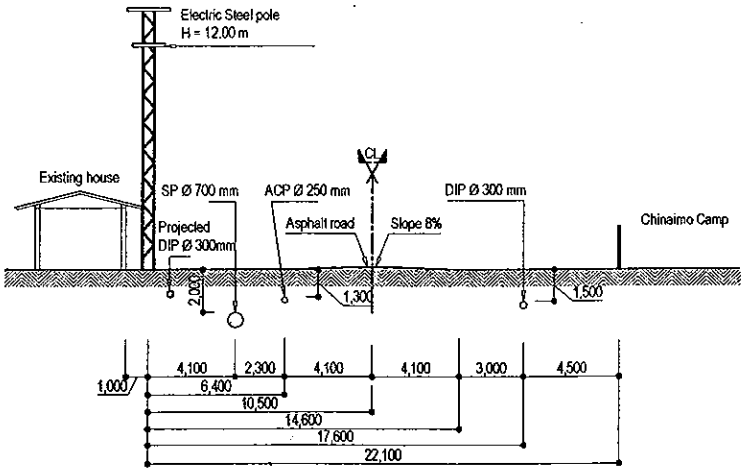
En association avec :



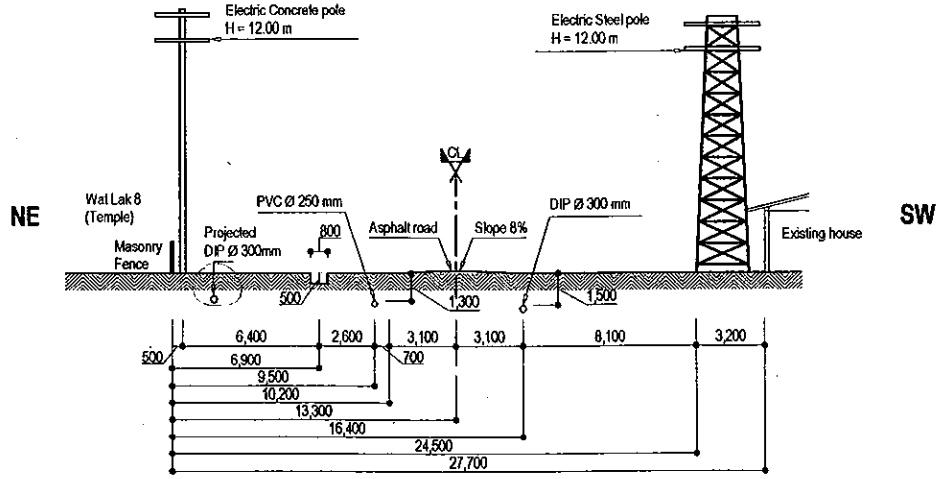
PROGRAMMATION DES AMENAGEMENTS PHASE 2 (2008-2012) ET 3 (2013-2017)				
Ouvrages	Existant	Phase 2		Phase 3
		JICA	AFD + autres	AFD + autres
Station de traitement	▭	▭		
Réservoir de distribution	○	○	○	
Booster ou station de reprise	▷	▷	▷	
Réseau primaire et secondaire structurant	——	——	——	- - - -

Note : les numéros font référence aux items du devis quantitatif et estimatif du rapport

Figure 2.2.1.1-g-(2) Plan (Phase-2 & 3) (AFD Project)



Main Road from Chomphet to Friendship Bridge and Thadeua
Between 0+000 and 0+100 (Chinaimo junction)
Scale 1:250 - Drwg. no. 001



Main Road from Chomphet to Friendship Bridge and Thadeua
Between 1+200 and 1+300 (Wat Lak 8)
Scale 1:250 - Drwg. no. 002

Figure 2.2.1.1-g-(3) Typical Cross Section (AFD Project)

NAM PAPA LAO

SCHEMA DIRECTEUR
DE DISTRIBUTION D'EAU POTABLE
DE LA PREFECTURE DE VIENTIANE

CONDUITE DE DISTRIBUTION
DE CHOMPHET A SALAKHAM
Sections en travers
Planche 1/5

Echelle: 1 : 250

Date:
Avril 2004

BCEOM
SOCIETE FRANCAISE D'INGENIERIE

LAO CONSULTING GROUP

2.2.1.2 Consideration on Natural Conditions

The climate in Laos is generally hot and humid climate whole through a year and the dry and the rainy season is distinctly identified. The rainy season is from May to October and the dry season from November to April. Almost all precipitation is recorded during the rainy season. Especially in the year of 2003, the precipitation in Vientiane was 1,481mm and 1,218mm rainfall, which is 82% of the total precipitation in that year, was recorded within 5 months of the rainy season.

Therefore the implementation plan and the construction method shall be planned with the consideration of such particular climatic conditions at the site.

2.2.1.3 Consideration on Socio-economic Conditions

Recently the population in Vientiane is presumed to be approximately 0.7mil and at present it is increasing year by year.

However since the infrastructure is insufficient for maintaining the normal urban life for such increasing populations, it is much worried that more future increase of population in Vientiane gives rise to the worse traffic congestion, the serious sanitary issues due to the deteriorated drainage system and the insufficient water supply.

In such circumstances, the function and roles of Vientiane No.1 Road is summarized as follows (Table 2.2.1.3-(1) and the Project road will be designed to recover such future outstanding issues as much as possible and to fulfill functions and roles mentioned in the Table.

Table 2.2.1.3-(1) Function and Roles of Vientiane No.1 Road

	Sikhai~Thatkhao (10km)	Thatkhao~F.Bridge~ Thanaleng Warehouse (18.9km)
Function	• Function as the Trunk Road - International Road as a part of Asian Highway A11 and as the National Road connecting to Road No.13-South. - Main Road connecting Wattay Airport to the center of Vientiane. • Function Living Network - The vital road for approx. 50,000 residence living alongside the road (approx. 10km). • Function as Business Network - 90% of hotels & many other tourist spots like restaurants, shops and temples are existing along the road.	• Function as the Trunk Road - International Road connecting to Thai through F. Bridge utilized for transporting import/export goods. - The future railway station (Thanaleng) is expected to increase more import/export goods. • Function Living Network - The main road connecting to the center of Vientiane which is vital for residents (approx. 19km). • Function as Business Network - A lot of factories and warehouses are found along the road. - Thanaleng Warehouse for the customs is located.
Roles	• The tourism road • The road for going to offices & school. • The living network for residents along the road.	• The industrial road. • The commutation road. • The living network for residents along the road.

2.2.1.4 Consideration on Construction and Procurement Conditions

(1) Construction conditions

In recent years, various urban infrastructure improvement projects have been implemented in Laos.

Especially for having had the big event of the ASEAN Summit in Vientiane in November 2004, such large-scale works as big hotels construction and roads improvement have been implemented here and there in Vientiane City.

(2) Procurement conditions

Entailing to the increase of the construction works, considerable foreign contractors who have heavy construction equipment are working in Vientiane. Therefore usual construction equipment could be available in Vientiane.

Even though some special construction materials are not available, they can be obtained by importing from Thailand and/or the third countries through local agents.

2.2.1.5 Participation of Local Construction Companies

The construction of this Project is to be undertaken by a Japanese contractor. Local contractors would join in spheres of supplying labors, leasing equipment and subcontracting some part of the Project.

For implementation of the Project, some special construction methods will be adopted but simple quality control, simple structure and more easier construction method shall be adopted as much as possible so that local contractors could have more chances to participate the Project.

In case the special construction method is adopted, such technology should be transferred to local contractors/engineers as much as possible.

2.2.1.6 Ability of Local Agencies in Management and Maintenance of the Road

The roads in Vientiane City are managed and maintained by DCTPC and VUDAA.

VUDAA takes charge of daily maintenance of the roads in Sikhouttabong, Chanhabouly, Xaysettha and Sisattanak District by providing approx. 80 staffs and DCTPC takes charge of the roads in the districts other than the above four (4) districts.

In relation to the Vientiane No.1 Road, VUDAA is taking care of the section from Sikhai to Chinaimo intersection and DCTPC from Chinaimo to Thanaleng. However, according to the information of VUDAA, it is not decided yet which organization will take responsibility for management and maintenance of the Project road after the completion of improvement work.

Having observed the existing situations, it deems to have no problems for VUDAA as well as DCTPC to manage and maintain the improved Project road with the overlay as well as the patching of the road surface. However, since VUDAA and DCTPC have few experiences for how to maintain properly the road drainage facility and various road facilities of the Project,
it is proposed to transfer the details of how to implement maintenance of such facilities and

at the same time make them well aware of that how important such maintenance works are for keeping the function of the road sufficiently in future.

2.2.1.7 Establishment of the Grade of Facilities

The road structure of this Project road is based upon the standard of AASHTO and「Road Structure Ordinance」in Japan.

Since the Project road is the international trunk road leading to Thailand through the Friendship Bridge and the most important main road in Laos,
it shall be improved to the road with durable structures and sufficient facilities for securing safe traffic.

VUDAA is implementing various urban drainage improvement projects financed by ADB and the Government of Thailand. Therefore, the Project road will be designed under close coordination with those projects so that the total urban drainage system can function effectively and consequently all residence can enjoy comfortable urban life.

2.2.1.8 Work Plan and Period

Work plan and period will be selected by taking into consideration of the facts mentioned as follows.

(1) Work plan

- Since the work is carried out on the road congested with many traffic and pedestrians, the occupied area for the work should be as minimum as possible so that inconvenience to traffics and pedestrians shall be minimized with the close coordination of MCTPC.
- During the work, the access to houses/shops along the road shall be frequently maintained.
- Since the earth work for construction of the drainage facilities takes place adjacent to the houses/buildings alongside the road, sequence of the work shall be planned to start from the down stream to up stream and the temporary facilities for preventing earth collapse shall be provided.
- In order to minimize the damages to the structures alongside the road, any vibration as well as settlement of the ground during the work shall be considered.
- The selected work plan shall be the one that can shorten the work period and make it possible to reuse the materials at its maximum for temporary facilities.

(2) Work period

- Commencement of the Project should be subject to the completion of the urban drainage facilities implemented by VUDAA, which are the outlets connected from the road drainage of the Project.
- The work schedule will be made by taking into consideration that the buried cultural properties survey can be conducted continuously together with the drainage construction.
- The road occupancy period will shorten as much as possible in order to minimize inconvenience to traffics and pedestrians.

2.2.2 Basic Plan

2.2.2.1 Improvement of the Existing Road

2.2.2.1-a Future Traffic Demand

(1) Present traffic volume

Present traffic volume and PCU converted volume surveyed at 11 major points of the Project road is shown in Table 2.2.2.1-a-(1).

Table 2.2.2.1-a-(1) Present Traffic Volume

Section		Lane Type	Slow Lane. (Unit/Day)				Traffic Lane (Unit/Day)							Total
			PC	MC	TT	Sub T.	Sedan	Pickup	Bus	L.Truck	Truck	Trailer	Sub T.	
		C.F.	0.25	0.25	0.50		1.0	1.0	1.5	1.5	1.5	1.5		
No.1	Sikhai~ Wattay	A.V.	659	18,728	3,772	23,159	3,410	5,739	675	2,502	302	11	12,639	21,117
		C.V.	165	4,682	1,886	6,733	3,410	5,739	1,013	3,753	453	17	14,384	
	Wattay~ Laksong	A.V.	758	20,607	3,514	24,879	4,901	5,278	651	1,359	80	12	12,281	20,430
		C.V.	190	5,152	1,757	7,098	4,901	5,278	977	2,039	120	18	13,332	
	Laksong~ Simuang	A.V.	249	8,743	1,578	10,570	2,911	2,634	271	722	51	10	6,599	10,163
		C.V.	62	2,186	789	3,037	2,911	2,634	407	1,083	77	15	7,126	
No.1A	Laksong~ R.4A	A.V.	439	10,982	1,773	13,194	2,881	2,457	451	653	14	2	6,458	10,760
		C.V.	110	2,746	887	3,472	2,881	2,457	677	980	21	3	7,018	
	R.4A~ Simuang	A.V.	249	8,023	1,432	9,704	3,232	2,890	371	420	40	1	6,954	10,154
		C.V.	62	2,006	716	2,784	3,232	2,890	557	630	60	2	7,370	
No.1	Simuang~ Thatkhao	A.V.	693	14,616	1,796	17,105	3,666	3,086	545	915	82	2	8,296	13,793
		C.V.	173	3,654	898	4,725	3,666	3,086	818	1,373	123	3	9,068	
	Thatkhao~ R.4A	A.V.	541	10,507	1,979	13,027	4,552	4,172	664	803	177	2	10,370	14,945
		C.V.	135	2,627	990	3,752	4,552	4,172	996	1,205	266	3	11,193	
	R.4A~ Chinaimo	A.V.	296	14,934	2,611	17,841	3,431	3,542	742	1,149	162	14	9,040	15,187
		C.V.	74	3,734	1,306	5,113	3,431	3,542	1,113	1,724	243	21	10,074	
	Chinaimo~ Nonghai	A.V.	311	10,116	1,353	11,780	1,158	1,522	409	1,155	121	11	4,376	8,507
		C.V.	78	2,529	677	3,283	1,158	1,522	614	1,733	182	17	5,224	
	Nonghai~ BeerLao	A.V.	583	8,936	1,154	10,673	1,720	2,091	750	1,794	456	111	6,922	11,435
		C.V.	146	2,234	577	2,957	1,720	2,091	1,125	2,691	684	167	8,478	
	BeerLao~ F.Bridge	A.V.	349	3,928	797	5,074	1,165	1,238	759	1,067	239	102	4,570	7,122
		C.V.	87	982	399	1,468	1,165	1,238	1,139	1,601	359	153	5,654	
	F. Bridge~ Thanaleng	A.V.	265	3,058	412	3,726	979	1,210	322	1,276	316	137	4,240	6,303
		C.V.	66	765	206	1,037	979	1,210	483	1,914	474	206	5,266	

Remark: PC=Pedal Cycle, MC=Motor Cycle, TT=Tuk-Tuk, PCU=Passengers Car Unit
C.F.=Conversion Factor, A.V.=Actual Volume, C.V.=Converted Volume

(2) Future traffic demand

Future traffic demand in the year of 2017 (10 years later) and 2027 (20 years later) is shown in Table 2.2.2.1-a-(2). For estimating the future volume, the expanding factor 2.85% is adopted which is indicated in the Feasibility Study.

Table 2.2.2.1-a-(2) Future Traffic Demand (PCU converted volume)

Section		Station	Distance (m)	Present Volume		Future Demand	
				2003	2004	2017	2027
R.1	Sikhai~Wattay	0+000~1+590	1,590	21,117	-	31,296	41,451
	Wattay~Laksong	1+590~3+900	2,310	20,430	-	30,278	40,103
	Laksong~Simuang	3+900~6+880	2,980	10,163	-	15,062	19,949
R.1A	Laksong~R.4A	0+000~1+050	1,050	10,760	-	15,947	21,121
	R.4A~Simuang	1+050~3+220	2,170	10,154	-	15,049	19,932
R.1	Simuang~Thatkhao	6+880~7+185	305	13,793	-	20,442	27,075
	Thatkhao~R.4A	7+185~8+490	1,305	-	14,945	21,535	28,523
	R.4A~Chinaimo	8+490~12+270	3,780	-	15,187	21,884	28,985
	Chinaimo~Nonghai	12+270~15+310	3,040	-	8,507	12,258	16,236
	Nonghai~BeerLao	15+310~18+300	2,990	-	11,435	16,478	21,824
	BeerLao~F.Bridge	18+300~24+300	6,000	-	7,122	10,263	13,593
	F. Bridge~Thanaleng	24+300~25+700	1,400	-	6,303	9,083	12,030

(3) Traffic capacity

Traffic capacity of the Project road after completion of the Project is shown in Table 2.2.2.1-a-(3). According to the HCM (Highway Capacity Manual), maximum traffic capacity per one (1) lane comes out from the design speed of the lane. The design speed for the Project road is 40km/h for the section between Sikhai and Simuang and 60km/h between Simuang and Friendship Bridge, which corresponds to maximum traffic volume 1,900 PCU/hour/lane and 2,200 PCU/day/lane respectively.

Table 2.2.2.1-a-(3) Traffic Capacity for Each Section (PCU converted volume)

Section			Lane	Max. Capacity	L.R.F.		H.V. R.F.	D.P. R.F.	Hourly Capacity	No. of Lane	Peak Ratio	H.D. Ratio	Daily Capacity
				PCU/h/l	L.W.	fw	fHV	fP	PCU/h/l	No.	k(%)	D(%)	PCU/day
Traffic Lane	R.1	Sikhai~Wattay	4	1,900	3.25	0.9	1.0	1.0	1,710	4	11.6	60	49,138
		Wattay~Laksong	4	1,900	3.25	0.9	1.0	1.0	1,710	4	7.6	60	75,000
		Laksong~R.4A (One Way)	2	1,900	3.25	0.9	1.0	1.0	1,710	2	7.7	100	44,416
		R.4A~Simuang (One Way)	1	1,900	3.25	0.9	1.0	1.0	1,710	1	9.9	100	17,273
	R.1A	Laksong~R.4A (One Way)	2	1,900	3.25	0.9	1.0	1.0	1,710	2	10.5	100	32,571
		R.4A~Simuang (One Way)	2	1,900	3.25	0.9	1.0	1.0	1,710	2	10.2	100	33,529
Slow and Combined Lane	R.1	Sikhai~Wattay	2(Slow)	1,900	2.15	0.6	1.0	1.0	1,140	2	11.6	60	16,379
		Wattay~Laksong	2(Slow)	1,900	2.15	0.6	1.0	1.0	1,140	2	7.6	60	25,000
		Laksong~R.4A (One Way)	2 (Combined)	1,900	3.25	0.9	1.0	1.0	1,710	2	7.7	100	44,416
		R.4A~Simuang (One Way)	1(Slow)	1,900	2.15	0.6	1.0	1.0	1,140	2	9.9	100	23,030
	R.1A	Laksong~R.4A (One Way)	2(Slow)	1,900	2.15	0.6	1.0	1.0	1,140	2	10.5	100	21,714
		R.4A~Simuang (One Way)	2(Slow)	1,900	2.15	0.6	1.0	1.0	1,140	2	10.2	100	22,353
Traffic and Combined Lane	R.1	Simuang~Thatkhao	4	2,200	3.25	0.9	1.0	1.0	1,980	4	9.0	60	73,333
		Thatkhao~Chinaimo	4	2,200	3.25	0.9	1.0	1.0	1,980	4	9.2	60	71,739
		Chinaimo~Nonghai	4	2,200	3.25	0.9	1.0	1.0	1,980	4	8.0	60	82,500
		Nonghai~BeerLao	4	2,200	3.25	0.9	1.0	1.0	1,980	4	9.4	60	70,213
		BeerLao~F.Bridge	4	2,200	3.25	0.9	1.0	1.0	1,980	4	9.7	60	68,041
		F.Bridge~Thanaleng	2	2,200	3.50	0.9	1.0	1.0	1,980	2	9.5	50	20,842

Remark: L.R.F.= Revision Factor by Lane, H.V.R.F.= Revision Factor by Heavy Vehicle
D.P.R.F.= Revision Factor by Drivers Population, H.D. Ratio= Heavy Direction Ratio

(4) Analysis of congestion degree and service level

Congestion degree and service level of the Project road after completion of the Project is

shown in Table 2.2.2.1-a-(4), which is worked out based upon HCM. HCM recommends the service level for urban area to be more than C. According to Table 2.2.2.1-a-(4), the service level at the section between Route No.4A and Simuang intersection shows C and D after 10 years and 20 years respectively, which is equal or lower than C.

However, two (2) slow lanes of the service level A (the road width is 2.15m) provided at both side of traffic lane recovers the low service level of the section.

Table 2.2.2.1-a-(4) Congestion Degree and Service Level (PCU converted volume)

Section			Width Of Lane	No. of Lane	Daily Capa.	Present Traffic V.		2017year			2027year		
						2003 year	2004 year	Traffic Volume	Conge. Degree	SL.	Traffic Volume	Conge. Degree	SL
T.L	R1	Sikhai~Wattay	3.25	4	49,138	14,384	-	21,318	0.43	B	28,235	0.57	C
		Wattay~Laksong	3.25	4	75,000	13,332	-	19,759	0.26	A	26,170	0.35	B
		Laksong~R.4A	3.25	2	44,416	7,126	-	10,561	0.24	A	13,988	0.31	B
		R.4A~Simuang	3.25	1	17,273	7,126	-	10,561	0.61	C	13,988	0.81	D
	1	Laksong~R.4A	3.25	2	32,571	7,018	-	10,401	0.32	B	13,776	0.42	B
		R.4A~Simuang	3.25	2	33,529	7,370	-	10,923	0.33	B	14,467	0.43	B
S&C. L	R1	Sikhai~Wattay	2.15	2	16,379	6,733	-	9,979	0.61	C	13,216	0.81	E
		Wattay~Laksong	2.15	2	25,000	7,098	-	10,520	0.42	B	13,933	0.56	C
		Laksong~R.4A	3.25	2	44,416	3,037	-	4,501	0.10	A	5,961	0.13	A
		R.4A~Simuang	2.15	2	23,030	3,037	-	4,501	0.20	A	5,961	0.26	A
	1	Laksong~R.4A	2.15	2	21,714	3,742	-	5,546	0.26	A	7,345	0.34	B
		R.4A~Simuang	2.15	2	22,353	2,784	-	4,126	0.18	A	5,465	0.24	A
T&C.L	R1	Simuang~Thatkhao	3.25	4	73,333	13,793	-	20,442	0.28	A	27,075	0.37	B
		Thatkhao~R.4A	3.25	4	71,739	-	14,945	21,535	0.30	B	28,523	0.40	B
		R.4A~Chinaimo	3.25	4	71,739	-	15,187	21,884	0.31	B	28,985	0.40	B
		Chinaimo~Nonghai	3.25	4	82,500	-	8,507	12,258	0.15	A	16,236	0.20	A
		Nonghai~BeerLao	3.25	4	70,213	-	11,434	16,476	0.23	A	21,822	0.31	B
		BeerLao~F.Bridge	3.25	4	68,041	-	7,121	10,261	0.15	A	13,591	0.20	A
		F.Bridge~Thanaleng	3.50	2	20,842	-	6,303	9,083	0.44	B	12,030	0.58	C

Service level is specified by HCM as follows:

A: The traffic volume is very less and the traffic flows freely.
B: The traffic flows freely but have a little restriction.
C: The traffic flows constantly with the reasonable driving speed.
This is the service level suitable for urban area.
D: The traffic is congested but still could keep tolerable driving speed.
E: The traffic volume reaches to maximum limit of the road capacity and forced to stop at times.
F: The traffic volume is over capacity and the traffic is forced to stop by severe congestions.

2.2.2.1-b Road Design

(1) Structural design criteria

As stated in Clause 2.2.1.1-a, (2), the basic concept of the Project is that the alignment of the road will be arranged within the present ROW and to avoid replacement of any houses / buildings / trees alongside the road.

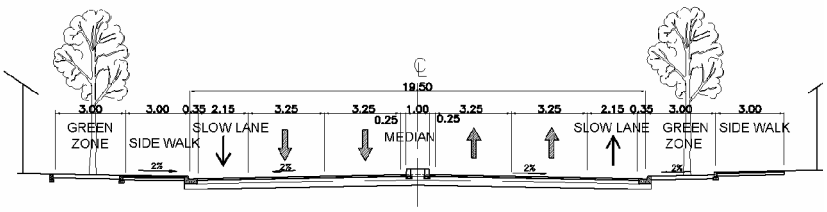
Considering the basic concept and based upon the Road Design Manual made by DOR in 1996 year as well as AASHTO, the general design criteria is established as shown in Table 2.2.2.1-b-(1).

