

Appendices

Appendix 1. Member List of the Survey Team

Appendix 1. Member List of the Survey Team

1. Field Survey

OI Hidemotsu	Leader for the Study Development Specialist, JICA
KANEKO Yoshiaki	Chief Consultant / Pacific Consultants International
TAKAI Yoshimi	Bridge Plannner 1 Pacific Consultants International
TAKADA Sakae	Natural Condition Surveyor 1 (Topography, Geology) Pacific Consultants International
FURUKAWA Takashi	Natural Condition Surveyor 2 (Hydrology) Pacific Consultants International
MIZUKOSHI Kazuo	Construction Planner / Cost Estimator Suntech International

2. Explanation of Draft Report

SHIONO Hiroshi	Leader for Explanation Draft Final Report Deputy Director, First Programme Division, Tsukuba International Center, JICA
KANEKO Yoshiaki	Chief Consultant / Pacific Consultants International
TAKAI Yoshimi	Bridge Plannner 1 Pacific Consultants International
FURUKAWA Takashi	Natural Condition Surveyor 2 (Hydrology) Pacific Consultants International

Appendix 2. Survey Schedule

Appendix 2. Survey Schedule

a. Itinerary of the Study (January 16, 2000 - February 24, 2000)

No.	Date	Day	Team Leader	Chief Consultant Bridge Planner I Hydrologist	Geologist	Construction Planner
1	Jan 16	Sun	Narita (NRT) to Bangkok (BKK)			
2	Jan 17	Mon	Bangkok (BKK) to Phnom Penh (PP) Courtesy call to the Japanese Embassy and JICA Courtesy call and meeting with Ministry of Public Works and Transport (MPWT)			
3	Jan 18	Tue	Discussion with MPWT			
4	Jan 19	Wed	Site investigation			
5	Jan 20	Thu	Discussion with MPWT			
6	Jan 21	Fri	Discussion with MPWT on the draft of the Minutes			
7	Jan 22	Sat	Internal meeting			
8	Jan 23	Sun	Data study, Internal meeting			
9	Jan 24	Mon	Signing of the Minutes			
10	Jan 25	Tue	Japanese Embassy and JICA Leave PP	Field survey		
11	Jan 26	Wed		Data collection	Selection of the survey company	NRT to BKK
12	Jan 27	Thu		Field inspection		BKK to PP
13	Jan 28	Fri		Hydrological study	Conducting field survey	Data collection
14	Jan 29	Sat				
15	Jan 30	Sun		Structural study	Data collection	Study on Construction cost
16	Jan 31	Mon				
17	Feb 01	Tue		Discussion on the design conditions	Report preparation	Related law
18	Feb 02	Wed				
19	Feb 03	Thu				
20	Feb 04	Fri				
21	Feb 05	Sat		Internal meeting	PP to BKK to NRT Arrival at NRT	Study on construction method and plan
22	Feb 06	Sun				
23	Feb 07	Mon				
24	Feb 08	Tue				
25	Feb 09	Wed				
26	Feb 10	Thu				
27	Feb 11	Fri				
28	Feb 12	Sat				
29	Feb 13	Sun				
30	Feb 14	Mon				
31	Feb 15	Tue				
32	Feb 16	Wed				
33	Feb 17	Thu				
34	Feb 18	Fri				
35	Feb 19	Sat				
36	Feb 20	Sun				
37	Feb 21	Mon				
38	Feb 22	Tue				
39	Feb 23	Wed		PP to BKK		PP to BKK
40	Feb 24	Thu		BKK to NRT		BKK to NRT

b. Itinerary of Explanation of DF/R (May 14, 2000 – May 24, 2000)

