Ministry of Public Works and Transport
Lao People's Democratic Republic

PREPARATORY SURVEY REPORT
FOR
THE PROJECT FOR
CONSTRUCTION OF SEKONG BRIDGE
ON NR16B
IN
THE SOUTHERN REGION OF LAOS

December 2013

JAPAN INTERNATIONAL COOPERATION AGENCY

CENTRAL CONSULTANT INC.

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Preface

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey on the project for construction of Sekong Bridge on NR16B in the southern region of Laos and entrust the survey to Central Consultant Inc.

JICA sent to Laos a survey team from March 21 to May 26, 2013. The survey team held discussions with the officials concerned of the Government of Laos, and conducted field investigations at the study area. As a result of further studies in Japan, the present report was finalized.

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

Finally, 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 survey team.

December 2013

Kazunori Miura
Director General,
Economic Infrastructure Department,
Japan International Cooperation Agency

Summary

Summary

(1) Country Overview

The Lao People's Democratic Republic (hereinafter, Laos) is a landlocked country situated between Thailand, Cambodia, Vietnam, Myanmar and China. Laos has a land area of 236,800 square kilometers and a total population of 6.65 million (World Bank, 2012), with a population density of 28 people per square kilometer.

Topographically, Laos stretches north to south, with much of the country being mountainous. It has relatively more forest resources remaining than its neighboring countries but has had problems with rapid deforestation in recent years. A full 61% of the country is secondary forest, and many people live in these forested areas.

Laos has a tropical monsoon climate with two main seasons: rainy and dry. The rainy season is from May to October, and the dry season is from November to April. In the project region of Sekong, average annual rainfall is 1,285 millimeters, with a large annual range of 1,000 millimeters in dry years and 1,600 millimeters in wet years. Temperatures are above 34°C all year long with high temperatures of 39°C in March and April and lows around 34°C in December.

The Laos gross domestic product (GDP) is $8.2 billion, with GDP per capita at $1,281 (Lao Statistics Bureau, 2011). Gross national income (GNI) per capita is $2,400 (WHO, 2013). The real rate of economic growth is 8.04% (2011), and the inflation rate is 7.6% (Lao Statistics Bureau, 2011). Total trade figures are $1.854 billion in exports and $2.423 billion in imports (Central Bank of Lao, 2011). Key export items are minerals, agricultural products, forest products, garments and electric power, and key import items are investment-related goods and consumer goods (Central Bank of Lao, 2011). Key industries are the service industry (approx. 38% of GDP), agriculture (approx. 28%) and manufacturing (approx. 27%).

The Lao planned economy has been stalled since 1975, but the country embarked on economic reform with its "New Economic Mechanism" in 1986. This mechanism introduced a market economy and promoted an open economic policy with widespread measures, establishing a banking system, tax system and foreign investment laws and privatizing state-owned enterprises. At the eighth party congress in 2006, Laos set long-term goals such as basically solving poverty by 2010 and shedding its least developed country (LDC) categorization by 2020.

Also, Laos is aiming to promote foreign investment as a means to accelerate socio-economic development. They are working to improve the investment climate, enacting a Japanese bilateral investment treaty in August 2008 and holding a bilateral public-private dialogue with Japan.

(2) Background, Chronology and Overview of the Project

In Laos, roads are the main means of transporting people and goods, accounting for 90% of passenger transport and 80% of freight transport. However, in the southern region bordering with Thailand and Vietnam (provinces of Savannakhet, Salavan, Sekong, Champasak and Attapeu), despite the importance of road development in terms of regional connectivity, the many mountains have slowed development efforts.

To date, Laos has actively developed its roads with assistance from different aid agencies, including JICA. Development projects in the south include National Roads 9 and 13, the Pakse bridge and the

Second Mekong International Bridge. Still, the road network is prone to failure in the rainy season.

Running across the southern region and connecting Thailand and Vietnam, NR 16 is one of these projects. NR 16 is bisected by the Sekong River. While there are currently ferries crossing the river, they operate on irregular schedules and suspend their service frequently in the rainy season, greatly impacting area residents. The area east of the river (eastern Sekong and northeastern Attapeu provinces) in particular has issues with ensuring stable transportation. This area is ridden with extreme poverty; more than 90% of the population is ethnic minority, and the area lacks the social infrastructure that is essential to improving MDG indicators. When river crossing services are suspended, this area becomes an isolated island, with obstructed access to social infrastructure and smooth goods distribution, and thus economic activity.

Maintaining stable transport is also an important issue to the economic development of southern Laos in addition to the improvement of the lives of area residents. The region is starting to show its potential in terms of mining and water resources development, including the area around the project site. Given these circumstances, the Laotian government has requested grant aid from Japan for construction of a Sekong bridge.

This study was performed to confirm the necessity and relevance of the requested project, as well as to make an appropriate outline design for the grant aid project, formulate a project plan and estimate project costs.

(3) Overview of Study Results and Details of the Project

JICA dispatched a preparatory study team (outline design study) to Laos from March 21 to May 26, 2013. In its study, the team consulted with Lao officials mainly to confirm the bridge location and access road alignment, longitudinal profile plans of the bridge and access road, bridge width, bridge format, environmental and social considerations, natural environment conditions, traffic volume, the procurement situation for construction materials and equipment, and the operation and maintenance system.

Based on the results of the study, in Japan the outline design preparatory study team discussed bridge location, access road alignment, the longitudinal and construction plans for the bridge and access roads, project outline cost estimation and also performed the outline design. They were then dispatched to Laos from October 9 to 13 to consult with Lao officials to confirm and approve details of the outline design and the costs borne by the Lao side.

In terms of bridge location, the most reasonable and economical location for total project cost would be to connect the bridge to National Road 16B which has already been constructed up to the Sekong River on either side. As the Lao Ministry of Public Works and Transport (MPWT) also strongly desired a bridge in this location to connect NR 16B in its original plans, the bridge location will connect National Road 16B.

In terms of longitudinal profile, bridge height was set such that driftwood will not strike the bridge girders in a 50-year flood of the Sekong River, and such that bridge girders would not flood in water levels of the largest recorded typhoon, Ketsana (a 100-year storm). In the interest of reducing costs, Lao and Japanese standards were adopted for the bridge format and access road specifications. Also, the outline design has appropriate scales and specifications for the bridge and access road to achieve their intended roles. When selecting construction methods, the team aimed to push completion to be as early as possible while keeping methods cost-effective.

An overview of the above results and plans finally proposed is as follows:

Item		Types and dimensions
Bridge location		Place where National Road No.16B crosses Sekong River
Width	Bridge	Carriageway: 3.5m×2=7.0m; marginal strip: 0.5m×2=1.0m; and foot pavement: 1.5m×2=3.0m; a total of 11.0m (effective width) wheel guard: 0.4m×2=0.8m a total of 11.8m (total width)
	Access road	Carriageway: 3.5m×2=7.0m; and shoulder: 1.5m×2=3.0m; and soft shoulder: 0.5m×2=1.0m a total of 11.0m (total width)
Bridge type		Extradosed bridge + PC box girder bridge
Bridge length and spans		80.0m＋110.0m＋65.0m (main bridge) + 45m (side span)
Bridge surface pavement		Asphalt pavement (carriageway: 80mm)
Abutment A1 (on the side of Sekong city)	Type	Reverse T-style
	Height	9.8m
	Foundation	Cast in-situ pile foundation (φ1.2m、L=9.5m、n=8)
Abutment A2 (on the side of Dak Cheung district)	Type	Reverse T-style
	Height	8.0m
	Foundation	Spread foundation
Pier P1	Type	Elliptical type
	Height	H=16.5m
	Foundation	Spread foundation
Pier P2	Type	Elliptical type
	Height	H=24.5m
	Foundation	Spread foundation
Pier P3	Type	Elliptical type
	Height	H=25.5m
	Foundation	Spread foundation
Access roads	Length	Side of city of Sekong: 227m and side of Dak Cheung district: 300m, a total of 527m
	Pavement	Asphalt pavement (Surface layer: 50mm + base layer: 50mm = 100mm)
Revetment work	Right bank	Gabion construction method: 3,024m^2

(4) Construction Period and Project Cost Estimation

When The Project is implemented through Japan's grant aid, 6.0 months will be required for the implementation design and 29 months for facility construction. Moreover, the amount of the estimated project cost to be borne by the Laos side is estimated at 3.57 million yen.

(5) Project Evaluation

1) Relevance

The relevance of this Project, which will be implemented through Japan's grant aid, has been determined through the following points.

① The beneficiaries of this Project extend to a large portion of the general public which includes poor people in the southern regions (directly benefitting 62,000 people living in Sekong Province including 29,000 people in the Lam Mam District, 19,000 people in Dak Cheung District, and

14,000 people in Kaleum District. Additionally, it will indirectly benefit 6.65 million Lao citizens in the surrounding areas).

② There is an urgent need to improve the lives of Lao residents through strengthening the routes important to the international transportation network, National Road No. 16 and National Road No. 16B. By strengthening these roads it will be possible to secure stable and smooth transportation which will stimulate the social economy, reduce the poverty of residents in the southern regions and improve the lives of the people of Laos.

③ After Project completion the Laos side will be able to manage and maintain the roads through its own funds, human resources and technology, without the need for excessively sophisticated techniques.

④ This Project is positioned as one of the concrete strategies within the Development Plan for the National Roads: 2011-2015 and this improvement project is essential to National Road 16B which is a core international transportation road for Laos.

⑤ There will be almost no negative effects on the environment from the implementation of this Project.

⑥ The Project can be implemented through the grant aid system of Japan without any particular difficulties.

⑦ Since the main bridge section will be 255m (80m+110m+65m) and be a long extradosed bridge, carrying out construction through the use of Laos' own technology alone would be difficult and thus it is necessary and advantageous to use the technology of Japan.

2) Effectiveness

i) Quantitative outputs

Through the implementation of this Project the following quantitative effects are expected.

Indicator	Reference value (2013)	Target value (2020) [3 years after project completion]
①Required time to cross the river (minutes)	15 (The average value including waiting time)	0.3 (Running speed 60km / h, bridge length 300m)
②Length of time possible to cross the river per day (Hours / day)	14 (The crossing by ferry) (Only during the day)	24 (Crossing by bridge) (All day)
③Number of days possible to cross the river per year (days/year)	305 (Crossing the river by ferry)	365 (Crossing by bridge)
④Daily traffic vehicle crossing (vehicles / day)	235 (crossing by ferry)	516 (crossing by bridge)
⑤Pedestrian crossing daily traffic (persons / day)	290 (crossing by ferry)	330 (crossing by bridge)
⑥International distribution transport distance (km) (Exports to neighbouring countries from southern produciton areas (incl. Sekong Province) which also includes those from Japanese companies)	About 900 (Sekong Province ⇒ Bangkok)	About 280 (Sekong Province ⇒ Da Nang)
⑦International distribution transit time (days) (export to Bangkong from Japanese companies in Da Nang)	7 (Da Nang ⇒ Bangkok) [Sea transport]	2 (Da Nang ⇒ Sekong ⇒Bangkok) [Land transportation]

ii) Qualitative outputs

① The construction of the target bridge is intended to replace the ferry system and secure stable distribution and human exchange. This is intended to stimulate production operations and distribution activities for local products and mineral resources in the southern region and thus contribute to the economic development and poverty reduction in this region.

② As the target bridge will secure a height that will not be inundated even in the case of a large scale, 100 year flood, if the surrounding areas are submerged in such a flood, the bridge will act as an emergency evacuation site for people and domestic animals.

③ It will become possible to export agriculture and forest products produced by Japanese companies in regions to the west of Sekong Bridge (such as the Bolaven Plateau) to Vietnam, particularly Da Nang port. Currently, the industrial goods of areas to the west of Sekong Bridge are mostly exported to Bangkok, thus this Project will increase the options for export locations. Moreover, if development continues on road 16B and 14D on the Vietnam side, the transportation distance to Vietnam's Da Nang port will become shorter than the Bangkok Route and will achieve a reduction in transport costs.

④ It will become possible to export to Thailand agriculture and forest products produced by Japanese companies in the currently underdeveloped area to the east of Sekong Bridge (centering around Dakchung). Moreover if the development continues on Road 16B and 14D on the Vietnam side, the choice of export destinations will increase to include both Vietnam and Thailand which will enable a stable shipment of products.

⑤ If Da Nang in Vietnam became a gateway to the southern region of Laos through the completion of this bridge, the transport distance would be less than one third that of the carry-out from the southern region to Bangkok which would create the benefits of a reduction in transportation costs and transit time.

⑥ Japanese companies that are expanding production activities in Da Nang's industrial park (56 companies as of December 2012), will obtain the benefit of being able to carry-out goods over the land route to the industrial goods markets in Bangkok. While shipping over sea to Bangkok takes approximately one week, the land route takes approximately two days, a significant decrease in transport time.

⑦ Japanese companies that are already carrying out production activities in Vietnam will be able to expand operations into Laos

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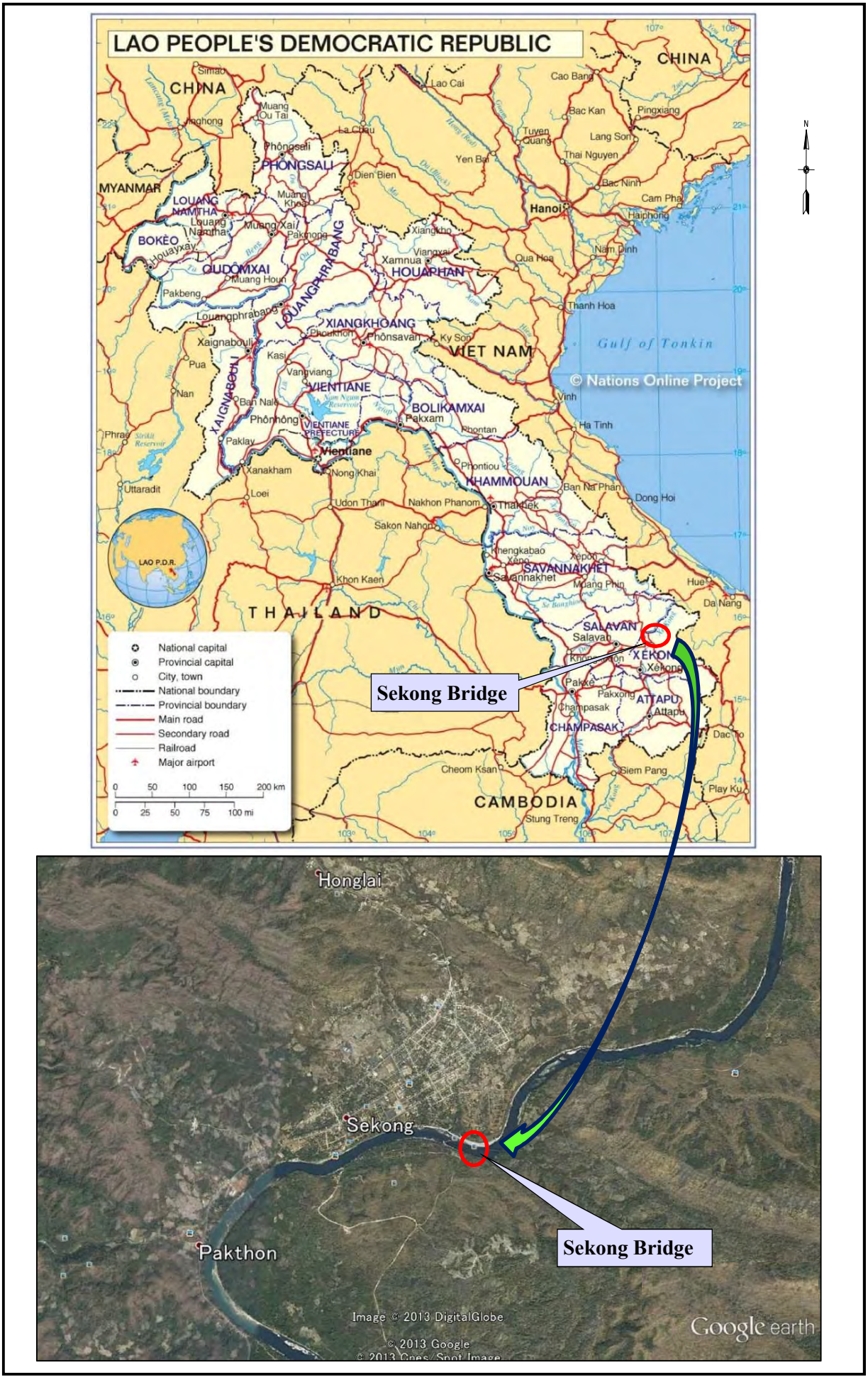

Location Map

Rendering of Sekong Bridge

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Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
AC	Asphalt Concrete
ADB	Asian Development Bank
AusAID	Australian Agency for International Development
CBR	California Bearing Ratio
DMH	Department of Meteorology and Hydrology
DOR	Department of Roads
DPWT	Department of Public Works and Transport, Sekong
EIA	Environmental Impact Assessment
E/N	Exchange of Notes
GDP	Gross Domestic Product
GNI	Gross National Income
HIV/AIDS	Human immunodeficiency virus infection / acquired immunodeficiency syndrome
HWL	High Water Level
IDA	International Development Association
IEE	Initial Environmental Evaluation
JICA	Japan International Cooperation Agency
KFW	Kreditanstalt für Wiederaufbau
M/D	Minutes of Discussion
MONRE	Ministry of Natural Resources and Environment
MPWT	Ministry of Public Works and Transport
NSEDP	National Socio-Economic Development Plan
O/D	Outline Design Study
ODA	Official Development Assistance
PC	Prestressed Concrete
PCU	Passenger Car Unit
RC	Reinforced Concrete
RMF	Road Maintenance Fund
SIDA	Swedish International Development Agency
STEA	Science Technology and Environmental Agency
UNDP	United Nations Development Programme
WB	World Bank

Chapter 1
Background of the Project

Chapter 1 Background of the Project

1-1 Background and Overview of Request for Grand Aid

In Laos, roads are the main means of transporting people and goods, accounting for 90% of passenger transport and 80% of freight transport. However, in the southern region bordering with Thailand and Vietnam (provinces of Savannakhet, Salavan, Sekong, Champasak and Attapeu), despite the importance of road development in terms of regional connectivity, the many mountains have slowed development efforts.

To date, Laos has actively developed its roads with assistance from different aid agencies, including JICA. Development projects in the south include National Roads 9 and 13, the Pakse bridge and the Second Mekong International Bridge. Still, the road network is prone to failure in the rainy season.

Running across the southern region and connecting Thailand and Vietnam, NR 16 is one of these projects. NR 16 is bisected by the Sekong River. While there are currently ferries crossing the river, they operate on irregular schedules and suspend their service frequently in the rainy season, greatly impacting area residents. The area east of the river (eastern Sekong and northeastern Attapeu provinces) in particular has issues with ensuring stable transportation. This area is ridden with extreme poverty; more than 90% of the population is ethnic minority, and the area lacks the social infrastructure that is essential to improving MDG indicators. When river crossing services are suspended, this area becomes an isolated island, with obstructed access to social infrastructure and smooth goods distribution, and thus economic activity.

Maintaining stable transport is also an important issue to the economic development of southern Laos in addition to the improvement of the lives of area residents. The region is starting to show its potential in terms of mining and water resources development, including the area around the project site. Given these circumstances, the Laotian government has requested grant aid from Japan for construction of a Sekong bridge.

This study was performed to confirm the necessity and relevance of the requested project, as well as to make an appropriate outline design for the grant aid project, formulate a project plan and estimate project costs.

1-2 Natural Environment

1-2-1 Weather and Hydrological Conditions

(1) Temperature, humidity and wind speed

According to data recorded at the Sekong observation station, the station nearest to the location of the bridge, the maximum temperature in the previous 11 years has been highest in April, about 39 degree Celsius and lowest in December, about 34 degree Celsius. The temperature is at 34 degree Celsius or higher throughout the year. The minimum temperature has been lowest in January, about 11 degree Celsius, the temperature for six months from October to March falling under 19 degree Celsius.

The humidity falls under the range between 59% and 85% throughout the year, the average being approximately 70%. It ranges between 55% and 77% in the dry season from October to April, but is higher in the rainy season from May to October, ranging between 73% and 85%. Since the temperature and humidity on the bridge construction site is fairly high in the rainy season, care must be taken for changes in the temperature of materials when designing, and for placement and care of concrete when carrying out construction work.

The wind speed ranges between 1.2m/s and 3.9m/s throughout the year, the annual average being 2.5m/s: it is not particularly windy on the site.

(2) Precipitation and rainfall pattern

The annual precipitation on the project site averages approximately 1,285mm over the past five years, though the gap between years is considerable with 1,000mm at the minimum and 1,600mm at the maximum. It rains scarcely during the period between November and March in Laos, and heavily during the period between April and October. The precipitation exceeds 200mm per month from July to September, but the annual precipitation is not particularly high at the project site. In recent years, however, it sometimes exceeds 400mm per month, which is a factor that could potentially cause a considerable impact on the construction plan and schedule, so the climate conditions must be well taken into account when planning the construction work. The Project will aim to complete the work to build the lower parts of abutments, foundation work and other work in the river before the river rises.

(3) Characteristics of the river channel

Sekong River originates in the Annamite Range in the southern part of Laos near the border with Vietnam, flows through the mountainous area and Sekong Province, and meets the Xenamnoy River and other tributaries before reaching Attapu. Merged by Xekaman River and the Xe XouRiver, it runs through the southwestern part of Cambodia and flows into the Mekong River from the left-hand side. The river basin area at the location of the new bridge is 5,483km2.

The banks of the river channel around the construction site are at high altitudes on both sides. The river width is approximately 120-210m when the river is at ordinary water-level and flooding, but when the largest flood occurred in the past the river water spread to the right bank and doubled the width to 430m because the right bank is lower than the left one. However, the right bank becomes gradually higher in the upstream direction from a point some 500m upstream of the bridge site. Thus the river width narrows from the bridge site to this point to approximately 320m.

These characteristics of the river channel will be well taken into account when the bridge location is determined.

(4) Flood conditions

The flood caused by Typhoon Ketsana (2009) had the following features:

- The observation station on the Sekong River recorded a maximum water depth of 20.04m.
- A surge and steep drop in water levels were observed.
- The peak water level exceeded the observation indicators, so the water level was observed afterwards by checking traces of the flood nearby.

The surge of the water level appears to be attributable to the following two reasons:

(i) A large volume of rainwater from the upstream mountain

(ii) Reservoir effects of the narrow channel of the river downstream (waterfalls and sediment deposits) and excavation of the riverbed

As summarized above, the channel of the Sekong River takes the form of a natural dam and the river is merged with tributaries with large basins in the lower course, both of which seem to cause a rise in the water level. It seems that, if a large amount of rainwater flows from the river basin of mountain, the water level of the river channel temporarily but suddenly rises. In line with this, this Survey will assume a design high-water discharge on the bridge site and make a bridge plan that will not be affected by flood.

(5) Design high-water discharge

The relevant regulations in Laos stipulate that the probability scale to be adopted for the bridge concerned should be, in the case of water level, T=1/50. A hydrological statistics analysis on data obtained at the Attapu observation station estimates that the design high-water discharge, with a probability of T=1/50 on the site of the Sekong Bridge, is 7,200m3/s after converting to flow.

(6) Highest experienced-water level

The Sekong River marked the highest experienced-water depth of 20.04m when it was hit by Typhoon Ketsana (September 30, 2009). Since the height of the riverbed which serves as the criteria for measuring the water depth is 107.517m, the highest experienced-water level is 127.557m (107.517m+20.04m). The water surface gradient on the bridge site at the time of the flood, in other words the highest experienced-water level on the bridge site 492m upstream of the water-level observation indicator, can be calculated according to the following formula:

Highest experienced-water level =

water level at observation station ＋1/1,673*492m =127.557m＋0.294m =127.851m → 128m

(7) Design high water level

1) Probability water level

The Sekong observation station started to observe the water level in 1990 and keeps a record of the water level observed for the 23 years up until 2012. Since it is located 492m downstream of the planned bridge construction site, the Study Team estimated the probability water level for each design

scale by processing the annual maximum water depth on the bridge site with probability statistical methods – that is, lognormal distribution and Gumbel distribution methods. The following table presents the results.

Table1-2-1 Probability water level (water depth)

（Unit: m）

Calculation method	T=1/10	T=1/20	T=1/50	T=1/100
Lognormal distribution	13.8	15.8	18.4	20.4
Gumbel distribution	14.1	16.2	18.9	20.9

In Laos, the return period is generally set out in accordance with the river size: a 1/100 probability is adopted if a bridge is built over the largest river of Laos, Mekong River, and a 1/50 probability if over tributaries. In addition, since a 1/50 probability was adopted when Hinheup Bridge was constructed over a tributary of the Mekong River under Japan's grant aid cooperation project, this Study will also adopt the same probability: that is, the water level of 18.4m (water depth).

2) Design high water level

The design high water level of a 1/50 probability is calculated by adding the probability water depth (18.4m) to the river bed height at the observation station (107.517m), which is:

107.517m+18.4m=125.917m→126m

1-2-2 Environmental and Social Considerations

1-2-2-1 Outline of Project Components

(1) Content of the Project

The Project consists of constructing a new bridge, but does not fall under the category of large-scale projects in the road, railway, or bridge sectors as shown in the Japan International Cooperation Agency (JICA) Guidelines for Environmental and Social Considerations (hereinafter called "JICA Environmental Guidelines"). It was determined that the Project does not have a significantly adverse impact on the environment, does not have characteristics that are liable to cause adverse environmental impacts, and is not located in a sensitive area. Therefore, based on the JICA Environmental Guidelines, the Project has been classified as Environmental Category B.

A summary of the Project components is as follows.

- New construction of the Sekong Bridge (bridge length=300 m (river-crossing span=240 m, side span=60 m))
- Newly constructed access roads (right bank side=180 m, left bank side=300 m)

(2) Target area of the Project

The target area of the Project is Sekong City in the Lamam District of Sekong Province, where National Road No. 16B in southern Laos intersects with the Sekong River at the Sekong Bridge construction site. The location map for the target area of the Project is shown below.

Figure 1-2-1 Target area of the Project

1-2-2-2 Baseline Environmental and Social Conditions

(1) Natural Environment

1) Protected areas

In Laos, there are 20 designated protected areas. The natural conservation area closest to the Project area in Sekong city is the Xe Xap area that straddles Sekong and Salavan Provinces (designated in 1996). However, since it is more than 70 km away, it will not affect construction work.

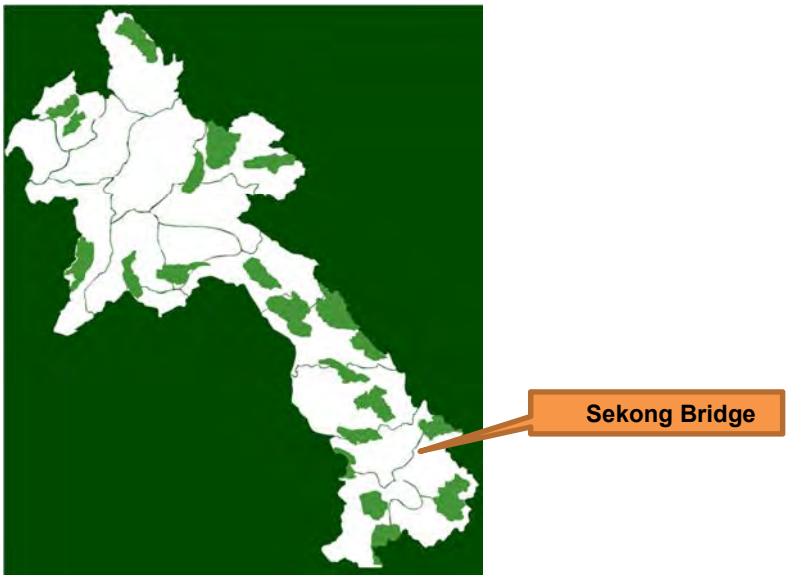


Figure 1-2-2 Protected areas in Laos

2) Ecosystems

There are no rare species on or near the Project site.

(2) Social Environment

Information regarding current conditions in the social environment is shown in "2-6 Survey of Social Conditions."

1-2-2-3 Systems and Organizations Relevant to Environmental and Social Considerations in the Host Country

(1) Laws and Regulations Relevant to Environmental and Social Considerations

The systems relevant to environmental and social considerations in Laos are prescribed in accordance with the Environment Protection Law (1999), the Regulation on Environmental Assessment (2000), and the Regulation on Environmental Impact Assessment of Road Projects (2003).

Laws and regulations relevant to environmental and social considerations that are applicable to the road sector are shown as follows.

Table 1-2-2 Environment-related laws and regulations in Laos (road sector)

Name of Law or Regulation	Effective Date
Environment Protection Law	April 3, 1999
Regulation on Environmental Assessment No.1770/STEA	October 3, 2000
Decree on Environmental Impact Assessment	February 18, 2010
Regulation on Environmental Impact Assessment of Road Projects	June 29, 2003
Law on Roads	April 3, 1999
Conservation of National, Historical and Natural Heritages	June 20, 1997
Law on Forest	December 24, 2007
Law on Water and Water Resources	November 2, 1996
Protected Area and Wildlife Regulations	June 7, 2001

(2) Organizations relevant to environmental and social considerations

Environment-related organizations in Laos are divided into the central level under the jurisdiction of the central government (Ministry of Natural Resources and Environment, National Environment Committee), the sector level, provincial level, and local level. The roles of each differ depending on the size and sector of the project.

1) Ministry of Natural Resources and Environment (MONRE)

The Science Technology and Environment Agency (STEA) was established in 1993 as an environment-related organization. Subsequently, the Department of Water Resources was integrated with the environment-related division of the STEA to form a new organization, and the Water Resources and Environment Agency (WREA) was established under the Prime Minister's Office in

2007 as the supervisory agency in the environment field. In 2011, WREA was integrated with land management geological divisions, etc. and upgraded to the Ministry of Natural Resources and Environment (MONRE).

MONRE creates environmental standards, evaluates Environmental Impact Assessments (EIA) and Initial Environmental Examinations (IEE), and conducts environmental management and monitoring.

2) National Environment Committee

The National Environment Committee was established in 2002 and consists of representatives from various government agencies. The deputy prime minister serves as chair of the committee, which is responsible for directing and coordinating environment-related activities in all areas of Laos.

3) Division for sector environment management and monitoring

As the division for sector environment management and monitoring, the Environment Protection Law stipulates that all ministries must have their own divisions for environment management and monitoring in place. However, at this point in time, only some of the ministries have completed this task.

The implementing agency for the Project, MPWT, has established the Department of Roads (DOR) as this sector environment management and monitoring division. The DOR conducts environmental assessments for projects and files environmental applications with MONRE. Once the content of this Project has been decided, it is expected that the DOR will conduct the Initial Environmental Examination and apply for environmental approval with MONRE.

4) Division for provincial environment management and monitoring

Divisions for provincial environment management and monitoring do not belong to the provincial governments, but are instead placed in each province as subordinate organizations of MONRE. Their primary role is to provide regional support for environmental problems.

(3) Environmental approval and authorization procedures

In accordance with the Environment Protection Law, businesses in Laos are required to implement an Environmental Impact Assessment (EIA) or an Initial Environmental Examination (IEE) in order to obtain environmental approval and authorization. The process for this is shown in the Regulation for Environmental Assessment (2000) and the Decree on Environmental Impact Assessment (2010).

All projects are divided into either Category 1 or Category 2. As this Project is classified as Category 1, an Initial Environmental Examination (IEE) will be conducted and environmental approval will be applied for.

- Category 1: Used for small-scale projects that have only a slight impact on the environment. Initial Environmental Examination (IEE) is required.
- Category 2: Used for large-scale development plans and projects. Environmental Impact Assessment (EIA) is required.

1-2-2-4 Analysis of Alternative Plans

For this Project, the Sekong Bridge will be constructed to fill in the missing link on National Road No. 16B to cross the Sekong River. It will connect Sekong City and the Lamam District east of the Sekong River and Dachung Province. For construction of the Sekong Bridge, alternative plans, including a "zero plan scenario," were compared and analyzed. A location map of the alternative routes is shown in Figure 1-2-3, with a comparison table of alternative plans shown in Table 1-2-3.

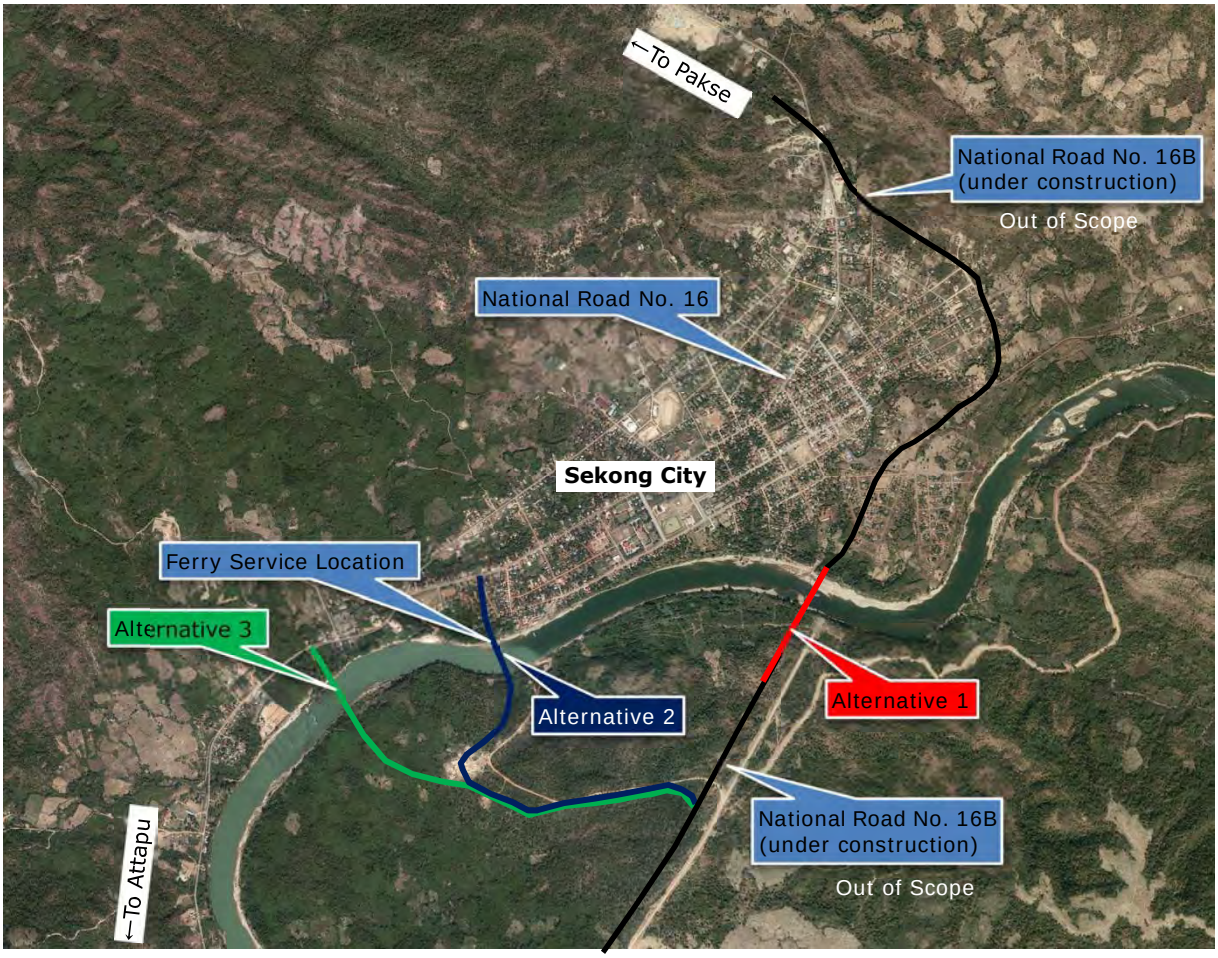


Figure 1-2-3 Location map of alternative routes

(1) Proposed Project plan (1st proposed bridge location)

This plan will allow the Sekong Bridge to be connected to National Road No. 16B, which is currently under construction. (Red route in Figure xxx.) Since this route does not pass through the urban center of Sekong City, smooth travel can be secured. Since there are no residences along the route and no need for resettlement, there are almost no problems in terms of environmental and social considerations. Additionally, the construction costs are the lowest among the three alternative plans, with the exception of the zero plan scenario.

(2) Alternative 1 (2nd proposed bridge location)

This plan will place the Sekong Bridge at the location where ferry service currently operates. (Blue route in Figure xxx) Since this route will use National Road No. 16 passing through the Sekong City center, there are concerns with traffic congestion and accidents. In addition to traffic accidents, since a new access road will be built, 26 residences on the right bank of river must be resettled, and there are many problems in terms of environmental and social considerations. In addition, the length of the bridge and the long extension of the access road give this the highest construction costs among the three plans.

(3) Alternative 2 (3rd proposed bridge location)

This plan will place the Sekong Bridge 3 km downstream. (Green route in Figure xxx.) As with Alternative 1, since this route will use National Road No. 16 passing through Sekong City center, there are concerns with traffic congestion and accidents. Since a new access road will be built, 3 residences (one of which is currently under construction) on the right bank side must be resettled. In terms of construction costs, this plan is the second highest after Alternative 1.

(4) Zero plan scenario

This is a “zero plan” scenario. (The Sekong Bridge is not constructed.) In the short-term, there are no problems in terms of environmental and social considerations. In the long-term, with the increase in traffic volume crossing the Sekong River, the wait time for ferry service will increase and traffic congestion within Sekong City will occur. This will cause environmental and social problems such as air pollution and traffic accidents. Economic loss will also occur.

Table 1-2-3 Comparison table of alternative plans

Item	Proposed Project plan	Alternative 1	Alternative 2	Zero option scenario
Summary	▪ Build the Sekong Bridge so that it connects with National Road No. 16B.	▪ Build the Sekong Bridge at the location of ferry service.	▪ Build the Sekong Bridge 3km downstream of National Road 16B.	▪ Do not build the Sekong Bridge.
Bridge	▪ Bridge length is 300m in total with 240m river-crossing span and 60m side span.	▪ Bridge length is 330m total with 270m river-crossing span and 60m side span.	▪ Bridge length is 320m total with 260m river-crossing span and 60m side span.	—
Access Road	▪ To connect with National Road No. 16B, currently under construction, the access road is 180 m on the right bank and 300 m on the left bank.	▪ Access road is 2 km.	▪ Access road is 2.2 km	—
Technical aspects	▪ Dry-season water level is the lowest (1.5m), which is advantageous for construction work.	▪ Dry-season water level is high (approx. 3m), which will cause difficulties in construction work.	▪ Dry-season water level is the highest (approx. 4m), which is the most unfavorable for construction work.	—
Construction costs	○ (good)	△ (fair)	△ (fair)	USD 0 (no cost)
Transport capacity	▪ Transport capacity will be improved. Smooth travel is ensured since route does not pass through Sekong city.	▪ Transport capacity will be improved, but since route passes through Sekong city, traffic congestion is a concern.	▪ Transport capacity will be improved, but since route passes through Sekong city, traffic congestion is a concern.	▪ Since ferries are used to cross the river, transport capacity will be limited.
Development effects	▪ The missing link in National Road No. 16B will be placed, and economic development along the route and over a wide area is projected.	▪ The missing link in National Road No. 16B will be placed, and economic development along the route and over a wide area is projected.	▪ The missing link in National Road No. 16B will be placed, and economic development along the route and over a wide area is projected.	▪ The river crossing area of the Sekong River will be bottlenecked and regional development will be hampered.
Social environment	▪ There will be no resettlement. ▪ Crossing the Sekong River once the bridge is completed is facilitated, providing a positive effect for ethnic minority groups.	▪ Resettlement for 26 residences on the Sekong City side will be necessary. Ferry service during construction will be disrupted. ▪ Crossing the Sekong River once the bridge is completed is facilitated, providing a positive effect for ethnic minority groups.	▪ Resettlement for 3 residences on the Sekong City side will be necessary. ▪ Crossing the Sekong River once the bridge is completed is facilitated, providing a positive effect for ethnic minority groups.	▪ Due to traffic congestion caused by an increase in traffic volume in the long-term, there is potential for an increase in traffic accidents.
Natural environment	▪ There are no rare fish or plant species in the Sekong River.	▪ There are no rare fish or plant species in the Sekong River.	▪ There are no rare fish or plant species in the Sekong River.	▪ In the long-term, air pollution due to traffic congestion is a concern.
Overall evaluation	▪ Highly convenient since the route does not pass through urban areas of Sekong City. ▪ Is the most economically efficient. ▪ Problems in terms of environmental and social considerations are minor.	▪ Very inconvenient since the route passes through urban areas of Sekong City. ▪ Poor economic efficiency. ▪ Many resettlements necessary.	▪ Inconvenient since the route passes through urban areas of Sekong City. ▪ Poor economic efficiency. ▪ Resettlements necessary.	▪ There is a limit to transport capacity. ▪ Inconvenient. ▪ In the long-term, an increase in traffic congestion and accidents is possible.
Optimal plan	Recommended as the optimal plan.	This plan is not recommended.	This plan is not recommended.	This plan is not recommended.

1-2-2-5 Scoping

Scoping has been implemented for the Project based on the JICA Guidelines for Environmental and Social Considerations (April 2010) and the items projected to impact the environment were selected. Scoping results are shown in Table1-2-4.