Table 2.2.2.1-b-(1) Structural Design Criteria

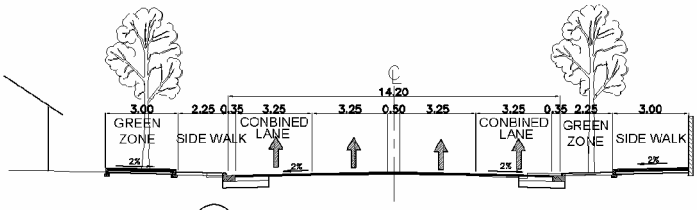
	Sikhai ~ Simuang	Simuang ~ BeerLao	BeerLao ~ F. Bridge	F.Bridge ~ Thanaleng
	0.000~6+880 (6.88km)	6+880~18+300 (11.42km)	18+300~24+300 (6.00km)	24+300~25+700 (1.40km)
Distinction	Urban Road	Suburban Road	Rural Road	
Design Traffic V.	After 10 and 20 years demand for pavement and traffic lane respectively.			
Design Speed	40 km/h	60 km/h		
Lane Number	4 Lanes (Both way) 2 Lanes (One way)	4 Lanes (Both way)		2 Lanes (Both way)
Median	4 Lanes: 1.0m width 2 Lanes: Non	4 Lanes: 0.7m width		Non
Width of Traffic L.	3.25m			3.50m
Width of Combined L.	3.25m			Non
Width of Slow L.	2.15m	Including Combined L		Non
Width of Sidewalk	3.0m(variable)	2.5m(variable)	Non	
Width of Greenbelt	2.25m(variable)	Non		
Width of Shoulder	0.35m (both sides)		Village Area: 2.50m Field Area: 1.50m	Field Area: 1.50m

The typical cross sections for each section are shown in Figure 2.2.2.1-b-(1) and (2).

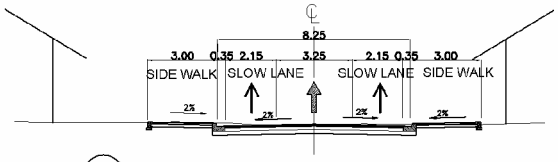
① Sikhai ~ Laksong (4-Traffic Lane / Sidewalk and Greenbelt)
② Laksong ~ Road No. 4A (2-Traffic Lane / One way –Road No. 1)
③ Route 4A ~ Simuang (1-Traffic Lane / One way – Road No. 1)
④ Laksong ~ Road No. 4A (2-Traffic Lane / One way – Road No. 1A)
⑤ Route 4A ~ Simuang (2-Traffic Lane / One way – Road No. 1A)
⑥ Simuang ~ BeerLao (4-Traffic Lane / Sidewalk)
⑦ BeerLao ~ Friendship Bridge (4-Traffic Lane / No-Sidewalk)
⑧ F. Bridge ~ Thanaleng (2-Traffic Lane / No-Sidewalk)



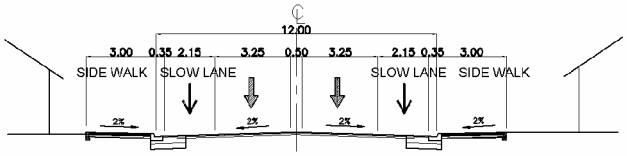
① 4 LANE SECTION (SEID WALK,GREEN ZONE)
(SIKHAY JCT. ~ LAKSONG JCT.)
STA.0+000 ~ STA.3+900



② 2 LANE SECTION (ONE WAY / ROUTE No.1)
(LAKSONG JCT. ~ 4A JCT.)
STA.3+900 ~ STA.4+480

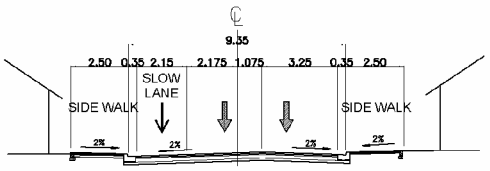


③ 1 LANE SECTION (ONE WAY / ROUTE No.1)
(4A JCT.~ SIMUANG JCT.)
STA.4+800 ~ STA.6+880

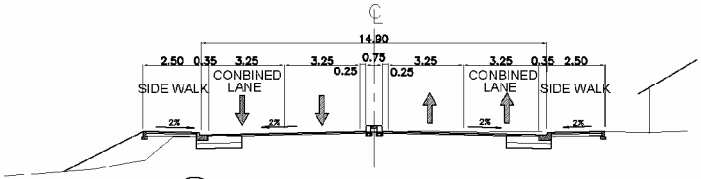


④ 2 LANE SECTION (ONE WAY / ROUTE No.1A)
(LAKSONG JCT. ~ 4A JCT.)
STA.0+000 ~ STA.1+050

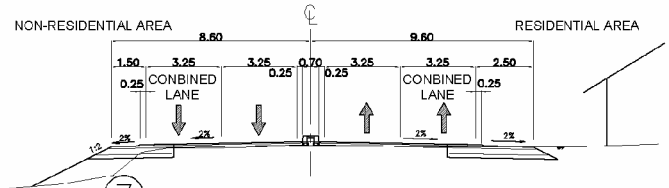
Figure 2.2.2.1-b-(1) Typical Cross Section



⑤ 2 LANE SECTION (ONE WAY / ROUTE No.1A)
(4A JCT. ~ SIMUANG JCT.)
STA.1+050 ~ STA.3+220

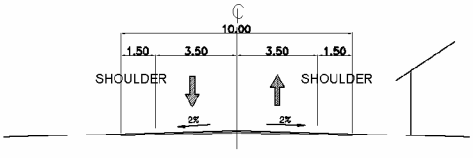


⑥ 4 LANE SECTION (WITH SEID WALK)
(SIMUANG JCT. ~ BEERAO)
STA.6+880 ~ STA.18+300



⑦ 4 LANE SECTION (WITHOUT SEID WALK)
(BEERLAO ~ FRIENDSHIP BRIDGE JCT.)
STA.18+300 ~ STA.24+120

- Chinaimo(12+270)~Beerlao(18+300) ; Flat Type median(Rood marking)
- Thatkhao(7+185)~Beerlao(18+300) ; Flat Type Sidewalk



⑧ 2 LANE SECTION (NO-SIDE WALK)
(BEERLAO~THANALENG)
STA.1+050 ~ STA.3+220

Figure 2.2.2.1-b-(2) Typical Cross Section

(2) Geometric design criteria

Geometric design criteria which is adopted in this Basic Study based upon AASHTO and 「Road Structure Ordinance」 in Japan are shown in Table 2.2.2.1-b-(2).

Table 2.2.2.1-b-(2) Geometric Design Criteria

	Sikhai~Simuang 0+000~6+880(6.88km)	Simuang~BeerLao 6+880~18+300(11.42k)	BeerLao~Thanaleng 18+300~25+700(7.40km)	Remark
Distinction	Urban Section	Suburban Section	Rural Section	
Design Speed	40 km/h	60 km/h		
Min. Curve Radius	60 m	150 m		
Min. Curve Length	CL≧1,498/R	CL≧5,054/R		L=0.0702V^3/R/C
Max. Grade	8%			
Min. Vertical Curve Length	30 m	40 m		
	凹:K≧8 凸:K≧5	凹:K≧15~18 凸:K≧14~18		
Sight Distance	40 m	80 m		
Typical Cross-fall	2 %			
Super-elevation	Non	150~260 m	4.0 %	Based on AASHT & present cross-fall
		260~400 m	3.5 %	
		400~600 m	3.0 %	
		600~900 m	2.5 %	
		900~1,200 m	2.0 %	
Transition of Super-elevation.	1/125 (The base line is the outside of traffic road)			

(3) Alignment

・ Horizontal alignment

The present min. curve radius in the Project road is shown in Table 2.2.2.1-b-(3), which satisfies the criteria described in the above.

Table 2.2.2.1-b-(3) Present Min. Curve Radius

	Design Speed	Present Min. C. R.	Curve Sta.
Road No.1	40 km/h	250 m	5+778~5+838
	60 km/h	185 m	7+962~8+072
Road No.1A	40 km/h	150 m	2+067~2+112

・ Vertical alignment

Since the Project road passes in the flatter terrain along Mekong River, the present grade of the road is 1~2 % in all.

As shown in Table 2.2.2.1-b-(4), the present maximum grade is 2.46 % in the section between Chinaimo and Nonghai and it is not necessary to take up for designing of the alignment.

Table 2.2.2.1-b-(4) The Present Maximum Grade

	Design Speed	Present Max. G.	Sta.
Road No.1	40 km/h	0.65 %	4+840~4+920
	60 km/h	2.46 %	14+880~14+960
Road No.1A	40 km/h	1.60 %	1+060~1+100

・ Number of lane and its width

Number of lane and width for the Project road is as shown in Table 2.2.2.1-b-(1).

2.2.2.1-c Pavement Design

(1) Pavement structure

・ Type of pavement

The asphalt concrete pavement is planned for the Project.

・ Pavement Structure

In principle, the overlay pavement is planned but in some sections at where the overlay couldn't adopt due to construction of the underground structures, the reconstruction pavement is planned as shown in Table 2.2.2.1-c-(1).

Even in the overlay section, for the construction of shoulder part at where the sub-grade and/or the sub-base is unstable, the reconstruction pavement will be adopted.

Further for the section at where the results of the boring test shows the existing pavement to be unacceptable as base-course or for the section at where CBR is too low (less than 3~4) to utilize as the sub-grade, those pavement unsuitable for sub-grade and/or sub-base would be replaced.

Table 2.2.2.1-c-(1) Pavement Structure for Sections

Section		Station	Overlay	Reconstruction
R.1	Sikhai~Wattay	0+000~1+590	○	―
	Wattay~Laksong	1+590~3+900	○	―
	Laksong~R.4A	3+900~4+800	○	―
	R.4A~Simuang	4+800~6+880	―	○
1	Laksong~R.4A	0+000~1+050	○	―
	R.4A~Simuang	1+050~3+220	―	○
R.1	Simuang~Thatkhao	6+880~7+185	○	―
	Thatkhao~R.4A	7+185~8+490	○	―
	R.4A~Chinaimo	8+490~12+270	○	―
	Chinaimo~Nonghai	12+270~15+310	○	―
	Nonghai~BeerLao	15+310~18+300	○	―
	BeerLao~F.bridge	18+300~24+300	○	―
	F. Bridge~Thanaleng	24+300~25+700	○	―

(2) ESAL Value (18kip Equivalent Single Axle Load)

Based upon the results of the traffic volume survey conducted in the Study, ESAL value in the 10 years performance period from 2008 to 2017 is calculated as shown in Table 2.2.2.1-c-(2).

Table 2.2.2.1-c-(2) ESAL Value for Each Section

Section		Station	Distance(m)	ESAL Value
R.1	Sikhai~Wattay	0+000~1+590	1,590	5.076,010
	Wattay~Laksong	1+590~3+900	2,310	3,507,593
	Laksong~R.4A	3+900~4+800	900	2,425,853
	R.4A~Simuang	4+800~6+880	2,080	3,144,219
R.1A	Laksong~R.4A	0+000~1+050	1,050	3,285,563
	R.4A~Simuang	1+050~3+220	2,170	2,801,352
R.1	Simuang~Thatkhao	6+880~7+185	305	2,691,286
	Thatkhao~R.4A	7+185~8+490	1,305	2,775,881
	R.4A~Chinaimo	8+490~12+270	3,780	2,957,056
	Chinaimo~Nonghai	12+270~15+310	3,030	2,157,594
	Nonghai~BeerLao	15+310~18+300	2,990	5,364,105
	BeerLao~F.Bridge	18+300~24+300	6,000	3,467,977
	F. Bridge~Thanaleng	24+300~25+700	1,400	4,882,980

Equivalent conversion factor of 18kip Equivalent Single Axle Load (ESAL) is referred to those used for the design of「The National Road Route 9」as shown in Table 2.2.2.1-c-(3) and traffic volume expanding factor「2.85%」is referred to the result of the Feasibility Study.

Table 2.2.2.1-c-(3) Equivalent Conversion Factor

Sedan	Pickup	Bus	Light Truck	Truck	Trailer
0.010	0.100	0.383	0.383	2.598	4.008

(3) Design CBR

The CBR test was conducted at 32 points for shoulder portion in 2003 and 50 points for base-course, sub-base and sub-grade in 2004/2005.

All data collected is attached herewith as Attachment-1. Based upon those data, the design CBR adopted for designing each section is shown in Table 2.2.2.1-c-(4).

The sub-grade of sections for the reconstruction pavement would be designed by the design CBR=15, because the excavated sub-grade material is replaced by the imported good material.

Table 2.2.2.1-c-(4) Design CBR for Each Section

Section		Station	Base-course		Sub-base		Sub-grade
			ATB	CBR	ATS	CBR	CBR (Rev.)
R.1	Sikhai~Wattay	0+000~1+000	19	23	24	24	21
	Wattay~Laksong	1+000~3+900	23	28	21	33	13
	Laksong~R.2	3+900~5+800	16	34	29	22	12
	R.2~Simuang	5+800~6+880	25	25	29	33	11
R.1A	Laksong~R.2	0+000~2+085	20	37	24	22	11
	R.2~Simuang	2+085~3+220	29	27	20	27	16
R.1	Simuang~Thatkhao	6+880~7+185	28	22	23	13	16
	Thatkhao~R.4A	7+185~8+490	21	31	22	37	13
	R.4A~Chinaimo	8+490~12+270	26	58	20	28	11
	Chinaimo~Nonghai	12+270~15+310	25	53	20	43	26
	Nomghai~BeerLao	15+310~18+300	26	68	27	29	16
	BeerLao~F.Bridge	18+300~24+300	24	74	17	22	9
	F. Bridge~Thanaleng	24+300~25+700	10	52	20	49	17

Remark: ATB= Average Base-course Thickness (cm)
ATS=Average Sub-base Thickness (cm)

(4) Design standard

「Guide for Design of Pavement Structure 1993 (AASHTO)」 is adopted for the design standard of pavement structure.

The details adopted are as follows.

・ Performance period:	10 years from 2008 to 2017.	
・ Cumulative 18-kip ESAL Traffic (W_{18}):	ESAL value in the 10 years Performance Period from 2008 to 2017, based upon the traffic volume survey results.	
・ Reliability (R):	R=80% (Z_R=－0.841, S_O=0.45)	
・ Performance criteria:	The original serviceability, P_O=4.2	
	The terminal serviceability, P_t=2.5	
・ Resilient modulus (MR):	MR is calculated from CBR value by the following formula, MR=1,500xCBR	
・ Layer coefficient:	Asphalt concrete layer,	a_1=0.39
	BTB layer,	a_2=0.30
	Base-course (CBR=80)	a_3=0.135
	Sub-base (CBR=30)	a_4=0.108
・ Layer drain coefficient:	Base-course	m_3=0.9
	Sub-base	m_4=0.8

The required SN for each section is calculated by the following formula.

$$Log_{10}(W_{18}) = Z_R \times S_O + 9.36 \times Log_{10}(SN + 1) - 0.20 + \frac{Log_{10}\{\Delta PSI / (4.2 - 1.5)\}}{0.40 + \{1094 / (SN+1)^{5.19}\}} + 2.32 \times Log_{10}(M_R) - 8.07$$

The pavement thickness is calculated by the following formula

$$SN = a_1D_1 + a_2D_2 + a_3D_3m_3 + a_4D_4m_4$$

(5) Pavement structure

The pavement structure worked out from the formula is shown in Table 2.2.2.1-c-(5) for each section.

Table 2.2.2.1-c-(5) Designed Pavement Structure

Section		W_{18}	SN_1	PT	Designed pavement structure						SN_2
					AC	BTB	BC	SB	BC	SB	
					New	New	New	New	Old	Old	
R.1	Sikhai~Wattay	5,076,010	2.429	OL	5.0cm	3.0cm	—	—	19.0cm	24.0cm	2.438
	Wattay~Laksong	3,507,593	2.747	OL	5.0cm	5.0cm	—	—	23.0cm	20.0cm	2.805
	Laksong~R.4A	2,425,853	2.665	OL	5.0cm	4.0cm	—	—	16.0cm	29.0cm	2.693
	R.4A~Simuang	3,144,219	2.553	Rec.	5.0cm	3.0cm	15.0cm	16.0cm	—	—	2.567
R.1A	Laksong~R.4A	3,285,563	2.899	OL	5.0cm	6.0cm	—	—	20.0cm	24.0cm	2.902
	R.4A~Simuang	2,801,352	2.504	Rec.	5.0cm	3.0cm	15.0cm	15.0cm	—	—	2.520
R.1	Simuang~Thatkhao	2,691,286	2.426	OL	5.0cm	3.0cm	—	—	28.0cm	23.0cm	2.482
	Thatkhao~R.4A	2,775,881	2.642	OL	5.0cm	4.0cm	—	—	21.0cm	22.0cm	2.743
	R.4A~Chinaimo	2,957,059	2.848	OL	5.0cm	3.0cm	—	—	26.0cm	20.0cm	2.942
	Chinaimo~Nonghai	2,157,594	1.934	OL	5.0cm	3.0cm	—	—	25.0cm	20.0cm	2.932
	Nonghai~BeerLao	5,264,105	2.713	OL	5.0cm	3.0cm	—	—	26.0cm	27.0cm	3.254
	BeerLao~F.Bridge	3,467,977	3.159	OL	5.0cm	6.0cm	—	—	25.0cm	17.0cm	3.162
	F. Bridge~Thanaleng	4,882,980	2.618	OL	5.0cm	6.0cm	—	—	10.0cm	20.0cm	2.634

Remark: SN_1 = Required SN, SN_2 = Designed SN, PT = Pavement Type
AC = Asphalt Concrete, BTB = Bituminous Treatment Base,
BC = Base-course, SB = Sub-base

(6) Replacement of base-course and sub-grade

The section, ether CBR is less than 20 or present surface is deemed to be not suitable for base-course by pot-halls, cracks and/or puddles, would be replaced by other good material. The section at where CBR of sub-grade is less than 3 that means the bearing capacity is insufficient, is replaced by good material too.

The section deemed necessary to replace is shown in Table 2.2.2.1-c-(6).

Table 2.2.2.1-c-(6) Base-course & Sub-grade Replacement Section

Station		Distance(m)		Condition of present Pavement surface	Pavement method	
		Left	Right		Pave. of AC. surface	Reconstruct. Pavement
1	4+600~4+750	150	150	Base-course, lack of B.C. (凹凸)	○	―
1A	0+300~0+700	400	―	―do―	○	―
1	7+800~7+950	150	150	Base-course, Lack of B.C. (Pot-halls, puddles)	○	―
	9+000~9+180	180	180	Base-course, Lack of B.C. (Pot-halls)	○	―
	11+940~12+080	140	140	Sub-grade, Lack of B.C. (CBR 3)	―	○
	18+400~18+600	200	200	―do― (CBR 3)	―	○
	19+400~19+500	100	100	―do― (CBR 4)	―	○
	21+030~21+120	90	90	Base-course, Lack of B.C. (Pot-halls)	○	―
	21+900~22+000	100	100	Sub-grade, Lack of B.C. (CBR 4)	―	○

2.2.2.1-d Improvement of soft ground

The boring survey was conducted at 13 locations at shoulder portion for expanding the present road. According to the results of the boring survey (Attachment-2), it is confirmed that the strata of good condition with N-Value being more than 10 is laying at the shallower place of 0.8~2.0m deep.

Soft material covering over the strata of good condition would be replaced by imported good material, the plan of which is shown in Figure 2.2.2.1-d-(1).
The section to be improved is shown in Table 2.2.2.1-d-(1.)

Table 2.2.2.1-d-(1) Improvement of Soft Ground

No.	Station	Left			Right		
		H	W	EL	H	W	EL
1	8+510~8+530	2.0	2.6	+165.00	2.0	10.8	+165.00
2	13+290~13+430	―	―	―	0.8	2.7	+168.00
3	16+250~16+510	1.8	2.0	+166.00	―	―	―
4	16+270~16+490	―	―	―	1.2	1.9	+166.50
5	17+470~17+690	0.8	3.1	+165.50	―	―	―
6	17+550~17+710	―	―	―	0.8	1.9	+165.45
7	18+790~19+210	1.1	2.5	+165.00	―	―	―
8	21+270~21+310	―	―	―	1.0	2.5	+162.90
9	22+090~22+270	―	―	―	0.7	4.3	+166.20
10	22+590~22+870	―	―	―	1.2	2.1	+165.80

Remark: H= Thickness of replacement, W=Width of replacement,
EL=Bottom elevation of replacement,

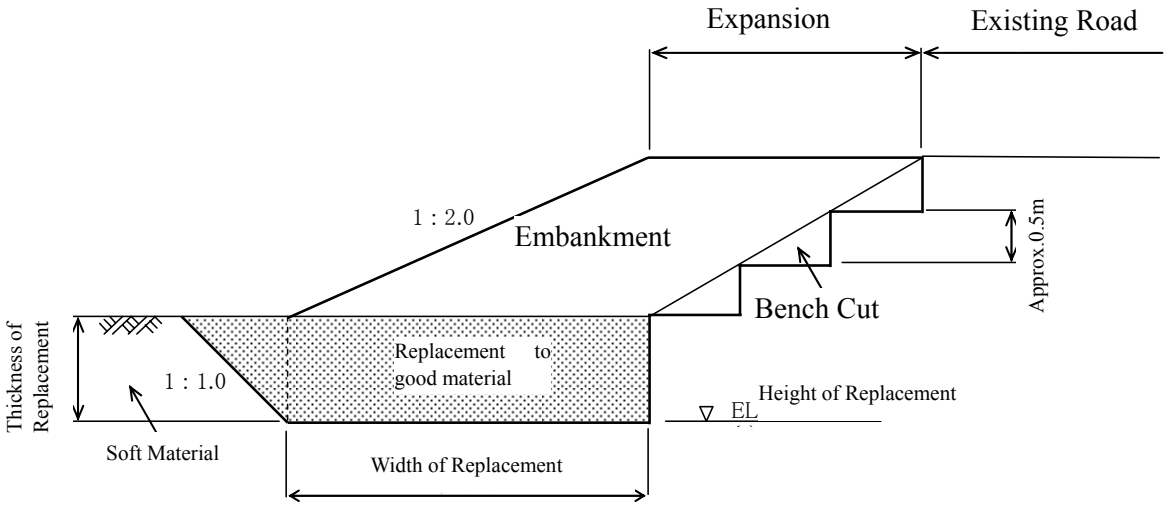


Figure 2.2.2.1-d-(1) Improvement of Soft Material

2.2.2.1-e Improvement of intersections

(1) Intersections to be improved

There are 18 major intersections in the Project road, within which 7 intersections have been already improved. So remaining 11 intersections will be improved as shown in Table 2.2.2.1-e-(1).