No.	Date	Day	Team Leader	Chief Consultant	Bridge Planner I	Hydrologist
1	May 14	Sun	Narita (NRT) to Bangkok (BKK)			
2	May 15	Mon	Bangkok (BKK) to Phnom Penh (PP) Courtesy call to Embassy of Japan and JICA Courtesy call to Mr. Khy Tainglim, Minister of Ministry of Public Works and Transport (MPWT)			
3	May 16	Tue	Discussion on DF/R with the officials of MPWT Site Survey			
4	May 17	Wed	Discussion on DF/R with MPWT			
5	May 18	Thu	Signing on the Minutes of Meeting between MPWT and JICA mission			
6	May 19	Fri	Report to JICA Office Report to Embassy of Japan Leave Phnom Penh	Report to JICA Office Report to Embassy of Japan		
7	May 20	Sat		Additional site survey with MPWT officials		
8	May 21	Sun		Internal Meeting		
9	May 22	Mon		Additional site survey with MPWT officials		
10	May 23	Tue		PP to BKK		
11	May 24	Wed		BKK to NRT		

Appendix 3. List of Party Concerned in the Recipient Country

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Japanese Side

Embassy of Japan in Cambodia

Mr. SAITO Masashi	Ambassador of Japan
YAMAMOTO Eiji	Minister Counsellor
ISHIMOTO Tsuyoshi	Second Secretary
MYOSE Kazuyuki	Second Secretary
WATANABE Yuji	Second Secretary

Japan International Cooperation Agency, Cambodian Office

MATSUDA Norio	Resident Representative
Mr. MASUDA Shinichi	Assistant Resident Representative
Mr. TAKAGAKI Yasuo	Transport and Port Advisor for Minister
Dr. NAKAMURA Ippei	Expert
Mr. KAWAMURA Masaru	Expert
Mr. HAGIWARA Tetsuo	Expert
Mr. AKIYAMA Kiyoshi	Expert
Mr. WATANABE Takashi	Expert
Ms. UMESAKI Michiko	Expert on Aid Coordination and management

Mekong River Commission

Dr. MASUMOTO Takao	Senior Project Officer
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Cambodia Side

Ministry of Public Works and Transport

Mr. KHY TAINGLIM	Minister
Mr. Tram Iv Tek	Secretary of State
Mr. UK CHAN	Under Secretary of State
CHHIN Kong Hean, P.ENG, M. Sc	Director-General of Public Works Research Centre
Dr. YIT BUNNA	Director of Public Works Research Centre
Ph.D. KHUN Sokha	Deputy Director of Public Works Research Centre
Mr. Tauch Chankosal	Director of Heavy Equipment Center

Ministry of Environment

Mr. Tea Chup (MD)	Director of Environment Impact Assessment Department
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Ministry of Water Resources and Meteorology

Mr. Seth Vannareth	Director of Department of Meteorology
Mr. Long Saravuth	Deputy Director of Department of Hydorology and River Works

Appendix 4. Minutes of Discussion

MINUTES OF DISCUSSIONS
ON
THE BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF
BRIDGES
ON
NATIONAL ROAD 6A
IN
THE KINGDOM OF CAMBODIA

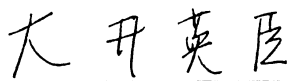
In response to the request from the Government of the Kingdom of Cambodia (hereinafter referred to as "Cambodia"), the Government of Japan has decided to conduct a basic design study on the Project for Improvement of Bridges on National Road 6A (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent to Cambodia a basic design study team (hereinafter referred to as "the Team"), which is headed by Mr. Hidetomi Oi, Development Specialist, JICA, and is scheduled to stay in the country from January 17 to February 23, 2000.

The Team held discussions with the concerned officials of the Government of the Kingdom of Cambodia, and conducted a field survey at the project site.

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

Phnom Penh, January 24, 2000



Mr. Hidetomi Oi
Team Leader
Basic Design Study Team
Japan International
Cooperation Agency



H.E. Mr. Khy Tainglim
Minister of Public Works and
Transport,
The Kingdom of Cambodia

ATTACHMENT

1. OBJECTIVE

The objective of the Project is to improve living conditions of inhabitants in the Project area by Rehabilitation of the bridges on National Road 6A.

2. PROJECT SITE

The bridges on National Road 6A.