Table1-2-4 Scoping draft

Impact items			Rating		Reasons for rating
			Before and during construction	During use	
Anti-pollution measures	1	Air pollution	D	D	During construction: Air pollution may occur temporarily when bringing in materials and while operating heavy machinery, etc., but impact is slight. During use: Some impact on air quality is expected due to gases emitted by vehicles from increased traffic volume, but only slightly. A decrease in gas emissions due to decreased traffic passing through the city and vehicles waiting for ferries is expected with bridge construction.
	2	Water pollution	B	D	During construction: Water pollution may occur due to wastewater from construction site/worker living quarters and leaking oil, etc. from heavy machinery and vehicles. During use: There will be almost no water pollution that impacts the surrounding environment.
	3	Waste	B	D	During construction: Some waste such as surplus soil from earthwork and scrap material may be generated. During use: There will be almost no waste generated that impacts the surrounding environment.
	4	Soil pollution	B	D	During construction: Soil pollution may occur due to oil, etc. leaking from heavy machinery and vehicles. During use: There will be almost no soil pollution that impacts the surrounding environment.
	5	Noise and vibration	B	C	During construction: Noise and vibration will occur during construction, possibly affecting nearby home and residents. During use: There will be an impact of noise due to an increase in traffic volume.
	6	Ground subsidence	D	D	Since the Project is a new bridge construction, large-scale water pumping will not be conducted. Thus, subsidence is not foreseen.
	7	Offensive odors	D	D	For the new bridge construction implemented for the Project, work that causes offensive odors is not foreseen.
	8	Bottom sediment	D	D	For the new bridge construction implemented for the Project, work that affects bottom sediment is not foreseen.
Natural environment	9	Protected areas	D	D	There are no protected areas or national parks in the target area of the Project or the surrounding area.
	10	Ecosystem	D	D	For the new bridge construction implemented for the Project, nothing that makes significant changes to the ecosystem is foreseen. There are no rare species in the target area of the Project or surrounding area.
	11	Hydrology	B	C	During construction: Since the Project is a new bridge construction, substructure work, etc. is expected to be conducted in the river. During use: If bridge piers are constructed in the river, these structures may change the river's flow regime.
	12	Topography and geology	D	D	Since the Project is a new bridge construction, earth filling and cutting is planned for the access road portion. However, as large-scale topography modification will not be done, almost no impact on the topography and geology is expected.

Impact items			Rating		Reasons for rating
			Before and during construction	During use	
Social environment	13	Resettlement	C	D	Before construction: Since the Project is a new bridge construction, resettlement is foreseen depending on the location of the bridge.
	14	Poor people	C	D	Before construction: There are poor people living in the area around the bridge location, who may be included for resettlement. During use: With the new bridge construction, a positive impact is expected in terms of time and cost needed for crossing the river. Also, markets and social services such as schools and hospital will become more accessible.
	15	Ethnic minorities and indigenous peoples	C	D	Before construction: Ethnic minority groups may be living in the area surrounding the bridge location. During use: With the new bridge construction, a positive impact is expected in terms of time and cost needed for crossing the river. Also, markets and social services such as schools and hospital will become more accessible.
	16	Local economies (employment, livelihoods, etc.)	D	D	During construction: Since the Project is a new bridge construction, no impact on local economies is expected duing construction. During use: With the new bridge construction, a positive impact is expected in terms of time and cost needed for crossing the river.
	17	Land use and utilization of local resources	D	C	During construction: Since the Project is a new bridge construction, no impact on land use is expected During use: With the new bridge construction, an impact on land use on the bank facing Sekong City is possible.
	18	Water usage	C	D	During construction: Since the Project is a new bridge construction, substructure work, etc. is expected to be conducted in the river, for which an impact is expected due to water turbidity. During use: Since there will be no change in flow volume of the river even after the new bridge is constructed, almost no impact to water usage is expected.
	19	Existing social infrastructures and services	D	D	During construction: Since the Project is a new bridge construction, and there are no existing transport facilities, and almost no impact to existing social infrastructures and services is expected. During use: With the new bridge construction, a positive impact in terms of access to existing social infrastructures and services is expected.
	20	Social institutions (social infrastructure, local decision-making institutions)	D	D	Since the Project is a new bridge construction, almost no impact on social infrastructure or local decision-making institutions is foreseen
	21	Misdistribution of benefits and damages	D	D	Since the Project is a new bridge construction, almost no misdistribution of benefits or damages is foreseen.
	22	Local conflicts of interest	D	D	Since the Project is a new bridge construction, no local conflicts of interest are foreseen.
	23	Cultural heritage	D	D	There is no cultural heritage is the target area of the Project and surrounding areas.
	24	Landscape	D	D	During use: After the bridge is completed, landscaping may be improved through tree planting on embankments.
	25	Gender	D	D	No gender discrimination is foreseen with this Project.
	26	Children's rights	C	D	During construction: It is necessary to investigate if there are possibilities for improper labor practices involving children.
	27	Infectious diseases (HIV/AIDS, etc.)	C	D	During construction: With the influx of workers, an increase in infectious disease such as HIV/AIDS is possible, thereby making investigation necessary.

Impact items			Rating		Reasons for rating
			Before and during construction	During use	
	28	Working conditions (incl. occupational safety)	C	D	During construction: It is necessary to investigate if there are possibilities of workers being forced into poor working conditions.
Other	29	Accidents	B	B	During construction: Construction accidents may occur. During use: An increase in traffic volume is expected with bridge construction and an increase in traffic accidents is a concern.
	30	Trans-boundary impacts and climate change	D	D	Since the Project is a new bridge construction, no trans-boundary impacts or effects on climate change are foreseen.
Overall rating			B	B	

Ratings A: Serious negative impact is expected.
B: Some negative impact is expected.
C: The level of impact is unknown at this time.
D: There is almost no negative impact.

From the results of scoping, it was determined that environmental and social considerations studies on the negative impacts of the following environmental items are necessary. Studies and inspections will be conducted for these items while referencing the bridge design policies.

- Item 2: Water pollution
- Item 3: Waste
- Item 4: Soil pollution
- Item 5: Noise and vibration
- Item 11: Hydrology
- Item 13: Resettlement
- Item 14: Poor people
- Item 15: Ethnic minorities and indigenous peoples
- Item 17: Land use and utilization of local resources
- Item 18: Water usage
- Item 26: Children's rights
- Item 27: Infectious diseases (HIV/AIDS, etc.)
- Item 28: Working conditions (incl. occupational safety)
- Item 29: Accidents

1-2-2-6 Results of Environmental and Social Considerations Studies

Environmental impact studies and predictions were conducted for items that were rated as B or C during the scoping process. In these studies, there are no items that were rated as A, for which serious negative impacts are expected.

(1) Item 2: Water pollution

During construction, water pollution may occur due to wastewater from construction site/worker living quarters and leaking oil, etc. from heavy machinery and vehicles.

(2) Item 3: Waste

Since it is necessary to fill in land for the access road portions, soil generated from construction work can be reused. Other scrap materials from construction will also be reused for the project to the greatest extent possible.

(3) Item 4: Soil pollution

Soil pollution will occur due to oil, etc. being leaked or emitted from heavy machinery and vehicles.

(4) Item 5: Noise and vibration

Noise and vibration will occur during construction, possibly affecting nearby home and residents. There are cases of damage to surrounding homes due to vibration.

In the area of and surrounding the Project, there are no facilities that are easily affected by noise and vibration such as schools, hospitals, and temples.

(5) Item 11: Hydrology

Since bridge piers will be constructed in the river, these structures may change the river's flow regime. During use, there will be almost no effect on the river's flow regime since the obstruction rate of the cross section will be taken into account for the substructure design.

(6) Item 13: Resettlement

There are three different plans regarding the placement location for the bridge. (Plan 1: Connecting to National Road No. 16B, Plan 2: Placed near ferry service, Plan 3: Shifted 3 km downstream.) As described in Table 1-2-3, Plan 1: Connecting to National Road No. 16B was agreed upon with MPWT. Resettlement would be necessary for 26 residences in Plan 2 and three residences in Plan 3. However, for the plan agreed upon with MPWT (Plan 1), no resettlement is necessary.

In addition, there are three candidate areas for building the temporary yard needed for construction. Although the location has not been decided at this point in time, all of the candidate areas are empty lots, which will not require any type of resettlement.

(7) Item 14: Poor people

Ethnic minority groups, who are also the poor, live in the area surrounding the Project on the outskirts of Sekong city. Although they were considered eligible for resettlement, it has been confirmed that there will be no resettlements needed, as described above.

Poor people who currently pay to cross the river using ferries will also become able to freely cross the new bridge to be built for the Project. Therefore, a positive impact is expected in terms of time and cost. Additionally, markets and social services such as schools and hospitals will become more accessible.

(8) Item 15: Ethnic minorities and indigenous peoples

The Alak people are an ethnic minority group that lives in the area surrounding the Project. Although they were considered eligible for resettlement, it has been confirmed that there will be no resettlements needed, as described above.

Ethnic minorities who currently pay to cross the river using ferries will also become able to freely cross the new bridge to be built for the Project. Therefore, a positive impact is expected in terms of time and cost. Additionally, markets and social services such as schools and hospitals will become more accessible.

(9) Item 17: Land use and utilization of local resources

With the new bridge construction, an impact on land-use on the bank facing Sekong City is possible. According to Sekong Province, they own the land on the bank facing Sekong City, and since there is an urban (residential) development plan in place, there will be no unregulated land use and no negative impact foreseen.

(10) Item 18: Water usage

In some villages along the Sekong River inhabited by ethnic minorities, water from the Sekong River is used as drinking water. In other villages, spring water and well water is used for drinking, while the use of water from the Sekong River is limited to daily use such as washing clothes, etc.

(11) Item 26: Children's rights

The enrollment rate for compulsory primary education (grades 1~5) in Laos is high at over 90%. Even in areas with a large poor population, such as ethnic minority villages, both boys and girls are given the opportunity to enroll in school. (This consists of primary education from grades 1~3 in some ethnic minority villages.) In addition, the Labor Law (2006) stipulates that children must be at least 14 years old to engage in labor. The possibility of improper labor practices involving children who are not receiving education is low, and no impact on children's rights from the Project is foreseen.

(12) Item 27: Infectious diseases (HIV/AIDS, etc.)

When executing the Project, there will be many jobs for skilled workers (steelworkers, formworkers, heavy machinery operators, etc.), unskilled laborers, security guards, etc. over a span of approximately two years. With the large unspecified number of workers coming from other areas for long-term stays, an increase in infectious diseases is a concern.

(13) Item 28: Working conditions (incl. occupational safety)

When executing the Project, there will be many jobs for skilled workers (steelworkers, formworkers, heavy machinery operators, etc.), unskilled laborers, security guards, etc. over a span of approximately two years and a half. The Labor Law of Laos (2006) stipulates working hours (6 days per week, 8 hours per day/48 hours per week), overtime (45 hours per month/3 hours per day), wages, and worker protection, etc.

(14) Item 29: Accidents

Accidents may occur during construction work.

An increase in traffic volume is expected with bridge construction and an increase in traffic accidents is a concern. Conversely, the number of traffic accidents in Sekong city is expected to decrease as vehicles will no longer pass through the city to cross the river with the construction of the Sekong Bridge.

1-2-2-7 Impact Assessment

Impact assessments based on the results of scoping and environmental studies are shown in Table1-2-5. Among the items rated B or C (expected impacts on the environment) during the scoping process, those that resulted in a D rating during the subsequent studies and the reason for the rating are listed in the table. For those for which the rating remained at B or C, an examination of mitigation measures and environmental management/monitoring plans will be formulated.

Table1-2-5 Impact assessments based on scoping drafts and study results

Impact items			Impact rating during scoping		Impact rating based on study results		Reasons for rating
			Before and during construction	During use	Before and during construction	During use	
Anti-pollution measures	1	Air pollution	D	D	—	—	
	2	Water pollution	B	D	B	D	During construction: Water pollution will occur due to wastewater from construction site/worker living quarters and leaking oil, etc. from heavy machinery and vehicles.
	3	Waste	B	D	B	D	During construction: Some waste such as surplus soil from earthwork and scrap material may be generated.
	4	Soil pollution	B	D	B	D	During construction: Soil pollution may occur due to oil, etc. being leaked or emitted from heavy machinery and vehicles.
	5	Noise and vibration	B	C	B	B	During construction: Noise and vibration may occur during construction, possibly affecting nearby home and residents. During use: An impact of noise due to an increase in traffic volume is foreseen.
	6	Ground subsidence	D	D	—	—	
	7	Offensive odors	D	D	—	—	
	8	Bottom sediment	D	D	—	—	
Natural Environemnt	9	Protected areas	D	D	—	—	
	10	Ecosystems	D	D	—	—	
	11	Hydrology	B	C	B	D	During construction: Since the Project is a new bridge construction, substructure work, etc. is expected to be conducted in the river. During use: Bridge piers will be constructed in the river, but the impact to flow conditions will be slight since the design takes the obstruction rate of the cross section into consideration.
	12	Topography and geology	D	D	—	—	
Social Environment	13	Resettlement	C	D	D	D	During construction: At the bridge location agreed upon with MPWT, it has been confirmed that there will be no resettlement for the bridge or access road portions.
	14	Poor people	C	D	D	D	During construction: At the bridge location agreed upon with MPWT, it has been confirmed that there will be no resettlement for the bridge or access road portions.
	15	Ethnic minorities and indigenous peoples	C	D	D	D	During construction: At the bridge location agreed upon with MPWT, it has been confirmed that there will be no resettlement for the bridge or access road portions.

Impact items			Impact rating during scoping		Impact rating based on study results		Reasons for rating
			Before and during construction	During use	Before and during construction	During use	
	16	Local economies (employment, livelihoods, etc.)	D	D	–	–	
	17	Land use and utilization of local resources	D	C	D	D	During use: With new bridge construction, an impact on land use on the bank facing Sekong city is possible, but due to Sekong Province's urban development plan, land will be used appropriately.
	18	Water usage	C	D	B	D	During construction: Since the Project is a new bridge construction, substructure work, etc. is expected to be conducted in the river. This will cause an impact on water usage in areas downstream due to water turbidity.
	19	Existing social infrastructures and service	D	D	–	–	
	20	Social institutions (social infrastructure, local decision-making institutions)	D	D	–	–	
	21	Misdistribution of benefits and damages	D	D	–	–	
	22	Local conflicts of interest	D	D	–	–	
	23	Cultural heritage	D	D	–	–	
	24	Landscape	D	D	–	–	
	25	Gender	D	D	–	–	
	26	Children's rights	C	D	D	D	During construction: The enrollment rate for children living in the area surrounding the Project is high and working conditions for children are stipulated by labor laws. Thus, children's rights are protected.
	27	Infectious diseases (HIV/AIDS, etc.)	C	D	B	D	During construction: With the large unspecified number of workers staying over a long term, an increase in infectious diseases is a concern.
	28	Working conditions (incl. occupational safety)	C	D	D	D	During construction: Labor laws stipulate working conditions (work hours, overtime, wages, etc.). Construction and safety plans that respect these laws will be formed.
Other	29	Accidents	B	B	B	B	During construction: Construction accidents may occur. During use: An increase in traffic volume is expected with bridge construction and an increase in traffic accidents is a concern.
	30	Trans-boundary impacts and climate change	D	D	–	–	
Overall rating			B	B	B	B	

Ratings A: Serious negative impact is expected.
B: Some negative impact is expected.
C: The level of impact is unknown at this time.
D: There is almost no negative impact.

1-2-2-8 Analysis of Mitigation Measures

For items rated B in the Environmental Impact Assessment, analysis results of necessary mitigation measures are shown in Table1-2-6 below.

Table1-2-6 Mitigation measures for predicted impacts

No	Environmental item	Mitigation measures	Implementing organization	Responsible organization	Cost
(During Construction)					
2	Water pollution	▪Use of oil fences and pollution control nets during pier construction ▪Regular inspections and maintenance for heavy machinery and construction vehicles	Contractor	MPWT	Included in construction costs
3	Waste	▪Reusing soil generated from construction and scrap materials ▪Appropriate waste removal to disposal sites/facilities	Contractor	MPWT	Included in construction costs
4	Soil pollution	▪Regular inspection and maintenance for heavy machinery and construction vehicles (inspections for oil leaks)	Contractor	MPWT	Included in construction costs
5	Noise and vibration	▪Use of low-noise, low-vibration heavy machinery ▪Prohibition of nighttime work	Contractor	MPWT	Included in construction costs
6	Hydrology	▪Reduction of cross-section obstruction rate (design phase)	Consultant	MPWT	Included in construction costs
18	Water usage	▪Use of oil fences and pollution control nets during pier construction ▪Prohibition of dumping wastewater generated at the construction site into the river	Contractor	MPWT	Included in construction costs
27	Infectious diseases (HIV/AIDS, etc.)	▪Implementation of awareness and education activities regarding hygiene and infectious diseases (HIV/AIDS) for workers	Contractor	MPWT	Included in construction costs
29	Accidents	▪Implementation of safety education for workers ▪Allocation of monitoring personnel during heavy machinery operation	Contractor	MPWT	Included in construction costs
(During Use)					
5	Noise and vibration	▪Placement of traffic signs ▪Repairing potholes, uneven surfaces	DPWT (Sekong Province)	MPWT	Included in maintenance costs
29	Accidents	▪Placement of traffic signs ▪Regulation by traffic police	DPWT (Sekong Province City traffic police	MPWT	Included in maintenance costs

1-2-2-9 Monitoring Plan

The Project will be implemented from October 2014 to the end of March 2017. Monitoring is necessary to ensure that the measures for mitigating the load expected to be placed on the environment during construction and during use are being properly implemented.

Monitoring for environmental items that require it will be implemented by contractors under the management of the Consultant, and reports will be made to the implementing agency, MPWT. Monitoring after the bridge is in use will be conducted by DPWT, which is charge of operation and maintenance of the facility.

Table1-2-7 Monitoring plan

Environmental item	Monitoring item	Area	Frequency	Implementing organization
(During Construction)				
Water quality	▪pH, SS	Area around construction site (Sekong River)	Twice per year	Contractor
Waste	▪Transport record of construction waste materials to disposal site	Area around construction site	Once per month	Contractor
Noise and vibration	▪Noise/vibration level ▪Usage of low-noise, low-vibration methods	Residential district on Sekong City side Construction site	Twice per year Once per month	Contractor Contractor
Accidents	▪Record of accidents and injuries	Construction site	Once per month	Contractor
(During Use)				
Accidents	▪Record of traffic accidents	Area around the Sekong Bridge		DPWT (Sekong Province)

1-2-2-10 Consultations with Stakeholders

When applying for the IEE for the Project, it is necessary to hold a meeting with stakeholders and attach the results of those consultations. MPWT plans to hold the meeting in August 2013 to coincide with the timing of the IEE application.

1-2-2-11 Land Acquisition and Resettlement

Land acquisition and resettlement are not necessary for this Project.

Chapter 2
Contents of the Project

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

2-1-1 Overall Goals and Project Purposes

2-1-1-1 National Socio-Economic Development Plan

Laos is currently working on the National Socio-Economic Development Plan (2011-2015), NSEDP, which is based on a long-term socioeconomic development strategy toward 2020 drawn up in October 2011. Viewing this plan as the overall plan, each ministry has formulated its own five-year plan. The period between 2011 and 2015 falls under the 7th NSEDP.

The 7th NSEDP is aimed at making the country a modern and industrialized society by 2020. It also seeks to graduate the country from the group of least-developed countries, LDCs, and create opportunities for enhanced regional and global partnerships. The goals and overall directions of the NSEDP may be summarized as follows:

[Goals]

(i) Ensure continuation of national economic growth with security, peace and stability, and ensure a GDP growth rate of at least 8% annually and GDP per capita to be at least USD 1,700;
(ii) Achieve the Millennium Development Goals by 2015, and adopt appropriate technology and skills, and create favorable conditions for graduating the country from LDC by 2020;
(iii) Ensure sustainability of development by emphasizing economic development with cultural and social progress while preserving natural resources and protecting the environment; and
(iv) Ensure political stability, peace and an orderly society.

To achieve the above goals, the public works transport sector is required to play the following roles.

[Directions]

Public works and the transport sector will be enhanced for higher productivity, which will be a key for modernization and industrialization. Moreover, the north-south and east-west economic corridors will be connected, along with the transportation network with neighboring countries.

[Targets]

- Connect and extend sub-regional roads to achieve 100% of the transportation plan (920km);
- Construct district municipal roads, rural roads to connect to focal areas and some Kumban development. Roads will be made to satisfy the relevant standards, all of which will be completed by 2015;
- Construct connection roads important to and necessary for national defense and security; and
- Complete the construction of roads leading to the port (Port of Vung Ang)

[Means]

- Increase loans and grant aid from abroad, particularly untied and unconditional assistance;
- Strengthen macro management through formulating technical standards necessary for management of laws, regulations, ordinance, construction, transport and shipping charges; and
- Promote the use of modern technologies, and enhance the capacity of human resources and organizational strengths of individual workers and the public sector.

2-1-1-2 Development Plan for the Connection of the National Roads

In 2011, the Ministry of Public Works and Transport (MPWT) formulated a "Development Plan for the Connection of the National Roads: 2011-2015" based on the NSEDP. The plan focuses on strengthening better connectivity of the following four road links: that is, development of road links contributing to:

(i) Economic growth
(ii) Safety and rural development
(iii) Safety and peace
(iv) Society and culture

Specific measures for the above four development policies are presented below in terms of road type.

(1) National roads

There are 16 projects across the country, of which three projects are completed: that is, National Road No. 9 (245km), National Road No. 8 (228km) and National Road No. 16B (111km) extending from Attapu to the border with Vietnam. Currently, eight projects are in progress; three in preparation and two applying for financial assistance.

It should be noted that the Project for Construction of Sekong Bridge is a part of a "Project for Construction of NR16B in the Southern Region of Laos".

(2) Provincial roads

The 7,200km long provincial roads provided a connection among the provinces across the country, for which there are 16 projects. Six projects have been already completed, and four projects are currently under construction; another four in preparation and six applying for financial assistance.

(3) District roads

The MPWT and its regional organizations have completed the following works in the previous several years

(i) Surveys, construction and repair work of district roads of 1,634.55km in length, including paved roads of 102.8km in length
(ii) Regular repair of district roads of 2,396.55km in length
(iii) Routine repair of district roads of 5,517.63km in length
(iv) Emergency repair of district roads of 286.12km

(4) Village Roads

Complete road development works linking regional cities, concentrated areas and village development groups conducted in the previous several years are as follows.

(i) Surveys, construction and repair work of village roads of 1,880.65km in length, including paved roads of 12.85km in length
(ii) Regular repair of village roads of 2,992.02km in length
(iii) Routine repair of village roads of 12,561.39km in length
(iv) Emergency repair of village roads of 334.64km in length

2-1-1-3 Overall Goals and Project Purposes

The overall goals of this project and project objectives are as follows.

・Overall goals

The project builds National Road No. 16B, which is an arterial road both domestically and internationally, then promotes the economic development of Laos.

・Project objectives

National Road No. 16 which crosses the southern part of Laos, connects Thailand, Laos and Vietnam but is divided by the Sekong River. Currently, ferries are operated to cross the river, but the service is irregular and frequently suspended in the rainy season, which has a substantial impact on the daily lives of residents living in the vicinity. In the east of the Sekong River (the eastern part of Sekong Province and the northeastern part of Attapu Province), in particular, 90% or more of the population are minority ethnic groups. These areas have long had insufficient social infrastructure and suffered from extreme poverty and an improvement in the situation is essential to improve the MDGs indicators. When the ferry services are suspended, these areas become an inaccessible corner of land and have problems with economic activities that are interfered with due to inaccessibility to social infrastructure and smooth logistics. Thus, securing stable traffic is an urgent task for the areas. Moreover, stable traffic is also important not just for higher living standards of local residents but also for economic development in the southern region of Laos. This includes the surrounding areas of the Project site, where development potentials have been becoming apparent and projects for the mining industry and water resources development have been conducted in recent years. In such circumstances, the Project aims, by constructing a bridge over the Sekong River as a mode of transport alternative to that of ferry services, to secure stable traffic, vitalize international logistics, facilitate the economic development of the surrounding areas and improve the convenience of local residents.

2-1-2 Outline of the Project

This Project is to build a bridge over Sekong River as a mode of transport alternative to the ferry services to achieve the overall goals. As direct outputs, the Project is expected, when implemented, to reduce the travel time for crossing the river, enable river crossing throughout the day and year, and increase the traffic volume over the bridge (vehicles and pedestrians), etc.. All of which will develop regional traffic and international logistics, vitalize the regional economy, improve the living standards and reduce poverty.

2-2 Outline Design of the Japanese Assistance

2-2-1 Design policy

This Project is to build a Sekong Bridge and access roads to remedy the present inconveniences caused by National Road No. 16B being interrupted by Sekong River where people are obliged to rely on an irregular ferry service and where the areas in the east of the river are isolated and one of the poorest districts in the country. Building the bridge will also contribute to more frequent traffic and exchanges between Laos and neighboring countries, realization of the function of the national road as an international arterial road, development of the regional economy and poverty reduction. The Project will be designed in accordance with the requests of the Government of Laos, the findings of field surveys, the results of discussions among the parties concerned, and the policy given below.

2-2-1-1 Basic Policy

The Design Policy to formulate the Outline Design is as follows.

(1) Scope of Cooperation

In 2012, the Lao People's Democratic Republic (hereinafter referred to as “Laos”) submitted a formal request for grant aid cooperation for the Project to the Japanese Embassy. The request concerned the construction work of the Sekong Bridge over Sekong River to act as a mode of transport to replace ferry services that are currently used to connect the city of Sekong and Dak Cheung district which are interrupted by the river.

This Preliminary Study was conducted chiefly to reconfirm the contents of the request and also confirm the location, longitudinal profiles, and cross sections of the bridge and access roads. It also confirmed bridge form, construction plan/integrating, procedures related to the environment, natural conditions UXO and other factors. As a result of discussions with the Lao side, the major scope of the request for Japan’s grant aid cooperation that has been finally confirmed covers:

- Construction of a PC concrete bridge (of two traffic lanes and foot pavements on both sides)
- Construction of access roads (one on abutment A1 of approx. 227m in length and the other on abutment A2 of approx. 300m in length, a total of 527m)
- Revetment work

(2) Location of the bridge and access roads

As for the location of the bridge, three plans were examined and compared, the result of which it has been concluded that Plan 1 (connecting the bridge with National Road No. 16B) is the most desirable on the following grounds:

(i) As construction work on National Road No. 16B has already progressed to reach a place near the location specified in Plan 1, connecting the bridge with the national road is the most reasonable; Furthermore the MPWT also strongly wishes to adopt Plan 1 to meet their initial plan;

(ii) The bridge and access roads do not go through the center of the city of Sekong, making accessibility to the bridge highly convenient;

(iii) Utilizing the shortest bridge length means it gains the highest economic efficiency among all bridge plans;
(iv) The authority has already gained consensus with the relevant residents to move, having no issues in terms of environmental and social considerations; and
(v) The access roads can be made the shortest, gaining the highest economic efficiency among all the plans.

(3) Size, etc.

1) Longitudinal profile plan of the bridge and access roads

As for the vertical heights of the bridge and access roads, three plans were examined and compared, as a result of which it has been concluded that Plan 2 (making HWL=126m) is the most desirable on the following grounds:

(i) The bridge beam under Plan 2 will not be struck by driftwood even if a 50-year flood occurs, and will not be submerged even if a 100-year flood (such as Typhoon Ketsana) occurs. A 50-year flood is a design flood generally applied to rivers other than the Mekong River.
(ii) The highest water level marked at the time of Typhoon Ketsana, 128m, is the flood level corresponding to a 100-year flood, and that the vertical height (height of bridge clearance) satisfies the 100-year flood level; and
(iii) The design concept under Plan 2 is similar to that of Hinheup Bridge built in Laos under a grant aid cooperation project.

2) Standard span length

The standard span length is 56m or longer, which is calculated by the following formula.

Span length L = 20+0.005Q＝20+0.005×7,200 m3/sec = 56m, where

Q means the design high-water discharge (7,200 m3/sec calculated in Section (2-1-2(1)5) Design high-water discharge)

3) Scope of cooperation for the access roads

To set the height of bridge clearance at HWL (128M) seen at the time of Typhoon Ketsana or higher, the access roads must be constructed in a zone where the design height of the road surface for the new bridge matches that of National Road No. 16B. The roads will be constructed under Japan's grant aid cooperation, which will cover approximately 180m on the side of Sekong city and approximately 300m on the side of Dak Cheung district.

(4) Contents of the request, and matters discussed and confirmed

The outline design will be determined under the conditions mutually confirmed by the Governments and the Study Team. Table 2-2-1 shows the contents of the request and matters discussed and confirmed at the times of the Preliminary and the Preparatory Surveys.

Table 2-2-1 Contents of the request, and matters discussed and confirmed

Item		Request items	Discussions and matters confirmed	
			At the time of information gathering and confirmation survey	At the time of Preparatory Survey
Subject bridge		Construction of Sekong Bridge	Construction of Sekong Bridge	Construction of Sekong Bridge
Location of bridge		On National Road No. 16B	On National Road No. 16B	Plan 1 has been selected ・ Plan 1: on National Road No. 16B ・ Plan 2: travel route of ferries ・ Plan 3: 3km downstream of Plan 1
Bridge length		300m	300m	300m
Bridge type		PC continuous box-girder bridge	PC continuous box-girder bridge	Extra dosed bridge
Width	Effective width	10.0m	10.0m	11.0m
	Carriageway	4.0m×2=8.0m	4.0m×2=8.0m	4.0m×2=8.0m
	foot pavements	1.0m×2=2.0m	1.0m×2=2.0m	1.5m×2=3.0m
No. of lanes		2 lanes	2 lanes	2 lanes
Design speed		60km/h	60km/h	60km/h
Design live load		HS25-44	None in particular	HS25-44
Access road		None in particular	On right bank:660m+600m=1,260m	On right bank: approx. 227m
			On left bank: 300m	On right bank: approx. 300m
Revetment work		None in particular	None in particular	On right bank: 3,024m^2

2-2-1-2 Policy on Natural Environment Conditions

(1) Earthquake-resistant design

1) Outline of earthquakes in Laos

Earthquakes are not frequent in Laos by international standards, compared to Japan, China, Indonesia, Myanmar and other quake-prone countries. Even so, Laos is bordered with China and Myanmar and there are concerns about damage from the earthquakes which occur near the borders with these neighboring countries. In fact, it was recently hit by the earthquakes listed below, so earthquake-resistant design must be taken into account. Figure 2-2-1 shows epicenters in Asia.

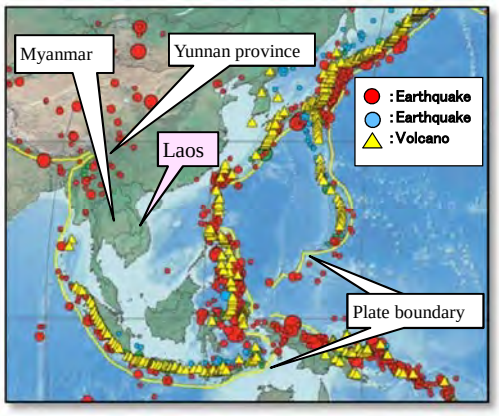


Figure 2-2-1 Epicenters in Asia

May 16, 2007: M6.3 (Bokeo Province)

- June 2, 2007: M6.1 (Yunnan Province of China bordered with Laos)
- March 24, 2011: M7.0 (the border between Laos, Myanmar and Thailand)

2) Earthquake-resistant design policy

National Road No. 16B on which Sekong Bridge will be built will serve as an important global arterial road underpinning logistics among Laos, Vietnam and Thailand. Any damage to the bridge caused by an earthquake or other form of disasters will have a considerable impact on not just international logistics but rescue, medical and fire-fighting activities, as well as emergency relief logistics, for residents afflicted. Since the bridge concerned plays a crucial role, the basic policy on designing will include an improvement in earthquake-resistance and a survey will be conducted on earthquake records from the past before setting out an appropriate design horizontal seismic coefficient.

2-2-1-3 Policy on Traffic Volume

Currently, no bridge is built over Sekong River, and vehicles and people use the ferry services to cross the river. For the traffic volume used for designing the bridge and access roads refer to Section 2-2-2-5(6)1)iii)Consideration of traffic volume for pavement design, which provides the traffic volume of vehicles, people, etc. by ferry.

The traffic survey was conducted for 12 hours between 6:00 – 18:00 on Friday, May 3, 2013.

- Trucks (with 3 axels or more): 10 trucks/12 hours
- Vehicles (with 2 axels): 54 vehicles/12 hours
- Motorbikes: 259 bikes/12 hours
- Pedestrians: 290 persons/12 hours

＊ Drivers and passengers of vehicles are not counted.

＊ Each motorbike is assumed to be ridden by one person, and passengers are counted as “pedestrians”.

2-2-1-4 Policy on Width

The cross sections of the bridge and access roads will have appropriate specifications in light of the traffic volume stated in the published report (Survey Report on the Project for Construction of Sekong Bridge), Lao road standards and the cross sections of National Road No. 16B which is currently under construction.

(1) Road standards in Laos

Table 2-2-2 shows the road standards in Laos. National Road No. 16B falls under Class III.

Table 2-2-2 Road standards in Laos

Road type	Class II	Class III
Design traffic volume	3,000～8,000	1,000～3,000
Design speed (km/h)	100 (flatland)	80 (flatland)
	80 (hillock)	60 (hillock)
	60 (mountainous area)	40 (mountainous area)
Lane width (m)	3.75 (flatland))	3.5 (flatland)
	3.75 (hillock)	3.5 (hillock)
	3.5 (mountainous area)	3.0 (mountainous area)
Width of paved road shoulder (m)	0.5 (flatland)	2.0 (flatland)
	0.5 (hillock)	2.0 (hillock)
	2.0 (mountainous area)	1.0 (mountainous area)

(2) Cross sections of National Road No. 16B

The cross sections of National Road No. 16B on the side of Sekong city differ from those on the side of Dak Cheung district, as shown in the following figure.

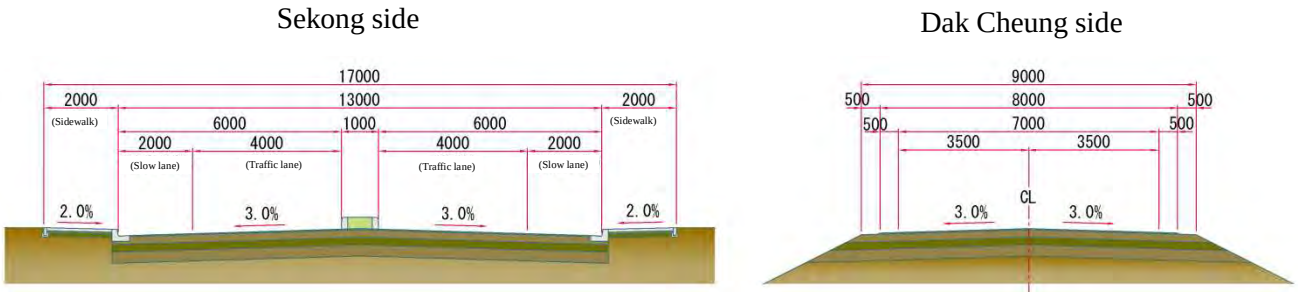


Figure 2-2-2 Cross sections of National Road No. 16B

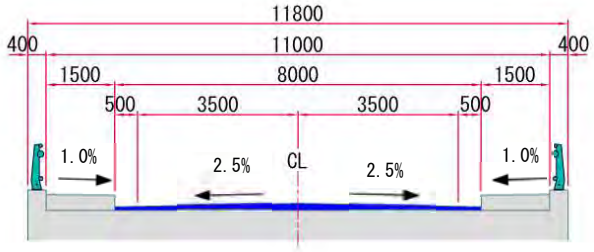
(3) Cross sections of the bridge and access roads

In light of the road standards in Laos and the cross sections of National Road No. 16B, the cross sections of Sekong Bridge and access roads have been designed as shown in Figure 2-2-3. In addition, since the bridge is close to the urban district of the city of Sekong and an increase in pedestrians due to a future expansion in the urban district should be taken into account, foot pavements of 1.5m in width

will be built on both sides.

The difference in width and cross slope between Sekong Bridge and National Road No. 16B will be adjusted with the access roads.

(Bridge)



(Access roads)

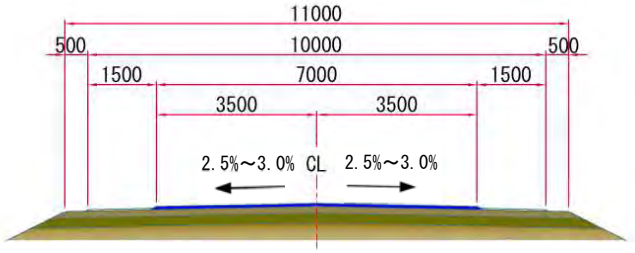


Figure 2-2-3　Cross sections of the bridge and access roads

2-2-1-5 Policy on Design Live Load

Since Sekong Bridge is on National Road No. 16B, an important international arterial road of Laos, it will comply with the country's standards, "Road Design Manual (1996)", adopting the following design live load.

・HS20-44×1.25（= HS25-44）

2-2-1-6 Policy on Social and Economic Conditions

The following matters and measures will be taken into account when planning, designing and constructing the bridge.

(i) Dust generated in the construction work: water sprinkling or other dust scatter prevention measures will be taken.

(ii) Noise and vibration in the construction work: construction methods causing as little noise and vibration as possible will be adopted.

(iii) Outflow of contaminants (e.g., oil): contaminant prevention measures will be taken.

(iv) Soil flowage and contamination of the river: pollution control measures will be taken for the river.

(v) Interference to general traffic: safety education will be provided to construction vehicles.

(vi) Measures for borrow and stone pits: borrow pits with the least environmental burdens will be selected. The existing stone pits will be used as much as possible to avoid collecting macadam from new places.

(vii) Accidents: safety and health education will be given to the persons concerned with the construction to prevent any accident.

In passing, the Study Team has confirmed that the project will not involve relocation of any residents.

2-2-1-7 Policy on the Circumstances Affecting Construction

(1) The state of labor services

Laos has some construction companies, engineers and industry workers who have experience in bridge construction under Japan's grant aid cooperation, but the number of such companies, etc. is not enough and their experience is not necessarily sufficient. In the field of PC bridge construction, in particular, they have fairly little technology and experience. Therefore, the Project will have engineers from Japan for work types requiring advanced technologies and for the fields where local builders have little experience. But the basic policy is to take advantage of local technical strength and manpower as much as possible in other fields.

As in the grant aid cooperation projects in the past, it is possible to hire workers in Laos. But they belong to construction companies, each of which has its own specialty, so it is important to ascertain these specialties. Employers of Lao workers will comply with the Lao Labor Act No.06/NA (enacted on December 27, 2007).

(2) The state of procurement of materials

1) Reinforcing bars, steel parts and PC steel

Reinforcing bars made in Laos, Thailand and Vietnam are in the marketplace in Laos, but Lao-made bars are of poor quality. Reinforcing bars made in third countries (such as Thailand, Vietnam and Japan) will be procured. Steel plates, shaped steel and other steel parts are not manufactured in Laos and will be procured in Japan or third countries (such as Thailand). PC steel is scarcely in the market place and there is no facility in the country which has reliable technologies to turn them into products. Therefore, PC steel for the Project will be imported from Japan or third countries after suppliers and manufacturers are specified and measures to confirm the quality are taken in advance.

2) Bridge attachments

Some bridge attachments may be procured, as in grant aid projects in the past, from the neighboring countries. Many of them have quality problems, so it is desirable to procure attachments in Japan.

3) Cement

Cement is produced in four provinces: Vang Vieng in the north, Thakhek in the centre, Salavan in the south and Savannakhet. Cement plants have been established with Chinese capital and thus acquired ISO of China. Judging from the road and bridge construction works in Laos, Lao cement is unstable in quality and often has insufficient strength, so this Project will consider using Thai cement.

4) Asphalt concrete

The number of plants manufacturing asphalt concrete is very few in Laos and the Study Team has confirmed the following six plants.

- A plant for the maintenance work located along a toll road near the city of Pakxe

- A plant currently in use for the Project for Improvement of National Road No.9 as East-West Economic Corridor of the Mekong Region, a grant aid cooperation project of Japan
- An old plant on National Road No. 8
- Three plants near the city of Vientiane

These plants are fairly old except the one used for the grant aid cooperation project for National Road No.9. They are in the condition neither to be relocated to the project site nor to supply stably quality concrete. The Study Team did not confirm any constructor which brought an asphalt plant from Thailand or Vietnam, either. Thus, an asphalt plant will be procured in Japan.

5) Banking materials and aggregates

For banking materials and aggregates, materials collected in the river 3km away and upstream of the bridge site will be processed and used for the project. A soil test shows that the CBR value of banking materials is 91, and a wearing test shows that the value of aggregates selected is 13.4%. This suggests that both kinds of materials are suitable for the project. An aggregate plan will be established near the bridge site.

(3) The state of procurement of construction machines

There are not so many companies undertaking civil engineering work near Sekong. They normally start to arrange for heavy construction machinery after receiving a construction contract, so the Study Team did not confirm any company that owns their own machinery. The team confirmed that some companies in Pakxe have heavy machinery but they have a limited number only.

General purpose machines for civil engineering work may be procured in the capital of the country, Vientiane, which is approximately 750km away from the project site. The Study Team confirmed in a hearing survey that Ubon Ratchathani Province of Thailand is much closer, approximately 270km away, and it is easier to procure machines there. Even so, this involves the import/export procedures and takes longer time.