Table 2.2.2.1-e-(1) Intersections Improvement Plan

No	Sta.	Name of Int.	Intersected Road	Type of Intersection
1	0+000	Sikhai	Road 13N/11	Y type & at-grade Int., Zebra R. Marking
2	1+000	Wattay A.P.	Wattay Air Port	T type & at-grade Int., Zebra R. Marking
3	1+590	Wattay T-2	Road T-2	T type & at-grade Int., Zebra R. Marking
4	3+900	Laksong	Road 1A	Y type & at-grade Int., Zebra R. Marking
5	6+880	Simuang	Road 1A	Y type & at-grade Int., Zebra R. Marking
6	7+185	Thatkhao	Road 4	+ type & at-grade Int., Zebra R. Marking
7	8+490	Road 4A	Road 4A	T type & at-grade Int., Zebra R. Marking
8	8+810	Road 7	Road 7	T type & at grade Int., Zebra R. Marking
9	12+270	Chinaimo	Boro Road	Y type & rotary at-grade, Zebra R.M.
10	15+310	Nonghai	Road 5	+ type & at-grade Int., Zebra R. Marking
11	24+120	F.Bridge	F.Bridge	T type & at-grade Int., Zebra R. Marking

(2) Design standard for intersection improvement

Design of intersection improvement is based upon the standard of「Road Structure Ordinance」in Japan and design criteria is shown in Table 2.2.2.1-e-(2).

Table 2.2.2.1-e-(2) Design Criteria for Intersection Improvement

	Sikhai~Simuang	Simuang~BeerLao	BeerLao~Thanaleng
	0+000~6+880 (6.88km)	6+880~18+300 (11.42km)	18+300~24+300 (6.00km)
Distinction	Urban Road	Suburban Road	Rural Road
Design Speed	40 km/h	60 km/h	
Added lane width	3.0m (in principle)		
Left-turn retention length	30.0m (in principle)		
Shifting length	40m	90m	
Tapered length	20m	30m	40m

2.2.2.2 Improvement of the Road Drainage

2.2.2.2-a Catchments area and outlets of the road drainage

Catchments area for the road drainage is demarcated into 22-area and the present outlets of drainage for each catchments area are shown in Figure 2.2.2.2-a-(1) and Table 2.2.2.2-a-(1).

Table 2.2.2.2-a-(1) The Present Condition of Drainages

CA	Outlet of drainage for each area
CA1	Through Hong Wat Tay & Hong Xeng to That Luang Marsh
CA2	Through DL1 & DL2 via Hong Xeng to That Luang Marsh
CA3	Through Hong Pasak via Hong Xeng to That Luang Marsh
CA4	Through DL3 via Hong Thong & Hong Ke to That Luang Marsh
CA5	A part of CA5 through DL4 via Hong Ke to That Luang Marsh and the other part of CA5 through DL5 via Hong Khoua Khao to That Luang Marsh
CA6	Through DL6 vi Hong Khoua Khao & Hong Ke to that Luang Marsh
CA7	Through existing canal to Mekong River
CA8	Through Hong Khoua Khao & Hong Ke to That Luang Marsh
CA9	Through existing open ditches to the lower field
CA10	Through existing open ditches to Mekong River
CA11	Through existing open ditches to the lower field
CA12	Through existing open ditches to the lower field
CA13	Through existing open ditches & surface of the road via adjacent ponds to That Luang Marsh
CA14	Through sdjacent ponds to That Luang Marsh
CA15	Through existing open ditches to Mekong River
CA16	Through existing irrigation canal to Mekong River
CA17	Through existing open ditches to Mekong River
CA18	Through existing open ditches to That Luang Marsh
CA19	Through existing open ditches to That Luang Marsh
CA20	Through surrounding lower field to That Luang Marsh and/or Mekong River
CA21	Through Hong Dua to Mekong River
CA22	Through surrounding lower field to That Luang Marsh and/or Mekong River

Remark: Outlet canal has been improved.
Outlet canal is scheduled to be improved.

2.2.2.2-b Completion schedule of discharge channels (Outlets)

The First Stage of the Improvement Project of Urban Drainage System has completed during the year of 1996 to 2001. The Second Stage of the Improvement Project of Urban Drainage System is on going from the year of 2002 to 2006.

Since this Urban Drainage System functions as the outlets of the road drainage in the Project, this Project could be commenced only after completion of this Urban Drainage System, the schedule of which is shown in Table 2.2.2.2-b-(1).

This Urban Drainage System is the project for the central area of the city and no schedule of drainage improvement at out of the city.

Table 2.2.2.2-b-(1) Completion Schedule of Discharge Channels

CA	Discharge Cannel		The year of Completion	Remark
	Name of Channel	Imp. Agency		
CA1	Hong Wat Tay No.1 (US. 2.3km)	VUDAA	March 2006	ADB Fund
	Hong Wat Tay No.2 (DS. 2.7km)	VUDAA	December 2005	Thai Fund
	Hong Xeng (4.2km)	VUDAA	March 2006	ADB Fund
CA2	DL1 (0.75km)	VUDAA	2000	Completed
	DL2 (0.63km)	VUDAA	2003	Completed
	Hong Wat Tay No.1 (US. 2.3km)	VUDAA	March 2006	ADB Fund
	Hong Wat Tay No.2 (DS. 2.7km)	VUDAA	December 2005	ADB Fund
	Hong Xeng (4.2km)	VUDAA	March 2006	ADB Fund
CA3	Hong Pasak (US. 1.5km)	MCTPC	1995	Completed
	Hong Pasak (DS. 1.7km)	VUDAA	2000	Completed
	Hong Xeng (4.2km)	VUDAA	March 2006	ADB Fund
CA4	DL3 (0.39km)	MCTPC	2001	Completed
	Hong Thong (1.75km)	VUDAA	2001	Completed
	Hong Ke (3.4km)	VUDAA	2001	Completed
CA5	DL4 (0.14km)	VUDAA	October 2005	ADB Fund
	DL5 (0.26km)	VUDAA	October 2005	ADB Fund
	Hong Thong (1.75km)	VUDAA	2001	Completed
	Hong Khoua Khao (2.50km)	VUDAA	2001	Completed
	Hong Ke (3.40km)	VUDAA	2001	Completed
CA6	Hong Khoua Khao (2.50km)	VUDAA	2001	Completed
CA8	Hong Khoua Khao (2.50km	VUDAA	2001	Completed
CA13	Hong Sovamemone (1.35km)	VUDAA	March 2006	ADB Fund

2.2.2.2-c Drainage Design

(1) Calculation of rainfall volume to discharge

Maximum rainfall volume at the drainage facilities from the furthest point of the catchments area is calculated with the following formula.

$$Q = \frac{1}{360} C \cdot I \cdot A$$

Q = Maximum rainfall volume to discharge (m^3/sec)

C = Discharge factor

Based upon the survey report by JICA on 2001 for existing road and drainage condition on Vientiane Municipality, C is determined as follows:

- Catchments area alongside the intersected road 0.65
- Catchments area alongside the Project road 0.80
- Road surface 0.90

I = Rainfall intensity within reach-time of flow (mm/hr)

A = Catchments area (ha)

(2) Rainfall intensity

In the Improvement Project of Urban Drainage System, Main drainages such as Hong Thong and Hong Khoua Khao are designed on the 10-year probability rainfall. On the other hand, the road drainages like DL3 (Pipe culvert) are designed on the 2-year probability rainfall.

Referring to the above, the drainages for this Project will be designed on the 2-year probability rainfall and the following formula, which was proposed in the feasibility study conducted in 1990 for the improvement of drainage system in Vientiane, will be used for calculation of the rainfall intensity.

$$\boldsymbol{I} = \frac{5835}{t + 65.40}$$

I = Rainfall intensity within reach-time of flow (mm/hr)

t = Reach-time of flow (min.)

10 min. time is adopted for minimum reach-time (t) and in this case Rainfall Intensity (I) becomes 77.4mm/hr.

(3) Hydraulic analysis of drainage facilities

The ability of flow of pipe culvert and U-type gutter is calculated with the following formula (Manning Formula) in the condition of natural flow.

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

V = Average velocity of flow (m/sec)

n = Roughness factor (U-type gutter = 0.015, concrete pipe = 0.013)

R = Hydraulic mean depth (=A/P, A : Flow area, P : Wetted perimeter length)

i = Longitudinal slope

80% flow ability of the section is adopted considering the expected decrease of ability due to the accumulated soil and debris flowed in the pipes and as the results, 0.6 m/s ~ 3.0 m/s flow velocity is adopted.

(4) Drainage system

- In the section between Sikhai and Laksong (3.9km) which is composed of 2-mount up type sidewalk, 4-traffic lane and 2-slow lane, the flow of the road drainage drop in to the U-type gutter and flow through the pipe culvert to the outlet.
- In the section between Laksong and Thatkhao (6.5km including R.1A) which is composed of 2-mount up type sidewalk and 4-traffic lane, the flow drop in to the side drain culvert and flow out to the outlet.
- In the section between Thatkhao and Beerlao (11.3km), the flow drop into the U-type gutter and flow through the pipe culvert to the outlet.
- In the section between Beerlao and Friendship Bridge (5.8km) which has flat type sidewalk, the flow is the natural flow to the surrounding lower field.
- The flow from the connecting road drops in to the public sewage inlet boxes provided alongside the Project road and flow in to the side drain culvert.
- Manholes will be installed for easier maintenance of the facilities in the interval of max. 100m. distance considering the capacity of equipment available for the cleaning work in the Vientiane city.
- Thickness of the backfilling including pavement on top of the culvert shall be minimum 0.6m so that the effects of the load and vibration caused vehicles on the road should be avoided. However it is allowed the minimum thickness to be 0.2m in case the culvert structure has to divert the hampered existing water supply and the countermeasure to cope with such adverse effects can be taken by adopting box culvert structure.

The drainage types that come out from the calculation result of the rainfall volume is shown in Table 2.2.2.2-c-(1) and Figure 2.2.2.2-c-(1).

Table 2.2.2.2-c-(1) Type of Drainage and Distance (Unit: m)

Type \ Section		Sikhai ~Laksong	Laksong~ Thatkhao	1A Laksong~ Simuang	Thatkhao~ Chinaimo	Chinaimo~ Beerlao	Total
		0+00～3+900	3+900～7+175	0+00～3+220	7+175～12+220	12+220～18+300	(m)
U-type gutter Ū 800×500×500		—	—	—	—	6,820m	6,820
U-type gutter	Ū 400×400	—	—	—	9,703m	—	9,703
	Ū 400×600	—	—	—	132m	—	132
	Ū 600×400	560m	—	—	—	—	560
	Ū 600×600	3,620m	—	—	—	—	3,620
	Ū 800×800	3,580m	—	—	—	—	3,580
Concrete pipe	ϕ 400	—	14m	—	—	—	14
	ϕ 500	—	640m	1,207m	—	1,030m	2,877
	ϕ 600	—	1,433m	1,921m	—	—	3,354
	ϕ 800	—	1,625m	1,418m	—	—	3,043
	ϕ 1,000	600m	864m	109m	—	—	1,573
Box culvert	□800×800	40m	—	—	—	—	40
	□1.00×1.00	—	280m	270m	—	—	550
	□1.50×1.50	—	543m	350m	—	—	893
	□1.50×1.50	—	171m	—	—	—	171

(Excluding cross pipe, between Beerlao and Thanaleng : natural flow)

(5) Treatment of sewage

Since the public sewerage system alongside the Project road is not fully arranged yet, domestic wastewater from houses and offices is disposed of individually to the existing open ditches. Raw sewage is disposed of through septic tank installed individually or directly to open ditches.

In this Project, in order to resolve such unsanitary conditions, the public sewage inlet boxes will be provided at proper positions to collect such sewage into these inlet boxes and flow out to the side drainage. However, any works whatsoever to connect to these inlet boxes from each houses shall be burdened by the beneficiary.

There is 23-factry alongside the Project road. At moment industry wastewater from those factories is being disposed to the existing drainage. However after completion of this Project, MCTPC shall prohibit disposal of the untreated factory wastewater to the improved drainage system.

2.2.2.3 Relocation of the Existing Water Supply Pipeline

The relocation is planned to follow the procedures that:

- Pipeline relocation would be carried out in section by section at the same time with construction of drainages.
- Pipeline relocation would be carried out by close coordination and mutual consent with LWSC.
- In case suspension of water supply is necessary, the prior notice would be made to the beneficiaries through LWSC by public announcement.
- Since the exact location of the existing pipeline, branching locations and numbers of branching from distribution to supply pipeline are not known, they would be verified by pre-excavation prior to the commencement of the works.
- Whole distance of relocated pipeline would be divided into 6 sections with the one section to be approx. 800m. And relocation will be carried out one section by one section under coordination with the construction sequence of drainage facilities.
- If the suspension of water supply will be necessary for the work to change function of old pipeline to new one, the work would be carried out in the nighttime from 22:00 to 05:00 by closing the adjacent stop valve.
- In order to definitely finish the nighttime work by 05:00, all necessary preparation for the work will complete before starting the nighttime work. The preparatory works are shown in Figure 2-2-3-(1).

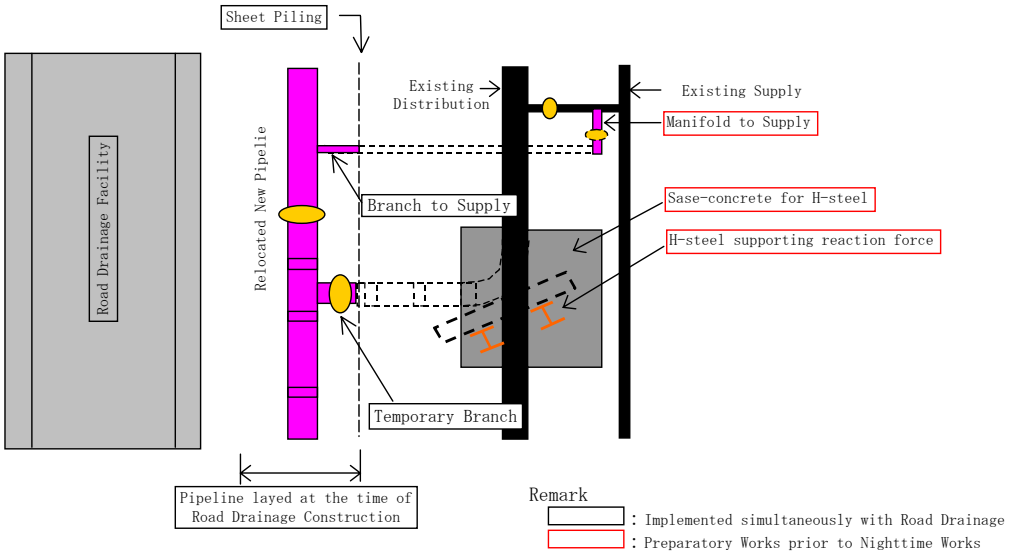


Figure 2.2.2.3-(1) Preparatory Works

2.2.2.4 Improvement of Road Facilities

Concept of improving road facilities is referred to Clause 2.2.1.1-d, (2). Based upon that concept, improvement of road facilities is planned as follows.

(1) Sidewalk

Mount up type sidewalk is provided between Sikhai intersection and Thatkhao intersection. No particular sidewalk is provided but the shoulder would be used as the flat type sidewalk between Thatkhao and Thanaleng.

Mount up type sidewalk is paved in the way described as follows so that it fits to the surrounding of the tourist city 'Vientiane'.

① For the sections in front of temples and very important historical structures, the sidewalk would be paved with bricks.
Total distance of this pavement is 6,803m.

② For other sections within the initial old city wall of Vientiane, the sidewalk would be paved with scrubbed finishing concrete.
Total distance of this pavement is 1,706m.

③ For the section outside the initial city wall except the section of the above ①, the sidewalk would be paved with concrete blocks.
Total distance of this pavement is 6,545m.

The width of sidewalk between Sikhai and Thatkhao intersection is, in principle, 3.0m wide and the width of sidewalk between Thatkhao and BeerLao is 2.5m wide.

When any house alongside the Project road hinders to keep the said width of sidewalk, the width will be narrowed to avoid to move such houses, etc. for the Project.

(2) Connection roads

Connection roads crossed or accessed to the Project road number 313 and all intersections will be paved with asphalt concrete.

(3) Approaches

There are a lot of houses, shops, restaurants and offices, etc. alongside the Project road. In any cases, smooth access to these buildings will be maintained in the way to use lower curbs for adjusting more than 15cm difference in level. The width of access planned depends upon the scale of the buildings concerned and applicable widths are 3.0m, 4.0m and 5.0m. The buildings concerned number 1,260.

(4) Bus stops

Subject to the request of the Government of Laos, 76-bus stops are planned as shown in Table 2.2.2.4-(1). The type of bus stop is the side lane stopping with bus bay. But in case the space is insufficient, a waiting shed and/or a signboard would be provided. Waiting shed shall be prepared by Lao side.

(5) Parking lots

Since no parking lots are provided in the existing road, a lot of cars are observed parking at both sides of the road. And it deems to be one of the main causes of present traffic congestions in the road. So, in this Project, parking lots are planned at 5 locations as shown in Table 2.2.2.4-(2).

Table 2.2.2.4-(2) Details of Parking Lots

Road	P. L. N0.	Station	Position	P. Capacity
R. N0. 1	1	5+459~5+545	Left	19
	2	5+869~5+981	Left	35
	3	6+206~6+286	Left	25
R. N0. 1A	4	0+832~0+915	Left	20
	5	0+840~1+105	Right	50
Total capacity for parking (Unit)				149

Table 2.2.2.4-(1) Details of Bus Stop

R. Station		Left side						Right side					
		No.	D. Station	Distance (m)	B.B.	W.S.	S.B.	No.	D. Station	Distance (m)	B.B.	W.S.	S.B.
R. No.1	—	—	—	—	—	—	—	1	0+060	—	—	—	○
	—	1	0+632	—	—	○	○	2	0+545	485	—	—	○
	—	2	0+928	296	—	—	○	3	1+085	540	—	○	○
	—	3	2+185	1,257	—	—	○	4	2+150	1,065	—	○	○
	—	4	2+640	455	○	—	○	5	2+625	475	—	—	○
	—	5	3+180	540	—	—	○	6	2+985	360	—	○	○
	—	6	3+810	630	—	○	○	7	3+790	805	—	—	○
	—	—	—	—	—	—	—	8	4+234	—	—	○	○
	—	—	—	—	—	—	—	9	4+680	446	—	○	○
	—	—	—	—	—	—	—	10	5+094	414	—	○	○
	—	—	—	—	—	—	—	11	5+608	514	—	○	○
	—	—	—	—	—	—	—	12	5+938	330	—	○	○
	—	—	—	—	—	—	—	13	6+118	180	—	○	○
	—	—	—	—	—	—	—	14	6+678	560	—	○	○
	—	—	—	—	—	—	—	15	6+980	302	—	—	○
R. No.1A	—	7	0+497	—	—	○	○	—	—	—	—	—	—
	—	8	1+417	920	○	—	○	—	—	—	—	—	—
	—	9	1+620	203	—	○	○	—	—	—	—	—	—
	—	10	2+010	390	○	○	○	—	—	—	—	—	—
	—	11	3+100	1,090	○	○	○	—	—	—	—	—	—
R. N0.1	7+650	12	7+670	—	—	—	○	16	7+610	—	—	—	○
	8+850	13	8+850	1,180	—	—	○	17	8+770	1,160	—	—	○
	9+380	14	9+380	530	—	—	○	18	9+339	569	—	—	○
	9+870	15	9+840	460	—	—	○	19	9+800	461	—	—	○
	10+200	16	10+160	320	—	—	○	20	10+120	320	—	—	○
	10+700	17	10+740	580	—	—	○	21	10+710	590	—	—	○
	11+270	18	11+310	570	—	—	○	22	11+280	570	—	—	○
	11+680	19	11+650	340	—	—	○	23	11+680	400	—	—	○
	12+020	20	12+040	390	—	—	○	24	12+000	320	—	—	○
	12+520	21	12+500	460	○	○	○	25	12+600	600	○	○	○
	13+020	22	13+068	568	○	○	○	26	13+130	530	○	○	○
	13+510	23	13+600	532	○	○	○	27	13+615	485	○	○	○
	14+300	24	14+360	760	○	○	○	28	14+320	705	○	○	○
	14+900	25	15+100	740	○	○	○	29	15+025	705	○	○	○
	15+600	26	15+600	500	○	○	○	30	15+619	594	○	○	○
	16+060	27	15+930	330	○	○	○	31	15+950	331	○	○	○
	16+910	28	16+975	1,045	○	○	○	32	16+910	960	○	○	○
	17+570	29	17+640	665	○	○	○	33	17+585	675	○	○	○
	17+880	30	17+900	260	○	○	○	34	17+840	255	○	○	○
	19+350	31	19+020	1,120	○	○	○	35	19+050	1,210	○	○	○
	20+590	32	20+565	1,545	○	○	○	36	20+485	1,435	○	○	○
	21+120	33	21+060	495	○	○	○	37	21+000	515	○	○	○
	21+920	34	21+865	805	○	○	○	38	21+770	770	○	○	○
	22+610	35	22+640	775	○	○	○	39	22+700	930	○	○	○
	23+720	36	23+620	980	○			40	23+670	970	○	○	○

Remark: R. Station = Requested Bus Stop Station
D. Station = Designed Bus Stop Station
B.B. = Bus Bay, W.S. = Waiting Shed, S.B. = Sign Board

(6) Pedestrian crosswalks

Pedestrian crosswalks are provided in the intersections. In addition, pedestrian crosswalks are planned in front of schools and city markets for securing safety of school children as well as peoples to/from markets as shown in Table 2.2.2.4-(3).

Table 2.2.2.4-(3) Details of Pedestrian Crosswalks

Road		No. of P.C.	Remark
R. N0. 1	Sikhai~Laksong	5	School
	Laksong~Thatkhao	3	School
R. N0. 1	Thatkhao~R. 4A	2	School
	Nonghai~BeerLao	1	Market
	BeerLao~F.Bridge	1	School
Total		12	

(7) Traffic signals

Traffic signals are planned at 7 intersections as shown in Table 2.2.2.4-(4). The installation of traffic signals shall be conducted by Lao side.

Table 2.2.2.4-(4) Intersections planned with New Traffic Signals

Station	Intersection	Intersected Road
0+000	Sikhai	R. No.13N/11
1+000	Wattay Airport	Wattay Airport
1+590	Wattay T-2	T-2 Road
7+185	Thatkhao	R. No.4
8+490	R. No.4A	R. No.4A
8+810	R. No.7	R. No.7
24+120	Friendship Bridge	F. Bridge Road

(8) Signboards

Considerable numbers of signboards are found along the present road but many of them are broken and/or impossible to distinguish. In this Project, traffic restriction signboards noticing speed limit, prohibition of parking and one way etc., traffic warning signboards indicating existence of intersections, curving and schools etc. and traffic allocation signboards showing pedestrians crosswalks and bus stops etc. will be installed. But traffic directional signboards will be excluded. 781 pieces of traffic signboards will be provided alongside the Project road.

(9) Guideposts

502 pieces of guideposts will be installed at every 5m intervals at the sections mentioned as follows for securing traffic safety. Details are shown in Table 2.2.2.4-(5).

① The section, adjacent to where ponds and/or canals exist.
② The section, alongside of where irrigation creeks exist.
③ The section, at where the acute curve exists. (at out curve shoulder)
④ The section, at where the height of embankment is more than 4m.