3. RESPONSIBLE ORGANIZATION AND IMPLEMENTING AGENCY

(1) Responsible Organization : Ministry of Public Works and Transport (MPWT)

(2) Implementing Agency : Heavy Equipment Center, MPWT

4. ITEMS REQUESTED BY THE GOVERNMENT OF THE KINGDOM OF CAMBODIA

After discussions with the Team, the following were finally requested by Cambodian side. JICA will assess the appropriateness of the request and will recommend to the Government of Japan for approval.

(1) Komgpong Preas 3rd Bridge (No.26)

(2) Komgpong Preas 1st Bridge (No.24)

(3) Komgpong Preas 2nd Bridge (No.25)

5. JAPAN'S GRANT AID SYSTEM

The Cambodian side understands the Japan's Grant Aid Scheme and the necessary measures to be taken by the Government of Cambodia explained by the Team and described in Annex-3 and Annex-4 of the Minutes of Discussions signed by both parties on April 10, 1999.

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6. SCHEDULE OF THE STUDY

- (1) The consultants will proceed to further studies in Cambodia until February 23, 2000.
- (2) Based on the Minutes of Discussions and technical examination of the study results, JICA will complete the final report and send it to the Government of Cambodia by August, 2000.

7. OTHER RELEVANT ISSUES

- (1) The Government of the Kingdom of Cambodia will take all possible measures to secure the safety of the concerned people during the study and implementation of the Project on condition that the Grant Aid by the Government of Japan is extended to the Project.
- (2) The Government of the Kingdom of Cambodia will remove all UXOs and mines in accordance with the results of the UXO and mine search. The search and removal work by the Government of the Kingdom of Cambodia will complete prior to the commencement of the detailed design and construction of the Project, respectively.

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MEMORANDUM
ON
THE BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF
BRIDGES
ON
NATIONAL ROAD 6A
IN
THE KINGDOM OF CAMBODIA

Based on Minutes of Discussions held on January 24, 2000, both the Government of the Kingdom of Cambodia (hereinafter referred to as "Cambodia") and the Japan International Cooperation Agency (hereinafter referred to as "JICA") party, the JICA Study Team have conducted the field survey and data collection since January 17, 2000, in Cambodia.

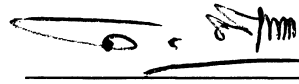
In the course of the field survey and discussions, both parties have confirmed the main items of the Project, such as basic policy of National Road 6A, design concept of the objective facilities, as described on the attached sheets.

The JICA Study Team will proceed to further works of the Basic Design Study in Japan.

Phnom Penh, February 21, 2000



Mr. Yoshiaki KANEKO
Chief Consultant
JICA Study Team



Mr. TAUCH Chankosal
Director
Heavy Equipment Center
Ministry of Public Works and
Transport

1. Basic Policy of the MPWT for National Road 6 A

After completion of the Rehabilitation Project of National Road 6A by the Japanese Government, this road has become one of the most important parts of the trunk roads through the capital of Phnom Penh among the country road networks.

However, the National Road 6A is located in the flood vulnerable area of the Mekong River and the Sap River. This is the biggest constraint to secure safety and permanent traffic function during floods such as 1996 Flood. Furthermore, increase of number of vehicles and heavy loading trucks have been serious problems to be solved. Frequent floods and the future trend of road transportation are making difficulties for securing safety transportation and maintenance of road embankments and bridges.

Furthermore, complex irrigation system using flood water in the flood plain near Project site is widely adopted for agriculture, mainly for rice cultivation. This is one of essential environmental issues to be considered relating to the National Road 6A.

Considering these situations, the MPWT would like to have the following basic policy on the National Road 6A:

- 1) To secure safety and permanent traffic function even during floods with equivalent scale of 1996 Floods or above.
- 2) To secure safety of road embankment and bridges against floods with equivalent scale of 1996 Floods or above.
- 3) To preserve surrounding social and natural environment, so that the improvement of the National Road 6A will not make any adverse impacts to them..

The JICA Study Team responded to the MPWT to convey above Basic Policy of the MPWT to JICA.