Mobile type working vehicles for the superstructure work are unavailable in Laos, and will be procured in Japan.

(4) Design and construction standards for the roads and bridge

1) Road design and construction standards

The road design will comply with the country's standards, "Road Design Manual (1996)", and the relevant Japanese standards where the manual does not stipulate necessary provisions. In other words, the design standards to be used for designing the roads will be:

- Road Design Manual (1996, Laos)
- Road Structure Ordinance (2004, Japan)

2) Bridge design and construction standards

Road Design Manual (1996) provides standards for roads and bridges in Laos. As for bridges, however, it gives provisions of design live load and design flood probability only. Thus the Project will apply to Japanese standards (Specifications for Highway Bridges and Bridge Structure Ordinance) for matters other than design live load and design flood probability. In other words, the design standards to be used for designing the bridge will be:

- Road Design Manual (1996, Laos)
- Specifications for Highway Bridges (2012, Japan)

2-2-1-8 Policy on the Use of Local Business Operators

The Study Team conducted hearings to local operators and learned that they had experience in dealing with PCI girder composite slab bridges with the girder lengths of some 30m, but no experience with PC box girder bridges or continuous girder bridges. A local constructor has received an order of road and bridge construction works, using Thai and Vietnamese subcontractors. The Study Team has confirmed their high technology capacity for civil engineering work from a road construction work in progress in the southern part of Laos.

As for local consultants, the Study Team conducted hearings and learned that their technology capacity was not necessarily poor but it appeared to be difficult to secure human resources suitable for Japan's grant aid cooperation project. It seems that the scope of local consultants' work is confined to measuring, and geological, traffic, environmental and other surveys.

2-2-1-9 Policy Dealing with the Operation and Maintenance Capacity of the Implementing Organizations

The governmental agency presiding over the Project is the Ministry of Public Works and Transport (MPWT) and the implementing organizations are the Department of Roads (DOR) of the MPWT and the Department of Public Works and Transport of Sekong (DPWT). The DPWT will also be in charge of the O&M after the completion of the bridge construction.

In Laos, the MPWT manages road administration and formulates five-year development plans, based on which each province draws up an annual project implementation plan and obtains the approval of the central government. As for the central government, the DOR of the MPWT resides over planning, construction and O&M of national roads, so that the DOR and DPWT of the provincial governments concerned are involved in the construction of national roads. Provincial DPWT are also in charge of O&M of national roads including regular repair, and the construction, O&M and repair plan of provincial roads. DPWT engages in these assignments under the management of the DOR and with subsidies.

2-2-1-10 Policy on Setting of Facility Grades

National Road No.16 starts in Chong Mek a border town in Thailand, passes through Pakxe, the second largest city of Laos, reaches the city of Sekong (Lam Mam District), where it branches off to

No. 16B. National Road No. 16B starts in the city of Sekong, crosses Sekong River, passes through Dak Cheung District, leads to the eastern boundary to Vietnam and is connected to National Road No. 14D (in Vietnam) before leading to Da Nang City. National Roads Nos. 16 and 16B connect Laos with Thailand and Vietnam, serving as an international arterial road necessary for and important to smooth logistics and economic development of the three countries.

Sekong Bridge to be built under the Project will be a fairly important bridge because it is over Sekong River, where National Road No. 16B lies.

(i) Design standards:

* Road design will comply with the design standards of Laos, which is supplemented by the Japanese design standards.

* For bridge design, design live load and design flood probability will comply with the design standards of Laos, and the design method with the Japanese design standards.

(ii) Design live load: HS25-44, stipulated as the standards in Laos, will be adopted.

(iii) Width:

* Bridge: carriageway: 3.5m×2=7.0m, marginal strip: 0.5m×2=1.0m; and foot pavement: 1.5m×2=3.0m (a total of 11.0m)

* Access road: carriageway: 3.5m×2=7.0m, and shoulder: 1.5m×2=3.0m (a total of 10.0m)

(iv) Road type: Class III

(v) Design speed: 60km/h (hillock)

2-2-1-11 Policy on Construction Methods and Schedule

(1) Policy on construction methods

Sekong River originates in the Annamite Range in the southern part of Laos near the border with Vietnam and flows down through Sekong Province before entering Cambodia and merging with the Mekong River from the left-hand side. The basin area on the construction site totals 5,483km^2. Judging from the rainfall recorded at the Sekong observation station, the rainfall on the site is generally scarce during the period between November and March, begins to increase in April and gets large in May to October. It exceeds 200mm especially from July to September. Still, the region does not particularly have a large amount of annual rainfall.

Therefore, the foundation work and work to build the lower parts of abutments in the river should avoid the flood season from May to October if possible. But if the work in the river has to be conducted in such a season, care must be taken particularly when a closing method and excavation works are applied.

(2) Policy on construction schedule

As already described above, the annual precipitation is not particularly large but overflows are frequent from July to September in the construction area. Thus, an efficient work schedule needs to take into account frequent overflows in a certain period of the year.

2-2-2 Basic Plan

2-2-2-1 Work Flow of the Basic Plan

The Basic Plan includes the present-state survey; selection of the bridge location; consideration of the bridge longitudinal profile plan; setting of the bridge size; consideration of the bridge type; consideration of a river improvement plan; and consideration of other matters necessary to implement the Project. It will then make a final decision on the bridge type. The figure below outlines the work flow of the Basic Plan.

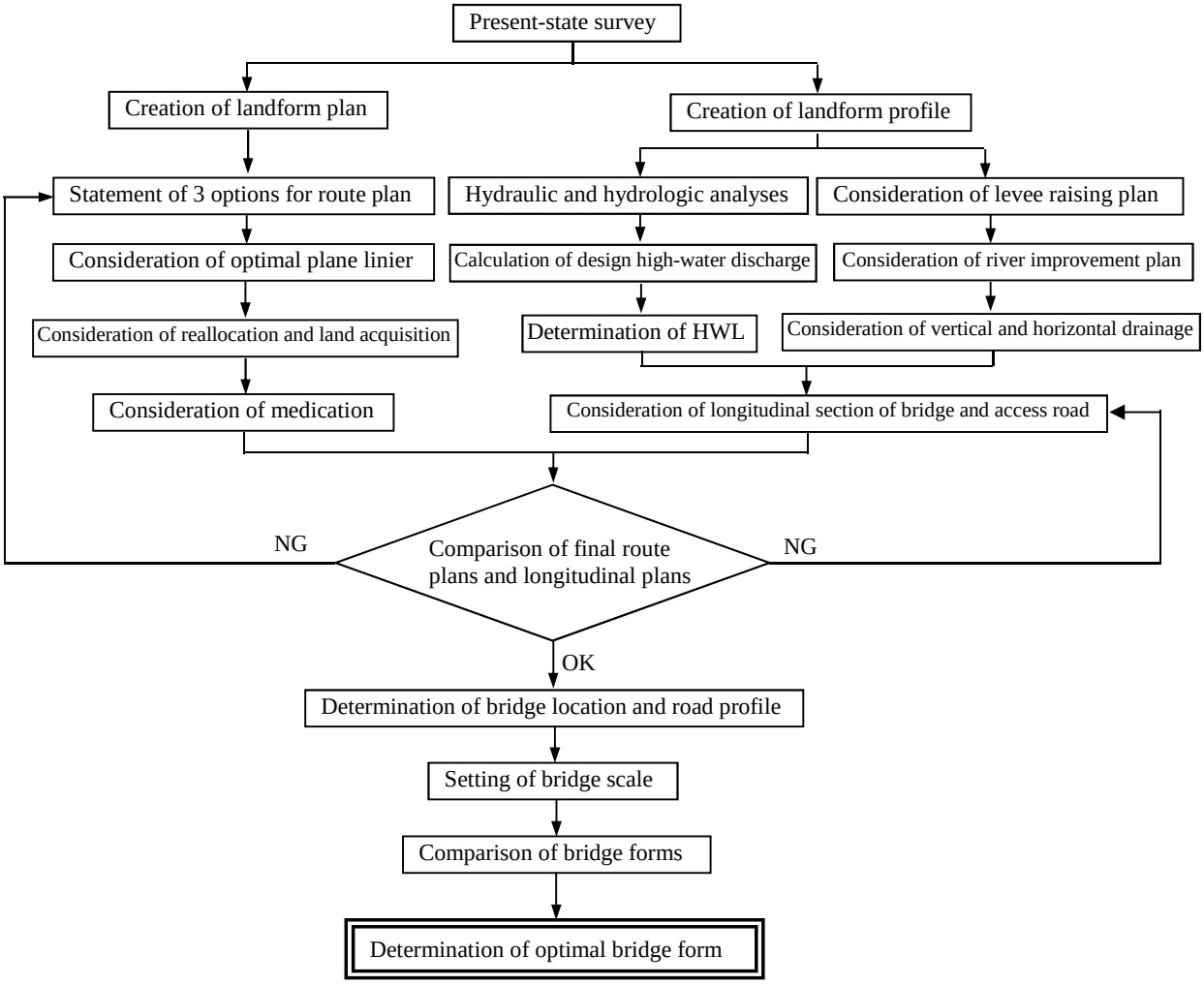


Figure 2-2-4 Work flow of the Basic Plan

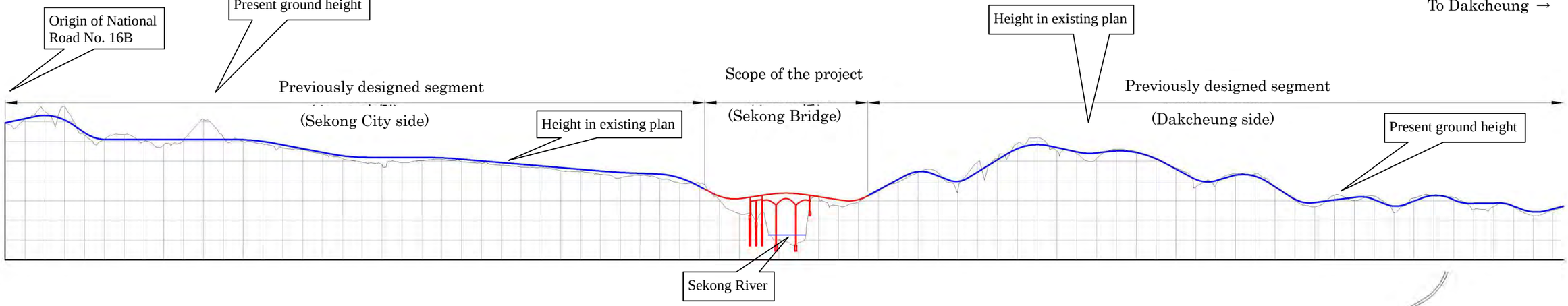
2-2-2-2 The Present State of Bridge Location

National Roads Nos. 16 and 16B connect Laos with Thailand and Vietnam, serving as international arterial roads necessary for and important to smooth logistics and economic development of the three countries. Sekong Bridge, to be built under the Project, will be a fairly important bridge because it is over Sekong River, where National Road No. 16B lies. Figure 2-2-5 and Figure 2-2-6 show the results of the present-state survey on National Road No. 16B and the bridge construction area.

←To Pakse

Profile of National Road No. 16B

To Dakcheung →



Alignment of National Road No.16B

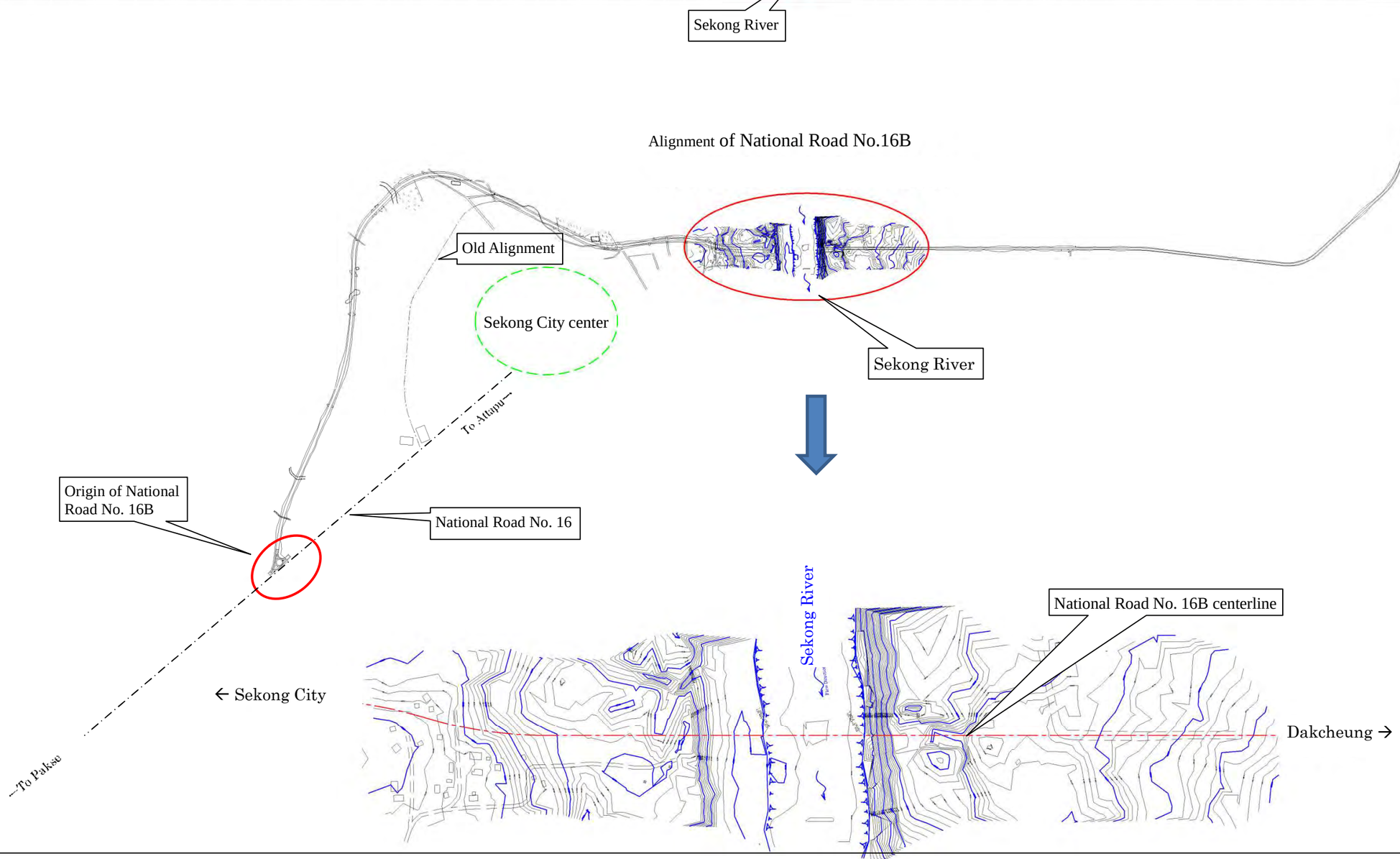
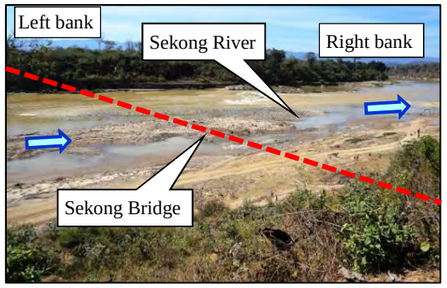
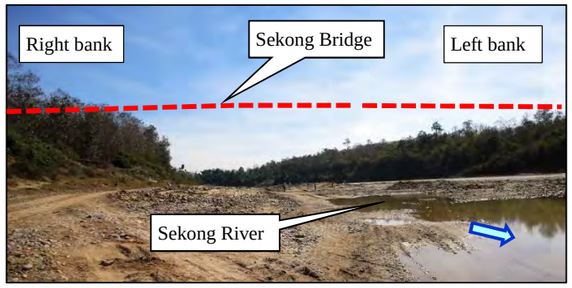


Figure 2-2-5 Situation Map of National Road No. 16B

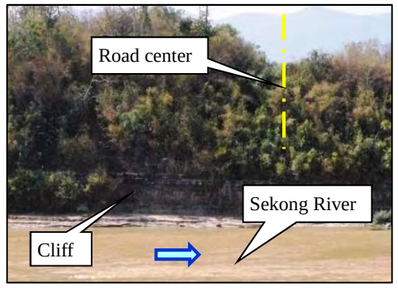


④ Sekong River in dry season

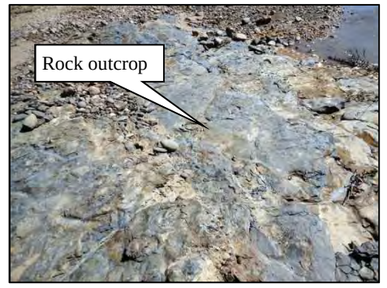
③ Relatively gentle terrain on the right bank



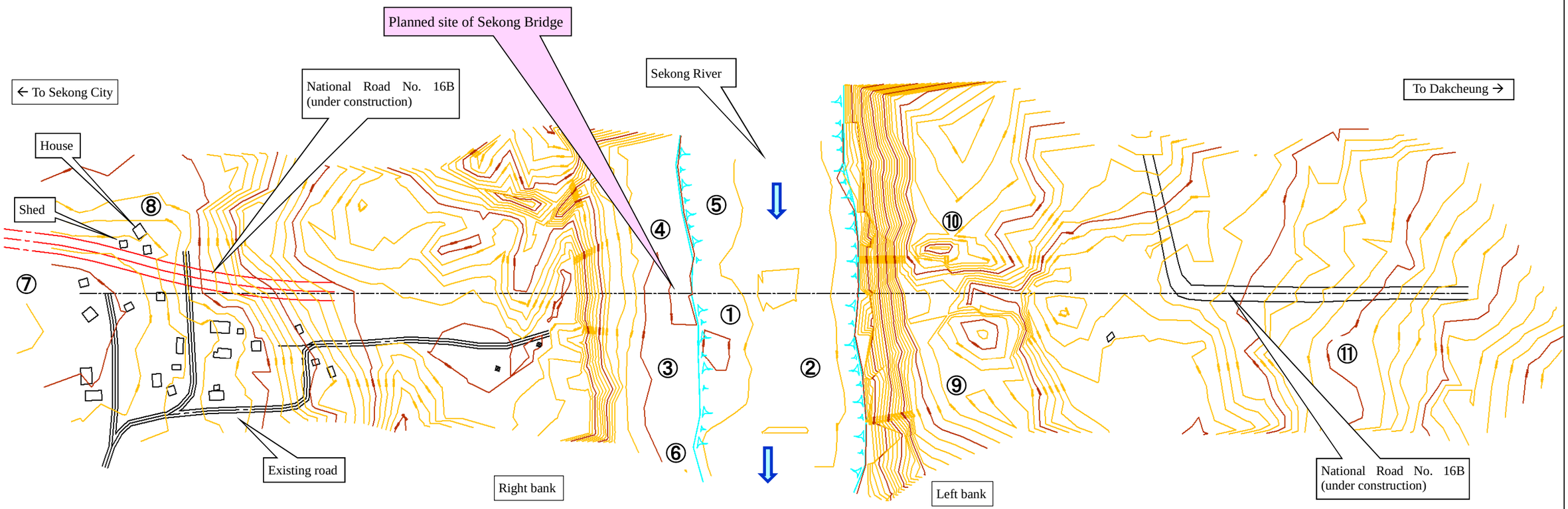
① Planned site of Sekong Bridge



② Steep left bank with a cliff



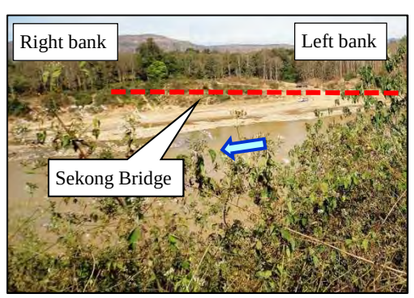
⑤ Rock outcrops on the river bed



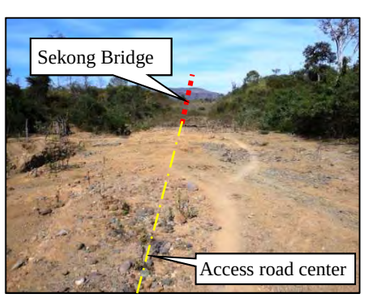
⑥ Gravel deposited in Sekong River

⑦ Construction situation on National Road No.16B

⑧ Private house, whose owner has agreed to relocate



⑨ Viewing the right bank from the left bank



⑩ Construction situation near Sekong Bridge

⑪ Construction situation on National Road No. 16B (left bank)

Figure2-2-6 Present-State Survey Map

2-2-2-3 Consideration of the Bridge Location

National Road No. 16 is interrupted by the Sekong River, and currently the ferry service is operated but irregular. Thus, a bridge is necessary to ensure stable passability.

The existing report presents an idea of building a bridge on National Road No. 16B which is under construction at the moment (Plan 1). The Study Team proposes other plans: Plan 2, where a bridge will be built at the landing place of the ferry, and Plan 3, where a bridge will be built at the location 3km downstream of the location proposed in Plan 1. Consideration of these plans is a crucial task of this Study: this section will compare and examine them before presenting the optimal one.

(i) Plan 1 (bridge to be connected with National Road No. 16B)

This is an idea presented in the existing report. National Road No. 16B is currently under construction, and this plan for building Sekong Bridge to be connected to the national road. The appropriateness of the plan will be examined and confirmed by conducting a landform survey, river survey, hydraulic and hydrologic analyses and survey on environmental and social considerations.

(ii) Plan 2 (bridge to be built at the landing place of the ferry)

This is an plan to use National Road No. 16 and the road on the left bank of Sekong River to build Sekong Bridge at the landing place of the ferry. However, the existing road to be connected with the national road is narrow and 20-odd residential houses are located alongside. Moreover, the road on the opposite bank is a clay road, which needs to be paved. To deal with these factors, the Study Team will investigate and confirm the necessity of land acquisition and relocation of the residents concerned. It will also study and confirm matters to be considered while the construction work is in progress in that the work is likely to interfere with the ferry service.

(iii) Plan 3 (bridge to be built 3km downstream of the site suggested in Plan 1)

This is an plan to shift the bridge site 3km downstream of the site suggested in Plan 1 and take the shortest route to be connected with National Road No. 16. It can avoid the problem with Plan 2 that the construction work may interfere with the ferry service. However, no road exists in the zones where the national road is connected with the right bank of Sekong River, and where the left bank is connected with the existing clay road, so the plan requires construction of a new road. This means that the plan requires relocation of residents and land acquisition, and therefore the Study Team will carefully conduct a landform survey and a survey on environmental and social consideration.

As a result of comparison and consideration of the three plans, the Study Team has concluded that Plan 1 (bridge to be connected with National Road No. 16B) is the most desirable (see Table 2-2-3) on the grounds:

(i) That the construction work of National Road No. 16B has already progressed to reach a place near the location specified in Plan 1, so connecting the bridge with the national road is the most reasonable plan; and that the MPWT also strongly wishes to adopt Plan 1 to meet their initial plan;

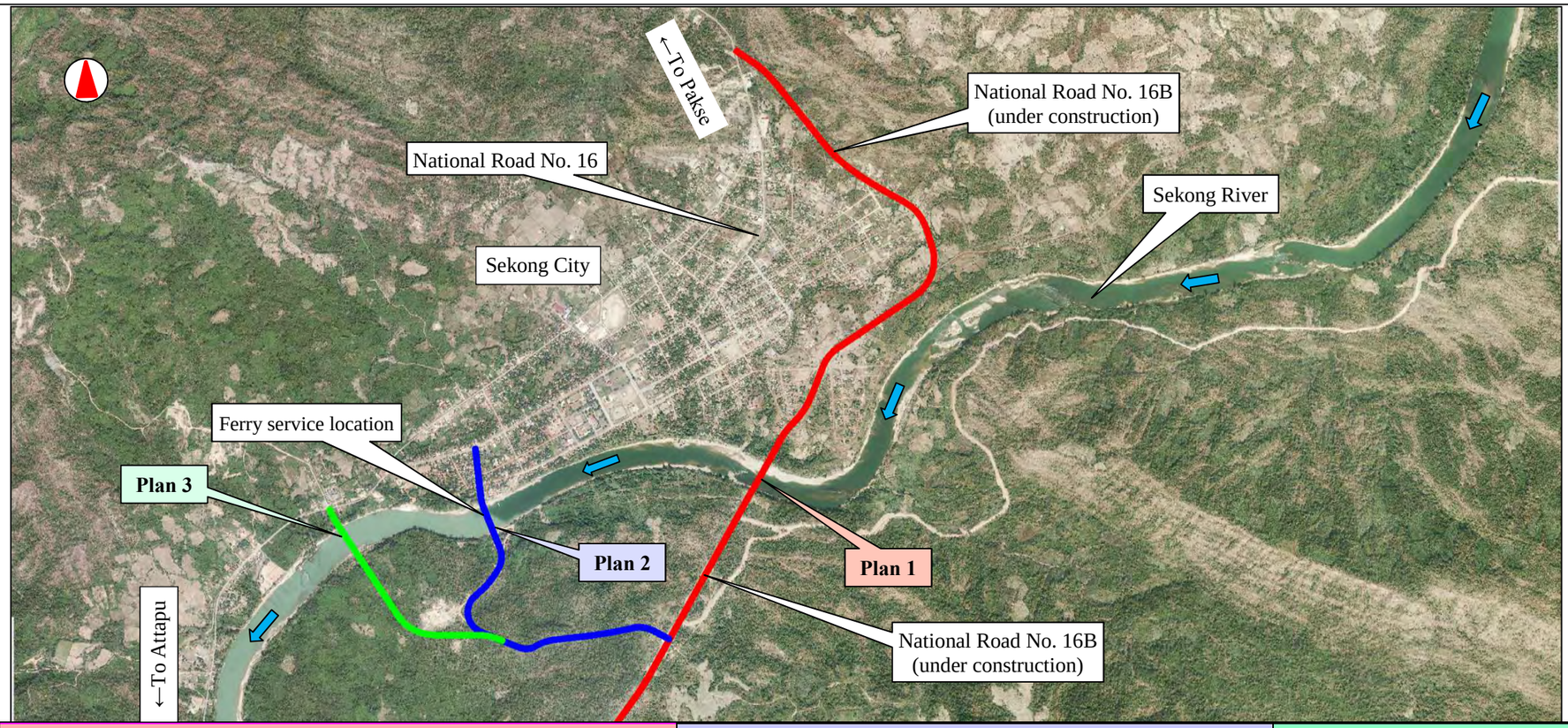
(ii) That the bridge and access roads do not go through the center of the city of Sekong, making the accessibility to the bridge highly convenient;

(iii) That it utilizes the shortest bridge length, gaining the highest economic efficiency of all other plans;

(iv) That the authority has already gained consensus with the relevant residents to move, having no problem in terms of environmental and social consideration; and

(v) That it can build the shortest, attaining the highest economic efficiency among all other plans.

Table2-2-3　Comparison table for suggested bridge locations



Alternatives		Plan 1 (Connecting to National Road 16B)		Plan 2 (At ferry service location)		Plan 3 (Shifting 3 km downstream)	
Summary of alternatives		Plan to build the Sekong Bridge connecting to National Road No. 16B		Plan to build the Sekong Bridge at the location of ferry service		Plan to build the Sekong Bridge 3km downstream of Plan 1	
Evaluation of alternatives	Route characteristics	•Since it does not pass through Sekong city, traffic congestion can be avoided and smooth travel is ensured. •National Road No. 16B is currently under construction, with the exception of the areas on either side of the planned Sekong Bridge construction (approx. 600m).		•Since National Road No. 16 passing through Sekong city will be used, this route will be greatly affected by traffic congestion, etc. •Since the route will connect National Roads 16 and 16B, the existing dirt road must be improved.		•Since National Road No. 16 passing through Sekong city will be used, this route will be greatly affected by traffic congestion, etc. •Since this route will connect National Roads 16 and 16B, a new access road is necessary.	
	Bridge length and economic efficiency	•This is the shortest bridge with a main span of 240m and side spans of 60m for a total length of 300m. •Since this has the shortest bridge length, it has the highest level of economic efficiency.		•This has a main span of 270m and side spans of 60m for a total length of 330m. •Since this has the longest bridge length, it has the lowest level of economic efficiency.		•This has a main span of 260m and side spans of 60m for a total length of 320m. •Since this is a medium-length bridge, it has a moderate level of economic efficiency.	
	Necessity and economic efficiency of access road	•National Road No. 16B is currently under construction, and since the route will connect to this road, a 527m access road will be built. •Since this is the shortest access road, it has the highest level of economic efficiency.		•Since the road on the left bank side of the Sekong River is a narrow dirt road (approx. 2km), road improvements are necessary. •Road improvement expenditures (approx. 2km) are necessary.		•Since there is no road on the left bank side of the Sekong River, a new access road (approx. 1km) is necessary. •Access road construction expenditures (approx. 1 km) and road improvement expenditures (approx. 1.2km) are necessary.	
	Impact by Sekong River	•Since this location has shallowest water depth (approx. 1.5m) in the dry season, it is the best in terms of executability.		•Since the water is very deep in the dry season (approx. 3m), there are difficulties in terms of executability.		• Since this location has the deepest water in the dry season (approx. 4m), it is the worst in terms of executability.	
	Environmental and social considerations	•Although there are multiple private residences in the vicinity of the right bank of the Sekong River, consent has been obtained for resettlement. Thus, there are no environmental or social problems. •There are no residences on either side (approx. 500m) of the planned Sekong Bridge construction. •There have been no rare species of fish or vegetation identified in the Sekong River.		•There are over 20 homes on the right bank side of the Sekong River, and resettlement will be necessary due to widening of the existing road. •There are no private homes on the left bank side of the Sekong River, and thus no environmental or social problems. •Since construction work may disrupt ferry service, an abundance of caution is necessary.		•There are two private residences on the right bank side of the Sekong River, and resettlement will be necessary due to construction of the access road. •There are no private residences on the left bank side of the Sekong River, and thus no environmental or social problems.	
	Construction (cost ratio)	•Bridge construction, access road construction 527m (1.00)		•Bridge construction, access road construction 2km (1.15)		•Bridge construction, access road construction 2.2km (1.12)	
	Overall evaluation	•Since the route does not pass through Sekong city, the level of convenience is very high. •With the shortest bridge length, this bridge is the most economically efficient. •Consent for resettlement has been obtained, and there are no environmental or social problems. •With the shortest access road, this is the most economical among all of the plans.	◎	•Since the route passes through Sekong city, the level of convenience is very low. •With the longest bridge length, this bridge is the least economically efficient. •Since resettlement is necessary, there are large environmental and social problems. •Since bridge costs and road improvement costs are high, this plan is the least economical.	△	•Since the route passed through Sekong city, the level of convenience is very low. •With the second-longest bridge length, this bridge is moderately economically efficient. •Since resettlement is necessary, there are large environmental and social problems. •Since bridge costs and road improvement costs are high, this plan is less economical.	△

2-2-2-4 Longitudinal Profile Plans of the Bridge and Access Roads

The construction work of a river-crossing bridge generally begins with the determination of the design high water level (HWL) for the longitudinal profile plan, and the project cost is economically lower with a profile height. However, the detail design (2003) of Sekong Bridge prepared by Lao and Vietnamese consultants sets the HWL of Sekong River at 122m, though the highest water level at the time of Typhoon Ketsana marked 127.557m well above the HWL by more than 5.5m. Because of this, the construction work of National Road No. 16B is currently suspended around the bridge construction site. The decision to define the profile height of Sekong Bridge is greatly affected by the HWL of Sekong River, so setting the HWL is crucial for the longitudinal profile plans of the bridge and access roads.

(1) Selection of longitudinal profile plans

Hydraulic and hydrologic analyses will be conducted to consider the design high water level (HWL). The Study Team has already obtained information about the water levels at the times of floods in the past through surveys on the existing data, hearings on the site and measurements taken, but will conduct surveys in detail for higher reliability of data and information. It will conduct these surveys and compare and examine the following three plans before making a decision on the longitudinal profiles of the bridge and access roads.

- Plan 1 (HWL=122m): the HWL will be set at 122m, the level set out in the detail design of Sekong Bridge (conducted in 2003). The height of road surface will be, however, higher than the longitudinal profile to be determined in light of the heights of bridge clearance and structure.
- Plan 2 (HWL=126m): a probability statistical investigation of data on river water depth has found that the maximum water depth of the 50-year probability is 18.4m. With the standard depth of riverbed of 107.517m, the HWL of the 50-year probability comes to be 126m (107.517+18.4=125.917m → 126m). The HWL obtained (126m) will be adopted as the longitudinal profile suggested as Plan 2.
- Plan 3 (HWL=128m): the largest water depth at the time of Typhoon Ketsana in 2009 was 20.04m, which is equivalent to the 100-year probability. In this case, the HWL comes to be 128m (107.517+20.04=127.557m → 128m).

  And the Study Team proposes the HWL of 120m in Plan 3.

(2) Consideration of the freeboard (0.5m)

The levees need to have necessary freeboard in light of wind wave, swell, splash and temporary rise in the water level due to driftwood at the time of floods. Since the design high-water discharge (Q) is 7,200m^3/s, the necessary freeboard will be 1.5m according to the following table.

Table 2-2-4 Relation between design high-water discharge and freeboard

Item	1	2	3	4	5	6
Design high-water discharge (m^3/s)	Less than 200	200 or more but less than 500	500 or more but less than 2,000	2,000 or more but less than 5,000	5,000 or more but less than 10,000	10,000 or more
Freeboard (m)	0.6	0.8	1.0	1.2	1.5	2.0

As for the height of bridge clearance, on the other hand, the above freeboard is adopted for ordinary rivers. If quite a lot of driftwood flows in the river and the above freeboard appears to be insufficient for flood control, the height of bridge clearance needs to be elevated accordingly. The "Standards for Installation of Bridges in Rivers in Designated Sabo Land (draft)" stipulates that the clearance will be made, in principle, at 0.5m.

In light of the facts that driftwood is expected to flow down the Sekong River at the time of floods and that Sekong River serves as erosion control, where fallen trees from natural forests are expected to flow down due to mountain landslides, the freeboard of 0.5m will be added to the standard freeboard.

Thus, the height of bridge clearance will be determined by setting the clearance at 1.5m＋0.5m＝2.0m.

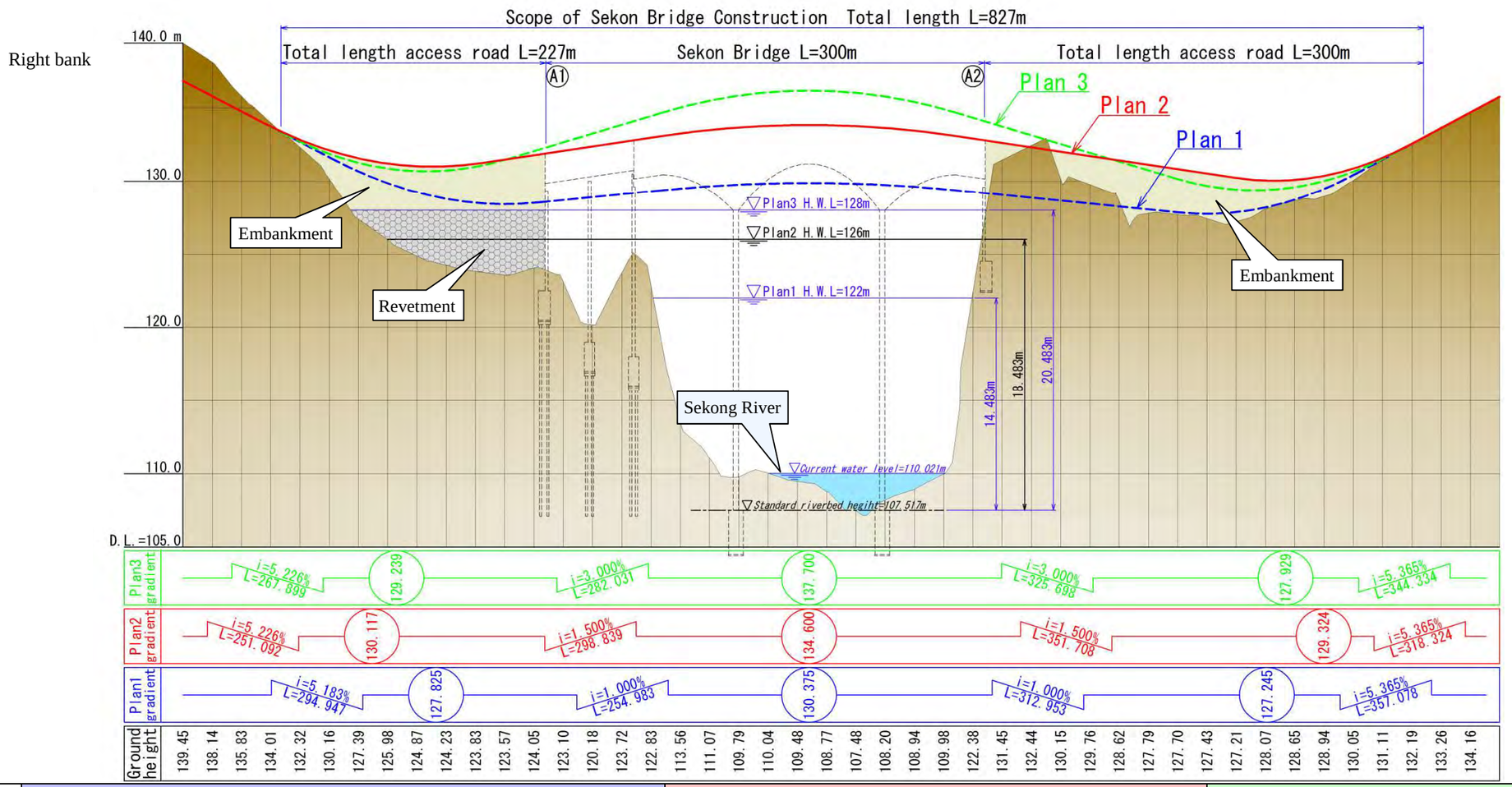
(3) Comparison of longitudinal profile plans

The Study Team has compared and examined summaries, advantages and disadvantages of three plans of the longitudinal profiles of the bridge and access roads (Plan 1: HWL=122m, Plan 2: HWL=126m and Plan 3: HWL=128m), and concluded to adopt Plan 2 (see Table 2-2-5) on the grounds:

(i) That the bridge beam under Plan 2 will not be struck by driftwood even if a 50-year flood occurs, and will not be submerged even if a 100-year flood (such as Typhoon Ketsana) occurs. A 50-year flood is a design flood generally applied to rivers other than Mekong River.

(ii) That the highest water level marked at the time of Typhoon Ketsana, 128m, is the flood level corresponding to a 100-year flood, and that the vertical height (height of bridge clearance) satisfies the 100-year flood level; and

(iii) That the design concept under Plan 2 is similar to that of Hinheup Bridge built in Laos under a grant aid cooperation project.



Alternatives		Plan 1 (High Water Level (HWL) = 122m)		Plan 2 (High Water Level (HWL) = 126m)		Plan 3 (High Water Level (HWL) = 128m)	
Summary of alternatives		•The vertical section height of the new bridge for this plan is set based on the planned HWL of 122m adopted by the Lao and Vietnamese consultants (2003 Detailed Design).		•The vertical section height of the new bridge for this plan is set based on the planned HWL of 126m determined by 50-year probability.		•The vertical section height of the new bridge for this plan is set based on the planned HWL of 128m obtained from the record high water level (2009).	
Evaluation of alternatives	Basis for vertical section height	•Although the 20-year probability places the planned HWL at 122m, river data from the 2003 detailed design estimates this level as a 50-year probability.		•Results of processing probability statistics on annual high water levels recorded over the past 23 years show that the 50-year probability planned HWL is 126m.		The highest water level during the Ketsana typhoon of 2009 was 20.04m. This is equivalent to the 100-year probability level, giving a HWL of 128m.	
	Impact of flooding	•Since the vertical section height for this plan is set based on the 20-year probability HWL, about half the bridge girder height will be submerged during a 50-year probability flood.		•Since the vertical section height for this plan is set based on the 50-year probability HWL, bridge girders will not be submerged even during a 100-year probability flood (HWL126m+freeboard2.0m=128m).		•Since the vertical section height for this plan is based on the 100-year probability HWL, driftwood will not collide with bridge girders even during a 100-year probability flood.	
	Vertical road alignment	•Although the vertical grade of National Road No. 16B is 5% or more at either end of the new bridge, due to cut earth and embankments, the minimum grade needed for drainage on the new bridge is 1%.		•Although the vertical section is 4m taller than Plan 1, the vertical grade for the new bridge will be 1.5%, since embankments will be built at bridge connection points on both sides of the river.		•Since the vertical section is 6m taller than Plan 1 and the height of the abutment will be kept at 12m (maximum limit), the vertical grade for the new bridge will be steep at 3%.	
	Impact of embankments	•Although a 4.6m embankment is needed behind the A1 abutment (right bank side), there are no particular problems with embankment height.		•Although an 8m embankment is needed behind the A1 abutment (right bank side), there are no particular problems with embankment height. However, a berm is necessary.		•Same as left.	
	Environmental and social considerations	•Since the embankment height is relatively low at 4.6m, there are no problems in terms of environment and social considerations.		•Since the embankment is approx. 8m, crossing the road will become somewhat difficult. •A road-crossing tunnel will be built for small animals.		•Same as left.	
	Economic efficiency	•Since this has the shortest vertical section among the three plans, it is the most economically efficient.		•Since this has a vertical section taller than Plan 1, its economic efficiency is moderate.		•Since this has the tallest vertical section among the three plans, it is the least economically efficient.	
	Overall evaluation	•Since bridge girders may be half submerged in a 50-year probability flood, there is a risk of the bridge being washed away. •There are no impacts due to embankments. •Most economical of the three plans.	×	•Driftwood will not collide with bridge girders in a 50-year probability flood, and bridge girders will not be submerged even in a 100-year probability flood. •There are some impacts caused by embankments due to their height (8m). •Moderate economic efficiency among the three plans.	◎	•Driftwood will not collide with bridge girders even in a 100-year probability flood. •There are some impacts caused by embankments due to their height (8m). •Least economical of the three plans.	○

2-2-2-5 Overall Plan

(1) Conditions of applicable design standards

1) Conditions of road design

Road design will comply with the design standards of Laos, which is supplemented by the Japanese design standards. Table 2-2-6shows the conditions of road design.