Table 2.2.2.4-(5) Details of Guideposts

Station		Position	D. (m)	No. (pc.)	Remark
R. No.1	4+610 ~ 4+630	Left	20	5	Box culvert
	4+600 ~ 4+615	Right	15	4	Box culvert
R. No.1A	0+805 ~ 0+827	Left, Right	44	12	Box culvert
R. No.1	8+505 ~ 8+535	Left, Right	60	14	High Embankment
	10+040 ~ 10+060	Left, Right	40	10	Canal
	11+405 ~ 11+420	Right	15	4	Canal
	11+420 ~ 11+432	Left	12	3	Canal
	12+315 ~ 12+390	Left	75	16	Pond
	16+260 ~ 16+475	Right	215	44	Creek
	16+440 ~ 16+500	Left	60	13	Creek
	17+590 ~ 17+620	Right	30	7	Pond
	17+980 ~ 18+025	Right	45	10	Acute curve
	18+040 ~ 18+160	Right	120	25	Acute curve
	18+168 ~ 18+187	Right	19	5	Box culvert
	18+168 ~ 18+207	Left	39	9	Box culvert
	18+210 ~ 18+396	Right	186	38	Creek
	18+770 ~ 19+200	Left	430	87	Irrigation creek
	18+600 ~ 19+150	Right	550	111	Irrigation creek
	21+170 ~ 21+440	Left	270	55	High embankment
	21+195 ~ 21+340	Right	145	30	High embankment
Total			2,390	502	

(10) Plant protection

There are 485 trees alongside the Project road, the roots of which will be protected with the circular curbs.

(11) Electric pole protection

There are 1,479 electric poles to be protected that locate within the sidewalk. They will be protected with curbs and pavement blocks at the root of poles.

2.2.2.5 The Buried Cultural Properties Survey

The survey of the buried cultural properties in the Project road will be conducted in the layer, the thickness of which is approx. 1.0m and exists in the depth of 1.0m ~ 2.0m from the road surface, and in the portion excavated for construction of under ground structures.

Further the evaluation of the area to survey and the survey method will follow to the recommendations made in the report of the Support Study for the BCP Survey conducted under JICA's Grant Aid Assistance.
The survey will be carried out at the time but preceded to the construction of under ground structures.

The conception of the survey is shown in Figure 2.2.2.5-(1).

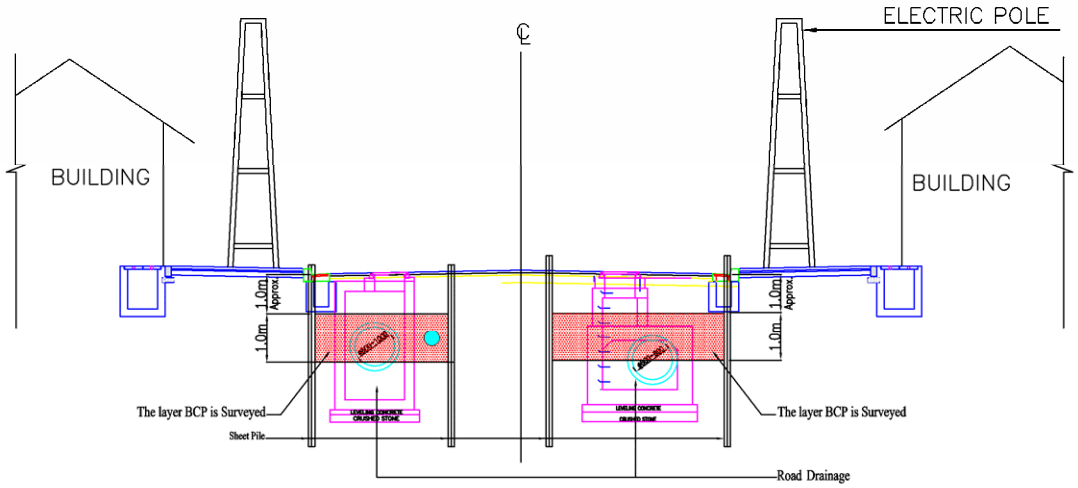


Figure 2.2.2.5-(1) BCP Survey

2.2.2.6 Drinking Water Supply and Distribution Project (AFD)

(Refer to Clause 2-1-1-7, (1) and (2))

2.2.2.7 Work Plan

Considering the work site to be in the center of the city and in the congested road with traffics and pedestrians, the first priority for selecting the work plan is to minimize working lot and inconvenience to traffic as well as pedestrians and at the same time to secure safety of all peoples concerned. It is necessary to get the basic agreement from road users and residents through public information about the Project by Lao side.

For achieving such important priorities, the following principles are set out so that more preferable work plan can be selected.
The concept of work plan is shown in Figure 2.2.2.7-(1).

① The present 4-lane section: 2-lane is closed and 2-lane is open to traffic.
② The present 2-lane section: 1-lane is closed and 1-lane is open. In case of 1-lane can not be open, both 2-lane are closed at daytime work with detours for traffic.
③ Major intersection (T-2): Road decking is provided at whole area of the intersection for securing public traffic.
④ The access to all houses alongside the Project road is always maintained.
⑤ In the event that the principles mentioned ② above can not be followed, the work at the section is to be carried out in the daytime by closing whole the road for traffic.
⑥ The closing time of the road is minimized as short as possible.
⑦ The temporary crosswalks for pedestrians are provided at the 100m interval at the under construction section between Sikhai Intersection and Thatkhao Intersection.

2.2.2.8 Alternative Designs to Contemplate Mitigation of Environmental Impacts

Subject to the 'Guidelines for Environmental and Social Considerations', it is studied in the Basic Study that the alternative designs shall mitigate adverse environmental impacts during the implementation of the Project.

The items studied are as follows:

(1) Road improvement

- No removal of houses
  It is planned to avoid any relocation of housings by arranging the alignment of the road to be within the existing ROW and to adjust the traffic lanes and the width of the sidewalks.
- No cutting of street trees
  It is planned to avoid cutting any trees alongside the road by shifting the centerline of the Project road.
- Up-grading of the traffic safety
  It is planned to provide sidewalks, slow lanes, pedestrians crosswalks, bus stops, road signs, guide posts and parking lots, etc. for improving circumstances of the road so as to secure and up-grade the traffic safety.
- Up-grading of the expediency for residents
  It is planned to provide smooth access to houses and parking lots alongside the road following to the interview to the residents.

(2) Road drainage improvement

It is planned to provide the public sewage inlet boxes at the locations requested by residents through the interview.

(3) Relocation of the water supply

The most effective work plan is worked out so as to minimize the time of the water supply suspensions.

(4) Sidewalks improvement

- It is planned to provide pavement with bricks in front of temples and important historical buildings so as to fit to the environment of the tourism city.
- It is planned to provide smooth access to houses and/or parking lots alongside the road in the way to employ lower curbs for adjusting differences of the level between the traffic road and the sidewalks.

(5) Plant and electric poles protections

It is planned to provide protections for plant and electric poles protection for fitting to the surrounding view of the Project road.

(6) The buried cultural properties survey

It is planned to conduct the survey in the section where will be excavated for construction of under ground structures. The survey precedes to the construction works.

(7) Coordination with the Drinking Water Supply and Distribution Project (AFD)

Necessary information of the Project will be provided to AFD regarding Phase-1 through MCTPC so as to avoid unnecessary inconvenience to the residents and damages to the improved road.

(8) Work plan

In the urban section between Laksong and Thatkhao, the daytime work with tentative closing traffic will be conducted based upon the agreement between Lao side and Japanese side. MCTPC should explain road users and residents alongside the Project road to understand some inconvenience and traffic disturbance during construction work.

(9) Others

- It is planned to reuse excavated materials for refilling the under ground structures and therefore the borrow pit is not required.
- The spaces allocated by the Lao Government will be used as disposal areas.
- It will be planned to employ equipment/machines with less vibrations and noises for the works.
- It is planned to maintain safe access to houses, offices and any commercial facilities during the implementation of the works.
- The counter measures will be taken against dusts arisen during the works.
- All equipment/machines/cars employed for the implementation of the work will be always maintained in good working conditions.
- The sanitary control will take place in the camps for staff/workers employed for the works.

(10) Relevant issues on the implementation stage

① Monitoring system

MCTPC (DOR) and Vientiane Capital are responsible for the monitoring and evaluation of the project environment during the implementation of the Project.

② Land Acquisition

It is planned to avoid any relocation of housings under the basic design. It should be confirmed for any extra or additional house before the commencement of the implementation stage.

③ No. of houses along the Project Road

Number of 2,000 houses face the Project Road. MCTPC conducted the interview survey whole those houses and obtained their basical agreement for the Project.

④ Public information

The various information of the Project will be put on the boards along the road for the residents and tourists at the implementation stage.

2.2.3 Basic Design Drawings

BASIC DESIGN STUDY
ON
THE PROJECT FOR THE IMPROVEMENT
OF THE VIENTIANE NO.1 ROAD
IN
THE LAO PEOPLE'S DEMOCRATIC REPUBLIC

JULY 2005

JAPAN INTERNATIONAL COOPERATION AGENCY

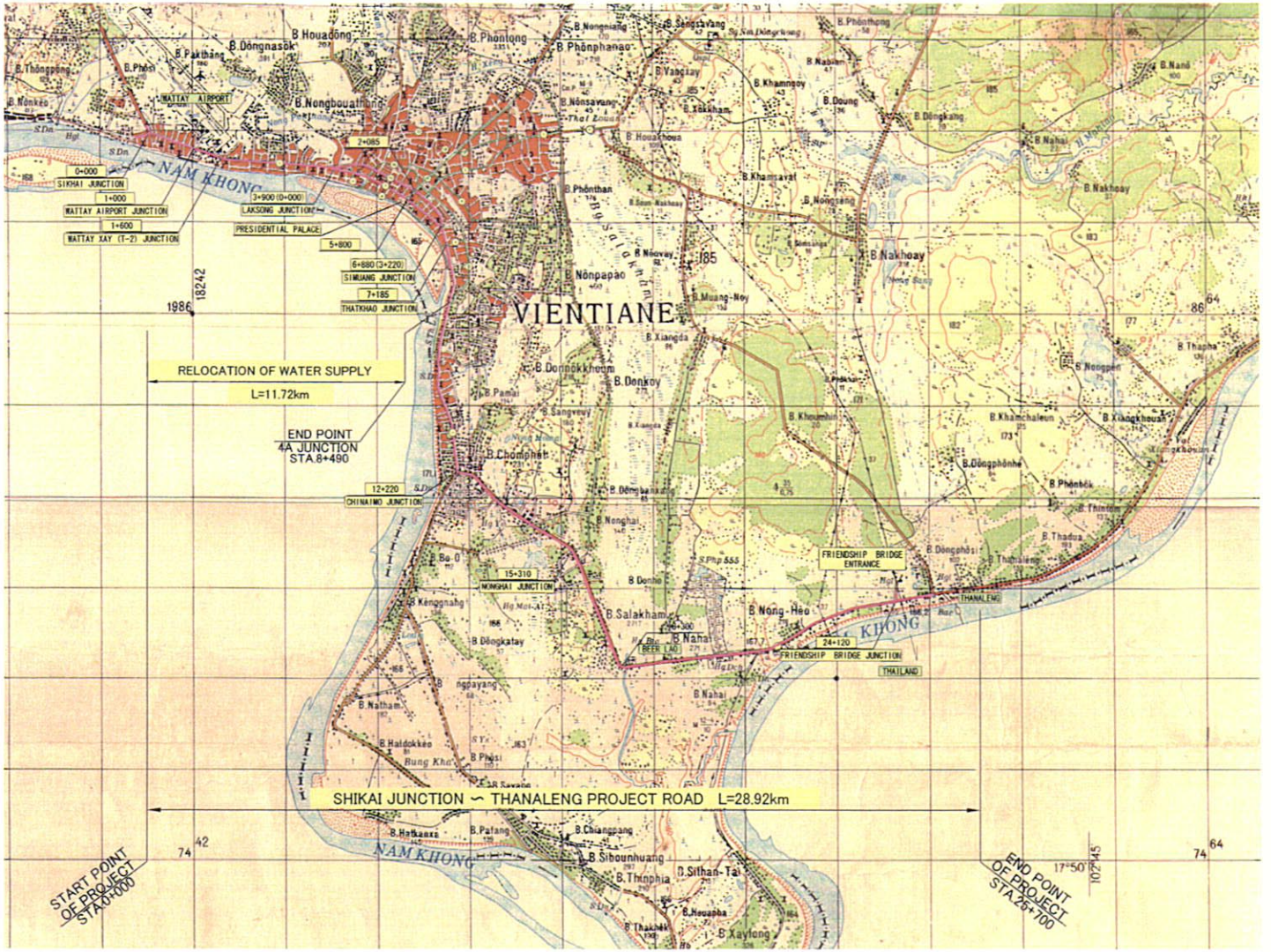
KATAHIRA & ENGINEERS INTERNATIONAL
CTI ENGINEERING INTERNATIONAL

CONTENTS OF DRAWINGS

1)	PROJECT LAYOUT	G - 1
2)	KEY PLAN	G - 2~16
3)	TYPICAL CROSS SECTION	G - 17~23
4)	PLAN AND PROFILE OF ROAD	PL - 1~97
5)	CROSS SECTION OF ROAD 1	CS - 1~31
6)	CROSS SECTION OF ROAD 1A	CS - 32~36
7)	RENOVATION PLAN OF JUNCTIONS	JC - 1~12
8)	PLAN OF DRAINAGE SYSTEM	DR - 1~3
9)	DRAINAGE PLAN	DR - 4~43
10)	DRAINAGE TYPICAL CROSS SECTION	DR - 44~53
11)	DRAINAGE PROFILE	DR - 54~71
12)	STRUCTURE OF BOX CULVERT	DR - 72~73
13)	STRUCTURE OF PIPE CULVERT	DR - 74~76
14)	STRUCTURE OF SIDE DITCH	DR - 77~80
15)	STRUCTURE OF MANOLE	DR - 81~84
16)	STRUCTURE OF BASIN	DR - 85~88
17)	PLAN OF OUTLET	DR - 89~130

CONTENTS OF DRAWINGS

18)	ARRANGEMENT AND STRUCTURE OF MEDIAN	M - 1
19)	ARRANGEMENT AND STRUCTURE OF SIDE WALK	M - 2∽6
20)	DETAIL OF APPROACHES TO HOUSES	M - 7
21)	DETAIL OF INTERSECTIONS	M - 8
22)	DETAIL OF ACCESS ROADS	M - 9
23)	DETAIL OF PLANT PROTECTION	M - 10
24)	DETAIL OF ELECTRIC POLE PROTECTION	M - 11
25)	DETAIL OF BUS STOP	M - 12
26)	DETAIL OF PARKING LOTS	M - 13∽16
27)	STANDARD PAVEMENT AND PEDESTRIAN MARKINGS	M - 17
28)	SCHEDULE OF ROAD SIGNS	M - 18∽20
29)	DETAIL OF TRAFFIC POSTS(SIGNALS)	M - 21
30)	DETAIL OF STREET LIGHTING	M - 22∽24
31)	DETAIL OF GUIDE POST AND KILOMETER POST	M - 25
32)	DETAIL OF CONCRETE CURB	M - 26



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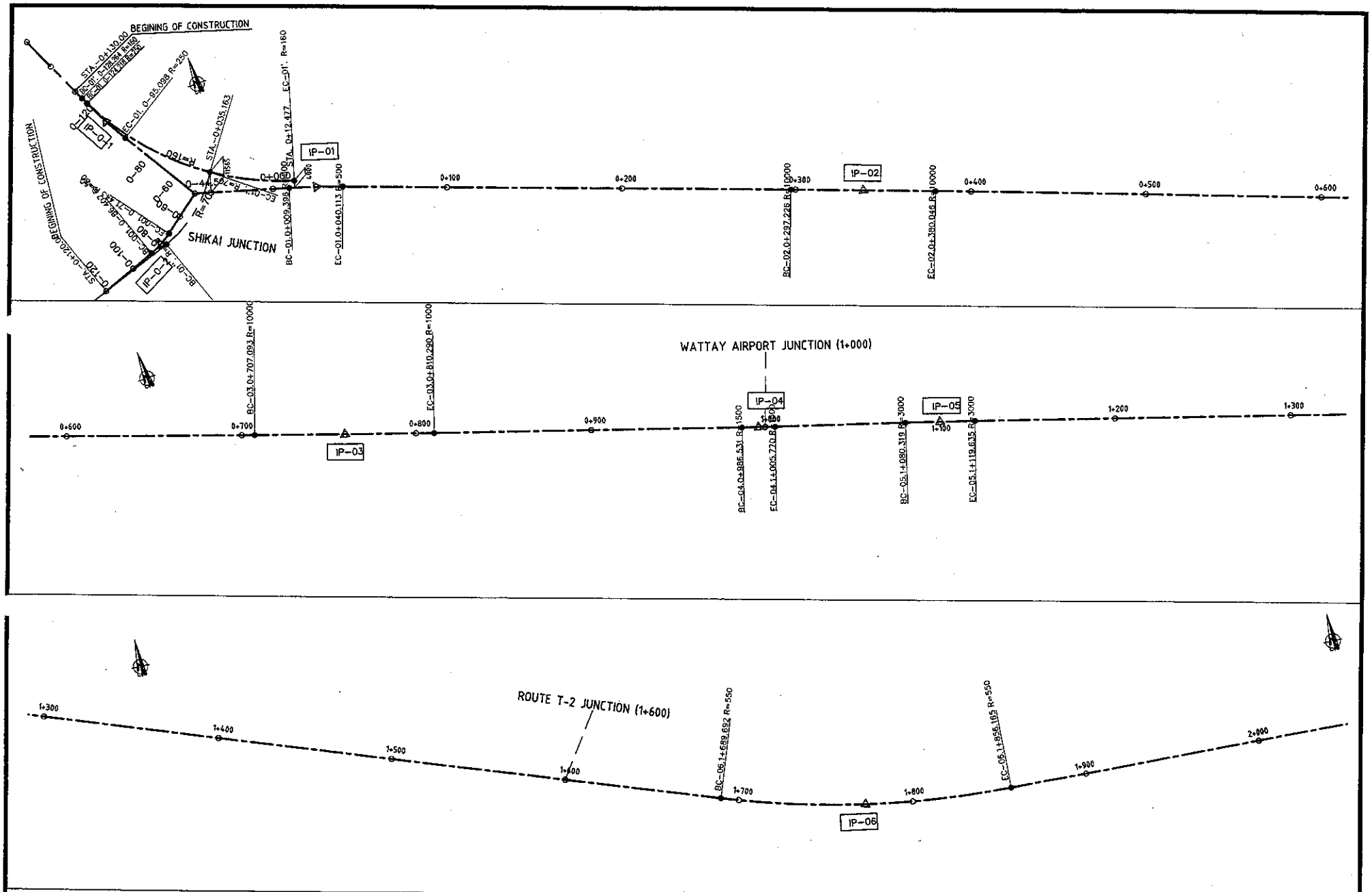

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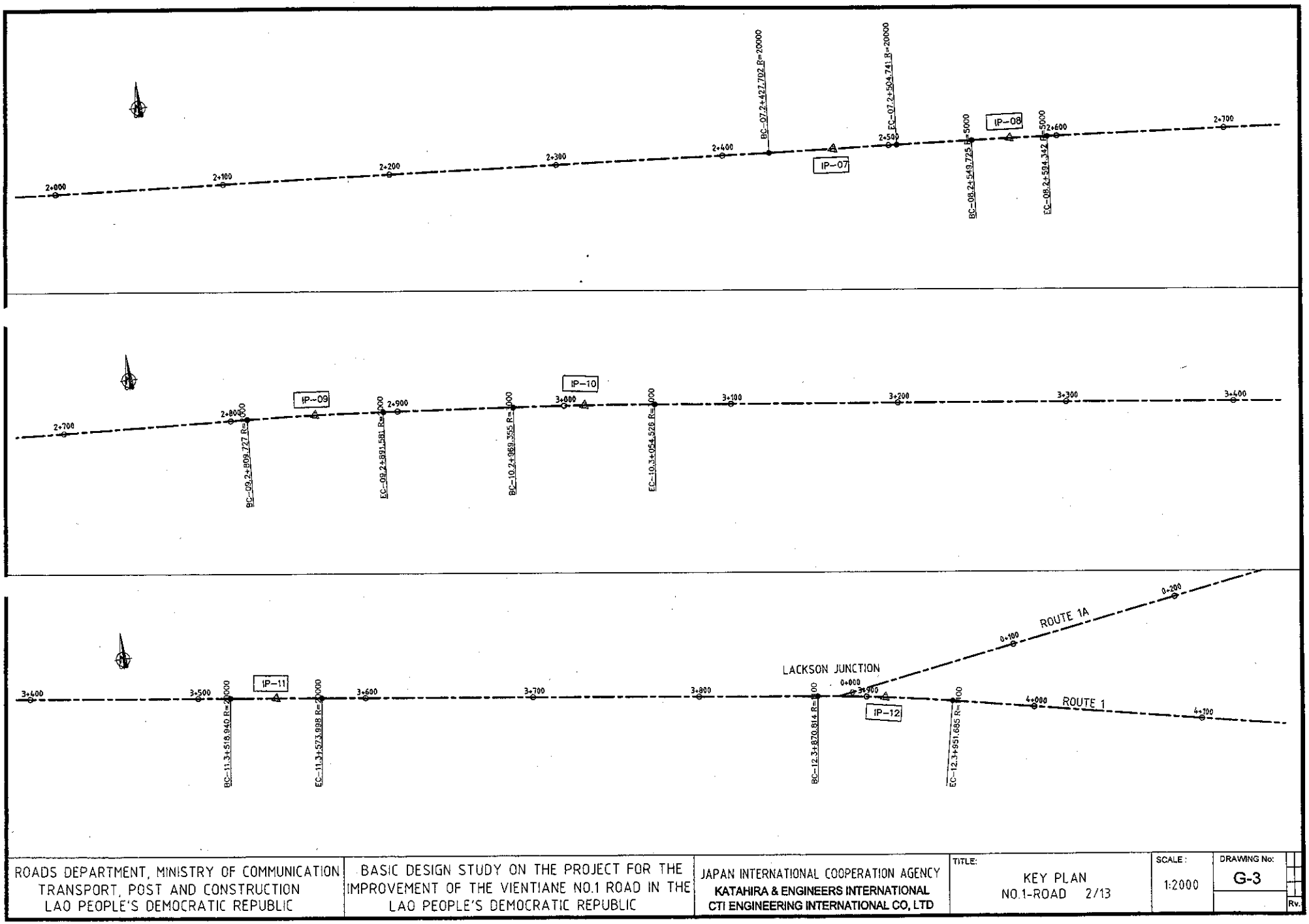
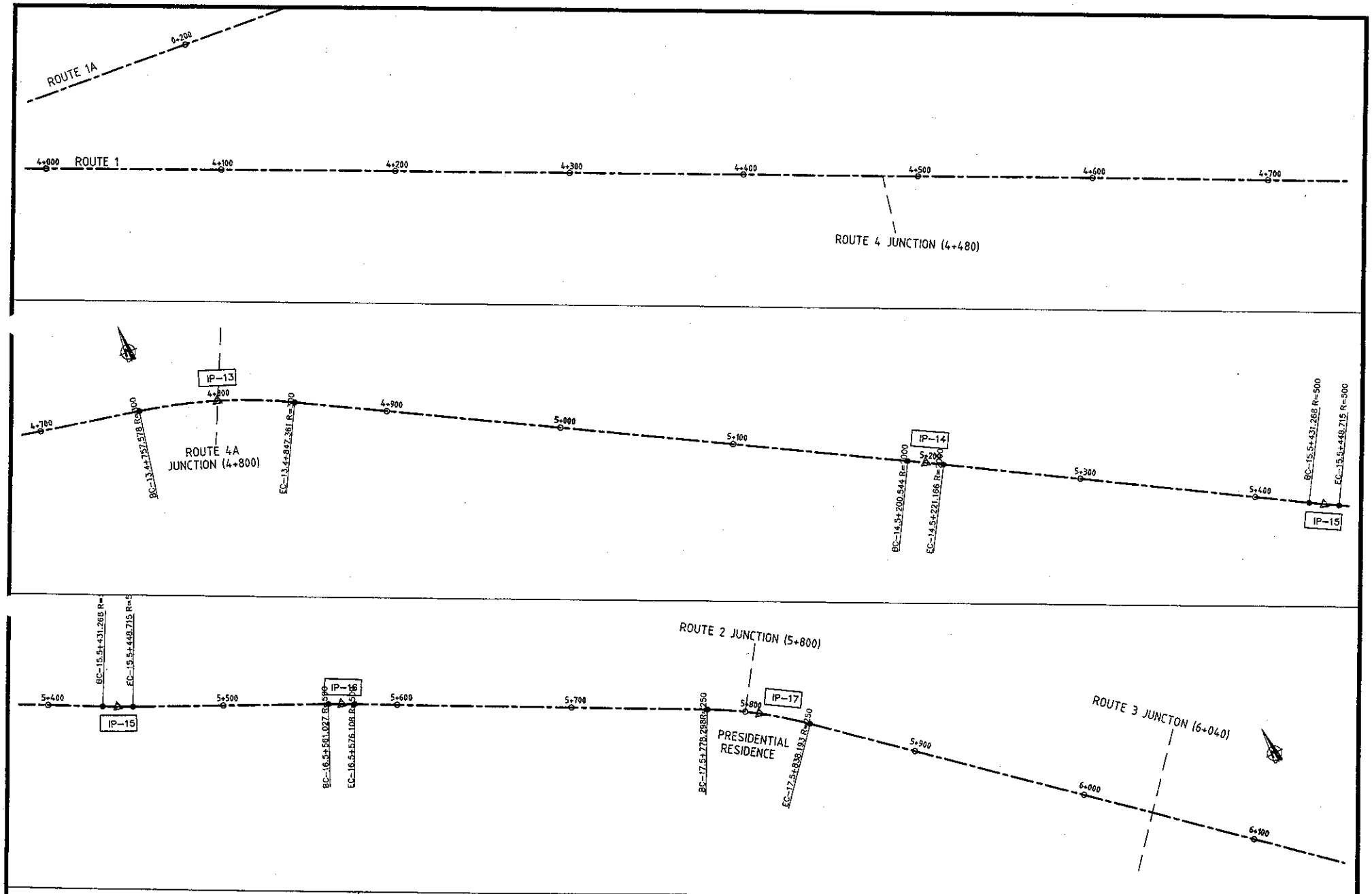


ROADS DEPARTMENT, MINISTRY OF COMMUNICATION TRANSPORT, POST AND CONSTRUCTION LAO PEOPLE'S DEMOCRATIC REPUBLIC	BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE VIENTIANE NO.1 ROAD IN THE LAO PEOPLE'S DEMOCRATIC REPUBLIC	JAPAN INTERNATIONAL COOPERATION AGENCY KATAHIRA & ENGINEERS INTERNATIONAL CTI ENGINEERING INTERNATIONAL CO, LTD	TITLE: KEY PLAN NO.1-ROAD 2/13	SCALE: 1:2000	DRAWING No: G-3 Rv.