2. Design Criteria

(1) Hydrological Design Criteria

- 1) Design scale of floods: Equivalent of 1996 Flood or above
- 2) Design high water level: -do-

(2) Design Criteria for Road and Bridge

1) Road Design Standard

Japanese standard is basically applied for the Study, however the standard of Cambodia is also taken into consideration due to the development of current trunk national road 6A to connect national roads 6 and 7.

- Road classification and geometric design standard: National Road Route 6A

Table-1 Geometric Design Standard (Applied Japanese standard)

Item	Unit	Standard
Design speed	km/h	60
Horizontal curve		
Minimum radius	m	120
Maximum superelevation	%	6
Minimum curve length	m	100
Vertical curve		
Minimum radius of sag curve	m	1,000
Maximum radius of crest curve	m	1,400
Maximum gradient	%	5
Cross slope of carriage way	%	2
Lane width	m	3.5

- Standard Cross Section of Road (Approach)

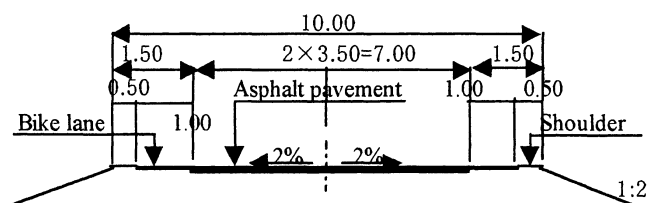


Figure-1 Standard Cross Section of Road

- Pavement Design Standard

The pavement design standard of Japan Road Association is applied in the approach road design.

Pavement Type : Asphalt Concrete (Design Life: 5 years)

2) Bridge Design Standard

The existing bridges on National Road 6A assumed to have been constructed between 1962 and 1968 applied AASHTO American or various countries standard.

In consideration of increase of recent traffic volume and heavy vehicles, bridge standard in this Study shall be corresponded to heavier size of traffic. National trunk roads 6 and 7 connecting to 6A are applied the Japanese standard.

Design standard is classified in the specification as below.

(a) Dead Load

The Following unit weights of materials shall be used in computing the dead load.

Table -2 Unit weight of Materials

Types of Dead Load	Unit Weight (kgf/m ³)	Types of Dead Load	Unit Weight (kgf/m ³)
Steel or cast steel	7850	Asphalt pavement	2300
Cast iron	7250	Bituminous material	1100
Aluminum alloys	2800	Compacted sand, earth/gravel	1900
Timber(treated/untreated)	800	Loose sand, earth, and gravel	1800
Concrete(plain)	2350	Under ground water	1000
Concrete(reinforced/prestress)	2500		
Cement mortar	2150		

Materials and Basic Strength:

*Concrete Compressive Strength (28days)

PC girder	$\sigma_{ck} = 350\text{kg/cm}^2$	Abutment, Pier	$\sigma_{ck} = 210\text{kg/cm}^2$
RC girder	$\sigma_{ck} = 240\text{kg/cm}^2$	Approach Wall	$\sigma_{ck} = 210\text{kg/cm}^2$
RC Slab, Cross Beam	$\sigma_{ck} = 240\text{kg/cm}^2$	RC pile (cast in place)	$\sigma_{ck} = 300\text{kg/cm}^2$
RC Curb, Hand Wall	$\sigma_{ck} = 210\text{kg/cm}^2$	PC Pile	$\sigma_{ck} = 400\text{kg/cm}^2$

* Steel Reinforcing Steel SD295, SD345 (Yield strength $\sigma_{py} = 30\text{ kg/mm}^2$)

Prestressing Steel T-12.7mm (Yield strength $\sigma_{py} = 160\text{kg/mm}^2$)

(b) Live Load

Taking into account the above mentioned and the world specifications of heavier loading, TL-25 Loading method (B-live load system) based on Japanese standard is adopted.