Table 2-2-6 Conditions of road design

Item			Standards in Laos	AASHTO	Road Structure Ordinance	**Value adopted**
Road type			Class III		General national road	**Class III**
Landform (Flatland/hillock/ mountainous area)			Hillock	Hillock	Hillock	**Hillock**
Design speed (km/h)			60	60	60	**60**
Design vehicle			HS-25 - 44	WB-40	Ordinary vehicle	**HS-25 - 44**
Vehicle width (m)			3.50 x 2	3.30 x 2	3.50 x 2	**3.50 x 2**
Width of shoulder (outside) (m)			2.00 x 2	1.5 x 2	0.75 x 2	**1.50 x 2**
Maximum longitudinal slope (%)			7.0	8.0	5.0	**1.539**
Maximum oneway grade (%)			10.0	10.0	10.0	**-**
Standard cross grade (%)			2.0 – 3.0	1.5 - 2.0	2.0	**2.5**
Stopping sight distance (m)			85	85	75	**-**
Minimum plane curve radius (absolute value) (m)			130	115	150	**∞**
Minimum vertical curve radius	凸	k-value		195	-	**-**
		(m)	2,500		1,400	**4,200**
	凹	k-value		18	-	**-**
		(m)	1,500		1,000	**3,400**
Minimum parameter of transition curve(m)					90	**-**
Minimum length of transition curve (m)					40	**-**

2) Conditions of bridge design

i) Hydraulic conditions

a) Return period

In Laos, the return period is generally set out in accordance with the river size: a 1/100 probability is adopted if a bridge is built over the largest river of Laos, Mekong River, and a 1/50 probability over tributaries. In addition, since a 1/50 probability was adopted when Hinheup Bridge was constructed over NmLik River, a tributary of Mekong River under Japan's grant aid cooperation project, this Study will also adopt the same probability.

b) Design high-water discharge

According to Section 2-1-2(1)5) "Design high-water discharge", the design high-water discharge of a 50-year probability on the bridge construction site is 7,200m^3/s.

c) Design high water level

According to Section 2-1-2(1)7) "Design high water level", the design high water level is 126m.

d) Freeboard

In line with the consideration made in Section 2-2-4(2) "Consideration of the freeboard (0.5m)", the height of bridge clearance corresponding to the design high-water discharge of 7,200m^3/s is 1.5m. If the freeboard (0.5M) as a sabo river is also taken into account, the height from the HWL to the bridge clearance is 1.5m+0.5m=2.0m.

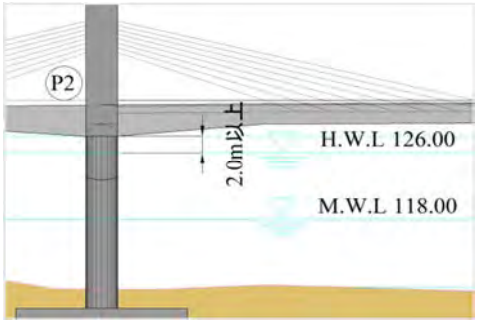
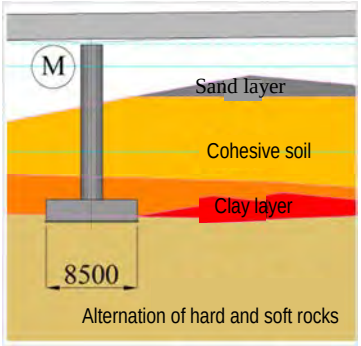


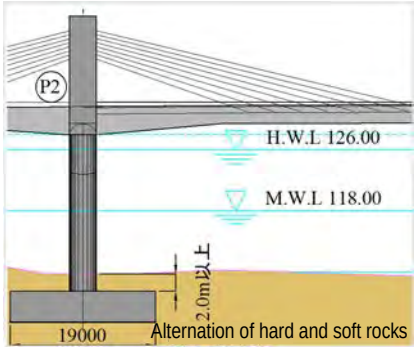
Figure 2-2-7 Height of bridge clearance

e) Depth of embedment

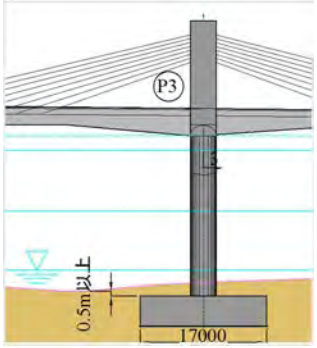
The Study Team has decided to secure the depth of embedment of 0.5m for Pier P3, which will be placed near the deepest riverbed, because the riverbed is made of bedrock, so as to create room to place protective concrete on the deepest riverbed. As for Piers P1 and P2, if the amount of earth covering necessary for the deepest riverbed, as in the case of Pier P3, is secured, it will be 3.0m or more. Thus, according to the Bridge Structure Ordinance, the Study Team has decided to secure the minimum amount, 2.0m in depth.



Pier P1
(10m or deeper from riverbed)



Pier P2
(2m or deeper from riverbed)



Pier P3 (0.5m or deeper from the deepest riverbed)

Figure 2-2-8 Depth of embedment

f) Revetment work

An embankment will be built behind Abutment A1 for the access roads, but when a large-scale flood occurs, the flow of Sekong River hits the front of the abutment and is likely to whirl. This could be a cause of local encroachment and scouring of the embankment, so revetment work will be applied to the slope of the embankment.

Revetment work will be applied to the embankment, which will be in-river-channel, to the height of the highest water level in the past. The gabion construction method will be adopted because it is a method generally adopted in Laos, materials can easily be procured, and filling stones can easily be taken from the river.

In passing, rocks are exposed at the pace near Abutment A1, so no revetment work is particularly needed to protect the abutment.

ii) **Design live load**

Since Sekong Bridge is on National Road No. 16B, an important international arterial road of Laos, it will comply with the country's standards, "Road Design Manual (1996)", adopting the following design live load.

・HS20-44×1.25（= HS25-44）

iii) **Seismic load**

a) Seismic distribution chart

Figure 2-2-9 shows the distribution of earthquakes which occurred during the period of 1975-2012 in Laos and whose magnitude was 4.0 or greater. In addition, the acceleration distribution map at the Sekong bridge on the earthquake mentioned above is shown in Figure 2-2-10.

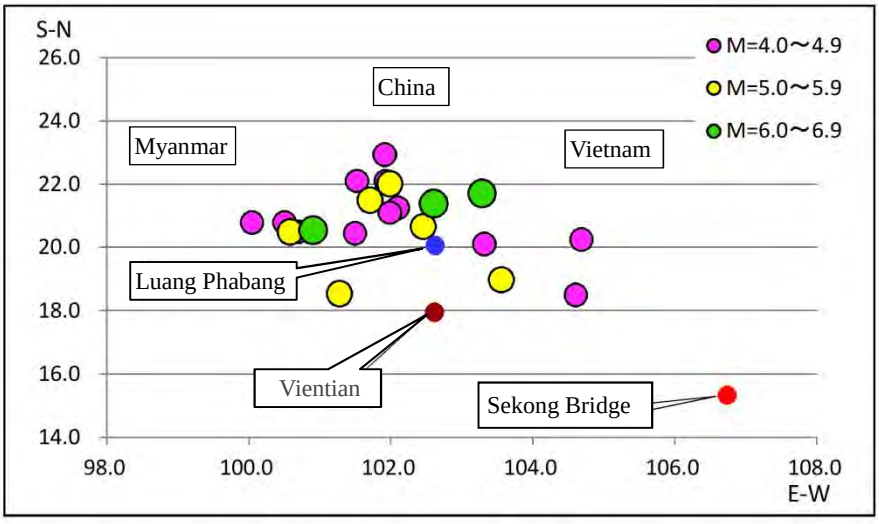


Figure 2-2-9 Seismic distribution chart in Laos

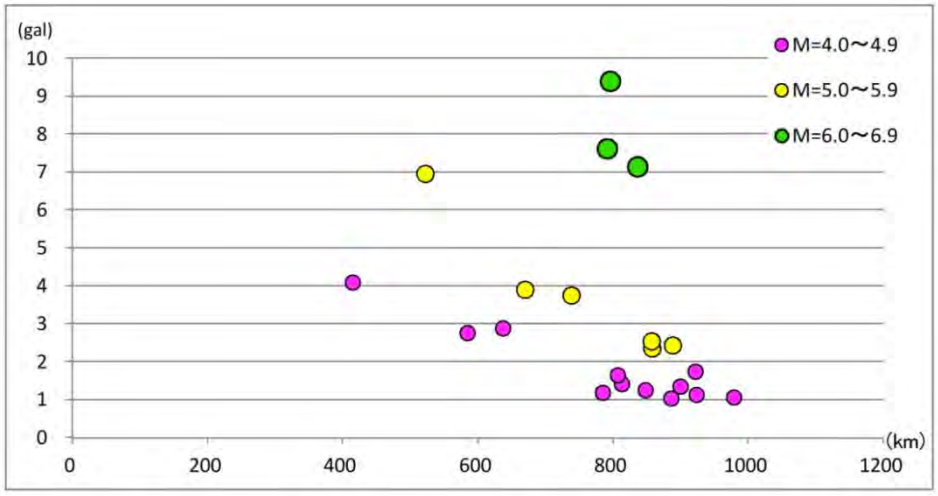


Figure 2-2-10 Acceleration distribution chart on Sekong Bridge site

b) Seismic load

Figure 2-2-9 shows the distribution of earthquakes which occurred during the period of 1975-2012 in Laos and whose magnitude was 4.0 or greater. The chart suggests that relatively large earthquakes in Laos occurred near the northern border with China, Vietnam and Myanmar.

Figure 2-2-10 shows the acceleration distribution on the bridge site, which suggests that the acceleration is fairly small, no greater than 10gal at most. This is because the acceleration near the hypocentral region in the northern part of the country (Luang Phabang) is above 60gal as in Figure 2-2-11, it diminishes on the bridge construction site which is approximately 400 – 1,000km away from the hypocentral region.

Accordingly, the appropriate design horizontal seismic coefficient on the bridge construction site will be set at Kh=0.1 on the grounds:

(i) That the acceleration of 60gal or greater has been generated near the hypocentral region. If the risk of earthquake near the bridge is taken into account, it is reasonable to make the design horizontal seismic coefficient Kh=0.1 (approx. 100gal).

(ii) That Japan's Specifications for Highway Bridges stipulates the minimum design horizontal seismic coefficient to be Kh=0.1.

(iii) That the AASHTO (American Association of State Highway and Transportation Officials) also sets out Kh=0.1, though the coefficient was Kh=0.06 when the association initially stipulated it in 1958.

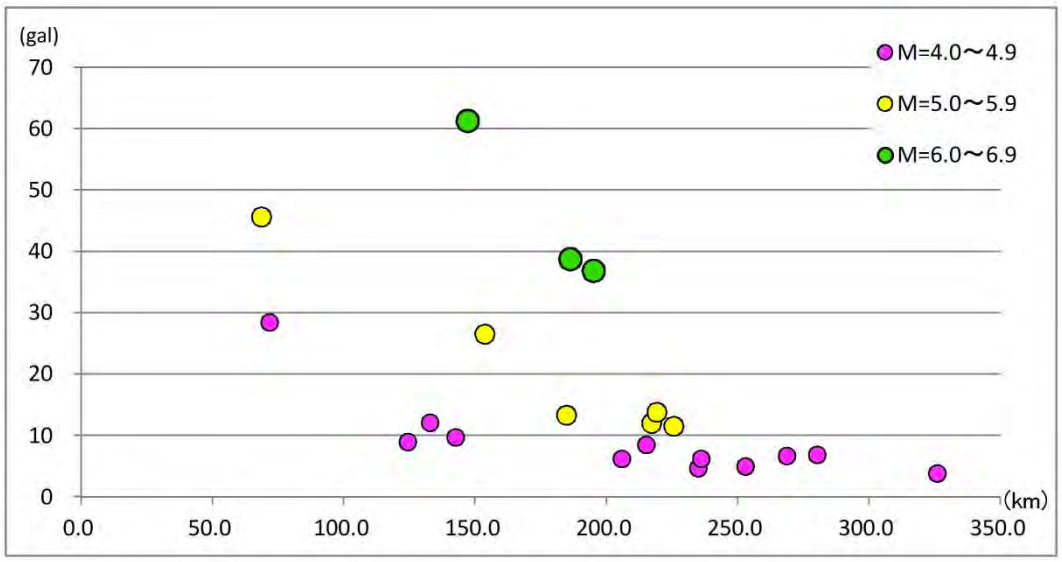


Figure 2-2-11 Acceleration distribution chart near hypocentral region

iv) **Material strength**

This Project shall adopt the following strengths of materials to be used.

(i) Design standard strength of concrete for PC superstructure

Design standard strength of concrete for PC superstructure will be set at σck＝35 N/mm^2.

(ii) Design standard strength of reinforced concrete

Design standard strength of reinforced concrete for substructure, foundation work, wheel guard, wall balustrade, etc. will be set at σck＝24 N/mm^2.

(iii) Design standard strength of plain concrete

Design standard strength of plain concrete for leveling, filling for foot pavements will be set at σck＝18 N/mm^2.

(iv) Reinforcing bar

The Project will use reinforcing bars of SD345.

(v) PC steel

The Project will use PC steel strand wires 27S15.2 (SWPR7BL) (diagonal member cables), 12S15.2 (SWPR7BL) (vertical prestressing), SWPR7BL 12S15.2, and 1S21.8 (SWPR19L) (transverse prestressing). It will also use diagonal member cables of double rust preventive type combining polyethylene coating and epoxy resin coating, and vertical and transverse prestressing cables of double rust preventive type with epoxy resin coating and grout.

v) **Procedure for setting the span length**

Figure 2-2-12 shows the procedure for setting the span length.

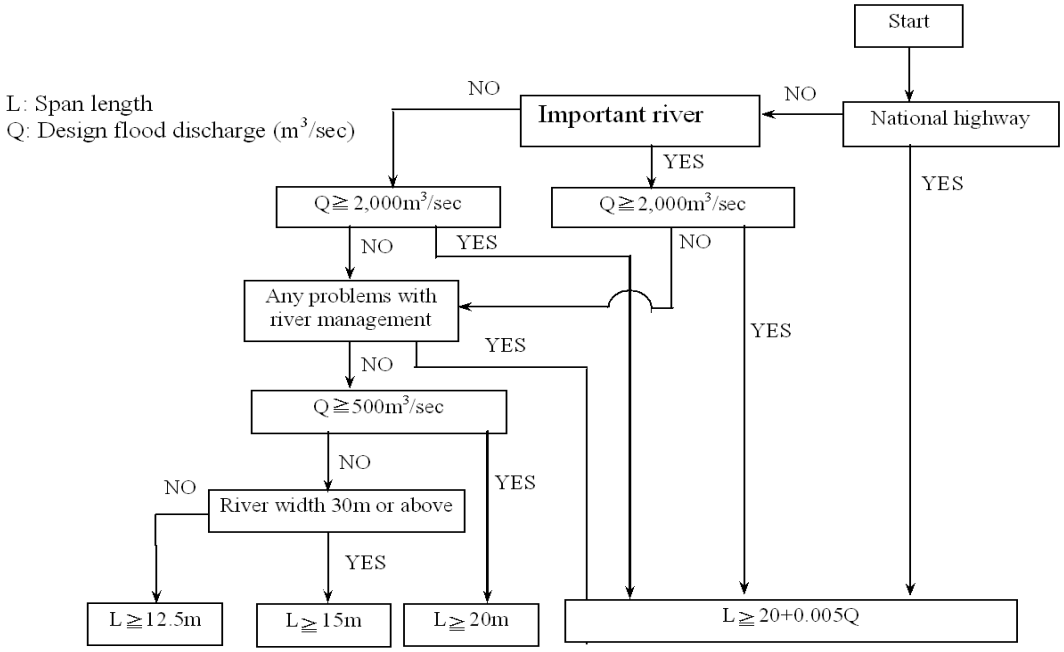


Figure 2-2-12 Procedure for setting the span length

The span length of the bridge calculated according to the procedure shown above will be:

L ≧20＋0.005Q＝20+0.005×7,200＝56m, when Design high-water discharge (Q) = 7,200m³/s.

(2) Cross section plan

As in Section 2-1-1 “Policy on Width”, the cross section of the bridge will be 3.5m×2=7.0m for carriageway; 0.5m×2=1.0 m for side strip; and 1.5m×2=3.0m for foot pavement, the total being 11.0m (effective width).

The standard cross section of the earth work part will be 3.5m×2=7.0m for carriageway; 1.5m×2=3.0 m for road shoulder; and 0.5m×2=1.0m for soft shoulder, the total being 11.0m (total width).

(3) Consideration of bridge length

1) Topography

Figure 2-2-13 shows a plain map of the bridge construction site, and Figure 2-2-14 a cross section of the road centerline. Although a river terrace is formed on the side of Abutment A1, the average ground level is low at 125m, which resulted in a wide range of inundation at the time of Typhoon Ketsana. A stable bank exists on the higher course and right and has no particular trace of erosion perhaps because the flowing water on the main stream prevented any collision to inundated parts. There are some eroded parts on the higher and lower courses of the river along the planned road, which appear to be due to the effects of tributaries. It is hardly possible to associate the erosions with typhoons because of their shapes.

Abutment A1 will be built on the side of the winding river hit by the water. As a result of severe erosions, rocks are exposed and a stable bank is formed. The area surrounding the location of Abutment A2 is bedrock, so the construction work will have little problem.

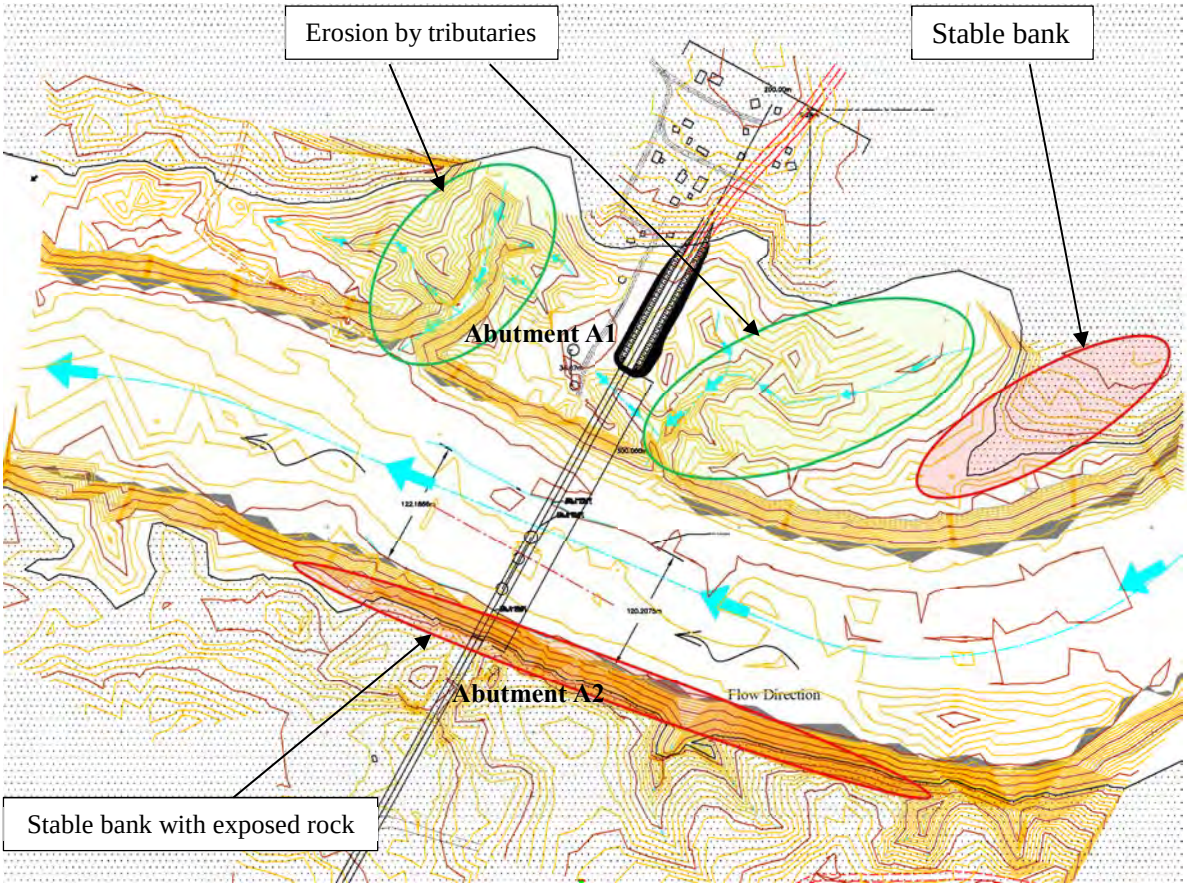


Figure 2-2-13 Plain map of bridge construction site

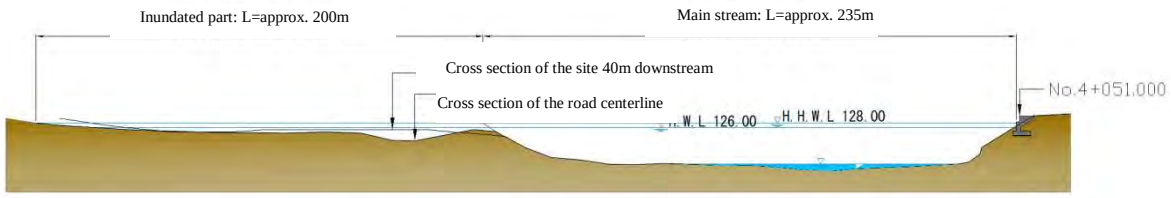


Figure 2-2-14 Cross-section of the road centerline

2) Consideration of the location of Abutment A1

Abutment A1 must be built in the area inundated at the time of Typhoon Ketsana from financial consideration as shown in Figure 2-2-15. The flow rate in the area is fairly low, 0.76m/s, according to the results of investigation shown in Table 2-2-7, and the area is unlikely to be directly eroded by the mainstream because of the presence of a stable bank on the higher course on the right bank. Thus, even if an abutment is placed in the area inundated, erosion of back fill is highly unlikely to occur, and thus it is possible to place an abutment there. More specifically, it will be built outside the existing natural water vein behind a natural levee on the main stream (see Figure 2-2-15) in order to avoid:

(i) High embankment by placing embankment on the existing water vein;

(ii) Local erosion on the higher course of the abutments due to the merger of an upstream tributary and the main river; and

(iii) Additional erosion to other parts due to interruption of the existing water vein.

Table 2-2-7 State of downward flows in the part inundated andmain stream at the time of Typhoon Ketsana

	Place inundated when flooding	Mainstream
Cross-section of the river (m2)	787.9	3843.0
Wetted perimeter (m)	203.7	239.9
Hydraulic radius	3.868	16.019
Roughness coefficient	0.05	0.04
Hydraulic gradeline	0.000237	
Average velocity (m/s)	0.76	2.45
Flow rate (m3/s)	598.0	9402.0
Total flow rate (m3/s)	10000	

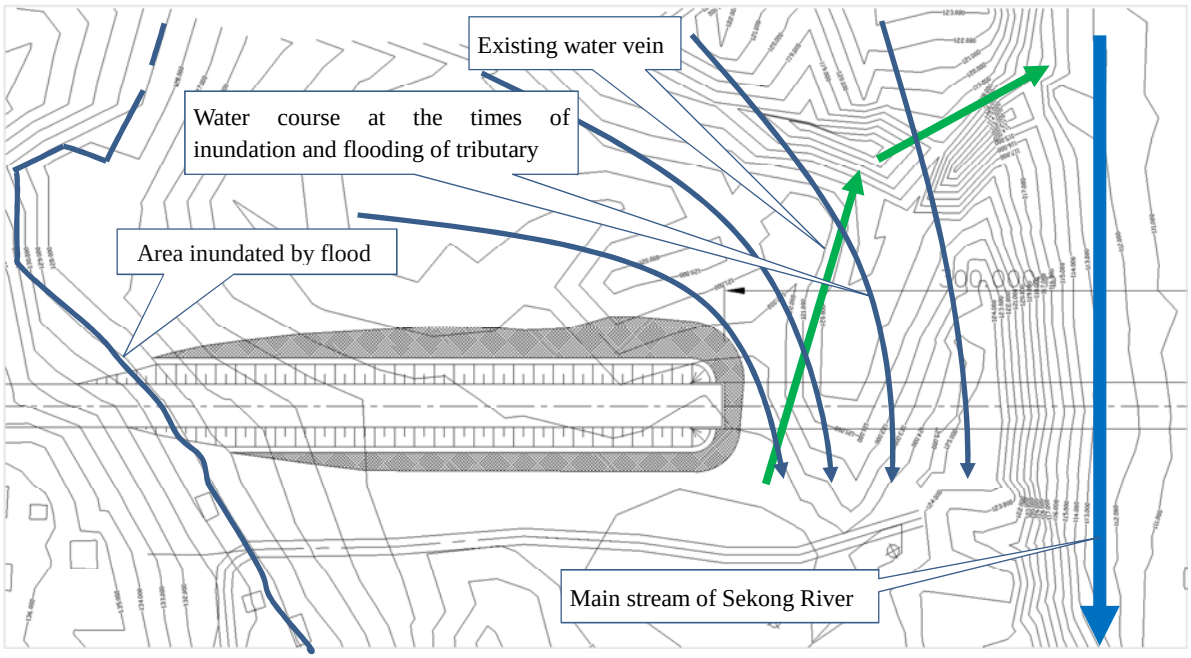


Figure 2-2-15 Landform around Abutment A1 and State of water flow at the time of flood

3) Consideration of the location of Abutment A2

As shown in Figure 2-2-16, Abutment A1 will be placed on a stable rock slope with No4+51.0m to minimize disadvantages of the cross-section area. It should be placed, however, so as not to place the main girder inside the slope.

Based on the locations of Abutments A1 and A2 determined as described above, the bridge length will be 300.0m.

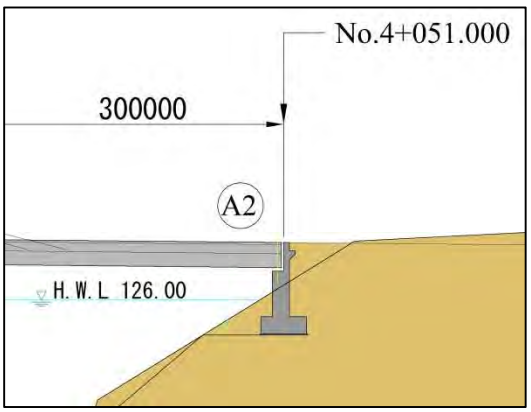


Figure 2-2-16 Location of Abutment A2

(4) Comparative review of bridge types

1) Primary comparative review

The Bridge Structure Ordinance sets out standard span lengths (lengths between abutments built in the effective river width) according to design flood discharge in order to prevent bridges from blocking river channels. As calculated in Section 2-1-2(1)5) "Design high-water discharge", design flow rate of the river is approximately 7200m^3/s, so the standard span length must be set at 56m or longer as shown below. If the standard span length exceeds 50m, it will be made 50m or longer.

・Standard span length = 20＋0.005×7200＝56m → 50m

The river width of the main stream is roughly 240m, and possible arrangements of effective spans can be the following four cases:

・4 equal spans (PC extrusion method for steel girder): L=4@60=240m
・4 unequal spans (PC cantilever erection method): L=50+70+70+50=240m
・3 equal spans (steel girder): L=3@80=240m
・3 unequal spans (PC cantilever erection method): L=70+100+70=240m

According to the relations between the superstructure work and recommended applicable spans presented in Table 2-2-8, the following six plans – Plan A to Plan E – have been selected as applicable bridge types for the span length given above. For comparison purposes, Plan F, a revised version of Plan D, has been also examined, whereby PC cables inside concrete is exposed to the exterior of concrete to enhance eccentricity for higher rationality on structure.

・Plan A: steel continuous plate girder (4@60=240m)
・Plan B: steel continuous box girder (4@60=240m and 3@80=240m)
・Plan C: continuous truss (4@60=240m and 3@80=240m)
・Plan D: PC continuous box girder (cantilever method) (50+70+70+50=240m and 70+100+70=240m)
・Plan E: PC continuous box girder (push-out or support method) (4@60=240m)
・Plan F: extradosed bridge (70+100+70=240m)

Table 2-2-8 Superstructure types and recommended spans

Superstructure type		Recommended span (50 m / 100 m / 150 m)	Curve applicable: Main structure	Curve applicable: Bridge deck	Girder height: Span ratio
Steel bridge	Simple composite plate girder		○	○	1/18
	Simple plate girder		○	○	1/17
	Continuous plate girder		○	○	1/18
	Simple box girder		○	○	1/22
	Continuous box girder		○	○	1/23
	Simple truss		×	○	1/ 9
	Continuous truss		×	○	1/10
	Reverse Langer girder		×	○	1/6,5
	Reverse Lohse girder		×	○	1/6,5
	Arch		×	○	1/6,5
PC bridge	Pretentioned girder		×	○	1/15
	Hollow slab		○	○	1/22
	Simple T girder		×	○	1/17,5
	Simple composite girder		×	○	1/15
	Continuous T girder, composite girder		×	○	1/15
	Continuous composite girder		×	○	1/16
	Simple box girder		○	○	1/20
	Continuous box girder (cantilever method)		○	○	1/18
	Continuous box girder (Push-out or support method)		○	○	1/18
	π shaped rigid frame ridge		×	○	1/32
RC Bridge	Hollow slab		○	○	1/20
	Continuous spandrel-filled arch		○	○	1/ 2

2) The secondary comparative review

Table 2-2-9 shows the results of a comparative review of Plans A to F selected in the previous review (see Table 2-2-8).

Table 2-2-9 Secondary comparative review

Superstructure type	Assessment	Mark
Plan A: steel continuous plate girder (4@60m)	・This is economically disadvantageous to PC girder because many parts of the main structure are produced in Japan and thus require marine transport, and land transport of 890m. ・ Slab, steel girder, bearing shoe and many other parts require complicated maintenance work.	×
Plan B: steel continuous box girder(4@m、3@80m)	・ The same as Plan A	×
Plan C: continuous truss (4@60m、3@80m)	・ The same Plan A	×
Plan D: PC continuous box girder (cantilever method) (50+70+70+50m and 70+100+70m)	・This is economically advantageous to steel girder because many parts of the main structure are produced in Laos with inexpensive labor and because it does not require many materials imported from Japan. ・No parts other than abutment and some bearing shoes on pier need maintenance work.	○
Plan E: PC continuous box girder (push-out or support method) (4@60)	・This is economically advantageous to a steel girder because many parts of the main structure are produced in Laos with inexpensive labor and because it does not require many materials imported from Japan. ・No parts other than abutment and bearing shoe on pier need maintenance work. ・The bridge will have a span length (60m) of the largest class even in Japan. It appears to be difficult to apply this method to such a long span length under the condition where it is difficult to manufacture high strength concrete (400kg/cm^2).	△
Plan F: extradosed bridge (70+100+70m)	・This is economically advantageous to steel girder because many parts of the main structure are produced in Laos with inexpensive labor and because it does not require many materials imported from Japan. ・No parts other than abutment and some bearing shoes on the pier need maintenance work.	○

3) The third comparative review

The six plans have been narrowed down to four as in Table 2-2-9.

・Plan 1: PC 3-span continuous rigid frame box girder bridge (overhang erection):
L=70+100+70m=240m

・Plan 2: PC 4-span continuous rigid frame box girder bridge (overhang erection):
L=50+70+70+50m=240m

・Plan 3: PC 5-span continuous box girder bridge (push-out erection):L=50+50+50+50+50m=250m

・Plan 4: extradosed bridge (overhang erection): L=70+100+70m=240m

Table 2-2-10 and Table 2-2-11 show the results of the comparative review of the above four plans. Accordingly, the Study Team has decided to adopt Plan 4 (extradosed bridge) on the grounds:

(i) That it is the most economical bridge type as with Plan 1;
(ii) That it requires a smaller number of piers and thus is superior to other plans in terms of workability, and structure, comfort to users and easiness of maintenance;
(iii) That it has the least impact on the river; and
(iv) That it has excellent appearance and characteristics in monuments or landmarks, and that Sekong Province and the MPWT have agreed with the plan.

4) Final comparative review

Extradosed bridge has been selected in the third comparative review. Meanwhile, the right bank from the Sekong Bridge construction site is inundated if a large-scale flood (HWL=126m) occurs and thus needs to have a bridge.

The Study Team has conducted a comparative review of the following two plans of superstructure types and extradosed bridge for the site inundated.

- Plan 1: PC 2-span connected post-tension t-shaped girder + extradosed bridge
- Plan 2: PC simply box girder bridge + extradosed bridge

Table 2-2-12 shows the results of the final comparative review. There is no difference between the two plans in terms of economic efficiency, but Plan 2, PC simply box girder bridge + extradosed bridge (extradosed bridge and continuous structure), will be adopted, which is superior in terms of structure and easiness of construction.

Table2-2-10　Third comparison table of bridge types (1/2)

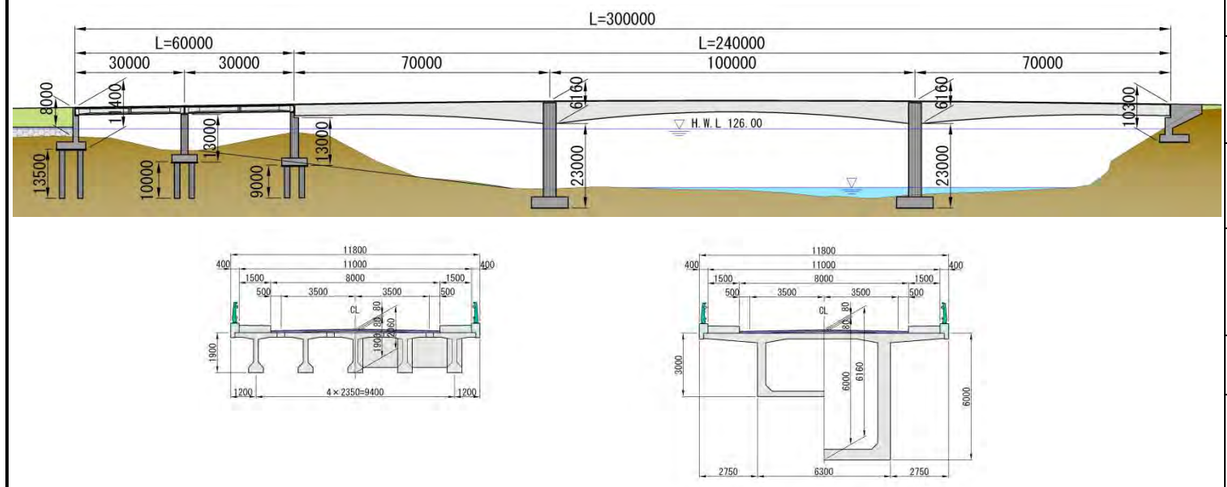
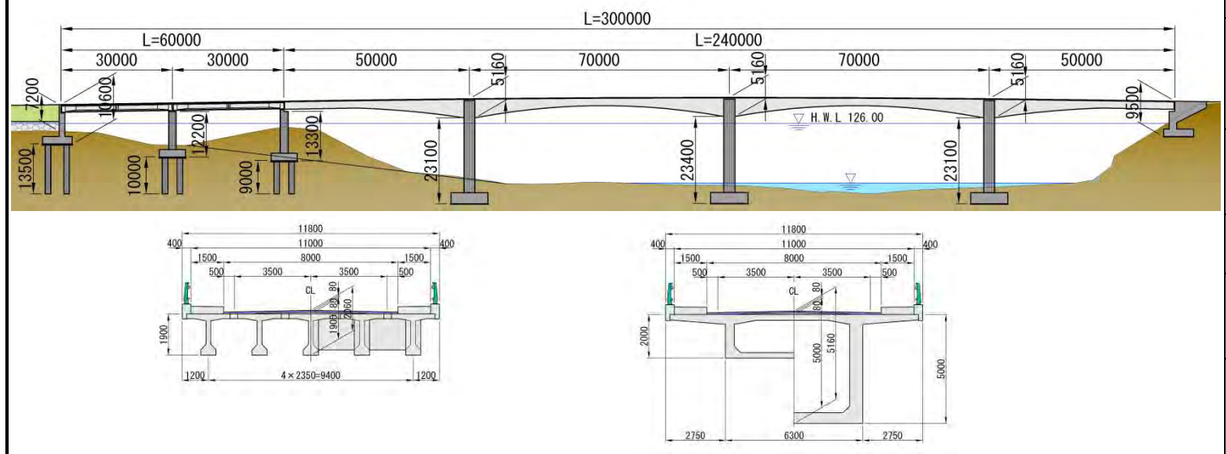
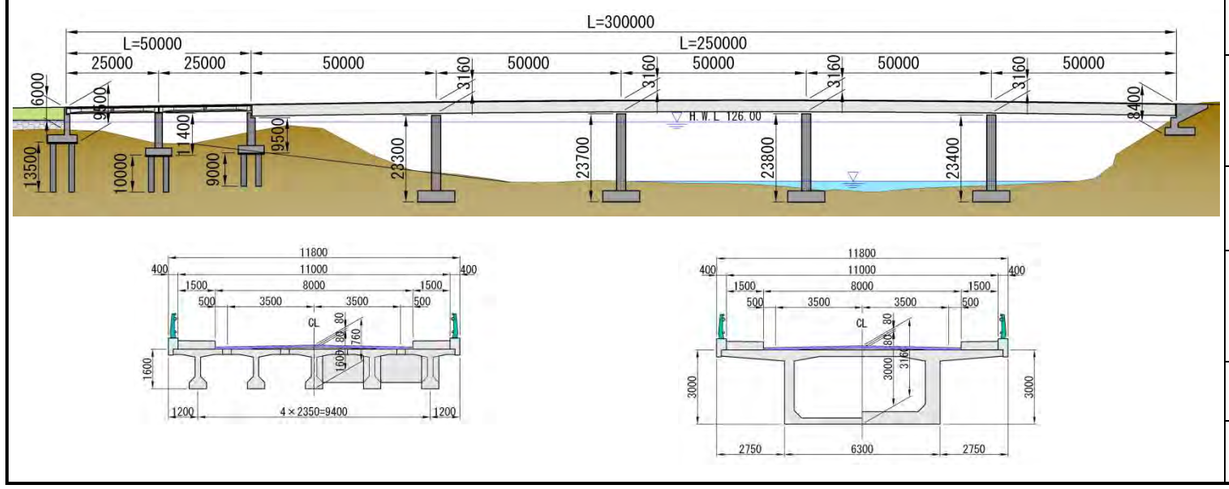
Bridge types	Properties	
Right bank　Plan 1: PC 3-span continuous rigid frame, box-girder bridge（Main Bridge）　Left bank 	Structural properties	• Continuous precast concrete box-girder bridge using cantilever construction. Used often in grant aid construction projects. • Superior durability and drivability due to its continuous rigid frame structure. • Length of the shortest span is 70m, which thoroughly meets the standard span length (≥ 50m) with no apparent problems.
	Workability	• Since this has the least number of bridge piers, it has the best workability regarding in-river construction work. • Since the main girder will be a cantilever erected by form travellers, it will not be affected by water level fluctuations of the river, and work can also be done during the rainy season. • Rough estimate of construction period: approx. 28 months (including side spans)
	Maintenance	• Since this is a concrete bridge, maintenance on the main body of the bridge is not necessary. • Since the upper section and bridge piers have a rigid joint structure (integrated structure), there are no bearing supports, making maintenance of the piers unnecessary.
	River properties	• Since this has the least number of bridge piers, it has the least amount of in-river work and impact on the environment of the three plans. • The river blockage ratio is approx. 4.0% (standard value = below 5%) and thus has no problems. This has the lowest blockage ratio of the three plans.
	Economic efficiency	• Since this has the least number of bridge piers, the costs are low for the lower section, making this the most economical. • Estimated construction cost ratio: 1.00 (including side spans)
	Overall evaluation	• Most economical bridge type of the three plans. • Since there are few bridge piers, it is superior in terms of workability. It is also superior in structural properties, drivability, and maintenance. • This bridge type has the least impact on the river.　◎
Right bank　Plan 2: PC 4-span continuous rigid frame, box-girder bridge（Main Bridge）　Left bank 	Structural properties	• Continuous precast concrete box-girder bridge using cantilever construction. Used often in grant aid construction. • Superior durability and drivability due to its continuous rigid frame structure. • Length of the shortest span is 50m, which meets the standard span length (≥ 50m) with no apparent problems.
	Workability	• Since there are numerous bridge piers, in-river work and effects on the water environment are greater than Plan 1. • Since the main girder will be a cantilever erected by form travellers, it will not be affected by water level fluctuations of the river, and work can also be done during the rainy season. • Rough estimate of construction period: approx. 36 months (including side spans)
	Maintenance	• Since this is a concrete bridge, maintenance on the main body of the bridge is not necessary. • Since the upper section and bridge piers have a rigid joint structure (integrated structure), there are no bearing supports, making maintenance of the piers unnecessary.
	River properties	• The river blockage ratio due to erecting bridge piers is approx. 4.5% and thus has no problems. • This has some impact on the river environment compared to Plan 1 due to in-river work for bridge pier construction.
	Economic efficiency	• This is the least economical of the three plans, but there is not a great difference. Economic efficiency is moderate when considering maintenance costs. • Estimated construction cost ratio: 1.04 (including side spans)
	Overall evaluation	• This is the least economical of the three plans. • Compared to Plan 1, there are more bridge piers, making workability inferior. However, it is superior in structural properties, drivability, and maintenance. • This bridge type has a moderate impact on the river.　○
Right bank　Plan 3:PC 5-span continuous box-girder bridge（Main Bridge）　Left bank 	Structural properties	• Continuous precast concrete box-girder bridge using incremental launching construction method. Has been used before for grant aid construction projects in Laos (Hinheup Bridge). • Different from the other two plans, this structure type has bearing supports. • Length of the shortest span is 50m, which meets the standard span length (≥ 50m) with no apparent problems.
	Workability	• Since this has the most bridge piers, it has the most in-river work and the largest impact on the environment. • Since the main girder will be incrementally launched using a launching nose, it will not be affected by water level fluctuations of the river, and work can also be done during the rainy season. • Rough estimate of construction period: approx. 36 months (including side spans)
	Maintenance	• Since this is a concrete bridge, maintenance on the main body of the bridge is not necessary. • Since maintenance on the bearing support section is necessary, this is inferior in terms of maintenance compared to the other plans.
	River properties	• Since this has the most bridge piers, it has the most in-river work and the largest impact on the environment of the three plans. • The river blockage ratio due to erecting bridge piers is within 5.0%, and thus has no problems, but this ratio is the highest compared to other plans.
	Economic efficiency	• The bridge construction costs are moderate, but economic efficiency is lessened when including maintenance costs. • Estimated construction cost ratio: 1.02 (including side spans)
	Overall evaluation	• This plan is less economical than other plans when considering maintenance costs. • Since there are many bridge piers, this has the largest impact on the river.　△