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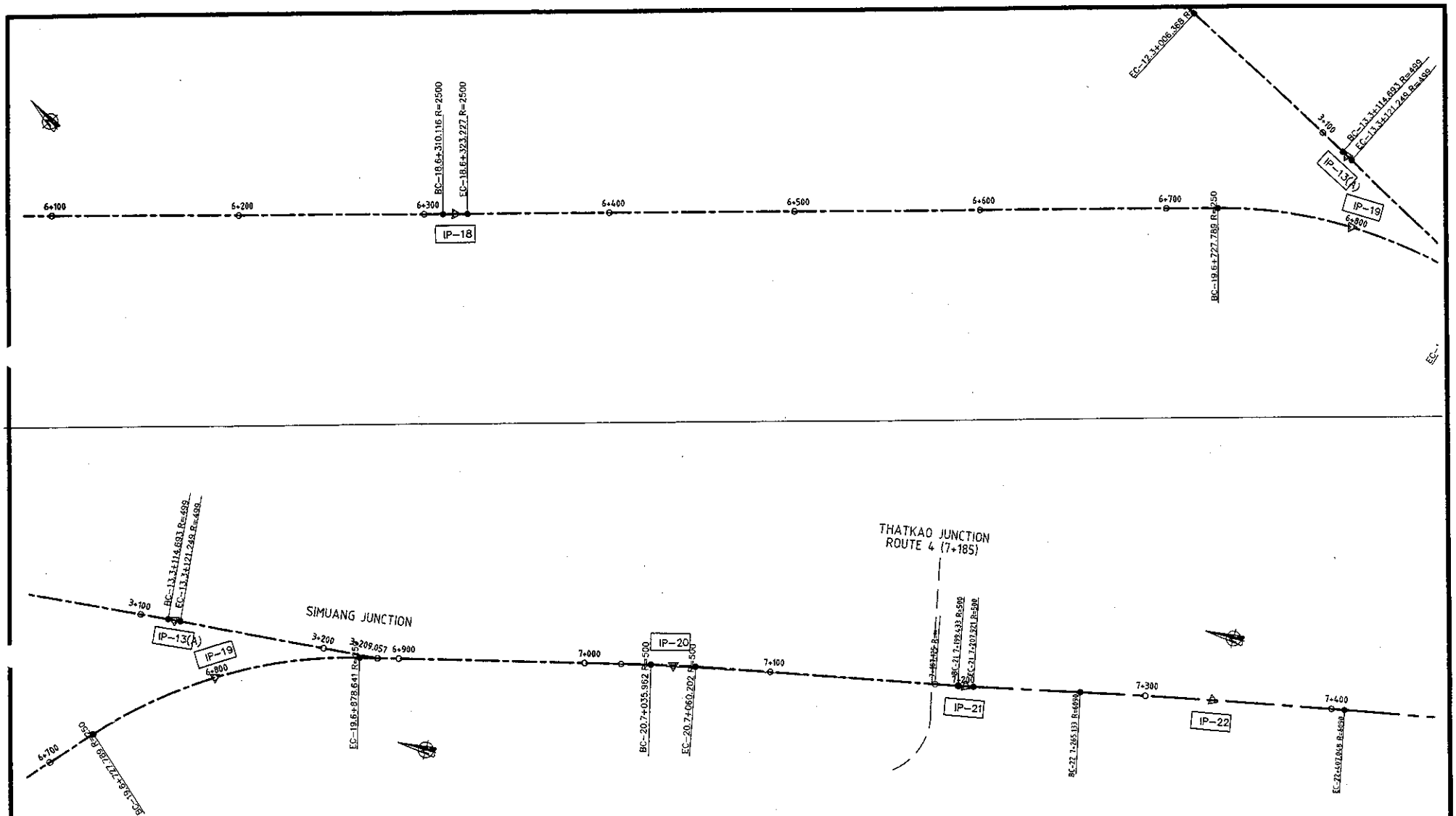

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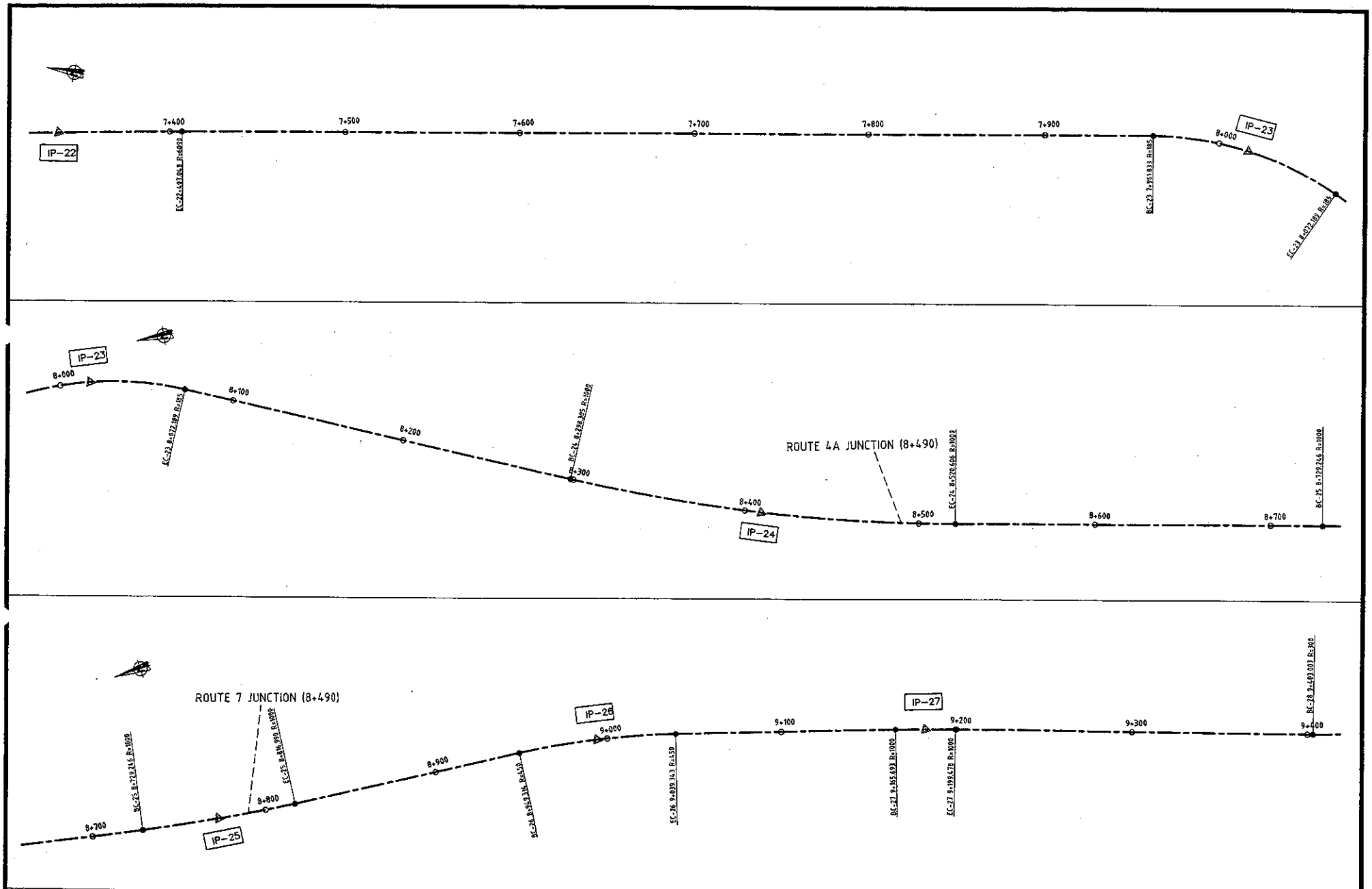

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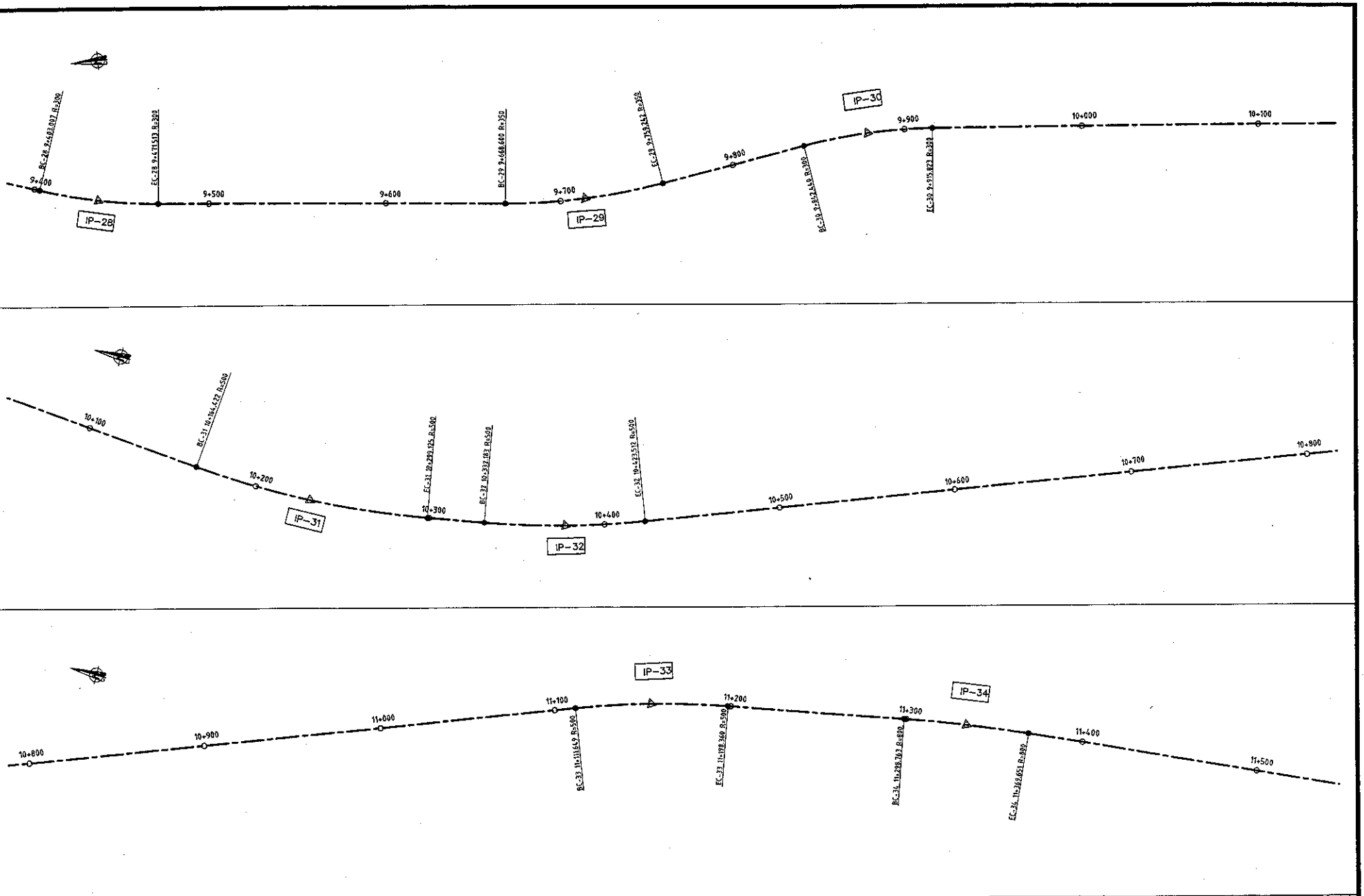

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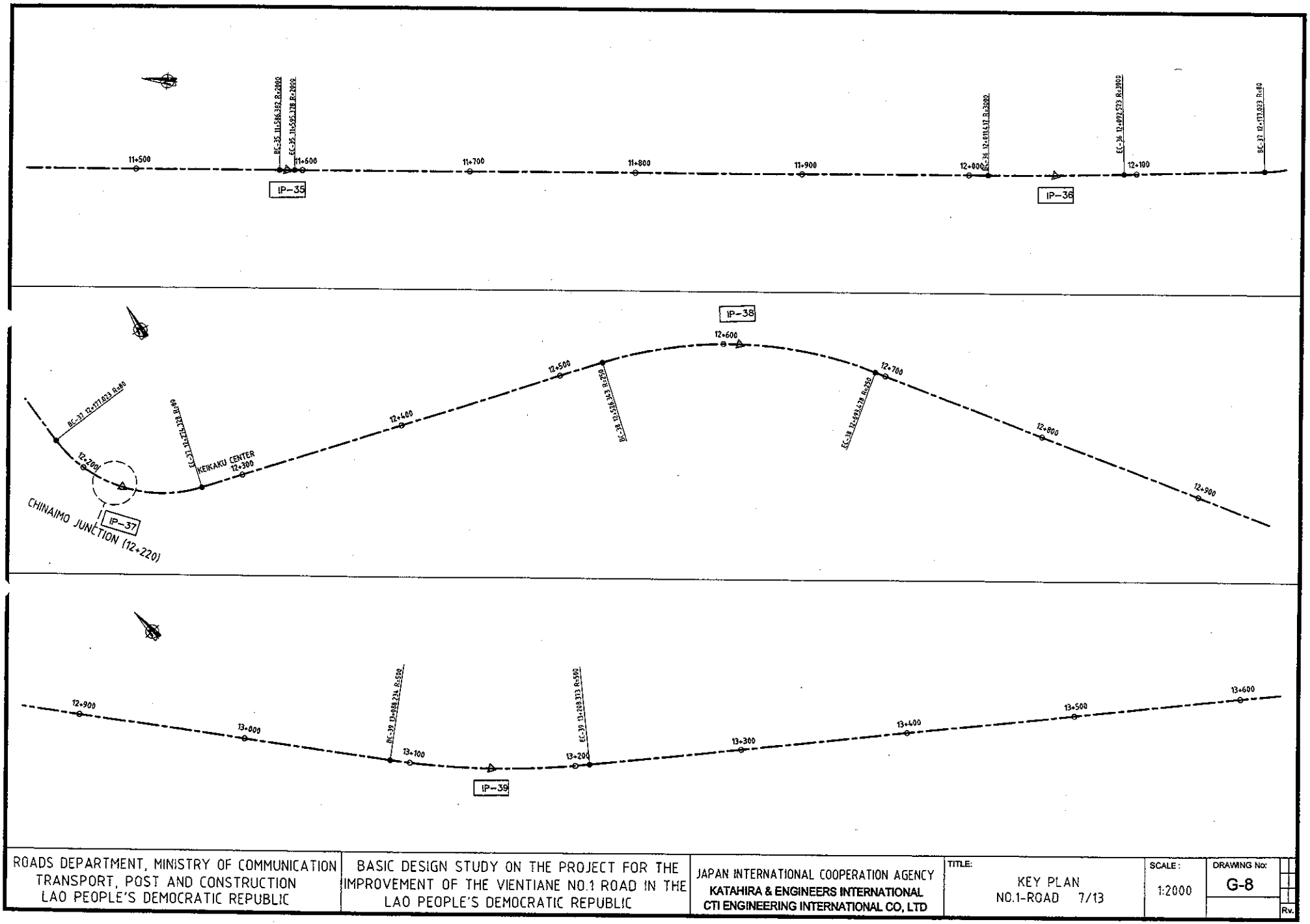

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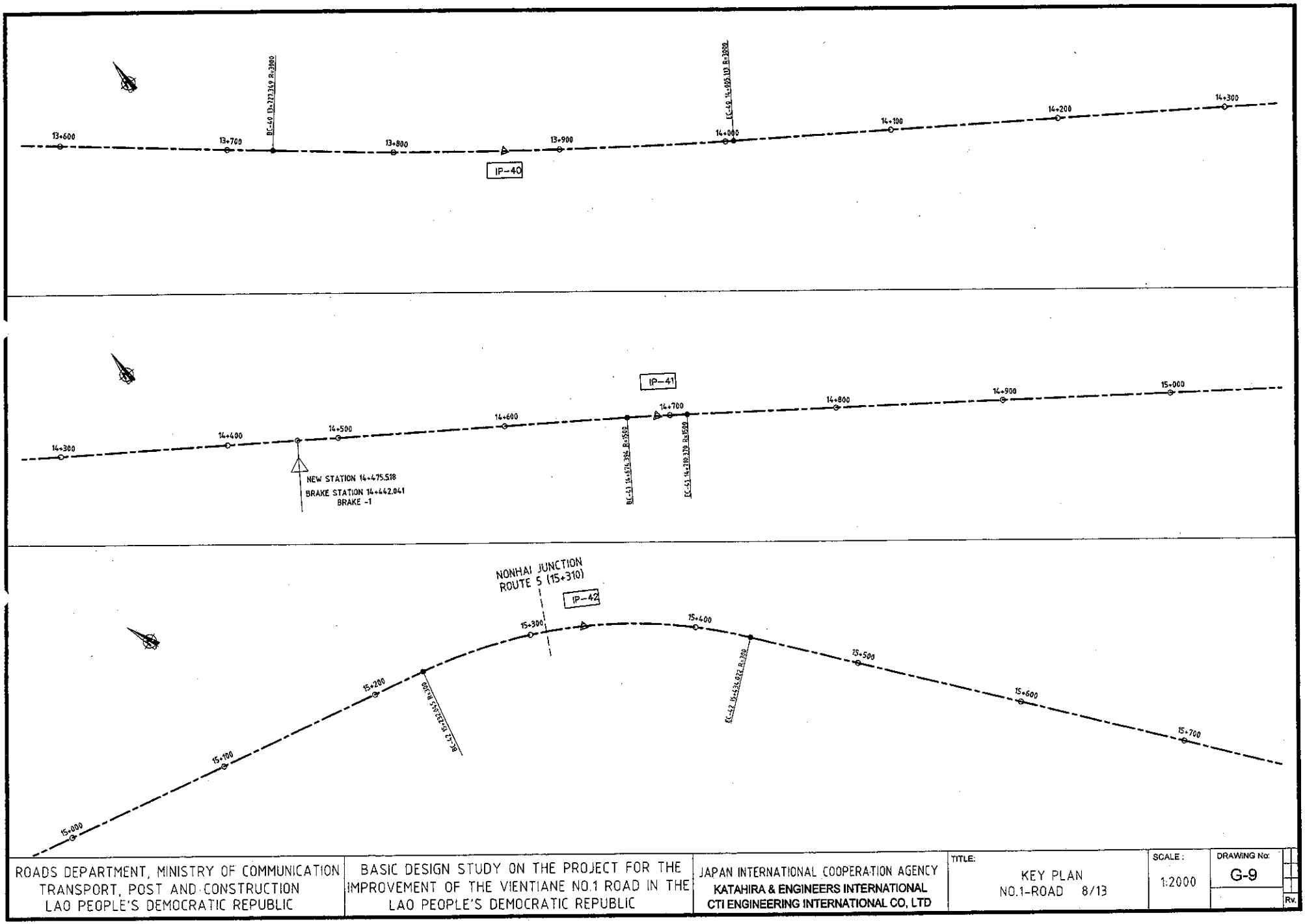