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(c) Other Main Loads

- Impact load - Earthquake - Influence of creep, shrinkage of concrete - Earth, water pressure

- Buoyancy, uplift - Wind load - Others

- Standard Cross Section of Bridge (No.24, 25,26)

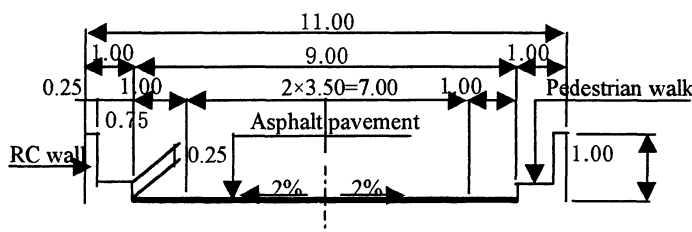


Figure -2 Standard Cross Section of Bridge

(d) Scale of Bridge

- Proposed Type Super-structure : PC I-shape girder (length 25-30m)
 Sub-structure: RC Reversed T-shape (abutment), RC Wall (pier)
 Foundation: Cast in place pile (dia. 1m), or PC pile (0.4m)
 Protection for bridge : Concrete, Gabion , etc.

- Bridge Length

Design flood water level, flood flow and clearance under girder according to hydrological and hydraulic analysis.

3. Necessary Measures to be taken by the Cambodian Side

- (1) In case that No.24 and No.25 bridges are need to be replaced as the result of the further study in Japan, No.24 Bridge shall be located at the left side toward Kompong Cham and No.25 Bridge at the exiting place considering the surrounding conditions. Regarding the replacement of Bridge No.24, an additional land acquisition and the property compensation (houses and valuable trees) should be taken by the Government.
- (2) The construction yard will be planned nearby the Bridge No.26, at the left side toward Kompong Cham. The Government should secure this land. The necessary land as a construction yard shall be decided based on the number of replaced bridge and the bridge length.


MINUTES OF DISCUSSIONS
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BASIC DESIGN STUDY
ON
THE PROJECT FOR IMPROVEMENT OF BRIDGES ON NATIONAL ROAD 6A
IN
THE KINGDOM OF CAMBODIA
(EXPLANATION ON DRAFT REPORT)

In January 2000, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Basic Design Study Team on the Project for Improvement of Bridges on National Road 6A (hereinafter referred to as "the Project") to the Kingdom of Cambodia, and through discussion, field survey, and technical examination of the results in Japan, JICA prepared a draft report of the study.

In order to explain and to consult the Kingdom of Cambodia on the components of the draft report, JICA sent to the Kingdom of Cambodia the Draft Report Explanation Team (hereinafter referred to as "the Team"), which is headed by Mr. Hiroshi Shiono, Deputy Director of First Program Division, Tsukuba International Center, JICA, from May 15 to 19, 2000.

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

Phnom-Penh, May 18, 2000

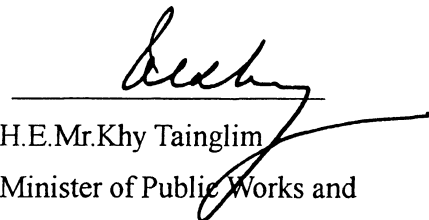


Hiroshi Shiono

Leader

Basic Design Study Team

Japan International Cooperation Agency



H.E. Mr. Khy Tainglim

Minister of Public Works and
Transport,

The Kingdom of Cambodia

ATTACHMENT

1. Components of the Draft Report

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

2. Japan's Grant Aid scheme

The Cambodian side understands the Japan's Grant Aid Scheme and the necessary measures to be taken by the Government of the Kingdom of Cambodia as shown in the Annex of this Minutes of Discussion.

3. Schedule of the Study

The Cambodian side will send comments on the draft report within one month after signing of this Minutes of Discussion. Taking into account the comments, JICA will complete the final report in accordance with the confirmed item and send it to the Government of the Kingdom of Cambodia by August 2000.