Table2-2-10　Third comparison table of bridge types (2/2)

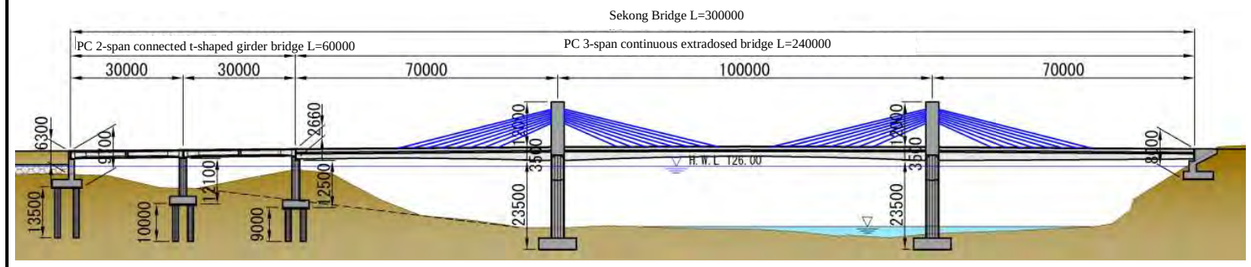
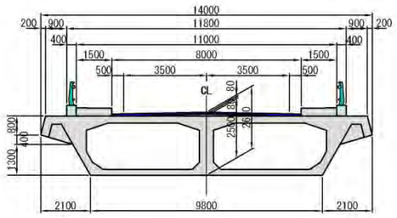
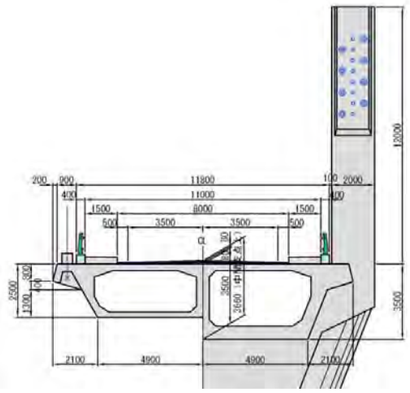
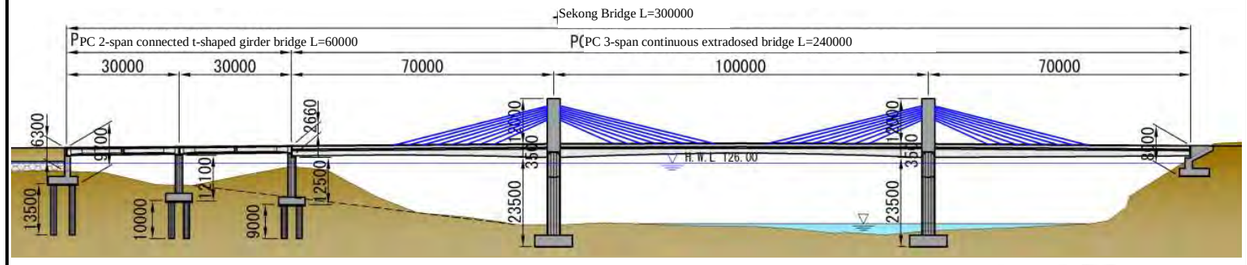
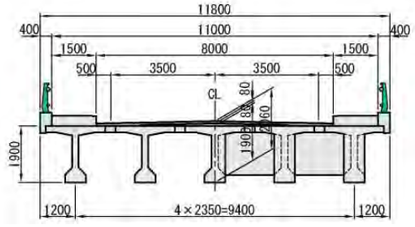
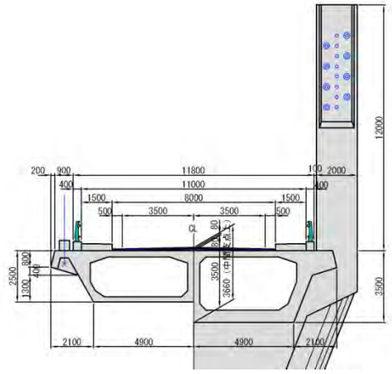
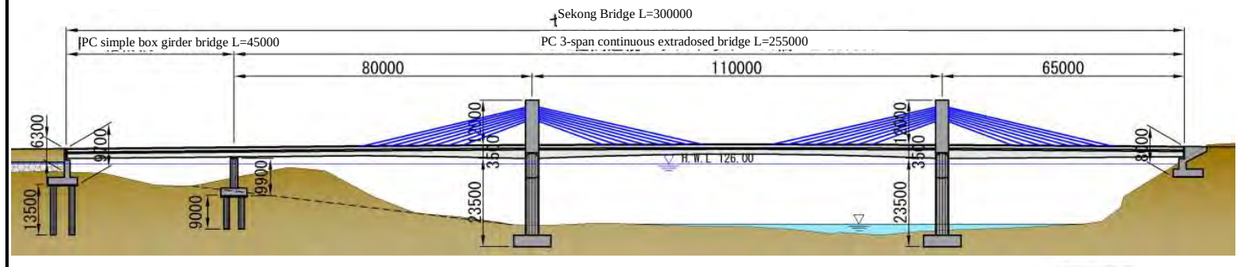
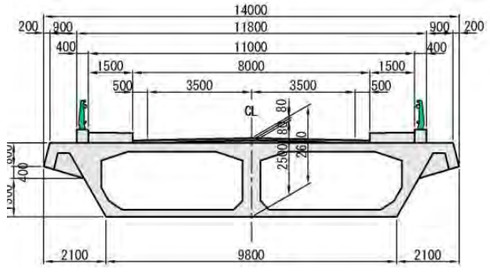
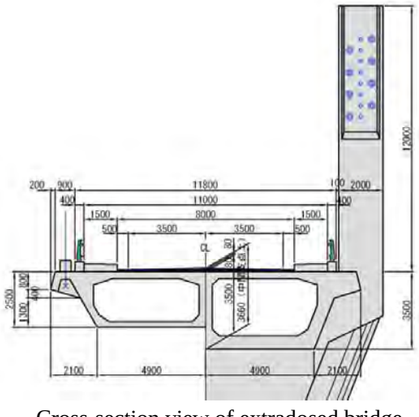
Bridge type	Properties	
Right bank　Plan 4: PC 3-span Extradosed bridge（Main Bridge）　Left bank   	Structural properties	• Extradosed bridge pursing the structural reasonableness of a rigid frame, box-girder bridge. Usage continues to increase in grant aid construction projects. • The girder height is half the height of Plan 1. The vertical section can be lowered overall, thereby making it more economical. • Superior durability and drivability due to its continuous rigid frame structure.
	Workability	• Since this has the least number of bridge piers, it has the best workability regarding in-river construction work. • Since the main girder will be a cantilever erected by form travellers, it will not be affected by water level fluctuations of the river, and work can also be done during the rainy season. • Rough estimate of construction period: approx. 29 months (overall construction period including side spans)
	Maintenance	• Since this is a concrete bridge, maintenance on the main body of the bridge is not necessary. • Since the upper section and bridge piers have a rigid joint structure (integrated structure), there are no bearing supports, making maintenance of the piers unnecessary.
	River properties	• Since this has the least number of bridge piers, it has the least amount of in-river work and impact on the environment of all the plans. • The river blockage ratio due to erecting bridge piers is approx. 3.0%, which is the best compared to the other plans.
	Economic efficiency	• As with Plan 1, this is the most economical. • Estimated construction cost ratio: 0.99 (including side spans)
	Overall evaluation	• This is the most economical bridge type. • Since there are few bridge piers, it is superior in terms of Workability. It is also superior in structural properties, drivability, and maintenance. • This bridge type has the least impact on the river.	◎

Table 2-2-12 Comparison Table of Final Bridge Types

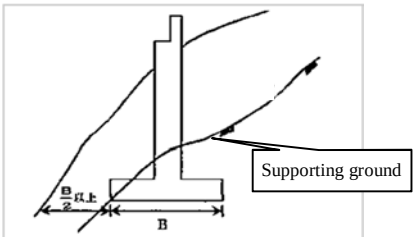
Bridge Type	Characteristics (inundated part + main bridge)		
Plan 1: PC 2-span connected post-tension t-shaped girder + extradosed bridge   Cross-section view of PC T-girder bridge  Cross-section view of extradosed bridge	Structural characteristics	・PC 2-span connected t-shaped girder bridge is built using temporary work girder. Quite a few bridges of this bridge type with 40m or shorter spans have been built under grant aid cooperation. ・T-shaped girder bridge takes a different structure from an extradosed bridge, requiring elastic joints. Thus, it is disadvantageous in terms of seismicity and comfort to users.	
	Workability	・T-shaped girder bridge requires work items completely different from those for construction of the main bridge part. So the combination of the two increases the number of work items and is disadvantageous in terms of workability. ・The construction work for T-shaped girder bridge can be conducted simultaneously with that for the main bridge part, so the overall construction schedule will be the same as that of Plan 2.	
	Maintenance	・T-shaped girder is a concrete bridge, so the bridge girder requires no maintenance work. ・The underwater part of a T-girder bridge needs a larger number of elastic joints and is inferior to Plan 2.	
	Characteristics of the river	・T-girder bridge is located in the inundated part and thus is not considerably affected by the river.	
	Economic efficiency	・The superstructure in the inundated part is economically efficient, but since it needs an additional abutment, this is more or less the same as Plan 2. ・Ratio of the estimated construction cost [1.00] (the main bridge part inclusive)	
	Overall evaluation	・There is not much difference in economic efficiency among the two Plans. ・The Plan requires a larger number of types of works and thus is disadvantageous in terms of workability. ・The inundated part requires a larger number of bearing shoes and elastic joints, so the Plan is disadvantageous in terms of structure, comfort to users and maintenance .	○
Plan 2: PC simply box girder bridge + extradosed bridge (continuous structure)   Cross-section view of PC box girder bridge  Cross-section view of extradosed bridge	Structural characteristics	・PC simply box girder bridge in the inundated part is a PC box girder type to be constructed with general falsework and has no particular problem with its structure. ・PC simply box girder bridge and extradoses bridge are continuously jointed. Thus, it is advantageous in terms of seismicity and comfort to users.	
	Workability	・It requires the exactly the same work items as falsework among side spans of the main bridge part, requiring a smaller number of work items and construction machines. Thus it is advantageous in terms of workability. ・The construction work can be conducted simultaneously with that for the main bridge part, so the overall construction schedule will be the same as that of Plan 1.	
	Maintenance	・Box girder is a concrete bridge, so the bridge girder requires no maintenance work. ・The inundated part requires a smaller number of bearing shoes and elastic joints, so the Plan is superior to Plan 1.	
	Characteristics of the river	・Box girder bridge is located in the inundated part and thus is not considerably affected by the river.	
	Economic efficiency	・The superstructure in the inundated part must be higher, but since the number of abutments is smaller by one, this is more or less the same as Plan 1. ・Ratio of the estimated construction cost [1.00] (the main bridge part inclusive)	
	Overall evaluation	・There is not much difference in economic efficiency among the two Plans. ・The Plan requires a small number of types of works and thus is advantageous in terms of workability. ・The inundated part requires a smaller number of bearing shoes and elastic joints, so the Plan is advantageous in terms of structure, comfort to users and maintenance.	◎

(5) Consideration of substructure and foundation types

1) Consideration of location of the foundation leveling work

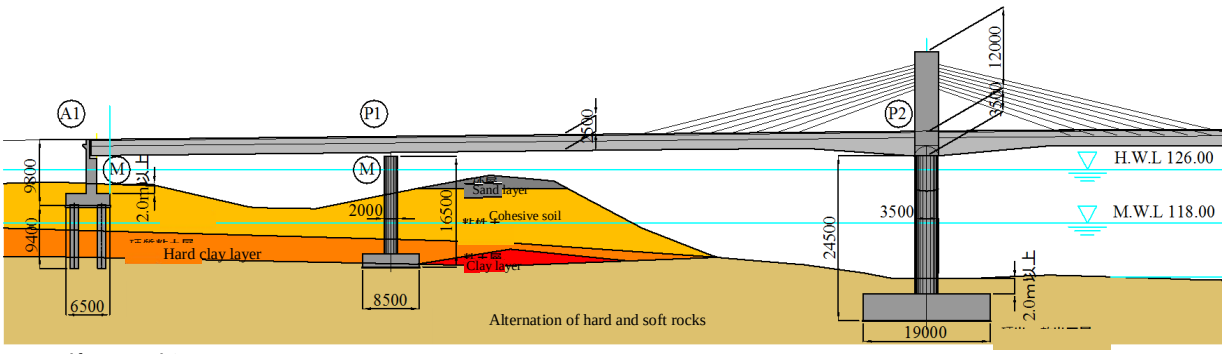
Figure 2-2-18 shows the relations between substructures and strata. The location of leveling work for the foundation has been set out in light of the relations with the strata and river

- Abutment A1: If spread foundation is adopted with the base rock layer as support layer, the pier height will exceed the maximum applicable height of reverse T-style abutments. Thus, pile foundation has been adopted to enable to use reverse T-style abutments. For the location of the foundation leveling work, earth covering of 2.0m or higher has been secured from the surrounding ground.
- Pier P1: The base rock layer will be used as support layer and sufficient earth covering has been secured.
- Pier P2: The pier is located on the stable base rock layer on the riverbed, and the center line of the river stream (the deepest riverbed) is highly unlikely to move near the location of the pier because of the shape of the winding river. Thus, irrespective of the location of the deepest riverbed, earth covering of 2.0m or higher has been secured from the riverbed near the pier site.
- Pier P3: The pier is located on the stable base rock layer on the riverbed. Earth covering of 0.5m or higher has been secured as room for placement of protection concrete from the neighboring latest riverbed.
- Abutment A2: The abutment is located on the rock slope. According to the Figure 2-2-17, the location of the foundation leveling work has been set at a location where sufficient front clearance can be secured.

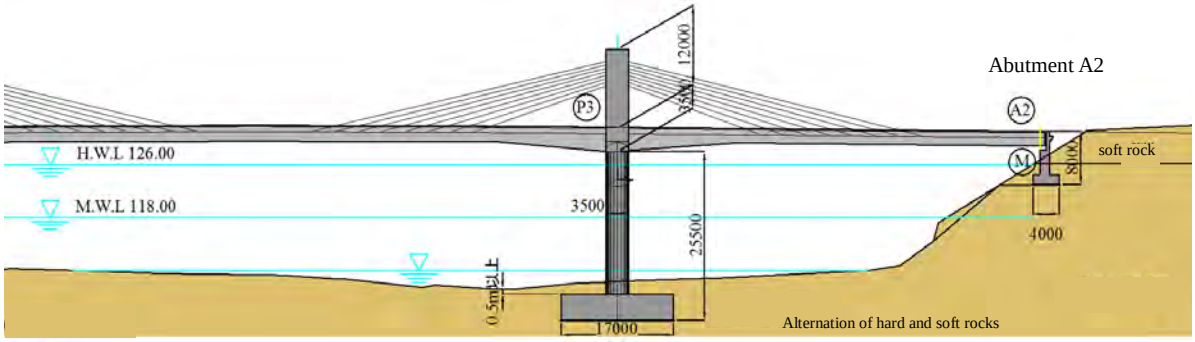


(b) Case where support layer is soft rock

Figure 2-2-17 Location of leveling work for direct foundation on slop



Abutment A1 Pier P1 Pier P2



Abutment A2

Pier P3

Figure 2-2-18 Relation of substructures and strata

2) Selection of the substructure types

The substructure types will be determined in reference to Table 2-2-13, the substructure type selection table. For the abutments, since the height falls under the range of 8.0 – 10.0m, reverse T-style has been selected. The piers are all to be placed in the river, so elliptical type has been selected that has only small impact on the river flow.

Table 2-2-13 Substructure type selection table

Bridge part	Structure type	Applicable height (m) 10 20 30	Characteristics
Abutment	1.Gravity type		With shallow support ground, the gravity type is suitable for direct foundation.
	2.Reverse T-style		Used in many bridges. Suitable for direct foundation/ pile foundation.
	3.Buttressed type		Suitable for tall abutments. Few materials are used for this type, but the lead time is long.
	4.Box type		Designed for tall abutments. The lead time is slightly long.
Pier	1.Column type		Low piers. Suitable for stringent intersection conditions and installation in a river.
	2.Rigid frame type		Relatively tall piers. Suitable for wide bridges. Their installation in a river may hinder water flow in time of flooding.
	3.Pile bent type		While they are the most cost efficient piers, they are not suitable for bridges with high horizontal force. Their installation in a river may hinder water flow in times of flooding.
	4.Elliptical type		Tall bridge piers. Suitable for bridges with high external force.

3) Selection of the foundation types

Pile foundation will be applied to Abutment A1 because the support layer is deep. Table 2-2-14 shows that cast in-situ pile foundation (all casing) is desirable, but since the piling work needs penetration to soft and hard rocks, a revolving all casing type has been adopted.

Spread foundation has been adapted to substructures for the bridge parts other than Abutment A1, since it is applicable.

Table 2-2-14 Foundation type selection table

Selection requirements \ Foundation types			Direct foundation	Cast pile foundation			Inner excavation pile foundation						Cast in-situ pile foundaiton				Caisson foundation		Steel pipe sheet pile foundation	**underground continuous wall foundation**
							PHC pile			Steel pipe pile										
				RC pile	PHC pile	Steel pipe pile	Final impact driving method	Blast agitation	Concrete impact	Final impact driving method	Blast agitation	Concrete impact	All casing	Reverse	Earth drill	Chicago board	Pneumatic	Open		
Ground requirements	Below support layer	Soft ground in the interlayer	△	○	○	○	○	○	○	○	○	○	○	○	○	×	○	○	○	○
		An extremely hard layer inside the inter layer	○	×	△	△	○	○	○	○	○	○	△	○	△	○	○	△	△	○
		Gravel in the interlayer: Gravel size 5 cm or below	○	△	△	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
		Gravel in the interlayer: Gravel size 5 cm～10 cm	○	×	△	△	△	△	△	△	△	△	○	○	△	○	○	○	△	○
		Gravel in the interlayer: Gravel size 10 cm～50 cm	○	×	×	×	×	×	×	×	×	×	△	×	×	○	○	△	×	△
		The layer has liquefiable ground	△	△	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	Conditions of the support layer	Support layer depth: Below 5 m	○	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
		Support layer depth: 5～15 m	△	○	○	○	○	○	○	○	○	○	○	△	○	○	○	○	△	△
		Support layer depth: 15～25 m	×	△	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
		Support layer depth: 25～40 m	×	×	○	○	○	○	○	○	○	○	○	○	△	△	○	○	○	○
		Support layer depth: 40～60 m	×	×	△	○	△	△	△	○	○	○	△	○	×	×	△	○	○	○
		Support layer depth: 60 m or above	×	×	×	△	×	×	×	×	×	×	×	△	×	×	×	△	△	△
		Soil properties of the support layer: Cohesivvve soil (20 N)	○	○	○	○	○	×	△	○	×	△	○	○	○	○	○	○	○	○
		Soil properties of the support layer: Sand/ gravel (30 N)	○	○	○	○	○	○	×	○	○	×	○	○	○	○	○	○	○	○
		High gradient (30º or above)	○	×	△	○	△	△	△	○	○	○	○	△	△	○	○	△	△	△
		The surface of the support layer is severely uneven	○	△	△	○	△	△	△	○	△	△	○	○	○	○	○	△	△	○
	Groundwater	Groundwater level is close to the ground surface	△	○	○	○	○	○	○	○	○	○	○	○	△	△	○	○	○	○
		Significant amount of spring water	△	○	○	○	○	○	○	○	○	○	○	○	△	×	○	○	○	△
		Artesian groundwater 2 m above the ground surface	×	○	○	○	×	×	×	×	×	×	×	×	×	×	△	△	○	×
		Groundwater velocity is 3m/ min or above	×	○	○	○	○	×	×	○	×	×	×	×	×	×	○	△	○	×
Structural properties	Load size	Low vertical load (span length 20m or below)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	×	△	×	×
		Moderate vertical load (span length 20m to 50m)	○	△	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
		High vertical load (span length 50m)	○	×	△	○	△	△	△	○	○	○	○	○	△	○	○	○	○	○
		Horizontal load is lower than vertical load	○	○	○	○	○	○	○	○	○	○	○	○	○	○	△	△	△	△
		Horizontal load is higher than vertical load	○	×	△	○	△	△	△	○	○	○	○	○	○	○	○	○	○	○
	Support type	Support pile		○	○	○	○	○	○	○	○	○	○	○	○	○				
		Friction pile		○	○								○	○	○					
Construction requirements	Construction on water	Water depth below 5m	○	○	○	○	△	△	△	△	△	△	×	○	△	×	△	△	○	×
		Water depth 5m or above	×	△	△	○	△	△	△	△	△	△	×	△	×	×	△	△	○	×
	Limited work space		○	△	△	△	△	△	△	△	△	△	△	△	△	○	△	△	×	△
	Batter pile construction			△	○	○	×	×	×	△	△	△	△	×	×	×				
	Effects of toxic gas		△	○	○	○	○	○	○	○	○	○	○	○	○	×	×	○	○	○
	Surrounding environment	Oscillation noise measures	○	×	×	×	△	○	○	△	○	○	△	○	○	○	○	○	Δ	○
		Effects on adjacent structures	○	×	×	△	△	○	○	△	○	○	○	○	○	△	△	△	△	○

(6) Consideration of the access roads

1) Pavement design

i) **Outline**

Investigations of the design high water level and structural height have found that the vertical alignment of the part of the road intervals in the front and back of Sekong Bridge will be affected by the bridge construction work and will need to be altered. Thus, this grant aid cooperation project will cover the civil engineering and pavement works for those parts as its component. This section examines the pavement components to be applied to the parts.

ii) **Setting of the pavement design period**

The pavement design period is a period when the pavement concerned is in an appropriate condition without any reconstruction work after the pavement work (except routine maintenance work, overlay, etc.). In this Project, the pavement design period will be set at 15 years, equivalent to the conditions of payment design charts in the relevant manual in Laos.

iii) **Consideration of traffic volume for pavement design**

a) Estimation of future traffic volume

Currently, there is no river-crossing facility in the bridge construction zone, but the ferry service is available. To estimating the future traffic volume, it is necessary to estimate it with the current volume as a basis and the potential traffic that can be generated by the opening of Sekong Bridge, independently.

b) Base traffic volume

The traffic volume of the ferry landing place near the bridge site measured under the “information gathering and confirmation survey concerning economic development in the southern region of Laos” will be used as the base traffic volume

Table 2-2-15 Traffic volume at ferry landing place on National Road No. 16B (2012)

Vehicle type		Actual no. (vehicle/day)	Mixing ratio
Automobiles		77	63.6%
Buses		0	0.0%
Trucks	2-axels	20	16.5%
Trucks	3- or more axels	20	16.5%
Trailers		4	3.3%
Total		121	
(Ref. motorbikes)		241	

Source: “Information gathering and confirmation survey concerning economic development in the southern region of Laos”

The growth rate of the base traffic volume will be calculated in accordance with the estimates made in the survey.

Table 2-2-16 Estimates of base traffic volume in future

Year	PCU/day	Growth rate
2012	240	
2015	320	1.333
2020	456	1.425
2025	663	1.454

Source: the Study Team

According to the conditions given above, the traffic volume in each year can be calculated by the following formulae. For the volumes in and after 2025, the estimated GDP growth rate will be used as the growth rate of the traffic volume.

Table 2-2-17 Growth rate of the base traffic volume in each year

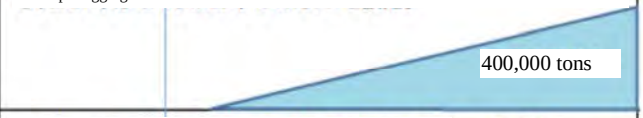
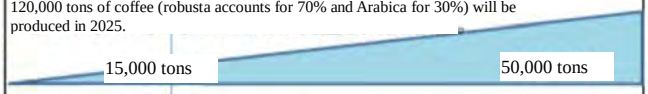
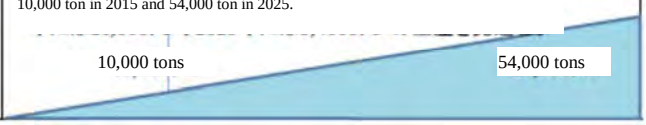
Period	Growth rate in each year	Remark
2012 – 2015	1.333^(1/3)=1.101	
2015 - 2020	1.425^(1/5)=1.073	
2020 - 2025	1.454^(1/5)=1.078	
2025 -	1.065	GDP growth rate

Source: the Study Team

c) Development traffic volume

The development traffic volume will be calculated for various scenarios of production plans for each type of development, and added to the base traffic volume calculated above.

Table 2-2-18 Development scenarios in the area along National Road No. 16B

	Current state and future prospect	2012 2015 2025
Bauxite	A JV of Rio Tinto and Mitsui Co has acquired concession of 484km". It conducts excavation work along NR16B. It takes at least 5 years to start production.	The World Bank estimates that the country has the production capacity of 1 million ton/year. The production is assumed to be zero in 2015 and 400,000 tons in 2025 in light of the situation of test-pit digging. 
Coffee	Coffee plantation of 400ha in Dak Cheung District. Bolaven Plateau (70,000ha) is said to be the most suitable for coffee plantation, which, together with production volume, is gradually expanding.	Land suitable for coffee production has been gradually developed (50,000ha or more). It is assumed that 15,000 tons of robusta will be produced in 2015, and that 120,000 tons of coffee (robusta accounts for 70% and Arabica for 30%) will be produced in 2025. 
Vegetables	Currently, vegetables are not grown under large-scale contract farming. But new cultivation on Bolaven Plateau is expected to reach the limit in future and vegetable business to gradually start.	Vegetable production is gradually expanding. Assuming that the expansion rate of the production on the plateau will continue, the production volume is assumed to be 10,000 ton in 2015 and 54,000 ton in 2025. 

Source: Report on "Information gathering and confirmation survey concerning economic development in the southern region of Laos"

Based on the development scenario given above, the traffic volume of Sekong Bridge can be calculated as follows.

Table 2-2-19 Development demand forecast

	2012	2015	2025	Remarks
Development forecast along NR16B				
Bauxite (ton)			400,000	
Coffee (ton)		15,000	50,000	
Vegetables (ton)		10,000	54,000	
Traffic volume increased due to development (vehicles/year)				
Bauxite (vehicles/year)			26,667	30 tons per tank truck
Coffee (vehicles/year)		1,500	5,000	20 tons per truck
Vegetables (vehicles/year)		1,000	5,400	20 tons per truck
Traffic volume increased due to development (PCU/year)				
Bauxite (PCU/year)			66,600	2.5 PCU
Coffee (PCU/year)		3,000	10,000	2.0 PCU
Vegetables (PCU/year)		2,000	10,800	2.0 PCU
Traffic volume of Sekong Bridge (PCU/year)				
Bauxite (PCU/year)			66,607	100% to Thailand
Coffee (PCU/year)		2,700	9,000	90% to Thailand
Vegetables (PCU/year)		1,800	9,720	90% to Thailand
Traffic volume of Sekong Bridge (PCU/day)				
Bauxite (PCU/day)			222	300days/year in operation
Coffee (PCU/day)		30	100	3 months from Dec. to Feb. in operation
Vegetables (PCU/day)		10	54	6 months from Mar. to Aug. in operation
Traffic volume of Sekong Bridge (high season: PCU/day)	189	349	945	
Traffic volume of Sekong Bridge (low season: PCU/day)	189	319	885	

Source: Report on “Information gathering and confirmation survey concerning economic development in the southern region of Laos”

These development traffic volumes are on a PCU-converted basis, the actual number of vehicles can be counted as follows.

Table 2-2-20 Calculation of development traffic volume in terms of the number of vehicles

	2015	2025	Remarks
Bauxite	-	222/2.5 =89 (vehicles/day)	Production starts in 2017 and 300days/year in operation
Coffee	30/2.0 =15 (vehicles/day)	100/2.0 =50 (vehicles/day)	3 months from Dec. to Feb.
Vegetables	10/2.0 = 5 (vehicles/day)	54/2.0 =27 (vehicles/day)	6 months from Mar. to Aug. in operation

Source: the Study Team

d) Future forecast of the entire traffic volume

In light of these conditions, the traffic volume of Sekong Bridge each year can be calculated as shown in the following table.

Table 2-2-21 Future forecast of entire traffic volume

Sekong bridge	Year	Traffic volume (vehicles/day)							Annual growth rate				Remarks
		Base traffic volume				Development traffic volume			Base				
		Small vehicles	2-axis trucks	3- or more axis trucks	trailers	Coffee	Vegetables	Bauxite		Coffee	Vegetables	Bauxite	
	2012	77	20	20	4				1.101				Results of traffic
B/D	2013	85	22	22	4				1.101				
	2014	93	24	24	5				1.101				
	2015	103	27	27	5	15	5		1.073	1.128	1.184		
	2016	110	29	29	6	17	6		1.073	1.128	1.184		
Service starts	2017	118	31	31	6	19	7	1	1.073	1.128	1.184	1.753	
1 year later	2018	127	33	33	7	22	8	2	1.073	1.128	1.184	1.753	
2 years later	2019	136	35	35	7	24	10	3	1.073	1.128	1.184	1.753	
3 years later	2020	146	38	38	8	27	12	5	1.078	1.128	1.184	1.753	
4 years later	2021	158	41	41	8	31	14	9	1.078	1.128	1.184	1.753	
5 years later	2022	170	44	44	9	35	16	17	1.078	1.128	1.184	1.753	
6 years later	2023	183	48	48	10	39	19	29	1.078	1.128	1.184	1.753	
7 years later	2024	197	51	51	10	44	23	51	1.078	1.128	1.184	1.753	
8 years later	2025	213	55	55	11	50	27	89	1.065	←	←	←	
9 years later	2026	227	59	59	12	53	29	95	1.065	←	←	←	
10 years later	2027	241	63	63	13	57	31	101	1.065	←	←	←	
11 years later	2028	257	67	67	13	60	33	108	1.065	←	←	←	
12 years later	2029	274	71	71	14	64	35	114	1.065	←	←	←	
13 years later	2030	292	76	76	15	69	37	122	1.065	←	←	←	
14 years later	2031	310	81	81	16	73	39	130	1.065	←	←	←	
15 years later	2032	331	86	86	17	78	42	138	1.065	←	←	←	

iv) **Calculation of pavement design traffic volume**

The accumulated traffic volume during the pavement design period will be calculated in light of the forecast of the future traffic volume above.

As shown below, the road is available for a certain period in the year, which affects the development traffic volume. Accordingly, the cumulative traffic volume for 15 years (2018-2032) will be calculated.

- Base traffic volume: Daily traffic volume in each year x 365 days
- Coffee: Daily traffic volume in each year x 365/4 days (3 months per year)
- Vegetables: Daily traffic volume in each year x 365/2 days (6 months per year)
- Bauxite: Daily traffic volume in each year x 365 days

Since the traffic volume for one way is used for the pavement design, the rate for both ways is set at 55% to calculate the traffic volume per one direction. At the same time, since the impact of smaller vehicles on the road surface is less, compact vehicles will be ignored in calculation.

Table 2-2-22 Calculation of pavement design traffic volume, by vehicle type (cumulative number of vehicles on one direction)

Year	Traffic volume (vehicles/day)						
	Base traffic volume				Development traffic volume		
	Small vehicles	2-axis trucks	3- or more axis trucks	Trailers	Coffee	Vegetables	Bauxite
2018	127	33	33	7	22	8	2
2019	136	35	35	7	24	10	3
2020	146	38	38	8	27	12	5
2021	158	41	41	8	31	14	9
2022	170	44	44	9	35	16	17
2023	183	48	48	10	39	19	29
2024	197	51	51	10	44	23	51
2025	213	55	55	11	50	27	89
2026	227	59	59	12	53	29	95
2027	241	63	63	13	57	31	101
2028	257	67	67	13	60	33	108
2029	274	71	71	14	64	35	114
2030	292	76	76	15	69	37	122
2031	310	81	81	16	73	39	130
2032	331	86	86	17	78	42	138
Cumulative traffic volume of 15 years		170,064	170,064	34,013	16,459	37,547	167,108

Source: the Study Team

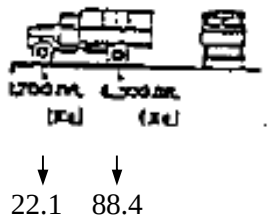
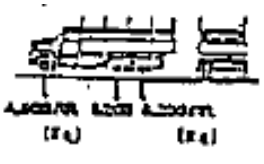
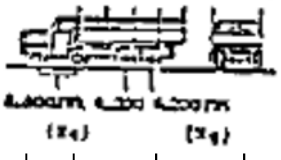
v) **Calculation of ESAs**

a) Axle load of passing vehicles

In general, actual axle loads often exceed the regulation values in developing countries. Thus, an axle load exceeding 30% of the rated value in a raining area stipulated in the road design manual of Laos will be adopted as the axle load of passing vehicles for designing

Moreover, vehicles for the traffic volume forecasts have been set out as follows.

Table 2-2-23 Design axle load for each vehicle type

Vehicle type	Design vehicle	Rated axle load *0.3 (kN)
2-axis trucks	8.5t (1.7+6.8)	 22.1 88.4
3- or more axis trucks, coffee and vegetables	21.0t (4.6+8.2+8.2)	 59.8 106.6 106.6
Trailers and bauxite	25.6t (4.6+4.6+8.2+8.2)	 59.8 59.8 106.6 106.6

Sources: Road Design Manual of Laos and the Study Team

b) Calculation of EF (equivalent axle load factor) per design vehicle

In pavement design, EF (80kN equivalent axle load factor) is used as an indicator expressing energy affecting the pavement body.

The EF value can be calculated according to the following formula:

EF = (Ls/80)^4.5

EF-values of each axle of design vehicles have been calculated, and then the integrated EF-value per vehicle obtained.

Table 2-2-24 Calculation of EF-value for each design vehicle

		1-axis	2-axis	3-axis	4-axis	
8.5t vehicle	Rated axle load	17.0	68.0			
	Rainy season	22.1	88.4			
	EF	0.003	1.576			ΣEF = 1.57
21.0t vehicle	Rated axle load	46.0	82.0	82.0		
	Rainy season	59.8	106.6	106.6		
	EF	0.270	3.639	3.639		ΣEF = 7.55
25.6t vehicle	Rated axle load	46.0	46.0	82.0	82.0	
	Rainy season	59.8	59.8	106.6	106.6	
	EF	0.270	0.270	3.639	6.639	ΣEF = 7.82

Source: the Study Team

c) Calculation of ESAs (equivalent standard axles) in design period

ESAs (cumulative 80kN equivalent axles) can be calculated by multiplying the EF value per vehicle for each design vehicle by the cumulative traffic volume in the pavement design period.

Table 2-2-25 Calculation of ESAs

Vehicle type	Cumulative traffic volume in pavement design period	Design vehicle	Cumulative traffic volume per design vehicle	EF	EF
2-axis trucks	170,064	8.5t	170,064	1.57	276,048
3- or more axis trucks,	170,064	21t	244,069	7.55	1,842,303
coffee	36,459				
vegetables	37,547				
bauxite	34,013	26.5t	201,120	7.82	1,572,400
Trailers	167,108				
			Total	ESAs =	3,681,751

Source: the Study Team

Accordingly, the ESAs value of the pavement design near Sekong Bridge can be calculated as 3.7*10^6.

vi) **Roadbed conditions**

As the roadbed condition, CBR will be set at 8% according to the roadbed CBR adopted for the roads under construction in the front and back of the bridge site and the results of a CBR test conducted by the Study Team.

vii)**Calculation of structural index (SN) in AASHTO design manual**

The structural index (SN) with which the pavement body must satisfy will be calculated according to the conditions given above. For the calculation, a basic nomograph presented in the AASHTO design manual will be used.

The conditions of the calculations are as follows:

a) Confidence

Arterial road in rural area 75-95

Since the bridge and access roads are expected to serve as an international arterial road in future and thus need to have highly reliable pavement structures, value 90 will be adopted.

b) Serviceability index

Initial serviceability index: p0 4.2 AASHO road test

Terminal serviceability index: p1 2.5 Major road

⊿PSI ＝ 4.2 - 2.5 ＝ 1.7

c) Effective resilient coefficient of subsoil

CBR＝8%

MR（psi）＝1500×CBR＝1500×8＝12,000 (general formula)

d) Standard deviation

Asphalt pavement: 0.4 - 0.5: median, 0.45, will be adopted

e) Structural index

The structural index for the pavement design (SN) will be calculated according to the nomograph in the following page. As a result,

SN = 3.6 (when CBR = 8%).

The pavement structure with this SN will be needed.

Calculation of SN: Sekong Bridge

Basic nomograph:

$$\log_{10}W_{18} = Z_R*S_0 + 9.36*\log_{10}(SN+1) - 0.20 + \frac{\log_{10}(\Delta PSI/(4.2-1.5))}{0.40 + 1094/(SN+1)^{5.19}} + 2.32*\log_{10}M_R - 8.07$$

Conditions	Contents		Unit
	W_{18}	Estimated future traffic volume in the service period	18kip/time
	R	Probability of confidence	%
	Z_R		
	S_0	Overall standard deviation	
	ΔPSI	Drop in serviceability index used for designing	
	M_R	Effective resilient coefficient of subsoil 1500*CBR 8%	psi

$\log_{10}W_{18}$	=	6.57
Z_R*S_0	=	-0.5769
$\log_{10}$（ΔPSI/（4.2-1.5））	=	-0.20
$2.32*\log_{10}M_R$	=	9.46

Right-hand side	5.95	$8.27 - Z_R*S_0 - 2.32*\log_{10}M_R + \log_{10}W_{18}$
$9.36\log_{10}(SN+1)$	6.203	
$\log_{10}(\Delta PSI/2.7)\ (SN+1)^{5.19}$	-553.000	The values are compared
$0.4(SN+1)^{5.19}+1094$	2,194.964	
Left-hand side	5.95	$9.36\log_{10}(SN+1) + \log_{10}(\Delta PSI/2.7)*(SN+1)^{5.19}/(0.4(SN+1)^{5.19}+1094)$
SN	**3.6**	
	Trial	

Source: the Study Team

viii) **Pavement structure design**

a) Layer coefficient

The layer coefficient for each pavement type (material) will be set as follows:

- Asphalt pavement: 0.4

- Base course (particle size-adjusted ballast): a2=0.14 (according to resilient coefficient of 33,200psi, Figure 2.6)

According to the thickness of asphalt mixture of 4 (in) and the resilient coefficient of subsoil of 15,000 or more,

θ=20, K1=3000～8000 and median of k2=0.5～0.7,

Resilient coefficient = $5500*20^{0.6}$ = 33,187.

- Subbase course (crusher-run): a3=0.08 (according to resilient coefficient of 10,300psi, Figure 2.7)

According to the thickness of asphalt mixture of 4 (in),

θ=7.5, K1=1500～6000 and median of k2=0.4～0.6,

Resilient coefficient = $3750*7.5^{0.5}$ = 10,269.

b) Consideration of paving thickness

・ Case where CBR=8% (minimum)

The minimum thickness of pavement

Surface layer + base layer (layer coefficient: 0.40): 4 inches or more => 10cm
Base course (layer coefficient: 0.14): 6 inches or more => 15cm
Subbase course (layer coefficient: 0.08): 6 inches or more => Thickness (D) satisfying the structural index will be adopted.
<Drainage coefficient of 1.0 will be adopted>

SN ＝ 10/2.54×0.40 + 15/2.54×0.14 + D/2.54 × 0.08 > 3.6
That is, the subbase course (crusher-run) of D=38.1cm or more is needed.