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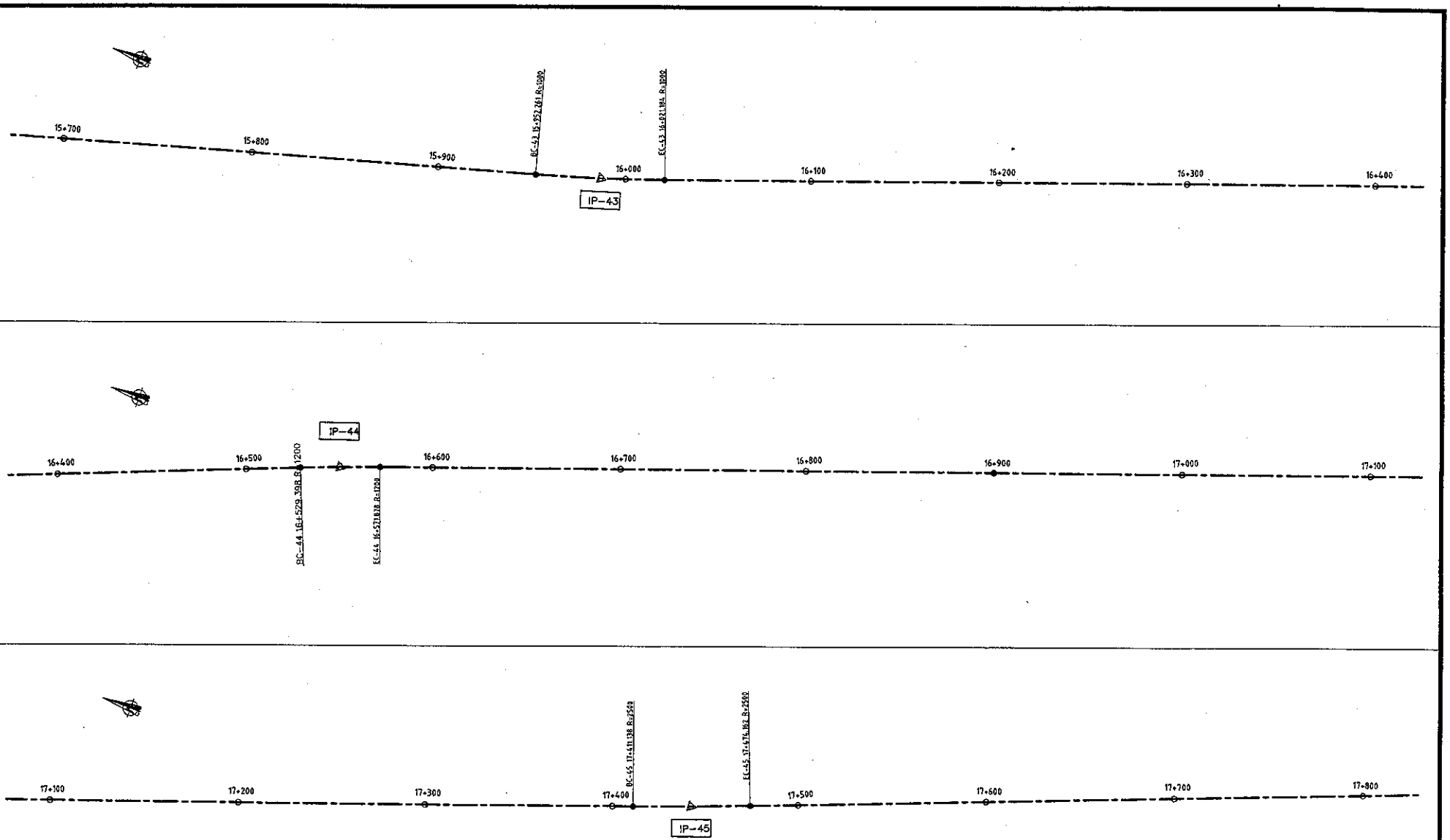

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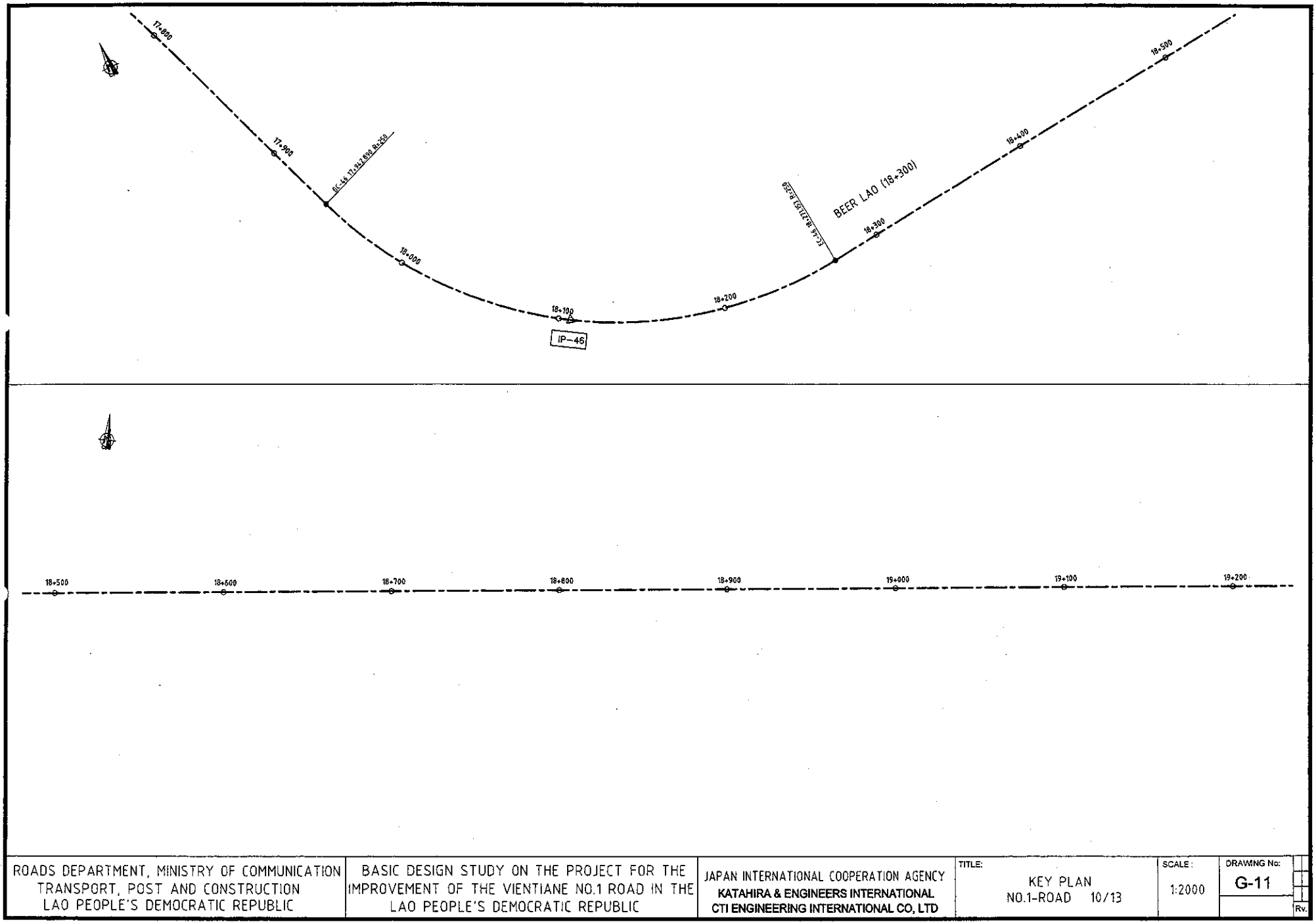

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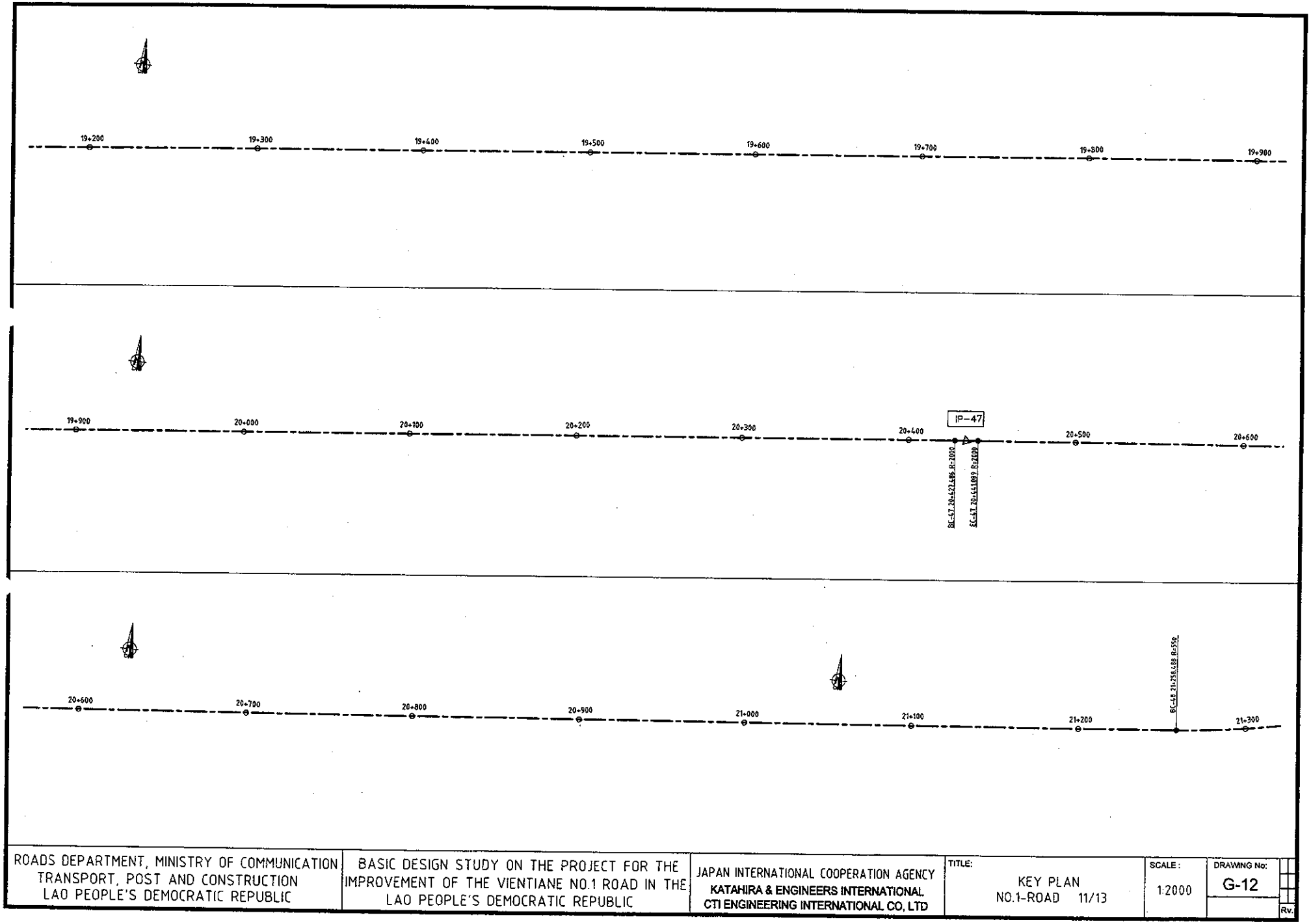

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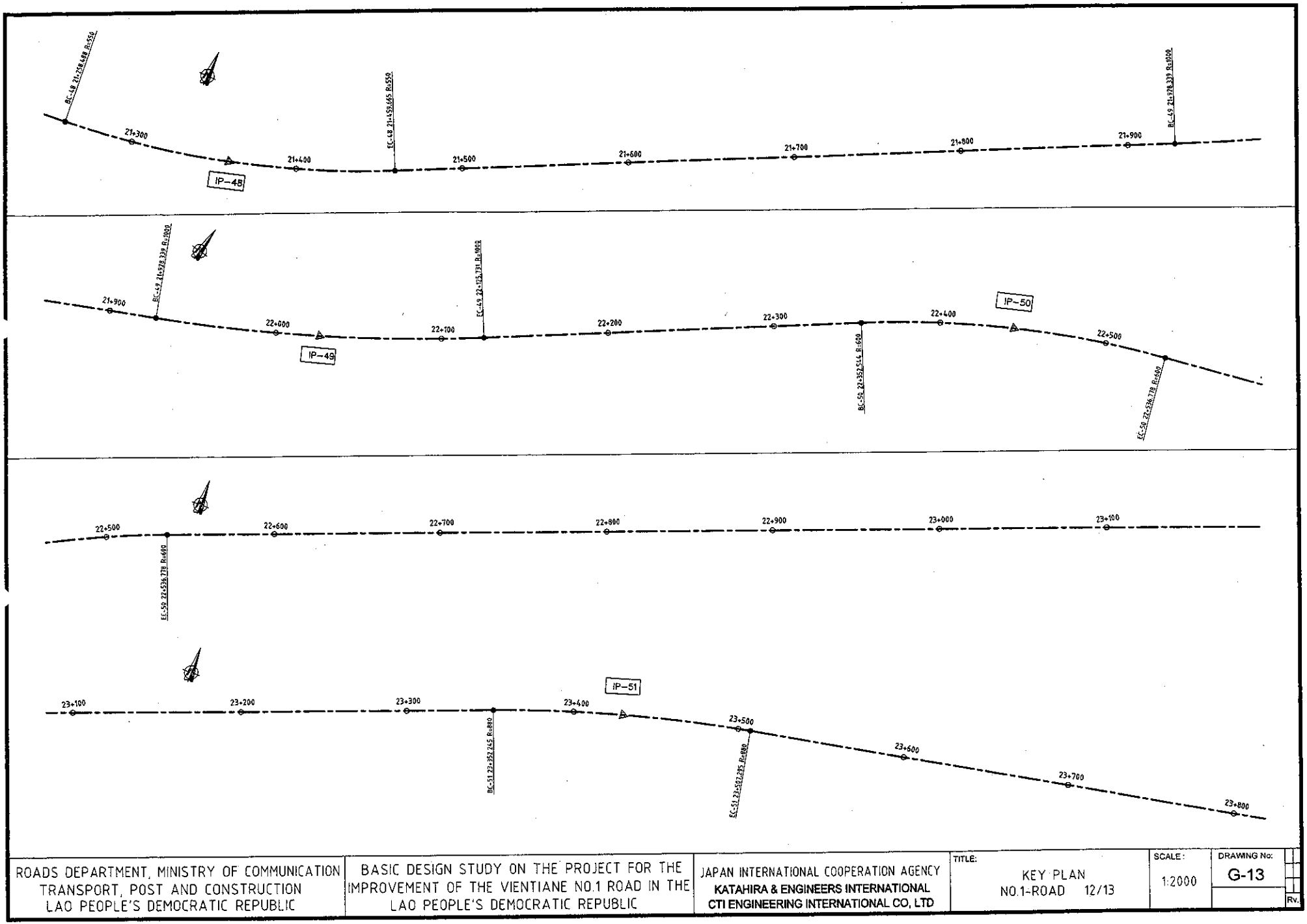

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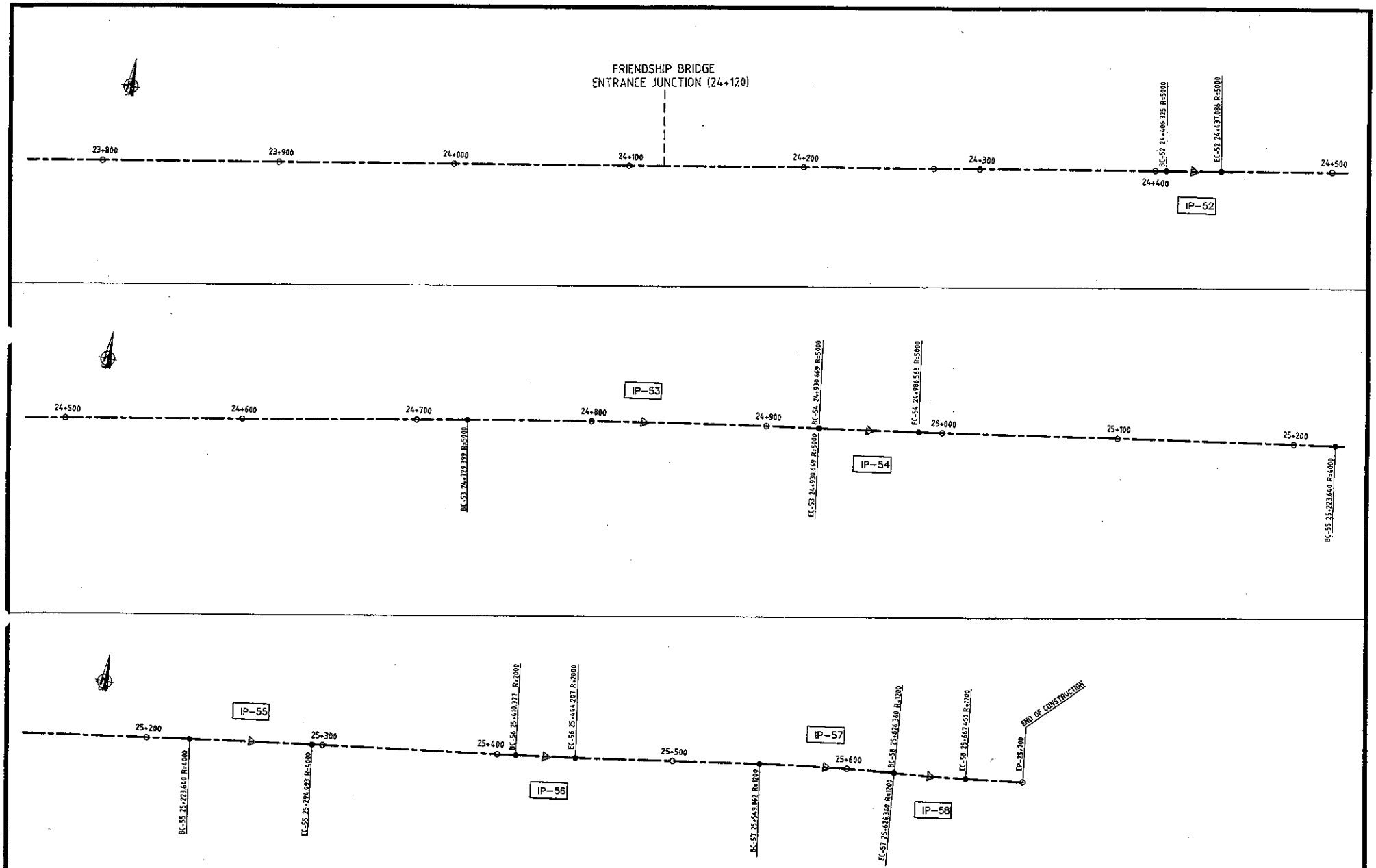
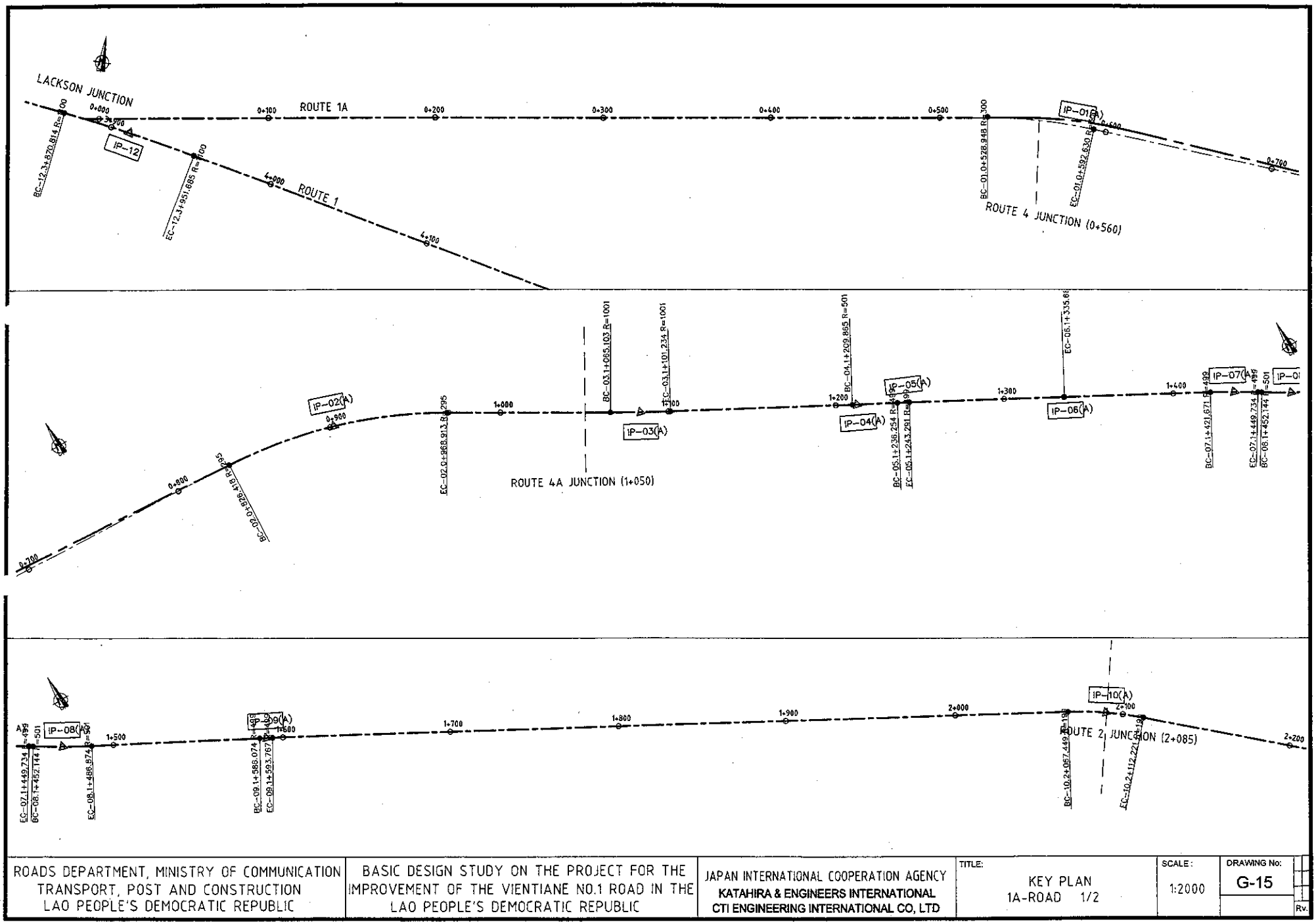
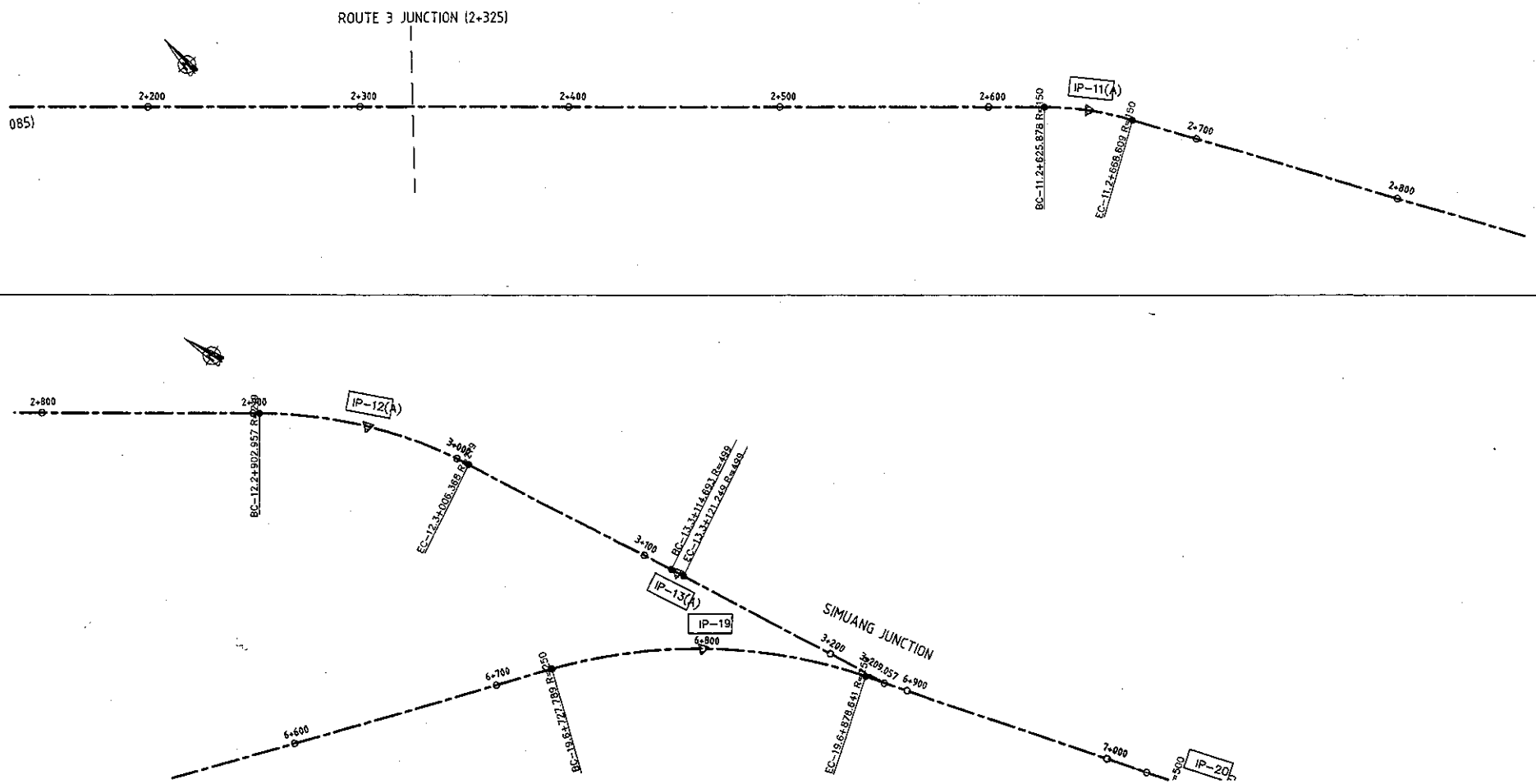