4. Other relevant issues

- (1) The Government of the Kingdom of Cambodia will take all possible measures to secure the safety of the concerned people during the study and implementation of the Project on condition that the Grant Aid by the Government of Japan is extended to the Project.
- (2) The Government of the Kingdom of Cambodia will remove all UXOs and mines in accordance with the results of the UXO and mine search. The search and removal work by the Government of the Kingdom of Cambodia will complete prior to the commencement of the detailed design and construction of the Project, respectively.
- (3) The Government of the Kingdom of Cambodia will complete the land acquisition before the commencement of the construction.
- (4) The Government of the Kingdom of Cambodia will take necessary measures including over loaded vehicles control to maintain the road and bridges properly.



- (5) In order to minimize land acquisition relating to Bridge No.24, the Cambodian side requested to conduct further study in the detailed design stage to reduce the shifting distance between the existing road and the new road around Bridge No.24.
- (6) The Cambodian side requested further consideration on the possibility of utilizing the equipments of the Road Construction Center (RCC) in the construction stage.

ANNEX

Major Undertakings to be taken by Each Government

No.	Items	To be covered by Grant Aid	To be covered by Recipient side
1	To secure land		●
2	To clear, level and reclaim the site when needed		●
3	To construct gates and fences in and around the site		●
4	To bear the following commissions to a bank of Japan for the banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
5	To ensure prompt unloading and customs clearance at the port of disembarkation in recipient country		
	1) Marine (Air) transportation of the products from Japan to the recipient country	●	
	2) Tax exemption and customs clearance of the products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site	(●)	(●)
6	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●
7	To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the verified contract		●
8	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid		●
9	To bear all the expenses, other than those to be borne by the Grant Aid, necessary for construction of the facilities		●

Appendix 5. Cost Estimation Borne by the Recipient Country

Appendix 5 Cost Estimation Borne by the Recipient Country

5-1. Project Cost Estimation

The expenditure to be borne by the Cambodian government in connection with the implementation of the project is estimated as shown below.

① Land Acquisition	:US\$ 48,088
② Construction Yards Leasing	:US\$ 94,642
③ Prosperity (House Moving) Compensation	:US\$ 3,336
④ Prosperity (Cash Trees) Compensation	:US\$ 315
Total	:US\$ 146,381

These costs are estimated as follow:

1) Land Acquisition

Land acquisition is indispensable to the construction of new roads (bridges) and the widening of existing rivers. These costs are as shown in Table 5.1.1.

Table 5.1.1 Land Acquisition Cost

Bridge No.	Location	Area (m ²)	Existing Conditions	Purchased Cost	
				US\$/m ²	US\$
Br.24	R.O.W	3,105	Rough area (Pond etc.)	0.00	0
		3,105	Agriculture land	2.50	7,763
		3,105	Residential land	5.00	15,525
	River Enlarge(L)	4,013	Agriculture land (Vegetable)	2.00	8,026
	River Enlarge(R)	8,387	Agriculture land (Rice)	2.00	16,774
Br.25	River Enlarge(L)	1,225	Rough area (Bush)	0.00	0
	River Enlarge(R)	494	Rough area (Pond etc.)	0.00	0
Br.26	River Enlarge(L)	2,080	Rough area (Pond etc.)	0.00	0
	River Enlarge(R)	2,080	Rough area (Pond etc.)	0.00	0
Total					48,088

2) Construction Yards Leasing

Leasing of land is necessary for the construction of a camp yard, a construction yard, detour roads and roads for the river winding. These costs are as shown in Table 5.1.2.

Table 5.1.2 Construction Yards Leasing

Bridge No.	Location	Area (m ²)	Existing Conditions	Leasing Period	Leasing Cost	
					US\$/m ²	US\$
Br.24	River Enlarge(L)	1,646	Agriculture land	1.5years	1.00	2,469
	River Enlarge(R)	1,660	Agriculture land	1.5years	1.00	2,490
Br.25	River Enlarge(L)	930	Rough area	1.5years	0.00	0
	River Enlarge(R)	416	Rough area	1.5years	0.00	0
Br.26	River Enlarge(L)	1,332	Rough area	1.5years	0.00	0
	River Enlarge(R)	1,332	Rough area	1.5years	0.00	0
	Detour Roads	5,815	Agriculture land	1.5years	1.00	8,723
		34,577	Rough area	1.5years	0.00	0
Overall Works	Construction Yard	12,000	Agriculture land	2.3years	2.00	55,200
	Camp Yard	5,600	Agriculture land	2.3years	2.00	25,760
Total						94,642