However, there is a considerable gap in thickness between the base course of 15cm and subbase course of 40cm. To make a balance between the courses, a case with the base course of 20cm will be examined.

Case where CBR=85 (improved)

The minimum thickness of pavement

Surface layer + base layer (layer coefficient: 0.40): 4 inches or more => 10cm
Base course (layer coefficient: 0.14): 6 inches or more => 20cm
Subbase course (layer coefficient: 0.08): 6 inches or more => Thickness (D) satisfying the structural index will be adopted.
<Drainage coefficient of 1.0 will be adopted>

SN ＝ 10/2.54×0.40 + 20/2.54×0.14 + D/2.54 × 0.08 > 3.6
That is, a subbase course (crusher-run) of D=29.3cm or more is needed.

c) Proposal of the pavement components in AASHTO design manual

According to the consideration made above, the Study Team proposes the following pavement components securing SN=3.6 or more.

<Pavement components>

Surface layer + base layer	10cm	Asphalt mixture
Base course	20cm	particle size-adjusted ballast
Subbase course	30cm	Crusher-run
Total	60cm	

SN＝10/2.54×0.4 + 20/2.54×0.14 + 30/2.54×0.08
＝3.622 ＞ 3.6･･･OK

(7) Outline of the facilities

In light of the consideration above, the facilities to be constructed under this Project can be summarized as in the following table.

Table 2-2-26 Outline of the facilities

Item			Types and dimensions
Bridge location			Place where National Road No.16B crosses Sekong River
Width	Bridge		Carriageway: 3.5m×2=7.0m; marginal strip: 0.5m×2=1.0m; and foot pavement: 1.5m×2=3.0m; a total of 11.0m (effective width) wheel guard: 0.4m×2=0.8m a total of 11.8m (total width)
	Access road		Carriageway: 3.5m×2=7.0m; and shoulder: 1.5m×2=3.0m; and soft shoulder: 0.5m×2=1.0m a total of 11.0m (total width)
Bridge type			Extradosed bridge + PC box girder bridge
Bridge length and spans			70.0m＋110.0m＋70.0m (bridge) + 50m (diameter lateralis)
Bridge surface pavement			Asphalt pavement (carriageway: 80mm)
Abutment A1 (on the side of Sekong city)		Type	Reverse T-style
		Height	9.8m
		Foundation	Cast in-situ pile foundation (φ1.2m、L=9.5m、n=8)
Abutment A2 (on the side of Dak Cheung district)		Type	Reverse T-style
		Height	8.0m
		Foundation	Spread foundation
Pier P1		Type	Elliptical type
		Height	H=16.5m
		Foundation	Spread foundation
Pier P2		Type	Elliptical type
		Height	H=24.5m
		Foundation	Spread foundation
Pier P3		Type	Elliptical type
		Height	H=25.5m
		Foundation	Spread foundation
Access roads		Length	Side of city of Sekong: 227m and side of Dak Cheung district: 300m, a total of 527m
		Pavement	Asphalt pavement (Surface layer: 50mm + base layer: 50mm = 100mm)
Revetment work		Right bank	Gabion construction method: 3,024m^2

2-2-3 Outline Design Drawings

Outline design drawings formulated according to the basic plan above will be provided in the following pages.

- Figure 2-2-19 General view of the entire bridge (1/3) to Figure 2-2-21 General view of the entire bridge (3/3)
- Figure 2-2-22 Plan view of access roads (1/2) to Figure 2-2-23 Plan view of access roads (2/2)
- Figure 2-2-24 Longitudinal section view of access roads
- Figure 2-2-25 Cross sectional view of access roads
- Figure 2-2-26 General view of box culvert

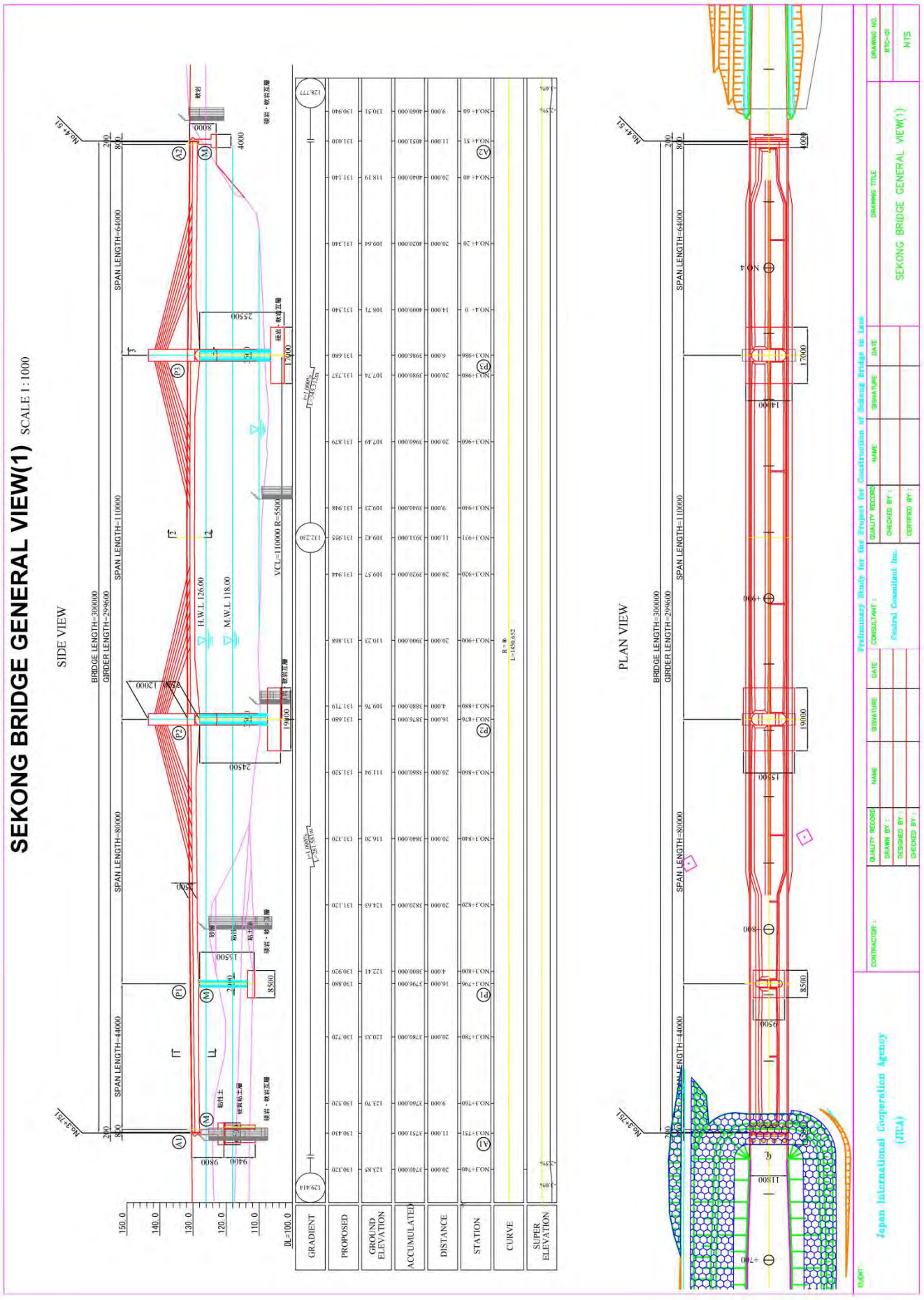


Figure 2-2-19 General view of the entire bridge (1/3)

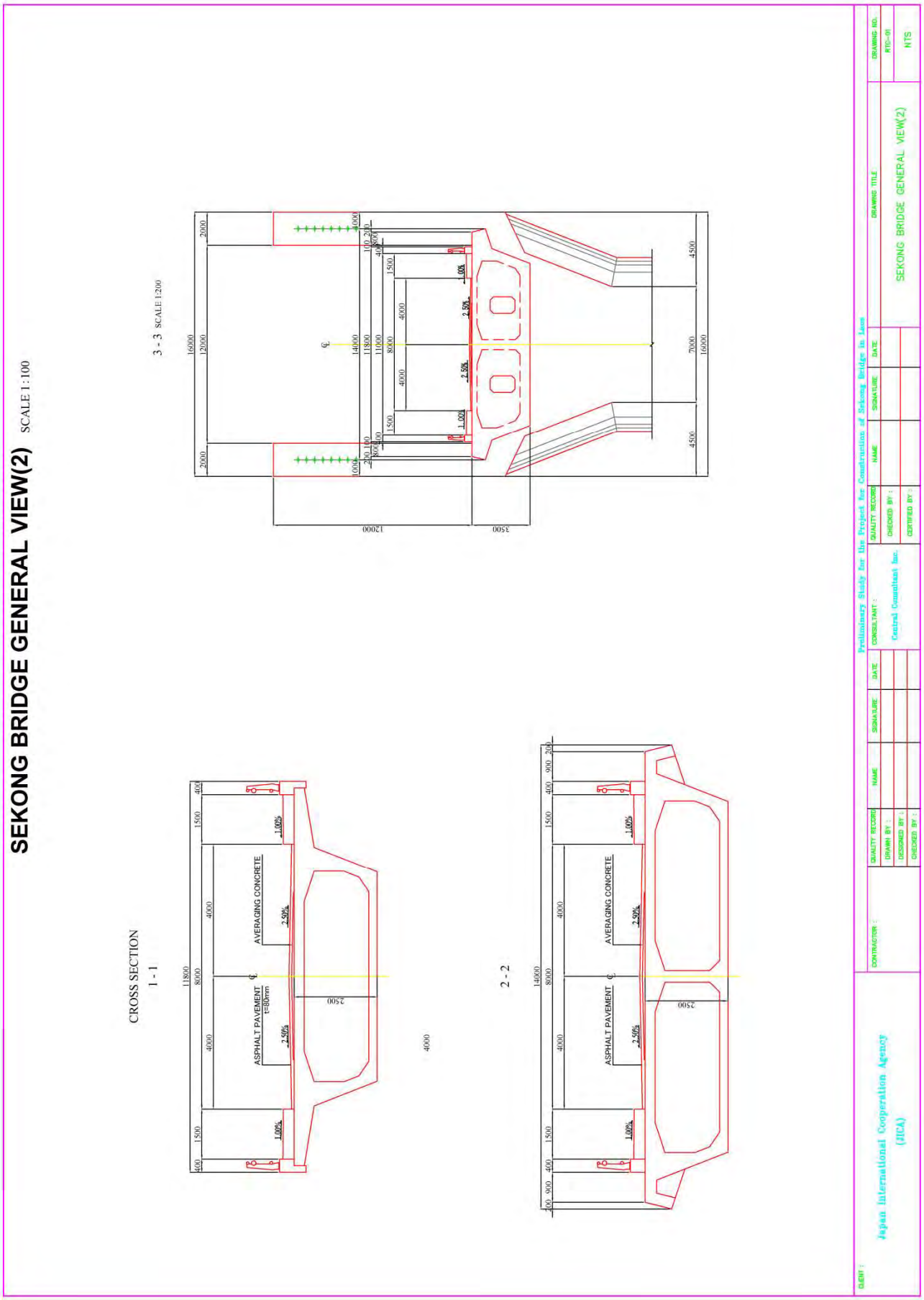


Figure 2-2-20 General view of the entire bridge (2/3)

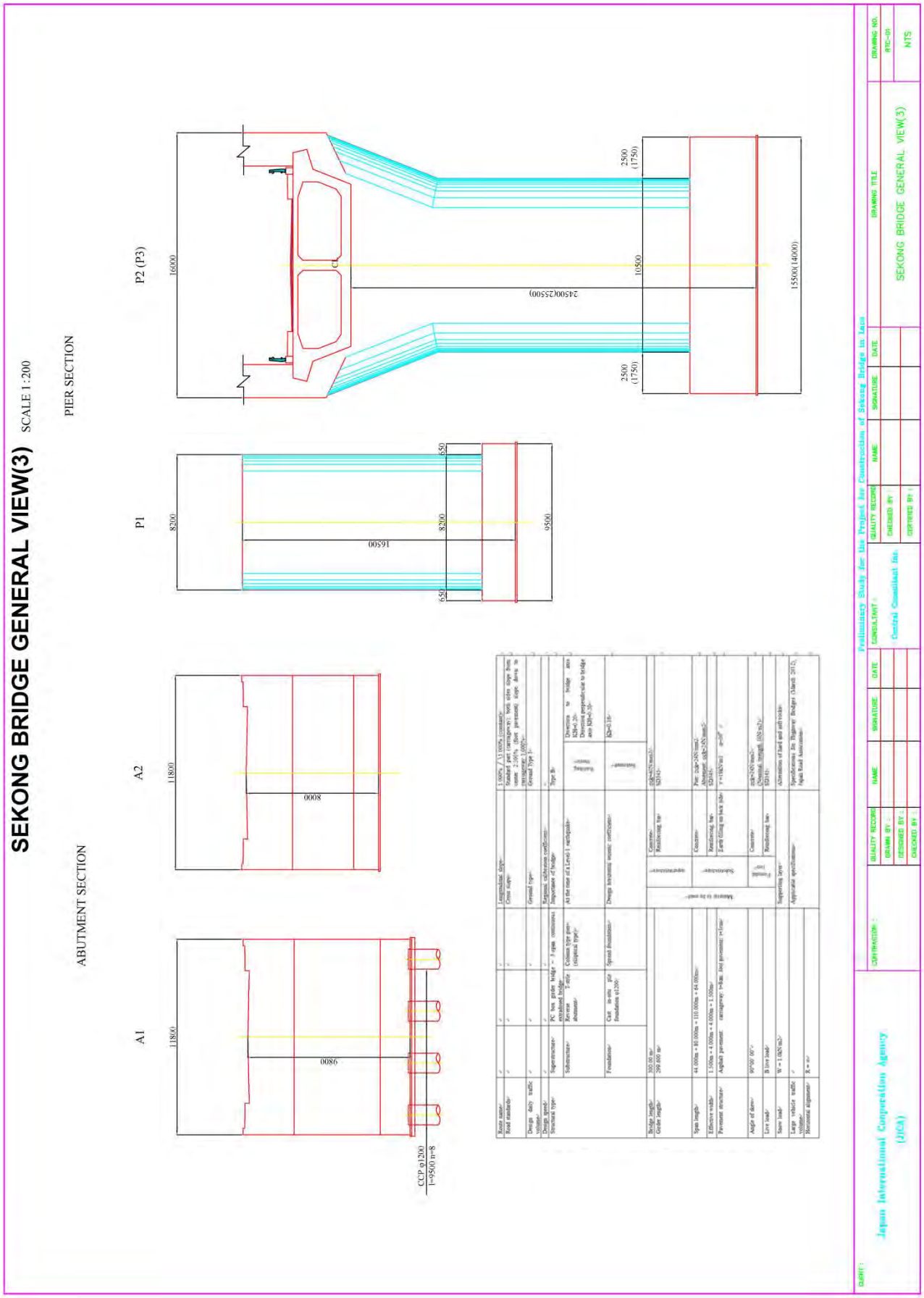


Figure 2-2-21 General view of the entire bridge (3/3)

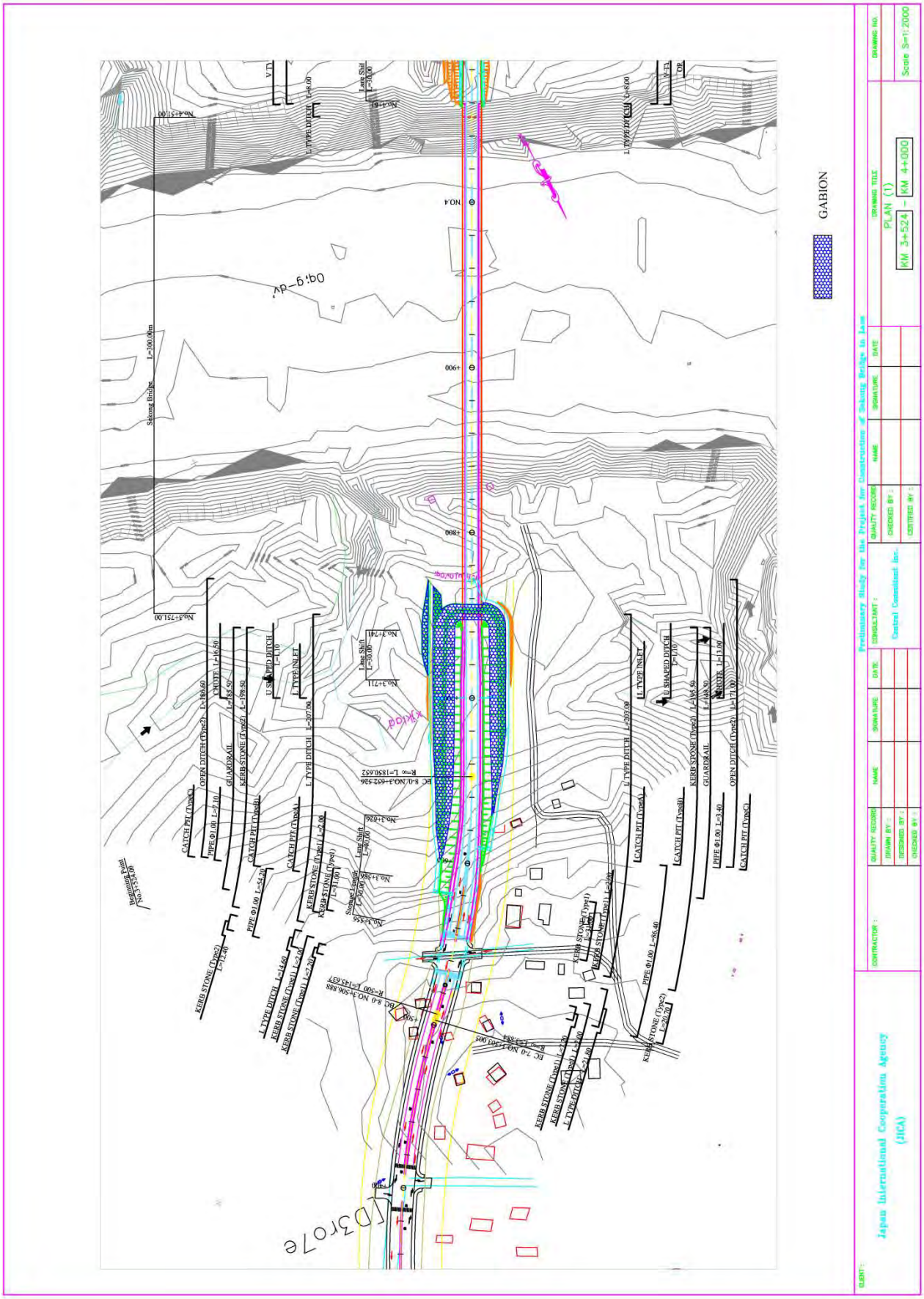


Figure 2-2-22 Plan view of access roads (1/2)

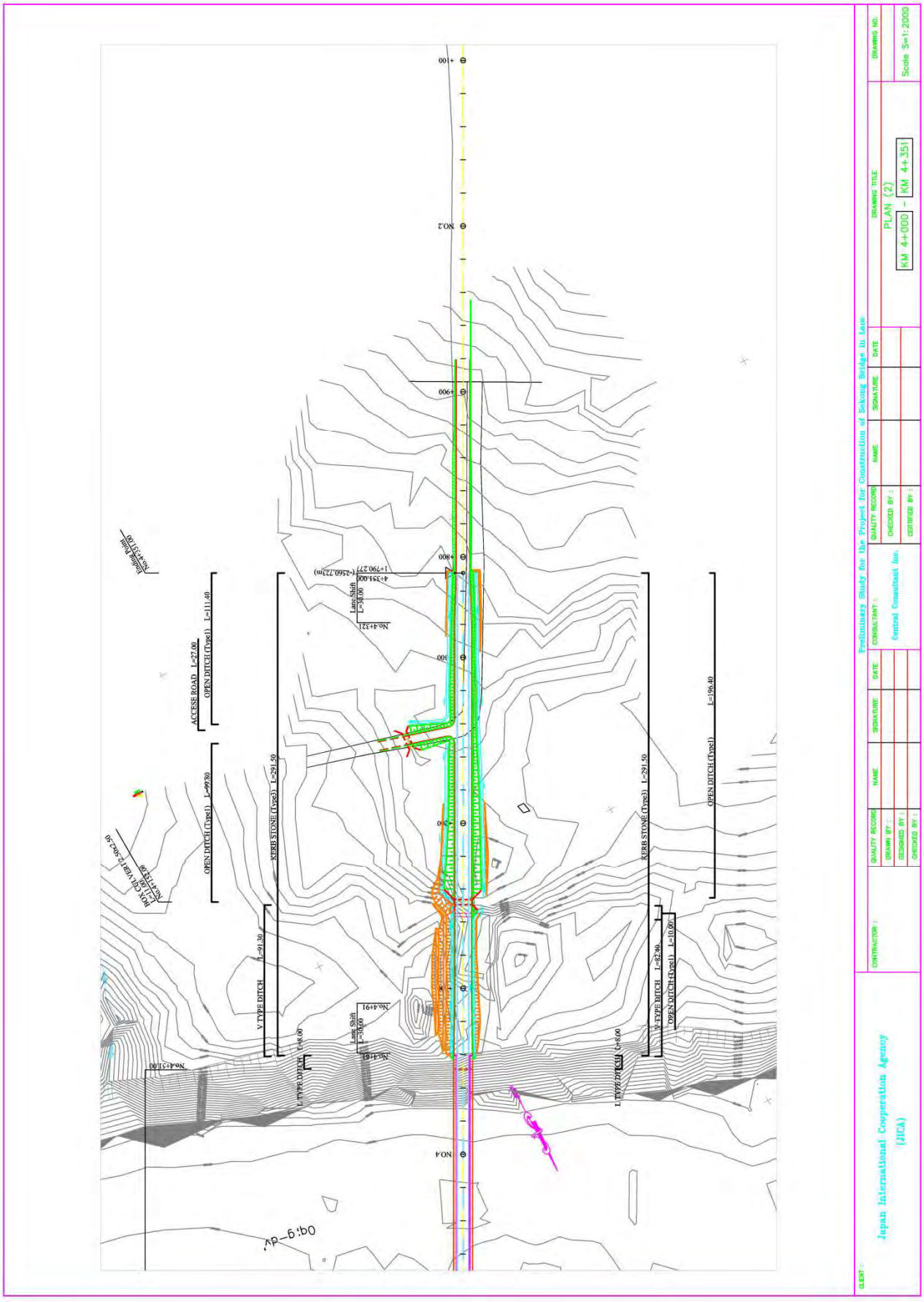


Figure 2-2-23 Plan view of access roads (2/2)

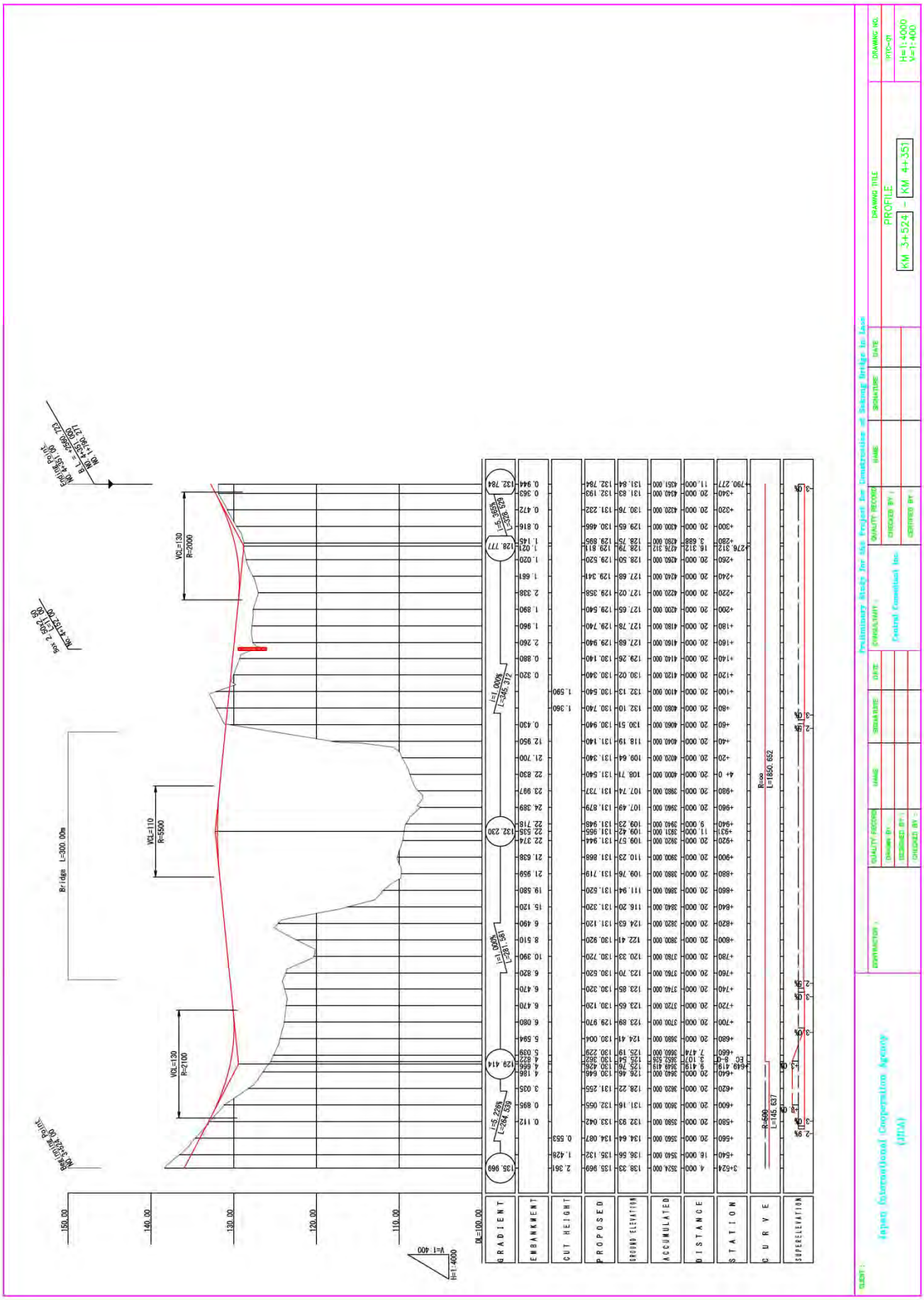


Figure 2-2-24 Longitudinal section view of access roads

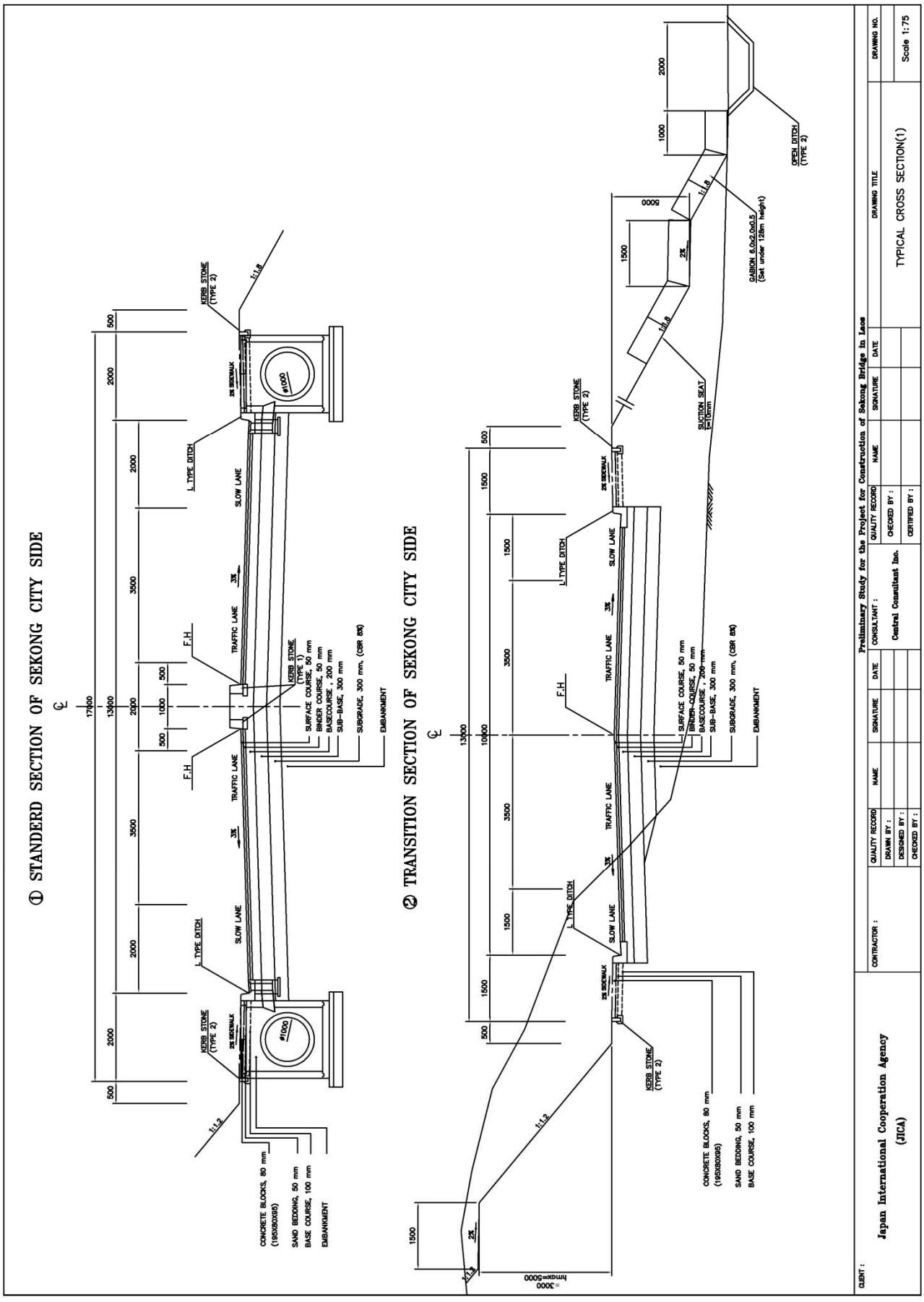


Figure 2-2-25 Cross sectional view of access roads

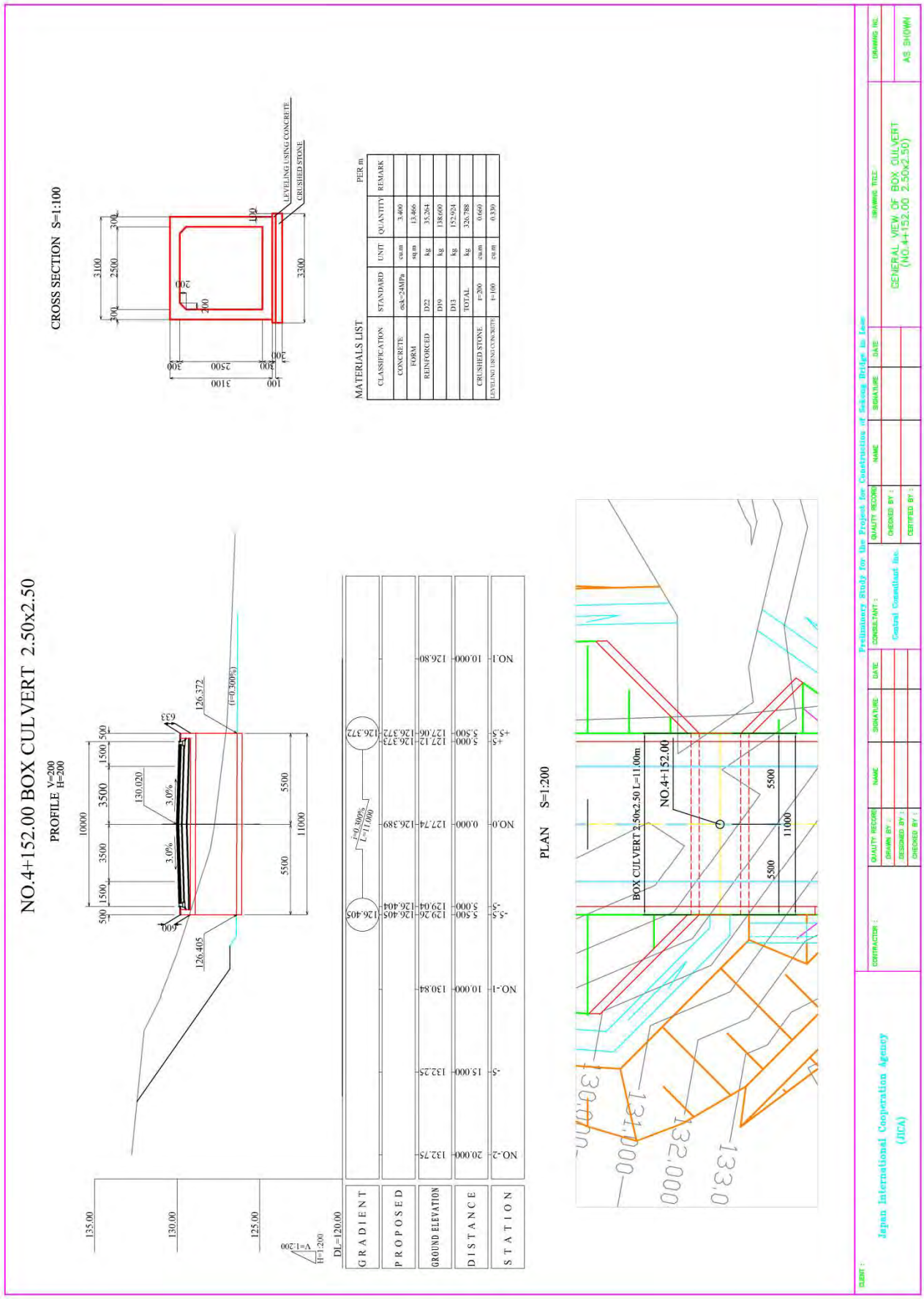


Figure 2-2-26 General view of box culvert

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

Assuming that this Project will be implemented within the framework of Japan's grant aid corporation, the following matters will be taken into account as the implementation policy.

(i) Local engineers, laborers, materials and equipment will be made maximum use of for implementation of this Project to contribute to vitalization of the regional economy, creation of job opportunities and promotion of technology transfer;

(ii) A request will be made to Laos to secure land (relocation of residential houses and land acquisition) necessary for the implementation of the Project prior to the commencement of the Project, with the expense to be borne by the Laos side;

(iii) A request will be made to Laos to exempt the parties concerned with the Project from any custom duties, domestic tax, value-added tax and other taxes in Laos in relation to the Project including procurement and import of materials and equipment for construction work;

(iv) A request will be made to Laos to facilitate the immigration ofparties concerned with the Project;

(v) The actual geological conditions will be confirmed at the time of implementing the foundation work, and the supporting soil for pile foundation will also confirmed. The construction work will be ensured with meticulous supervision.

(vi) Appropriate and reasonable construction methods will be adopted in light of rainfall and fluctuations of the water level. At the same time, a realistic and reliable construction plan will be formulated.

(vii) Proposals for the method, timing and operation of the maintenance work after the completion of the construction work will be presented. The Project also includes OJT of Lao engineers in charge of the maintenance and management of the outputs.

2-2-4-2 Important Notices on Construction Work

(1) Safety during the construction period

To ensure safety during the construction period, the parties concerned will chiefly take the following matters into consideration.

- The entrance for construction vehicles will be located at the crossing of National Roads Nos.16 and 16B. But since the traffic including motorbikes is heavy on National Road No. 16, an international arterial road, guards will be stationed at the entrance to prevent traffic accidents.
- The construction work will be conducted in the river, so supervisory and liaison systems concerning a rise of the river water will be established to avoid any flooding accidents and ensure safe work.

(2) Environmental conservation during the construction period

To conserve the environment during the construction period, the parties concerned will take the following matters into consideration.

- The generation of dust due to construction vehicles running will be restrained by water sprinkling, speed limit and other measures.
- Work in the early morning and late at night will be avoided in relation to noise and vibrations from construction machines.
- Reserve tanks, pumps and other devices will be prepared to take measures against river water contamination due to mud water effluent from the construction work in the river for substructures, etc.
- Turfs will be planted or other measures taken on the slopes of embankment.

(3) Compliance with the labor standards law

The contractors will comply with the existing construction-related laws and regulations in Laos, respect appropriate labor conditions and practices, prevent any dispute with workers and ensure safety.

(4) Maximum use of non-flood season

Laos has a climate of high temperature and heavy rain. The Sekong region has a rainy season in May to October, and the monthly precipitation is 200mm or more in July to September. The cost of waterproof elements for the foundation work for piers varies substantially depending on the season. Thus, it has been designed to conduct the foundation work in the non-flood season (from November to April). These conditions will be clearly stated in bidding documents so that every applicant for the bidding can fully understand, and instructions will be given to contractors to make maximum use of the non-flood season.

(5) Customs clearance

Since Laos is a landlocked country with no harbor facilities of its own, all construction materials and equipment to be procured in Japan and third countries will be delivered via Thailand and Vietnam. Thus, the construction schedule will be drawn up in full consideration of the time required for transport, unloading, customs clearance and other necessary procedures.

(6) Emphasis on quality control of concrete

The major work of the Project is to build substructures, that is, Abutments A1 and A2, and Piers P1, P2 and P3 on one hand, and, on the other, superstructures, that is, concrete girder and PC cables. In other words, the majority of the construction work is concrete work. Thus, it must be carried out with a primary focus on the quality control of concrete, ranging from management of aggregates, sand, water, cement and other raw materials to regulations of specifications of concrete mixture plants; regulations of transport of concrete; management of concrete management; care of concrete placed.

2-2-4-3 Scope of Works

In implementing this grant aid cooperation project, the Governments of Japan and Laos will be responsible for the scope of works outlined in the following table.

Table 2-2-27 Matters for which the Governments of Japan and Laos are responsible

Japanese side	Lao side
・Replacement of Sekong Bridge (300m in length) and construction of access roads of 527m and revetments covered by the cooperation project stated in the Basic Plan ・Construction and removal of temporary facilities (material and equipment yards, administration office, etc.) ・Safety measures for the construction work and general traffic passing by the site during the construction period ・Anti-environmental pollution measures during the construction period ・Procurement, import and transport of construction materials and equipment listed in the Material and Equipment Procurement Plan. And re-export of import equipment to the countries of origin ・Creation of the implementation design, bidding and contract documents, bidding assistance and supervision of the construction work shown in the Consultant Supervision Plan. Surveillance of the environmental management plan is also included.	・Land acquisition and removal of facilities and residential buildings affected by the Project ・Issuance of IDs to the persons concerned and stickers for construction vehicles ・Provision of waste disposal sites necessary for the Project ・Surveillance of the entire construction site during the construction period ・Supervision by Lao governmental officers during the construction period ・Provision of facilities for the entry, stay, etc. of Japanese and persons from third countries for the Project

2-2-4-4 Construction Supervision Plan

(1) Basic policy for consultant supervision

On the assumption that the Project will be implemented under the framework of Japan's grant aid cooperation, the basic policies for construction supervision are listed as follows.

- The quality of the construction work has a considerable impact on the lifetime and durability of the facilities constructed, so the quality control will be viewed as the top priority issue for the supervisory work. Particular focus will be placed on the revetment work which involves the concrete, foundation and river works.
- The second priority issues next to the quality supervision will be supervision of progress, safety and payments.
- To achieve these issues, the contractor and consultant will hold joint on-site inspections and regular meetings once a week or so to clarify and discuss problems and measures to take.
- In addition, the representatives of the MPWT, contractor and consultant will hold monthly regular meetings to clarify and discuss problems and measures to take.
- Local engineers will be hired as inspectors to facilitate transfer of construction and supervision technologies including the methods of supervising quality, progress and safety.
- Instructions to the contractor, minutes of all meetings, reports to the client, etc. will be documented, and these communications made in writing.

(2) Construction supervision by consultant

The major assignments included in the consultancy agreement will be listed below.

1) Stage of creation of bidding documents

Following the results of the Outline Design Survey Report, the consultant will conduct implementation design of each facility, create documents related to construction contracts and obtain the approval of the MPWT of the Lao Government.

- Design report
- Drawings
- Bidding documents

2) Stage of bidding for construction

The MPWT will conduct open bidding and appoint a Japanese contractor with the support of the consultant. An agency which is appointed by the Government of Laos and participates in the open bidding and the subsequent construction contract will have the entire right to approve any matters related to the construction contract. The consultant will, on the other hand, engage in the services listed below and support the MPWT.

- Advertising of the bidding
- Preliminary qualification screening
- Bidding and bidding evaluation

3) Stage of construction supervision

The contractor appointed as a result of the bidding will conclude the construction agreement with the MPWT, the representative of Laos, issue a commencement order to the contractor and start construction supervision. The scope of construction supervision includes reports on the work progress directly to the MPWT, the Japanese Embassy in Laos and JICA, and monthly reports by mail to other parties concerned. The consultant will supervise the contractor concerning administrative affairs for the work progress, quality, safety and payments, and provide remedies and proposals for technical matters. It will also conduct a deficiency inspection one year after the completion of the construction supervision.