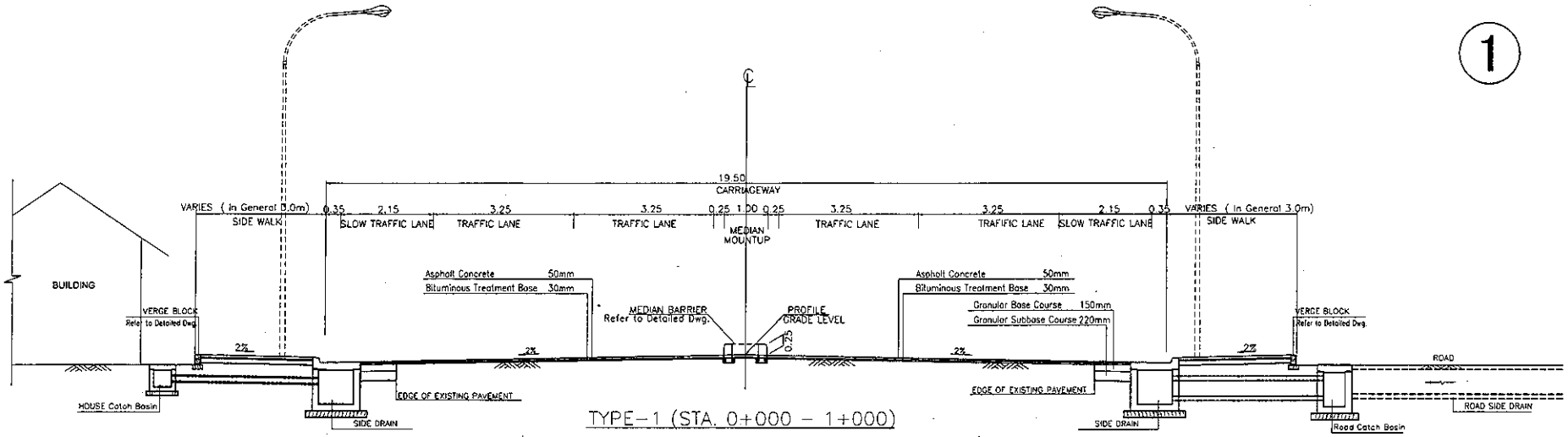
ROADS DEPARTMENT, MINISTRY OF COMMUNICATION TRANSPORT, POST AND CONSTRUCTION LAO PEOPLE'S DEMOCRATIC REPUBLIC	BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE VIENTIANE NO.1 ROAD IN THE LAO PEOPLE'S DEMOCRATIC REPUBLIC	JAPAN INTERNATIONAL COOPERATION AGENCY KATAHIRA & ENGINEERS INTERNATIONAL CTI ENGINEERING INTERNATIONAL CO, LTD	TITLE: KEY PLAN NO.1-ROAD 13/13	SCALE: 1:2000	DRAWING No: G-14 Rv.



ROADS DEPARTMENT, MINISTRY OF COMMUNICATION TRANSPORT, POST AND CONSTRUCTION LAO PEOPLE'S DEMOCRATIC REPUBLIC	BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE VIENTIANE NO.1 ROAD IN THE LAO PEOPLE'S DEMOCRATIC REPUBLIC	JAPAN INTERNATIONAL COOPERATION AGENCY KATAHIRA & ENGINEERS INTERNATIONAL CTI ENGINEERING INTERNATIONAL CO, LTD	TITLE: KEY PLAN 1A-ROAD 1/2	SCALE: 1:2000	DRAWING No: G-15 Rv.

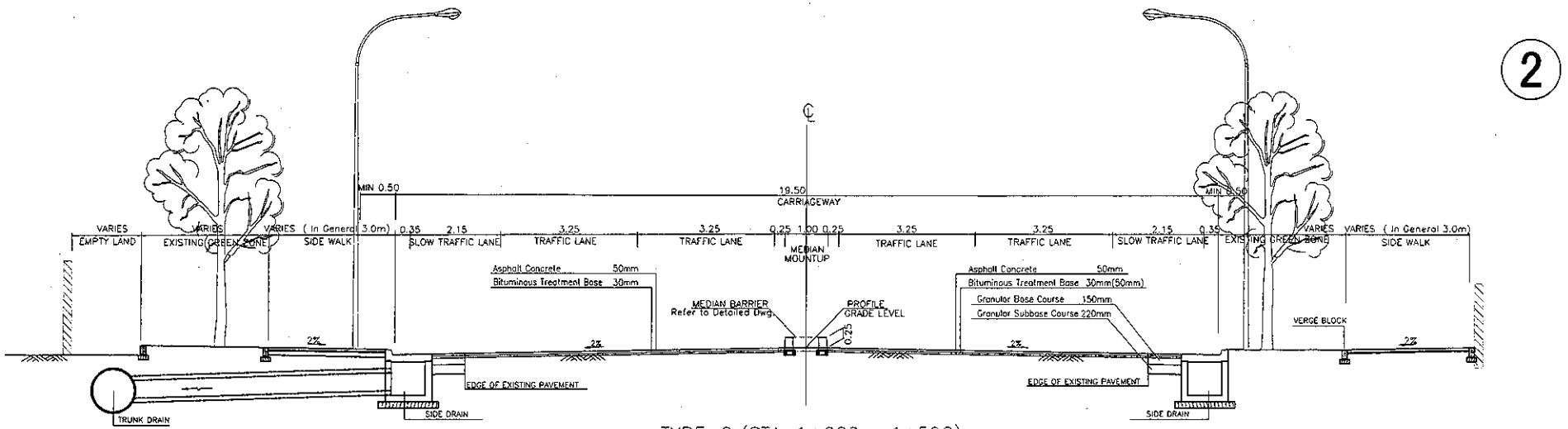


ROADS DEPARTMENT, MINISTRY OF COMMUNICATION TRANSPORT, POST AND CONSTRUCTION LAO PEOPLE'S DEMOCRATIC REPUBLIC	BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE VIENTIANE NO.1 ROAD IN THE LAO PEOPLE'S DEMOCRATIC REPUBLIC	JAPAN INTERNATIONAL COOPERATION AGENCY KATAHIRA & ENGINEERS INTERNATIONAL CTI ENGINEERING INTERNATIONAL CO, LTD	TITLE: KEY PLAN 1A-ROAD 2/2	SCALE: 1:2000	DRAWING No: G-16 Rv.



TYPE-1 (STA. 0+000 – 1+000)
(SHIKAI JUNCTION – WATTAY AIRPORT ENTRANCE)

NOTE : 1.The width of the sidewalk mentioned in the drawing is the general width.The width shall be narrowed at places where houses/buildings are affected by the sidewalk so as to avoid relocation.
2.For the dimensions of drainage facilities, refer to 'DRAINAGE TYPICAL DRAWING'.

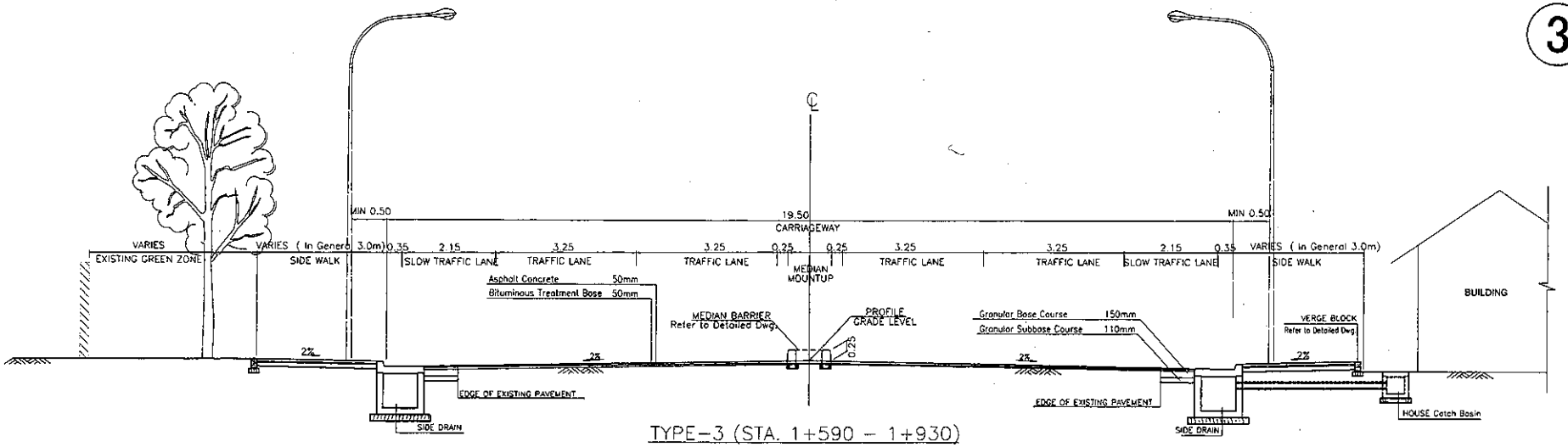


TYPE-2 (STA. 1+000 – 1+590)
(WATTAY AIRPORT ENTRANCE – WATTAY JUNCTION (T2))

NOTE : 1.The width of the sidewalk mentioned in the drawing is the general width.The width shall be narrowed at places where houses/buildings are affected by the sidewalk so as to avoid relocation.
2.Numbers inside brackets indicate pavement thickness for sta.1+480 – sta.1+590.
3.For the dimensions of drainage facilities, refer to 'DRAINAGE TYPICAL DRAWING'

ROADS DEPARTMENT, MINISTRY OF COMMUNICATION TRANSPORT, POST AND CONSTRUCTION LAO PEOPLE'S DEMOCRATIC REPUBLIC	BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE VIENTIANE NO.1 ROAD IN THE LAO PEOPLE'S DEMOCRATIC REPUBLIC	JAPAN INTERNATIONAL COOPERATION AGENCY KATAHIRA & ENGINEERS INTERNATIONAL CTI ENGINEERING INTERNATIONAL CO, LTD	TITLE: TYPICAL CROSS SECTION R-1-(1)	SCALE : S=1:100	DRAWING No: G-17 Rv.

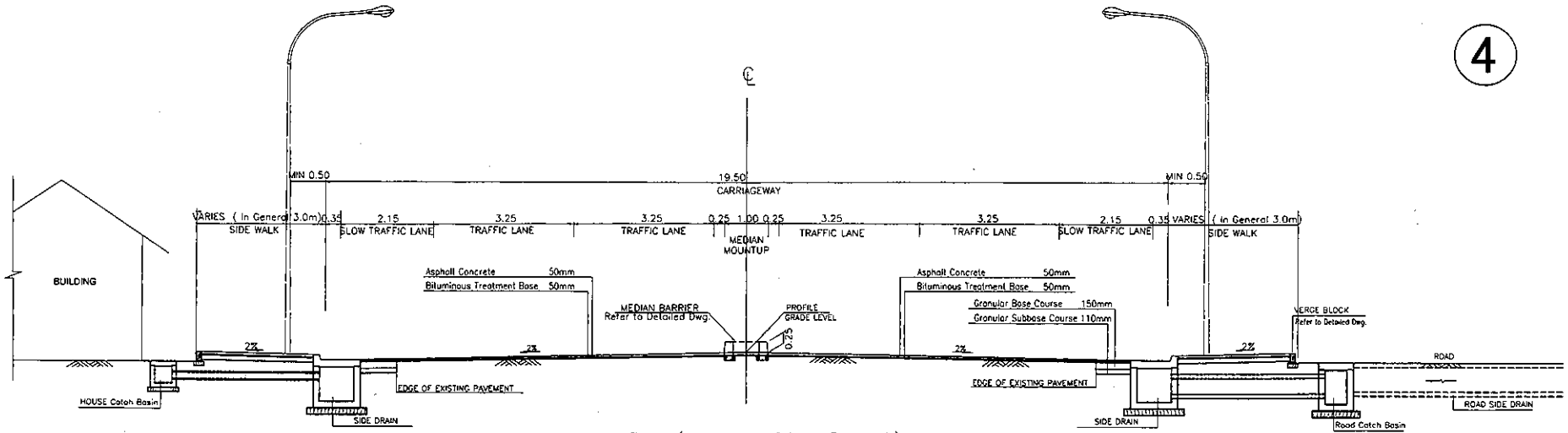
3



TYPE-3 (STA. 1+590 - 1+930)
(WATTAY JUNCTION (T2) - LAKSONG JUNCTION)

NOTE : 1.The width of the sidewalk mentioned in the drawing is the general width.The width shall be narrowed at places where houses/buildings are affected by the sidewalk so as to avoid relocation.
2.For the dimensions of drainage facilities, refer to "DRAINAGE TYPICAL DRAWING"

4

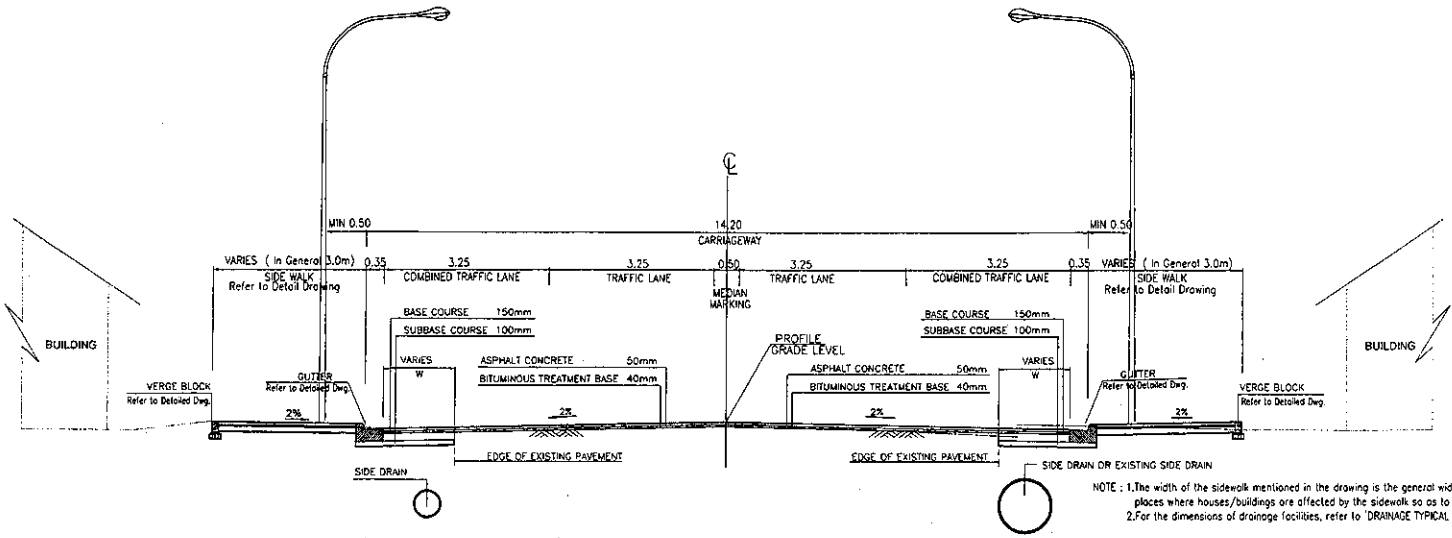


TYPE-4 (STA. 1+930 - 3+960)
(WATTAY JUNCTION (T2) - LAKSONG JUNCTION)

NOTE : 1.The width of the sidewalk mentioned in the drawing is the general width.The width shall be narrowed at places where houses/buildings are affected by the sidewalk so as to avoid relocation.
2.For the dimensions of drainage facilities, refer to "DRAINAGE TYPICAL DRAWING"

ROADS DEPARTMENT, MINISTRY OF COMMUNICATION TRANSPORT, POST AND CONSTRUCTION LAO PEOPLE'S DEMOCRATIC REPUBLIC	BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE VIENTIANE NO.1 ROAD IN THE LAO PEOPLE'S DEMOCRATIC REPUBLIC	JAPAN INTERNATIONAL COOPERATION AGENCY KATAHIRA & ENGINEERS INTERNATIONAL CTI ENGINEERING INTERNATIONAL CO, LTD	TITLE: TYPICAL CROSS SECTION R-1-(2)	SCALE: S=1:100	DRAWING No: G-18 Rv.

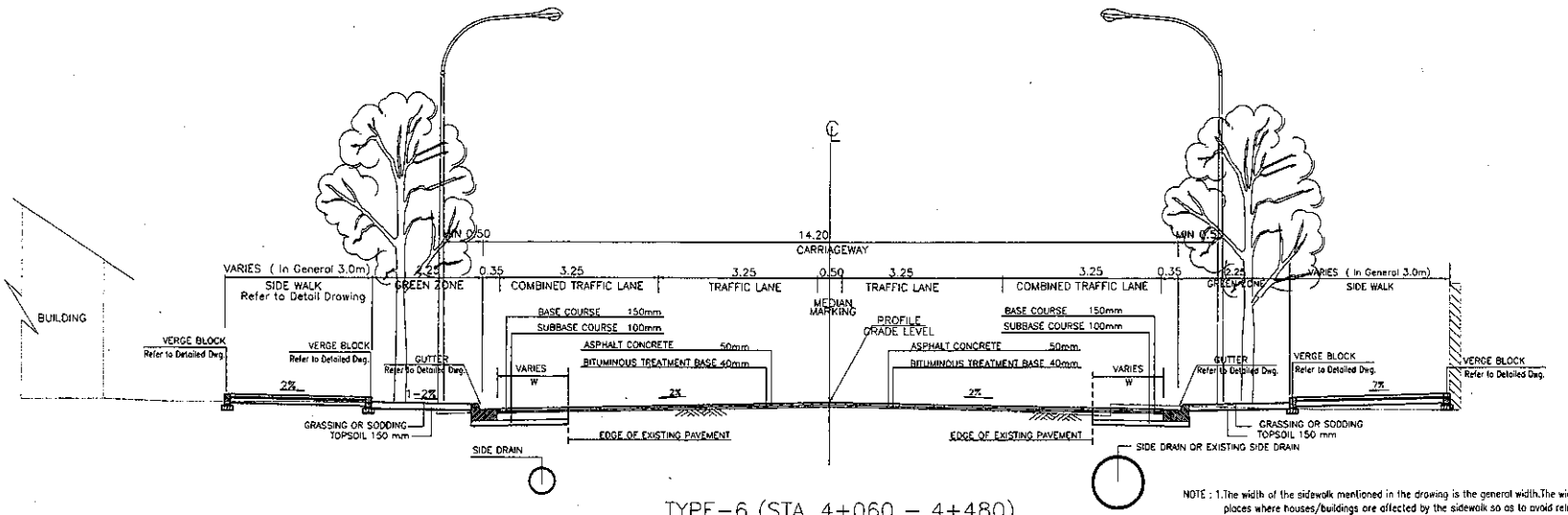
5



NOTE : 1.The width of the sidewalk mentioned in the drawing is the general width.The width shall be narrowed at places where houses/buildings are affected by the sidewalk so as to avoid relocation.
2.For the dimensions of drainage facilities, refer to 'DRAINAGE TYPICAL DRAWING'

TYPE-5 (STA. 3+960 - 4+060 , STA. 4+480 - 4+800)
(LAKSONG JUNCTION~ROAD 4AJUNCTION)

6

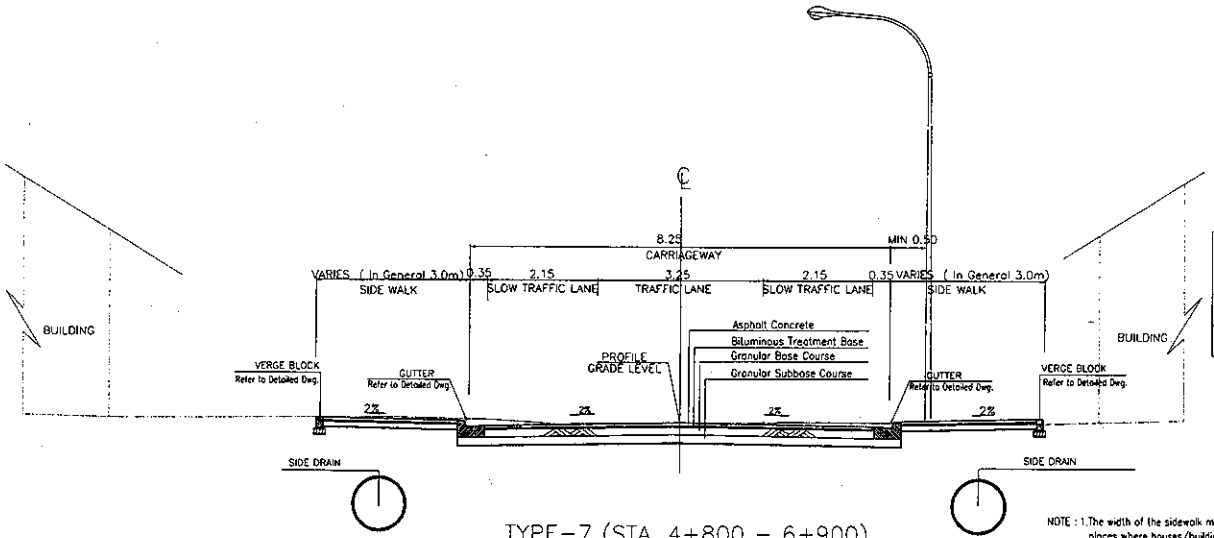


NOTE : 1.The width of the sidewalk mentioned in the drawing is the general width.The width shall be narrowed at places where houses/buildings are affected by the sidewalk so as to avoid relocation.
2.For the dimensions of drainage facilities, refer to 'DRAINAGE TYPICAL DRAWING'

TYPE-6 (STA. 4+060 - 4+480)
(LAKSONG JUNCTION - ROAD 4A JUNCTION)

ROADS DEPARTMENT, MINISTRY OF COMMUNICATION TRANSPORT, POST AND CONSTRUCTION LAO PEOPLE'S DEMOCRATIC REPUBLIC	BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE VIENTIANE NO.1 ROAD IN THE LAO PEOPLE'S DEMOCRATIC REPUBLIC	JAPAN INTERNATIONAL COOPERATION AGENCY KATAHIRA & ENGINEERS INTERNATIONAL CTI ENGINEERING INTERNATIONAL CO, LTD	TITLE: TYPICAL CROSS SECTION R-1-(3)	SCALE: S=1:100	DRAWING No: G-19 Rv.