3) Mining Royalty on Borrow-pit

This project requires materials for embankment of approach roads and detour roads. If the materials are to be procured from borrow-pits belonging to the Cambodian government, the mining royalty is calculated as follows:

$$\text{Mining royalty} = 128,000\text{m}^3(\text{Required Earth Volume}) \times \text{US\$}1.0 / \text{m}^3 = \text{US\$}128,000$$

4) Prosperity (House Moving) Compensation

The prosperity (house moving) compensation is necessary for the construction of new approach roads (bridges) to Br.24 and Br.25. These costs are as shown in Table 5.1.3.

Table 5.1.3 Prosperity (House Moving) Compensation

Bridge No.	Type of House	No. of house	Total Area (m ²)	Compensation Cost	
				US\$/m ²	US\$
Br.24	Bamboo Wall	16	285.65	2.00	571
	Wooden Wall	7	399.00	5.00	1995
	Wooden Wall	1	90.00	5.00	450
Br.25	Bamboo Wall	1	40.00	2.00	80
	Wooden Wall	1	48.00	5.00	240
Total		26	862.65		3,336

5) Prosperity (Cash Trees) Compensation

The prosperity (cash trees) compensation is necessary for the construction of new approach roads to Br.24. These costs are as shown in Table 5.1.4.

Table 5.1.4 Prosperity (Cash Trees) Compensation

Name of Tree	No. of Tree	Compensation Cost	
		US\$ / No.	US\$
Mango	1	30	30
Coconut	6	15	90
Sugar Palm	11	15	165
Tamarind	5	5	25
Other Trees	1	5	5
Total	24		315

5.2 Operation and Maintenance Plan

5.2.1 Operation and Maintenance System

Large-scale repair works will not be necessary until before 20 to 30 years after the completion of bridges by following the operation and maintenance method mentioned in 3.3.2. Similarly, large-scale repair works are not required regarding the approach roads, as its design life is 5 to 10 years. Therefore, the operation and maintenance after the completion of this project will be carried out by the present system ; Department of Road under Department of Public Works

5.2.2 Operation and Maintenance Method

Though the main objective of this project is the constructions of bridges, the approach roads are taken as the objectives of the operation and maintenance. That doing after the completion of the bridges must be performed in line with Table 5.2.1.

Table 5.2.1 Maintenance and Operation Schedule

	Item	Maintenance and Repairing Works	Period
Bridge	①Drain Pipe	Clearing of sediments	3 months
	②Expansion Joint	Repairing of shrieked metal and seal rubber	3 months
	③Handrail	Repairing damages by traffic accidents	3 months
	④Shoe	Removal of earth deposits	6 months
	⑤Superstructure	Repairing of cracks	1 year
	⑥Substructure	Repairing of cracks	1 year
	⑦River Protection	Repairing of scours	1 year
Road	①Road Surface	Patching, smoothing	1 month
	②Shoulder/Slope	Planting (turf), reinforcement of earth, repairing masonry	1 month

4.0 mans / month is sufficient for periodical checking and minor maintenance of the items mentioned in the above table. It is important to keep records of the results of periodical checking on the road resister and grasp the condition of damage in order to establish the repair schedule and its scale. Therefore, the periodical checking system must be established at the early hands.

5.2.3 Operation and Maintenance Cost

The operation and maintenance cost per year is estimated as shown below:

Personal expenses (engineer)	:US\$20 /man×2 men / month×12 months=US\$480	
Personal expenses (worker)	:US\$5 / man×2 men / month×12 months =US\$120	
Miscellaneous materials cost	:Lump-sum	=US\$480
Vehicle hire charge	: <u>US\$60 / day×1 day / month×12 months</u> =US\$720	
	Total	US\$1,800

Therefore, as the estimated total cost is low, there should be no problems both in terms of the budgets and manpower concerning with the operation and maintenance.