(3) Personnel plan

Personnel and their roles necessary at the stages of detailed design, bidding and construction supervision are as follows.

1) Stage of detailed design

- Manager: technical supervision of the detail design, supervision of the coordination of operations as a whole, and responsibility to contact the client
- Bridge engineers (superstructure): field survey, structural calculation, creation of drawings and quantity calculation in relation to superstructure design

- Bridge engineers (substructure): field survey, structural calculation, stability analysis, creation of drawings and quantity calculation in relation to substructure design
- Road engineers: calculation to define the liner, determination of standard cross-section, consideration of the slope work, design of road drainage, creation of drawings and quantity calculation for road design
- River engineers: field survey, structural calculation, stability analysis, creation of drawings and quantity calculation in relation to design of river structures
- Construction plan and estimation: creation of construction plan, and estimation using the design quantity and unit prices for the construction work obtained from the outputs of the detailed design
- Bidding documents: creation of bidding documents

2) Bidding stage

The consultant will support the MPWT concerning the finalization of documents for preliminary screening and bidding documents, implementation of the preliminary screening and bidding evaluation.

- Manager: supervision of the consultancy services throughout the bidding work
- Bridge engineers: approval of the bidding documents and assistance to bidding evaluation

3) Stage of construction work supervision

- Manager: supervision of the entire consultancy services throughout the construction work
- Permanent engineers: management of the work supervision on site, progress reports to the relevant organizations in Laos and coordination
- Structural engineers: revisions to the construction plan for the bridge and revetment works, concrete work, supervision of PC tightening for the superstructures, etc. For the foundation work, they will confirm subgrades that are made clear after the excavation work and adjust the on-site foundation work, if necessary.

2-2-4-5 Quality Control Plan

The following table summarizes the quality control plan for the Project

Table 2-2-28 List of items subject to quality control (proposal)

Item			Test Method	Frequency of Test
Subgrade (macadam)	Blended material		Liquid limit, plasticity index (<sieve No. 4)	For each blend
			Particle-size distribution (blending)	〃
			Aggregate abrasion loss test	〃
			Aggregate density test	〃
			Maximum dry density (compaction test)	〃
	Laying		Density test (compaction rate)	Once/day
Prime coat / tack coat	Material	Bituminous material	Quality certificate	For each material
			Application amount	Per 500 m^2
Asphalt	Material	Bituminous material	Quality certificate, ingredient analysis table	For each material
		Aggregates	Particle-size distribution (blending)	For each blend, once/month
			Water absorption	For each material
			Aggregate abrasion loss test	〃
	Blending test		Stability	For each blend
			Flow value	〃
			Porosity	〃
			Aggregate porosity	〃
			Tensile strength (indirect)	〃
			Residual stability	〃
			Design asphalt amount	〃
	Laying		Mixing temperature	As needed
			Rolling temperature	For each transport
			Marshall test	About once/day
Concrete	Material	Cement	Quality certificate, chemical & physical test results	For each material
		Water	Ingredient test result	For each material
		Admixture	Quality certificate, ingredient analysis table	For each material
		Fine aggregates	Oven dry density	For each material
			Grain size distribution, fineness modulus	〃
			Percentages of clay lumps and soft particles	〃
		Coarse aggregates	Oven dry density	For each material
			Flake content	〃
			Particle-size distribution (mix)	〃
			Sodium sulfide diagnosis (missing mass)	〃
	At the time of blend test		Compressive strength test	For each blend
	At the time of laying		Slump	Once/batch
			Temperature	Once/day
	Strength		Compressive strength test (7 days, 28 days)	Once/day or = 50 m^3
Steel bars	Material		Quality certificate, tensile test result	For each lot
Structural steel	Material		Mill sheet	For each lot
Coating	Material		Quality certificate, ingredient table	For each lot
Bearing	Material		Quality certificate, strength test result	For each lot
Lighting equipment	Material		Quality certificate, strength test result	For each lot

2-2-4-6 Procurement Plan

(1) Procurement of construction materials and equipment

Materials that can be produced in Laos include sand, aggregates, subbase course materials and timber, and others will be imported. The material procurement policy is as follows.

- Materials that are constantly imported and made available at the Lao market, and have sufficient quality will be produced.
- Products that are locally unavailable will be procured in Japan or third countries. The countries of origin will be determined after candidate countries are compared in terms of price, quality, time required for customs clearance and other factors.

The following table presents possible countries of origin of the major construction materials.

Table 2-2-29 Possible countries of origin of major construction materials

Item	Country of origin			Reason for choosing Japan
	Laos	Japan	Third countries	
PC steel		○		The material is not on the market in Laos and can be procured in neighboring third countries, but it is not certain if they satisfy the specifications required.
Steel balustrade		○		Balustrade is a material conspicuous to passengers, and products of neighboring third countries may have uneven quality and result in a defective finish.
Structural steel for temporary construction and scaffolding		○		Lease products that are locally unavailable will be procured in Japan.
Rubber bearing		○		It is not on the market in Laos. It can be procured in neighboring third countries but may have uneven quality and fail to satisfy the specifications required.
Shaped steel		○		It is not on the market in Laos. It can be procured in neighboring third countries but may fail to satisfy the specifications required.
Bituminous material	○			
Aggregate	○			
Asphalt/bituminous mixture	○			
Portland cement	○			
Expansion device		○		It is not on the market in Laos. It can be procured in neighboring third countries but may have uneven quality and fail to satisfy the specifications required.
Cement additive		○		It will be procured in Japan to secure the quality.
Reinforcing bar	○			
Wood for form	○			
Plywood for form		○		It will be procured in Japan to secure the quality.
Steel form for main girder		○		It has to be accurately made, so will be procured in Japan.
Light oil	○			
Gasoline	○			
Waterproof material for bridge face		○		It will hardly be procured in Laos or neighboring countries. If it is used on site, it will be generally imported from Japan

(2) Construction machinery

Construction machinery for road construction is available in Laos, but bridge production and erection machines are not and will be procured in Japan, Thailand or other third countries.

A concrete plant will be built in the camp yard because an existing raw concrete plant in Laos is old and also because of the need of effective quality control of concrete.

The following table lists the countries of origin of major construction machines, together with the reason for procurement in Japan.

Table 2-2-30 Possible countries of origin of major construction machines

Machine type	Specifications	Country of origin			Reason for choosing Japan
		Laos	Japan	Third countries	
Bulldozer	15～32 t	○			
Backhoe	0.6m3	○			
Dump truck	10t	○			
Wheel loader	1.2m3	○			
Truck crane	16～45 t	○			
Rafter truck crane	15～25 t	○			
Motor grader	3.1m	○			
Road roller	10-12 t	○			
Tire roller	8-20 t	○			
Vibratory roller	0.8-1.1 t	○			
Tamper	60-100kg	○			
Large breaker (attachment)	1,300kg	○			
Concrete plant	30m^3/hr			○	It is difficult to locally procure it.
Sprinkler truck	5,500Lit			○	Only a small number of trucks are available on the market in Laos, and it is difficult to locally procure it.
Crusher plant			○		It cannot be produced in Laos. A plant will be procured in Japan, which enables appropriate plant designing due to the nature of raw stones.
Concrete pump truck	90～110m^3/h		○		The contractor owns one, but it is difficult to procure it.
Large generator			○		It is difficult to locally procure it.
Jack for tightening steel wires	225 t		○		It is difficult to locally procure it.
Temporary girder			○		It is difficult to locally procure it and to rent one from any third country (such as Thailand). Thus, it will be procured in Japan.

2-2-4-7 Implementation Schedule

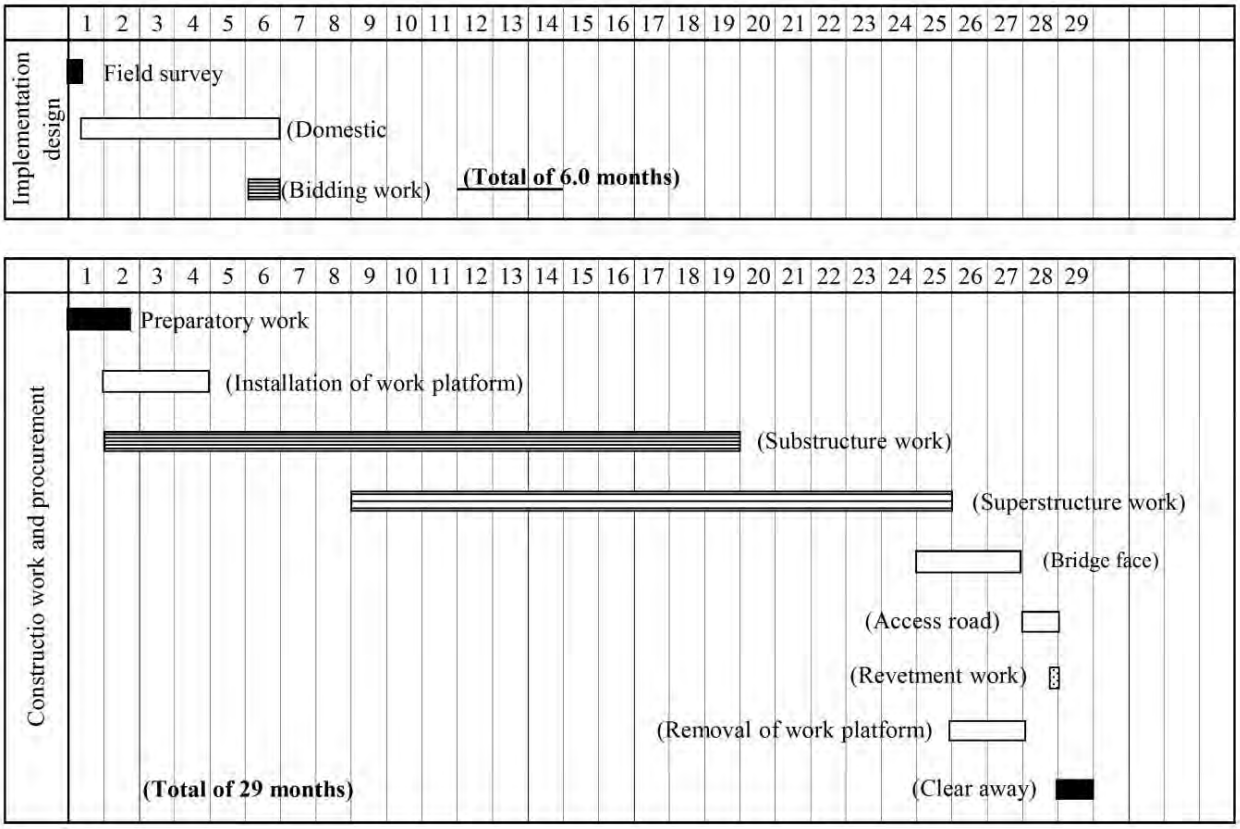
The consultant will conclude exchange of notes (E/N) on the implementation design of the Project, conclude the consultancy agreement with the Government of Laos and start to engage in the implementation design services for the Project as a grant aid cooperation project. After the commencement of the services, the consultant will conduct a field survey for the implementation design for two weeks or so and, after returning to Japan, formulate the detailed design and create bidding documents.

Having concluded exchange of notes (E/N) on the bidding assistance, construction supervisory work and construction of the main bridge and access roads, the consultant will assist the Government of Laos in holding biddings, preparing bidding documents, screening the qualifications of business operators, selecting the contractor and concluding the construction contract.

After the bidding, the contractor will conclude the construction contract with the Government of Laos, have the contract attested by the Government of Japan, receive the order for commencement of the construction work issued by the consultant, and start the construction work.

Table 2-2-31 shows the implementation schedule described above.

Table 2-2-31 Implementation Schedule



2-3 Obligations of the Recipient Country

In the implementation of this project plan, the Government of Laos will be required to engage in the following matters.

2-3-1 General Matters in A Japan's Grant Aid Cooperation Project

- Providing data and information necessary for the implementation of the project plan
- Securing land necessary for the implementation of the project plan (road site, work site, camp yard, and material and equipment storage site)
- Leveling the grounds of each construction site prior to commencement of the construction work.
- Opening an account with a bank in Japan under the name of the Government of Laos and issuing the authority to pay (A/P)
- Unloading cargoes promptly at the unloading points and taking measures to exempt them from taxes and customs duties
- Exempting Japanese companies and individuals concerned with the Project from customs duties, domestic taxes and other taxed imposed in Laos in relation to the outputs and services supplied under the contract attested
- Based on the contract approved or in relation to the services provided, permitting persons concerned with the Project to enter and stay in Laos for the purpose of the implementation of relevant work
- Granting permits and other authorities, where necessary, in relation to the implementation of the Project
- Maintaining, managing and preserving the facilities to be built under the project rightly and effectively
- Bearing all the expenses other than those financed by Japan's grant aid cooperation within the scope of the Project

2-3-2 Matters Unique to the Project

- Removing facilities affected by the construction work
- Securing additional land necessary for the Project other than the land for the existing road
- Providing and leveling land for the temporary yard
- Providing spoil bank and waste disposal site
- Observing the entire construction site during the construction period
- Supervision by officers of the Government of Laos during the construction period

To be completed prior to commencement of the construction work

2-4 Project Operation and Maintenance Plan

Laos will superintend the implementation and O&M of the Project, whereas the provincial office of the MPWT – that is, the Department of Public Works and Transport of Sekong (DPWT) – will be responsible for the O&M of the bridge and roads.

The O&M after the project output starts to provide services is largely classifiable into annual O&M and that to be conducted once several years. The O&M required for the Project is as listed below.

(1) Annual inspection and O&M

- Removal of sand and dirt from, and cleaning of drainage pipes on the bridge face, places around the bearing shoes and drain ditches
- O&M for traffic safety work such as repainting of road marking
- Inspection and repair of revetments after flooding
- Removal of boulders, driftwoods, etc. after flooding
- Weed control of road shoulders and slopes

(2) O&M once every several years

- Overlay of pavement of the bridge face and access roads

The revetment work is crucial for maintenance of the bridge to be built in this Project. The structures such as revetments are designed to be robust against a 50-year probability high-water discharge. Even so, they may collapse or have an outflow if faced with unpredictable local erosion or large flooding of a probability higher than the applicable one. Thus, the DPWT will be required to establish a scheme, whereby they can, if such an event has occurred, immediately conduct inspections and repair any collapse and erosion of the structures. If damage is neglected, the back-filled sediment behind the abutments may flow out, resulting in subsidence of the abutments and disruption of the traffic.

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

2-5-1-1 Cost Born by the Government of Japan

The project will be implemented in accordance with the Japan's Grant Aid scheme and the cost will be determined before concluding the Exchange of Note for the project.

2-5-1-2 Cost Borne by the Lao Side

Table 2-5-1 Costs borne by the Lao side

Item	Amount to be borne (million kip)	Conversion to JPY (million yen)
(1) Rented land cost	93.5	1.16
(2) Bank charges	194.8	2.41
Total	288.3	3.57

2-5-1-3 Conditions of cost estimation

- Estimation time: May 2013
- USD exchange rate: US$1.0 = JPY 96.32 (three-month average from April 30 2013)
- LAK exchange rate: US$1.0 = LAK 7,790 (three-month average from April 30 2013)
- Construction period: 29 months
- Others: The Project will be implemented according to the Guideline for Grant Aid Cooperation issued by the Government of Japan. The above estimated project cost will be revised by the government prior to E/N.

2-5-2 Operation and Maintenance Cost

The DPWT will be in charge of the O&M of the new bridge and access roads to be built under the Project. The major O&M tasks after the completion of bridge construction are, as in Table 2-5-2, routine inspections, cleaning and repair work, the cost being estimated (converted to the annual average) at 397 Lao million kip. This accounts for 0.13 % of the maintenance budget of the MPWT, 302.5 billion kip (FY2009), so it appears that they will be able to afford appropriate maintenance activities.

Table 2-5-2 Major maintenance items and costs

Category	Frequency	Parts to be inspected	Task	Estimated cost (million Kip)		Remarks
				Per work	Per year (annual average)	
Maintenance of drain ditches, etc.	Twice a year	Drainage of bridge face Side ditch	Sediment removal	125	250	
Maintenance for traffic safety work	Once a year	Road marking	Repainting	62	62	Expected to be 10% of direct cost
Maintenance of roads	Twice a year	Shoulders and slopes	Weed control	16	32	
Inspections and repair of revetments	At the time of flooding (assumed to be once every 2 years)	Revetments and bed beaching	Repair of damaged parts	56	28	Expected to be 2% of direct cost
Maintenance and repair of pavements	Once every 5 years	Paved surface	Overlay and repair of cracks, pot holes, etc.	127	25	Expected to be 10% of direct cost
Annual average equivalent of the management costs					397	

Note: The indirect cost is expected to include 40% of the direct cost.

Chapter 3
Project Evaluation

Chapter 3 Project Evaluation

3-1 Preconditions

The preconditions for the implementation of the Project are as follows.

① At the time of constructing Sekong Bridge, 8,400 m^2 will be necessary (which includes the temporary yard) and therefore eviction of individuals currently utilizing this land must be completed before the start of construction.

② Approval must be obtained from the Initial Environmental Examinations (IEE) for the bridge's construction

③ Permission must be obtained to mine the borrow pit and quarry as well as to fell trees.

3-2 Necessary Inputs by Recipient Country

The matters Laos should address in order to achieve and sustain the effects of the project are outlined below.

① In order to smoothly implement this project, the budget outlined in "3-5-1-2 Costs borne by the Loa side" of this report must be secured in advance.

② Of the above, it is necessary to ensure the complete securing of leases for construction yards, and so on, by the time construction begins.

③ In order to ensure the permanent function of the bridge to be built in the project, the operation and maintenance outlined in "3-4 Project Operation and Maintenance Plan" of this report must be implemented and the necessary personnel and costs to ensure this must be secured.

3-3 Important Assumptions

To external conditions necessary to achieve and sustain the effects of this project are outlined below.

① Although the new bridge and connecting roads have been planned with a design speed of 60km/h, due to the fact that it is close to the city, safety measures, such as the installation of speed limit signs, are to be enforced to prevent accidents.

② Although the new bridge and connecting roads have been designed to also cover trailer loads (43 tons), to maintain the service life of the bridge, measures such as prohibition/regulation of overloading, etc. is to be implemented.

3-4 Project Evaluation

3-4-1 Relevance

The relevance of this Project, which will be implemented through Japan's grant aid, has been determined through the following points.

① The beneficiaries of this Project extend to a large portion of the general public which includes poor people in the southern regions (directly benefitting 62,000 people living in Sekong Province including 29,000 people in the Lam Mam District, 19,000 people in Dak Cheung District, and 14,000 people in Kaleum District. Additionally, it will indirectly benefit 6.65 million Lao citizens in the surrounding areas).

② There is an urgent need to improve the lives of Lao residents through strengthening the routes important to the international transportation network, National Road No. 16 and National Road No. 16B. By strengthening these roads it will be possible to secure stable and smooth transportation which will stimulate the social economy, reduce the poverty of residents in the southern regions and improve the lives of the people of Laos.

③ After Project completion the Laos side will be able to manage and maintain the roads through its own funds, human resources and technology, without the need for excessively sophisticated techniques.

④ This Project is positioned as one of the concrete strategies within the Development Plan for the National Roads: 2011-2015 and this improvement project is essential to National Road 16B which is a core international transportation road for Laos.

⑤ There will be almost no negative effects on the environment from the implementation of this Project.

⑥ The Project can be implemented through the grant aid system of Japan without any particular difficulties.

⑦ Since the main bridge section will be 255m (80m+110m+65m) and be a long extradosed bridge, carrying out construction through the use of Laos' own technology alone would be difficult and thus it is necessary and advantageous to use the technology of Japan.

3-4-2 Effectiveness

(1) Quantitative outputs

Through the implementation of this Project the following quantitative effects are expected.

Indicator	Reference value (2013)	Target value (2020) [3 years after project completion]
① Required time to cross the river (minutes)	15 (The average value including waiting time)	0.3 (Running speed 60km / h, bridge length 300m)
② Length of time possible to cross the river per day (Hours / day)	14 (The crossing by ferry) (Only during the day)	24 (Crossing by bridge) (All day)
③ Number of days possible to cross the river per year (days/year)	305 (Crossing the river by ferry)	365 (Crossing by bridge)
④ Daily traffic vehicle crossing (vehicles / day)	235 (crossing by ferry)	516 (crossing by bridge)
⑤ Pedestrian crossing daily traffic (persons / day)	290 (crossing by ferry)	330 (crossing by bridge)
⑥ International distribution transport distance (km) (Exports to neighbouring countries from southern produciton areas (incl. Sekong Province) which also includes those from Japanese companies)	About 900 (Sekong Province ⇒ Bangkok)	About 280 (Sekong Province ⇒ Da Nang)
⑦ International distribution transit time (days) (export to Bangkong from Japanese companies in Da Nang)	7 (Da Nang ⇒ Bangkok) [Sea transport]	2 （Da Nang ⇒ Sekong ⇒ Bangkok) [Land transportation]

(2) Qualitative outputs

① The construction of the target bridge is intended to replace the ferry system and secure stable distribution and human exchange. This is intended to stimulate production operations and distribution activities for local products and mineral resources in the southern region and thus contribute to the economic development and poverty reduction in this region.

② As the target bridge will secure a height that will not be inundated even in the case of a large scale, 100 year flood, if the surrounding areas are submerged in such a flood, the bridge will act as an emergency evacuation site for people and domestic animals.

③ It will become possible to export agriculture and forest products produced by Japanese companies in regions to the west of Sekong Bridge (such as the Bolaven Plateau) to Vietnam, particularly Da Nang port. Currently, the industrial goods of areas to the west of Sekong Bridge are mostly exported to Bangkok, thus this Project will increase the options for export locations. Moreover, if development continues on road 16B and 14D on the Vietnam side, the transportation distance to Vietnam's Da Nang port will become shorter than the Bangkok Route and will achieve a reduction in transport costs.

④ It will become possible to export to Thailand agriculture and forest products produced by Japanese companies in the currently underdeveloped area to the east of Sekong Bridge (centering around Dakchung). Moreover if the development continues on Road 16B and 14D on the Vietnam side, the choice of export destinations will increase to include both Vietnam and Thailand which will enable a stable shipment of products.

⑤ If Da Nang in Vietnam became a gateway to the southern region of Laos through the completion of this bridge, the transport distance would be less than one third that of the carry-out from the southern region to Bangkok which would create the benefits of a reduction in transportation costs and transit time.

⑥ Japanese companies that are expanding production activities in Da Nang's industrial park (56 companies as of December 2012), will obtain the benefit of being able to carry-out goods over the land route to the industrial goods markets in Bangkok. While shipping over sea to Bangkok takes approximately one week, the land route takes approximately two days, a significant decrease in transport time.

⑦ Japanese companies that are already carrying out production activities in Vietnam will be able to expand operations into Laos

Appendices

Appendix-1. Member List of the Study Team

The study team consists of the following members.

(1) Field Survey

Name	Assignment	Organization / Position
Shigeki Miyake	Leader	Director, Transportation and ICT Division 2 Transportation and ICT Group Economic Infrastructure Department, JICA
Daiki Ise	Project Coordinator	Transportation and ICT Division 2 Transportation and ICT Group Economic Infrastructure Department, JICA
Teruo Nakagawa	Project manager / Bridge planner / Development planner	Central Consultant Inc.
Makoto Itoi	Bridge designer	Central Consultant Inc.
Satoru Aoki	Road designer	Central Consultant Inc.
Masahiro Shiratori	Natural condition surveyor I (topography & geology)	Central Consultant Inc.
Jun Umeno	Natural condition surveyor II (hydraulics & hydrology)	Central Consultant Inc.
Hiroyuki Kotani	Social condition surveyor	Central Consultant Inc.
Masato Nidaira	Socio-Environmentalist	Central Consultant Inc.
Hirofumi Takayama	Construction planner / Cost estimator	Central Consultant Inc.

(2) Explanation of the Draft Outline Design

Name	Assignment	Organization / Position
Machiko Kamiya	Leader	Senior Representative, JICA Laos Office
Daiki Ise	Project Coordinator	Transportation and ICT Division 2 Transportation and ICT Group Economic Infrastructure Department, JICA
Teruo Nakagawa	Project manager / Bridge planner / Development planner	Central Consultant Inc.
Makoto Itoi	Bridge designer	Central Consultant Inc.

Appendix-2. Study Schedule

(1) Field Survey

	Month	Date	Day of the week	Leader	Project Coordinator	Chief Consultant	Bridge Designer	Road Designer	Natural Condition Surveyor I	Natural Condition Surveyor II	Socio-Environmentalist	Social Surveyer	Cost Estimator	Road Designer (Assistant)
				Shigeki Miyake	Daiki Ise	Teruo Nakagawa	Makoto Itoi	Satoshi Aoki	Masaharo Shiratori	Jun Umeno	Masato Nidaira	Hiroyuki Kotani	Hirofumi Takayama	Shinya Toyosaki
1		20	wed	Narita → Vientiane		Narita → Vientiane				Narita → Vientiane				
2		21	thu	Courtesy call on JICA Laos Courtesy call on EoJ Courtesy call on MPWT		Courtesy call on JICA Laos Courtesy call on EoJ Courtesy call on MPWT				Courtesy call on JICA Laos Courtesy call on EoJ Courtesy call on MPWT				Narita → Vientiane
3		22	fri	Vientiane → Pakse Courtesy call on DPWT		Vientiane → Pakse Courtesy call on DPWT				Vientiane → Pakse Courtesy call on DPWT				Vientiane→Pakse Site Survey
4		23	sat	Site Survey Meeting with DPWT		Site Survey Meeting with DPWT				Site Survey Meeting with DPWT				Site Survey
5		24	sun	Pakse → Vientiane		Pakse → Vientiane				Pakse → Vientiane				Pakse→Vientiane
6	3	25	mon	Meeting with MPWT and DPWT about M/D		Meeting with MPWT and DPWT about M/D				Meeting with MPWT and DPWT about M/D				Vientiane →Bangkok→
7		26	tue	Discussion of M/D and signing on M/D Report to EoJ, JICA Laos		Discussion of M/D and signing on M/D Report to EoJ, JICA Laos				〃				→Narita
8		27	wed	Vientiane→Bangkok→		Collect materials				Collect materials		Narita → Vientiane		
9		28	thu	→Narita		Vientiane → Pakse Site Survey				Vientiane → Pakse Site Survey			Narita → Vientiane	
10		29	fri			Site Survey				Vientiane → Pakse Site Survey				
11		30	sat			〃				Site Survey				
12		31	sun			Pakse → Vientiane Internal Meeting				Pakse → Vientiane Internal Meeting				
13		1	mon			Collect materials				Collect materials				
14		2	tue			〃					Vientiane→ Bangkok	Collect materials		
15		3	wed			〃					→Narita	〃		
16		4	thu			Prepare a report				Prepare a report		Prepare a report		
17		5	fri			Meeting with MPWT Report to JICA Laos				Meeting with MPWT Report to JICA Laos		Meeting with MPWT Report to JICA Laos		
18		6	sat			Collect materials				Collect materials		Collect materials		
19		7	sun			Internal Meeting Organize materials				Internal Meeting Organize materials		Internal Meeting Organize materials		
20		8	mon			Collect materials				Collect materials		Collect materials		
21		9	tue			〃				〃		Vientiane→ Bangkok	Collect materials	
22		10	wed			〃				〃		→Narita	〃	
23		11	thu			Prepare a report				Prepare a report			Prepare a report	
24		12	fri			Meeting with MPWT Report to JICA Laos and EOJ				Meeting with MPWT Report to JICA Laos and EOJ			Meeting with MPWT Report to JICA Laos	
25	4	13	sat			Collect materials				Prepare a report			Organize materials	
26		14	sun			Internal Meeting		Haneda → Vientiane Internal Meeting		Vientiane→Bangkok			Internal Meeting	
27		15	mon			Collect materials		Collect materials		→Narita			Collect materials	
28		16	tue			〃		〃					〃	
29		17	wed			Vientiane→Bangkok→		Vientiane → Pakse Site Survey					Vientiane→Pakse Site Survey	
30		18	thu			→Narita		Site Survey					Site Survey	
31		19	fri					〃					〃	
32		20	sat					〃					〃	
33		21	sun					Pakse → Vientiane	Site Survey				Pakse→Vientiane	
34		22	mon					Collect materials	〃				Collect materials	
35		23	tue					〃	〃				〃	
36		24	wed					〃	〃				〃	
37		25	thu					〃	〃				〃	
38		26	fri					〃	〃				〃	
39		27	sat					Organize materials	〃				〃	
40		28	sun					Internal Meeting	Organize materials				Internal Meeting	
41		29	mon					Collect materials	Site Survey				Collect materials	
42		30	tue					〃	〃				〃	
43		1	wed					〃	〃				〃	
44		2	thu					〃	〃				〃	
45		3	fri					〃	〃				〃	
46		4	sat					Organize materials	Organize materials				Organize materials	
47		5	sun					Internal Meeting	Internal Meeting				Internal Meeting	
48		6	mon					Collect materials	Site Survey				Collect materials	
49		7	tue					Prepare a report	〃				Prepare a report	
50		8	wed					〃	〃				〃	
51		9	thu					Vientiane →Bangkok→	〃				Report to JICA Laos	
52		10	fri					→Haneda	〃				Vientiane→ Bangkok	
53		11	sat						〃				→Narita	
54		12	sun						Organize materials					
55		13	mon						Site Survey					
56		14	tue						〃		Narita → Vientiane			
57	5	15	wed						〃		Meeting with MPWT			
58		16	thu						〃		Collect materials	Site Survey		
59		17	fri						〃		Vientiane → Pakse→Sekong			
60		18	sat						〃		Site Survey			
61		19	sun						〃		〃			
62		20	mon						〃		〃			
63		21	tue						Site Survey Sekong→Pakse		Site Survey Sekong→Pakse			
64		22	wed						Pakse→Vientiane		Pakse→Vientiane			
65		23	thu						Meeting with MPWT		Meeting with MPWT			
66		24	fri						Report to JICA Laos		Report to JICA Laos			
67		25	sat						Organize materials		Organize materials			
68		26	sun						〃		〃			
69		27	mon						Vientiane→Bangkok		Vientiane→Bangkok			
70		28	tue						→Narita		→Narita			

(2) Explanation of the Draft Outline Design

				Leader	Project Coordinator	(Chief Consultant	Bridge Designer
				Machiko KAMIYA	Daiki ISE	Mr. Nakagawa	Mr. Itoi
1	Oct.	9	Wed		Narita (12:00) → Bangkok (16:30) Bangkok (19:50) → Vientiane (21:00)		
2		10	Thu	9:00 Meeting with MPWT about DBD and M/D (Confirmed) PM Courtesy call on JICA Laos office			
3		11	Fri	AM Discussion of M/D (if necessary) or preparation of M/D signing PM Signing on M/D			
4		12	Sat		Vientian(13:50) → Bangkok(14:55)		

Appendix-3. List of Parties Concerned in the Recipient Country

(1) Ministry of Public Works and Transport：MPWT

Sommad Pholsena	Minister
Laokham Sompheth	Director General, Department of Roads
Ngampasong Muongmany	Deputy Director General, Department of Roads
Manivone Khayavong	Director, Technical and Environment Division, Department of Roads
Anousone Manisouk	Civil Engineer, Environmental Soecialist, Technical and Environment Division, Department of Roads
Phonephana Phrommala	Engineer, Technical and Environment Division, Department of Roads
Math Sounmala	Director Genaral, Department of Planning and Cooperation
Santisouk Simmalavong	Chief of Cabinet
Viengsavath Siphandone	Director General, Department of Transport

(2) Department of Public Works and Transport, Sekong：DPWT

Lieng Khamphoune	Vice Governor, Sekong Province
Soulaphen Muenviseth	Deputy Chief of Cabinet
ThongThep SOURIGNO	Deputy Director
Thongsouk	-
Sovath Sydavong	Road office
Sainao Tichak	Deputy Director
Bounchanh SENGDALA	Project Manager Unit of 16B Project
KhamThaly Vongphomxay	-

(3) Ministry of Natural Resource and Environment：MNRE

Singthong Pathoummady	Deputy Director General, Department of Meteorology and Hydrology
Surinh KOUSONSAVATH	Deputy Director of Angro-Climate division
Kham Phoumi	Department of Meteorology Sekong province

(4) Ministry of Energy and Mines Department of Energy Business Contract Division)

Soukvisan Khinsamone	Civil Engineer

(5) Ministry of Home Affairs National Geographic Department)

Chnthone PIKEOPASEUTH	Deputy Director

(6) Ministry of Labour and Social Welfare：MLSW)

Wanthong KHAMDALA	Deputy National Programme Director

(7) Ministry of Home Affairs：MHA

Chanthone PIOKEOPASEUTH	Deputy Director of Technical Equipment

(8) Ministry of Planning and Investment

Onkeo OUNALOM	Deputy Director General

(9) Road Maintenance Fund：RMF

Phonethip THAMMALATH	Acting Head of the Secretariat

(10) UXO LAO

Wanthong KHAMDALA	Deputy National Programme Director

(11) SDMT(State Enterprise for Survey Design and Material Testing)

Aphaymany KONGSAYSY	Deputy Director of Technical Department

(12) Embassy of Japan

Masahiko Mitsumoto	First Secretary
Hideyuki Onishi	Counsellor

(13) JICA Laos Office

Koichi Takei	Chief Representative
Yoshiharu Yoneyama	Senior Representative
Machiko Kamiya	Senior Representative
Mayumi Miyata	Representative

(14) JICA Expert (MPWT)

Noriyuki Mori	Planning Advisor to the Cabinet Office in Infrastructure Development

(15) UXO LAO

Akihito Hayashi	JICA Advisor for UXO Sector

Appendix-4. Minutes of Discussions

(1) Field Survey

Minutes of Discussions
on the Preparatory Survey for the Project for
Construction of Sekong Bridge on NR16 in the Southern Region of Laos

In response to the request from the Government of the Lao People's Democratic Republic (hereinafter referred to as "Laos"), the Government of Japan decided to conduct a Preparatory Survey for the Project for Construction of Sekong Bridge on NR16B in the Southern Region of Laos (hereinafter referred to as "the Project"), and entrusted the Survey to Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent the Preparatory Survey Team for the Outline Design (hereinafter referred to as "the Team") to Laos. The Team is headed by Mr. Shigeki MIYAKE, Director, Transport and ICT Division 2, Economic Infrastructure Department, JICA, and is scheduled to stay in the country from March 20th to March 27th, 2013.

The Team held a series of discussions with the officials concerned of the Government of Laos and conducted a field survey in the Project area. In the course of the discussions, both sides have confirmed the main items described in the attached sheets. The Team will proceed to further works and prepare the Preparatory Survey Report.

Vientiane, March 26th, 2013

Shigeki MIYAKE
Leader
Preparatory Survey Team
Japan International Cooperation Agency
Japan

Laokham SOMPHETH
Director General
Department of Roads
Ministry of Public Works and Transport
Lao People's Democratic Republic

ATTACHEMENT

1. Objective of the Project

The objective of the Project is to secure smooth and safe connectivity at integral part of NR16B by constructing Sekong Bridge.

2. Project Site

The project site locates in Phonkham Village, Lamam District, Sekong Province which is shown in Annex1.

3. Responsible and Implementing Organizations

The responsible organization is the Department of Roads, Ministry of Public Works and Transport. The implementing organization is the Department of Roads, Ministry of Public Works and Transport and the Department of Public Works and Transport in Sekong Province.

The organization charts are shown in Annex 2.

4. Items requested by the Government of Laos

4-1. It is written on the application form that the Laos side request construction of Sekong Bridge with approach road. JICA will assess the appropriateness of the request through the Preparatory Survey and will report the findings to the Government of Japan. Implementation and components of the Project will be decided by the Government of Japan.

4-2. Both sides confirmed that there was no duplication for the Project to be conducted by the other donors or private enterprises.

5. Japan's Grant Aid Scheme

5-1. The Laos side understands the Japan's Grant Aid Scheme and necessary measures to be taken by the Government of Laos. The Team explained the procedures for the Project described in Annex-3, 4.

5-2. The Laos side will take the necessary measures, as described in Annex-5 for smooth implementation of the Project, as a condition for the Japanese Grant Aid to be implemented.

6. Environmental and Social Considerations

6-1. Both sides confirmed that the Laos side shall conduct the necessary procedure concerning the environmental assessment (including stakeholder meetings, Initial Environmental Examination (IEE) etc.) and make IEE report of the Project. The IEE approval shall be received from the responsible authorities and submitted to JICA Laos office by November 30, 2013.

6-2. The Laos side informed to the Team that land acquisition, resettlement and compensation for the Project Affected Persons (PAPs) and secure the land had already completed.

7. Schedule of the Study

7-1. The Team will proceed with further studies in Laos until May 31, 2013.

7-2. JICA will prepare a draft final report in English and dispatch a mission to Laos in order to explain its contents around October 2013.

7-3. If the contents of the draft final report is accepted in principle by the Laos side, JICA will complete the final report in English and send it to Laos around January 2014.

8. Other Relevant Issues

8-1. The Laos side confirmed that the following undertakings should be taken by the Laos side at the Laos expenses under the Project if implementation of the Project is accepted by the Government of Japan.

(1) To provide tax exemption for construction materials and equipment for the Project

(2) To secure sites for material storing yard, temporary construction yard and waste disposal.

(3) To relocate existing utilities within the Project site to designated area or Project affected area.

(4) To arrange issuance of license, permission and other necessary procedures for the Project

(5) To detect, discriminate and clear UXO's in the areas shown by the Japanese side before the commencement of the detailed design

8-2. Both side agreed that Sekong Bridge should be built at the position where National Road 16B intersects Sekong River.

8-3. Both side agreed that the height of the bottom of bridge girder should be higher than the height that united HWL of the 50-year probability and the allowance specified to Japan's Structural Standard for River.
In addition, the height of the bottom of bridge girder is higher than the previous highest water level (128m) during Ketsana typhoon.

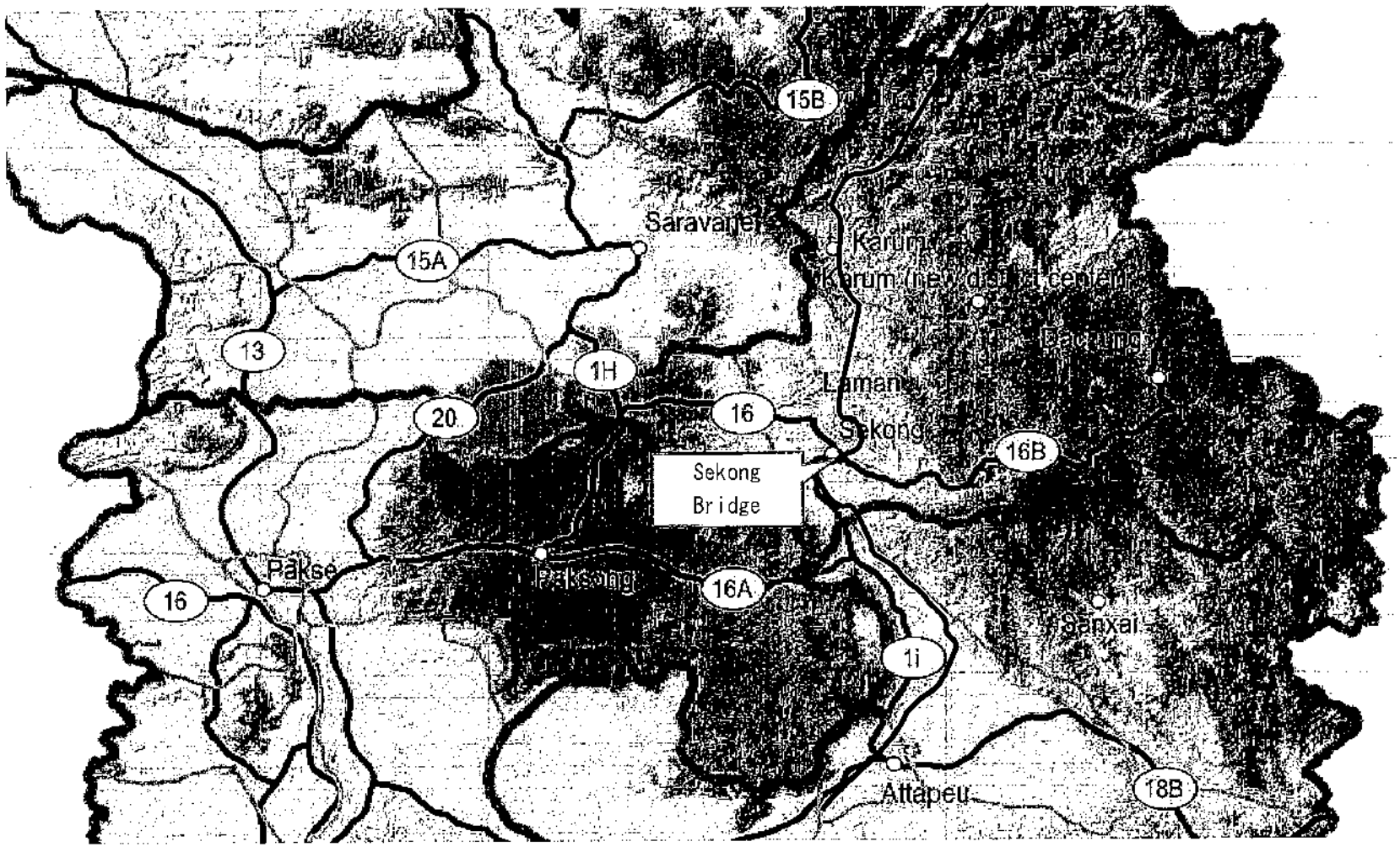
8-4. Both side agreed that the width of Class III specified to Road Design Manual of MPWT should be applied to the effective bridge width (lane width 3.5m x 2 + shoulder 0.5m x 2 + sidewalks 1.5m x 2=11.0m).
In addition, the transition to the effective width (17.0m) in the urban area of National Road 16B is carried out in the section of the approach road of the Project.