7



TYPE-7 (STA. 4+800 – 6+900)

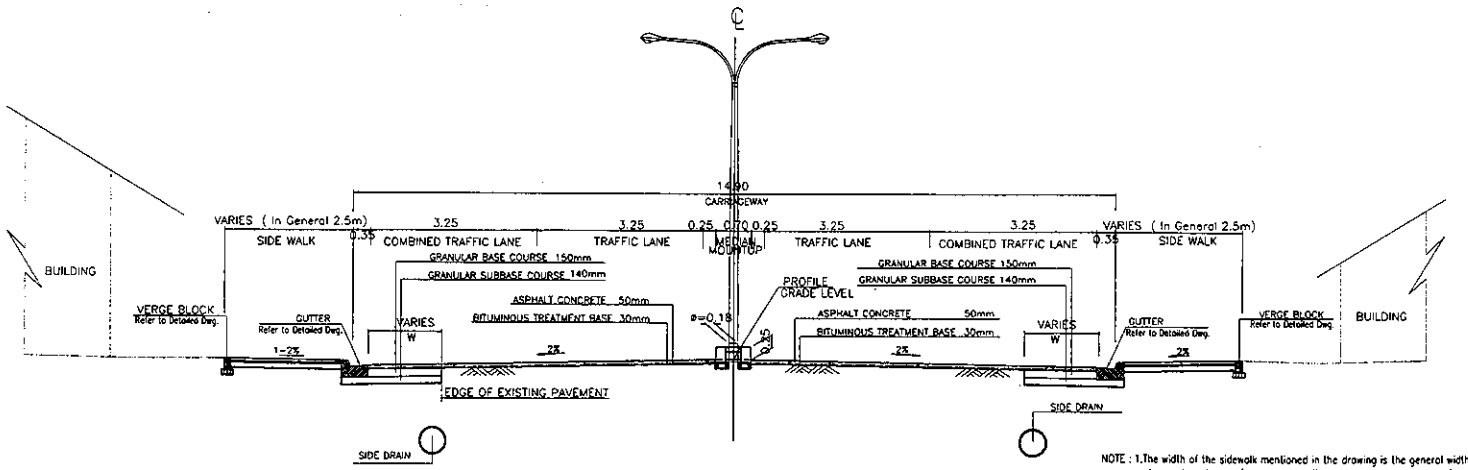
(ROAD 4A JUNCTION – SIMUANG JUNCTION)

PAVEMENT STRUCTURE COMPOSITION

TYPE	STATION	ASPHALT CONCRETE mm	BITUMINOUS TREATMENT BASE mm	GRANULAR BASE COURSE mm	GRANULAR SUBBASE COURSE mm
7-1	4+800 to 5+800 (ROAD 4A JCT. to ROAD 2 JUNCTION)	50	40	150	100
7-2	5+800 to 6+900 (ROAD 2 JCT. to SIMUANG JUNCTION)	50	30	150	160

NOTE : 1.The width of the sidewalk mentioned in the drawing is the general width.The width shall be narrowed at places where houses/buildings are affected by the sidewalk so as to avoid relocation.
2.For the dimensions of drainage facilities, refer to 'DRAINAGE TYPICAL DRAWING'

8



TYPE-8 (STA. 6+900 +7+280)

(SIMUANG JUNCTION – THATKHAO JUNCTION)

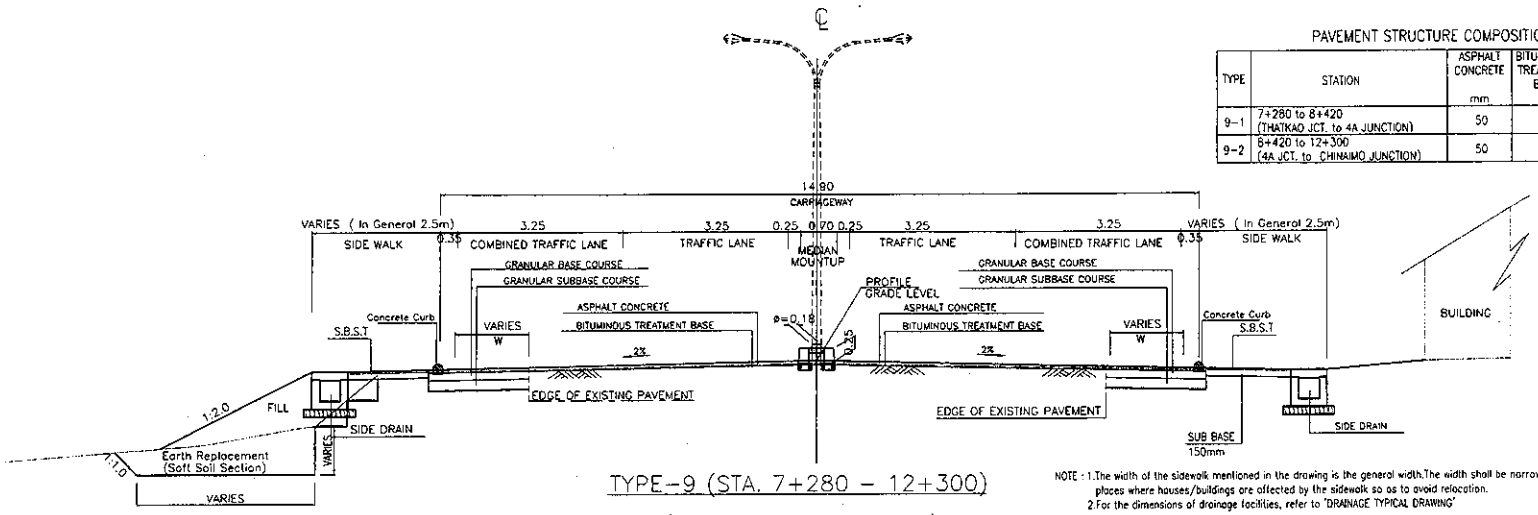
NOTE : 1.The width of the sidewalk mentioned in the drawing is the general width.The width shall be narrowed at places where houses/buildings are affected by the sidewalk so as to avoid relocation.
2.For the dimensions of drainage facilities, refer to 'DRAINAGE TYPICAL DRAWING'

ROADS DEPARTMENT, MINISTRY OF COMMUNICATION TRANSPORT, POST AND CONSTRUCTION LAO PEOPLE'S DEMOCRATIC REPUBLIC	BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE VIENTIANE NO.1 ROAD IN THE LAO PEOPLE'S DEMOCRATIC REPUBLIC	JAPAN INTERNATIONAL COOPERATION AGENCY KATAHIRA & ENGINEERS INTERNATIONAL CTI ENGINEERING INTERNATIONAL CO, LTD	TITLE: TYPICAL CROSS SECTION R-1-(4)	SCALE: S=1:100	DRAWING No: G-20	Rv.

9

PAVEMENT STRUCTURE COMPOSITION

TYPE	STATION	ASPHALT CONCRETE mm	BITUMINOUS TREATMENT BASE mm	GRANULAR BASE COURSE mm	GRANULAR SUBBASE COURSE mm
9-1	7+280 to 8+420 (THATKAO JCT. to 4A JUNCTION)	50	40	150	200
9-2	8+420 to 12+300 (4A JCT. to CHINAIMO JUNCTION)	50	30	150	210



TYPE-9 (STA. 7+280 - 12+300)

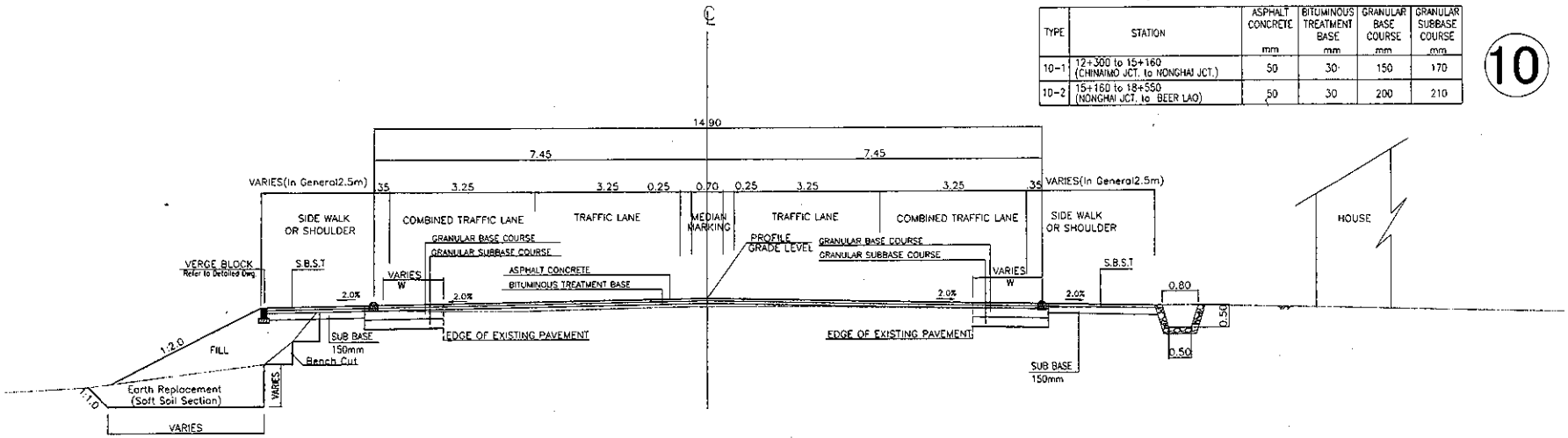
(THATKHAO - CHINAIMO)

NOTE : 1.The width of the sidewalk mentioned in the drawing is the general width.The width shall be narrowed at places where houses/buildings are affected by the sidewalk so as to avoid relocation.
2.For the dimensions of drainage facilities, refer to 'DRAINAGE TYPICAL DRAWING'

10

PAVEMENT STRUCTURE COMPOSITION

TYPE	STATION	ASPHALT CONCRETE mm	BITUMINOUS TREATMENT BASE mm	GRANULAR BASE COURSE mm	GRANULAR SUBBASE COURSE mm
10-1	12+300 to 15+160 (CHINAIMO JCT. to NONGHAI JCT.)	50	30	150	170
10-2	15+160 to 18+550 (NONGHAI JCT. to BEER LAO)	50	30	200	210



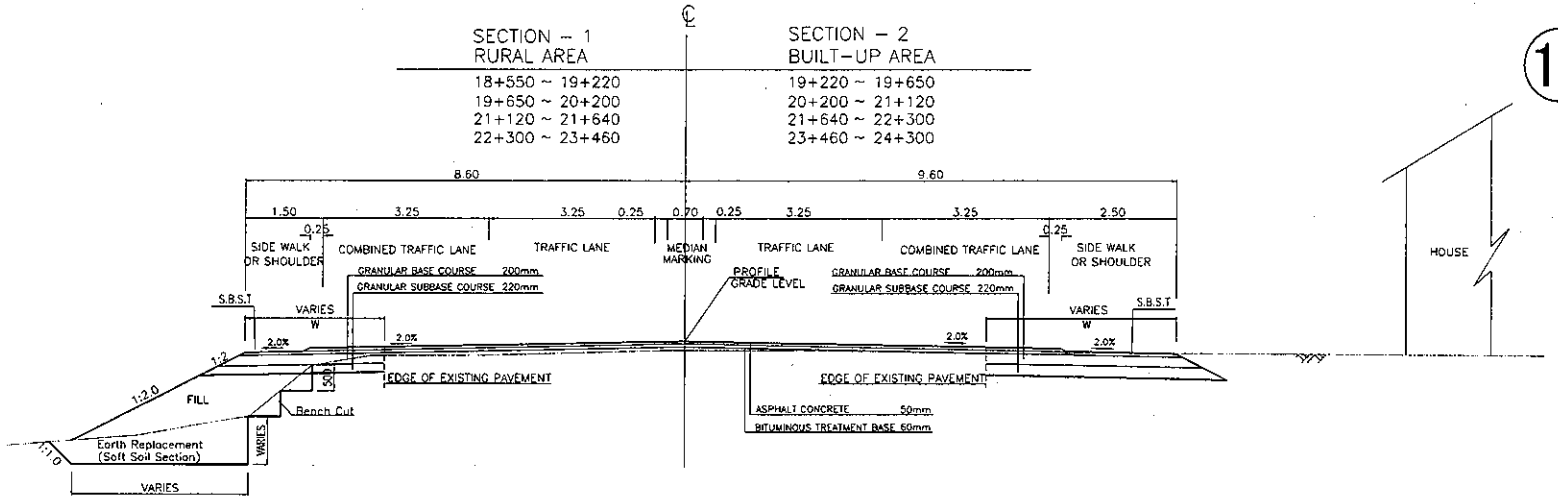
TYPE-10 (STA. 12+300 - 18+550)

(CHINAIMO JUNCTION - BEER LAO)

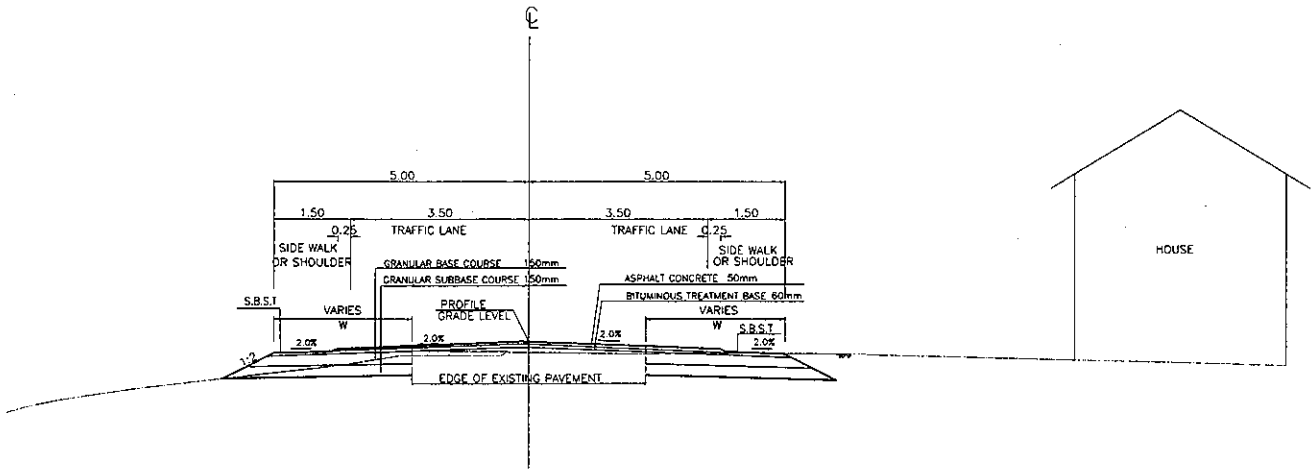
NOTE : 1.The width of the sidewalk mentioned in the drawing is the general width.The width shall be narrowed at places where houses/buildings are affected by the sidewalk so as to avoid relocation.
2.For the dimensions of drainage facilities, refer to 'DRAINAGE TYPICAL DRAWING'

ROADS DEPARTMENT, MINISTRY OF COMMUNICATION TRANSPORT, POST AND CONSTRUCTION LAO PEOPLE'S DEMOCRATIC REPUBLIC	BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE VIENTIANE NO.1 ROAD IN THE LAO PEOPLE'S DEMOCRATIC REPUBLIC	JAPAN INTERNATIONAL COOPERATION AGENCY KATAHIRA & ENGINEERS INTERNATIONAL CTI ENGINEERING INTERNATIONAL CO, LTD	TITLE: TYPICAL CROSS SECTION R-1-(5)	SCALE: S=1:100	DRAWING No: G-21 Rv.

SECTION – 1 RURAL AREA	SECTION – 2 BUILT-UP AREA
18+550 ~ 19+220	19+220 ~ 19+650
19+650 ~ 20+200	20+200 ~ 21+120
21+120 ~ 21+640	21+640 ~ 22+300
22+300 ~ 23+460	23+460 ~ 24+300



TYPE-11 (STA. 18+550 – 24+300)
(BEER LAO – FRIENDSHIP BRIDGE GATE)



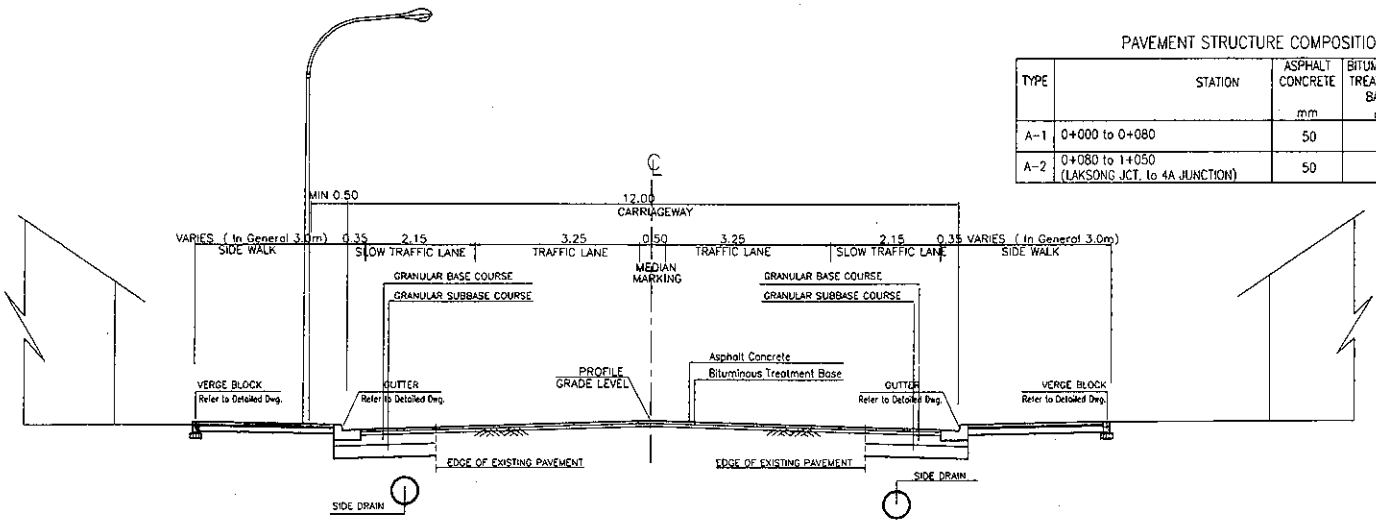
TYPE-12 (STA. 24+300 – 25+700)
(FRIENDSHIP BRIDGE GATE~THANALENG)

ROADS DEPARTMENT, MINISTRY OF COMMUNICATION TRANSPORT, POST AND CONSTRUCTION LAO PEOPLE'S DEMOCRATIC REPUBLIC	BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE VIENTIANE NO.1 ROAD IN THE LAO PEOPLE'S DEMOCRATIC REPUBLIC	JAPAN INTERNATIONAL COOPERATION AGENCY KATAHIRA & ENGINEERS INTERNATIONAL CTI ENGINEERING INTERNATIONAL CO, LTD	TITLE: TYPICAL CROSS SECTION R-1-(6)	SCALE: S=1:100	DRAWING No: G-22 Rv.

A

PAVEMENT STRUCTURE COMPOSITION

TYPE	STATION	ASPHALT CONCRETE mm	BITUMINOUS TREATMENT BASE mm	GRANULAR BASE COURSE mm	GRANULAR SUBBASE COURSE mm
A-1	0+000 to 0+080	50	40	150	110
A-2	0+080 to 1+050 (LAKSONG JCT. to 4A JUNCTION)	50	60	150	100



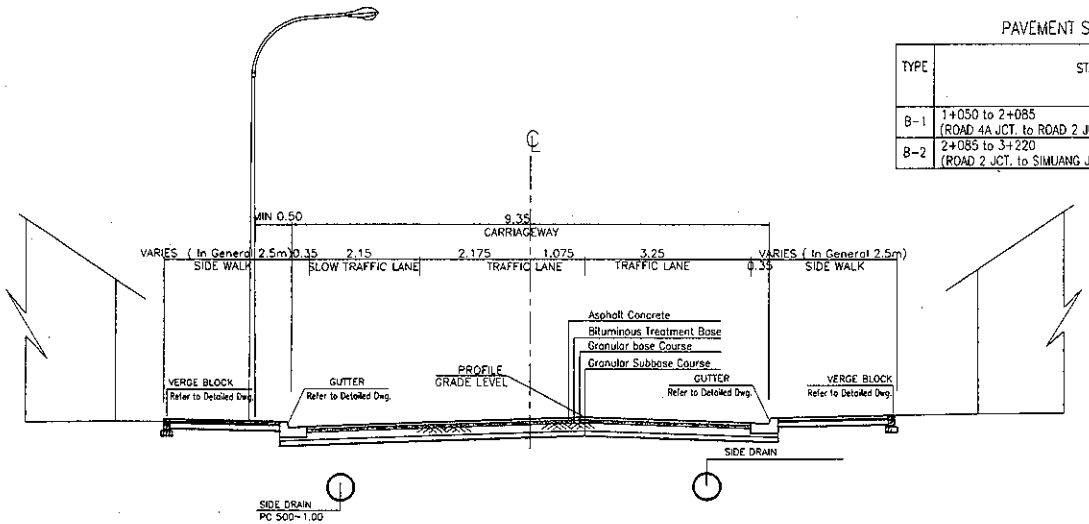
(A) TYPE-1 (STA. 0+000 - 1+050)

(LAKSONG JUNCTION - ROAD 4A JUNCTION)

B

PAVEMENT STRUCTURE COMPOSITION

TYPE	STATION	ASPHALT CONCRETE mm	BITUMINOUS TREATMENT BASE mm	GRANULAR BASE COURSE mm	GRANULAR SUBBASE COURSE mm
B-1	1+050 to 2+085 (ROAD 4A JCT. to ROAD 2 JUNCTION)	50	60	150	100
B-2	2+085 to 3+220 (ROAD 2 JCT. to SIMUANG JUNCTION)	50	30	150	150



(B) TYPE-1 (STA. 1+050 - 3+220)

(ROAD 4A JUNCTION - SIMUANG JUNCTION)

ROADS DEPARTMENT, MINISTRY OF COMMUNICATION TRANSPORT, POST AND CONSTRUCTION LAO PEOPLE'S DEMOCRATIC REPUBLIC	BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE VIENTIANE NO.1 ROAD IN THE LAO PEOPLE'S DEMOCRATIC REPUBLIC	JAPAN INTERNATIONAL COOPERATION AGENCY KATAHIRA & ENGINEERS INTERNATIONAL CTI ENGINEERING INTERNATIONAL CO, LTD	TITLE: TYPICAL CROSS SECTION R-1A-(1)	SCALE: S=1:100	DRAWING No: G-23 Rv.