8-5. The Laos side shall secure enough budget and personnel necessary for the operation and maintenance of the facilities implemented by the Project, including the periodical maintenance work after the completion of the Project.

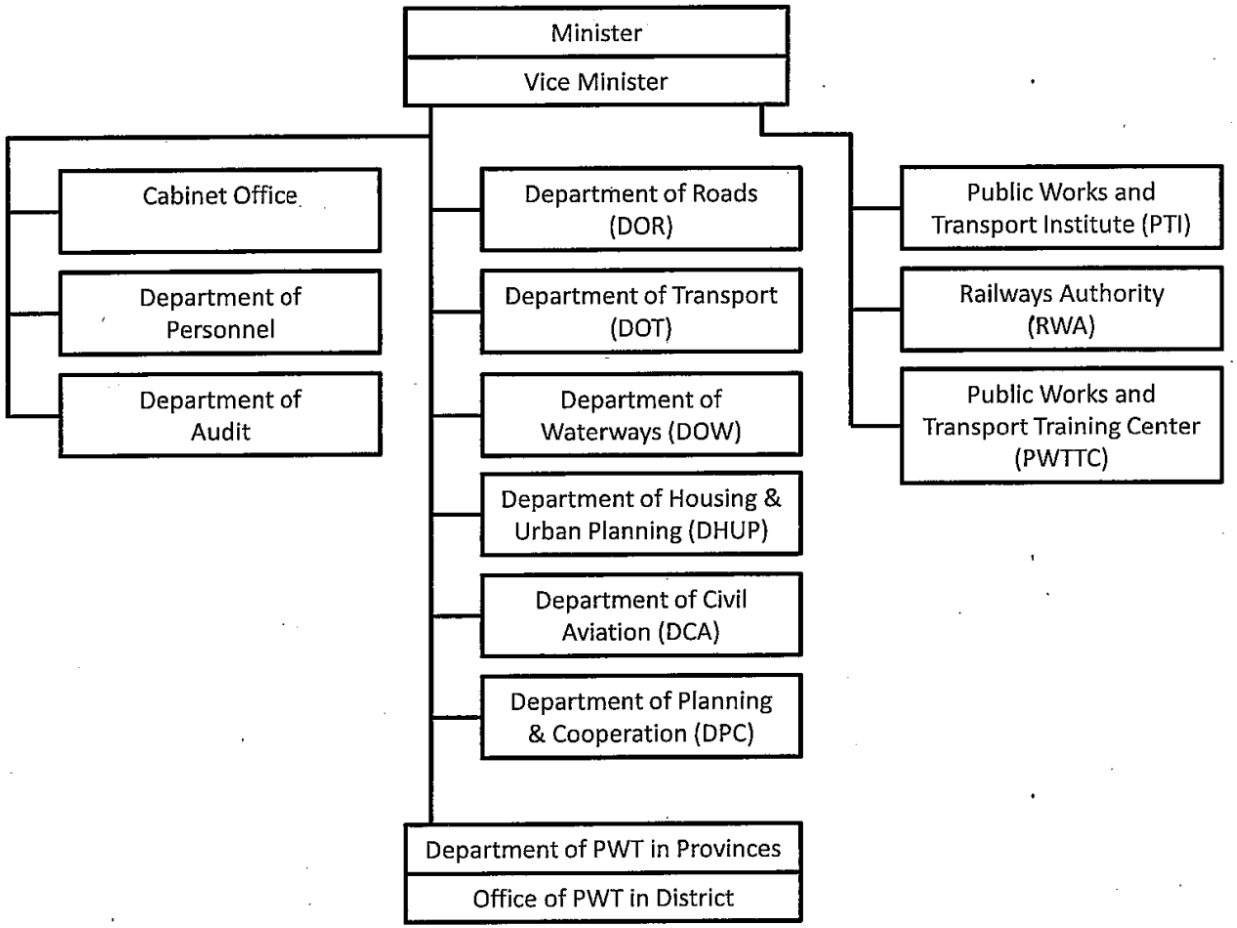
8-6. The Laos side informed to the Team that an official name of the bridge for the project will be determined by the Laos side after the bridge construction is completed.

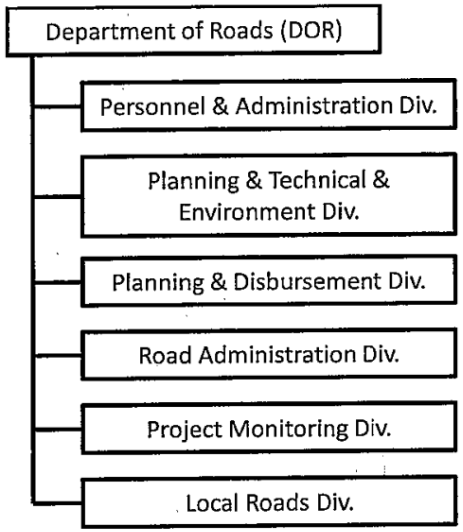
Annex-1 Project Site
Annex-2 Organization Chart
Annex-3 Japan's Grant Aid
Annex-4 Flow Chart of Japan's Grant Aid Procedures
Annex-5 Major Undertakings to be taken by Each Government

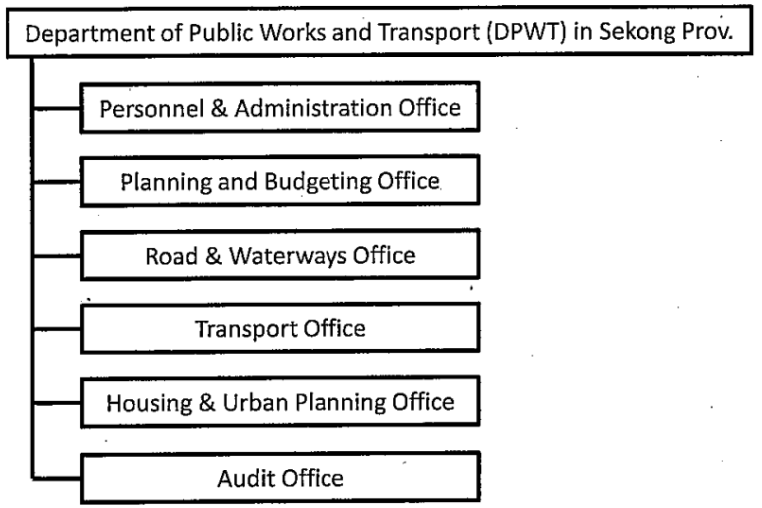
Southern Part of Laos



Ministry of Public Works and Transport




Department of Roads (DOR)
Personnel & Administration Div.
Planning & Technical & Environment Div.
Planning & Disbursement Div.
Road Administration Div.
Project Monitoring Div.
Local Roads Div.


Department of Public Works and Transport (DPWT) in Sekong Prov.
Personnel & Administration Office
Planning and Budgeting Office
Road & Waterways Office
Transport Office
Housing & Urban Planning Office
Audit Office

JAPAN'S GRANT AID

The Government of Japan (hereinafter referred to as "the GOJ") is implementing the organizational reforms to improve the quality of ODA operations, and as a part of this realignment, a new JICA law was entered into effect on October 1, 2008. Based on this law and the decision of the GOJ, JICA has become the executing agency of the Grant Aid for General Projects, for Fisheries and for Cultural Cooperation, etc.

The Grant Aid is non-reimbursable fund provided to a recipient country to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for its economic and social development in accordance with the relevant laws and regulations of Japan. The Grant Aid is not supplied through the donation of materials as such.

1. Grant Aid Procedures

The Japanese Grant Aid is supplied through following procedures :

·Preparatory Survey

- The Survey conducted by JICA

·Appraisal &Approval

-Appraisal by the GOJ and JICA, and Approval by the Japanese Cabinet

·Authority for Determining Implementation

-The Notes exchanged between the GOJ and a recipient country

·Grant Agreement (hereinafter referred to as "the G/A")

-Agreement concluded between JICA and a recipient country

·Implementation

-Implementation of the Project on the basis of the G/A

2. Preparatory Survey

(1) Contents of the Survey

The aim of the preparatory Survey is to provide a basic document necessary for the appraisal of the Project made by the GOJ and JICA. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of relevant agencies of the recipient country necessary for the implementation of the Project.
- Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of a outline design of the Project.
- Estimation of costs of the Project.

The contents of the original request by the recipient country are not necessarily approved in their initial form as the contents of the Grant Aid project. The Outline Design of the Project is confirmed based on the guidelines of the Japan's Grant Aid scheme.

JICA requests the Government of the recipient country to take whatever measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization of the recipient country which actually implements the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country based on the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA employs (a) registered consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

(3) Result of the Survey

JICA reviews the Report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the appropriateness of the Project.

3. Japan's Grant Aid Scheme

(1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes(hereinafter referred to as "the E/N") will be singed between the GOJ and the Government of the recipient country to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Government of the recipient country to define the necessary articles to implement the Project, such as payment conditions, responsibilities of the Government of the recipient country, and procurement conditions.

(2) Selection of Consultants

In order to maintain technical consistency, the consulting firm(s) which conducted the Survey will be recommended by JICA to the recipient country to continue to work on the Project's implementation after the E/N and G/A.

(3) Eligible source country

Under the Japanese Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. When JICA and the Government of the recipient country or its designated authority deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm are limited to "Japanese nationals".

(4) Necessity of "Verification"

The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese

yen with Japanese nationals. Those contracts shall be verified by JICA. This "Verification" is deemed necessary to fulfill accountability to Japanese taxpayers.

(5) Major undertakings to be taken by the Government of the Recipient Country

In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as Annex.

(6) "Proper Use"

The Government of the recipient country is required to maintain and use properly and effectively the facilities constructed and the equipment purchased under the Grant Aid, to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Grant Aid.

(7) "Export and Re-export"

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

(8) Banking Arrangements (B/A)

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

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

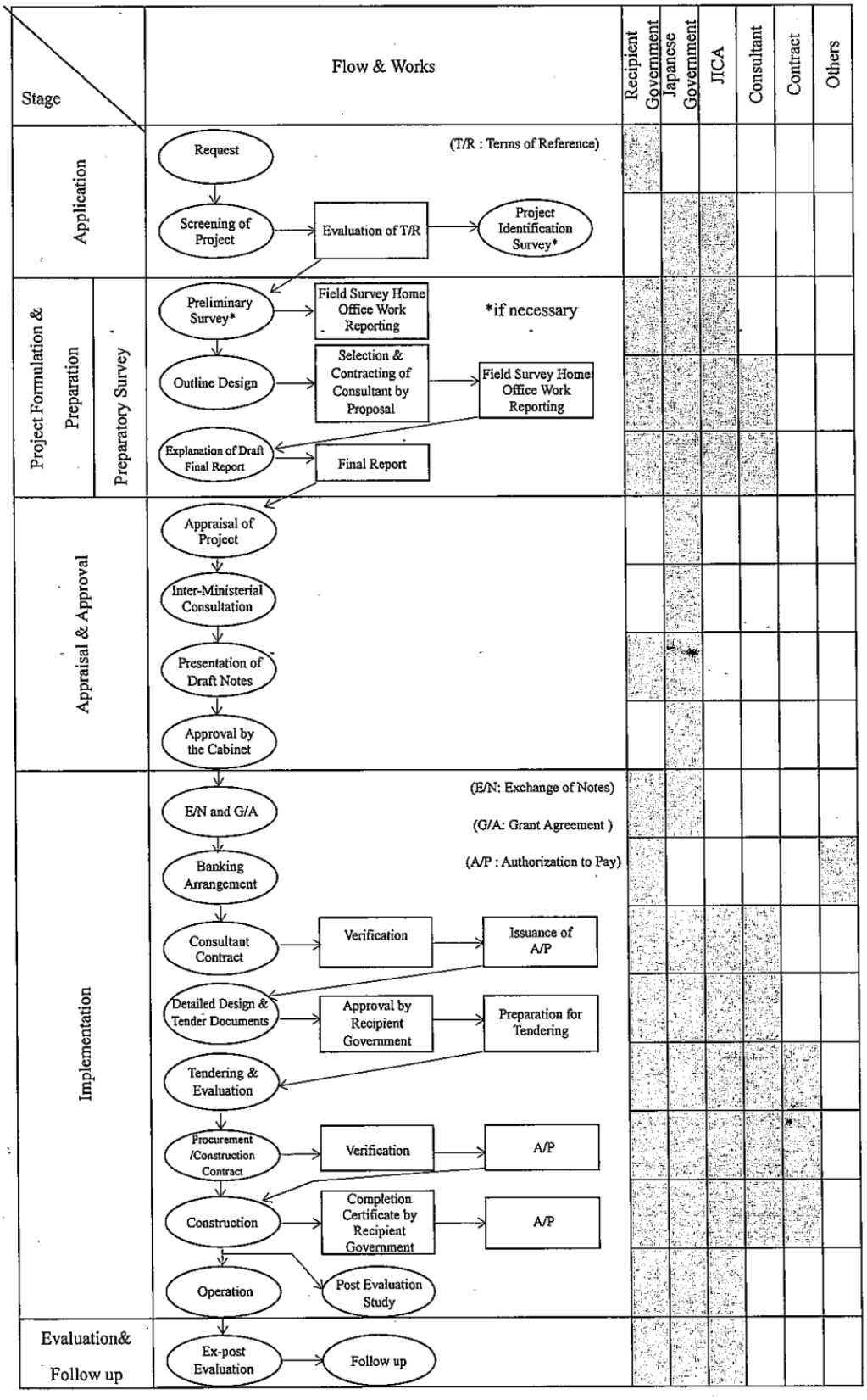
(9) Authorization to Pay (A/P)

The Government of the recipient country should bear an advising commission of an Authorization to Pay and payment commissions paid to the Bank.

(10) Social and Environmental Considerations

A recipient country must carefully consider social and environmental impacts by the Project and must comply with the environmental regulations of the recipient country and JICA socio-environmental guidelines.

FLOW CHART OF JAPAN's GRANT AID PROCEDURES



Major Undertakings to be taken by Each Government

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	to secure lots of land necessary for the implementation of the Project and to clear the sites		●
2	To ensure prompt customs clearance of the products and to assist internal transportation of the products in the recipient country		
	1) Marine (Air) transportation of the Products from Japan to the recipient country	●	
	2) Tax exemption and custom clearance of the Products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site	●	
3	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and the services be exempted		●
4	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●
5	To ensure that the Facilities be maintained and used properly and effectively for the implementation of the Project		●
6	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project		●
7	To bear the following commissions paid to the Japanese bank for banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
8	To give due environmental and social consideration in the implementation of the Project.		●

(B/A : Banking Arrangement, A/P : Authorization to pay)

(2) Explanation of the Draft Outline Design

Minutes of Discussions
on the Preparatory Survey for the Project for
Construction of Sekong Bridge on NR16 in the Southern Region of Laos
(Explanation on Draft Final Report)

In March 2013, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Preparatory Survey Team on the Project for Construction of Sekong Bridge on NR16 in the Southern Region of Laos, and through discussions, field surveys and technical examination of the results in Japan, JICA prepared a Draft Final Report of the study.

In order to explain the Draft Final Report and to consult with the concerned officials of the Government of Laos on its contents, JICA sent to Laos the Preparatory Survey Team (hereinafter referred to as "the Team"). The Team is headed by Ms. Machiko Kamiya, Senior Representative, JICA Laos Office and is scheduled to stay from October 9 to October 11, 2013.

As a result of the discussions, both sides confirmed the main items described in the attached sheets.

Vientiane, October 11th, 2013

Machiko KAMIYA
Leader
Preparatory Survey Team
Japan International Cooperation Agency
Japan

Laokham SOMPHETH
Director General
Department of Roads
Ministry of Public Works and Transport
Lao People's Democratic Republic

ATTACHEMENT

1. Project Component

   After the explanation of the contents of Draft Final Report by the Team, the Laos side agreed in principle to the project contents.

2. Cost Estimation

   The Team explained to Laos side the estimated project cost as attached in Annex-1. Both sides confirmed that this cost estimate was provisional and would be examined further by the Government of Japan for its final approval. Furthermore, both sides agreed that the Project Cost Estimation as attached in Annex-1 should never be duplicated or disclosed to any third parties before the signing of all the contract(s) with contractor(s) for the Project.

3. Japan's Grant Aid Scheme

   The Laos side understood the Japan's Grant Aid scheme and the necessary measures to be taken by the recipient country as explained by the Team and described in Annex-3, Annex-4 and Annex-5 of the Minutes of Discussions signed on March 26, 2013.

4. Schedule of the Study

   JICA will complete the final report in accordance with the confirmed items and send it to the Laos side around December, 2013.

5. Environmental and Social Considerations

5-1. The Laos side agreed to complete the IEE certification process and inform the result to JICA Laos office by the end of November, 2013.

5-2. Both sides agreed the contents of the Environmental Checklist as shown in Annex-2.

5-3. The Laos side agreed that the monitoring for Environmental and Social considerations should be conducted by the Ministry of Public Works and Transport, Department of Roads (hereinafter referred to as "DOR") or Public Works and Transport Institute (hereinafter referred to as "PTI") and the Department of Public Works and Transport (hereinafter referred to as "DPWT") in

Sekong Province in accordance with the Monitoring Plan for the Project described in the Preparatory Survey Report and IEE report.
The results of the monitoring will be provided to JICA Laos office by filling the Monitoring Form attached as Annex-3. As regards "During use" phase, Laos side shall gather records of traffic accidents data for three years after completion of Sekong Bridge and report to JICA Laos office once per year.

5-4. The Laos side agreed that JICA will disclose the results of the monitoring conducted by DOR and DPWT on JICA's website.

6. Other Relevant Issues

6-1. Both sides confirmed that in case that Unexploded Ordnances (UXOs) are found in the project area during the construction period, the Laos side takes full responsibility to clear them immediately.

6-2. Both sides agreed that Sekong Bridge should be built at the position where National Road 16B intersects Sekong River.

6-3. Both sides agreed that the height of the bottom of bridge girder which was decided as High Water Level (HWL) is 128m (including freeboard), which is higher than the height that united HWL of the 50-year probability and the freeboard specified to Japan's Structural Standard for River.
In addition, the height of the bottom of bridge girder is higher than the previous highest water level during Ketsana typhoon.

6-4. Both sides agreed that the width of Class III specified to Road Design Manual of MPWT is applied to the effective bridge width (lane width 3.5m x 2 + shoulder 0.5m x 2 + sidewalks 1.5m x 2=11.0m).
In addition, the transition to the effective width (17.0m) in the urban area of National Road 16B is carried out in the section of the approach road of the Project.

6-5. Both sides agreed that Sekong Bridge will be constructed as an "Extradosed bridge". Because the girder height of Extradosed bridge is lower than that of box girder-bridge, and which make the height of embankment of access road lower. In addition, Extradosed bridge is easier to maintain as compared to other types of bridges.

6-6. The Japanese side explained the project cost to be covered by the Laos side and budget and personnel necessary for the operation and maintenance, as indicated in the Draft Final Report/Annex-1. The Laos side agreed to secure necessary budget and personnel. In addition, The Laos side explained that the maintenance budget for Sekong Bridge is 0.13% of maintenance budget in MPWT (annual budget in 2009) and the Laos side can secure enough budget for maintenance of Sekong Bridge.

6-7. Both sides agreed that an official name of the bridge for the project will be determined by the Laos side before the bridge construction is completed.

6-8. The Laos side shall bear the following costs as a condition for the Japan's Grant Aid to be implemented.

(1) The commissions for the banking services based upon Banking Arrangement (B/A).

(2) The advising commission of the Authorization to Pay (A/P).

6-9. Laos side shall promote improvements of surrounding situations of Sekong Bridge as described below for enhancing positive impacts by constructing Sekong Bridge. Laos side will periodically report the progress to the Japanese side.

- Completion of NR16B (including replacement of bridges) by completion of Sekong Bridge.
- Setting international border crossing point on NR16B, which foreign people can come and go between Laos and Vietnam, by completion of Sekong Bridge.
- To promote Vietnam side to improve NR14 which is in Vietnam side and connected to NR16B in Laos.
- Improvement of existing roads in eastside of the Sekong River.

Annex-1 Project Cost Estimation (provisional)
Annex-2 Environmental Checklist
Annex-3 Monitoring Form

Annex-1

CONFIDENTIAL

Project Cost Estimation

(1) Cost Borne by the Government of Japan

This page will not be disclosed until all the contracts for the Project are concluded.

(2) Cost Borne by the Lao Side

Table- 2 Costs borne by the Lao side

Item	Amount to be borne (10,000 US$)	Conversion to JPY (million yen)
(1) Land acquisition cost	-	-
(2) Rented land cost	1.2	1.16
(3) Cost of relocation of utility poles, etc.	-	-
(4) Bank charges	2.5	2.41
Total	3.7	3.57

(3) Conditions of cost estimation

- Estimation time: May 2013
- USD exchange rate: US$1.0 = JPY 96.32 (three-month average from April 30 2013)
- LAK exchange rate: US$1.0 = LAK 7,790 (three-month average from April 30 2013)
- Construction period: 29 months
- Others: The Project will be implemented according to the Guideline for Grant Aid Cooperation issued by the Government of Japan. The above estimated project cost will be revised by the government prior to E/N.

(4) Operation and Maintenance Cost

Table- 3 Major maintenance items and costs

Category	Frequency	Parts to be inspected	Task	Estimated cost (million Kip)		Remarks
				Per work	Per year (annual average)	
Maintenance of drain ditches, etc.	Twice a year	Drainage of bridge face, Side ditch	Sediment removal	125	250	
Maintenance for traffic safety work	Once a year	Road marking	Repainting	62	62	Expected to be 10% of direct cost
Maintenance of roads	Twice a year	Shoulders and slopes	Weed control	16	32	
Inspections and repair of revetments	At the time of flooding (assumed to be once every 2 years)	Revetments and bed beaching	Repair of damaged parts	56	28	Expected to be 2% of direct cost
Maintenance and repair of pavements	Once every 5 years	Paved surface	Overlay and repair of cracks, pot holes, etc.	127	25	Expected to be 10% of direct cost
Annual average equivalent of the management costs					397	

Note: The indirect cost is expected to include 40% of the direct cost.

Annex2

Environmental Checklist

Category	Environmental item	Main checkpoints	Yes: Y No: N	Specific environmental and social considerations (Reason for Yes or No, rationale, mitigation measures, etc.)
1 Approvals, explanations	(1) EIA and environmental approvals	(a) Have environmental assessment reports (EIA Report, etc.) been created?	(a) N	(a) Environmental procedures were started from September 2013.
		(b) Has the EIA Report, etc. been approved by the government of the relevant country?	(b) N	(b) It is expected to be approved without problems. (Planned approval acquisition: November 2013)
		(c) Does approval for the EIA Report, etc. have attached conditions? If there are attached conditions, have those conditions been met?	(c) N	(c) Attached conditions are not expected.
		(d) Apart from the above, have environmental approvals been obtained from local governing agencies if required?	(d) N	(d) Approvals and authorizations apart from the above (approval from MORNE) are not required.
	(2) Explanation for local stakeholders	(a) Has an appropriate explanation of the Project content and impacts been given to local stakeholders with full disclosure, and has their agreement been obtained?	(a) N	(a) The system in Laos requires that results of consultations with stakeholders be attached when obtaining environmental approval. This consultation is planned for late June 2013.
		(b) Have comments from residents, etc. been reflected in the Project?	(b) N	(b) Consultation results are expected to be reflected.
	(3) Alternative plan analysis	(a) Have multiple alternative plans for the Project been analyzed? (Including analysis of items related to the environment/society.)	(a) Y	(a) Multiple alternative plans have been analyzed. The adopted plan is also being examined from technical, economic, and environmental aspects.
2 Anti-pollution measures	(1) Air pollution	(a) Is there an impact from air pollutants emitted by travelling vehicles, etc.? Is there compliance with the environmental standards of the relevant country?	(a) N	(a) Because of the scale and content of the construction, very little air pollution is expected to be generated. Although some dust is expected, it will be limited to certain areas and have very little impact.
		(b) If air pollution in the area near the route already exceeds environmental standards, will the Project further exacerbate air pollution? Will anti-pollution measures be taken?	(b) N	(b) Because of the scale and content of the construction, air pollution will not be exacerbated. With Project implementation, travel performance will be improved and gas emissions decreased.
	(2) Water quality	(a) Will the water quality in the areas downstream decline due to soil runoff from exposed surface soil in land-filled areas and areas where earth was cut?	(a) N	(a) There will be next to no runoff from land-filled areas and earth-cut areas
		(b) Will the Project impact water sources such as wells in the surrounding area?	(b) Y	(b) Care must be taken in regard to wastewater from the construction site/worker living quarters and oil/grease from heavy machinery and vehicles flowing into the river.
	(3) Noise and vibration	(a) Is the level of noise and vibration from railways and traveling vehicles in compliance with the standards of the relevant country?	(a) N	(a) A standard has not been set. However, measures for preventing noise and vibration from overloaded trucks should be examined in the future.
		(b) Is the level of low-frequency sound from railways and traveling vehicles in compliance with the standards of the relevant country?	(b) N	(b) A standard has not been set. In order to reduce the level of low-frequency sound, improvements to bridge joints, etc. will be considered.

Environmental Checklist

Category	Environmental item	Main checkpoints	Yes: Y No: N	Specific environmental and social considerations (Reason for Yes or No, rationale, mitigation measures, etc.)
C Natural environment	(1) Protected areas	(a) Is the site located within a protected area as stipulated by the laws of the relevant country and international treaties? Does the Project impact protected areas?	(a) N	(a) The area around the Project site is not protected.
	(2) Ecosystems	(a) Does the site include virgin forests, tropical old-growth forests, or important ecological habitats (coral reef, mangrove swamps, mudflats, etc.)?	(a) N	(a) None included.
		(b) Does the site include habitats for rare species that must be protected according to the laws of the relevant country or international treaties?	(b) N	(b) None included.
		(c) If a significant impact on the ecosystem is a concern, have measures been taken to mitigate the impact?	(c) N	(c) There is no significant impact on the ecosystem.
		(d) Have measures been taken in regard to blockage of movement paths for wild animals and livestock, division of habitats, and prevention of traffic accidents involving animals?	(d) N	(d) Since this Project is the construction of a new bridge, no habitats will be divided.
		(e) Will the construction of the bridge/road cause deforestation and poaching that accompanies development, desertification, and/or dried swamps, etc? Is there a risk of disturbing the ecosystem due to an introduction of pests or non-native species (those not naturally inhabiting the region)? Have countermeasures for this been prepared?	(e) N	(e) Since the Project is the construction of a new bridge, there are no impacts that accompany development.
	(3) Hydrology	(a) Will the flow of surface water or ground water be adversely impacted by changes in the river system caused by the placement of structures?	(a) N	(a) Since the Project is the construction of a new bridge, substructure work, etc. is expected to be conducted in the river, causing a temporary impact. After handover, the impact on the flow of the river will be minimal since the obstruction rate of the cross section is taken into account for the substructure design.
	(4) Topography and geology	(a) Are there places with poor soil quality on the route where slope failure or landslides may occur? If so, has proper action been taken through construction methods, etc.?	(a) N	(a) There are no places where slope failure or landslides will occur.
		(b) Will slope failure or landslides occur due to civil engineering work such as landfilling or earth cutting? Have appropriate measures been taken to prevent slope failure and landslides?	(b) Y	(b) Although the scale of work is not large, slopes for landfilling and earth cutting will be thoroughly analyzed.
		(c) Will soil runoff occur in areas of landfilling, earth cutting, soil disposal, and/or soil extraction? Have appropriate measures been taken to prevent soil runoff?	(c) Y	(c) Appropriate measures to prevent soil runoff during construction and after handover will be implemented.

Annex2

Environmental Checklist

Category	Environmental item	Main checkpoints	Yes: Y No: N	Specific environmental and social considerations (Reason for Yes or No, rationale, mitigation measures, etc.)
4 Social environment	(1) Resettlement	(a) Will there be any involuntary resettlement that accompanies project implementation? If so, have efforts been made to minimize the impact of resettlement?	(a) N	(a) Since there are no people residing at the project site, there will be no resettlement.
		(b) Have proper explanations regarding compensation and livelihood reconstruction measures been given to residents prior to resettlement?	(b) –	(b) Not applicable
		(c) Has a study been conducted for resettlement with a plan including compensation for replacement costs and recovery of local infrastructure?	(c) –	(c) Not applicable
		(d) Will payment of compensation be made prior to resettlement?	(d) –	(d) Not applicable
		(e) Has a document for compensation policies been drafted?	(e) –	(e) Not applicable
		(f) Does the plan for resettlement include proper consideration for social vulnerable persons such as women, children, the elderly, the poor, and ethnic minorities/indigenous peoples?	(f) –	(f) Not applicable
		(g) Will an agreement regarding resettlement be reached prior to resettlement?	(g) –	(g) Not applicable
		(h) Is there a system in place for the appropriate implementation of resettlement? Are implementation capacity and budgetary provisions sufficient?	(h) –	(h) Not applicable
		(i) Is there a plan for monitoring the effects of resettlement?	(i) –	(i) Not applicable
		(j) Has a system been created for processing complaints?	(j) –	(j) Not applicable
	(2) Lives and livelihoods	(a) If a bridge/access road is built for new development, will there be an impact on existing means of transportation and the residents using those means? Will there be large changes in land usage/ livelihood means, and/or loss of employment? Does the plan give consideration to mitigating these impacts?	(a) N	(a) Since the Project is the construction of a new bridge, access to infrastructure will be improved for neighboring residents. (Positive impacts are expected.) There will be no change in land usage and means of livelihoods.
		(b) Will the lives of other residents be adversely impacted by the Project? Will consideration be given to mitigating these impacts if necessary?	(b) N	(b) Same as above.
		(c) Is there a risk of disease outbreaks (including infectious diseases such as HIV) from the population influx from other regions? Will considerations for appropriate public health measures be made according to need?	(c) Y	(c) Since a large unspecified number of workers will be living in the area over a long term, the spread of infectious disease is a concern.
		(d) Will road traffic in the surrounding areas be negatively impacted by the Project? (congestion, increase in accidents, etc)	(d) Y	(d) Smooth travel will become possible with the bridge construction. Conversely, an increase in traffic volume is predicted, with a rise in traffic
		(e) Will this hinder the movement of residents?		

Annex2

Environmental Checklist

Category	Environmental item	Main checkpoints	Yes: Y No: N	Specific environmental and social considerations (Reason for Yes or No, rationale, mitigation measures, etc.)
				accidents a concern.
		(f) Will overpasses, etc. block sunlight or cause electromagnetic wave interference?	(e) N (f) N	(e) Since the Project is a new bridge construction, movement of residents will be greatly improved. (f) Since the Project is a new bridge construction, sunlight, etc. will not be blocked.
	(3) Cultural heritage	(a) Does the Project present a risk of damaging anthropological, historical, cultural, or religiously important heritages or historical remains? Have measures stipulated by the domestic laws of the relevant country been considered?	(a) N	(a) There are no cultural heritages, etc. located at or near the site. If discovered during construction, it will be reported to the controlling MORNE, and discussions for subsequent action will be necessary.
	(4) Landscape	(a) If there are any landscapes that should be especially considered, will they be adversely impacted? If so, will necessary measures be taken?	(a) N	(a) There are no landscapes that need special consideration.
	(5) Ethnic minorities and indigenous peoples	(a) Have considerations been made to lessen the impact on the culture and lifestyles of ethnic minority groups and indigenous people of the relevant country? (b) Will the rights regarding land and resources of ethnic minorities and indigenous peoples be respected?	(a) N (b) Y	(a) Although there are ethnic minority groups in the area, the Project does not impact their culture or lifestyles. With the bridge construction, a positive impact is expected, including improving access to social infrastructure for ethnic minorities. (b) The land and resources of ethnic minority groups will not be impacted.
	(6) Working conditions	(a) Are laws pertaining to working conditions in the relevant country being observed for the Project? (b) Are the physical aspects of safety for people working on the Project being considered? (These may include installing safety equipment to prevent work-related accidents and management of toxic substances.) (c) Are the non-physical aspects of safety for people working on the project being planned and implemented? (These may include formulating a plan for safety/health and conducting safety education including traffic safety and public health.) (d) Will appropriate measures be taken to ensure that Project security personnel do not compromise the safety of people working on the Project or residents of the area?	(a) Y (b) Y (c) Y (d) Y	(a) Work will be conducted in accordance with laws pertaining to working conditions during construction. (Amended Labor Law 2006) (b) Preventative measures for work-related accidents during construction will be thorough. (c) A plan for safety and health will be formulated and safety education during construction will be conducted. (d) Safety education will be conducted for security personnel.

Annex2

Environmental Checklist

Category	Environmental item	Main checkpoints	Yes: Y No: N	Specific environmental and social considerations (Reason for Yes or No, rationale, mitigation measures, etc.)
5 Other	(1) Impacts during construction	(a) Will mitigation measures be prepared for pollution during construction? (noise, vibration, turbid water, dust, gas emissions, waste, etc.)	(a) Y	(a) The submission of an environmental management and monitoring plan/mitigation measures for pollution during construction is required when applying for environmental permissions.
		(b) Will the natural environment (ecosystem) be adversely impacted by construction work? Will mitigation measures be prepared for these impacts?	(b) N	(b) There will be no significant impact on the natural environment (ecosystem) during construction.
		(c) Will the social environment be adversely impacted by construction work? Will mitigation measures be prepared for these impacts?	(c) N	(c) There will be no significant impact on the social environment during construction.
	(2) Monitoring	(a) Will monitoring for the employer be planned and conducted for environmental items that may have an impact from among those listed above?	(a) Y	(a) The submission of an environmental management and monitoring plan for pollution during construction is required when applying for environmental permissions. Monitoring will thus be conducted following this plan.
		(b) In what way will the items of the relevant plan, along with methods and frequencies, etc. be stipulated?	(b) Y	(b) Following the environmental management and monitoring plan, mainly the construction contractor will implement monitoring once per month. The construction supervisor will then make a monthly report to the employer.
		(c) Will a monitoring system for the employer be established? (including organization, personnel, equipment, budget, etc., and the continuity of these items)	(c) Y	(c) A monitoring system by the construction supervisor will be secured. For the one year following handover, it will be necessary to establish a system for monitoring by MPWT.
		(d) Has the method and frequency, etc. for reporting from the employer to the governing agencies been defined?	(d) Y	(d) This is defined in the environmental management and monitoring plan.
6 Focal points	Referencing other environmental checklists	(a) If necessary, relevant items from other checklists pertaining to roads, railways, and forestry may be added to this list and assessed. (For large-scale deforestation, etc.)	(a) –	(a) Not applicable
		(b) If necessary, relevant items from other checklists pertaining to the transmission, transformation, and distribution of electricity may be added to this list and assessed. (For constructing facilities for the transmission, transformation, and distribution of electricity, etc.)	(b) –	(b) Not applicable
	Precautions when using the environmental checklist	(a) If necessary, trans-boundary problems or impacts on global climate change may be checked. (For example, trans-boundary waste disposal, acid rain, depletion of the ozone layer, factors contributing to global warming, etc.)	(a) N	(a) Since the project does not involve large-scale construction, there are no trans-boundary or global environment problems.

Annex3

Monitoring Form (During Construction)

1. Water Quality (Discharged water and Sekong river)

Monitoring Item (Unit)	Measured value (Average)	Measured value (Maximum)	Country's standard	Referred international standards	Frequency
pH			N/A	5.8 ~ 8.6 (Japan)	Twice per year
SS			N/A	200mg/l (Japan)	Twice per year

2. Waste

Monitoring Item	Frequency	Monitoring results during monitoring period
▪Transport record of construction waste materials to disposal site	Once per month	

3. Noise and Vibration

Monitoring Item	Frequency	Monitoring results during monitoring period
▪Noise/vibration level	Twice per year	
▪Usage of low-noise, low-vibration methods	Once per year	

4. Accidents

Monitoring Item	Frequency	Monitoring results during monitoring period
▪Record of accidents and injuries	Once per year	

Monitoring Form (During Use)

1. Accidents

Monitoring Item	Frequency	Monitoring results during monitoring period
▪Record of traffic accidents	Once per month	

List of References (1/2)

No	Title	Form	Original/Copy	Issued by	Year
1	National Socio-Economic Development Plan (NSEDP:2011-2015)	PDF	Copy	Laos Government	2011
2	Development Plan for the Connection of the National Roads (2011-2015)	Word	Copy	MPWT	2011
3	ROAD DESIGN MANUAL	Hard copy	Copy	MCTPCDC	1996
4	National Road Network Diagram	Hard copy	Copy	MPWT	2013
5	Road Project Diagram	Hard copy	Copy	MPWT	2011
6	Mekong Bridge Location Map	Hard copy	Copy	MPWT	2013
7	MPWT Organization Chart	PPT	Copy	MPWT	2012
8	Other Donor Assistance Projects Table (Transportation Sector)	PDF	Copy	MPWT	2013
9	MPWT Road Department Annual Budget (5 years)	Hard copy	Copy	MPWT Road Department	2005
10	Revenue Funding of Road Maintenance Fund (2005-2012)	Hard copy	Copy	RMF	2012
11	Income and Expenses of RMF and Other Institutions (2005-2012)	Hard copy	Copy	RMF	2012
12	Expenditure and management items of RMF (2005-2012)	Hard copy	Copy	RMF	2012
13	Location Map of Bombing	jpg	Copy	UXO-LAO	
14	Environmental and Social Operation Manual (Road Sector)	Hard copy	Copy	MPWT	2009
15	Decree on Environmental Impact Assessment	PDF	Copy	Prime Minister's Office	2010
16	Decree on Compensation and Resettlement of People Affected by Development Projects	Hard copy	Copy	Water Resources and Environment Administration (WREA)	2011
17	Regulations for Implementing Decree on Compensation and Resettlement of People Affected by Development Projects	Hard copy	Copy	Water Resources and Environment Administration (WREA)	2011
18	Socio-economic ATLAS of the Lao PDR (Including the Population Census 2005)	CD	Copy	LAO DEPARTMENT OF STATISTICS	2011
19	GISD Data (Sekong Province) (Schools, Hospitals, Roads, Land use etc)	Soft copy	Copy	Geospatial Information Authority of Laos	2012
20	Mineral Resource Map of Lao	Soft copy	Copy	Ministry of Natural Resource and Environment	2012
21	Map of Concession Area up to Jan. 2013	Soft copy	Copy	Ministry of Natural Resource and Environment	2013
22	Agricultural Development Project (2011-2015)	Soft copy	Copy	Ministry of Agriculture & Forest	2011
23	Development Plan of Sekong Province (2011-2015)	Soft copy	Copy	Sekong Province	2011

List of References (2/2)

24	Lao Census of Agriculture 2010/11 Highlights	Hard copy	Copy	Ministry of Agriculture & Forest	2012
25	Poverty in Lao 2008	Hard copy	Copy	Ministry of Planning & Investment	2008
26	The Geography of Poverty and Inequality in Laos	Hard copy	Copy	Swiss National Center of Competence in Research N-S	2012
27	2011 Statistical Report on Tourism in Laos	Hard copy	Copy	Tourism Development Dept.	2012
28	Traffic Data of National Road 16B 2003 - 2009	Hard copy	Copy	MPWT (Sekong Province)	2009
29	Topographic Map of Sekong Province 1/100,000	Hard copy	Copy	Geospatial Information Authority of Laos	2003
30	Affiliation List of Coffee Association	Hard copy	Copy	Sinuque Copffee	
31	Daily Water Level in Sekong Observatory (1990－2012)	Hard copy	Copy	Meteorology and Hydrology Section Sekong Province	
32	Daily Rainfall in Sekong Observatory (2002－2012)	Hard copy	Copy	Meteorology and Hydrology Section Sekong Province	
33	The Maximum Temperature in Sekong Observatory (2002-2012)	Hard copy	Copy	Meteorology and Hydrology Section Sekong Province	
34	The Minimum Temperature in Sekong Observatory (2002-2012)	Hard copy	Copy	Meteorology and Hydrology Section Sekong Province	
35	Wind Direction and Wind Power in Sekong Observatory (2008－2012)	Hard copy	Copy	Meteorology and Hydrology Section Sekong Province	
36	Humidity in Sekong Observatory (2002－2012)	Hard copy	Copy	Meteorology and Hydrology Section Sekong Province	
37	The Dam Project Location Chart / Summary in Sekong River Basin	Hard copy	Copy	Ministry of Energy and Mines Department of Energy Business Contract Division	
38	Daily Water Level in Attapeu Observatory (1990－2012)	Hard copy	Copy	Department of Meteorology and Hydrology Lao People's Democratic Republic	
39	Daily Flow in Attapeu Observatory (1990－2012)	Hard copy	Copy	Department of Meteorology and Hydrology Lao People's Democratic Republic	
40	Topographic map 1:200,000	Hard copy	Copy	Ministry of Home Affairs National Geographic Department	
41	Topographic map 1:100,000	Hard copy	Copy	Ministry of Home Affairs National Geographic Department	
42	Topographic map 1:50,000	Hard copy	Copy	Ministry of Home Affairs National Geographic Department	